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For Contents, see the unnumbered pages which form the front covers of the separate numbers.

ERRATA GRAVIORA

p. 29 note 4. Dr. L. O. Williams informs me that the Chicago Museum acquired the Coulter Herbarium not directly from Coulter but from the University of Chicago, first on indefinite loan, later as gift.

p. 31 note 19. By egregious oversight the name of Andrew Denny Rodgers III was omitted.

p. 61 par. 3. Second synonym should be *Tephrosia purpurea* var. *angustissima.*

p. 78, line 7 from bottom. Add to synonymy *Micheliella anisata* (Sims) Briquet in Engler & Prantl, Nat. Pflanzenfam. Teil IV. Abt. 3a: 325. 1897.

p. 100. The three species included under *Aneilema* become *Murdannia nudiflora* (L.) Brenan, *M. Keisak* (Hasskarl) Handel-Mazzetti, and *Gibasis linearis* (Bentham) Rafinesque in the improved classification adopted by Rohweder, Die Farinosae in der Vegetation von El Salvador, 1956 (Commelinaceae pp. 98—178).

p. 105. For a different opinion on *Warea*, see "Nomenclatural and taxonomic corrections in *Warea* (Cruciferae)" by R. B. Channell and C. W. James, Rhodora 66: 18—26, 1964.

p. 173, key lead 6a. should read as follows:
6a. Lower leaves with flat segments 1 mm. or more wide; upper leaves with progressively more slender segments . .
5a. *G. rigidula* var. *rigidula*

Guy Nesom

SIDA CONTRIBUTIONS TO BOTANY

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CONTENTS

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EVOLUTION OF THE GRAY'S AND SMALL'S MANUAL RANGES

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"Those who are ignorant of history are condemned to repeat it." To suggest that botanists, and especially systematic botanists, are ignorant of history may seem surprising, exercised as they are with precedents, priorities, author-citations, and bibliographic rummaging. But their history does not go beyond the merely chronological or anecdotal. Critical evaluation, interpretation, explanation, discernment of patterns, precedents for positive actions — there is scarcely even an awareness that such remoter intellectual levels exist. As for introducing sociology, philosophy, psychology — a scientists is above such things. He clings to his scientific purity in his day-to-day work, certain that science cannot help but progress in the soundest possible way.

The sad truth is that science does not advance purely or even chiefly by scientific means. It is, after all, simply one form of human cultural activity, and a victim of the same shortcomings and influences as any other such activity. What seems to me extraordinary is that systematic botanists, the nature of whose work should keep them from the extremes of narrow-minded dogma, remain so stubbornly ignorant of their own condition. Instead of making a broad-ranging, critical scrutiny of themselves, they clutch at devices which will make them respectable in the eyes of true scientists. But salvation does not lie in cytotaxonomy or chemotaxonomy or tabulating for IBM machines. It lies in gaining sufficient breadth and understanding to enable the taxonomist to become master in his house and not the witless object of accidents and outside forces. And this requires stepping outside the narrow cultural limits within which American botany is confined.

In reviewing the history of the familiar "Manual ranges" into which the eastern third of North America has been divided for over a century, I wish to point out that the division does not have a scientific basis, has never been critically examined, and is accepted today out of inertia and intellectual vacuum; that the factors which led to this state of affairs were chiefly economic, social, and political, with mere chance playing a significant role; that while some of these have changed hardly at all, others have changed and are changing in ways of direct importance to the progress of systematic botany; that a knowledge of all of them, changing and unchanging, can enable a botanist to organize his efforts in a way to extract the most from his opportunities and suffer the least from his handicaps. I reject the assertion that "the only thing History has to teach us is that it can teach us nothing."

SIDA 1 (1): 1—31. 1962.

HISTORICAL RECORD

In 1817 there appeared *A Manual of Botany for the Northern States . . . to the North of Virginia,* by members of the botanical class in Williams College, Massachusetts. A year later appeared a second edition, Amos Eaton now acknowledging authorship. The title for this and the two following editions (3rd in 1822, 4th in 1824) is slightly altered: *Manual of Botany for the Northern and Middle States,* but the specification *to the North of Virginia* (then including West Virginia) remains. With the 5th edition in 1829 the title becomes *Manual of Botany for North America . . . North of the Gulf of Mexico.* What this really meant is revealed in the introductory notice on botanical districts. "The Northern and Southern districts are separated by a line drawn fom the mouth of the Delaware River . . . in a direction to intersect the south end of Lake Michigan . . . leaving all Pennsylvania and the north part of Delaware, of Maryland and of Ohio, in the Northern district. This direction of the division line is required, because southern plants extend to higher latitudes on the western side of the Allegany range, than on the eastern side." These two districts are further broken down into Eastern and Western divisions. "The Allegany mountain is the division line in the Southern district; a line drawn from the intersection of the Allegany mountain and the river Potomack, in the direction of Cayuga lake, is the division line in the Northern district." For the following two editions the title and subtitle are unchanged, but this is not true of the botanical districts. In the 6th edition (1833) no menion is made of them, the shock of the arrival of Torrey's edition of Lindley's Natural System being so great that Eaton devotes nearly four pages to denouncing it and similar works, omitting the geographic section. With the 7th edition (1836) passion had only partially subsided. Eaton quotes with great satisfaction the remarks of W. J. Hooker in praise of the Linnaean system (in the latter's British botany). Parts of Hooker's *Flora Boreali-Americana* (a flora of Canada), had appeared, and according to Eaton, all the information was incorporated in his revised *Manual.* But the only change in botanical districts was a minor one suggested by Western botanists. "J. L. Riddell, of Cincinnati, has been his chief guide in drawing the line between the Eastern and Western regions. The value of the Catalogue of Mr. Gibbs, of Columbia, S. C., kindly sent by the author, was in great measure lost on account of its being received too late" (Preface, p. v.). On page 9, under "Location of Species," we are told that "S. at the end of a specific description indicates that it grows South of the North line of Virginia, as well as North. W. (capital) within the parenthesis after a species, indicates, that it grows West of the Allegany range and its continuation through Cayuga Lake, &c. — also East of the West line of Missouri and Arkansas." In a footnote we are told of this last statement "This limit is authorised by Drs. Short, Peter, Riddell and Lock." These comments are repeated in the 8th edition (1840), now entitled *North American Botany; Comprising the Native and Common Cultivated Plants, North of Mexico,* prepared by Eaton and Dr. John Wright. There are three new abbreviations: A. for Alpine, L. (Littoribus) for seashore, O. (Omnibus locis) for "throughout the Northern and Southern States." There is a further brief section headed "Arctic, Rocky Mt., and Oregon Species," with a confusing second A. for Arctic, R. for "On the Rocky Mt. or west of it; or between the Mt. and the States of Missouri and Arkansas," and Cal. for California. In a footnote in the preface (p. vi), Eaton reports with evident satisfaction, "These five last editions extended to two thousand copies each — and one of them to two thousand five hundred."

Eaton was a teacher and popularizer of botany, not a botanist by virtue of original studies or researches. He was not a notable collector, nor did he attempt to accumulate a good herbarium. Indeed, his final word (p. 16 of the 7th edition) showed that he never even considered careful documentation as a method, for he declares that the only way to assemble adequate geographic data is for every natural history society "to devote a secure place to the preservation of manuscript catalogues of all collecting botanists." He did not travel widely, and his notions of Western and Southern geography were decidedly naive, as the preceding quotations show. Despite the inflated title used for editions 5 through 8 of his *Manual,* he never seriously intended it for use much outside the area of the first four. Thus his comment in edition 8 (p. 16), after explaining the abbreviations for Arctic and Rocky Mountain: "These distant localities will not embarrass the student; because a solitary R. or A. will, at first glance, indicate, that such species are not to be expected elsewhere." It seemed not to trouble him at all that his early, simple separation into North and South and subdivision into East and West had become utterly incongruous; he kept on using them until the last. One suspects that the "distant localities" were thrown in for possible benefit to sales, a suspicion strengthened by his complacent footnote about the number of copies in the earlier editions.

As a compiler rather than an investigator, a rather superficial popularizer instead of a critical student, and finally as a reactionary violently opposing the newer approaches to classification, Eaton did not attract followers of high calibre. Although Mrs. Lincoln's *Familiar Lectures on Botany,* patterned on his own, continued to be a best seller for years after his death, he had no real botanical successor in direct line. But history did repeat itself, though with a difference, in the work of Alphonso Wood, whose *A Class-Book of Botany* first appeared in 1845, and in a revised edition only a year later. As Wood himself tells us (preface to the 1860 edition), "It was originally prepared with immediate reference to the wants of the author's own pupils, with scarcely a hope of approval from the community beyond." It was Williams College all over again, this time at small Kimball Union Academy near Hanover, New Hampshire. The flora which comprised a major part of the book covered "that section of the United States which lies north of the Capitol, that is, of the 39th parallel, including essentially the states lying north of the Ohio River and Maryland." Then, with an eye to sales, it is added, "With some exceptions, therefore, this Flora will answer for the adjacent states of Delaware, Maryland, Virginia, Kentucky, Missouri, and the Canadas." Like Eaton, Wood was encouraged by the commercial success of his book, and, again like Eaton, became expansionist, with the added stimulus of the desire to keep ahead of the new rival, Gray's *Manual*. For the 1860 edition (3rd copyright date; unrevised new printings of the 1846 editions were confusingly numbered as new editions), "The limit of our Flora in this new series has been much extended. It now embraces the territory lying east of the Mississippi River with the exception of the Southern Peninsula of Florida, and South of the Great Lakes and the River St. Lawrence. . . . This Class-Book is, therefore, now professedly adapted to the student's use from Quebec to New Orleans and from St. Pauls *(sic)* to St. Augustine." Unlike Eaton, Wood had actually traveled through much of this large area: "Therefore, into nearly every section of this territory, from the St. Lawrence and the Lakes to the Gulf, and from the Sea-Coast to the Great River, the author has made repeated excursions in delighted converse with the vegetable world." But like Eaton he was not a notable collector and did not build the large herbarium one might have expected, though he seems to have done more in this regard than did his predecessor. He too was a compiler rather than an investigator; his primary aim likewise was teaching and popularizing, not research. And, once more like Eaton, he had no botanical successor.

In 1824 John Torrey published the first volume of what was to remain an unfinished work, *A Flora of the Northern and Middle Sections of the United States,* covering the same area as Eaton's early editions: the states north of Virginia. In 1826 appeared the more condensed *A Compendium of the Flora of the Northern and Middle States,* for the same area, this time described as "north of the Potomac." Torrey was to set the pattern for future progress by corresponding and exchanging with European botanists in order to have critical identifications, and by championing the Natural System against the Linnaean. His efforts were to come to full flower in the never-finished *Flora of North America* (1838-1843), undertaken jointly with Asa Gray, and in numerous reports on the collections that began to pour in from newly-explored Western territories. Meantime his fellow New Yorker, Lewis C. Beck, in 1833 supplied a flora using the Natural System: *Botany of the Northern and Middle States,* again stated to be those "north of Virginia." A second edition in 1848 had the slightly modified title *Botany of the United States North of Virginia.* In the same year appeared the famous first edition of Gray's *Manual of the Botany of the Northern United States, from New England to Wisconsin and South to Ohio and Pennsylvania.* It was destined to be the last manual for the area that may be called the Old North — that it, the area north of the Mason-Dixon line and the Ohio River. Scientifically it carried on the Torreyan traditions of critical identifications and use of the Natural System. But it had still more important reasons for being: it would offset Wood's odious popularity, and affirm Gray's position as leader for the critical botanists, and, not least, it would make money. Prestige, rivalry, and commercialism were to dominate the subsequent history of the *Manual* until the 7th edition and, inevitably, of the later Southern floras as well.

We may never know with certainty all the reasons that led Gray to abandon a regional boundary of more than forty years' standing, adopted first by Eaton, and accepted without question by Torrey, Beck, Wood, and Gray himself. External chance played a part. As late as May, 1855, in a letter to Darwin, he speaks of "this moderate area (bounded by the Atlantic Coast, New Brunswick, St. Lawrence, Great Lakes, Mississippi, and Potomac or Chesapeake Bay)." Darwin's request for information about plant distribution seems to have set Gray thinking. When the 2nd edition of his *Manual* appeared in 1856 (foreword dated June 30), it had been expanded to include "Kentucky, Virginia, and all east of the Mississippi," an area retained for the three remaining editions prepared by Gray himself: 3rd (1857), 4th (1862), and 5th (1867), the last with the range re-worded to "east of the Mississippi and north of North Carolina and Tennessee." (There is some confusion because of various reprintings, the earlier merely as "revised edition" without number; I have followed copyright dates in listing the editions as numbered here.) In an article entitled "Statistics of the flora of the Northern United States," published (1856-1857) just after the appearance of the revised *Manual,* Gray discusses the botanical reasons for the change. "The work, which forms the basis of the following statistics of the botany of the Northern United States, has now been extended in geographical area beyond the limits of the Northern States, politically so-called; inasmuch as this area includes Virginia and Kentucky, and stretches westward to the Mississippi River. The south boundary of 36° 30' has been adopted (instead of Mason and Dixon's line) because it coincides better than any other direct geographical line with the natural division between the cooler-temperate and the warm-temperate vegetation, — between the flora of the northern and of the southern Atlantic states. Few characteristically southern plants advance to the north of it, and those chiefly on the coast of the low south-eastern corner of Virginia, in the Dismal Swamp, and the environs of Norfolk. Could we vary the line where it intersects the longitude of Washington, carrying it north until it reaches the James River, and thence due east again, the small quadrangle thus excluded would exclude nearly all the properly southern indigenous plants now comprised in the volume, and mark the true division eastward between our southern and northern botanical regions, namely, at the northern limit of the Live Oak, the Long-leaved Pine, and the Black Moss (Tillandsia unseoides) . . . On the Mississippi, the plant most southern in character which crosses the parallel is Jussiaea repens. This sparingly extends up the Ohio to lat. 38°, where also the Taxodium reaches about as far north as on the Atlantic Coast." And prophetically he remarks, "Probably a good many more southern species inhabit this (southeastern) corner of Virginia, of which I have as yet no indications." It was in effect an ante-bellum act of cultural aggression against the South. It passed unchallenged, among other reasons, because there were few botanists in the South (and many of these were, like Darby and Chapman, immigrants from the North), because knowledge of the details of distribution was still very inadequate, and because the whole matter was viewed from a strictly Northern standpoint. State boundaries or parallels of latitude and longitude are hardly ideal for delimiting botanical regions. They were matters of convenience, especially in view of the limited knowledge of the day. Despite the listing of species and plausible sound of his remarks, Gray's new boundary cannot be said to have a solid botanical basis. It did, of course, supply more ample data for answering Darwin's queries, but that is not the same thing. Small, with vastly more field experience than Gray, later considered the Mason-Dixon line a better floristic dividing point.[1]

Its convenience was certainly reinforced by decidedly non-botanical considerations. A major purpose in putting out the *Manual* was to make money,[2] and the enlargement of the area covered could be expected to mean more sales. Whether Gray had by this time gotten wind of Wood's plan to annex the whole South in his next edition I do not know. M. A. Curtis in 1857 warned Gray about Wood's travels in the South,[3] and other friends may well have done so early enough to influence Gray's decision on the new boundary. Or perhaps the strategic and commercial benefits to his continuing war with Alphonso Wood were in this case pure serendipity growing out of his efforts to give Darwin a satisfactory answer. I doubt that his motives were pure. Whatever they were, they rigidly fixed the botanical boundary between North and South from that day to this. Although he was too cautious to sweep in the whole South, as Eaton had done before and Wood was to do again in 1860, he eventually felt compelled to stand up to his rival. In 1869 (preface dated 1868), in his *Field, Forest and Garden Botany* (decidedly a commercial venture), he too annexed the rest of the country east of the Mississippi River. Meantime he had induced Chapman to write a Southern flora, published in 1860, about which more later.

Before taking up the short and simple history of the strictly Southern floras, we must follow the subsequent history of the *Manual* and its rivals, the Britton and Brown *Illustrated Flora* and Britton's *Manual*. Other than the minor instance of Darby, Southern botany had no independent existence, but was merely a pawn in the rivalry between Gray and

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[1] All notes are at end of article.

Wood and thereafter between the Gray Herbarium and the New York Botanical Garden.

In 1890, two years after Gray's death, there appeared a 6th edition of his *Manual* (copyright date 1889), "revised and extended westward to the 100th Meridian," by Sereno Watson and John M. Coulter. It has been suggested that the extension was due to the fact that both men were Westerners (actually Midwesterners by origin, but both had been active in the Far West). I doubt if the retiring, scholarly Watson would have made such a departure from precedent had he worked alone. It is a thoroughly characteristic action of the aggressive Coulter, ever a schemer, promoter, opportunist, and in general the first major politician in American botany.[4] It was really repeating Gray's 1856 move, this time toward the West instead of the South. One wonders what might have happened if, in 1890, two botanists from the South had put out a new edition of the *Manual.* I suspect the results would have been exactly parallel with those of the 1890 edition of Watson and Coulter: the annexed territory would prove to have included too much that was foreign to the Old North, and the boundary would have been moved back. This happened with the 7th edition of the *Manual* (1908), by Benjamin Lincoln Robinson (from Illinois) and Merritt Lyndon Fernald (from Maine). "To cover a more natural area . . . some alterations have been made in the geographic limits adopted in the sixth edition. . . . (1) the exclusion of the territory at the west between the 96th and 100th meridians, . . . (2) the inclusion of the Canadian provinces of Nova Scotia, Prince Edward Island, New Brunswick, and the greater part of Quebec and Ontario." The more strongly northeastward slant continued with the 8th edition (1950) by Fernald alone: "The northern limit of range now includes the area south of the Straits of Belle Isle and from Anticosti Island westward along the 49th parallel of latitude in Quebec to the northwestern corner of Minnesota. The western and southern limits are unchanged."

There are curious parallels, and even more curious contradictions, between the events of 1820—1860 and those of 1890—1935. Nathaniel Lord Britton, Ph.D. (in geology), was the first non-medical doctor to write a manual, and the first to adopt the metric system. His one-volume *Manual* was preceded by the three-volume *Illustrated Flora of the Northern United States, Canada and the British Possessions from Newfoundland to the Parallel of the Southern Boundary of Virginia, and from the Atlantic Ocean Westward to the 102nd Meridian,* whose first volume appeared in 1896. With its crude drawings, slovenly taxonomy, and outrageous nomenclature, this was a repudiation of everything for which Torrey and Gray had striven. It was a naked act of imperialist aggression, not only covering the over-extended range of the 6th edition of Gray's *Manual,* but annexing still more territory to the west and north. "For convenience," says the introduction, "the whole of Nebraska has been included . . . a manual of the whole Flora of the northeastern part of the continent, with the exception of that of Greenland and the Arctic Circle." A second edition in 1913 took in the same area. This dreadful production was still being reprinted and sold as late as 1950. A companion work in one volume, evidently intended to displace Gray's, and similarly titled *(Manual of the Flora of the Northern States and Canada)*, appeared in 1901, followed by a 2nd edition in 1905 and a 3rd in 1907. The area for all was much the same as that of the large *Illustrated Flora:* "from Newfoundland and Labrador to Manitoba, the southern boundary of Virginia, Kentucky and Kansas, and the western boundary of Kansas and Nebraska." That Britton's *Manual* failed to displace Gray's is chiefly owing, I believe, to the lack of illustrations. The long popularity of the *Illustrated Flora* was certainly owing to the pictures, which made it a commercial success at the same time that it was a scientific failure. Those not wishing to invest in the expensive 3-volume work would naturally purchase instead that 1-volume work which did have illustrations. There is irony in the fact that the very thing Britton introduced so lavishly in his *Illustrated Flora* was also responsible for Gray's *Manual* defeating his own. Certainly it cannot be said that the general public, whose purchases determined commercial success, gave much scrutiny to scientific merit. Illustrations and commercial success were the only things the *Illustrated Flora* and the illustrated Gray's *Manual* had in common.

Whether it was really necessary to endure the two editions of the *Illustrated Flora* for the sake of progress is a matter of conjecture. Taxonomically speaking they represent the most backward steps ever taken in American botany. But Britton's real contribution was the assembling of the rich library and herbarium resources of the New York Botanical Garden. It may be that from a crudely practical standpoint a popular commercial success had to be produced to accomplish this, quite apart from any question of merit or ethics. In any case, it was possible for Henry A. Gleason in 1952 to put out a work that repudiated nearly everything that Britton stood for. The label "3rd edition" is rightly eschewed for *The New Britton and Brown Illustrated Flora of the Northeastern United States and Adjacent Canada,* which for quality stands in extreme contrast with its predecessors. Brittonian imperialist aggression is abandoned, though not that of Gray: "Its southern boundary from east to west follows the southern lines of Virginia, Kentucky, and Missouri. To the west, it extends to the west boundary of Missouri, Iowa, and Minnesota, and to the north, it follows the northern boundaries of Minnesota and Michigan. From the eastern end of Lake Superior it follows the forty-seventh parallel of latitude across Ontario . . . to the St. Lawrence River. . . . It excludes Anticosti, Newfoundland, Sable Island, St. Pierre, and Miquelon." A companion 1-volume *Manual* by Arthur Cronquist is in press (autumn 1962); presumably its geographic area will be the same.

The history of the Southern floras is shorter and simpler, and as has been indicated already, it mainly follows and is subordinate to that of the Northern ones. Only three authors are involved, all of them Northerners by origin, only two actually residing in the South. The first was John Darby of Massachusetts, whose career was somewhat similar to that of his contemporary, Alphonso Wood. His *A Manual of Botany Adapted to the Productions of the Southern States* was published in 1841 at Macon, Georgia, where the author taught at the Wesleyan Female College. This was reprinted at Savannah in 1847. A new edition appeared in 1855 (reprinted in 1869) as *Botany of the Southern States,* published in New York, with preface dated Auburn, Alabama. Just what was meant by "Southern States" is nowhere explained. In the text there are frequent references to the Carolinas, Georgia, Florida, and Alabama, with occasional ones to "S. Western states," to Louisiana, and rarely to Texas. About the author Gray said "he would probably claim to have a good general, but no very profound acquaintance" with systematic botany.[5] After thus damning with faint praise, Gray proceeded to damn quite brutally by completely ignoring the systematic section of the book in his review, devoting his attention solely to the morphological and physiological portion. Darby's specimens were lost in shipment — the same calamity that befell his contemporary S. B. Buckley a few years later — and it is difficult now to tell whether Gray's contempt for him was altogether justified. The hundreds of localities cited by Darby constituted a really impressive addition to the knowledge of the distribution of Southern plants at that time, and some comment on this was surely in order. Later Chapman, dutifully following Gray's lead, also pointedly ignored Darby's work. Darby himself moved to Kentucky in 1869, after that state had been annexed to the Gray's *Manual* range, and he seems to have given up systematic botany altogether.

A. W. Chapman, also a native of Massachusetts, taught briefly in Georgia following his graduation from Amherst, became interested in medicine, took a degree at Louisville, Kentucky (according to Trelease; Barnhart's footnote in Kimball's reminiscences does not mention this), and spent most of his life practising in northern Florida. In Dupree's life of Asa Gray, surprisingly little is told of the relations between the two men. It is known that Chapman corresponded with Gray, and that the latter encouraged him at length to write a *Flora of the Southern United States,* itemized as Tennessee, North and South Carolina, Georgia, Alabama, Mississippi, and Florida, published in New York in 1860. In his preface Chapman remarks, "My original design did not contemplate so wide a field; but was limited to an enumeration of the plants of the Carolinas, Georgia, and Florida, — to which, chiefly, my attention has been directed during the past thirty years. But, influenced by the solicitation of friends, and by the apparent need of a more general work, I have extended my plan, so as to embrace all the States south of Virginia and Kentucky, and east of the Mississippi River." He adds that "The plan of the work is nearly the same as that adopted by Professor Gray, in his excellent Manual of the Botany of the Northern United States." He also strongly recommends Gray's textbooks to his readers. Like the *Manual* and his own *Flora*, these were all published by the same New York company. It is obvious that Chapman's boundaries were chosen to match those of Gray's *Manual*. Except for his brief comment about having been persuaded to extend west to the Mississippi River, he offers no explanations, botanical or otherwise, for the stated limits. These remain the same for the 2nd edition (1883; reprint of the first with supplement) and 3rd edition (1897). Trelease, who visited Chapman the winter before the latter's death, quotes these remarks by him regarding new species: "But, you know, even if I were not at the end of my work, I should prfer someone else to name them. I never did care to name species, as so many others do." In the preface to the 2nd edition of his flora he had said, "And now, since the different sections of all the States which are included have been pretty thoroughly explored, and future acquisitions will, probably, be comparatively few in number," indicating that he did not much believe in new species anyway.

It is an interesting example of the role of chance or coincidence in history that both Chapman and Small were color-blind to shades of red.[6] But their ideas about new species were in violent contrast. John Kunkel Small, native of Pennsylvania (his surname was an Americanization of Pennsylvania Dutch *Schmal*), never lived in the South, though he made numerous and sometimes extended visits there, chiefly in the Atlantic states, especially Florida. Employed by Britton primarily as curator, he was also expected to implement Brittonian imperialism, with the South (and later the Southwest) as his special territory. Legend has it that Britton, fearful of a destructive fire (it was in the days of gas lights), allowed no one to work at the New York Botanical Garden after dark. He also expected Small to devote his daylight hours to curatorial duties. Small had a large and musical family (he himself had once been flute-player in the New York Philharmonic), and after supper there was a performance by a family orchestra until bed-time for the children. Work on his *Flora of the Southeastern United States* (published by the author, 1903; followed, like Chapman's, by a reprint with supplement as 2nd edition, in 1913) is said to have been carried on during midnight hours, and on the basis of no more than one specimen of each species or sometimes even genus. Those who have used the book will find the story wholly believable. Its taxonomy and nomenclature are thoroughly typical of the Britton school. It was another weapon of political warfare, not a work of careful scholarship. Understandably, its geographic area extends west to parallel that of the *Illustrated Flora*, but for some reason the 102nd meridian was given up for the 100th, thus matching the limits of the 6th edition of Gray's *Manual*. No explanation for the choice is given; neither line makes any sense botanically. It seems to have become clear eventually that the area was overextended and instead of a 3rd edition there appeared in 1933 the *Manual* *of the Southeastern Flora* (reprinted in 1953 by the University of North Carolina Press, the first production of a manual in the South since Darby's of 1847), reverting to exactly the limits of Chapman's floras. The parallel with the similar reversion to earlier and narrower limits for the 7th edition of Gray's *Manual* is striking. But imperialism was not being abandoned. There was to be a *Manual of the South-Central Flora* to keep the states west of the Mississippi River in the Brittonian fold, and parts of it were actually written.[7] But the driving hand of Britton had been removed with his retirement in 1929, Small himself was nearing the end of his life, and his successor-designate, E. J. Alexander, belonged to a generation among whom writers of regional manuals were virtually extinct, and authors even of whole state floras very rare.[8]

We may round out the account of Southern floras with brief notes on another abortive one, and three recently initiated. Less powerful and aggressive than Britton, but like him a representative of the Age of Empire Builders, William Trelease early sought to make the Missouri Botanical Garden a Gray Herbarium of the West, specifically preparing the ground for a *Manual of the Southwestern Flora,* which was to have been written by J. M. Greenman. Trelease himself collected in Louisiana, Arkansas, Oklahoma, and Texas, and made taxonomic studies of such typically Southwestern groups as *Agave* and *Yucca.* He hired numerous collectors, and bought up all available private collections, especially in Texas. Greenman's students were put to work on revisions of genera prominent in the region, and until his retirement he used to state in his annual reports that "progress has been made toward a Flora of the Southwest."[9] Unlike the rival manual of Small, not a page of it appears ever to have been written. Seemingly all the ingredients for effective results were there: herbarium and library facilities, institutional backing, a trained taxonomist, abundant help, advance planning. Yet the result was complete failure.

History is once more repeating itself, though not exactly; how great the difference will be remains to be seen. Once more broad-scale plans have been made, and facilities and personnel accumulated, this time for an innovation and an anomaly in American botanical history; a regional flora for the Southeast carried down to genera only. It is an innovation and an anomaly on several other counts: it is being done at Harvard, which had never before attempted anything like it; and its geographic limits, taking the Chapman and later Small area with the addition of Arkansas and Louisiana, match neither a predecessor nor a natural area. When first announced in the AIBS Bulletin for April, 1956 (p. 26), this was to do more than any previous flora. "This massive project, planned to locate and identify every kind of vascular plant in a thousand mile square area, will have the cooperation of botanists in several southern universities. The study will cover the plants of Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina and Tennessee. C. E. Wood, Jr., of the Arnold Arboretum and Reed C. Rollins of the Gray Herbarium will conduct the study. The project, which is expected to take 20 years, was first proposed and supported by George R. Cooley, a retired Albany, N. Y. banker who has devoted years to the study of the southern flora. The project will now also have financial assistance from the National Science Foundation. Three separrate treatises on the vascular flora of the southeast are planned," two volumes to be devoted to the wild flora, a third to the cultivated plants. Twelve cooperating botanists are listed, seven of them permanent residents in the South. For immediate results, it was decided to prepare a generic flora, published as a series of articles in the Journal of the Arnold Arboretum. In my understanding of the term, a "generic flora" is not a flora at all, that word properly signifying an account of species.[10] In any case, the "generic flora" (currently appearing at a speed which, if maintained, will require well in excess of another half century to complete) is not comparable with the other manuals and floras here discussed. That it is also incongruous from a historical-cultural viewpoint will be very evident from my following accounts of backgrounds and perspectives.

Lastly there are two regional floras now being worked on by myself. The first in conception (but likely to be last in execution) was a *Flora of the Gulf Southwest*, intended more or less to take the place of the abortive manuals of Greenman and Small, covering Arkansas, Oklahoma, Louisiana west of the Mississippi River, and Texas east of the Pecos. The boundaries, mostly artificial, were adopted in the belief that it was best to concentrate on the area which has never had a flora. Small's *Manual of the Southeastern Flora,* Ryberg's *Flora of the Prairies and Plains,* and Wooton and Standley's *Flora of New Mexico* make it much less urgent to include parts of the states covered by them. In other words, the old method of arbitrary lines was followed out of precedent, utility, and convenience. Purely botanical reasons were involved only in excluding Trans-Pecos Texas; otherwise science had nothing to do with it.

It becomes obvious quite early that a *Flora of the Gulf Southwest* could not be completed without a great deal of study in the states east of the Mississippi River. After some tentative probings in the form of field trips and synoptical studies of wide-ranging groups, a number of ideas gradually took shape. Many of these have been summarized and documented in my synopsis of *Bonamia,* written more for that purpose than for taxonomic reasons. The major conclusions to be stated are first, that a generic flora fills no real need — what is urgently required is a working manual of the species, in the Torrey and Gray tradition instead of the Brittonian, with nomenclature according to present rules; second, that we have progressed sufficiently to begin using botanical boundaries for the Southeast instead of the traditional arbitrary ones; third, that we have now developed library and herbarium facilities that make it possible to write Southern floras with little dependence on outside resources; fourth, that floras get written because one person makes up his mind to do it, not because of mass-planning. I am therefore actively working on a concise *Flora of the Southeast* as well as a *Flora of the Gulf Southwest.*

HISTORICAL BACKGROUND: CULTURAL

Perhaps the first thing that strikes one about the historical record is the abundance of authors and floras in the North, and their paucity in the South — and the futher strange fact that all three authors of Southern floras came from the North. This is exactly contrary to what the much greater richness and diversity of the Southern flora would lead one to expect. Surely, one would think, the stimulation offered by that flora, and the long blooming season, ought to have resulted in far more interest in and study of the plant life by those born in the South. Plainly the reasons are not botanical. That social, cultural, and economic conditions determined the progress of botany is an inescapable conclusion, and the manner and reasons are easily found. Not only can the state of affairs be readily explained in terms of general history, but even small details can be traced to non-botanical origins.

To begin with, American scientists have been overwhelmingly of lower and middle class origins. The rich and aristocratic rarely have cultivated science to the extent of making significant scientific contributions, though some have been financial patrons. We can see at once a major reason why the North alone supplied all the authors of regional floras. Although there existed a landed aristocracy in the Old North, there was never the social cleavage that existed in the South. It was a region of grass-roots democracy, with a comparatively homogeneous population of little men in terms of wealth and power. It was also a region where book-learning was highly regarded everywhere. In New England especially, in the first half of the 19th Century, there developed a passion for exotic and esoteric knowledge that became a lesser tulipomania, together with a missionary zeal to carry the gospel of learning to the West and South.[11] What more natural than to write botany manuals amid such cultural conditions? Especially when the shrewd Yankee knew there would be plenty of buyers for his books. There seems to have been an ideal level of urbanization and commercial growth at which the countryside was still familiar, and the pursuit of Linnaeus's harmless science was among the many little luxuries now widely available. Not until the next century would extreme urbanization make inroads into the serious pursuit of botany by non-professionals, and it would then become difficult to disentangle the internal complications, arising from specialization and the rise of more technical aspects of botany, from external blighting influences.

After the Civil War two new factors strongly influenced the development of American botany. One was the appearance of the newly-rich "malefactors of great wealth" with the great increase in Northern industrialization. The Gray Herbarium was to benefit modestly from the new Northern wealth; Britton was to exploit is as no botanist before or since. He used it to build the New York Botanical Garden and to hire Small; much of Small's field work in Florida was directly sponsored by wealthy individuals. In the South, only the short-lived Biltmore Herbarium near Asheville, North Carolina, came out of the post-war Northern wealth, but this was hardly more than a plaything of the Vanderbilt family.[12] It had scarcely begun to function when it was largely destroyed by a flood, never to be revived; the surviving remnants were eventually turned over to the U. S. National Herbarium.

The second post-war influence was to be very slow in taking effect. This was the rise of a powerful, centralized, Federal government. Ironically, despite long and violent (and still continuing) opposition to centralized authority, the South was to benefit far more than the North from the activities of Federal agencies. In terms of botany, this meant chiefly the work of the Bureau of Agriculture and the U. S. National Herbarium,[13] and very recently the National Science Foundation, National Institute of Health, and other research-sponsoring units. It is worth noting here that every one of the regional floras and manuals for both the Northeast and the Southeast was entirely a private venture.

In contrasting Southern with Northern conditions, it must be kept in mind that there were really two Souths, or rather three, if Texas is taken into account. This has fateful consequences in the history of Southern botany. The semi-fictional Old South is the Plantation or Lowland South, whose earliest flowering was in Tidewater Virginia. This was dominated by a landed, slave-holding aristocracy which was itself slave to climatic conditions, "King Cotton," and the British textile industry. Before the one-crop economic system had developed a stranglehold (which it did, ironically, with notable help from a Connecticut Yankee: Eli Whitney, inventor of the cotton gin), this aristocracy could produce a Thomas Jefferson, but it never again rose to such an intellectual level. Its members were well educated and well read, but all this was increasingly as part of the social graces, and fitted more and more to the conservative outlook of a leisure class. One did not stoop to the kind of vulgar grubbing that Yankees did; one did not write textbooks, nor get into squabbles about new systems of classification. That before the Civil War Henry William Ravenel of South Carolina, owner of 32 slaves, should study the local flora and put out notable exsiccatae of fungi, was extraordinary — indeed, unique. But Ravenel was only modestly rich, and after the war it was dire need that led him to resume collecting botanical specimens for sale. The deep shock of defeat and ruin did not induce the planter aristocracy to turn to such things as the pursuit of botany for its own sake. They bided their time, eventually regained political control (fossilizing it in the style that until today has kept large city populations under control of rural counties from Georgia to Texas), and promoted a romanticized image of themselves as the true and only Old South.

The intellectual history of these people is among the most absorbing and perplexing subjects confronting the historians. Because it is so vividly illustrated in the history of Southern botany, it deserves extended comment here. The blighting influence of a slave economy and a dominating oligarchy, so different from Northern conditions, seems obvious. But it is not that simple. The ancient Greeks had a slave economy and ruling oligarchies, but cultural blight was conspicuously not a result. And indeed the Old South in its earlier period did not display the intellectual sterility[14] that characterized it during the height of its political power and has been defensively clung to ever since. Stephen Elliott's *Sketch of the Botany of South-Carolina and Georgia* (1816—1824, 2 volumes) stands even today as one of the finest local floras ever written in the United States. It was the work of a South Carolina banker who had no training in botany. That the Old South never again showed itself capable of producing anything of the kind was but one facet of a growing mental rigidity[15] whose roots were certainly in the South's "Peculiar Institution": Negro slavery. This was a very different thing from slavery among the Greeks. Slaves with them were often prisoners of war, not men born to slavery, and not irrevocably doomed to remain slaves; racism was not involved. And this was slavery in the midst of bustling commercialism, centered in city-states; with an atmosphere quite unlike that of the rural Old South, which remained culturally a frontier region until quite recent times, and was antipathetic toward the rude commercialism so typical of Yankees. The social rigidity imposed by slavery and racism engendered mental rigidity, which was greatly intensified in resisting the forces that were undermining the entire slave economy. Though many even in the Old South believed that slavery would ultimately die a natural death, very few there were eager to see a way of life that was good to them disappear.

Despite the very successful efforts in politics and propaganda by the Plantation South, there was and is another South: the Upland South, or the South of small farmers who owned no slaves. These people were closer to the Old North in social and economic conditions than they were to the Plantation South. That they differed so greatly in intellectual interests and activities (not in abilities; the falsity of the hillbilly legend has been demonstrated by the events of World War II and after) may be explained in part by the fact that they still lived under frontier conditions for decades after the North had become urbanized and industrialized, and in part by the overwhelming influence on the entire South of the politically and socially dominant plantation aristocracy. The most telling influence of the latter was its hostile attitude toward public education. One of the most costly activities of the Federal government during Reconstruction was the establishment of public schools and the importation of teachers. But when the men of the Old South resumed control, they showed little enthusiasm for such things.[16] Illiteracy was in their view a desirable thing for the non-slave-holding whites and the former slaves both. Simple lack of education made it impossible for botanical manuals to be written or even read by the very people in the South who, judging by what had happened in the North, were most apt to have produced them.

The men of the Upland South were intensely loyal to their home states, most of them supporting the Confederacy without question in a war that was not in their own best interests, and falling in with the political schemes and racism that dominated Southern history afterward. But there were notable exceptions. Eastern Tennessee made one unsuccessful attempt to set up a new state, and "Tennessee Johnson," by refusing to follow his home state into secession, was destined to find himself in the White House, granting presidential pardon to the leaders of the Confederacy, who did not belong to his South. West Virginia, of course, is the conspicuous example of the split between Upland and Lowland South, carried to successful political outcome for the former. North Carolina was never so dominated by the plantation aristocracy as were her neighboring states, and Florida, which for long was sparsely settled, likewise was never fully a part of the legendary Old South. Despite the political catch-phrase "the Solid South," the South is not and never was such a unity.

We shall review the significance of all this in the current and future history of Southern botany shortly. But first we must take up the special case of Texas, which, although a member of the Confederacy, is not a typically Southern state, botanically or otherwise. It is as much Western as Southern, but most of all it is just Texas, never forgetting that for nine years before becoming one of the United States it was a sovereign nation. The Plantation South and negro slavery did spread into the southeastern part of the state, but never attained the level they did in Louisiana and states east of the Mississippi River. Another landed aristocracy, the Cattle Barons, did develop farther west, but by the nature of things it was not numerous nor old, and without slavery did not develop into anything like the Old South. The real core of settlement in the state was an approximately north-south strip down the middle, from the western borders of pine forest out into the rich prairies, with particular concentrations along the margin of the Edwards Plateau with its many springs. The settlers before the Civil War were diverse: many from the Upland South, some from the Middle West, great numbers from Germany and other European countries. In social and economic terms, these people belong with those of the Old North and the Upland South; despite geographic proximity and political association with the Plantation South, they are not an integral part of it. Noteworthy is the fact that of the seven original (pre-

Sumter) states of the Confederacy, only Texas submitted the Ordinance of Secession to popular vote; in the other six it was passed by the ruling oligarchy.

All of the South remained impoverished for long after the Civil War, although Texas did not suffer as much as most. Nevertheless the "Big Rich" so much talked about nowadays are a quite recent phenomenon, as well as a minority. They do, however, mark the first major step in the economic developments which have produced the New South. For Texas it was a special item: oil. For the whole South, it was a complex and varied group of developments in the direction of urbanization and industrialization, given enormous impetus by World War II. We need not go into details. It is enough to point out that although far from having equalled the North, the South is now well along in an economic boom very similar to that experienced in the North a little before and more especially after the Civil War.

When we look back at the history of the various botany manuals, it is easy to see how much of that history is only a manifestation of the general history of the times: of social conditions, economic developments, intellectual climate. Purely botanical matters are of extraordinarily little consequence. Eaton's manuals were popular and influential with the general public, falling in so well with the spirit of the time and the region. But they did not establish either the professional practice or the reputation of American botany. Torrey and Gray did successfully introduce the Natural System, and accomplished much good work; yet the spirit of the age which followed them was such that their efforts to establish a tradition of sound scholarship failed, and their hopes of accomplishing the basic task of writing a complete flora of the country were never realized. The Northeast, thanks to its long democratic tradition, devotion to public education, sympathetic intellectual climate, and earlier and greater economic development, is now supplied with good, recent floras which reflect the benefits of repeated revisions and the prolonged and intensive work of many hands. The South, because of internal social and cultural conditions, had to have its few and very inadequate floras written by outsiders. But social, cultural, and economic conditions are not static, and we have now reached a stage at which we can begin to see the shape of things to come, and the reasons for them. But before proceeding to diagnosis and prognosis, we must briefly fill in the pertinent scientific background.

HISTORICAL BACKGROUND: SCIENTIFIC

The entire history of the manual ranges is one of inadequate progress with the rather elementary job of compiling a catalogue. There is virtually nothing that could be called intellectual development in it, such changes in concepts or techniques as appeared being of external origin, the majority coming from Europe. Following is a list of those developments which were mainly scientific in origin or nature and which influenced the manuals. Not that they were purely scientific, of course. All had in greater or lesser degree contributing cause in contemporary social and economic conditions, but are most conveniently discussed in tems of their manifestations in the scientific world.

The Natural System.—Linnaeus himself considered his simple procedure of counting stamens and pistils no more than a convenience, to be replaced some day by an approach using many characters. Many of his followers with more limited mental horizons (Eaton among them) would have preferred to keep things simple forever. But the Linnaean System became more and more obviously unworkable as knowledge of the world's flora increased. The organization of that flora into orders and families based on many features, a work almost entirely carried out by Europeans, required much more in the way of critical study and evaluation than before. Torrey's promotion of the Natural System in American botany was but one aspect of his efforts to create a truly critical science on this side of the Atlantic. With its establishment American botany for the first time acquired intellectual substance, however modest.

Darwinism.—Although Asa Gray himself was a leading champion of the theory of evolution, acceptance of it brought no change in his approach to classification. A species was treated as a morphological type which for all practical purposes was constant. Not until the new sciences of genetics and ecology had been born and made some growth could there develop the concept of a species as a population which might include considerable variation. All the manuals and floras that have been published for the two ranges so far have been quite uninfluenced by evolutionary theory. While this was largely by default (only Gleason among the various authors had experience with intensive work in ecology, or had given attention to the philosophical bases in his research), it is as things should be, for the proper function of a flora is to record facts and make them accessible, not to theorize. This point will be elaborated further under *Neo-Darwinism.*

Nomenclatural Codes.—This of course means chiefly the American Code, which represented neither profound thought nor a deep desire to aid science. In its extremism with regard to priority, going outside the genus to find the earliest names for species and creating unnecessary new combinations (in contrast with what Fernald would later refer to acidly as "the sensible and therefore discarded Kew Rule," under which only names already existing within the genus had to be considered), it followed the preachings of a few Europeans like Otto Kuntze in Germany. In its use of undesignated trinomials, it borowed from zoological practise. Its type method, commonly held up as a great American contribution, was simply a refinement of the "preuves" of Alphonse de Candolle's *La Phytographie.*

Far more significant than its content were the concealed purpose of the Code and the manner in which it was promulgated. It was here that Britton[17] stooped his lowest to get ahead of the Gray Herbarium. Receiving no support from the Harvard botanists and only scattered support elsewhere, he arranged for "A Committee of the Botanical Club, American Association for the Advancement of Science," a hitherto nonexistent group, made up of henchmen rather suddenly and mysteriously appointed, to put out a *List of Pteridophyta and Spermatophyta Growing without Cultivation in Northeastern North America* employing the hundreds of unfamiliar names required by the American Code. In the preface it is stated with bland mendacity that "the general rules on which the list has been compiled are in accordance with the views of the great majority of North American students of systematic botany." Britton was chairman of the committee, which included no members from Harvard, from the South, the Far West, or Canada. The territory included was "the area of the 6th edition of Gray's Manual, with the addition of the States of Kansas and Nebraska, and the Canadian Provinces from Manitoba to Newfoundland." This of course was the territory to be covered by the *Illustrated Flora* whose first volume appeared three years later. At one stroke Gray's *Manual*, with its old nomenclature, had been outmoded. Those who wished to keep abreast of the new would have to buy the *Illustrated Flora* and later Britton's *Manual*. The American Code was a Brittonian device for achieving political power and commercial advantage.

In a period of great corruption in public life, this kind of thing was not unusual. The growing imperialist sentiment of the time, soon to erupt in the war with Spain and to be personified in Teddy Roosevelt, found added attraction in something specifically named the *American* Code. Britton very successfully exploited attitudes and techniques of a society whose ideals were far removed from those of Torrey and Gray. Eventually there were compromises; the International Code of today includes some features from the American one, and is the only code in use. The two most recent Northern floras are essentially alike as to nomenclature, but differ considerably from any predecessors. The South still suffers with Small's *Manual*, nominally following the American Code but not consistent in that respect, and very different from the current Northern counterparts.

The Rise of Technical Botany.—During Britton's own lifetime there occurred a great development in non-taxonomic fields of botany, especially those employing the microscope and the laboratory. These were not involved in disgraceful nomenclatural squabbles, had the attraction of newness, and the appearance of being more truly scientific than taxonomy seemed to be. There is supreme irony in the fact that before he reached retirement, the very science in which Britton had tried to make himself supreme had fallen into disgrace, in great part as a direct result of his own actions. He had made himself the leader not of American botany, but only of a discredited segment of it.

Much of the newer technical botany had little to do with the preparation of manuals, and botany became more and more a study for specialists. But at least three fields were to have much to do with the attitudes and methods of future writers of manuals: genetics, cytology, and ecology. Only with the aid of these would it become possible to develop the concept of species as population rather than morphological type. But one still of necessity recognizes a population as belonging to a secies more by the visible morphology than anything else. Despite much ballyhoo about the "New Systematics," sound taxonomy is not so very far removed from what Torrey and Gray tried to do. This is especially true when progress has hardly advanced out of the primitive stage, as is true of our knowledge of the Southern flora.

Neo-Darwinism.—This exists in its most virulent form among modern vertebrate zoologists, who by virtue of having simple and limited materials upon which to work have progressed so far beyond basic taxonomy that they are no longer really taxonomists at all. It is a measure of the weakness of American systematic botany, reinforced by modern mass culture and the urge to conform, that the botanists have accepted ideas and assertions which do great harm to the sound progress of plant taxonomy. Just as Brittonism had exploited taxonomy as an instrument of political and commercial warfare, so Neo-Darwinism has exploited it as a vehicle for the pseudo-science of phylogeny. Indeed, it has even come to be taught as dogma that the purpose of taxonomy is to construct a family tree, not to be taxonomy at all. Basic taxonomy, as I conceive it, comprises a body of factual information, and serves as the basis for many other kinds of study. Phylogeny does neither; it only diverts taxonomy into a bastard activity between science and fiction. After the twin calamities of Brittonism and phylogeny, it is a marvel that any honest taxonomy still exists.

An important difference between Brittonism and Neo-Darwinism is that while the former still took into account the general public, the latter is meant only for the professionals. It is doubly hostile to the preparation of floras, and ought to be rigidly excluded from consideration by anyone engaged in such work.

Over-all Scientific Background.—It has been said that the 19th was a Biological Century, while the 20th is a Century of the Physical Sciences. There is no question but that writing floras was a more common, more acceptable, and much easier activity during the 1800's than now. In today's intellectual climate, so heavily dominated by the physical sciences and mathematics, with confused overtones of war and space travel, the peaceful writing of mundane floras finds little encouragement. The weak science of botany seeks to borrow strength by adopting techniques from those more powerful. I think it would gain more strength if it sought a clearer understanding of its condition and a firmer grasp on its proper business. At this stage in our progress, I believe the writing of floras is an ideal means of doing both.

Incidentals.—Though I have gone to some lengths to demonstate how cultural and economic conditions lay behind the greater success of Northern botany, there is at least one contributing factor in the nature of the materials being studied. The flora of the Northeast is smaller and simpler than that of the South. It also has much more in common with that of Europe than does the Southern flora, and the work of European botanists certainly helped to make easier the task of those writing floras for the North. On the other hand, today's Southern botanists have benefits from rapid transportation and communication that facilitate their work in a way never before possible.

HISTORICAL PERSPECTIVES

History is the product of forces. Enough has been said, I think, to demonstrate my thesis that botanical history—specifically illustrated by the evolution of the two manual ranges—is only a minor part of cultural, social, and economic history, and its progress is subject to a host of influences quite remote from itself. Yet the history of a science ought to differ from general history, since science has (at least in short-range view) concrete, specific objectives. Why then has American botany been so completely the victim of circumstances? The answer I believe lies in the failure of American botanists to view themselves and their activities scientifically.

Surely the first task for American botany was to get the country's flora written up and made accessible to everyone, and this task is still unfinished. As a scientific task, it ought to be scientifically delimited, but even this primary step has still not been taken. For the manual ranges, straight lines may be tolerated in a pioneer era, as a matter of practical convenience. But after three generations of Southern floras and more of Northern ones, we have surely progressed far enough to demand something better. We particularly need to have the dividing line scrutinized from the Southern side, not just the Northern.

The imposing array of authors and manuals for the North is matched by an even more imposing array of large herbarium and library collections. The South still lags, but not nearly so much as before. Good and recent herbarium collections are available in quantity at institutions within the South, and although library facilities are less adequate, there is no longer the complete monopoly once enjoyed by the North. Facilities are not a barrier to progress at present.

Personnel is another matter entirely. Not because of small numbers; never before have there been so many Ph.D.'s. But it is precisely here, ironically, that most of the trouble lies. The character, attitudes, and instilled beliefs of the modern American professional botanist are largely inimical to the writing of floras. This means that the most immediate and influential intellectual atmosphere is likewise inimical to such work. We have come back to cultural and social influences, this time at a more immediately personal level.

Must we at this point give up hope of any further scientific evaluation? No; if human history is indeed the product of forces, we have some possibility of the detection and objective evaluation of those forces. In fact we have already done so in recounting the past history of the two manual ranges. One might be led to predict then that their future history will simply continue to reflect the functioning of largely irrelevant forces, and nothing scientific can be done about it. Nothing purely scientific, perhaps, but having demonstrated to what an extent botany is a cultural pursuit, we need not be thus restricted. Let us try to discern some of the influences that are harmful, and need to be resisted, and some that are favorable and need to be aided.

In speaking of Britton and the Age of Empire Builders, I briefly indicated the non-botanical context: the Robber Baron era of corruption, monopoly, power politics, and expansionism. Their work represented a direct importation into "pure" science of contemporary cultural attitudes and activities such as had never before taken place. The next period, overlapping in time with the Age of Empire Builders, I have called the Age of Dilettantes. This was in part a reaction against the immediately preceding period, in part an acceptance of it. The Empire Builders went in for regional and even continental floras, dabbled in all groups, did work of generally poor quality, championed the American Code and all the needless nomenclatural upsets that went with it, and left to their heirs immense herbarium and library facilities — along with a ruined reputation for plant taxonomy as a science. Their heyday saw the great rise of other fields of botany, so strikingly illustrated in the career of that great opportunist, John Merle Coulter. Laboratory botany benefited hugely from the loss of sound scientific standing by taxonomy. The Dilettantes who succeeded the Empire Builders no longer wrote general floras, but specialized (sometimes very narrowly), did work of generally high quality, supported compromises and the International Code, took their rich working facilities pretty much for granted, and — being themselves all Ph.D.'s — went on grinding out Ph.D.'s more numerous than distinguished. The trend toward more careful work received an opportune boost in the form of cytological methods, a European innovation which fit in perfectly with the American flair for push-button gadgets and had altogether phenomenal success in the United States. Taxonomy began to be restored to favor in the eyes of the laboratory scientists.

Now another cultural trend is beginning to be prominent: the drift to stereoptyed mass-culture, in part arising from the constant increase in population. In terms of botany, it means more and more Ph.D.'s being ground out according to remarkably uniform pattern — taught out of mass-produced, standardized textbooks, in stereotyped courses. Taxonomists grow up with dogmas (myths, really) floating in the air, never set down in clear terms and never critically examined or even questioned: taxonomy had gone bad; one must lean over backward to avoid publishing unnecessary names or describing too many species; one had to specialize in order to be really scientific; one did not waste time on introduced plants; phylogeny was the real thing, work on general floras was bad. And in line with the growing American tradition, one mustn't criticize. The Age of Dilettantes is passing into the Age of Conformists, in which often excellent but specialized work goes hand in hand with uncritical conformity and intellectual shallowness.

What I have described is really the cultural history of Northern botany. For the South there was the long stagnation from the 1830's to the 1940's. But the illustrious early period with Stephen Elliott, and the immense spurt of activity since World War II, make it plain that the long stagnation was something forced by special factors, not evidence of lack of capacity. By reason of this very gap in its past, the New South has a lively history ahead of it, and we can not only see that history beginning to take shape; we can perceive the details and the reasons for them. It is no accident that two of the four largest herbariums in the South are in Texas and two in North Carolina; that those in Texas began their current growth earlier; that there are more native sons among the taxonomists in those two states than in any others in the South; that a descriptive flora of West Virginia is nearly completed, while the Old Dominion has nothing comparable now or in prospect; that Florida, North Carolina, Tennessee, and Texas lead in the number of active botanical centers. These are wholly expectable consequences of economic progress[18] in areas least dominated by the Planter Aristocracy. But the whole South is becoming urbanized and industrialized, and the pattern of change keeps spreading and intensifying. Historians of the future may find the current progress of botany at the University of Georgia even more notable than the examples just cited.

The South's needs botanically are decidedly regional, something out of step with the national trend to uniformity. The South has also been a stronghold of individualism as well as states' rights, again out of step with the national trend to mass-culture. And more than any other section, it has a great awareness of history.[19] These ingredients in the intellectual atmosphere are added sources of strength to those who have the special advantages, in performing belatedly a necessary scientific task, of modern facilities and, not least, the lessons of history.

In so applying the lessons of history, something new is introduced into American science. Plainly the opportunity before Southern botany is not simply to imitate what has been done before, or to fall in with the Age of Conformists. The more independent it is, the more it draws on those regional cultural peculiarities that offer strength and encouragement, the greater its scientific achievement will be.

APPENDIX ONE

CALAMITY AND SOUTHERN BOTANY

Chance undoubtedly plays a part in history, and in the history of Southern botany, ill chance has figured more largely than for any other section of the country. Jones and Meadows, in tabulating American institutional herbaria, note that seven had been partly or wholly destroyed by fire in the first half of the 20th Century. Four of these were in the South (Clemson College in South Carolina, University of Tennessee, Tuskegee Institute in Alabama, University of Kentucky). To these may be added the Biltmore Herbarium in North Carolina, partly destroyed by flood, and never restored. For one half-century period alone, a quarter of the country was victim of more than half the major catastrophes. In the 19th Century, important collections made by Darby and Buckley were lost while being shipped north. The deliberate destruction of most of Rafinesque's herbarium must also be counted as a Southern calamity, for Rafinesque had made particular effort to obtain Southern collections, and had named many species from the region. Having at all times much less than the North or the Pacific states, the South could not afford to lose even an equal amount with them, but it lost much more.

The premature deaths of men of great promise has darkened the history of botany in all sections, and the South had its full share — Thomas Walter, Hardy Croom, W. B. Fox, to mention but one for each of the three centuries in its history. As with the lost collections, the small numbers of those who pursued botany in the South made the loss of each one greater than if it had occurred elsewhere.

In commenting on Reinhold Niebuhr's thesis that the American people have had too happy a history, and are therefore not really prepared for world leadership, C. Vann Woodward points out that the South, having suffered defeat and ruin in the Civil War, is different and unique in just this respect. It is a strange coincidence that the history of Southern botany, quite apart from the episode of the War, should be more touched with tragedy than that of any other section.

APPENDIX TWO

THE PATTERN OF ALIENS AND FRONTIERSMEN IN SOUTHERN BOTANY

What is a *Southern* botanist? The best answer I think lies in Oswald Spengler's conception of race, as the manifestation of a distinctive culture, not a matter of blood. "It is what one *has,* not what one *is.* . . . The one is ethos; the other — zoology." This hardly fits the dogma of Anglo-Saxon supremacy and the preoccupation with family ties so typical of the Planter Aristocracy of the Old South. As a matter of historical record, even they did not practice what they proclaimed. There was the embarrassing French origin of the old Huguenot families who were numerous and prominent in South Carolina high society; but at least they were old, and the definition of Anglo-Saxon could be stretched just enough to include them. General Beauregard, handsome and with polished manners, in charge when Fort Sumter was fired upon, popular hero and darling of Charleston society, was a Creole from Louisiana. Jefferson Davis, President of the Confederacy, came of an upstart Western family, only one generation settled in Mississippi, and while regarded with condescension and mistrust by the older aristocracy, nonetheless was made President, later to become not only apologist but prime symbol of the Plantation Aristocracy.

Such unsettled social conditions of course reflect the frontier status in which the South remained so long. The pattern in political life was duplicated in botany, and has been consistently followed for two hundred years. Thomas Walter was an English immigrant, Stephen Elliott, a native son; Darby and Chapman were Yankees, while Rugel, Gattinger, and Mohr came from Germany, and the two Michaux from France. There is special attraction for botanists in frontier country with still unknown plants, of course. But there is also a non-scientific factor in the attraction of frontier conditions for individualists, and taxonomic botany has been overwhelmingly carried on by men who were strongly individualistic. A running theme in Geiser's *Naturalists of the Frontier* is that of gifted men crushed by unfavorable frontier conditions, men who in more civilized surroundings might have risen high. But with civilized society they might have proved temperamentally incompatible; it was in their character to choose the frontier, and their achievements there as likely as not greater than they might have been in different circumstances.

Texas inevitably offers the most spectacular illustration of the pattern of aliens and frontiersmen, and the changes now under way. It had no native botanists until well into the 20th Century. Berlandier came from Switzerland (born just across the border in France), Drummond from Scotland, Lindheimer and Roemer from Germany, Reverchon from France; Dr. Edwin James, Charles Wright, Buckley, and Riddell were from the Northeastern United States, and Gideon Lincecum was born in Georgia. After nearly a century and a half of botanical exploration, the picture today is in part one of extreme contrast, in part one of the continuation of old patterns. Texas today has more native-born taxonomic botanists than any other state in the South, almost more than all the rest combined, even if we count only those who have recently published books about or described new species in its flora (M. C. Johnston, Fred Jones, C. L. Lundell, Ellen Schulz Quillen, Chester Rowell, B. C. Tharp, B. L. Turner, Barton Warnock, Eula Whitehouse). In a remarkable illustration of "curious chances," the alien element is represented by three Canadian-born botanists (Walter Lewis, Lloyd Shinners, Alfred Traverse[20]), one from each of the three major sections of Canada (British Columbia, Prairie Provinces, Eastern Canada), working respectively at a state college, a private university, and a private research corporation, and pursuing three different aspects of systematic botany (cytotaxonomy, classical taxonomy, paleobotany). The out-of-state Americans are represented by a North Carolinian (D. S. Correll) and a Louisianan (R. A. Vines) in the Lincecum tradition, while a Yankee from Indiana (N. C. Henderson) is the most recent addition to the roster of Texas systematic botanists.

The pattern in the rest of the South is less extreme, but similar. There are fewer native-born botanists, and almost no aliens, while immigrants from the North are a large contingent, continuing the pattern that goes back nearly a century and a half. In time we may expect the native sons to become a majority,[21] but it is unlikely that there will ever be an era of exclusively home-grown botanists. Even Britain, the world's most prolific producer of botanists, in her Golden Age, had such men as the Germans Seemann and Stapf. Although Rafinesque complained[22] of "not having been able to explore as yet the Southern States, deterred by the bad roads, unhealthy climate, scanty fare, heavy expenses and state of society. A pedestrian Botanist is not always very welcome there," the South has traditionally been hospitable to botanists, even enduring the rabid Unionist and Yankee A. W. Chapman all through the Civil War. It is a tradition likely to continue.

After this brief additional sampling of the historical record, we may answer the question posed at the start. A Southern botanist is one who lives in the South and devotes himself to botany. Origins may be incidentally interesting, but are not involved in the definition.

Commentary on aliens and frontiersmen would be incomplete without some mention of those whose families have been in America several generations longer than the family of the present President of the United States or the families of most of the nation's citizens, but who scarcely enjoy the usual status of early settlers. The blighting influence of the slave economy on Southern whites has already been noted. For the negroes it was of course much more extreme, and made worse by racist attitudes on both sides. We have seen how, in terms of botanical history, the release of the Upland White from long cultural suppression has begun to have positive results. We may well expect that the longer and more severe cultural suppression of negroes will be followed by a longer period of recovery. But recovery is visibly under way, and like so much else in the New South, at a quickening pace.

I vividly recall an incident that took place a year or two after I came to Texas. I was showing a Northern visitor some native weeds in a vacant lot in Dallas. While we were on hands and knees digging specimens (as I recall, the plant was our attractive though small-flowered native bindweed, *Convolvulus hermannioides)*, a young colored lady stopped to watch, and at length asked what we were doing. We explained as well as we could. "Oh," she exclaimed, "I just love flowers and wish I could know more about them!" Such had been my own feelings from earliest childhood. But for her there was no chance; for her children, perhaps.

Another incident, a year or two later, in St. Louis, on a Sunday afternoon. I had gone out North Broadway Street to collect bees and wasps in waste areas fringing the Mississippi River bottoms. Waiting at the street-car stop to go back into town was a colored man of indeterminate but considerable age. He could hardly wait for me to come up before breaking into angry speech about a miserable patch of corn across the street underneath a huge cottonwood tree. He was up from Mississippi to visit relatives; back home they knew how corn ought to be grown, and planting it under a cottonwood was all wrong. "It cain't *'cumulate,"* he insisted repeatedly, indignant that anybody should treat corn like that, "it cain't *'cumulate!"* Illiterate he might have been; unintelligent or incompetent he certainly was not. And again the natural love of plants was plain to see.

Just as this paper was beginning to be written, there was showing close to campus the motion-picture version of the prize-winning Broadway play, *A Raisin in the Sun,* written by and about negroes. Some weeks earlier I had heard its author, Laraine Hansberry, in a radio interview, telling with bitter intelligence some of the personal beliefs that had been voiced in the play ("Why give God the credit for the things man does for himself?"). Memorable in the picture is the scene in which the matriarch, defending a bedraggled house plant in their Chicago flat from the cynical daughter, exclaims, "It expresses *me!"*

On my latest visit to Montgomery, Alabama, first capital of the Confederacy, a local newspaper had this to report (19 July 1962): "Two years ago, Bullock County had around 2,200 white and five Negro voters. It now has about 2,100 white and around 1,000 Negro voters. "

The interest is there, the ability is there; the opportunity has been wanting, but is plainly on the way. The next Southeastern flora will still be hardly past the pioneer stage. It may well be that the first definitive Southern flora will be written a generation (or two, or three) hence by a colored botanist, quite possibly one born in Mississippi.

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Since the titles and dates for the various manuals and floras are given in the text, they are not repeated here. Many of the titles in this list are not specifically cited in either the text or the notes, but they were among the most helpful to me in trying to understand Southern culture and history. To those who do not know the South, and to those who think that they do, I strongly recommend the very recent books dealing with the South and the Civil War listed below. Today's Southern intellectual has moved far beyond the rather naive and limited viewpoint of the Twelve Southerners who in 1930 published *I'll Take My Stand.* But he belongs to a small minority; the South in general still is far behind. Botanists, being themselves a small minority, should feel special kinship with the historians, sociologists, and men of letters.

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NOTES

[1] "The Mason-Dixon Line is, in a way, biological as well as political. Its vicinity is the dividing line between early seasons southward and later seasons northward, in the first half of the year and vice-versa in the second half." (Small, 1923, p. 194.)

[2] For numerous indications of this, see Dupree's biography.

[3] Quoted by Lyon, 1939.

[4] Rodgers' biography attempts to make a shining hero out of Coulter, but fortunately records enough facts so that something nearer the truth can be read between the lines. Two items may be cited in particular. In his early career, Coulter several times obtained special funds from his institution of the time to build up the herbarium, which he proceeded to take along as personal property when he left, ultimately selling it to the Field Museum in Chicago. None of the major discoveries for which he became famous in his post-taxonomic period was reported in a paper by Coulter alone; all were joint-authorships with a graduate student. Marcus E. Jones had this to say (Contrib. West. Bot. 15: 75, 1929): "Coulter seems to have been the one who started the nefarious scheme of taking part of the credit for work he never did, and which went into disrepute with Scribner. Rose was his pupil, one of the best, and took up the Umbelliferae. Coulter's part in this publication was that of sitting once in a while with Rose while Rose explained the work he had done on the genera. Coulter's chief part in the deliberations was smoking rank cigars and stinking up the room with tobacco smoke. It was the same method which produced Coulter's Flora of Texas, but to date no one has ever claimed being the clerk who got it out." Coulter's *Botany of Western Texas* (Contrib. U.S. Nat. Herb. vol. 2, 1891—1894) is such a poor piece of work that I am inclined to believe it was indeed his alone, and evidence of what the calibre of his work was when he did not have more talented associates to exploit. On the basis of the record, it appears that his famous last words ("I should like to be of service") omitted two important ones: "to Coulter."

[5] Despite his usual good humor and geniality, Gray could at times be ruthless and even vindictive. His treatment of S. B. Buckley is a clear case in point. Gray evidently believed that with the many collections from Texas in his possession (those of Berlandier, Drummond, Leavenworth, Lindheimer, Wright, and others), he had a pretty complete representation of the state's flora. He was incensed when Buckley published numerous new species without consulting him and without supplying a good set of specimens, so much so that in a paper in the Proceedings of the Philadelphia Academy he denounced Buckley, dismissed his new species as worthless, and all but ordered the Academy not to publish any more of Buckley's work. The Civil War supervened, and it was some years before Buckley was able to defend himself. He pointed out that the main shipment of his specimens had been lost in transit, so that he had to get along with mere scraps that he had kept with him for

study; this was the reason for the poor quality of his specimens, which Gray had particularly noted, and for his failure to distribute duplicate sets. We can add today that Gray was mistaken about the Texas flora; a large proportion of Buckley's new species were perfectly good, and are recognized today. One cannot help wondering if Darby also was unfairly condemned, but unfortunately we do not have even poor fragments of his specimens.

[6] See the reminiscences of Chapman by Kimball, and of Small by Wherry.

[7] See the introductory remarks in Pennell's "Scrophulariaceae of Trans-Pecos Texas."

[8] In a quick compilation I find just eight living American botanists who have authored a descriptive flora or manual of a state or region: Davis (Idaho), Harrington (Colorado), Munz (California), Stevens (North Dakota), Strausbaugh and Core (West Virginia), Gleason (The New Britton & Brown), Cronquist (its companion Manual). Half of these men are now retired. (The concluding volume of the West Virginia flora, and Cronquist's Manual, are reported in press as I write this: October 1962.)

[9] Personal communication from Dr. Robert E. Woodson, Jr.

[10] See also my acid remarks on the generic flora in connection with *Drosera,* this journal pp. 53-59.

[11] Julia Hale's *The Peterkin Papers* is the classical work depicting the mania for learning. See further in Van Wyck Brook's *The Flowering of New England.*

[12] *Biltmore Botanical Studies* ran to just two numbers, published in 1901 and 1902. A detailed history of the very unusual institution which issued them is greatly to be desired; almost no information about it is available in print.

[13] In the first 21 volumes of *Contributions from the U.S. National Herbarium,* two short papers by E. S. Steele (in volumes 13 and 16) are the only ones that deal chiefly or exclusively with plants of the Gray's *Manual* range. There are eight papers, some quite long, devoted to plants of the South (including Texas), plus three whole volumes (Botany of West Texas, Plant Life of Alabama, Flora of the District of Columbia). In addition, a number of monographs (that of *Panicum,* for example) are of groups most prevalent in the South. Later volumes of the Contributions have come to deal almost exclusively with foreign plants, chiefly Latin American.

[14] "This made for a society gay and polished, even brilliant . . . The surprising thing is that this society was so sterile intellectually." (Fletcher Pratt, *Ordeal by Fire,* p. 181.) "The South, like most aristocracies, was deficient in education, both of the corporate body and of the individual member." (Ibid., p. 280.) "They were kind, hospitable, liberal and honorable. But it also noted that their lives were trivial, involving nothing more important than the concoction of mint juleps. 'They visit each other, eat, drink and are merry, and that is all. They have excellent qualities,, but no occasion calls them forth.' " (Review of John Pendleton Kennedy's *Swallow Barn, or a Sojourn in the Old Dominion,* summarized and quoted in Howard Floan's *The South in Northern Eyes,* p. 91.)

[15] "Thus when the frontier period passed . . . the Old South had had as investigators a considerable number of gifted and vigorous workers. The South, however, had become preoccupied with the States' Rights movement. . . . From this time educational movements in the South dwindled." (S. W. Geiser, *Naturalists of the Frontier,* Chapter 13, Notes on Scientists of the First Frontier, p. 263.) An interesting and rather depressing illustration of the tenacious survival of the Old South's mental rigidity is to be found in Herbert Ravenel Sass's *Adventures in Green Places.* This is a series of essays on the natural history and antiquities of the South Carolina low country, in which, incredibly, there is not even the mention of the names of Thomas Walter and Stephen Elliott, nor even of the author's kinsman, Henry William Ravenel. In one footnote (p. 101) we are told primly about the name of William Mazyk Porcher that it is "a French Huguenot name and therefore to be pronounced Porshay," but nothing is said of Dr. Francis Peyre Porcher who, to help the Confederacy, prepared *Resources of the Southern Fields and Forests, Medical, Economical and Agricultural,* published at Charleston in 1863 (followed by a new edition in 1869). An entire chapter is devoted to Plantation Pageantry (pp. 92—119), the make-believe knightly tournaments which were among the highlights of ante-bellum social life. At the end is inserted a defense of Calhoun! That a man with pretensions of scholarliness should, in a book of local natural history, omit all mention of the most illustrious naturalists in the past, and come to the defense of social frivolities and Calhounism, is striking evidence of how the culture of the Old South could restrict intelligence.

[16] "The new leadership of the South was to be more enterprising, less cultured, but cautious and tight-fisted. . . . On the other hand, these people did not share the ante-bellum Democrats' opposition to Federal appropriations. . . . They would press steadily for the

segregation of the Negro and his elimination from politics, and they were not particularly interested in providing improved educational facilities." (Nichols, *The Stakes of Power,* pp. 212—213.)

[17] Britton is an even more significant figure in American botanical history than Asa Gray, and a thorough-going biography of him is badly needed. About this very remarkable if not very admirable man I have been able to learn almost nothing of real significance. I have talked with several botanists who knew him, but they all suffered too much from what I have politely called "the narrow cultural limits" of American botany. They saw, but had no comprehension of what they were seeing. About one thing they agreed: "He was a driver," and those he employed were expected to produce. That he wanted quantity without regard to quality is apparent in the work of Rydberg and Small, and in his own taxonomic work. His own writings are dull as dishwater. His infrequent ventures into non-taxonomic discussion (see as an example "Darwin and Botany," Ann. New York Acad. Sci. 19: 28—33, 1909) display a thoroughly commonplace mind. He was a power politician first and foremost, who by some strange chance seized on botany as an ideal field in which to exercise his talents.

[18] Though economic conditions are important, and I refer to them repeatedly, they are not everything. I quite agree with the views of Fletcher Pratt (see the introduction to his *Ordeal by Fire*); other things may outweigh economic considerations. We have a neat illustration of this in the contrasting condition of systematic botany in two Southern states which rank among the poorest economically. West Virginia is one of the leaders, with an established, important botanical journal (Castanea), and a keyed, descriptive, illustrated state flora. Arkansas ranks near the bottom. The lingering effects of past history are plain to see. West Virginia represents one non-slave-holding portion of the pre-war South which broke away from Virginia to remain with the Union; Arkansas joined the Confederacy, and though only in part a plantation state (in the 1850 Census it ranked 12th in number of slaves; only Florida, the District of Columbia, Delaware and New Jersey ranked lower) it accepted the political and inevitably the cultural domination of the Plantation Aristocracy, with its blighting influence on the intellectual climate. In explaining West Virginia's achievements despite handicaps, we must certainly include the role of active individuals as a major factor.

[19] It is interesting to note that of the tiny handful of living historians of American botany (Dupree, Ewan, Geiser, McKelvey, McVaugh, and—on the strength of this paper—Shinners), one half now reside in the South (Ewan, Geiser, Shinners), and two more formerly did (Dupree, as student at Texas Technological College; McVaugh, at the University of Georgia). When we add the Southern awareness of its history to Western preoccupation with history, inevitably we find Texas again has had major attraction. It can hardly be pure chance. However subtly the ingredients of intellectual climate may function, we have visible evidence that they do.

[20] Dr. Lewis is currently on extended leave in Europe and Africa. Dr. Traverse has very recently (September, 1962) left the Shell Development Company to train for the Episcopal ministry.

[21] Exportation of Southern brain-power has been one reason for the low number of Southern botanists who are Southern born. The present Head Curator of the New York Botanical Garden is a native of Georgia.

[22] See his *New Flora of North America (First Part)*, p. 11. Had Rafinesque come on horseback, he might have been somewhat more kindly received. In the South, a gentleman did not travel on foot.

ANNUAL SISYRINCHIUMS (IRIDACEAE) IN THE UNITED STATES

LLOYD H. SHINNERS

Only three annual species of *Sisyrinchium* occur in the United States. It is thoroughly characteristic of the elusiveness of taxonomic characters in the genus that one of them *(S. rosulatum)* is sometimes perennial. The major area for all three is in eastern Texas and Louisiana. There one of them *(S. minus)* is native, but it has been introduced into California and North Carolina, and abroad into Argentina and Uruguay. The other two are natives of temperate South America which were introduced into the Southern United States (and elsewhere around the world) beginning in the middle or latter part of the 19th Century, but did not become well established and common until relatively recent times. These two hybridize readily in their new home, as apparently is true also in the areas where they occur together as natives in South America. Nevertheless they appear to be maintaining their identities as separate species. There has been no indication of crossing between the two aliens and the native *S. minus,* a fact now made readily understandable by Oliver and Lewis's report (1962) of the haploid chromosome numbers: 16 in each of the two aliens, 5 in *S. minus.*

The species and hybrids are all easily recognized from the colors of the fresh flowers, but such information is grievously lacking with most herbarium specimens. This account is based primarily on my own extensive field observations and collections made from Texas to northern Florida, in large part (1956-1961) under a grant from the National Science Foundation for preliminary field work toward a flora of the Gulf Southwest. An extended tour of the Northeastern States during the winter of 1945-1946, and shorter trips at intervals since, have enabled me to examine types and other specimens at the Chicago Natural History Museum (Field Museum), the Gray Herbarium, the Missouri Botanical Garden, the New York Botanical Garden, the University of Texas, Texas A. & M. College, Tulane University, the United States National Herbarium, and the United States National Arboretum Herbarium, as well as Southern Methodist University. I am indebted to the many curators and librarians (several now deceased) who so kindly made their facilities available during my visits. Most recently I have to thank Dr. Robert L. Wilbur for the loan of collections from the Duke University Herbarium; Dr. George B. Van Schaack, of the Missouri Botanical Garden, for a copy of the original description of *S. valdivianum;* and Prof. J. Leandri, of the Paris Museum, for notes and a photograph of the type of *S. micranthum.*

Despite the sometimes perennial habit of *S. rosulatum* the three an-

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nual species are generally easily recognized as such, and it takes but little experience to be able to distinguish them on sight from the more numerous perennial ones. Apart from intangible features of general appearance, their gamut of flower colors is almost completely different from that of the perennials, excepting a few Far-Western ones. Only the uncommon albino form of *S. minus* (white with yellow eye) duplicates what may appear in the perennials. The latter (all those in the South and East, a majority of those in the West) have medium to large perianth ranging from white to light blue, deep violet-blue, or even purplish blue (but still decidedly on the blue side), with yellow eye. The annuals never have a distinctly blue perianth (though often bluish or greenish in withering), the colors ranging from pinkish lavender to rosy purple (often partly or largely white with eye-ring and stripes) to yellow, and in the hybrids to various shades of brownish purple or purple-red (see key below and notes on hybrids at end). Taxonomically these form an artificial group, but it is convenient to treat them together.

KEY TO THE ANNUAL SPECIES

1a. Ovary and capsule oblong-ellipsoid or oblong-pyriform, more than 1½ times as long as broad; stamens well exserted, about half the length of the perianth; perianth variously lavender-pink to purple-rose, white with yellow eye, or all yellow. . . . . .1. *S. minus*

1b. Ovary and capsule globose or subglobose, shorter to barely longer than broad; stamens barely or not exserted, 1/6—1/3 as long as the perianth; perianth variously colored (see next couplet), but never just as in the preceding (following two species hybridize freely; see remarks at end of text).

2a. Perianth yellow with brown-red eye ring and often a single brown-red center line on each lobe; length (half-width) of perianth 5—10 mm.; diameter of capsule 2.7—3.5 mm. . . . . .2. *S. exile*

2b. Perianth white to lavender-pink or bluish-purple-tinged, with yellow eye circled by rose-purple eye ring and commonly three (but sometimes one, or none, or more) lines or stripes down each lobe; length (half-width) of perianth 9—16 mm.; diameter of capsule 3.0—4.2 mm. . . . . .3. *S. rosulatum*

1. S. MINUS Engelmann & Gray, Pl. Lindh. p. 55 (Boston Journ. Nat. Hist. 5: 263). 1845. "Margin of pools, &c. in the prairie west of San Felipe," Austin Co., Texas, *Lindheimer Fl. Tex. Exs. 313,* April, 1844 (holotype GH, isotypes MO, SMU). — *S. flexuosum* Rafinesque, Aut. Bot. p. 65. 1840. "Arkanzas and Texas." Not *S. flexuosum* (L.) Sprengel, Syst. 1: 167, 1825. — ***S. Bermudiana*** var. ***minus*** (Englemann & Gray) Klatt, Linnaea 31:69. 1861. — *S. Thurowii* Coulter & Fisher, Bot. Gaz. 17: 352. 1892. "Hockley, Texas" (Harris Co.), *Thurow* (holotype F; a rare yellow-flowered form). — *S. Canbyi* Bicknell, Bull. Torr. Bot. Club 28: 588—589. 1901. Holotype: Columbia, Brazoria Co., Texas, *Wm. M. Canby 238,* 25 March 1900 (NY). To my eye the perianth on the type is

rosy lavender, not "bright purplish blue" as described by Bicknell. — The name *S. geniculatum* Herbert is given as a synonym of this by Baker and Johnston, but I do not believe this is correct (see remarks in list of doubtful or excluded names at end).

The usual perianth color in this species is a distinctive purple-rose (in my notes I find I most often called it magenta-rose) which is quite uniform, except for being occasionally lighter or darker than usual; rarely it is pale enough to be called lavender-pink. There is not a continuous series of intermediates between this and the other two color forms, which are even more uniform. White is occasional and widespread, usually few individuals amony many of the typical form, rarely in reverse proportions, or by itself. The yellow form I have found only once (at Needville, Fort Bend Co., Texas), growing with and less common than the typical form. The type of *S. Thurowii* is the only other record of the yellow known to me.

These color forms are highly significant in relation to the evolution of the Texas flora. They are clearly due to spontaneous mutation, not to introgression, since the chromosome number is unique in the genus. Such mutation I believe is occurring now and has long occurred, and is sufficient by itself to explain the origin of many of our existing species and varieties. It would be of great interest to know the precise details of the inheritance of color forms, and in particular why there are no intermediates. As for survival value, to try to read anything of the sort into these variations is to indulge in wild fantasy. At least two of the forms are successful in invading new territory. The third is so rare that it has so far given no indication of spreading, but this proves nothing about its future.

Because it was first found in Texas in natural habitats, and for long was known only from there and adjacent Oklahoma (Rafinesque's "Arkanzas"; see remarks below on distribution), I believe the species is native to this area. Its weedy behavior is shared by numerous species indubitably native. From its habitats, and the recency of the records, I believe that in Louisiana it is largely introduced. It is unquestionably an introduction in California and North Carolina, and I have no doubt that the same is true of its occurrence in Argentina and Uruguay (reported by Johnston, 1938).

Rafinesque reported this species from both Texas and "Arkanzas." Like Nuttall's "Arkansa," the latter term referred to the old Arkansas Territory, which included eastern Oklahoma. Although Waterfall does not include *S. minus* in his catalogue of the Oklahoma flora (1952), it is not at all unlikely that the species once occurred there; it has long been common as far north as Dallas, Texas. All the United States collections I have seen from outside Texas are cited below. For the latter state I have merely listed the counties from which it is known. Since the publication of my 1948 map, it has been found as a roadside weed in Montgomery and Tyler counties, and introduced with St.

Augustine grass sod in Nacogdoches County, all east of the area shown on the map.

CALIFORNIA. Los Angeles Co.: in grassy field dominated by Phalaris Lemmoni; Sepulveda Blvd., northwest of Los Angeles airport, *Frank W. Gould 2287,* 15 April 1944 (SMU). "Flowers white." (Distributed as *S. bellum* var.) LOUISIANA. Grant Parish: 4.6 miles southeast of Colfax (from road junction on U. S. Highway 71), road shoulder, *Shinners 29,510,* 18 April 1962 (SMU). "Perianth magenta-rose (white on one plant)." Madison Parish: 2.8 miles west of Waverly, foot of road fill by creek, *Shinners 28,221,* 18 April 1960 (SMU). "Perianth white with yellow eye." Same locality and date, *Shinners 28,240* (SMU). "One plant with magenta-rose perianth (all others seen white)." Natchitoches Parish: Natchitoches, swampy open ground, *E. J. Palmer 7486,* 3 May 1915 (MO). Red River Parish: 1.4 miles west of Grand Bayou, road fill, *Shinners 27,227,* 22 April 1958 (SMU). "Perianth purple-rose; lobes several-striped on back." St. Martin Parish: 1.8 miles south of Parks, dried-up ditch, *Shinners 28,128,* 16 April 1960 (SMU). "One plant only." Tensas Parish: 3 miles north of Helens, margin of swamp forest, hardwoods, *J. Ewan 19054,* 20 April 1957 (NO). "Flowers very pale pink, mostly past." NORTH CAROLINA. Durham Co.: Duke campus, waste places, *W. B. Davis 819,* 17 May 1932 (DUKE). TEXAS. Aransas, Atascosa, Austin, Bastrop, Bee, Bell, Brazoria, Brazos, Dallas, Dimmit, Falls, Fort Bend, Harris, Karnes, Kleberg, Liberty, Llano, Matagorda, Montgomery, Nacogdoches, Navarro, Nueces, Robertson, San Patricio, Travis Trinity, Tyler, Williamson; also "Seguin—Lavernia (Guadalupe or Wilson Co.), "Victoria—Goliad" (counties with same names).

2. S. EXILE Bicknell, Bull. Torr. Bot. Club 28: 573—574. 1901. "Sandy sea shores at Galveston," Galveston Co., Texas, *J. E. Bodin,* 25 February 1890, "herb. Univ. of Minn. and U. S. Nat. herb." (latter specimen examined). — *S. Brownii* (sphalm. *Brownei)* Small, ex Small & Alexander, Bot. Interpr. Iridaceous Pl. Gulf States (Contrib. New York Bot. Gard. 327): 330. 1931. ("Excerpt from the forthcoming Manual of the Flora of the Southeastern United States.") Not designated in the list of new binomials (unnumbered page at end), and no type indicated; noted only as "S E La." It was in fact named in honor of Prof. Clair A. Brown of Louisiana State University. For unknown reasons I find no notes on the type from my New York visit in 1946, but the description leaves no doubt as to the identity of the plant. I did examine the following later collection at New York. LOUISIANA, Livingston Parish: roadside, pine land near Hammond, *C. A. Brown 3846*, 9 April 1932. "Flowers yellow, purple brown line on inside of petals." — This is *S. micranthum* of many authors (see doubtful and excluded names at end).

In flower color this is rather uniform, the chief variation being the extent to which the brown-red eye ring extends as a thin line down each perianth segment. Predominantly the perianth is medium yellow, very rarely pale or sulfur yellow. The species is now a common and often abundant weed of sandy road shoulders and damp sandy ground along highways in southeastern Texas and Louisiana, and has spread north into Arkansas. East of the Mississippi River it is still largely restricted to areas near the Gulf, chiefly in northern Florida, but it occurs as a lawn weed as far northeast as Statesboro, Bulloch Co., Georgia (Gordon P. DeWolf, in letter). I was surprised in tabulating the records to find none for Alabama. I feel certain that it occurs there, but I failed to collect it in several trips to the three southernmost counties made with *Sisyrinchium* particularly in mind. State and county (parish) records are as follows.

ARKANSAS. Bradley, Union. (Also Drew, according to Moore, 1958.) FLORIDA. Clay, Jackson, Polk, St. Johns. (Also Washington, on basis of hybrids; see detailed notes on these at end.) LOUISIANA. Acadia, Allen, Beauregard, Bienville, Calcasieu, Jackson, Lafayette, La Salle, Livingston, Natchitoches, Rapides, Sabine, St. Helena, St. Tammany, Vermilion, Vernon, West Feliciana, Winn. (Also Evangeline, Jefferson Davis, on basis of hybrids.) MISSISSIPPI. Pearl River. TEXAS. Angelina, Austin, Chambers, Galveston, Hardin, Harris, Jasper, Jefferson, Liberty, Montgomery, Newton, Panola, Polk, Rains, Robertson, Sabine, Shelby, Trinity.

Apparently the first collection of this species from the United States was made in Texas by Elihu Hal, probably in 1872. There is a specimen at the Gray Herbarium with no data except "flowers yellow," the collector's name, and that of the state. Hall collected at various central Texas localities from the coast inland to Austin and Dallas. He may well have found the plant at Galveston, where Bodin later collected the type of *S. exile*. One possible means of introduction for both this species and *S. rosulatum* is suggested by an incident reported in Winifred Kimball's reminiscences of Chapman, occurring some time after 1887. "When a South American ship brought up clay from the 'Rio de la Plata' as ballast, and my father had it spread over the garden, Doctor Chapman's interest grew apace. He watched over each new 'weed' that cropped up." There are specimens in the Gray Herbarium from Easter Island (collected in 1904), Fiji (Viti Levu, 1927), Hawaii (Hawaii National Park, 1943) and Australia (Queensland, 1943). The original home of this now very widespread weed seems to have been in the region from southern Brazil to northern Argentina. Since 1820, at least, the name *S. micranthum* has been used for the plant here discussed. The following remarks by John Sims, accompanying the illustration of it under that name in Curtis's Botanical Magazine (47: t. 2116, 1820) are worth quoting. "We find no account of this plant but what has been derived from the description and figure above quoted, which were taken from a solitary dried specimen in Jussieu's herbarium, collected in Peru. Communicated in July last by Mr. Anderson, of the Botanic Garden at Chelsea; to whom it was sent by Mr. Otto, from the Royal Botanical Garden at Berlin."

3. S. ROSULATUM Bicknell, Bull. Torr. Bot. Club 26: 228—229. 1899. "Dry open places in sandy soil, coast of South Carolina and Alabama. South Carolina: Sullivan's Island (Charleston Co.), May 8, 1852, Professor Lewis B. Gibbes. Alabama: Mobile, April 6, 1896, May 5, 1896. Dr. Charles Mohr." (Mohr specimens examined, US.) Bicknell states "flowers not seen, reported to me by Dr. Mohr as being of a reddish purple or wine color.") — This is *S. laxum* in the sense of I. M. Johnston, 1938; not *S. laxum* Otto ex Sims (see doubtful or excluded names at end). Duplicates of my collection down to 1962 were all distributed under this name.

Apart from the evident hybrids discussed below, there is great variation in flower color in this species, especially in pattern, which I believe indicates spontaneous genetic diversity rather than introgression. The perianth is rather large and showy, commonly white with varying amounts of rose-purple in the form of an eye ring and lines down the segments, but occasionally colored throughout. It is also more variable in stature than *S. exile.* My observations confirm Johnston's statement that it is the more variable of the two species. He suggested that hybridization might be responsible for certain plants "which present embarrassing combinations of character." This is certainly the case in Florida, Louisiana, and Texas. *S. rosulatum* in the United States occupies much the same area as *S. exile.* In Texas it is much less common, but in Alabama and Mississippi it is more so, than the yellow-flowered species.

ALABAMA. Baldwin, Mobile, Washington. ARKANSAS. Union. (Also Ashley, Bradley, Drew, according to Moore, 1958.) FLORIDA. Escambia, Jackson, Jefferson, Washington. LOUISIANA. Acadia, Allen, Beauregard, Bienville, Bossier, Calcasieu, Caldwell, Catahoula, Grant, Jackson, La Salle, Madison, Morehouse, Rapides, St. Helena, St. Mary, Winn. (Also Evangeline, Jefferson Davis, Vernon, on basis of hybrids.) MISSISSIPPI. Claiborne, Rankin. NORTH CAROLINA. Brunswick. SOUTH CAROLINA. Charleston. (Syntype of the species; no recent collections seen.) TEXAS. Angelina, Jasper, Jefferson, Nacogdoches, Newton, Tyler. (Also Polk, Trinity, on basis of hybrids.)

The oldest collections from the United States were those from South Carolina (1852) and Alabama (1896) on which Bicknell based the species. It was found in "open fields, Richland," presumably St. Mary Parish, Louisiana, by R. S. Cocks in June, 1908 (NO). But most of its North American range has been attained more recently. When I began field work in the Gulf States in 1945, it was rare in southeastern Texas (I found it only in Jefferson County); now it is frequent there. In Louisiana and eastward it is generally as common as *S. exile* or more so; certainly it is much more conspicuous. Its original home was nearly the same as that of *S. exile,* from southern Brazil to Argentina. Whether Johnston's report of *S. laxum* from Europe refers to this species or the true *S. laxum* I do not know.

2 X 3. S. EXILE X ROSULATUM. The binomial *S. Metae* Herter probably was based on a nothomorph of this cross (see under doubtful or excluded names at end). In Louisiana intermediates between the species are rather common (elsewhere they are much less so), nearly always in association with the parents, the majority appearing to be first-generation hybrids, while apparent back-crosses or second-generation segregates are rather uncommon. Below ae cited 15 collections representing such intermediates, with notes on perianth color. All are deposited at SMU, and all but the last one were collected by myself.

FLORIDA. Washington Co.: 1.8 miles east of Shipley, *27,009*. "White with chocolate-red central ring; lobes with slender dorsal central line." LOUISIANA. Allen Parish: 3.2 miles northwest of Oakdale, *23,043*. "Light brownish mauve with light yellow eye; tepals with single darker central stripe." Same locality, *23,068*. "Medium large, light yellow. Growing with *S. micranthum* (i.e. *exile)*, 2 color forms of *S. laxum* (i.e. *rosulatum)*, unidentified intermediate type, 1 plant with large, pale yellow, lined perianth." Same locality, *23,069*. "Large, pale yellow with dark lines," growing with preceding. Beauregard Parish: 0.5 mile north of Ragley, *23,665*. "Garnet, tepals with darker base and central line." — 3.7 miles south of Longville, *23,543*. "With yellow eye, tepals scarlet-mauve at base and center." Calcasieu Parish: 4 miles south of Gillis, *23,153*. "Smaller than in *S. laxum* (i.e. *rosulatum)*, mauve with scarlet tinge, lobes with single dark central stripe." Evangeline Parish: 8.5 miles east-southeast of Oakdale, *27,970*. "Withered (2 P.M.), tube yellow." Jefferson Davis Parish: 5.1 miles southeast of Jennings, *23,140*. "Light scarlet-mauve, tepals with dark central line." Rapides Parish: 2.5 miles northeast of Glenmora, *23,255*. "Medium large, mauve with scarlet tinge." Vernon Parish: 2.3 miles northwest of Leesville, *22,753*. "Smaller than in *S. laxum* (i.e. *rosulatum)*, white with mauve ring around yellow eye." — 2.2 miles northwest of Anacoco, *23,673*. "Brownish mauve, tepals darker at base and down center." Winn Parish: 7.5 miles north of Winnfield, *23,342*. "Scarlet-mauve." TEXAS. Polk Co.: 2 miles east of Livingston, *23,488*. "Perianth 1/3 larger than in associated *S. micranthum* (i.e. *exile)*, tepals brownish mauve, darker down center and at base." Trinity Co.: 1 mile west of Neches River, *R. L. Oliver 312*. "Light yellow with yellow center; outside base mauve-brown and along veins"; perianth as large as in typical *S. rosulatum*.

During April and May of 1956, when a majority of the above collections were made, the presumed first-generation hybrids (with perianth of intermediate size, of distinctive scarlet-mauve or brownish-mauve color unlike any forms of the parents, with a single central line on each segment) were very common and remarkably uniform. In subsequent years they have been much less plentiful. There is no indication that the two species are becoming completely mongrelized. On the contrary, they appear to be retaining their separate identities to an astonishing degree. Whatever mechanism or mechanisms served to maintain the two in their native area evidently continues to operate in their new home. I have seen no evidence of crossing between an annual and a native perennial species, though there is evident hybridization among several of the latter (see comments in my *Spring Flora of the Dallas-Fort Worth Area, Texas,* 1958).

I have made no attempt to grow these plants or try artificial crosses. Much intensive genetical and doubtless chemotaxonomic work could be done on them, with a large staff of assistants, numerous graduate students (possibilities of several Ph.D. theses at least), and a succession of research grants, each larger than the one I received for work on the entire flora of the Gulf Southwest. Having committed myself to general flora work in an enormous area where it is desperately needed, I have no time for such things. To anyone trying to view the development of American botany in some reasonable scientific and historical perspective, it is all food for some very melancholy thoughts.

DOUBTFUL OR EXCLUDED NAMES

All the botanists who have done revisionary work including the three annuals (Klatt, Baker, Bicknell, Johnston, Foster) knew the plants only from herbarium specimens. But *Sisyrinchium* simply is not a genus that can be worked out solely in the herbarium. I have no acquaintance with the South American species other than the two introduced ones, but feel sufficiently well acquainted with the two to know the limits of their variation, and to reject all of the names referred to them in Johnston's really very creditable revision.

S. geniculatum Herbert, Edward's Bot. Reg. 1843 Misc. p. 84. Placed under the heading "Columnea staminea cylindrica,' the entire description is as follows. "5. Geniculatum, mihi; ex prov. Texas dicto, parva caule geniculato perianthio limbo laete coeruleo." This is listed by Johnston as "nomen" only, in the synonymy of *S. minus.* Earlier Baker had indicated like identity by citing it under *S. Bermudiana* L. "Var. 3. S. GENICULATUM Herb.," with *S. minus* as synonym. There is enough description in the original publication so that it must be regarded as validly published, even though what was said is, for this genus, all but useless for identification. If indeed identical with *S. minus,* its name would have to be adopted for that species, being two years older, unless its still older appearance as *nomen nudum* in association with a Brazilian plant can be taken as grounds for rejecting it as a *nomen confusum.* The description of the perianth as "limbo laete coeruleo" certainly does not fit any of the known color forms of *S. minus,* but would apply very well to *S. pruinosum* and other native perennials of Texas. It is very probable that Herbert had a Drummond collection, and Drummond unhappily worked in a veritable hot-bed of complex forms, introgressive hybrids, and what not involving the abundant native perennials of south-central Texas. Whether *S. geniculatum* could be satisfactorily identified even with a type specimen at hand is doubtful at best. Things are complicated by the fact that the name did appear in print a year before the species was described, and it was then associated with a Brazilian species which according to Johnston was *S. laxum* (i.e. *S. rosulatum*). This first appearance was in "Contributions towards a flora of Brazil," by Gardner, in London Journ. Bot. 1: 538, 1842. The account there is as follows: "217. Sisyrinchium *geniculatum. Herbert Mss. in Herb. Hook.* HAB. In moist sandy places at Tejuca. *Fl.* Nov." The use of the plural "Mss." implies that Herbert annotated several specimens with this name, but as it was published the following year for a Texas plant, Brazilian material was by implication excluded by Herbert himself.

S. laxum Otto ex Sims, Bot. Mag. 49: 2312. 1882. "This new species of SISYRINCHIUM was introduced into the Chelsea garden in 1820, by Mr. Otto, curator of the Berlin Botanical Garden, under the name which we have adopted. . . . Communicated by Mr. Anderson of the Chelsea garden, who has treated it as an alpine, and it has survived the last winter exposed to the open air. Native country unknown." The plate, which must stand as the type for this species, shows the top of a plant only. The flowers appear relatively small in proportion to the very large capsules; the perianth is whitish with dark purple lines (the description says only "white-streaked"), quite similar to *S. rosulatum* except that the lines are uniformly very thin all the way down to the very narrow eye ring (in *S. rosulatum* they widen toward base, and the eye ring is usually very prominent). Light was shed on the identity of the plant figured by Sims when I received an unidentified specimen from New Zealand, though I did not at first realize it. The specimen is *M. B. Ashwin 530,* from Lower Hutt, Wellington, North Id., 3 Nov. 1958 (SMU). "Forming small tufts in dry ground by roadside. Introduced weed." Most unfortunately flower color is not noted, but the dried perianth shows the uniformly thin lines exactly as in Sims's plate. In other respects, especially the very large capsules, the specimen is an almost perfect match for the plate, which evidently represented the plant exactly in life size. The larger capsules on the specimen are 6 mm. in diameter (the larger one in the plate is 8 mm.), much too large for *S. rosulatum.* The perianth in the New Zealand specimen is 15 mm. long as pressed, the whole plants (two on the sheet) coarser than even robust forms of *S. rosulatum,* and the roots are noticeably stouter and tougher. I take the New Zealand specimen to be the true *S. laxum,* but have seen no others to match it. Its native country is still unknown, though presumably it is South American.

S. Metae Herter, Revista Sudamericana de Botanica 5: 28. 1937. Johnston places this in the synonymy of *S. laxum* (1938, p. 391), but Herter describes it as having white flowers, the tepals 3—5 mm. long (too small for either *S. laxum* or *S. rosulatum),* and lacking the purple coloring of those species. I strongly suspect that it is a hybrid form, quite probably involving *S. exile,* but since still other species not familiar to me occur in Uruguay and might hybridize with *S. exile* or *S. rosulatum,* I cannot decide this point. Anyone wishing to adopt a bionomial for the hybrids would have to settle the identity of *S. Metae* and other names placed in synonymy by Johnston.

S. micranthum Cavanilles, 6ta Dissertatio Botanica p. 345; pl. 191, fig. 2. 1788. *"Habitat in Peru: examinatum ibi a D. Josepho de Jussieu. V. S. unicum exemplar apud eius nepotem."* Neither description nor figure is conclusive. Flower color unfortunately is not mentioned. A photograph of the type reveals that the drawing was crudely made, but the specimen itself is immature, and no great help either. It is erect and densely leafy. Prof. Leandri very kindly compared with it some small plants of *S. exile* which I had collected in St. Helena Parish, Louisiana, and reports that they seem to belong to the same species, but that on the Jussieu specimen "les racines sont toutefois un peu plus fortes." This is exactly a distinction just noted between *S. laxum* and *S. rosulatum.* Chiefly on the basis of general appearance, nature of the roots, and geographic location, I believe that the true *S. micranthum* is not the now cosmopolitan annual which has so long passed under that name, but a closely related species, perhaps perennial, of highland regions in western and northern South America. I believe Johnston was correct in making *S. iridifolium* H.B.K. (from Venezuela) a synonym of *S. micranthum;* probably *S. scabrum* Schlechtendal & Chamisso is also the same. These plants will have to be studied in the field by someone who also knows *S. exile* in a living state.

S. Pearcei Philippi, Linnaea 33: 251. 1864—1865. Listed by Johnston with query as synonym of *S. laxum.* The original description states that the perianth is yellow, so that it cannot be either *S. laxum* or *S. rosulatum;* it may well belong to the true *S. micranthum.*

S. uniflorum Gay ex Philippi, Linnaea 29: 63. 1857. Listed by Johnston as synonym of *S. laxum.* In the original description the word "caerulei" (sky-blue) is applied to the perianth, and the plant is compared with the blue-flowered *S. chilense,* differing in having scabrous stem. Neither color nor stem indument apply to *S. laxum* or *S. rosulatum.*

S. valdivianum Philippi, Anal. Univ. Chile 91: 616—617. 1895. Despite the length of the description, not much of real help appears in it. The capsule is described as 4—5 mm. in diameter, and on this basis the name canont apply to *S. rosulatum.*

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CHROMOSOME NUMBERS OF SISYRINCHIUM (IRIDACEAE) IN EASTERN NORTH AMERICA[1]

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Chromosome numbers for 18 species of *Sisyrinchium* with basic complements of $x = 8$, 9, and 17, have been reported (Vilmorin and Simonet, 1927; Maude, 1940; Bowden, 1945; Covas and Schnack, 1946; Sermonti, 1948; Skottsberg, 1953; Lewis and Oliver, 1961). The 8 and 9 series contain both diploid and high polyploid species, but only diploid species are found in the secondary $x = 17$ series.

MATERIALS AND METHODS.—Immature flower buds were collected in the field and were fixed in modified Carnoy's solution (4: 3: 1). As soon as possible after fixation the buds were stored at refrigerator temperatures for periods up to 8 months; only after 7 months was deterioration noted in some cells. Buds were squashed in 1% acetic-orcein and PMCs or more occasionally somatic cells were studied. Representative chromosomes were drawn with the aid of a camera lucida at X2300. The first set of voucher specimens are filed at the Southern Methodist University herbarium (SMU). Field work for this study was supported in part by the National Science Foundation, G-9800.

For one collection seeds were soaked in water until the radicle appeared and then sown on a culture medium (Lewis and Elvin-Lewis, 1961) to facilitate more rapid growth. After pretreatment for 1-2 hours in supersaturated paradichlorobenzene, the seedlings were fixed and stained following the procedure used for the buds and mitosis was studied in root tips and apical meristems.

OBSERVATIONS.—Fifteen species and one hybrid of *Sisyrinchium* from a total of 50 populations are listed in Table 1 with their chromosome numbers and voucher data. For 11 species the collections represent a wide range of morphological variation including atypical individuals, but in each case the chromosome numbers were found to be consistent. Chromosome numbers for 9 species are reported for the first time. These include *S. minus* Engelm. & Gray, $n = 5$; *S. fibrosum* Bickn., $n = 8$; *S. campestre* Bickn., $n = 16$; *S. intermedium* Bickn., $n = 16$; *S. laxum* Otto, $n = 16$; *S. mucronatum* Michx., $n = 16$; *S. sagittiferum* Bickn., $n = 16$; *S. arizonicum* Roth., $2n = 34$-36; *S. atlanticum* Bickn., $n = 48$. Those for the remaining species, *S. albidum* Raf., *S. bermudiana* L. (as *S. angustifolium* Mill.), *S. ensigerum* Bickn., *S. langloisii* Greene, *S. mi-*

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[1] EDITOR'S NOTE. It was not until after this paper went to press that I was able to reach a conclusion about the correct names of the introduced annuals. I believe that *S. laxum* of this paper is correctly *S. rosulatum* Bicknell, and *S. micranthum* is rather *S. exile* Bicknell. See "Annual Sisyrinchiums (Iridaceae) in the United States," this issue, pp. 32—42. —*L. H. Shinners.*

SIDA 1 (1): 43—48. 1962.

cranthum Cav., and *S. pruinosum* Bickn., agree with counts by Bowden (1945) and Lewis and Oliver (1961).

The number for *S. minus* Engelm. & Gray adds a new basic number of $x = 5$ to the genus (Fig. 1, 2). Although an undetermined diploid species in the $x = 8$ series has been reported from South America (Bowden, 1945), the number of $n = 8$ for *S. fibrosum* Bickn. (Fig. 3) is the first report of a diploid North American species in this series. All other species studied, with the exception of *S. arizonicum* Roth., occur in the $x = 8$ series at either the tetraploid or the dodecaploid level. Only a tentative count of $2n = 34$ or 36 is reported for *S. arizonicum* Roth.

There is little difference in chromosome size for most species of *Sisyrinchium* (Fig. 1-9), although *S. bermudiana* L. (Fig. 11) has larger chromosomes than *S. atlanticum* Bickn. (Fig. 10) in the same basic series.

Meiotic "irregularities" were rarely observed except for the extreme bunching of chromosomes. This phenomenon was observed for most collections and consequently only a small proportion of the meiotic metaphase and anaphase plates could be accurately interpreted. Despite this, pollen were usually normal in appearance except for one collection from 1.5 miles west of the Neches River and Highway 94, Trinity Co., Texas *(Oliver, 312)*. In a sample of 100 pollen grains from each of several plants, pollen was non-staining, appeared shriveled, and micropollen were frequent. Meiosis was not observed, but the number of microspores per PMC at the tetrad stage, and frequency based on a random sample of 100 PMCs, was 4 microspores (6%), 5 microspores (26%), 6 microspores (36%), 7 microspores (12%), 8 microspores (12%), 9 microspores (4%), and 10 microspores (4%). With only 6% normal tetrad formation, meiosis was probably highly irregular. These plants are morphologically intermediate between *S. laxum* Otto and *S. micranthum* Cav., which were both growing in the immediate vicinity, and are assumed to be hybrids between these species.

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Table 1. CHROMOSOME NUMBERS OF SISYRINCHIUM IN EASTERN NORTH AMERICA.

Taxon	Gametic No.	Voucher
S. *minus* Engel. & Gray	5	TEXAS. Nacogdoches Co., Nacogdoches, *Oliver 317* (tepals purple), *Oliver 318* (tepals white); Brazos Co., 10.7 miles SE of College Station, *Oliver* 296.*
S. *fibrosum* Bickn.	8	GEORGIA. Pike Co., 0.5 miles N of Pike Co.-Upson Co. line on Hwy. 19, *Oliver 327*.
S. *albidum Raf.*	16	LOUISIANA. Bossier Par., 5.6 miles E of Bossier City, *Oliver 272*†. TEXAS. Nacogdoches Co., Fern Lake Fire Tower, *Oliver 243*†, 0.6 miles S of Nacogdoches, *Oliver 241*†.
S. *campestre* Bickn.	16	ARKANSAS. Ouachita Co., 7 miles SW of Y city, *Oliver 302*. KANSAS. Wayne Co., 1.7 miles E and 1 mile S of Wayne, *Morley,* 12 May 1961; Republic Co., 1 mile E and 0.7 miles N of Belleville, *Morley,* 13 May 1961.
S. *ensigerum* Bickn.	16	TEXAS. Hays Co., 1 mile S of San Marcus, *Osborne 39*; Lampasas Co., 8.9 miles S of Lampasas, *Osborne 42;* Wilson Co., 10 miles S of Stockdale, *Osborne 38*.
S. *intermedum* Bickn.	16	TENNESSEE. Polk Co., 1 mile N of Hwys. 64 and 30 junction, *Oliver 325**.
S. *langloisii* Greene	16	TEXAS. Brazoria Co., 3.7 miles S of Freeport, *Lewis 5571,* 4 miles S of Freeport, *Lewis 5569B**; Chambers Co., 2.3 miles SW of Hwys. 121 and 87 junction, *Oliver 252;* Panola Co., Lake Murvaul, *Oliver 276;* San Augustine Co., 3 miles E of Attoyac River on Hwy. 21, *Oliver 248*.
S. *laxum* Otto	16	TEXAS. Angelina Co., 5 miles S of Lufkin, *Oliver 310;* Jasper Co., Hwys. 96 and 1004 junction, *Lewis 5626;* Nacogdoches Co., Stripling Island, *Oliver 304;* Newton Co., 4.7 miles S of Newton, *Lewis 5618*.

Figs. 1-11. Meiotic chromosomes of *Sisyrinchium* originally drawn at X2300 and reduced by ca. 28% in reproduction. Fig. 1. *S. minus*, $n = 5$, *Oliver 296*. Fig. 2. *S. minus*, $n = 5$, *Oliver 318*. Fig. 3. *S. fibrosum*, $n = 8$, *Oliver 327*. Fig. 4. *S. campestre*, $n = 16$ (one side of metaphase II), *Oliver 302*. Fig. 5. *S. campestre*, $n = 16$, *Morley*, 13 May 1961. Fig. 6. *S. pruinosum*, $n = 16$, *Lewis 5615*. Fig. 7. *S. sagittiferum*, $n = 16$, *Oliver 241*. Fig. 8. *S. sagittiferum*, $n = 16$, *Oliver 269*. Fig. 9. *S. intermedum*, $n = 16$, *Oliver 325*. Fig. 10. *S. atlanticum*, $n = 48$, *Oliver 253*. Fig. 11. *S. bermudiana*, $n = 48$, *Oliver 292*.

S. micranthum Cav.	16	TEXAS. Angelina Co., 5 miles S of Lufkin, *Oliver 309;* Hardin Co., 1.4 miles SW of Votaw, *Lewis 5630;* Trinity Co., 1 mile N of Neches River, *Oliver 311.*
S. mucronatum Michx.	16‡	CANADA. ONTARIO. Bruce Co., Oliphant, *Heimburger,* 17 June 1961.
S. pruinosum Bickn.	16	ARKANSAS. Hempstead Co., 1 mile SW of Hope, *Lewis 5615*†. TEXAS. Aransas Co., 4.2 miles SW of Aransas Pass, *Lewis 5591,* 0.2 miles S of Aransas Wildlife Refuge Headquarters, *Lewis 5597,* 1 mile W of Aransas Wildlife Refuge Headquarters, *Lewis 5592,* 1 mile NE of Rockport, *Lewis 5575*†*;* Ellis Co., 1 mile N of Italy, *Oliver 281;* Henderson Co., 5.3 miles W of Hwys. 175 and 31 junction, *Osborne 48;* Lampasas Co., 4 miles W of Lampasas, *Osborne 45;* Matagorda Co., 4.7 miles NE of Markham, *Lewis 5572;* San Patricio Co., 0.2 miles W of Welder Wildlife Foundation Headquarters, *Lewis 5580*†; Van Zandt Co., 3 miles SE of Wills Point, *Oliver 278*†; Wharton Co., Louise, *Lewis 5599.*
S. sagittiferum Bickn.	16	LOUISIANA. La Salle Par., 2.5 miles SE of Gene, *Oliver 269.* TEXAS. Nacogdoches Co., 10 miles S of Nacogdoches, *Oliver 237*†; Orange Co., 3.8 miles SW of Orange, *Oliver 255.*
S. laxum X *micranthum*	16‡	TEXAS. Trinity Co., 1 mile N of Neches River and Hwy. 94, *Oliver 312.*
S. arizonicum Roth.	17-18‡	MEXICO. DURANGO. 19 miles SE of Durango, *Waterfall 15541* (SMU).
S. atlanticum Bickn.	48	TEXAS. Chambers Co., 1 mile NE of Hwys. 121 and 87 junction, *Oliver 253*,* 5 miles NE of Ferry Landing, *Oliver 251*.*

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* Chromosomes of 3 plants examined; otherwise the number is based on the study of 1 plant.

† Atypical collection.

‡ Chromosome number from somatic cells.

S. bermudiana L.	48	LOUISIANA. West Feliciana Par., 10 miles S of La.-Miss. state line on Hwy. 61, *Oliver 266.* TEXAS. Nacogdoches Co., Goodman's Bridge over Angelina River, *Oliver 308,* 1 mile NE of Nacogdoches, *Oliver 316,* 10 miles S of Nacogdoches, *Oliver 292.*

NEW NAMES IN ARENARIA (CARYOPHYLLACEAE)

LLOYD H. SHINNERS

Arenaria as it occurs in the Southeastern and Gulf Southwestern United States is a very heterogeneous assemblage which for convenience is best treated as a single genus, in the broad sense of Fernald (1919, 1950) and Maguire (1951, 1952). To it may be added a few species from related genera in which they are anomalous or transitional toward *Arenaria.* Mattfeld (1929) rejected Fernald's union of *Alsine (Minuartia)* with *Arenaria,* but his version of *Minuartia* does not carry conviction. It too is extremely heterogeneous both morphologically and geographically, and one wonders what gain there is in maintaining two large and poorly differentiated genera instead of one. Fernald's arguments are answered only in part. That the difference between a capsule dehiscing by three valves and one dehiscing by six teeth is not great is shown for example by *Arenaria Benthamii,* in which the capsule dehisces somewhat unevenly, appearing at times to have three partly divided valves, though ordinarily it is about equally 6-parted. In *A. Drummondii,* the three valves commonly are slightly but distinctly notched at apex. Surely it is better to keep these in a single admittedly diverse genus.

About one point I must agree with Mattfeld. Like Small before (under *Alsinopsis),* he associates the Texan *Stellaria Nuttallii (Arenaria Drummondii)* with *Arenaria patula,* both species with notched petals much like those of *Cerastium,* and approaching (but less extreme than) those of *Stellaria.* If notched petals may occur in *Arenaria,* then it is plain that other North American species of *Stellaria* with merely notched rather than deeply bifid petals must also be placed there. Furthermore, since capsule shape varies greatly within *Arenaria,* there is no good reason to leave under *Cerastium* the handful of anomolous species which have three styles, an essential feature of *Arenaria.* These changes will leave both *Cerastium* and *Stellaria* more homogeneous, while the circumscription of the already very heterogeneous *Arenaria* is not significantly altered.

The necessary new names (and one previously published but not mentioned in Maguire's revision), together with a new species and a routine new combination, may be grouped as follows.

1. SPECIES FROM STELLARIA WITH MERELY NOTCHED PETALS

A. DRUMMONDII Shinners, Field & Lab. 17: 89. 1949. *Stellaria Nuttallii* T. & G., Fl. N.A. 1: 183—184. 1838. (Not *Arenaria Nuttallii* Pax, 1893.) Peculiar in having pedicels which become reflexed in age. *Minuartia Nuttallii* (T. & G.) Mattfeld, 1921, is illegitimate, being a later homonym of *M. Nuttallii* (Pax) Briquet, 1911. Despite the similarity in petals, this does not seem to be closely related to *A. patula.*

SIDA 1 (1): 49—52. 1962.

A. **Jamesiana** (Torrey) Shinners, comb. nov. *Stellaria Jamesiana* Torrey, Ann. Lyc. N.Y. 2: 169. 1827. (The spelling *Jamesii* was adopted later.) There is startlingly close resemblance between this and the Asiatic *A. holosteoides* (C. A. Meyer) Edgeworth in Hooker f., Fl. British India 1: 241, 1874. The following collection extends the range of *A. Jamesiana* to TEXAS. Culberson Co.: infrequent annual *(sic)* beneath pines, South McKittrick Canyon, top of Guadalupe Mts., alt. 8000 ft., J. C. Hunter Ranch, *Barton H. Warnock 12025,* 5 Sept. 1954 (SMU).

A. **Stephaniana** (Willdenow) Shinners, comb. nov. *Stellaria Stephaniana* Willd. in Schlecht., Berlin Mag. 1816 p. 194. (Not seen; reference taken from DC., Prodr. 1: 399, 1824, and Ledebour, Fl. Ross. 1: 379—380, 1842.) *Stellaria dichotoma* L., Sp. Pl. 2: 603. 1753. (Not *Arenaria dichotoma* Krock, 1793, nor Moench, 1794.) "Petals divided only ½" (Popov, Flora Srednei Sibiri 1: 406, 1957, in description of *Stellaria* Series Dichotomae). Represented in North America by the following.

A. STEPHANIANA var. **americana** (Porter) Shinners, comb. nov. *Stellaria dichotoma* var. *americana* Porter ex B. L. Robinson, Proc. Amer. Acad. 29: 289. 1894. *Alsine americana* (Porter) Rydberg, Fl. Montana (Mem. N.Y. Bot. Gard. 1) p. 144. 1901. *Stellaria americana* (Porter) Standley, Fl. Glacier Nat. Park (Contrib. U.S. Nat. Herb. 22 pt. 5) p. 336, 1921.

2. SPECIES FROM CERASTIUM WITH THREE STYLES

A. **anomala** (Waldstein & Kitaibel) Shinners, comb. nov. (nom. nov. by Code recommendation, the basinym being a later homonym). *Cerastium anomalum* Waldst. & Kit. ex Willd., Sp. Pl. (ed. 4) 2: 812. 1799. (Not *C. anomalum* Schrank, Briefe ueber den Donaumoor p. 75. 1795. This reference not seen; taken from Schwarz, cited under *Cerastium dubium,* below.) *Stellaria viscida* Bieberstein, Fl. Taur.-Cauc. 1: 342. 1808. (Substitute name for *Cerastium anomalum,* proposed without reference to *C. anomalum* Schrank, hence illegitimate.) *Stellaria dubia* Bastard, Suppl. Fl. Maine-et-Loire p. 24. 1812. (Not seen; taken from Schwarz, l.c. Not *Arenaria dubia* Suter, Fl. Helv. 1: 266—267. 1802. This itself is illegitimate, being a substitute name for *A. hybrida* Villars, Prosp. p. 48, 1779, but it nevertheless prevents transfer of *Stellaria dubia* to *Arenaria.) Cerastium dubium* (Bastard) Schwarz, Mitt. Thuering. Bot. Ges. 1: 98. 1949.

Soellner (1954) reports that *C. anomalum* and *C. cerastoides (Arenaria trigyna,* below) are clearly allied and differ from *Cerastium* proper cytologically.

A. **argaea** (Boissier & Balansa) Shinners, comb. nov. *Cerastium argaeum* Boiss. & Bal. ex Boiss., Diagn. Ser. II. 6: 38. 1849.

A. **iranica** Shinners, nom. nov. *Cerastium persicum* Boiss., Diagn. Ser. I, 1:54. 1842. (Not *Arenaria persica* Boiss., 1842.)

A. **Kotschyi** (Boissier) Shinners, comb. nov. *Cerastium Kotschyi* Boiss., Fl. Or. 1: 715. 1867.

A. **trigyna** (Villars) Shinners, comb. nov. *Cerastium trigynum* Vill., Prosp. p. 48. 1779. (Not seen. Published also in Hist. Pl. Dauph. 1: 269, 1786, and 3: 645, 1789.) *Stellaria cerastoides* L., Sp. Pl. 1: 422. 1753. (Not *Arenaria cerastioides* Poiret, 1789, nor Persoon, 1805.) *Cerastium cerastoides* (L.) Britton, Mem. Torr. Bot. Club 5: 150 1894. (As *cerastioides.)* *Cerastium lapponicum* Crantz, Inst. 2: 402. 1766. (Substitute name for *Stellaria cerastoides* L., hence illegitimate.) *C. refractum* Allioni Fl. Pedem. 2: 117. 1785.

3. SPECIES FROM STELLARIA WITH SLIGHTLY EMARGINATE OR ENTIRE PETALS OR NONE

A. **Fassettii** Shinners, nom. nov. *Stellaria muscorum* Fassett, Rhodora 39: 460. (Not *Arenaria muscorum* Fischer ex DC., 1824.) Closely related to the next species, but with well-developed petals exceeding the sepals.

A. **fontinalis** (Short & Peter) Shinners, comb. nov. *Sagina fontinalis* Short & Peter, Transylv. Journ. Med. 7: 600. 1836. *Stellaria fontinalis* (Short & Peter) B. L. Robinson, Proc. Amer. Acad. 29: 286. 1894. *Alsine fontinalis* (Short & Peter) Britton, Mem. Torr. Bot. Club 5: 356. 1894.

A. **Godfreyi** Shinners, nom. nov. *Stellaria paludicola* Fernald & Schubert, Rhodora 50: 197. 1948. (Not *Arenaria plaudicola* B. L. Robinson, Proc. Amer. Acad. 29: 298. 1894.) *Stellaria uniflora* of authors, not Walter.

4. MISCELLANEOUS

A. **ludens** Shinners, sp. nov. Perennis? (radix deest) tenella 14—16 cm. alta aspectu *Drymariae leptophyllae (D. tenellae)*. Caulis ad lineas puberulus, apicem versus solum ramosus. Folia parva internodiis breviora subciliata cuspidata basi subconnata, inferiora obovato-lanceolata subpetiolata 6—7 mm. longa 2—3 mm. lata, superiora lineari-lanceolata 5—7 mm. longa 0.5—1.0 mm. lata. Inflorescentia laxe divaricato-cymosa 9—13 cm. lata sat pauciflora parvibracteata. Pedicelli 3—7 mm. longi. Sepala 2.8 mm. longa ovato-lanceolata subacuminata glabra subscariosa cum costa unica viridi. Petala alba obtusiuscula sepalis quartam partem breviora. Capsula oblongo-ovoidea calyce paulum brevior dentibus nunc 4 nunc 6 dehiscens. Semina matura non visa. HOLOTYPE: infrequent above upper spring, igneous soil, Madera Canyon on Mt. Livermore, Davis Mts., alt. 7900 feet, Jeff Davis Co., Texas, *Barton H. Warnock 7419,* 11 Sept. 1947 (SMU). Two stems, presumably from two plants, are on the type sheet; the one at the left has 4-toothed capsules, that on the right 6-toothed. The latter is assumed to be the normal form, since the occurrence of 4-parted capsules is exceptional in the genus.

A. LANUGINOSA (Michaux) Rohrbach var. **cinerascens** (B. L. Robinson) Shinners, comb. nov. *A. saxosa* var. *cinerascens* B. L. Robinson, Proc. Amer. Acad. 29: 293. 1894. If the variable western forms are treated as a variety rather than a subspecies, the earliest available epithet in the rank is *cinerascens.* Not credited to Texas by Maguire, although Robinson (1897, p. 240) cites *A. saxosa* from the Guadalupe

Mountains, Texas, collected by Havard. Its occurrence there is confirmed by the following specimen: Guadalupe Mountains 2.7 miles north of Pine Springs Camp near Highway 62, Culberson Co., *Eula Whitehouse 17044,* 22 Sept. 1946 (SMU).

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DROSERA (DROSERACEAE) IN THE SOUTHEASTERN UNITED STATES: AN INTERIM REPORT

LLOYD H. SHINNERS

After cursory study, I concluded that E. L. Reed had been correct in describing the common Texas species of *Drosera* as new and distinct from the eastern *D. brevifolia* (1915). It accordingly appears as *D. annua* E. L. Reed in my *Spring Flora of the Dallas-Fort Worth Area, Texas* (1958). In the same month that the book appeared (April), a trip to Florida enabled me to see and collect the eastern species, which proved conspicuously different from the Texas plant. It was a distinct surprise when two years later Dr. Carroll E. Wood, Jr., in a commentary on Southeastern *Drosera,* dismissed *D. annua* as not worthy of recognition. Further study in both field and herbarium leaves me completely satisfied not only that *D. annua* is a distinct species from *D. brevifolia,* but that what has long passed as *D. brevifolia* is in fact an undescribed species and not what Pursh named at all. This provokes skeptical thoughts about Harvard's "massive project" for a generic flora of the Southeastern United States, of which Dr. Wood's paper is a part. Before making detailed comments, let me offer my synopsis of the Southeastern species of *Drosera.*

This account is based primarily on collections in the SMU Herbarium, and my own field observations in Texas, Louisiana, Alabama, and Florida. I had hoped to examine the material used by Miss Wynne, whose revision Dr. Wood mainly followed (the most notable difference being that she did not even mention *D. annua).* Because the New York Botanical Garden was closed for remodeling at the time, I borrowed instead the Southeastern material (except of *D. rotundifolia)* from the U.S. National Herbarium. After the study was essentially finished, it became possible to borrow from New York, but only a few specimens (kindly selected for me by Dr. Arthur Cronquist) were examined, and as it turned out, none had been annotated by Miss Wynne. I am grateful to the various curators for the use of their material.

KEY TO SOUTHEASTERN DROSERA

1a. Leaf blades no wider than the petioles

  2a. Petals 7-10 mm. long; plant 12-40 cm. tall while in flower; leaves with gland-tipped hairs only, or (in a few specimens from northern New Jersey and New York) also minutely and inconspicuously gland-dotted; blooming July-August; southern Maryland (introduced), New Jersey to Massachusetts. . . . . 1. *D. filiformis*

2b. Petals 10-20 mm. long; plant 25-60 cm. tall while flower; leaves with gland-tipped hairs and at least dorsally with numerous sessile glands; blooming April-May; Southeastern Coastal Plain in Georgia, Florida, and Mississippi (reportedly extending to South Carolina and Louisiana) . . . . 2. *D. Tracyi*

1b. Leaf blades much wider than the petioles

3a. Scape glabrous or with inconspicuous, sessile glands; stipules prominent

4a. Petioles glabrous or with inconspicuous, sessile glands. 3. *D. intermedia*

4b. Petioles with few to many, moderately long hairs lacking gland-tips

5a. Leaf blades suborbicular to reniform-orbicular, the largest broader than long; calyx cylindrical-ovoid just before and after flowering, the sepals thin, narrowly oblong-oblanceolate or oblong, mostly united less than ¼ . . . . 4. *D. rotundifolia*

5b. Leaf blades narrowly obovate to suborbicular, the largest as broad as long or narrower, calyx cup-shaped for funnelform-campanulate just before and after flowering, the sepals firm, oblong-elliptic to ovate-elliptic, united about ⅓ 5. *D. capillaris*

3b. Scape with gland-tipped hairs except toward base; stipules absent or vestigial

6a. Petals 1-5, light to deep lavender-pink, 2.5-8.0 mm. long; sepals 2.5-4.0 mm. long; frequent to rather common west of Mississippi River, rare in S. Alabama and E. Tennessee . . . . 6. *D. annua*

6b. Petals 5, pure white, 5-10 mm. long; sepals 3.0-4.5 mm. long; Gulf and Southeastern Coastal Plain, southern Louisiana to Florida, north to Virginia . . . . 7. *D. leucantha*

1. D. FILIFORMIS Rafinesque. The Maryland record for this species is as follows. Prince Georges Co.: Suitland Bog, *E. H. Walker 4162,* 5 Aug. 1947 (US). "Flowers pinkish or purple, closed. In seepage bog. Introduced by A. V. Smith. Growing successfully and spreading. New plants sprout from fallen leaves." Wood reports it from North Carolina and doubtfully from South Carolina and Georgia, but I have seen no material from so far south.

2. D. TRACYI Macfarlane in L. H. Bailey, Standard Cyclop. Hort. 2: 1077. 1914. *D filiformis* var. *Tracyi* Diels, Pflanzenreich IV. 112: 92. 1906. For nomenclatural quibblers, it should be pointed out that *Drosera Tracyi* Macfarlane is a new name, not a new combination based on Diel's earlier publication of it as variety (this in turn based on the then only manuscript binomial). Wynne (1944) stated that this differed "only in its pale green pubescence, larger size, and more robust habit" from *D. filiformis,* and in 1952 apparently did not consider it worth even varietal status. Wood speaks of it as "a very distinct taxon," which it certainly is. The marked difference in flowering period cannot be ex-

plained as due merely to difference in latitude, and this added to the other features given in the key seems to me to warrant treating it as a species. Wynne reports it (1952) from "S.C. to Fla. and La." (incorrectly assigning it the same flowering period as *D. filiformis)*. I have seen specimens only from the following states and counties. FLORIDA. Bay, Gulf, Wakulla, Walton. GEORGIA. Brooks, Colquitt, Thomas. MISSISSIPPI. George, Harrison, Jackson. Petals pink to rose-purple.

3. D. INTERMEDIA Hayne. Distinctive in its tendency to develop definite, leafy stems, and in the long petioles and narrow leaf blades. Said by both Wynne and Wood to extend west to Texas in the Gulf States, but I have seen no specimens from west of Mississippi. ALABAMA. Mobile. FLORIDA. Calhoun, Escambia, Franklin, Highlands, Lake, Sumter. GEORGIA. Charlton, Harrison. MISSISSIPPI. Hancock, Harrison, Jackson. NORTH CAROLINA. Brunswick, Gates, Henderson, New Hanover, Onslow. SOUTH CAROLINA. Aiken, Chesterfield, Kershaw, Lexington, VIRGINIA. Princess Anne. Flowering July-August. Petals white (color noted on only one specimen out of 41 examined).

4. D ROTUNDIFOLIA L. No material of this species was borrowed. The following two specimens at SMU are the only ones seen from the Southeast. NORTH CAROLINA. Henderson Co.: in pasture peat bog at East Flat Rock, *Don Correll 3321,* 27 July 1935 (distributed as *"Drosera capillaris* Poir.?"). Macon Co.: wet sphagnous pockets on ledges of cliff; Horse Cove, near Highlands, *W. B. Schofield 9071,* 7 July 1958. Said by Wynne and Wood to extend south to Georgia and South Carolina (latter queried by Wood). Color not noted on any specimens at hand (32 sheets, mostly Northeastern); described by Fernald as white, rarely pink.

5. D. CAPILLARIS Poiret, Encycl. Meth. Bot. 6: 299. 1804. *D. brevifolia* Pursh, Fl. Am. Sept. 1: 211. 1813 ("1814"). Not *D. brevifolia* of authors from Chapman (1860) on, which is mostly *D. leucantha,* below. Pursh's entire description follows:

> 3. D. pusilla; scapis radicatis simplicibus, foliis brevibus cuneatis vix petiolatis, petalis ovalibus. *brevifolia*
>
> In sandy swamps of Georgia, *Enslen.* June. *v.s.*
> *in Herb. Enslen.* The smallest of all the species
> known; flowers rose-coloured.

Without seeing the type (location unknown; possibly not in existence; Diels cites another Enslen specimen bearing no locality beyond Southern U.S.) there may be a little doubt as to what Pursh had, since the description says nothing about pubescence on the scape (though failure to mention it suggests there was none) or presence of stipules. Pursh listed only four species, the other three being *D. rotundifolia, D. longifolia,* and *D. filiformis;* he makes no mention of *D. capillaris.* But his statements "smallest of all the species known; flowers rose-coloured" apply exactly to *D. capillaris* among the Southeastern species. The words cannot possibly refer to the plant with large, white flowers which

Chapman and later authors mistakenly have called *D. brevifolia*. The phrase "foliis brevibus cuneatis vix petiolatis" of course excludes *D. filiformis*, and makes both the very long-petioled *D. intermedia* and the round-leaved *D. rotundifolia* very unlikely candidates. Enslen collected in Lower Georgia, which I take to mean the Coastal Plain. The only species in this area to which Pursh's description reasonably applies is *D. capillaris*. The amplified descriptions of *D. brevifolia* given by Nuttall and by Torrey & Gray indicate that they applied the name chiefly to *D. capillaris* (which name they also do not mention), but included forms of other species under it. Occasional plants with rather long, narrow leaves superficially resemble *D. intermedia*. I have seen specimens from the following states and counties (parishes). ALABAMA. Mobile. FLORIDA. Duval, Escambia, Glades, Highlands, Hillsborough, Indian River, Lake, Lee, Liberty, Manatee, Pinellas, Polk, Seminole. GEORGIA. Baker, Sumter. LOUISIANA. Beauregard, Rapides, St. Tammany. MISSISSIPPI. Jackson; also "Avondale" (county not determined). SOUTH CAROLINA. Berkeley, Charleston, Georgetown, Hampton, Kershaw, Sumter. TEXAS. Jasper, Robertson, Van Zandt, Waller. VIRGINIA. Nansemond, Prince George, Sussex. Flowering late February-June, and less freely July-September. Petals pale lavender-pink or almost white.

My number 23,514 from Beauregard Parish, Louisiana, distributed as *D. annua*, is *D. capillaris*.

6. D. ANNUA E. L. Reed, Torreya 15: 246—247. 1915. This is very closely related to *D. maritima* St. Hil. of southern Brazil and Uruguay, of which I have seen only five specimens, one of them sterile. In *D. maritima* the naked portion of the scape is 1.5—2.5 (rarely —4) times as long as the leaves, the sepals are obtuse or subacute, and the lowest pedicel is 1.0—3.5 mm. long. In *D. annua* the naked portion of the scape is 2.5—7.0 times as long as the leaves, the sepals are acute or subacute, and the lowest pedicel is 1—5 mm. long. These differences may appear slight. But considering how closely herbarium specimens of *D. annua* and *D. leucantha* may resemble each other when well-opened flowers and color data are lacking, while live plants could not possibly be confused, I prefer to treat the North and South American plants as two species. Some rather robust specimens collected by Dr. B. C. Tharp on Padre Island, Texas, greatly resemble the South American species. At the other extreme, collections made by Dr. H. K. Svenson in Coffee and Franklin Counties, Tennessee, are exceptionally small. In addition to the records given below, Barclay (1938) reports *D. annua* from Latimer, Le Flore, and McCurtain counties in eastern Oklahoma.

ALABAMA. Mobile. ARKANSAS. Ashley, Bradley, Calhoun, Drew, Hot Springs, Jefferson, Miller, Pope. LOUISIANA. Allen, Calcasieu, Vernon, Winn. TENNESSEE. Coffee, Franklin. TEXAS. Anderson, Bastrop, Brazos, Cherokee, Galveston, Hardin, Harris, Jefferson, San

Patricio, Smith; also Padre Island (county not determined). Flowering late February—early June.

7. D. **leucantha** Shinners, sp. nov. Annua (interdum perennans?) parva grandiflora exstipulata foliis obovatis petiolatis scapo glanduloso-pubescente petalis candidis 5—10 mm. longis. HOLOTYPE: St. Simon's Island, near Brunswick, Glynn Co., Georgia, *Arthur Conquist 5255,* 11 April 1947 (SMU; isotypes NY, US). "Among cabbage palmetto is moist pale gray sand that is blackened with organic matter. Delicate perennial *(sic!).* Fls. white, just beginning to open about 8 A.M. Closing again shortly after noon." This is *D. brevifolia* in the sense of Chapman, Small, and Fernald, and in part of Wynne and Wood; not of Pursh, which is *D. capillaris,* as explained under no. 5. The following additional specimens have been seen. FLORIDA. Alachua Co.: Gainesville, *Gerrit S. Miller Jr. 438* (US). Brevard Co.: Titusville, *R. E. Earle* (US). Collier Co.: East Henson Marsh, *L. J. Brass 15970* (US). Duval Co.: near Jacksonville, *A. H. Curtiss 4554* (US). Escambia Co.: 5.4 miles south of McDavid, *Shinners 29,702* (SMU). Jackson Co.: just east of Grandridge, *Shinners 26,990* (SMU). Lake Co.: vicinity of Eustis, *G. V. Nash 10* (US). (Petals noted as pink, but I believe this an error; Nash also collected 3 numbers of the pink-flowered *D. capillaris* at the same locality.) Manatee Co.: Manatee, *J. H. Simpson* (US). St. Johns Co.: without locality, *Miss Reynolds (Herb. J. D. Smith)* (US). (Mixed collection: 6 plants of *D. leucantha,* 1 of *D. capillaris.)* Washington Co.: Caryville, *Shinners 27,018* (SMU). GEORGIA. Chatham Co.: 0.5 mile south of Savannah, *Gilbert G. Rossignol* (US). LOUISIANA. Calcasieu Parish: Dequincy, *F. W. Pennell 10236* (NY). (Mixed collection, partly *D. annua.)* St. Tammany Parish: vicinity of Covington, *Bro. Anect 29* (US). Tangipahoa Parish: Hammond, *Lewena Gallup 11* (US). MISSISSIPPI. Harrison Co.: Biloxi, *S. M. Tracy 5116* (US). Jackson Co.: Ocean Springs, *Josephine Skehan (Seymour & Earle Mexican Gulf Coast Flora no. 34)* (SMU). NORTH CAROLINA. Pender Co.: Rowe's Bridge, Burgaw, *R. K. Godfrey 3463* (US). SOUTH CAROLINA. Darlington Co.: W. Hartsville, *J. B. S. Norton* (US). Dorchester Co.: vicinity of Charleston, *K.W.H. 125a* (SMU). VIRGINIA. Elizabeth City Co.: Hampton, *D. Harrison* (US); *Gerrit S. Miller Jr.* (US). Nansemond Co.: south of South Quay, *Fernald & Long 12089* (US). Sussex Co.: about 4 miles northwest of Homeville, *Fernald & Long 9940* (US). Flowering February—June.

This very striking species was first described by Stephen Elliott, who mistakenly called it *D. rotundifolia.* He stated that it is annual, and has a white corolla. Torrey and Gray cite Elliott, and like him refer the plant to *D. rotundifolia.* Chapman calls it *D. brevifolia,* and describes it as annual without rhizomes. Small's *Flora* follows Chapman's nomenclature, but says that it is "biennial, or perennial by short rootstocks." In his *Manual,* there is no mention of rootstocks or duration. Fernald, also following Chapman's nomenclature, describes the whole genus as consisting of "low perennials or biennials" but says nothing further about the life-span of this species; he states "petals white, 5—8 mm. long" and "the large flower closing at noon." Wynne makes no mention of duration. Her description of the petals as "white to pink, 4—5 mm. long" is obviously based on a mixture, and does not apply to most of the plants belonging to *D. leucantha.* Wood considers the species basically perennial, but "apparently behaves as an annual in many areas and has been so described *(D. annua* Reed)." Like Wynne he of course was referring to a mixture, but nothing he included under the name is typically perennial.

DROSERA AND THE SOUTHEASTERN GENERIC FLORA

A flora is an account of the species of plants of a given area. A generic flora is a contradiction in terms. It is not a flora, but a device for evading the trying job of writing one. In the case of the Droseraceae, in which Small both failed to splinter the genera and overlooked the fact that Rafinesque had done so, a discussion of genera seems particularly pointless. When in the course of it we are given a rehash of an unsatisfactory previous account of the species with the addition of fresh error, one may well ask just what good it all is.

The completeness of information in a flora depends on the amount of direct study that has been done on the plants and in the area concerned. When such study has been done by many persons over periods of hundreds of years, it is possible to produce a work like Clapham, Tutin & Warburg's recent *Flora of the British Isles,* including details on habitat preferences, pollination, chromosome number, and so on. The phrase "biologically oriented flora" is to me altogether meaningless. When we consider *Drosera* in particular, we find that out of 33 references cited by Wood, not one relates to the Southeast as delimited for the proposed generic flora, and a previous bibliography of 3¼ pages to which reference is made likewise contains not a single title reporting work done on the plants in that area. To offer all this as material for a "biologically oriented" flora of the Southeast is as preposterous as it is pretentious.

What is needed first and foremost is direct study of the Southeastern plants themselves. The best of the insufficient authentic information we have is to be found in the floras of Elliott, Chapman, and Small, and in the publications of Roland M. Harper — men who lived in the South or did extensive field work there. But this is not enough for a good, up-to-date flora of the area. Much activity is now under way there, but it is hampered by the very lack of a manual. The greatest contribution that could be made toward a definitive flora of the Southeast is a concise interim guide as complete as present knowledge permits. It is far too early to think of an encyclopedic treatise.

An erudite compilation from publications largely only tangential or irrelevant may be of interest to some, but it is not the material out of which a Southeastern Flora of any kind can be made.

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KEY TO SOUTHEASTERN GLABROUS-STYLED TEPHROSIA (LEGUMINOSAE)

LLOYD H. SHINNERS

The thorough study of the American barbistyled species of *Tephrosia* by Wood (1949) included all the Southeastern members of the genus but a handful which in the latest available accounts (Rydberg, 1923; Small, 1933) are placed under *Cracca.* Necessary corrections of nomenclature under *Tephrosia (nomen conservandum)* are summarized below, together with one new species which has come to light. Grateful acknowledgement is made for the loan of material from the University of Florida and the New York Botanical Garden.

KEY TO THE SPECIES

1a. Stem densely spreading-pubescent....................1. *T. corallicola*
1b. Stem appressed-pubescent (sometimes with a few spreading hairs also) or glabrate.
  2a. Leaflets 2.8—9.0 mm. wide, mostly over 4 mm.
    3a. Stipules 1—3 mm. long; flowering in fall..........2. *T. Curtissii*
    3b. Stipules 4—8 mm. long; flowering in spring.......3. *T. Seminole*
  2b. Leaflets 1.0—4.5 mm. wide, mostly under 3.5 mm..4. *T. angustissima*

1. T. CORALLICOLA (Small) Leon, Fl. de Cuba 2 (Contrib. Ocas. Mus. Nac. De La Salle, Habana, 10): 304. 1951. (According to Gray Herbarium Card Index.) *Cracca corallicola* Small, Bull. Torr. Bot. Club 36: 160. 1909. Known only from Dade County, Florida; type "in pinelands between Cocoanut Grove and Cutler," *Small 2112* (isotypes examined, FLAS, NY). Flowering in November.

2. T. **Curtissii** (Small) Shinners, comb. nov. *Cracca Curtissii* Small ex Rydberg, N. Amer. Fl. 24 (3): 179. 1923. Type from "sand ridges near Cape Malabar," Brevard County, Florida, *Curtiss 584** (isotype examined, NY). A second collection has been seen, from beaches near Jupiter Inlet, Palm Beach County, Florida, *Curtiss 5561* (FLAS, NY). Flowering in September.

3. T **Seminole** Shinners, sp. nov. Videtur perennis parva subdecumbens. Caulis strigosa cum pilis paucis patentibus. Stipulae deltoideo-setaceae 4—8 mm. longae. Foliola 9—15 oblongo-oblanceolata 18—34 mm. longa 2.8—5.0 mm. lata obtusa mucronata subtus tenuiter strigosa rufonervosa. Racemi terminales et axillares breviter pedunculosi graciles laxi. Pedicelli 6—7 mm. longi. Calyx 5 mm. longus laxe appresso-pilosus dentibus tubae longitudine sesquilongis. Corolla 8—9 mm. longa. HOLOTYPE: Godden's Mission, Big Cypress (Collier County?), Florida, *Perley Poore Sheehan,* 12 March 1919 (NY). "Medicinal Plants of the Seminole Indians. Devil's shoe-string—(cracca purpurea): Used as a specific for

nose-bleed. The whole plant is steeped in cold water, and the decoction is then used as a wash.—Plant a short-stemmed vine with compound leaves and small but handsome flowers; the fruit is a narrow pod. It grows on prairies." Noted by Wood in 1948 as "not *T. purpurea.*" PARATYPE: East Florida, *Dr. Leavenworth,* no other date (sterile; determined as *Cracca Curtissii)* (NY).

Known only from the above two fragmentary specimens. Stem rather thinly strigose and with some spreading hairs. Stipules deltoid-setaceous, 4—8 mm. long, persistent. Leaflets 9—15, oblong-oblanceolate, 18—34 mm. long, 2.8—5.0 mm. wide, obtuse and mucronate, rather thinly strigose beneath, glabrouse above, the veins prominent beneath and rufous. Racemes rather short-peduncled, both axillary and terminal, slender and loose, the lower nodes (seen on only 1 sheet in early flower) 12—32 mm. apart, a reduced leaf sometimes present at 1st or 2nd node. Pedicels 6—7 mm. long in flower. Calyx 5 mm. long, rather loosely appressed-pilose, the acuminate teeth 1.5 times as long as the tube. Corolla 8—9 mm. long (as pressed). Fruit not seen.

4. T. ANGUSTISSIMA Shuttleworth ex Chapman, Fl. S. U.S. p. 96. 1860. *Cracca angustissima* (Shuttleworth) Kuntze, Rev. Gen. 1: 174. 1891. *Tephrosia purpurea* (Shuttleworth) B. L. Robinson, Bot. Gaz. 28: 201. 1899. Frequent in Dade County, Florida; one collection seen from Brevard County (near Eau Gallie; NY). Flowering May—early December.

EXCLUDED SPECIES

T. CINEREA (L.) Persoon, Syn. Pl. 2: 327. 1807. *Cracca cinerea* (L.) Morong, Ann. N.Y. Acad. Sci. 7: 79. 1892. This is known only from an old record as a waif in ballast ground at Mobile, Alabama, in June, 1888 (? last numeral not clear on label), collector not named but presumably C. Mohr, No. 19 (NY). There is no evidence that it has persisted. It may be distinguished by emending the above key as follows.

3b. Stipules 3—8 mm. long.
  4a. Corolla 8—9 mm. long; leaflets rather thinly strigose beneath. *T. Seminole*
  4b. Corolla 11—13 mm. long; leaflets densely strigose beneath. *T. cinerea*

ADDENDA ON BARBISTYLED SPECIES

T. FLORIDA (F. G. Dietrich) C. Wood var. **gracillima** (B. L. Robinson) Shinners, comb. nov. *T. ambigua* var. *gracillima* B. L. Robinson, Bot. Gaz. 28: 201. 1899. I believe that there is sufficient morphological difference combined with geographic separation to justify recognition of this variety.

T. MOHRII (Rydberg) Godfrey, Brittonia 10: 169. 1958. *Cracca Mohrii* Rydberg, N. Amer. Fl. 24 (3): 164. 1923. Reasons for maintaining this as distinct from *T. virginiana* are given by Godfrey, l. c.

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CHROMOSOME NUMBERS OF *LINUM* FROM THE SOUTHERN UNITED STATES AND MEXICO

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About 150 species of *Linum* are recognized throughout a predominantly tropical and subtropical distribution. In North America, Small (1907) included 48 species in *Cathartolinum* and only 5 in *Linum*, although Winkler (1931) transferred all species to *Linum*. A total of 36 species have been studied cytologically of which 12 are found in North America.

MATERIALS AND METHODS.—Plants were collected in the field in Alabama, Floriad, Georgia, Mississippi, New Mexico, Texas, and Mexico. Immature flower buds were fixed following the procedure of Lewis and Oliver (1961) from which PMCs are more rarely somatic cells were examined. Occasionally, seeds obtained from commercial sources and herbarium sheets were cultured on a medium developed by Lewis and Elvin-Lewis (1961). Seeds were first soaked in water for 1-2 days and 1 day after germination mitosis was observed in root tip cells. All chromosome drawings were made with the aid of a camera lucida at X 2300. Vouchers for all collections are filed in the Southern Methodist University Herbarium and duplicates have been distributed elsewhere. We appreciate the verifications of some collections by Dr. C. Marvin Rogers, Wayne State University. Field work was in part aided by a grant from the National Science Foundation, G-9800.

RESULTS AND DISCUSSION.—Fourteen species and varieties have been studied from 31 localities as listed in Table 1. Three species, *L. grandiflorum* ($n=8$, Fig. 1), *L. perenne* L. ($2n=18$), and *L. usitatissimum* ($n=15$, Fig. 15), are introduced into North America and our results verify those counts by previous workers. Of the remaining species, all indigenous to this continent, the numbers for *L. lewisii* ($n=9$, Fig. 2) and *L. rigidum* ($n=15$, Fig. 15) verify those of Kikuchi (1926, 1929), Dillman (1933), and Ray (1944). However, Ray (1944) reported *L. medium* as $n=15$, but from 22 plants collected in Florida, Mississippi, and Texas, only $n=18$ (Fig. 8-9) and $2n=36$ were found. From plants collected in North Carolina, Ray also reported *L. virginianum* with $n=15$, but from Georgia we found 2 plants with $n=18$ (Fig. 11). Unfortunately Ray does not appear to have preserved voucher specimens so that it is not possible to check his determinations. The first chromosome numbers are reported for *L. arenicola* ($n=18$, Fig. 4), *L. floridanum* var. *chrysocarpum* ($n=18$, Fig. 5), *L. greggii* ($n=18$, Fig. 6-7), *L. imbricatum* ($n=15$, Fig. 12), and *L. pratense* ($n=9$, Fig. 3).

SIDA 1 (2): 63—68. 1962.


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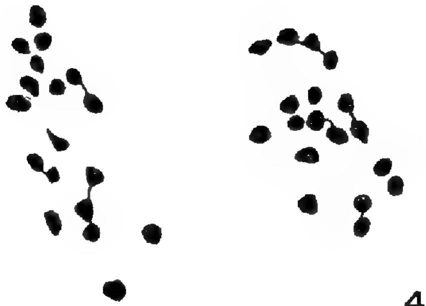
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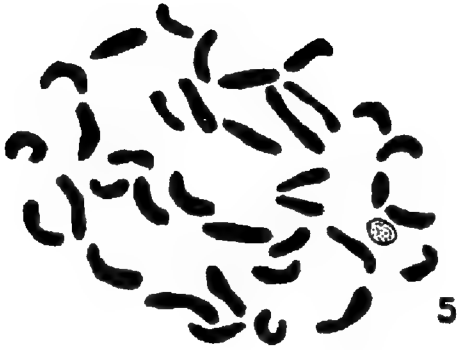
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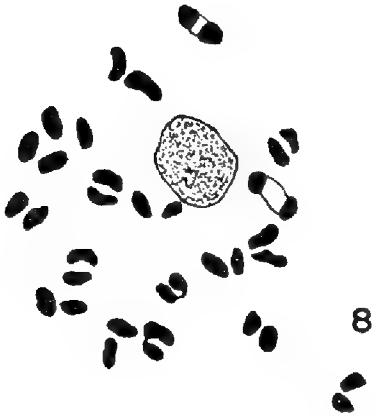
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Although meiosis was generally found to be regular, a somewhat lower chiasmata frequency than is normal often resulted in incomplete bivalent formation. Consequently the chromosome numbers of PMCs at diakenesis (Fig. 8) and prometaphase (Fig. 12) were usually obscure and difficult to determine.

The North American species of *Linum* were grouped by Winkler (1931) into two sections, *Linum (Eulinum)* and *Cathartolinum*. The latter, considered by Small (1907) of generic rank, includes a majority of the North American species and was divided by Small into numerous sections. Those species having styles united one-half or more, large yellow petals, alternate leaves, and, so far as known, a chromosome number of $x=15$, form a natural group in *Linum* which Small recognized by his sections *Rigida, Multicaulia,* and possibly *Sulcata* under *Cathartolinum*. Thus LINUM, section MULTICAULIA (Small) Osborne, comb. nov., based on *Cathartolinum*, section *Multicaulia* Small, N. Am. Fl. 25:71, 1907, is proposed to include *L. imbricatum* (type species) and *L. rigidum*. Additional research may prove that other species particularly those from the sections *Rigida* and *Sulcata* may be included in this section.

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Figs. 1-15. Chromosomes of *Linum* drawn with the aid of a camera lucida originally at X 2300 reduced by 21% in reproduction. Fig. 1. *L. grandiflorum*, $n = 8$, *Osborne 70*. Fig. 2. *L. lewissi*, $n = 9$, *Osborne 78*. Fig. 3. *L. pratense*, $n = 9$, *Osborne 47*. Fig. 4. *L. arenicola*, $n = 18$, *Osborne 64*. Fig. 5. *L. floridanum* var. *chrysocarpum*, $2n = 36$, *Osborne 69*. Fig. 6. *L. greggii*, $n = 18$ (anaphase II with two poles), *Lewis 5743*. Fig. 7. *L. greggii*, $n = 18$, *Lewis 5752*.

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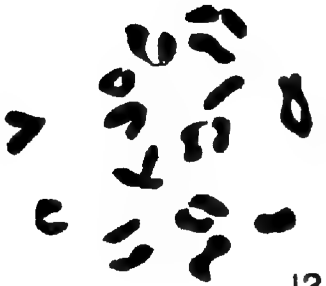

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Table 1. CHROMOSOME NUMBERS FOR 13 SPECIES OF LINUM

Taxon	*n*	2*n*	Voucher
Section *Linum*			
L. grandiflorum Desf.	8	..	TEXAS. Harrison Co., Karnack (cultivated), *Osborne 70* (4).*
L. lewisii Pursh	9	..	TEXAS. Howard Co., 9.5 miles W of Big Spring on Hwy. 80, *Osborne 78* (3).
L. perenne L.	..	18	Rowe's Seed (2).
L. pratense (Norton) Small	9	..	TEXAS. Dallas Co., Kiest Park, Dallas, *Osborne 47* (2), *51* (4); Hill Co., 8.7 miles N of Hillsboro, *Oliver 284* (2); Somervell Co., 9.4 miles N of Brazos River on Hwy. 50, *Osborne 50* (4).
L. usitatissimum L.	15	..	TEXAS. Harrison Co., Karnack (cultivated), *Osborne 80* (4).
Section *Cathartolinum*			
L. arenicola (Small) Winkler	18	..	FLORIDA. Monroe Co., Big Pine Key, *Osborne 65* (2), Park Key, *Osborne 64* (3).
L. floridanum (Planchon) Trelease var. *chrysocarpum* Rogers	18	36	MISSISSIPPI. Hancock Co., 6.2 miles ENE of Pearl River on Hwy. 90, *Osborne 69* (2).
L. greggii (Engelm.) Small	18	..	MEXICO. COAHUILA. 3.1 miles N of Los Llanos, *Lewis 5743* (2). NUEVO LEON. 11 miles E of junction of Hwys. 57 and 60, *Lewis 5752* (5).

Fig. 8. *L. medium* var. *texanum*, $n = 18$, *Osborne 54*. Fig. 9. *L. medium* var. *texanum*, $n = 18$, *Osborne 55*. Fig. 10. *L. schiedeanum*, $n = 18$, *Osborne 75*. Fig. 11. *L. virginianum*, $n = 18$, *Osborne 56*. Fig. 12. *L. imbricatum*, $n = 15$, *Lewis 5588*. Fig. 13. *L. rigidum* var. *berlandieri*, $n = 15$, *Oliver 285*. Fig. 14. *L. rigidum* var. *rigidum*, $n = 15$ (anaphase II with two poles), Lewis 5590. Fig. 15. *L. usitatissimum*, $n = 15$, *Osborne* 80.

L. medium (Planchon) Britton var. *texanum* (Planchon) Fern.	18	36	FLORIDA. Collier Co., 7.1 miles E of Naples, *Osborne 63* (2); Sarasota Co., 1 mile W of junction of Hwys. 41 and 777, *Osborne 61* (2). MISSISSIPPI. Hancock Co., 0.5 miles W of St. Louis Bay on Hwy. 90 *Osborne 68* (2). TEXAS. Hardin Co., Kountze Fire Lookout Tower, *Lewis 5627* (1); Marion Co., Jefferson, *Osborne 57* (3), Lake of the Pines, nr Jefferson, *Osborne 55* (6); Nacogdoches Co., Stephen F. Austin Experimental Forest, *Osborne 53* (4), *54* (2).
L. schiedeanum S. & C.	18	36	TEXAS. Brewster Co., Bib Bend National Park, Chisos Mountains, *Osborne 73* (2), *74* (2), *75* (5), *76* (2). MEXICO. COAHUILA. 3.1 miles N of Los Llanos, *Lewis 5730* (1).
L. virginianum L.	18	..	GEORGIA. Pike Co., 0.5 miles N of Pike-Upson Co. line and Hwy. 19, *Osborne 56* (2).
Section *Multicaulia*			
L. imbricatum (Raf.) Shinners	15	..	TEXAS. San Patricio Co., 5 miles SE of Mathis, *Lewis 5588* (4).
L. rigidum Pursh var. *rigidum*	15	30	TEXAS. Bee Co., 0.9 miles N of Pettus, *Osborne 33* (2); San Patricio Co., Port Aransas, *Lewis 5590* (3).
L. rigidum Pursh var. *berlandieri* (Hook.) T. & G.	15	..	TEXAS. Bee Co., 0.5 miles N of Tuleta, *Osborne 32* (2); Hill Co., 8.7 miles NE of Hillsboro, *Oliver 285* (3).

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* Number of plants examined.

CALAMINTHA (LABIATAE) IN THE SOUTHERN UNITED STATES

LLOYD H. SHINNERS

The last world-wide account of *Satureja* (by Briquet in Engler & Prantl, 1897) defines the genus very broadly, merging with it *Micromeria* and *Calamintha,* which the generally conservative Bentham (in DC., 1848) had retained as distinct. DeWolf, in summarizing the cultivated species (1954), observed that Briquet "enlarged *Satureja* to such an extent that it was almost undefinable." He follows several recent European authors by recognizing five genera instead of one. The largest of those involving wild plants of the South is *Calamintha,* including the species treated in Small's *Manual* as *Clinopodium* groups *Herbacea* and *Fruticosa.* Only half of the six native species which I consider valid in the two groups have had proper combinations published for them under *Calamintha.* It is primarily to supply the missing ones, and incidentally to comment on their synonymy and taxonomy, that this brief account has been prepared. The species sometimes referred to *Satureja* but not included in *Calamintha,* and known to occur wild in the South (broadly delimited), are as follows.

ACINOS ARVENSIS (Lamarck) Dandy, Journ. Ecology 33: 326. 1946. *Satureja Acinos* (L.) Scheele. *Clinopodium Acinos* (L.) Kuntze. Neither Fernald nor Gleason reports this European weed from south of the Mason-Dixon Line; the following collection thus extends its range (see also Strausbaugh & Core, 1958). WEST VIRGINIA. Hampshire Co.: plentiful in old peach orchard near Hanging Rock, *Wilbert M. Frye 8895,* 25 June 1949 (SMU).

CLINOPODIUM VULGARE L. *Satureja vulgaris* (L.) Fritsch, including var. *neogaea* Fernald, Rhodora 46: 388. 1944. The species is represented at SMU by 19 sheets from North America (D.C., Michigan, New Jersey, North Carolina, Quebec, Vermont, Virginia, West Virginia, Wisconsin) and 11 from Europe (British Isles, Czechoslovakia, France, Germany, Italy, Netherlands, Sweden). All have leaves pilose on both surfaces, the European ones more variable as to density, but not separable from the North American plants; most are exactly the same. On the basis of this limited but diversified sample, it does not appear that Fernald's variety (supposed to differ in having leaves glabrous or only sparsely strigose above, and to represent the native American race) is at all tenable. The species is primarily northern, extending south in the mountains to western North Carolina.

MICROMERIA BROWNEI (Swartz) Bentham var. PILOSIUSCULA Gray. *M. pilosiuscula* (Gray) Small. *M. xalapensis* (HBK) Bentham.

SIDA 1 (2): 69 — 75. 1962.

Satureja Brownei (Swartz) Briquet var. *pilosiuscula* (Gray) Briquet. Central and northern Florida, adjacent Georgia (Decatur Co.), southern Louisiana (St. Bernard Parish), southern Texas (Brazoria to Cameron counties near the coast, locally inland in Bexar and Colorado counties); through Mexico to Guatemala. *M. Brownei* var. *Brownei* is confined to Jamaica; another variety is found in Cuba (rare) and Mexico (Yucatan Peninsula), and closely related species in the Bahama Islands and Hispaniola (Shinners, 1962).

PILOBLEPHIS RIGIDA (Bartram) Rafinesque, New Fl. N.A. 3: 52—53. 1838 ("1836"). *Satureja ? rigida* Bartram ex Bentham, Lab. Gen. et Sp. p. 354. 1832—1836. (Not seen; quoted in DC., Prodr. 12: 211. 1848.) *Pycnothymus rigidus* (Bartram) Small, Fl. S.E. U.S. (ed. 1) p. 1042. 1903. This is one of the many cases in which Small needlessly supplied a new name, overlooking the much older one of Rafinesque. The species occurs almost throughout peninsular Florida.

The following key and notes on *Calamintha* are based chiefly on collections at Southern Methodist University, Florida State University, and the University of Florida. Material of the introduced species was borrowed from the Gray Herbarium, and a few sheets of *C. arkansana* were examined on a visit to the University of Texas. Grateful acknowledgment is made to the several curators for their courtesies.

KEY TO THE SPECIES

1a. Herbaceous perennial (may flower the first year, appearing annual)
  2a. Stem pubescent; leaf blades elliptic to ovate
    3a. Corolla 22—35 mm. long; calyx 10—13 mm. long; leaf blades sharply and rather coarsely toothed . . . . 1. *C. grandiflora*
    3b. Corolla 7—18 mm. long; calyx 2.8—10.2 mm. long; leaf blades entire or with shallow, rounded or incurved teeth
      4a. Calyx 6.0—10.2 mm. long, the hairs inside the throat barely or not exserted; blades of larger stem leaves 2—5 cm. long
        2. *C. officinalis*
      4b. Calyx 2.8—6.0 mm. long, the hairs inside the throat exserted, prominent; blades of larger stem leaves 0.8—2.4 cm. long
        3. *C. Nepeta*
  2b. Stem glabrous or pubescent only at nodes; leaf blades linear to elliptic lanceolate on flowering stems (broader on sterile shoots)
    5a. Nodes glabrous or inconspicuously pubescent; middle stem leaves 1—5 mm. wide, entire or occasionally with 1 or 2 teeth on each margin; plant developing stolons (commonly wanting at main flowering period), their leaves with orbicular-ovate or orbicular-rhombic blades; corolla 7—12 mm. long
      4. *C. arkansana*
    5b. Nodes moderately to densely pubescent; middle stem leaves 3—12 mm. wide, with 1—4 teeth on each margin; plant not developing stolons, sometimes with ascending leafy shoots, their

leaves with oblanceolate to oblong-obovate blades; corolla 10—14 mm. long . . . . 5. *C. glabella*

1b. Shrubby perennial
  6a. Corolla 27—50 mm. long, bright red or rarely yellow; calyx 8—18 mm. long . . . . 6. *C. coccinea*
  6b. Corolla 10—20 mm. long, light lavender or lavender pink with dark dots; calyx 6.0—7.5 mm. long
    7a. Leaves subsessile, minutely and densely pubescent
      8a. Leaf blades linear- to oblong-lanceolate, widest about middle, not strongly tapered at base, with entire, revolute margins 7. *C. Ashei*
      8b. Leaf blades oblanceolate or obovate, tapered at base, the lower more or less toothed, the upper often entire and with revolute margins . . . . 8. *C. dentata*
    7b. Leaves petioled, glabrous . . . . 9. *C. georgiana*

1. C. GRANDIFLORA Moench. *Satureja grandiflora* (Moench) Scheele. There is no reliable record of the occurrence of this as a wild plant. In the Gray Herbarium there is one specimen from the herbarium of H. P. Sartwell, "*Legit* Curtiss," the habitat given as "Carol." followed by an illegible word, seemingly "Lenten" but possibly "Septen." was meant. To this has been added, in Asa Gray's handwriting, "wild? Calamintha officinalis L." The plant, native of Europe, is cultivated in the United States. It has been in my garden in Dallas for two years, barely surviving, and showing no inclination to bloom. Unless fresh evidence is forthcoming, this species should be excluded from the Southern flora.

2. C. OFFICINALIS Moench. *Satureja Calamintha* (L.) Scheele. The only North American specimen I have seen is the following, at the Gray Herbarium. VIRGINIA. Isle of Wight Co.: rich calcareous slopes along James River, west of old Fort Boykin, *Fernald & Long 13739*, 8 Sept. 1941. (Flowers past: calyx 6 mm. long, villous.)

3. C. NEPETA (L.) Savi. *Clinopodium Nepeta* (L.) Kuntze. *Satureja Nepeta* (L.) Scheele. *S. Calamintha* var. *Nepeta* (L.) Briquet, var. *nepetoides* (Jordan) Briquet, and var. *glandulosa* (Requien) Briquet. The *C. Nepeta*-*C. officinalis* complex is represented at SMU by 21 sheets from Europe and 10 from North America; an additional 46 from North America were borrowed. I am unable to follow with this material the very detailed account given by Briquet in *Les Labiées des Alpes Maritimes* or the very brief one given by Fernald. In one notable case, I found myself trying to call duplicates of *Ahles 17630*, from Granville County, North Carolina, by two different names, though when placed side by side they obviously represented only one moderately variable entity. There does seem to be a fairly good break between *C. Nepeta* and *C. officinalis*, and they are accordingly accepted as distinct though closely related species. *C. Nepeta* was found by Asa

Gray and J. Carey in Virginia and North Carolina in July, 1841, and had appeared at scattered localities elsewhere before the end of the 19th Century. It seems to have continued to spread gradually, but avoids the Coastal Plain. The record for Mobile County, Alabama, listed below, presumably represents a waif only; there are no recent collections from there. *C. Nepeta* is in flower from July to October. I have seen specimens from the following states and counties. ALABAMA. Jackson, Mobile. ARKANSAS. Sevier. DC. GEORGIA. Whitfield. KENTUCKY. Fayette. MARYLAND. Baltimore, Calvert, Talbot. NORTH CAROLINA. Forsyth, Granville, Orange, Vance. TENNESSEE. Anderson, Benton, Carroll, Cumberland, Knox, Roane, Rutherford. VIRGINIA. Botetourt, Campbell, Caroline, Chesterfield, Giles, Goochland, Hanover, James City, Rockbridge, Rockingham, Shenandoah, Smyth, Spotsylvania, Wythe, York. (Rather surprisingly, Strausbaugh & Core, 1958, do not report it from West Virginia.)

4. C. **arkansana** (Nuttall) Shinners, comb. nov. *Hedeoma arkansana* Nuttall, Trans. Amer. Phil. Soc. n.s. 5: 186. 1834. "In moist and rocky prairies near the sources of the Kiamesha river. Flowering in May and June." (The locality is in eastern Oklahoma, at that time part of Arkansas Territory; see Geiser, 1956.) *Calamintha Nuttallii* Bentham in DC., Prodr. 12: 230. 1848. (Bentham cites "*Micromeria Nuttallii* Torr. et Gr. ms.," which presumably is the real original for the name. Illegitimate by present rules, since the epithet *arkansana* was available.) *C. glabella* var. *Nuttallii* (Bentham) Gray, Man. (ed. 2) p. 307—308. 1857. (Doubly illegitimate, since both the preceding and the following are cited.) *Micromeria glabella* var. *angustifolia* Torrey, Fl. N.-Y. 2: 67. 1843. *Satureja glabella* var. *angustifolia* (Torrey) Svenson, Rhodora 42: 7—8. 1940. *Calamintha glabella* var. *angustifolia* (Torrey) DeWolf, Baileya 2: 150. 1954. (Basinym incorrectly given as *Satureja glabella* var. *angustifolia* (Torrey) Svenson.) The name *Hedeoma glabrum* was used by Nuttall (Genera 1: 16, 1818) for this species and the next which he did not at first separate; it is nomenclaturally an illegitimate new name for the next species, proposed by Persoon.

Despite the great similarity in general appearance between this and the next, I agree with Fernald that the two are to be regarded as distinct although closely related. The peculiarity of leafy stolons (seldom present on herbarium specimens) needs to be studied during periods when the plant is not in flower. *C. arkansana* blooms from late May to early August. It is a plant of limestone areas, extending southwest from the Ozark region into central Texas, where it is rare. ARKANSAS. Baxter, Fulton, Izard, Lawrence, Randolph, Sharp, Stone. OKLAHOMA. Murray, Pontotoc, Rogers, Seqouyah. TENNESSEE. Wilson. TEXAS. Bell, Travis.

5. C. GLABELLA (Michaux) Bentham, in DC., Prodr. 12: 230. 1848. *Cunila glabella* Michaux, Fl. Bor.-Am. 1: 13. 1803. "In rupibus ripariis fluvii *Tennassee,* juxta Nashville." *Hedeoma glabrum* Persoon, Syn. Pl.

2: 131. 1807. (The change in form of the specific epithet was probably only a slip of the pen, reference being made to "Michx. sub Cunila." Pursh and Nuttall follow Persoon but change the gender to feminine, which under present rules is not permissible.) *Satureja glabella* (Michaux) Briquet in Engler & Prantl, Nat. Pflanzenfam. Teil IV. Abt. 3a: 302. 1897.

Flowering late May—July. Said by Fernald to occur in Kentucky, Tennessee, southern Missouri, and Arkansas. I have seen specimens from the following states and counties. ARKANSAS. Benton, Garland, Logan, Newton, Saline, Washington. OKLAHOMA. McCurtain.

6. C. COCCINEA (Nuttall) Bentham in DC., Prodr. 12: 229. 1848. *Cunila coccinea* Nuttall ex Hooker, Exotic Flora 2: t. 163. 1825. (There is a second t. 163 opening volume 3; Bentham erroneously quotes the latter. He also cites "*Melissa coccinea* Spreng., Syst. 2: 229," 1825, but that page is devoted to *Acer;* the precise citation is Syst. 4 pt. 2: 224, 1827, where *Cunila coccinea* is given as synonym.) Type (not seen): Florida, *Ware* (ANSP). Description supplied by Hooker from cultivated specimens, grown by Mr. H. Shepherd from seed from the type collection. *Satureja coccinea* (Nuttall) Bertoloni, Misc. Bot. 8: 23. (Not seen. Published in 24 parts, 1842—1863, according to Pritzel.) *Clinopodium coccineum* (Nuttall) Kuntze, Rev. Gen. Pl. 2: 515. 1891. *Clinopodium macrocalyx* Small, Fl. S.E. U.S. p. 1043 and p. 1337. 1903. Type: dry pine barrens, Indian River, Florida, *Curtiss 2012,* August (isotype examined, FLAS). *Satureja macrocalyx* (Small) Druce, Rept. Bot. Exch. Club 4 (1916): 644. 1917.

In flower from April to October. There is a tendency for flowers to be larger in the southeastern part of the range of this species(peninsular Florida), but the range of variation is continuous from one extreme to the other. The isotype of *Clinopodium macrocalyx* which I examined has calyx only 13 mm. long, and on this basis would run to *C. coccineum* in Small's own key; it does, however, have a very large corolla (46 mm. long). ALABAMA. Baldwin, Mobile. FLORIDA. Bay, Citrus, Escambia, Franklin, Gulf, Hernando, Holmes, Indian River, Okaloosa, Orange, Osceola, Pasco, Santa Rosa, Seminole, Wakulla. GEORGIA. Chandler, Emmanuel, Toombs, Wheeler, MISSISSIPPI. Harrison, Jackson, Stone.

7. C. **Ashei** (Weatherby) Shinners, comb. nov. *Satureja Ashei* Weatherby, Rhodora 26: 80. 1924. Type: sandy pine woods, near Ocala, Marion Co., Florida, *W. W. Ashe,* April, 1923 (GH). Paratype: near Astor Park, Lake Co., Florida. *Ashe,* April 1823 (GH). (These specimens not examined. The detailed original description, key, and localities, leave no doubt as to the identity of the plant.) *Clinopodium Ashei* (Weatherby) Small, Bull. Torr. Bot. Club 51: 385. 1924.

Flowering late January to October. Another of the many endemics centering in the lake region of peninsular Florida; specimens seen from

Highlands, Marion, Polk, and Volusia counties. Dried plants of the next species lacking lower leaves are superficially very similar to this.

8. C. DENTATA Chapman, Fl. S. U.S. p. 318. 1860. "Sand ridges near Aspalaga, Florida" (Gadsden Co.) "Sept. and Oct." *Clinopodium dentatum* (Chapman) Kuntze, Rev. Gen. Pl. 2: 515. 1891. *Satureja dentata* (Chapman) Briquet in Engler & Prantl, Nat. Pflanzenfam. Teil IV. Abt. 3a: 302. 1897. In flower from April to October. Confined to northern Florida and southeastern Georgia. FLORIDA. Bay, Gadsden, Liberty, Wakulla, Walton. GEORGIA. Tattnall.

9. C. **georgiana** (Harper) Shinners, comb. nov. *Clinopodium georgianum* R. M. Harper, Bull. Torr. Bot. Club 33: 243. 1906. New name for *Thymus carolinianus* (non "Walter") Michaux, Fl. Bor.-Am. 2: 9. 1803. Michaux described this species, but based his name on *Thymbra ? caroliniana* Walter, Fl. Carol. p. 162, 1788, which in reality was the quite different *Macbridea pulchra* Elliott, correctly to be called *M. caroliniana* (Walter) Blake, Rhodora 17: 132, 1915. DeWolf (1954) perpetrates several errors by referring this to *"Calamintha caroliniana* (Nuttall) Bentham"; neither of those authors is to be credited with the combination. The relevant *sensu* synonymy is as follows. *Calamintha caroliniana* (non "Walter") Sweet, Hort. Brit. (ed. 2) p. 408. 1830. Sweet quotes only *Thymus grandiflorus* "B. M." (i.e., Sims, Bot. Mag. 25: t. 997, 1807). Sims gives both *Thymus carolinianus* Michaux and *Thymbra ? caroliniana* Walter as synonyms, with query, and goes on to say "We have very little doubt that Walter's plant is the same with ours, but are not sufficiently certain with respect to Michaux's, to dare to adopt his specific name." It would be extremely difficult to decide whether Sims's name was legitimate or not on the basis of his statements about the synonymy. Fortunately we are spared this decision because it is illegitimate as a later homonym of *Thymus grandiflorus* (L.) Scopoli, Fl. Carniolica (ed. 2) 1: 424, 1772. Similarly *Calamintha grandiflora* (Sims) Pursh, Fl. Am. Sept. 2: 414, 1813 ("1814"), is illegitimate as a later homonym of C. *grandiflora* (L.) Moench, 1794. (In fact it is doubly illegitimate because Pursh cites all three of the binomials mentioned by Sims without query, but failed to adopt the oldest one.) *Satureja caroliniana* (non "Michaux") Briquet in Engler & Prantl, Nat. Pflanzenfam. Teil IV. Abt. 3a: 302. 1897. All the binomials with the epithet *caroliniana* are of course synonyms of *Macbridea caroliniana* (Walter) Blake on the basis of Walter's type, even though Michaux, Sweet, and Briquet all meant *Calamintha georgiana* on the basis of their descriptions.

Flowering from May to October. The most widespread (but not most abundant) of the shrubby species. FLORIDA. Holmes. GEORGIA. Baker, Clarke, Decatur, Elbert, Richmond, Screven, Upson. LOUISIANA. St. Tammany. MISSISSIPPI. Harrison, Pearl River. NORTH CAROLINA. Anson. SOUTH CAROLINA. Abbeville, Anderson, Chesterfield.

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SYNOPSIS OF COLLINSONIA (LABIATAE)

LLOYD H. SHINNERS

The difference between two stamens and four in the Labiatae often separates genera and whole tribes. Briquet in 1897 concluded that *Collinsonia*, which had accumulated species with both numbers, should be divided. Accordingly he segregated two species having four stamens as *Micheliella*, overlooking the fact that Rafinesque exactly eighty years before had published the genus *Hypogon*, likewise differing in having four stamens. Although each author recognized two species in his segregate genus, they were not all the same ones. Briquet's *Micheliella verticillata* is indeed very distinct from the others, as indicated in the key below, and is here considered sole representative of a new subgenus. Rafinesque's *Hypogon verticillatum*, despite the confusing identity of epithets, is an entirely different species, the long misunderstood *Collinsonia serotina* Walter (*C. punctata* Elliott), which may have either two or four functional stamens, with intermediate forms having greater or lesser development of rudiments or filaments. Even without this awkward variation. *Hypogon* is too similar in all other respects to *Collinsonia* proper to justify segregation. Likewise *Micheliella*, separating *M. anisata* (which also is in reality *C. serotina)* from the species it greatly resembles and associating it with the quite dissimilar *C. verticillata*, is obviously an unnatural genus. *Collinsonia* is here recognized with its pre-1897 limits, including the peculiar *C. verticillata* as sole representative of a subgenus defined on the basis of features of inflorescence and secondarily of leaves rather than number of functional stamens.

In addition to the material at Southern Methodist University, I have had the use of collections from Florida State University, the University of Florida, the Gray Herbarium (not including those referred to *Micheliella*, which I carelessly forgot to explain were to be included in *Collinsonia* when requesting the loan), North Carolina State College, and the University of North Carolina. My thanks are due the various curators for their courtesies.

COLLINSONIA L., Sp. Pl. 1: 28, 1753, and Gen. Pl. (ed. 5) p. 16, 1754.
Only original species and automatic type: C. CANADENSIS L.

Hypogon Rafinesque, Fl. Ludov. p. 148. 1817. (Also on p. 41 as *nomen provisorium.)* Lectotype species: *H. verticillatum* Raf. = COLLINSONIA SEROTINA Walt.

Diallosteira Rafinesque, Neogenyton p. 2, 1825. (Reference for this and the next not seen; taken from Merrill, Index Rafinesquianus p. 206 and p. 209, 1949.) Type (only) species: *D. punctata* (Ell.) Raf. ex Jackson = COLLINSONIA SEROTINA Walt.

SIDA 1 (2): 76—83. 1962.

Pleuradenia Rafinesque, Neogenyton p. 2. 1825. Two species: *P. praecox* (Walt.) Raf. ex Jackson *("precox")*, identity uncertain (either *Collinsonia serotina* Walt. or *C. tuberosa* Michx.); *P. scabra* ("Pers.") Raf. ex Jackson = COLLINSONIA SEROTINA Walt.

Micheliella Briquet in Engler & Prantl, Nat. Pflanzenfam. Teil IV. Abt. 3a: 325. 1897. Lectotype species: *M. verticillata* (Baldwin) Briquet = COLLINSONIA VERTICILLATA Baldwin. This is here recognized as constituting *Collinsonia* subg. **Micheliella** (Briquet) Shinners, stat. nov., differing from subg. *Collinsonia* in having flowers subverticillate or alternate instead of opposite, lacking floral bracts, and having pedicels with enlarged flattened bases. (See also first couplet in key below.) The number of functional stamens is variable in subg. *Collinsonia* as here defined and is not a usable basis for separating the subgenera.

KEY TO THE SPECIES

1a. Flowers close-set in groups of 3—6 in lower and middle part of the simple inflorescence; floral bracts absent, the pedicels with widened, flat bases; leaves 4 (rarely 2), closely crowded (subopposite or subverticillate) in upper part of stem, all rather long-petioled; flowering spring—early summer . . . . 1. *C. verticillata*

1b. Flowers 2 at all nodes of the simple or branched inflorescence; floral bracts present, minute to large, the pedicels not enlarged at base; leaves 6 or more, opposite, the uppermost greatly reduced, short-petioled or sessile; flowering late summer—fall.

  2a. Blades of larger stem leaves 8—25 cm. long, with 11—42 teeth on each margin, glabrous or variously pubescent beneath; plant with large, woody, irregular, more or less elongate, rhizome-like crown 4—15 cm. long; stem 2—7 mm. thick near base

    3a. Flowering calyx 3.2—7.6 mm. long, the lower (narrower) teeth subacute to acuminate, the midvein barely or not exserted; stamens variously 2 with 2 rudiments, or 2 with 2 short to full-length empty filaments, or 4 and all anther-bearing; leaf blades pubescent or pilosulous over the surface beneath; Coastal Plain, North Carolina to southeastern Louisiana, rare inland 2. *C. serotina*

    3b. Flowering calyx 2.3—4.3 mm. long, the lower teeth with elongate, subulate tips partly formed by extension of midvein; stamens 2 with 2 rudiments, or rarely anther-bearing stamens none; leaf blades glabrous or variously hispidulous or pubescent beneath; interior and northern (except for one outlying locality in northern Florida) . . . . 3. *C. canadensis*

  2b. Blades of larger stem leaves 4.0—10.5 cm. long, with 5—15 teeth on each margin, glabrous or hispidulous on the main veins beneath; plant with usually small, rounded, lobed, or elongate tuberlike crown (up to 5 cm. across or 6 cm. long); stem 1—4 mm. thick near base..4. *C. tuberosa*

1. C. VERTICILLATA Baldwin ex Elliott, Sketch Bot. S.C. & Ga. 1: 36—37. 1817. "Var. *a.* grows near Milledgeville, between the Oconee and Oakmulgee rivers (Baldwin Co.), Georgia." According to Weatherby (1942) the type of this species, collected by Dr. Boykin, is preserved at Charleston. — *Micheliella verticillata* (Baldwin) Briquet in Engler & Prantt, Nat. Pflanzenfam. Teil IV. Abt. 3a: 325. 1897. — *Hypogon verticillatum* (Baldwin) House, N.Y. State Mus. Bull. 233-234: 67. 1922. (Not *Hypogon verticillatum* Rafinesque, which is a synonym of *C. serotina;* see under no. 2, below.)

Flowering April—June. GEORGIA. Floyd, Richmond, Walker. NORTH CAROLINA. Polk. TENNESSEE. McMinn.

2. C. SEROTINA Walter, Fl. Carol. p. 65. 1788. According to Fernald and Schubert (1948), there is a specimen in the Walter Herbarium which is the same as *C. punctata* Elliott. I do not consider this or any other specimen at the British Museum a holotype. The material preserved there was sent to Fraser by Walter. It may include isotypes or topotypes, or merely supplementary material, but it is not the primary Walter collection. Because of lack of labels and mixups among those preserved, we have no means of knowing precisely what the nature of the specimens is. In this case the type region plus the scanty description are in agreement with the evidence from the specimen, and I am willing to accept the latter as added justification for adopting Walter's name. — *C. scabriuscula* Aiton, Hort. Kew. (ed. 1) 1: 47. 1789. "East Florida. Mr. *John Bartram.*" The description and type locality are sufficient to establish the identity of this species. Why the name is not even mentioned in Small's floras is a mystery; it was accepted by Chapman and by Gray in the *Synoptical Flora,* though misunderstood by them. — *C. anisata* Sims, Bot. Mag. 30: t. 1213. 1809. Described from cultivated material. "Native of S.C." *C. serotina* Walter is cited as doubtful synonym. The plate, which must be taken as the type, is quite distinctive, and represents an extreme form with very short, wide calyx teeth which at first I thought separable from *C. serotina.* — *C. ovalis* Pursh, Fl. Am. Sept. 1: 21. 1813 ("1814"). "In South Carolina, Fraser." Referred to *C. canadensis* by Bentham, but the phrase "calycis dentibus brevissimis" excludes that species and quite definitely applies to this one. — *C. scabra* Pursh, l. c. p. 20. Illegitimate substitute name for *C. scabriuscula* Aiton and *C. praecox* Walter, both placed in synonymy without query. — *Hypogon anisatum* (Sims) Rafinesque, Fl. Ludov. p. 148. 1817. — *Collinsonia punctata* Elliott, Sketch Bot. S.C. & Ga. 1: 36. 1817. "In rich soils. Frequent." There is a phototype at the Gray Herbarium on which Mr. Weatherby has noted "Leaves almost tomentose is rather strong." — *C. verticillaris* Rafinesque, Fl. Ludov. p. 41. 1817. — *Hypogon verticillatum* Rafinesque, l.c. p. 142. This may have been merely a slip of the pen, but as published is an illegitimate substitute name for *Collinsonia*

verticillaris. Merrill *(Index Rafinesquianus* p. 206) mistakenly equates this with *Micheliella verticillata* (Baldwin) Briquet. — *Collinsonia canadensis* var. ? *puberula* Bentham in DC., Prodr. 12: 253. 1848. "In Louisiana (Drumm.!) in Alabama (Rugel!)."—*C. canadensis* var. *punctata* (Elliott) Gray, Syn. Fl. N.A. 2 pt. 1: 351. 1878. (By Fernald this name was extended to apply to pubescent-leaved forms of *C. canadensis.)* — *Diallosteira punctata* (Elliott) Rafinesque ex Jackson, Index Kewensis 1: 741. 1893. — *Pleuradenia scabra* ("Pers.") Rafinesque ex Jackson, l.c. 2: 562. 1894. (This properly goes back to *Collinsonia scabriuscula* Aiton; Persoon merely misspelled the name.) — *Hypogon verticillare* (Rafinesque) Nieuwland, Amer. Midl. Nat. 3: 178. 1914.

This is the only *Collinsonia* that I have seen in the field, and a merry indoor chase it has led me. My lone collection (no. 28,956) was made 9.8 miles northwest of Loxley in Baldwin County, Alabama, 26 October 1960. The plants were past flowering, but in a few withered corollas it was possible to find four well-developed filaments. After much ransacking of synonymy, I concluded that it was the long forgotten *C. verticillaris* Rafinesque. The real answer to the puzzle came with the loan from Florida State University. Godfrey & Kral 54288, from Wacissa Springs, Jefferson County, Florida, 20 October 1955, showed flowers in the same inflorescence with two and with four stamens. Once stamen-number was rejected as a taxonomic character, it became possible to delimit *Collonsonia serotina* more satisfactorily. It is a variable species, especially as to width of calyx teeth and density of leaf pubescence. Some North Carolina specimens proved difficult to determine, closely approaching *C. canadensis.* There may be introgressive hybridization in that state, but on the whole I think the variation in the two species is a matter of homologous mutations. The ranges of the two are almost entirely separate. The hairs in *C. serotina* are rather long and slender; in *C. canadensis* they are coarse and hispidulous, or short, or absent. The inflorescence in both species may have glandular-capitate hairs or sessile glands, so that the key character used by Small is quite worthless. One specimen of *C. serotina* from Decatur County, Georgia (just west of Jim Woodruff Dam, *Richard S. Mitchell 1319,* FSU) is notable in having a simple inflorescence and only 3 pairs of stem leaves, so that in aspect it suggests *C. verticillata.* The same specimen shows exceptionally broad though not short calyx teeth.

Flowering September—October. Except for a few puzzling collections from interior North Carolina, and one unmistakable one from De Kalb County, Georgia, this is a Coastal Plain species, from the Carolinas through northern Florida to southeastern Louisiana. ALABAMA. Baldwin, Lee. FLORIDA. Alachua, Clay, Columbia, Escambia, Gadsden, Holmes, Jackson, Jefferson, Leon. GEORGIA. Decatur, De Kalb, Meriwether. LOUISIANA. Washington. MISSISSIPPI. Forrest. NORTH CAROLINA. Richmond, Rockingham, Stanly. SOUTH CAROLINA. Beaufort, Lexington.

It is this species which William Bartram found in or near Baldwin County, Alabama, and described in his travels. Harper, following Mohr, identified it as *C. anisata*. Mohr states incorrectly (1903, p. 15) that Bartram named it *C. anisata*. Bartram did not give it a specific name, speaking of it merely as a *Collinsonia*.

3. C. CANADENSIS L., Sp. Pl., 1: 28. 1753. "*Habitat in* Virginiae, Canadae *sylvis*." There is no description, but reference is made to description and figure in the Hortus Cliffortianus, and to Colden. A Hortus Cliffortianus specimen in the British Museum was designated lectotype by Epling, Journ. Bot. 67: 6, 1929 (phototype in Gray Herbarium examined). — *C. canadensis* var. *cordata* and var. *ovata* Pursh, Fl. Am. Sept. 1: 20. 1813 ("1814"). — *C. angustifolia* Rafinesque, Med. Fl. 1: 114. 1828. "Kentucky, Ohio, &c." — The name *C. canadensis* var. *punctata* is used by Fernald for pubescent-leaved forms of this species, but on the basis of type is a synonym of *C. serotina*.

As already indicated under the preceding, this species varies greatly in pubescence. If varieties are recognized, there really should be more than two. On the basis of the material I have seen, I prefer to regard these as minor variations not worthy of nomenclatural recognition. I have seen specimens from as far north and west as Vermont, Ontario, Michigan, and Indiana; it is reported in literature from Quebec (Gleason), Wisconsin (Fernald), llinois (Jones & Fuller), Missouri (Palmer & Steyermark), and Arkansas (several manuals). Authenticated records for the South are summarized below; that for Arkansas, which I have not been able to verify, is discussed at the end. Except for an outlying station in northern Florida, it barely enters the Coastal Plain.

Flowering August—October. ALABAMA. (*S. B. Buckley*, without locality.) D.C. ("Near Great Falls, Maryland.") FLORIDA. Jackson. GEORGIA. Cass, Clay, Forsyth, Richmond. KENTUCKY. Bell, Estill, Lyon. MARYLAND. Frederick. NORTH CAROLINA. Alexander, Ashe, Avery, Buncombe, Burke, Caldwell, Cherokee, Clay, Forsyth, Gaston, Graham, Greenville, Harnett, Haywood, Henderson, Jackson, Lexington, Macon, Madison, McDowell, Mitchell, Randolph, Rowan, Stokes, Swain, Transylvania, Union, Watauga, Yadkin, Yancey. (Also Glade Gap, county not determined.) SOUTH CAROLINA. Abbeville, Edgefield, Greenville, Lancaster, McCormick, Pickens. TENNESSEE. Carroll, Grundy, Knox, Roane. VIRGINIA. Appomattox, Bedford, Botetourt, Clarke, Craig, Fairfax, Fauquier, Giles, Montgomery, Rockbridge, Smythe, Spotsylvania, Surry. WEST VIRGINIA. Cabell, Greenbrier, Hampshire, Pocahontas, Summers, Tucker.

In the Synoptical Flora, Gray reports *C. scabriuscula* as extending west to "E. Ark." He used that name, rather strangely, for *C. tuberosa*, which does extend northwest to Memphis, Tennessee, just across the Mississippi River from Arkansas (or did extend; it was collected there in 1853). Unfortunately there is no voucher for the Arkansas record at the Gray Herbarium. In later manuals only *C. canadensis* is credited to that state. I have seen no specimens to verify this either, although the occurrence of the species in several counties in the Missouri Ozarks makes it seem likely.

4. C. TUBEROSA Michaux, Fl. Bor.-Am. 1: 17. 1803. "In umbrosis humidisque sylvarum Carolinae." Phototype, GH. — As noted just above, Gray misapplied the name *C. scabriuscula* Aiton (properly a synonym of *C. serotina)* to this species. *C. praecox* Walter is possibly but by no means certainly the same (see remarks under doubtful or excluded names at end).

This is really much more distinct than may appear from the key. The seemingly inconclusive feature of leaf pubescence was inserted to help separate this from *C. serotina,* whose geographic range it shares in large part.

Flowering September. ALABAMA. Blount, Tuscaloosa. GEORGIA. Whitfield. LOUISIANA. East Feliciana, Orleans. MISSISSIPPI. Harrison. NORTH CAROLINA. Allamance, Chatham, Guilford, Henderson, Richmond. (Also Blowing Rock, county not determined.) SOUTH CAROLINA. Berkeley, Calhoun, Chester, Dorchester, Orangeburg, Sumter. TENNESSEE. Shelby.

DOUBTFUL OR EXCLUDED NAMES

The following list does not include the very numerous misapplications of names, of which the two most noteworthy have been mentioned in the text (*C. canadensis* var. *punctata* for forms of *C. canadensis* instead of *C. serotina; C. scabriuscula* for *C. tuberosa* instead of *C. serotina).* The precise disposition of most of these names could probably be determined. Since in all cases but one there are older valid names for the species to which they might possibly belong, their identity is of academic interest only. I prefer to devote my inadequate time to matters that really require it.

In addition to the following, there are five *nomina nuda* listed in Merrill's Index Rafinesquianus *(C. bicolor, C. cordata, C. grandiflora, C. heterophyla, C. longiflora)* which need not be considered. From the type localities, the first four are to be referred to *C. canadensis.*

C. ANISATA var. MAJOR Bentham in DC., Prodr. 12: 254. 1848. "In Georgia (Nutt.!) et Florida (herb. Hook.!)." The Georgia specimen may have been *C. serotina,* the Florida one almost certainly was.

C. CUNEATA Wenderoth, Schrift. Ges. Bef. Gesammt. Naturw. Marb. 2: 242. 1831. Cited by Bentham as doubtful synonyn of *C. canadensis.* I have not seen the original description. All recognized species of the genus have older names.

C. DECUSSATA Moench, Meth. p. 379. 1794. Said by Bentham and Gray to be a synonym of *C. canadensis.*

C. HETEROPHYLLA Graham. Merrill (Index Raf. p. 206) states that *C. bicolor* Rafinesque ex M'Murtrie is probably this. I can find no other mention of such a binomial.

C. PRAECOX Walter, Fl. Carol. p. 65. 1788. This may be *C. tuberosa,* but it also may be a form of *C. serotina.* No specimen is preserved, and the brief description is inconclusive. Because only *C. tuberosa* and *C. serotina* occur in Walter's home area, it is extremely tempting to equate *C. praecox* with *C. tuberosa.* The comment that it has flowers both terminal and lateral would certainly apply to normal forms of *C. tuberosa,* but *C. serotina* may rarely have lateral flowering branches also. As Gray noted, *C. tuberosa* is not early-flowering. In the interest of nomenclatural stability, I believe that *C. praecox* Walter should not displace *C. tuberosa.*

C. PURPUREA Oemler ex Elliott, Sketch Bot. S.C. & Ga. 1: 35. 1817. Appears only as a synonym of *C. scabra* (i.e., *C. serotina).*

C. SCABRA "Persoon," Syn. Pl. 1: 29, 1805, and C. SCABRA "Elliott," Sketch Bot. S.C. & Ga. 1: 35, 1817. Both authors credit the name to Aiton, so that these are simple errors for *C. scabriuscula* and have no nomenclatural standing. But *C. scabra* Pursh was apparently a deliberate substitute name (see under *C. serotina).*

C. URTICIFOLIA Salisbury, Prodr. p. 75. 1796. Listed in Index Kewensis as a synonym of *C. canadensis.*

C. VERTICILLATA var. PURPURASCENS Elliott, Sketch Bot. S.C. & Ga. 1: 37. 1817. "Near Crooked river bridge, Camden county, Georgia." The species occurs in the interior. The unusual specimen of *C. serotina* from Decatur County, Georgia, noted in the text under that species, makes me wonder if Elliott did not have something like it (with simple inflorescence and a few leaves, stimulating *C. verticillata).* Camden County is on the coast in extreme southeastern Georgia, where *C. serotina* rather than *C. verticillata* is to be expected. According to Weatherby, no specimen is preserved in the Elliott Herbarium in Charleston.

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SYNOPSIS OF CONRADINA (LABIATAE)

LLOYD H. SHINNERS

The account of the small Southeastern genus *Conradina* in Small's *Manual of the Southeastern Flora* illustrates several of that author's shortcomings. Four species are keyed and named; an anomalous plant is briefly described in addition. Of the four named species, *C. puberula* Small is merely a form of *C. canescens,* in fact the same form that Gray considered typical of the latter; the types came from nearly the same locality. *C. montana,* described as new, had been named earlier in the same year as *C. verticillata* Jennison. Small knew almost nine months before publishing that the other name was already in press (letter from Jennison to Small, dated 10 March 1933, accompanied by galley proofs, filed as specimen, NY), but did not bother to correct his text. The anomalous plant he mentions is in fact a very distinct species, of which he saw only abnormal material. It was his regular custom to prepare his floras solely on the basis of what he had at New York, ignoring important collections at Cambridge, Washington, and St. Louis. Recently activity in building up herbarium collections in the Southern States underscores the limitations of the older centers. Of the two new species of *Conradina* described in this synopsis, New York has no material at all of one (of which the Gray Herbarium has only a sterile specimen), and no normal flowering material of the other (which is represented at New York and the Gray Herbarium only by duplicates of the same collection).

The genus *Conradina* comprises small shrubs with entire leaves which have dense, appressed or matted pubescence on the lower surface. In other woody Labiatae of the Southeast which without flowers might be mistaken for *Conradina,* the leaves are glabrous or have spreading hairs. The chief generic peculiarity is in the corolla tube, which is abruptly bent up above the middle, rather than straight or gradually curved. What benefit this may be to the plant is difficult to imagine. Add to this the peculiarity that each of the species occupies a geographic area entirely separate from all the others, one of them quite remote from the rest *(C. verticillata* on the Interior Low Plateau, the others on the outer Coastal Plain), and we have a rich subject for useless speculation that the phylogenists have so far overlooked.

In preparing this synopsis I have had the use of collections at Florida State University, the University of Florida, the Gray Herbarium, the New York Botanical Garden, the University of North Carolina, and Southern Methodist University. My thanks are extended to the various curators for their help.

SIDA 1 (2): 84—88. 1962.

CONRADINA Gray, Proc. Amer. Acad. 8: 294—295. 1870 (Dec. 31). *C. canescens* (T. & G.) Gray, the only original species, is automatically the type.

KEY TO THE SPECIES

1a. Calyx tube glabrous or very minutely and inconspicuously puberscent outside . . . . . 1. *C. glabra*

1b. Calyx tube densely short-pubescent or both pubescent and pilose outside

  2a. Calyx tube densely short-pubescent and also pilose with moderately long (0.3—0.8 mm.) gland-tipped hairs (the teeth with longer hispid hairs); stem or main branches partly decumbent and rooting; plants of Kentucky and Tennessee, flowering May—early June . . . . . 2. *C. verticillata*

  2b. Calyx tube densely short-pubescent, often also pilose with long (mostly 1—2 mm.) glandless hairs like those on the teeth, rarely also short-pilose with gland-tipped hairs less than half as long as the glandless ones; stems erect or short-decumbent, not freely rooting; plants of Florida and coastal Alabama, flowering all year

    3a. Lower lip of corolla 4—9 mm. long; leaf blades with midrib moderately to very densely pubescent beneath, the inrolled margins usually concealing all or nearly all the surface of the blade; peduncles absent or very short, each axil with 1—6 flowers

      4a. Larger leaves on well-developed flowering branches 7—20 mm. long, mostly equalling or exceeding the internodes; middle lobe of lower lip of corolla 3.2—5.5 mm. long; flowers 1—3 per axil; coastal Alabama and northwestern Florida 3. *C. canescens*

      4b. Larger leaves on well-developed flowering branches 6.0—8.2 mm. long, mostly shorter than their internodes; middle lobe of lower lip of corolla 2—4 mm. long; flowers 1—6 per axil; interior peninsula Florida (Highlands Co.) . . . . 4. *C. brevifolia*

    3b. Lower lip of corolla 9—16 mm. long; leaf blades with midrib glabrous to moderately densely pubescent beneath, contrasting with the very densely pubescent surface of the blade (latter usually only partly concealed by the inrolled margin); peduncles evident, with 1—12 flowers each . . . . . 5. *C. grandiflora*

1. C. **glabra** Shinners, sp. nov. Frutex parva ramosa maxima parte glabra. Folia sessilia vel subsessilia subtus cana ramulorum juniorum lineari-oblanceolata 18—23 mm. long 1.6—3.0 mm. lata subacuta, ramulorum veterum minora sublinearia obtusa. Pedunculi brevissimi pubescentes 1—3-flori. Pedicelli pubescentes calycis longitudinem 1/3—2/3 attingentes. Calyx 6.2—7.0 mm. longus, tube glabra vel minutissime puberula, dentes ciliati, faux hispido-pilosa. Corolla extus pilosula 12—15 mm. longa. HOLOTYPE (with normal stamens): steep, sandy,

wooded bluff 1½ miles west of junction of Rt. 12 and road to Torreya State Park, Liberty Co., Florida, *F. H. Sargent 6219,* 29 April 1952 (SMU). PARATYPES (some with aborted anthers, as noted) (all from Florida): Gadsden or Liberty Co.: between Bristol and Greensboro, *E. West & H. H. Hume,* 28 March 1936 (FLAS, 2 sheets with normal anthers, 1 with aborted anthers, the filament tips enlarged, malformed). Liberty Co.: 10 miles southwest of Bristol, *E. J. Palmer 38556,* 11 April 1931 (GH, NY, two sheets each, all showing aborted anthers, the filament tips irregularly expanded and flattened). Common, along outer margin of bayhead, 7 miles south of Wilma, *A. A. Will,* 1 April 1961 (FLAS, anthers small or absent). Santa Rosa Co.: dry sand, edge of Swamp, Rt. 90, at roadside park, west of Milton, *S. C. Hood 1868,* 8 April 1949 (FLAS). County not known: one twig at bottom center of mixed sheet with fragmentary specimens of *C. canescens,* from Herb. John A. Lowell ("Transferred from the Boston Society of Natural History to the Gray Herbarium . . . Oct. 2, 1941"), data uncertain (there are several labels plus pencilled notes, but it could not be determined which are to be associated with this particular fragment) (GH).

Much branched shrub under 1 m. tall, largely glabrous. Leaves subsessile or sessile, closely canescent beneath, those of young shoots linear-oblanceolate, 18—23 mm. long, 1.6—3.0 mm. wide, subacute, with narrowly revolute margins; those on older growth almost linear, 7—14 mm. long, obtuse, with strongly revolute margins. Peduncles very short, minutely pubescent, 1—3 flowered. Pedicels about 1/3—2/3 as long as the calyx, minutely pubescent. Calyx 6.2—7.0 mm. long, resin-dotted, glabrous or very minutely and inconspicuously pubescent except for the hispid-pilose throat and margins of the teeth. Corolla pilosulous outside, 12—15 mm. long (as pressed), the lower lip 4—7 mm. long; color unknown but apparently very pale lavender or white.

This is the anomalous plant briefly noted by Small, but not named. Because the Palmer specimens (the only ones seen by Small) do not show normal anthers, they are not suitable for designation as holotype and isotypes.

2. C. VERTICILLATA Jennison, Journ. Elisha Mitchell Sci. Soc. 48: 268—269. 1933 (April). HOLOTYPE: on sandy beach, north bank of the Clearfolk River near Rugby, Fentress Co., Tennessee, *Jennison & Sharp 3-432,* 16 May 1931 (TENN., presumably destroyed in the 1934 fire; apparent isotype, lacking number but with other label data the same, GH). *C. montana* Small, Man. S.E. Fl. p. 1167. 1933 (after Nov. 30). HOLOTYPE: near Rugby, Tennessee (NY, not seen; sterile topotype, *Mrs. Ferriss (Herb. Albert Ruth),* July, 1903, NY). Corolla said to be lavender in the original description, pink on the only specimen seen bearing color data *(Braun s.n.,* cited below). The following collections have been examined.

KENTUCKY. McCreary Co.: river bank, South Fork Cumberland River, *E. Lucy Braun s.n.,* 18 June 1935 (GH). (Also sterile specimens, same locality and collector, GH, NY.) TENNESSEE. Fentress Co.: Rugby, sandy soil, *Albert Ruth,* 27 June 1894 (sterile) (GH). About 1 mile north of Rugby, in sand on beach along north bank of Clear Fork River, *Jennison 33-124,* 28 May 1933 (NY; apparent duplicate but lacking number, GH). Sandy beach along Clear Fork River near Rugby, *Jennison 1111,* 5 May 1934 (NY, SMU). Morgan Co.: in sand banks of Clear Fork of Cumberland River, Rugby, *Jennison s.n.,* 4 June 1931 (GH). Sandy bars along stream and gravelly slopes, Rugby, *H. K. Svenson 4085,* 19 Aug. 1930 (sterile) (GH). Scott Co.: mouth of No Business Creek on South Fork River, rocky and sandy soil of Big Island, *A. J. Sharp, R. E. Shanks, E. Clebsch 3835,* 20 June 1947 (flowers past) (NY). Also CULTIVATED, TENNESSEE, Knox Co.: Sanford Arboretum, Knoxville, *A. F. Sanford,* 10 May 1935 (GH).

3. C. CANESCENS (T. & G.) Gray, Proc. Amer. Acad. 8: 295. 1870. *Calamintha canescens* T. & G. ex Bentham in DC., Prodr. 12: 229. 1848. "In Florida ad Tampa Bay (h. Gray!) ad Apalachicola (Drumm.!)." For reasons given below, the cited specimens have been disregarded and a lectotype designated in the Gray Herbarium, on a mixed sheet, at left, with blue label "Calamintha canescens Fla." on which has been added "T. & Gr." in Gray's hand-writing, and above which "A. W. Chapman" has been written on the sheet (at right is a smaller strip of paper with specimen from Herb. C. W. Short, pasted on the larger sheet). — *C. puberula* Small, Bull. Torr. Bot. Club 25: 469—470. 1898. "Florida: Apalachicola, old specimen, collector uncertain; later specimen, *A. H. Curtiss,* no. 2014. Also two specimens collected by Dr. Chapman." *(Curtiss 2014* and one Chapman specimen from NY examined.)

Corolla light lavender or lavender-blue, or white with colored lower lip; throat and lower lip with dark dots. In flower all year, but most freely in late winter (February). Common in sand along the coast from Mobile and Baldwin counties, Alabama, east to Franklin County, Florida; rarely slightly inland (in Okaloosa and Walton counties, Florida). There is a decidedly unscientific local legend that this is the true rosemary of Europe *(Rosmarinus officinalis),* brought to Florida by early British settlers and naturalized (clipping from St. Andrews Bay News, 8 April 1924, filled with specimen, NY; see also Hepburn, 1956, p. 7, under Panama City).

Neither this species nor *C. grandiflora* (which for long was not separated from it) occurs about or near Tampa Bay, and there is no material in the Gray Herbarium so designated. I suspect some mixup or error of labelling, and therefore consider the first collection cited by Bentham unsuitable for lectotype. It is uncertain whether Torrey and Gray (particularly Gray, who usually handled the Sympetalae) saw the Drummond material before naming the species. There is some indication that they did not until later. Several labels in the Gray Herbarium read "*Keithia* sp. Bentham," suggesting that Torrey and Gray had provided the specific epithet first, and that Bentham's acceptance of it came later. Hence Bentham's second collection is passed over also. This creates no problem, fortunately, for *Drummond 23* (GH) belongs to the very same form and is from about the same locality as the designated lectotype. I have selected from the material at the Gray Herbarium the sample which from the nature of the label appears to be oldest, and which conforms to what Gray in his 1870 description indicated as the typical form, the one with calyx tube short-pubescent only ("calyce . . . dentibus (rarius tubo) pilis patentissimis hirsutis"). This is identical with what Small later described as the alleged species *C. puberula.* The two are merely genetic forms of one, and are not geographically segregated. My no. 29,264 from 10 miles south of Foley, Baldwin Co., Alabama, 7 April 1961 (SMU), has two branches from different plants, one showing calyx short-pubescent only, the other both short-pubescent and pilose.

4. C. **brevifolia** Shinners, sp. nov. C. canescenti persimilis, foliis brevioribus plerumque remotis cum fasciculis axillaribus quasi verticillatis; floribus ad 6 in quaque axilla, florum labio inferiore minus profunde diviso (loba media 2—4 mm. longa). HOLOTYPE: scrub, southwest of Avon Park, Highlands Co., Florida, *Ray Garrett 41,* 16 Feb. 1948 (FLAS, acc. no. 50231). PARATYPES (also Highlands Co.): Clay pit, Avon Park, *J. B. McFarlin 10135,* 6 Feb. 1935 (FLAS, acc. no. 49469). In very sandy soil along road 567 about 7 miles east of Avon Park, *Chas. C. Dean 64200,* 13 Feb. 1946 (NCU). — In additiont to these, a sterile specimen from the same county at first thought to be *C. grandiflora* doubtless is to be referred to *C. brevifolia* instead (the loan had been returned before I saw flowering material of the new species and the specimen has not been reexamined): in the scrub north of the Botanic Gardens, *McFarlin 10349,* 6 April 1936 (GH).

5. C. GRANDIFLORA Small, Bull. Torr. Bot. Club 51: 386—387. 1924. "The type specimens were collected by the writer on the ancient sand-dunes near Sebastian, Florida, April, 1921." (Topotype specimens collected by Small et al., Indian River Co., FLAS, GH, NY, NCU.)

Corolla color (noted on only a few specimens) lavender, pinkish, or pink-purple. Confined to eastern peninsula Florida, from Volusia County south to Dade County.

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SYNOPSIS OF DICERANDRA (LABIATAE)

LLOYD H. SHINNERS

Like *Conradina, Dicerandra* is a small genus confined to the Southeastern United States. Long known to comprise three annual species, it must now be redefined to include a woody-based perennial. The primary generic character is the presence of a spur-like or horn-like appendage on the anther sacs. All the known species are also characterized by being largely glabrous and having the calyx white or roseate at the mouth. All are typically fall-blooming (but see special notes on numbers 1 and 3). The summit of the taproot and base of stem are often swollen, presumably the effect of some parasitic organism, but the cause is not known.

Grateful acknowledgment is made for the use of collections from Florida State University, the University of Florida, the Gray Herbarium, the New York Botanical Garden (one sheet only, received unidentified with loan of *Conradina)*, the University of North Carolina, and Southern Methodist University.

DICERANDRA Bentham, Bot. Reg. 15: t.1300. 1830. (Not seen; taken from Bentham in DC., Prodr. 12: 242. 1848.) New name for *Ceranthera* Elliott, Sketch Bot. S.C. & Ga. 2: 1822. (Not *Ceranthera* Beauvois, 1807, nor Rafinesque, 1818.) Elliott's only species, *C. linearifolia,* is automatically the type.

KEY TO THE SPECIES

1a. Stamens prominently exserted; lower lip of calyx 1.5—3.0 mm. long, divided ¼—½ into two wide-based, acuminate teeth
  2a. Perennial, woody below, with numerous erect to ascending branches from near base; corolla white or yellowish white with purple dots.................................... 1. *D. frutescens*
  2b. Annual, unbranched or with few spreading to ascending branches well above base; corolla pale to deep lavender or reddish purple with darker dots
    3a. Peduncles (except at uppermost nodes) evident, usually well-developed, few-flowered, the inflorescence rather loose; anther horns acuminate.............................. 2. *D. linearifolia*
    3b. Peduncles absent or very short, the flowers numerous and crowded in the axils of leaves or leafy bracts; anther horns obtuse or barely acute........................ 3. *D. densiflora*
1b. Stamens included; lower lip of calyx 2.5—4.0 mm. long, divided nearly to base into two narrow, long-acuminate teeth
4. *D. odoratissima*

1. D. **frutescens** Shinners, sp. nov. Suffrutex parvula ad 50 cm. alta glabra nisi ad nodos superiores, pedunculos, pedicellos, calyces (basin

versus solum) corollas (extus solum). Folia sessilia vel subsessilia, oblongo-linearia (in novellis linearia), integerrima, obtusa, subcoriacea, punctata, inferiora 12—17 mm. longa 1.8—2.6 mm. lata, superiora minora. Pedunculi breves vel subnulli bracteati uniflori. Pedicelli dimidium calycis aequantes. Calyx subtubulosus 13-nervosus 7.5—8.5 mm. longus limbo albido. Corolla extus pilosula alba vel luteola labio inferiore rubro-punctato; tuba apicem versus reflexa modo generis *Conradinae.* Stamina exserta; antherae rubro-purpureae valde aristatae. Stylus exsertus pilosulus bifidus. HOLOTYPE: sandy scrub, 20 miles south of Sebring, along Rt. 27, Highlands Co., Florida, *F. H. Sargent 6600,* 28 August 1953 (SMU). "Habitat: sandy scrub." PARATYPES (all from Highlands Co., Florida): Lake Placid, *L. J. Brass 15604,* 9 September 1945 (GH). "Gregarious locally in sandscrub; aromatic perennial about 50 cm. high; calyx lobes white; corolla white or yellow, purple-spotted." In scrub near Lake Placid, *J. B. McFarlin 10559,* 7 October 1936 (FLAS, GH). Route 8-A, Hicoria, *Brass 14646,* 16 February 1945 (half-dead stems with new sprouts, both leafy and flowering) (GH). "Very abundant on roadsides in sandscrub; bushy, woody herb to 50 cm.; aromatic; flowers white, prominently marked with purple." Sandhills near Lake Stearns, *John K. Small & Paul Matthaus 11613,* 8 January 1925 (long past flowering) (NY). PARATYPES from Sumter Co., Florida: sandy scrub, 5 miles west of Wildwood, *E. West,* 22 September 1938 (FLAS). Dry sandy road bank 7 miles west of Wildwood, *West & Arnold,* 8 November 1946 (in fruit) (FLAS).

The Small & Matthaus collection had been labelled *Dicerandra,* but later filed with *Conradina,* and was received in the loan of material of that genus from New York. The glabrous leaves made *Conradina* seem unlikely, and in the course of working over *Dicerandra,* an anomalous specimen received as *Ceranthera linearifolia* (now the holotype of the new species) revealed its true identity. The long-exserted stamens with conspicuously horned anthers, the white-lipped calyx, and the glabrous leaves are all characteristic of *Dicerandra.* The shrubby habit and the bent corolla-tube suggest *Conradina,* but hardly call for a merger of the two genera. *D. frutescens* adds still another to the many restricted endemics of the Florida Lake Region.

2. D. LINEARIFOLIA (Elliott) Bentham, Bot. Reg. 15: t. 1300. 1830. *Ceranthera linearifolia* Elliott, Sketch Bot. S.C. & Ga. 2: 94. 1822. "Grows abundantly in the high pine barren ridges between the Flint and Chatahouchie rivers" (in extreme southwestern Georgia, where it is reported as "frequent" by Thorne, 1954). "Flowers September and October." No type is preserved, according to Weatherby (1942). *D. linearis* Bentham, Lab. Gen. et Sp. p. 413. 1832—1836. (Not seen. Apparently only a slip of the pen; Bentham himself gives this as synonym of *D. linearifolia* in DC., Prodr. 12: 243 (1848.)

This is the most widespread and most frequently collected member of the genus. The rather outlying record cited below from Palm Beach

Co., Florida, is based on an A. H. Curtiss collection (without number) dated 20 May 1895 (GH). I suspect an error in labelling; both locality and date are questionable. Coastal Alabama through northern Florida to southern Georgia. Specimens seen from the following states and counties. ALABAMA. Baldwin. FLORIDA. Alachua, Duval, Escambia, Gadsden, Holmes, Jackson, Leon, Liberty, Madison, Okaloosa, Palm Beach, Santa Rosa, Taylor, Wakulla, Walton, Washington. GEORGIA. Baker, Berrien, Jenkins, Taylor.

3. D. DENSIFLORA Bentham in DC., Prodr. 12: 243. 1848. "In Florida orientali (h. Torr.!)" (specimen not seen). *Ceranthera densiflora* (Bentham) Gray, Syn. Fl. N.A. 2 pt. 1: 365. 1878. Northern peninsular Florida; doubtfully South Carolina (see remarks below), and said by Small (1933) to extend into Georgia. FLORIDA. Alachua, Columbia, Dixie, Gilchrist, Lafayette, Levy, Suwanee, Volusia, SOUTH CAROLINA. Locality not given, *Curtis*, "ex Herb. H. P. Sartwell" (GH). Possibly an error in labelling. For the Jasper County record of Ahles et al., see under next species.

4. D. ODORATISSIMA Harper, Bull. Torr. Bot. Club 28: 479. 1901. TYPE: dry sand-hills near Seventeen-Mile Creek, Coffee Co., Georgia, *Roland M. Harper 695* (isotype, GH). Additional specimens seen from Berrien Co., Georgia, and Jasper Co., South Carolina. The latter were reported as *D. densiflora* by Ahles, Bell and Radford (1958); they differ from the others in having calyx roseate at the mouth instead of white. The corolla in this species is white.

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VEGETATIVE KEY TO WOODY LABIATAE OF THE SOUTHEASTERN COASTAL PLAIN

LLOYD H. SHINNERS

Conradina is distinguished technically by the bent corolla tube, *Dicerandra* by the appendaged anthers, *Trichostema* by the abbreviated upper corolla lip. Without flowers it is hardly possible to key them. In the course of working up *Conradina, Dicerandra,* and *Calamintha,* a number of sterile or fruiting specimens were encountered, most often guessed to be *Conradina.* Actually all the woody species can be readily determined by vegetative characters or a combination of vegetative characters and geography, as shown in the following key.

1a. Lower surface of leaf blades densely gray-pubescent with appressed or matted (very rarely loose or somewhat spreading) hairs (midrib glabrous or glabrate in some species, remainder of lower surface often partly or wholly concealed by inrolled margins)

  2a. Midrib densely gray-pubescent beneath

    3a. Plants of coastal Alabama and northwestern Florida *Conradina canescens*

    3b. Plants of interior peninsular Florida...... *Conradina brevifolia*

  2b. Midrib glabrous to moderately densely pubescent beneath, contrasting with the very densely pubescent surface of the blade

    4a. Plants of northwestern Florida............... *Conradina glabra*

    4b. Plants of eastern peninsular Florida...... *Conradina grandiflora*

1b. Lower surface of leaf blades glabrous or finely pubescent with erect or spreading hairs or sparingly hispid-pilose

  5a. Upper surface of leaf blades sparself to moderately densely hispid with rather long hairs from swollen bases (with or without very short hairs as well)........................... *Piloblephis rigida*

  5b. Upper surface of leaf blades glabrous or minutely pubescent

    6a. Stem and branches glabrous except at nodes *Dicerandra frutescens*

    6b. Stem (at least younger parts) and branches densely and minutely pubescent

      7a. Hairs curled or bent upward or downward (sometimes short, straight, glandular hairs also present)

        8a. Hairs stiff, straight, very short; leaf blades obtuse to rounded or slightly indented at apex, the larger on petioles less than 2 mm. long; central and southern peninsular Florida .... *Trichostema suffrutescens*

        8b. Hairs loosely curled or wavy; leaf blades obtuse to subacute,

SIDA 1 (2): 92—93. 1962.

the larger on petioles up to 10 mm. long, northern Florida to southeastern Louisiana and South Carolina *Calamintha georgiana*

7b. Hairs spreading at right angles, straight

9a. Leaf blades widest about at middle (linear to oblong-lanceolate) .... *Calamintha Ashei*

9b. Leaf blades widest above middle (oblong-oblanceolate to obovate)

10a. Internodes of twigs uniformly pubescent with very short hairs; leaves all entire .... *Calamintha coccinea*

10b. Internodes of twigs with mixed pubescence: densely covered with very short glandular hairs (usually of uneven lengths), sparsely pilose with long glandless hairs, at least near nodes; larger leaves toothed above middle *Calamintha dentata*

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——————. 1962c. Synopsis of *Dicerandra* (Labiatae). Sida 1: 89-91.

MICROMERIA BROWNEI AND ITS ALLIES (LABIATAE)

LLOYD H. SHINNERS

In 1903, Small recognized two species of *Micromeria* in the Southern United States: *M. pilosiuscula* in Texas (and Mexico) and *M. Brownei* in Florida (and the West Indies). In 1933, he recognized only one for the continental United States, the Florida plants being placed with the Texas ones under *M. pilosiuscula.* In attempting to evaluate Small's conclusions, I found that some West Indian material (from the Bahamas and Hispaniola) is indeed very distinct from *pilosiuscula,* but the true *M. Brownei* (from Jamaica) does not differ significantly except in average size and geography. Some future monographer may prefer to establish a hierarchy of subspecies and varieties to accommodate all of these under one species name. I prefer to recognize separate, though admittedly closely related, species, one of them with three varieties. My immediate purpose has been merely to settle the nomenclature of the plant of the United States. As an interesting sidelight, it is possible to point out that in Florida it represents not a primarily West Indian element (it does not occur in the southern part of the state, and the plants of the Bahamas and Cuba are not the same), but a Texano-Mexican one.

All members of the group are small, commonly mat-forming weeds of damp places, with lavender or partly white corolla. This brief account is based on collections at Florida State University, the University of Florida, the Gray Herbarium (U.S. and West Indian only), the New York Botanical Garden, and Southern Methodist University, to whose several curators grateful acknowledgement is made.

KEY TO SPECIES AND VARIETIES

1a. Shortest calyx teeth 1/5—1/6 as long as entire calyx; margins of calyx teeth either glabrous or hispid-ciliate; larger leaf blades 5—20 mm. wide; plants of Cuba, Jamaica, Guatemala, Mexico, and the United States
  2a. Margins of calyx teeth glabrous or rarely (one Jamaican collection) inconspicuously ciliate with hairs about 0.1 mm. long
    3a. Plants of Jamaica; larger leaf blades 5—12 mm. wide, glabrous; pedicels 3—7 mm. long. . . . . 1a. *M. Brownei* var. *Brownei*
    3b. Plants of continental North America; larger leaf blades up to 20 mm. wide, glabrous or pubescent; pedicels 3—15 mm. long 1b. *M. Brownei* var. *pilosiuscula*
  2b. Margins of calyx teeth hispid-ciliate with hairs 0.3—0.6 mm. long; plants of Cuba (rare) and Yucatan. . . . 1c. *M. Brownei* var. *ludens*

1b. Shortest calyx teeth 1/3 as long as entire calyx; margins of calyx teeth prominently hispid-ciliate; larger leaf blades 4—6 (rarely — 11) mm. wide; plants of the Bahamas and Hispaniola

4a. Pedicels (except uppermost ones) 1.0—3.5 mm. long, shorter than the adjacent petioles; marginal hairs of calyx teeth spreading; Bahamas .... 2. *M. bahamensis*

4b. Pedicels 3.0—6.5 mm. long, longer than the adjacent petioles; marginal hairs of calyx teeth incurved-ascending, subappressed; Hispaniola .... 3. *M. domingensis*

1. M. BROWNEI (Swartz) Bentham, Lab. Gen. et Sp. p. 372. 1832—1836. (Not seen; quoted in DC., Prodr. 12; 223. 1848.) *Thymus Brownei* Swartz, Prodr. p. 89. 1788. Type locality: Jamaica. *Satureia Brownei* (Swartz) Briquet in Engler & Prantl, Nat. Pflanzenfam. Teil IV. Abt. 3a: 300. 1897. (As *"S. Brownii,"* but this was not the spelling adopted by Swartz.)

1a. M. BROWNEI var BROWNEI. Confined to Jamaica, at various altitudes, from 200 feet up to 2200 feet; 13 sheets examined (FLAS, GH, NY). All have glabrous calyx teeth except the following, on which these are more or less short-hispid-ciliate. Bluefields and vicinity; on wall, Bluefields Mountain, 700 m. alt., *N. L. Britton & Arthur Hollick 1994,* 6—7 March 1908 (NY). Flowering collections dated January, February, March, July, August, September.

1b. M. BROWNEI var. PILOSIUSCULA Gray, Syn. Fl. N.A. 2 pt. 1: 359. 1878. Type locality: near San Antonio, Bexar Co., Texas. *Satureia Brownei* var. *pilosiuscula* (Gray) Briquet in Engler & Prantl, Nat. Pflanzenfam. Teil IV. Abt. 3a: 300. 1897. *Micromeria pilosiuscula* (Gray) Small, Fl. S.E. U.S. pp. 1042, 1337. 1903. *Thymus xalapensis* H.B.K., Nov. Gen. (4to ed.) 2: 316—317. 1818. "In declivitate montium Mexicanorum soli oriente obversorum inter villam Pileta et urbem Xalapa, alt. 760 hex." (Vera Cruz, Mexico). *Micromeria xalapensis* (H.B.K.) Bentham, Lab. Gen. et Sp. p. 372. 1832—1836. (Not seen; quoted in DC., Prodr. 12: 223. 1848.)

Very variable as to stature, dwarf plants with glabrous leaves being hardly distinguishable from var. *Brownei* except by geography. Pubescent-leaved forms (intergrading with glabrous ones) occur in Texas and Mexico. At the northeastern extremity of its range (Florida, Georgia, Louisiana) only the glabrous form is found. This is evidently the end-product of selective migration from the west and southwest. Since var. *pilosiuscula* does not occur in the West Indies, and since it is absent from the southern part of Florida (where West Indian plants would normally be expected), it must be regarded as an unusual Texano-Mexican element in the flora of Florida. The general distribution of this variety, on the basis of specimens examined, is summarized by country and department or state, and for the United States by county. GUATEMALA. Alta Verapaz, Huehuetenango, Quiche. MEXICO. Jalisco, Nuevo Leon, San Luis Potosi, Sinaloa, Tabasco, Tamaulipas, Vera Cruz.

UNITED STATES. FLORIDA. Alachua, Bradford, Brevard, Clay, Flagler, Gadsden, Gilchrist, Hillsborough, Jackson, Lake, Levy, Orange, Osceola, St. Johns, Seminole, Volusia. GEORGIA. Decatur. LOUISIANA. St. Bernard. TEXAS. Aransas, Bexar, Brazoria, Cameron, Colorado. In flower in the United States from February to September, farther south apparently nearly all year.

1c. M. BROWNEI var. **ludens** Shinners, var. nov. A var. *Brownei* recedit calycis dentibus hispido-ciliatis. HOLOTYPE: wayside, near Sabicu, Rangel, Sierra del Rosario, Pinar del Rio Province, Cuba, *Bro. Alain 6137,* January, 1957 (NY). PARATYPES (all NY): Cultivated, Est. Agronomica, Santiago de Vegas, Habana, Cuba, *J. Acuna 19539,* 5 Feb. 1955. Near Merida, Yucatan, Mexico, *Porfirio Valdez 35,* in 1896. Locality illegible ("Coym. . . . Is."?), Yucatan, Mexico, *Gaumer 109,* ex Herb. Gray. The disjunct distribution between Cuba and Mexico suggests that of *Egletes viscosa,* especially f. *bipinnatifida* (cf. Shinners, 1949).

2. M. **bahamensis** Shinners, sp. nov. *M. Brownei* affinis. Caulis ad vel infra nodos pilosula. Folia perparva, petiolis puberulis, laminis glabris vel (imprimis facie superiore) parce hispidulis varie subintegris vel argute denticulatis, majoribus 4—6 mm. latis (rarissime 11 mm.). Pedicelli 1.0—3.5 mm. longi, plerumque petiolis breviores. Calyx 3.5—4.1 mm. longus profunde lobatus (dentibus minoribus calycis tertiam partem aequantibus), dentes longe patenter hispido-ciliati. Corolla extus pilosula. HOLOTYPE: Berry Islands, Lignum Vitae Cay, Bahama Islands, *N. L. Britton & C. F. Millspaugh 2302,* 2 February 1905 (GH; isotype, NY). A total of nineteen sheets has been examined (GH, NY). The species is apparently common and widespread in the Bahamas, in flower December to May and in August. With a single exception the specimens are remarkably uniform, with very small leaves. The exception, with blades up to 11 mm. wide, is *Britton & Millspaugh 3114,* sink holes near Georgetown, Great Exuma, 22—28 February 1905 (NY).

3. M. **domingensis** Shinners, sp. nov. Praecedenti persimilis, differt pedicellis 3.0—6.5 mm. longis petiolos excedentibus, calycis dentibus subappresse hispido-ciliatis. HOLOTYPE: Civ. Santo Domingo, Cordillera Central, prov. de Azua, San Juan, El Varanjo, edge of brook, c. 800 m., Hispaniola, *E. L. Ekman (Mus. Bot.* Stockholm Pl. Ind. Occ. N:O H.13505), 8 September 1929 (GH).PARATYPE: Santo Domingo, Cordillera Central, prov. de la Vega, Constanza, edge of thickets in swamps, ca. 1200 m. *E. L. Ekman (Mus. Bot. Stockholm Pl. Ind. Occ. N:O H. 13915),* 25 October 1929 (NY). These are the only specimens seen. The altitude and flowering dates suggest physiological differences between this and *M. bahamensis.*

NAME OF DOUBTFUL APPLICATION

Micromeria stolonifera Bentham, Lab. Gen. et Sp. p. 371. 1832—1836. (Not seen; quoted in DC., Prodr. 12: 223. 1848.) Type locality: Mexico

("Nova Hispania"), Mocino et Sesse. "A. M. Brownei differt caulibus subfirmioribus acute tetragonis et foliis latioribus sessilibus, nec petiolo limbum aequante donatis. Rami et folia Gratiolam referunt. An M. xalapensis var. ? (v. s. olim in herb. Lamb.)" I have seen no collections bearing this name, and none that could be satisfactorily referred to it. Although petiole-length varies in *M. Brownei* var. *pilosiuscula,* the leaves are never really sessile. I am unable to identify Bentham's plant.

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——————. 1933. *Micromeria.* Man. S.E. Fl. p. 1168.

NOTES

WEED TRANSPORT IN ST. AUGUSTINE GRASS SOD IN TEXAS. — St. Augustine grass *(Stenotaphrum secundatum)* is commonly recommended for lawns because its dense growth is supposed to choke out weeds. There is only limited truth in the claim. The grass is established by plugs or sods rather than by seeding. A spectacular illustration of the transport of weed seeds with the sod was provided by the landscaping of the new Science Information Center at Southern Methodist University in Dallas, Texas. Built on a moderate slope on what was originally rolling prairie of calcareous, black clay, it was supplied with a small, enclosed courtyard on the west side. Because of the slope of the land, it was necessary to remove earth to a depth of over six feet at the north and almost three at the south. A small live oak *(Quercus virginiana)* near the southwest corner was preserved by being boxed in on a sort of island, but even here the top soil was removed. The main part of the court was left completely bare, but almost within days a few sprouts of Johnson grass *(Sorghum halepense)* appeared. Whether these represented deep penetration of rhizomes of plants growing in the area before excavation, or whether bits of rhizome or seeds were brought in by scraping machinery or other means afterward, is not known. The newly exposed ground was otherwise bare until planted. The building was dedicated the afternoon of 3 November 1961, and in characteristic Texas fashion, the landscape plantings were all put in on the morning of the same day. For the courtyard, these comprised chiefly 10-foot yaupon *(Ilex vomitoria)* against the retaining wall at the north, and a red oak (perhaps *Quercus Shumardii)* and a live oak *(Q. virginiana)* of similar size near the middle. Most of the area was carpeted with small squares of St. Augustine grass sod. The ensuing winter was exceptional for the number of severe freezing spells, lasting several days each, with temperatures down to 17° F. several times, and once as low as 8°. This is not ideal weather for St. Augustine grass, and much of it died. In the spring the courtyard was a weed patch gratifying to botanical eyes. In April and May, five weedy grasses and nine miscellaneous weeds were found in bloom:

Poa annua
Hordeum pusillum
Alopecurus carolinianus
Agrostis hyemalis
Cynodon dactylon

Sisyrinchium minus
Cerastium brachypodum
Sibara virginica
Ranunculus muricatus
Euphorbia spathulata
Limnosciadium pinnatum
Coreopsis tinctoria
Senecio imparipinnatus
Krigia gracilis

In June *Paspalum dilatatum* (Dallis grass) flowered. *Smilax Bona-nox* (cat brier) was present next to the red oak, but may have been

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brought with it rather than in the sods. It is characteristic of the Texas flora that of the 17 weedy species present (I consider St. Augustine grass another weed; certainly in my own yard, intended for flowers, it is a pest), all but four are native to Texas. The exceptions are *Poa annua* (spear grass, Eurasian), *Cynodon dactylon* (Bermuda grass, African or Asian), *Paspalum dilatatum* (Dallis grass, South American), and *Ranunculus muricatus* (buttercup, European). The last-named was new to Dallas County, the nearest previously known occurrence being in Gregg County, 125 miles to the east. It is fairly common in the southeastern third of the state and in Louisiana. The precise source of the sod could not be determined, but according to an employe of the landscape company which handled the work, it probably came from Houston. That city is about 270 airline miles south and slightly east of Dallas. All the species mentioned are known to occur there. It may well have been the source of the Dallas occurrence of *Melochia pyramidata,* mentioned in my *Spring Flora of the Dallas—Fort Worth Area* (1958, p. 267). This also is a native species, perhaps as far north as Comal County, where it was collected by Charles Wright in 1850. Similarly the native South Texas weed *Calyptocarpus vialis,* occurring naturally as far north as Bell and San Saba counties, has turned up more than 100 miles farther north as a weed in St. Augustine grass lawn in Highland Park, Dallas: in front of Christian Science Church, *Shinners 13,358,* 14 May 1952 (SMU). "A few small patches." Still another example of such weed transport is provided by a specimen of *Sisyrinchium minus* from the campus of Stephen F. Austin State College in Nacogdoches *(R. L. Oliver 317,* 3 May 1961; SMU), which is noted as "apparently introduced in the San Augustine grass (from Brazos River bottom, Houston area) which was set out in fall of 1960." — *Lloyd H. Shinners.*

EICHHORNIA AZUREA (PONTEDERIACEAE) IN THE TEXAS COASTAL BEND: NEW TO THE UNITED STATES. — The common water hyacinth, *Eichhornia crassipes* (Martius) Solms, with short, greatly inflated petioles, was collected in Texas as early as 1903 by Reverchon (east of La Porte, Harris County), and has been found as far north as Dallas. The following is apparently the first United States record of the related *E. azurea* (Swartz) Kunth, with elongate petioles thicker toward base but not abruptly inflated. TEXAS. San Patricio Co.: growing around shores of Lake Corpus Christi, *Fred B. Jones 1160,* 6 July 1955 (SMU). The species is reported by Alexander (N. Amer. Flora 19: 56—57, 1937) from Mexico, Central America, the West Indies, and South America. It is not included in the recent (undated; 1961?) *Flowering Plants and Ferns of the Texas Coastal Bend Counties* by Fred B. Jones, Chester M. Rowell, Jr., and Marshall C. Johnston, which lists *E. crassipes* only, as occurring in "ditches, lakes, etc." — *Lloyd H. Shinners.*

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ANEILEMA (COMMELINACEAE) IN THE UNITED STATES. — Two Asiatic species of *Aneilema* have become established in the Southeastern United States within the present Century, but as yet no American flora treats both of them. A Mexican species has been found very close to the Texas border, and is worth noting as something to watch for on the American side. The three may be distinguished as follows.

1a. Annual or perennial with fibrous roots, the stems at least partly decumbent and rooting at the nodes; leaves several to many, all but the uppermost with short but distinctly differentiated sheath; southeastern Texas east to Atlantic Coast
  2a. Sepals 2—3 mm. long, glabrous; flowers early becoming exserted on long, naked peduncles, several or many in each inflorescence 1. *A. nudiflorum*
  2b. Sepals 5—6 mm. long, hispid-pilose on back, at least near tip; flowers tardily exserted on short, usually 1-flowered peduncles 2. *A. Keisak*
1b. Perennial with tuberous-thickened roots, the erect stem with 1—3 leaves, only the lowest with well defined sheath; Mexico, possibly Trans-Pecos Texas .... 3. *A. lineare*

1. A. NUDIFLORUM (L.) R. Brown ex Kunth, Syn. Pl. 4: 66. 1843. (This combination is merely implied by R. Brown in Prodr. Fl. Nov. Holl. p. 271, 1810: "Hujus generis sunt Commelina virgata, nudiflora, spirata, medica, *Vahl.* enum." Vahl, Enum. Pl. 2: 176, 1785, credits *Commelina nudiflora* to Linnaeus.) *Commelina nudiflora* L., Sp. Pl. 1: 41—42. 1753. (Linnaeus cites his own *Flora Zeylanica* and Plukenet's *Almagestum.* In his *Mantissa Plantarum Altera,* p. 177, 1771, he gives a new description evidently based on later material than was available in 1753. Kunth, in validating the transfer to *Aneilema,* specifies the Plukenet illustration as representative, in effect making it the type. Fortunately this agrees with Linnaeus's own emendation. C. B. Clarke, in DC., Mono. Phan. 3: 144, 1881, retains the name *Commelina nudiflora* L. "Sp. Pl. 1, p. 61, nec Mant. 177, nec auct." in place of *C. diffusa* Burman, citing a Ceylon specimen in Burman's herbarium. Presumably he thought this the same as the plant described in Linnaeus's *Flora Zeylanica.* At the same time he recognizes *Aneilema nudiflorum* on p. 210, which is nomenclaturally impossible by present rules, since the latter was a new combination based on the former. Clarke however cites there "Commelina nudiflora, Linn.! Mant. p. 177 (nec Sp. Pl. nec Fl. Zeyl.)," reversing the typification established by Kunth and implied by Linnaeus himself. Since Linnaeus, in the citation from the *Flora Zeylanica,* specifies "involucro nullo" (and presumably because of that very peculiarity chose the epithet *nudiflora),* it is difficult to understand why Clarke should have equated *Commelina nudiflora* with the spathe-bearing *C. diffusa.* In any case his rejection of Kunth's typification can-

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not be accepted. The double listing of the Linnaean binomial in Index Kewensis is to be disregarded; only the first entry, as synonym of *Aneilema nudiflorum,* should stand.)

This species was first reported from the United States by Small in 1910 (Bull. Torr. Bot. Club 37: 513—514) as established around Braidentown (Bradenton, Manatee Co.), Florida, where it had been observed for several years. In the second edition of his *Flora of the Southeastern United States* (p. 1328, 1913), the range is given as southern Georgia and Florida. In his *Manual of the Southeastern Flora* (p. 263, 1933), he says "Fla. to Ga." The plant has spread to the western Gulf region, as shown by the following collection. TEXAS. Jefferson Co.: nursery garden of P. A. Winkler, Voth Road, Beaumont, *V. L. Cory 49974,* 3 October 1945 (SMU). "Introduced from further east, and is a pest and hard to eradicate from gardens."

2. A. KEISAK Hasskarl, Commelinaceae Indicae pp. 32—34. 1870. With var. (alpha) *nutans,* pp. 33—34, and var. (beta) *erectum,* p. 34. First reported from the United States by Neil Hotchkiss in 1940 (Rhodora 42: 21) from Minim Island, Georgetown County, South Carolina, as *A. nudiflorum.* This he corrected to *A. Keisak* in reporting it from numerous localities from Virginia to Georgia in 1951 (Rhodora 53: 92—93). Radford in the latter year also reported it from several localities in North Carolina (ibid. p. 25). Fernald considered it a native species of bicentric distribution between Virginia and eastern Asia (Rhodora 42: 392, 441—442; 1940; Gray's Manual, 8th ed., p. 393, 1950). In view of the other records, there is little doubt of its being introduced in North America.

3. A. LINEARE (Bentham) Woodson (as *linearis),* Ann. Mo. Bot. Gard. 29: 148. 1942. *Tradescantia linearis* Bentham, Pl. Hartw. p. 27. 1839. Superficially this has considerable resemblance to *Tradescantia Wrightii,* differing conspicuously in the branched, open inflorescence, quite unlike the condensed, umbel-like one typical of *Tradescantia.* The following collection comes from just south of the Big Bend region of Texas. COAHUILA. Frequent in shade on north, igneous slopes of Picache del Centinela, Del Carmen Mts., alt. 6000 ft., *Barton H. Warnock 11624,* 24 August 1953 (SMU). Other specimens have been seen from Durango and Jalisco.

In publishing the generic name *Aneilema,* Robert Brown treated it as feminine. It may be argued that he was entitled to do so, since it was a manufactured word. The last three syllables are a Greek word meaning veil or covering, and the word in Greek is neuter. Since such Linnaen generic names as *Erigeron* have been altered from the gender assigned by Linnaeus to the etymologically correct one, consistency requires that the same be done with Brown's. — *Lloyd H. Shinners.*

SIPHONYCHIA TRANSFERRED TO PARONYCHIA (CARYOPHYLLACEAE). — The small Southeastern genus *Siphonychia* has been maintained as distinct from *Paronychia* on the basis of having perianth parts united. But in a majority of the species these are joined much less than half way, while in *S. Rugelii* the joining is very weak, the segments sometimes being hardly more than appressed rather than firmly united. On the other hand, in *Paronychia Drummondii* the segments are united about a fourth their length at maturity. The generic difference is thus one of degree only, not of basis structure, and the degree is virtually non-existent in the case of *Paronychia Drummondii*. The most striking thing about the species of *Siphonychia* is their overwhelming similarity in nearly all respects to Southeastern representatives of *Paronychia*. I can distinguish only four species rather than the seven accepted by Earl L. Core in "A taxonomic revision of the genus *Siphonychia*," Journ. Elisha Mitchell Sci. Soc. 55: 339—345, 1939. Their names under *Paronychia* are as follows.

P. **patula** Shinners, nom. nov. *Siphonychia diffusa* Chapman, Fl. S. U.S. (ed. 1) p. 47. 1860. Not *Paronychia diffusa* A. Nelson, Bull. Torr. Bot. Club 26: 237. 1889.

P. AMERICANA (Nuttall) Fenzl ex Walpers, Rep. 1: 262. 1842. *Herniaria americana* Nuttall, Amer. Journ. Sci. 5: 291. 1822. *Siphonychia americana* (Nuttall) T. & G., Fl. N.A. 1: 173. 1838. *Siphonychia pauciflora* Small, Fl. S.E. U.S. (ed. 1) pp. 402, 1330. 1903. Nuttall's original description speaks of the plant as "paucifloris" and goes on to specify that "the clusters of flowers contain from about three to five." Torrey and Gray, in a description based in part on the same material as Nuttall's, say "Bracts very small, similar to the leaves." Thus by Small's key the type material of *S. americana* must be placed in *S. pauciflora*. In reality the distinctions do not hold, and I can make out only a single somewhat variable species.

P. **erecta** (Chapman) Shinners, comb. nov. *Siphonychia erecta* Chapman, l.c. p. 47 *S. corymbosa* Small, Bull. Torr. Bot. Club 24: 337. 1897. *Odontonychia corymbosa* (Small) Small, Fl. S.E. U.S. (ed. 1) pp. 402, 1330. 1903. It is possible to recognize three and possibly more pubescence types in this species. The original *S. erecta* is a form with stem largely glabrous, but short-pubescent above. More common are forms with stem either short-pubescent or relatively long-pubescent throughout. They do not seem to be so much variations in degree as a group of distinct Mendelian characters. Core, following Small, describes the perianth segments of *S. corymbosa* as ovate, which is not correct; his illustration accurately depicts them as long and narrow, precisely as in *S. erecta*. As with the stem, there is variation in pubescence on the perianth tube. Again I can recognize only one somewhat variable species.

P. RUGELII Shuttleworth ex Chapman, Fl. S. U.S. (ed. 3) p. 397. 1897. (Published earlier as synonym only, under the next.) *Siphonychia Rugelii* (Shuttleworth, ined.) Chapman, Fl. S. U.S. (ed. 1) p. 47. 1860. *Forcipella Rugelii* (Shuttleworth) Small, Bull. Torr. Bot. Club 25: 150.

1898. *Gibbesia Rugelii* (Shuttleworth) Small, ibid. p. 621. *Odontonychia interior* Small, Man. S.E. Fl. pp. 483, 1504. 1933. *Siphonychia interior* (Small) Core, Journ. Elisha Mitchell Sci. Soc. 55: 344. 1939. Chapman nowhere mentions the indurated bracts which Small made the basis for his segregate genus *Forcipella (Gibbesia)*. Here is what Small originally had to say: "Flowers . . . 2—3 in an involucre composed of two bracts and their broad 2-parted stipules, each, or only 2 seated in a hard, clamp-like involucel, whose two lobes are notched. Calyx of 5 linear-subulate distinct (sometimes cohering at the base) sepals." His illustration in the *Manual* shows only the bracts and stipules, not the clamp-like involucel. In *Godfrey & Houk 60289* (SMU), from Lafayette County, Florida, many of the cymes have abortive (diseased?) flower buds around the bases of open flowers. Conceivably these were what Small took to be an involucel; I have been unable otherwise to find any such structure. The perianth tube is scarcely differentiated, the segments merely having appressed margins toward base rather than being firmly united. In other specimens there is a definite tube, the segments being distinctly united. It is understandable that Chapman should at different times have put this species in both *Siphonychia* and *Paronychia*. I concur in his second choice, restoring it to the genus in which Shuttleworth had first placed it.

To the above may be added a few supplementary notes on species included in Core's "The North American species of *Paronychia*," Amer. Midl. Nat. 26: 369—397, 1941.

P. DRUMMONDII T. & G. Hitherto known only from Texas, this can now be added to the flora of LOUISIANA. Allen Parish: 7.2 miles west of Kinder, *Shinners 21,489*, 8 September 1955 (SMU). "Sandy fencerow, pine land. Perianth white."

P. BALDWINII (T. & G.) Fenzl. Including *P. riparia* Chapman. Those familiar with the Gulf States know how uncertain the difference between annual and perennial often is. I am unable to distinguish two species on this basis, and pubescence varies quite independently of apparent duration.

P. FASTIGIATA (Rafinesque) Fernald var. NUTTALLII (Wood) Fernald. Formerly known only from three counties in Pennsylvania, this occurs also in VIRGINIA. Giles Co.: on dry rocky open exposed path to the top of Bald Knob, ½ mile s.e. of Mountain Lake P.O., alt. 4300 feet, *Hugh H. Iltis 2011*, 1 August 1943 (SMU). The perianth is pubescent and the segments rather prominently short-awned. — *Lloyd H. Shinners.*

STELLARIA COREI SHINNERS, NOM. NOV. (CARYOPHYLLACEAE). — Based on *S. pubera* ssp. *silvatica* Beguinot, Nuov. Giorn. Bot. Ital. n.s. 17: 385. 1910. *S. pubera* var. *silvatica* (Beguinot) Weatherby, Rhodora 26: 171. 1924. *S. silvatica* (Beguinot) Maguire ex Gleason, Phytologia 4: 23. 1952 (March). (Not *S. sylvatica* (Maxim.) Maxim. ex Regel, 1862.) *S. tennesseensis* (non Mohr) Strausbaugh & Core, Castanea

17: 165. 1952 (December). (Basinym cited as *Alsine tennesseensis* Small, Fl. S.E. U.S. pp. 422, 1330, 1903. Small's combinaton was however based on *A. pubera tennesseensis* Mohr, the type of which according to Weatherby belongs to a form of var. *pubera*. Small mistakenly applied the name to var. *silvatica*, as did Strausbaugh and Core.) I believe that this plant is properly treated as a species distinct from, although closely related to, *S. pubera*. But neither of the names it has received in that rank can be retained. It seems altogether fitting to associate with it the name of the man who as botanist, editor, and administrator has done so much for Appalachian and Southeastern botany.

I wish to thank Dr. G. B. Van Schaack of the Missouri Botanical Garden for confirming the validity of *Stellaria sylvatica* (Maxim.) Maxim. ex Regel. — *Lloyd H. Shinners.*

RANUNCULUS TRACHYCARPUS (RANUNCULACEAE) IN SOUTH-CENTRAL LOUISIANA: NEW TO NORTH AMERICA. — The occurrence of the Mediterranean *Ranunculus trilobus* Desf. in Pointe Coupee Parish, Louisiana, was reported in 1960 (S.W. Nat. 5: 170). On seeing quite similar plants in April, 1962, in nearby Avoyelles Parish, I assumed that they represented a range extension for the new introduction. But on comparison of herbarium specimens they proved to be quite different, having decidedly spiny instead of merely papillose-roughened achenes, and the larger leaves were not pinnately divided. In the key in Lyman Benson's "A Treatise of the North American Ranunculi" (Amer. Midl. Nat. 40: 1—261, 1948: see especially p. 110) they ran to *R. muricatus* L. which they obviously were not, having larger petals and smaller achenes, more or less pilose stems, leaves, and sepals, and long-pedicelled flowers. They could not be determined with any of the recent standard North American or European floras, but were finally identified as *R. trachycarpus* Fisch. & Mey. in George E. Post's *Flora of Syria, Palestine and Sinai* (2nd ed., by John Edward Dinsmore) 1: 15—16, 1932, and checked in Edmond Boissier's *Flora Orientalis 1:* 55—56, 1867. There was a single specimen so named in the SMU Herbarium, from Sharon Plain, Kabbara Marshes, Israel, *A. Grizi s.n.,* 24 May 1954. This consists of two mowed plants which had put up new branches with smaller, more divided leaves than those of the Louisiana specimens, and have more densely spiny achenes, but they evidently belong to the same species, which is described as a variable one. *Ranunculus trachycarpus* Fisch. & Mey. may therefore be recorded from LOUISIANA, Avoyelles Parish: 7.2 miles southeast of Bunkie, *Shinners 29,519,* 18 April 1962 (SMU). "Roadside ditch, wet silty clay. Petals yellow. Locally abundant from Bunkie to here."

In reporting *R. trilobus,* I said that the manner of introduction was entirely unknown. In the case of *R. trachycarpus* there is a clue from some associated weeds: Persian clover *(Trifolium resupinatum)* and

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crimson clover *(T. incarnatum)*, both of which are widely planted on road shoulders almost throughout Louisiana and which maintain themselves in such habitats. *T. resupinatum* is the more persistent of the two, and shows more tendency to spread, especially to ditches or along ditch banks. Both clovers are native to the Mediterranean region. If commercial seed imported from that area had been used for some of the road-shoulder plantings, it may have been the vehicle for the transport of the two species of *Ranunculus*. — *Lloyd H. Shinners.*

WAREA AURICULATA INSTEAD OF W. AMPLEXIFOLIA OF SMALL (CRUCIFERAE). — In his *Manual of the Southeastern Flora* (pp. 573—574, 1933), Small uses the name *Warea amplexifolia* (Nuttall) Small for a plant with auricled-clasping upper leaves. The combination is nomenclaturally impossible, since it is identical with one already made by Nuttall himself. Small supposed that Nuttall had had a mixture, part of his material being *W. sessilifolia* Nash. In such case he ought to have written *W. amplexifolia* (Nuttall) Nuttall emed. Small. Payson (Ann. Mo. Bot. Gard. 9: 312—312, 1922) also believed that Nuttall had had a mixture, agreeing with Small except for the author-citation. Neither author checked Nuttall's type material, the belief that it was mixed resting only on two pieces of circumstantial evidence. The epithet *amplexifolia* is inappropriate for a plant with merely sessile or barely clasping upper leaves, although this is what was illustrated by Nuttall himself in transferring *Stanleya ? amplexifolia* to *Warea*. In his first publication, under *Stanleya*, he gave "East Florida" as the place of origin, but in the second this becomes "West Florida." Neither item can be accepted as proving that Nuttall had a mixture. In evaluating the epithet *amplexifolia* it has mistakenly been assumed that the question is which of two Florida plants it fits better. This is the wrong frame of reference. Nuttall was thinking in terms of a Florida plant and the only previously described *Stanleya, S. pinnatifida (S. pinnata)*, which has petioled leaves, and the epithet *amplexifolia* is therefore to be taken as relative to a petioled-leaved condition. This is not so inappropriate for *Warea sessilifolia* with sessile to slightly clasping upper leaves; furthermore the lower leaves of this species may be distinctly clasping. The reference to "West Florida" in the second publication dealing with Nuttall's species may have been merely a slip of the pen on his part, or it may have been a deliberate correction or clarification of the very vague older usage of the terms "East Florida" (primarily northeastern as now delimited, but sometimes loosely applied to more than half of northern Florida) and "West Florida" (originally meaning only the Pensacola area, but at times extended to include the entire panhandle section). Florida had then been only recently added to the United States, and these terms were both subject to change. Hence

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neither of the inferential arguments about a Nuttallian mixture can be accepted.

Much more important than supposition is the question of what Nuttall actually had. Dr. Walter M. Benner kindly checked material at the Philadelphia Academy for me. He reports that there is only one specimen named by Nuttall, and that it has sessile leaves. In other words, the only concrete evidence we have indicates that Nuttall did not have a mixture, and the only thing he did have was the plant shown in his illustration of *Warea amplexifolia*. This is identical with *W. sessilifolia* Nash, and the plant thought to be *W. amplexifolia* by Nash, Small, and Payson becomes

W. **auriculata** Shinners, sp. nov. *W. amplexifoliae* affinis, sed foliis superioribus profunde auriculato-amplexicaulibus. HOLOTYPE: sandy soil, Lake Wilson Road, Loughman, Kissimee, Osceola Co., Florida, *Mary L. Singeltary*, 25 September 1937 (DUKE, no. 46189). PARATYPE: High hill near Lake Apopka (Orange Co: ?), Florida, *Ralph McWilliams*, 22 September 1935 (SMU; Schallert Herb. No. 19696). This is *Warea amplexifolia* in the sense of recent authors, not of Nuttall, for whose plant the following synonymy may be given.

W. AMPLEXIFOLIA (Nuttall) Nuttall, Journ. Phila. Acad. 7: 83, with pl. 10. 1834. *Stanleya ? amplexifolia* Nuttall, Amer. Journ. Sci. 5: 297. 1822. *Warea sessilifolia* Nash, Bull. Torr. Bot. Club 23: 101. 1896. The inadmissible combination *W. amplexifolia* "(Nuttall) Small," Bull. Torr. Bot. Club 23: 409, 1896, belongs here on the basis of type, but was applied by Small to *W. auriculata*. The following specimen may be cited for the label data concerning lower leaves of *W. amplexifolia*. Open woodland, sandy soil, near Lake Bradford, Leon Co., Florida, *R. K. Godfrey 53890*, 22 September 1955 (DUKE, SMU). "Lower leaves on non-flowering plants clasping."

I am grateful to Dr. Benner for the information concerning Nuttall's specimen at Philadelphia, and to Dr. R. L. Wilbur for the loan of material from the Duke University Herbarium. — *Lloyd H. Shinners.*

WISSADULA GRANDIFOLIA INSTEAD OF W. MACRANTHA (MALVACEAE): NOMENCLATURAL CORRECTIONS. — In his "Entwurf einer Monographie der Gattungen *Wissadula* und *Pseudabutilon*" (Kungl. Svenska Vetenskapsak. Handl. Bd. 43 No. 4, 1908), Rob. E. Fries described *Wissadula macrantha* as a new species, comprising three varieties. One of the three, var. *grandifolia*, was based on a species named a year before. Because it represented only a localized race, Fries considered it undesirable to retain it as a species and subordinate the most widespread race as a variety. Under present rules of course the presumed phylogenetic status has no bearing on the nomenclature: the first name in the rank of species is the one that must be used for the whole ensemble. Though more than half a century has elapsed since the monograph was published, the necessary nomenclatural emendations have not been made. They are supplied herewith.

WISSADULA GRANDIFOLIA E. G. Baker ex Rusby, Bull. N.Y. Bot. Gard. 4: 328. 1907. *W. macrantha* var. *grandifolia* (E. G. Baker) R. E. Fries, Kungl. Sv. Vet.-Akad. Handl. 43 no. 4: 68. 1908.

W. GRANDIFOLIA var. **brevipedunculata** (R. E. Fries) Shinners, comb. nov. *W. macrantha* var. *brevipedunculata* R. E. Fries, l.c. p. 69.

W. GRANDIFOLIA var. **macrantha** (R. E. Fries) Shinners, comb. nov. *W. macrantha* R. E. Fries, l.c. pp. 67—68. (Illegitimate name, since the earlier *W. grandifolia* was included within the circumscription of the new species.) — *Lloyd H. Shinners.*

GENTIANA DELOACHII (W. P. LEMMON) SHINNERS, COMB. NOV. (GENTIANACEAE). — Based on *Dasystephana DeLoachii* W. P. Lemmon, Bartonia 19: 18, 1938. A glabrous, greenish-flowered species, of which "three specimens have been collected, all from Georgia: one in dry acid soil near Clyo, Effingham Co.; two from the vicinity of Statesboro, Bulloch Co." Described as having separate anthers. The article "Connate anthers in *Gentiana* (Gentianaceae)" by Wilbur H. Duncan and Clayd L. Brown (Rhodora 56: 133—136, 1954) does not mention this species. — *Lloyd H. Shinners.*

AGASTACHE BREVIFLORA (GRAY) EPLING VAR. HAVARDII (GRAY) SHINNERS, COMB. NOV. (LABIATAE). — Based on *Cedronella breviflora* var. *Havardi* Gray, Proc. Amer. Acad. 20: 309. 1885. *Agastache pallidiflora* (Heller) (Rydberg) ssp. *Havardi* (Gray) Lint & Epling, Amer. Midl. Nat. 33: 221. 1945. Found in the Chinati, Chisos, Davis, and Guadalupe Mountains, Trans-Pecos Texas. The distinctions between *A. breviflora* and the variable *A. pallidiflora,* as treated in Harold Lint and Carl Epling's "A revision of *Agastache*" (Amer. Midl. Nat. 33: 207—230, 1945) are not convincing. I prefer Gray's earlier, broader version, which under *Agastache* requires this new combination. — *Lloyd H. Shinners.*

SCUTELLARIA LAEVIS (LABIATAE), ANOTHER ENDEMIC IN TRANS-PECOS TEXAS. — *Scutellaria* is an extremely difficult genus, especially in western and southwestern Texas. It is gratifying to be able to name a new species which is very distinct and easily recognized. It is in most respects a perfectly typical member of the Section *Resinosae* as defined in Carl Elping's "The American species of *Scutellaria*" (Univ. California Pub. Bot. 20 no. 1: 57—69, 1942), but is unique in that group in having a glabrous stem. Because of this peculiarity it is here named.

S. **laevis** Shinners, sp. nov. Perennis multicaulis humilis (20—35 cm. alta) sublignosa e radice crasso lignoso. Caules glabri. Folia brevissime petiolata integra parce minutissimeque scabro-puberula vel glabriuscula, inferiora elliptico-ovata penninervia obtusiuscula 11—21 mm. long

6—11 mm. lata, superiora gradatim minora oblongo-lanceolata. Flores spicato-racemosi brevipedicellati pedicellis scabro-puberulis. Calyx 3.0—3.5 mm. longus minutissime scabro-puberulus vel glabriusculus. Corolla pallida 14—17 mm. longa extus pilosula. Nuculi crebre obtuse muriculati. HOLOTYPE: ten miles north of Van Horn, north slope of Beach Mountain, Culberson Co., Texas, *D. S. Correll 13973,* 19 August 1946 (SMU). "Flowers white tinged with lavender, talus." PARATYPES (both SMU): on red sandstone along arroyo and base of canyon in southwestern slopes of Beach Mtn., 6½ miles northwest of Van Horn, Culberson Co., Texas, *U. T. Waterfall 5087,* 14 July 1943. Numerous in the bed of the creek in the head of Victoria Canyon, alt. 5600 ft., Hudspeth Co., Texas, *L. C. & Leon Hinckley 102,* 18 June 1949 (in fruit).

The light-colored corolla is also distinctive in this group, if consistent, but color is known only from the type collection. Other species of *Resinosae* have corolla deeply colored (purple-blue or lavender-blue) except for a white spot on the palate. — *Lloyd H. Shinners.*

SOLANUM GODFREYI SHINNERS, NOM. NOV. (SOLANACEAE). — Based on *S. floridanum* Shuttleworth ex Dunal in DC., Prodr. 13 (1): 306. 1852. (Not *S. floridanum* Rafinesque, Fl. Tell. p. 107. 1840.) "In Floridae apricis, prope S. Marks," *Rugel* (type not seen). *S. carolinense* var. *floridanum* (Shuttleworth) Chapman, Fl. S. U.S. p. 349. 1860. I agree with Asa Gray (Syn. Fl. N.A. 2 pt. 1: 227, 1878) that this should not be referred to *S. carolinense.* In the original description the stem is said to be glabrous below but "caeterum pilis longis simplicibus vel basi stellatis pilosus." The only specimen I have seen has entirely glabrous stem, but stellate-pubescent leaf blades. It is in fruit only, and apart from the stem seems to fit quite well the rather lengthy description given by Dunal. It comes from the general region of the type locality, but slightly farther east, in Taylor County: clearings of swampy woodland, vicinity of Nuttal's Rise, along the Aucilla River, *R. K. Godfrey 60037,* 7 July 1960 (SMU). — *Lloyd H. Shinners.*

SIDA CONTRIBUTIONS TO BOTANY

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THE TAXONOMIC SIGNIFICANCE OF EVOLUTIONARY PARALLELISM[1]

ARTHUR CRONQUIST

New York Botanical Garden, New York 58

The recognition by Darwin that the natural system of classification is in essence an evolutionary system is a major landmark in taxonomic history. Let me read you a passage from Chapter 14 of *Origin of Species:* ". . . The Natural System is founded on descent with modification . . the characters which naturalists consider as showing true affinity between any two or more species, are those which have been inherited from a common parent, all true classification being genealogical . . community of descent is the hidden bond which naturalists have unconsciously been seeking. . . ." A corollary of this principle is that a natural taxonomic group is per se monophyletic, and that polyphyletic groups are in contrast artificial and should be rejected.

Those concepts have become so firmly entrenched in taxonomic thinking as to approach the status of dogma. However, as we learn more about phylogeny, a strict and literal application of the monophyletic requirement in taxonomy has gotten us into more and more trouble. More and more groups that have been considered to be natural are turning out not to be strictly monophyletic. They may be natural in the sense that all the included subgroups are evolutionarily closely related and have many features in common, but they are not monophyletic in the sense of being descended from an original species of the group which has all the essential characters of the group.

The mammals are an outstanding example, with a well documented fossil record, of a natural taxonomic group which is clearly not monophyletic in the strictest sense. We shall return to this fact in a few minutes.

The angiosperms, a large and highly natural taxonomic group of plants, cannot yet be traced back to a common ancestor by means of fossils, but on the basis of comparative morphology of the living members it is very probable that the eventual ancestor of all angiosperms was not itself an angiosperm, but rather a gymnosperm. The characteristic xylem vessels of angiosperms have evidently originated several times among the primitive members of the group. Stages in the development of the closed carpel, usually regarded as an essential feature of angiosperms, can be observed among the living members of the primitive order Ranales. Within the Ranales one can also see all stages

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[1] Presidential address delivered to the American Society of Plant Taxonomists at Corvallis, Oregon, 29 August 1962.

SIDA 1 (3): 109—116. 1963.

in the evolution of the typical angiosperm stamen from the ancestral microsporophyll with embedded sporangia. Furthermore, it seems clear, again on the comparative morphology of living species, that the development of the closed carpel and the typical angiospermous stamen with filament and anther took place in several related evolutionary lines within the Ranales, in parallel fashion, rather than being strictly monophyletic. Differentiation of the perianth into calyx and corolla has likewise taken place independently in various families, as has also the origin of petals from staminodes.

Double fertilization and the extreme reduction of the female gametophyte are about all we have left as characters unique to the angiosperms and uniformly expressed in primitive as well as advanced members. Even these characters are suppressed in certain apomictic forms, although the suppression is doubtless secondary. There is no reason to believe that these embryological characters, on whose evolutionary history we have no very good evidence, are any more nearly monophyletic than the characters of vessels, perianth, stamens, and carpels. On the contrary, whenever we *do* get reasonable evidence on the phylogeny of characters which mark major taxonomic groups, it generally turns out that these develop through parallel evolution in the various closely related but separate lines which collectively make up the ancestral stock of the group.

This same problem with the monophyletic requirement, often in an even more severe form, permeates our whole system of classification. The tribes of the Compositae do not in general represent strictly monophyletic groups; rather they are constellations of genera which show certain evolutionary trends in common and are to some extent linked by transitional species. If my concepts of relationships within the family are correct, the hypothetical ancestor of all the genera of the Astereae would be placed not in the Astereae, but in the Heliantheae; similar statements could be made about most of the other tribes. The common ancestor to all species of the genus *Achaetogeron* would surely be placed in *Erigeron,* if we had it, rather than in *Achaetogeron.* Although I would not yet want to be firmly committed to this next statement, I suspect that the common ancestor to all species of *Baccharis* would be an *Archibaccharis,* the common ancestor to all species of *Archibaccharis* would be a *Conyza,* and the common ancestor to all species of *Conyza* would be an *Erigeron.* The most primitive existing species of *Erigeron,* in turn would on morphological grounds be just as well referred to *Aster,* and in fact it was first described as *Aster peregrinus* Pursh. It is now referred to *Erigeron* mainly because of its obvious relationship to species which are necessarily included in *Erigeron.*

The difficulties attendant on a strict application of the monophyletic concept in classification have led a few taxonomists in recent years to exclude the concept entirely from taxonomic theory and practice, to attempt to divorce phylogeny from taxonomy. I recognize the problems these people have felt, and I sympathize with their struggles, but I disagree with the proposed solution. It is the evolutionary concept which has given meaning to the whole idea of a natural system, just as Darwin said it would. An attempt should therefore be made to resolve the conflict, rather than to dissolve what has been a most fruitful union.

I believe the conflict is resolvable, and the terms of the resolution have already been laid down, now 17 years ago, by George Gaylord Simpson. In 1945 he pointed out that the monophyletic requirement must be interpreted broadly in order to be useful taxonomically (see "The principles of classification and a classification of mammals," American Museum of Natural History Bulletin, vol. 86). Again, let me quote: "The condition that classification must be consistent with phylogeny has as its most important corollary the requirement that all the animals within a given group, whatever its rank, must have had a common origin. . . . The principle that the units of classification must have a unified origin, or be monophyletic, easily leads to absurdity if not reasonably interpreted. Its complete *reductio ad absurdum* is the suggestion that each group must have originated from a single pair of animals, a requirement that has perhaps never been fulfilled in the history of life and that certainly cannot be demonstrated in any case. The rule that a group, to be considered monophyletic, must be derived from a single species of a preceding group is more reasonable and can sometimes be met in practice, but it also requires qualification. It is not at all clear that practical classification could consistently meet this requirement if phylogenetic knowledge were complete. In fact, knowledge is so far from complete that adherence to such a rule would lay classification open, to an unnecessary and undesirable degree, to the caprices of shifting theory and individual opinion. It is not useful to set up a classification in which groups with different names cannot be distinguished morphologically, but this does happen if theoretical monophyly is too strictly demanded. . . . Given a group that is composed of related animals and defined by morphological and related data, the most practical and, at least for the present, the most desirable additional requirement seems to be not that it should be derived from one immediately antecedent genus or species, but, with intentional vagueness, that its immediate ancestry should be included within a group of lower rank than itself. For instance, it is not probable on the basis of present knowledge that all the animals here included in the Mammalia arose from the Reptilia as a single species, genus, or even family, but it is not suggested on this account that some of them should be returned to the Reptilia or that another class should be created for them. They certainly arose from a unified group of reptiles of much smaller scope than a class, perhaps a family or perhaps a superfamily, and for practical purposes this is an adequate fulfillment of the requirement of monophyly."

To recapitulate, if a taxonomic group of a particular rank is derived wholly from another group of lower rank, that is a sufficient degree of monophylesis for taxonomic purposes. Dr. Simpson has very recently (1961, in his book *Principles of Animal Taxonomy*) modified this concept to read "of the *same* or lower rank," and here I feel he may have gone a bit too far. His point, however, is well taken. Monophylesis and polyphylesis are not such utterly distinct things as the terms would suggest. There is a continuous gradation from the strictest monophylesis to the most utter polyphylesis in proposed taxonomic groups. In order to be natural and acceptable, a taxonomic group must fall somewhere toward the monophyletic end of this scale, rather than toward the polyphyletic end.

It now appears that a workable taxonomic system cannot provide a perfect reflection of evolution, no matter how abundant the evidence on which it is based. Furthermore, conclusions must usually be based on more or less inadequate evidence; none of us has witnessed the events of geologic time. But the phylogenetic concept still provides the underlying rationale for the natural system. Taxonomy can provide only a somewhat muddy reflection of evolution, but a reflection all the same.

Once we admit the broad interpretation of the monophyletic requirement, as I believe we must do in order to have a workable system, then we are committed to the position that similarities due to evolutionary parallelism, as well as those due strictly to inheritance from a common ancestor, provide some indication of relationship and should be considered in the formulation of the taxonomic system. Just how *much* weight should be given to parallelism is another question, to which we will return later.

As long ago as 1912 Wernham pointed out that "critical tendencies are no less important than critical characters" (see the final paper in his series on floral evolution in the New Phytologist, vol. 11). He further pointed out that "the general relation between the significant features of the ancestry and those of the descendants is, that in the former the characters in question are not constant throughout the group, nor may they be completely evolved. In other words, we are dealing with *tendencies* to characters, and not with the critical characters themselves, in the case of the ancestry. In the progeny, on the other hand, the characters are constant and completely evolved; and the line which unites ancestor and descendants represents the transition between the tendencies and their realization." He goes on to provide several examples. Probably most of us here can provide equally good examples from our own experience.

The proposition that similarities due to common descent, to inheritance from a common ancestor, indicate relationship is of course self-evident. We have pointed out that taxonomists have been forced, on a pragmatic basis, to accept also the proposition that similarities due to parallelism also provide some evidence of relationship. Let us now proceed to an inquiry into why this should be so, or how it can be so.

A concise expression of the most generally accepted present concept of the mechanism of evolution would be something like this: Random mutation and natural selection, modified by the influence of happenstance survival in small populations. I submit that random is the wrong word here, and that it has had an unfortunate effect on our thinking. To me, and I think to many other people, random implies that any one thing is as likely as any other thing. Thus in a table of random numbers, any one number in the series is as likely in any particular slot as any other number. Mutations are at random only in the sense that there is a large element of chance, and that we cannot control or predict them individually; they are certainly not at random in the sense of one mutation being as likely as any other. It is abundantly clear that the different mutations which can occur in a particular gene do not occur with equal frequency, nor is the mutation rate from one allele to another the same in opposite directions. There are even genes which influence the rate and dirction of mutation in other genes. All this is well known to geneticists. As long ago as 1940 Dobzhansky stated that mutability, like other characteristics, is under partial genetic control.

The proposed statement of evolutionary mechanism would thus be more accurate if the word differential were substituted for random: Differential mutation and natural selection, modified by the influence of happenstance selection in small populations. With this phraseology, it is more obvious that not all evolutionary channels are open to any one group, and that different groups will have different evolutionary potentialities. At the grosser levels this is of course immediately obvious anyway. An oak doesn't have much chance of evolving into a carnivore, nor is a dog likely to develop photosynthesis. But it is also true at other, less obvious levels. The Solanaceae and Scrophulariaceae are so closely related that it is difficult to draw a precise line between them, but as Dr. H. A. Gleason has pointed out to me in conversation, they differ in their evolutionary potentialities for the production of certain types of chemicals. The Solanaceae very often produce alkaloids; in Wernham's terminology, they might be said to have a critical tendency toward the production of alkaloids. The Scrophulariaceae only very rarely produce alkaloids, although they do sometimes produce glycosides.

The occurrence of diffuse centromeres in *Luzula, Juncus,* and certain genera of the Cyperaceae is one more evidence of the generally recognized affinity between the Juncaceae and Cyperaceae. It is significant to our discussion that although the Cyperaceae are on both floral and vegetative characters the more advanced of the two families, only some of the cyperaceous genera have diffuse centromeres, whereas others have the more standard point centromeres. It seems very probable, then, that the occurrence of diffuse centromeres in these two families represents a case of parallelism rather than of inheritance from a common ancestor. I should add, of course, that no one character by itself provides proof positive of relationship; diffuse centromeres also occur in *Spirogyra*. Nevertheless, the occurrence of this rare character in the Juncaceae and Cyperaceae suggests that these two families have in common an unusually high potentiality to evolve in this direction. Some of the foregoing information on the occurrence of diffuse centromeres was provided for me by John Ebinger.

Clarkia and *Oenothera* provide another example at a lower taxonomic level. Here I get my information, as you might guess, from Harlan Lewis. *Clarkia* characteristically occurs in dry country, bordering deserts, but not actually in them. Individual colonies at the drier margins of the range lead a precarious existence, and are subject to being wiped out in bad years. The plants are annual, and the seeds germinate as soon as the moisture and temperature conditions are right. If the moisture supply then fails before the seeds are mature, no seeds are left over to begin again the following year. It appears that the one thing *Clarkia* lacks to be a potentially successful desert annual is a variable period of dormancy, so that some seeds would last over until the second or third year, regardless of how favorable conditions may be in the interim. In the many thousands, perhaps millions of years that *Clarkia* has occupied a habitat in which such a change would have a strong survival value, it appears to have been unable to evolve such a feature. Presumably the proper mutations just have not occurred. The closely related genus *Oenothera*, on the other hand, occurring in similar habitats, has in several lines given rise to desert species with a variable period of seed dormancy. There is nothing in the obvious characteristics of the plants to suggest that the evolution of desert species should be easier for the one genus than the other; the difference instead appears to lie in the mutative potentialities.

Now let us return to theoretical considerations. The existence of the same character in two different groups may be due either to their having inherited the character directly from a common ancestor, or to their having developed the character independently by parallel evolution. We are concerned here only with the second situation, not the first. If the character was independently developed in the two groups, it is still true, at the very least, that their respective ancestors had similar evolutionary potentialities with regard to that character, and thus were genetically similar—not necessarily identical—in this particular respect. Thus, evolutionary parallelism with regard to a particular character is one straw in the wind, indicating a degree of similarity and possible relationship among the ancestors. Now if we add another character in which these same two groups resemble each other, by parallel evolution, we have two straws in the wind, and so on. Thus, the more characters the two groups have in common, the greater must have been the genetic similarity of the ancestors of these groups—even though they did not have the characters under consideration, and the possession of these characters by the modern descendants is due to parallel evolution rather than direct inheritance from a common ancestor. Furthermore, the less common a particular character is in other groups, the more significant its independent development in two lines becomes, as an indicator of relationship.

Therefore, we come to the general principle that evolutionary parallelism tends to indicate relationship, and that it should be given due weight, along with other factors, in arriving at taxonomic conclusions. This is true regardless of whether one believes that all evolutionary trends must be explained in terms of survival value, or whether one believes, as I do, that some evolutionary trends are essentially orthogenetic and not directly related to survival value. Now, for purposes of argument, let us assume that I am correct in believing that there is every gradation from evolutionary trends which are essentially Darwinian to those which are essentially orthogenetic. Then, the greater the selective control, the less the taxonomic significance of the parallelism, and vice versa. If the control is essentially selective, then all the similarity that is required between the ancestors is the *ability* to produce the necessary mutations; selection does the rest. If the control is essentially orthogenetic, the ancestors must be sufficiently similar so that both of them produce these mutations in considerably greater frequency than other mutations, so that the mutation pressure, operating along with the other causes of speciation, can cause parallel evolutionary developments.

On theoretical grounds, therefore, characters which are not closely correlated with survival value and ecologic niches are likely to be more important taxonomically, in many instances, than characters which are directly influenced by selection. This is especially true in the angiosperms, in which the evolutionary barriers between different ecological niches are frequently minimal, and one family may fill highly diverse niches.

On purely pragmatic grounds, plant taxonomists over the last two centuries have come to this same operating principle. The characters used to distinguish the families and orders of angiosperms are in large measure things which are difficult to relate to Darwinian evolution. Such things as hypogyny, perigyny, and epigyny; polypetaly, sympetaly, and apetaly; apocarpy and syncarpy; placentation; numbers of floral parts of each kind, and the like. I hasten to point out, however, that the situation in the vertebrates is different. There the whole structure of the organism is intimately correlated with the way it makes its living: what kind of food it eats, how it captures that food, and how it keeps from being used as food by something else. Here the evolutionary barriers between different ecologic niches are formidable, and within each general niche the selective pressures operating on different but related taxa tend to be similar, and different from the selective pressures operating on taxa occupying different general niches. I have pointed out elsewhere that this difference in mode of evolution is responsible for the great difficulty of recognizing and defining the families and orders of angiosperms, as contrasted with the relative ease with which such groups are recognized in the vertebrates—but that is another story.

It is interesting to note that Wernham, with no knowledge of genes and not very much knowledge of heredity, also came to the conclusion that nonadaptive characters are more likely to be important than adaptive ones. He spoke of "biological" characters, which are directly related to some vital function or advance, and "fortuitous" characters, which have no relation to the environment nor to any biological function. He concluded that "A group of plants may share a number of biological characters in common without being therefore nearly related," but, on the contrary "The occurrence of several common fortuitous characters in a series of plant-forms is valid evidence of their mutual affinity; and the greater the number of common characters, the closer the affinity." To this I would add simply that this evidence is significant even if the similarities are due to parallel evolution instead of direct inheritance from a common ancestor.

BOTANICAL SURVEY ALONG THE YELLOWKNIFE HIGHWAY, NORTHWEST TERRITORIES, CANADA

I. CATALOGUE OF THE FLORA

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The Yellowknife Highway, begun in 1957 and officially opened in 1961, makes accessible a previously remote area in the District of Mackenzie, Northwest Territories. The area was botanically almost unknown. Thus the highway offered an unparalleled opportunity for botanical exploration. The 280 mile road links Yellowknife with Enterprise (see figure 1), a settlement on the Mackenzie Highway, the only all-weather road giving access to the Northwest Territories.

With the belief that a study of the highway region's flora and vegetation would be a significant contribution to knowledge of plants in boreal western North America, I carried out a botanical survey along the highway from August 2-14, 1958; June 15-August 9, 1959; June 13-August 4, 1961; and August 7-September 2, 1962. My work along the highway involved the following major procedures.

(1) The making of a plant collection to document the flora, and the recording of distributional, phenological, habitat, life-form, and other data. Major attention was paid to vascular plants but many non-vascular plants, especially lichens and mosses, were collected also. Some significant floristic records have already been reported (Thieret, 1961, 1962, 1963) and a paper on the life-form spectrum of the southern Mackenzie Great Plains has been published (Thieret, 1963).

(2) The carrying out of a primary survey of the vegetation, that is, recognizing and describing the major plant communities and listing their floristic composition. A paper on grasslands near Fort Providence has already appeared (Thieret, 1959).

This paper is one of two that will present the data obtained. It contains a catalogue of the plants collected, a total of 4160 numbers. The concluding paper will contain descriptions of the region and of its major plant communities.

Southwestern District of Mackenzie, that portion of Mackenzie in which the highway is located, is about the size of Louisiana, Mississippi, Alabama, and Georgia combined. Prior to the work of Porsild (1945) and Raup (1947), little serious field study of plants had been done there. The specimens available as vouchers for the flora had been collected for the most part at Great Slave Lake or along the Mackenzie River. No study had been made of the vegetation. Porsild (1945) published an annotated catalogue of the alpine flora of the east slope of the Mackenzie Mountains, based largely on his collections made along the NWT portion of the Canol Road. Raup's *Botany of Southwestern Mackenzie*

SIDA 1 (3): 117—170. 1963.

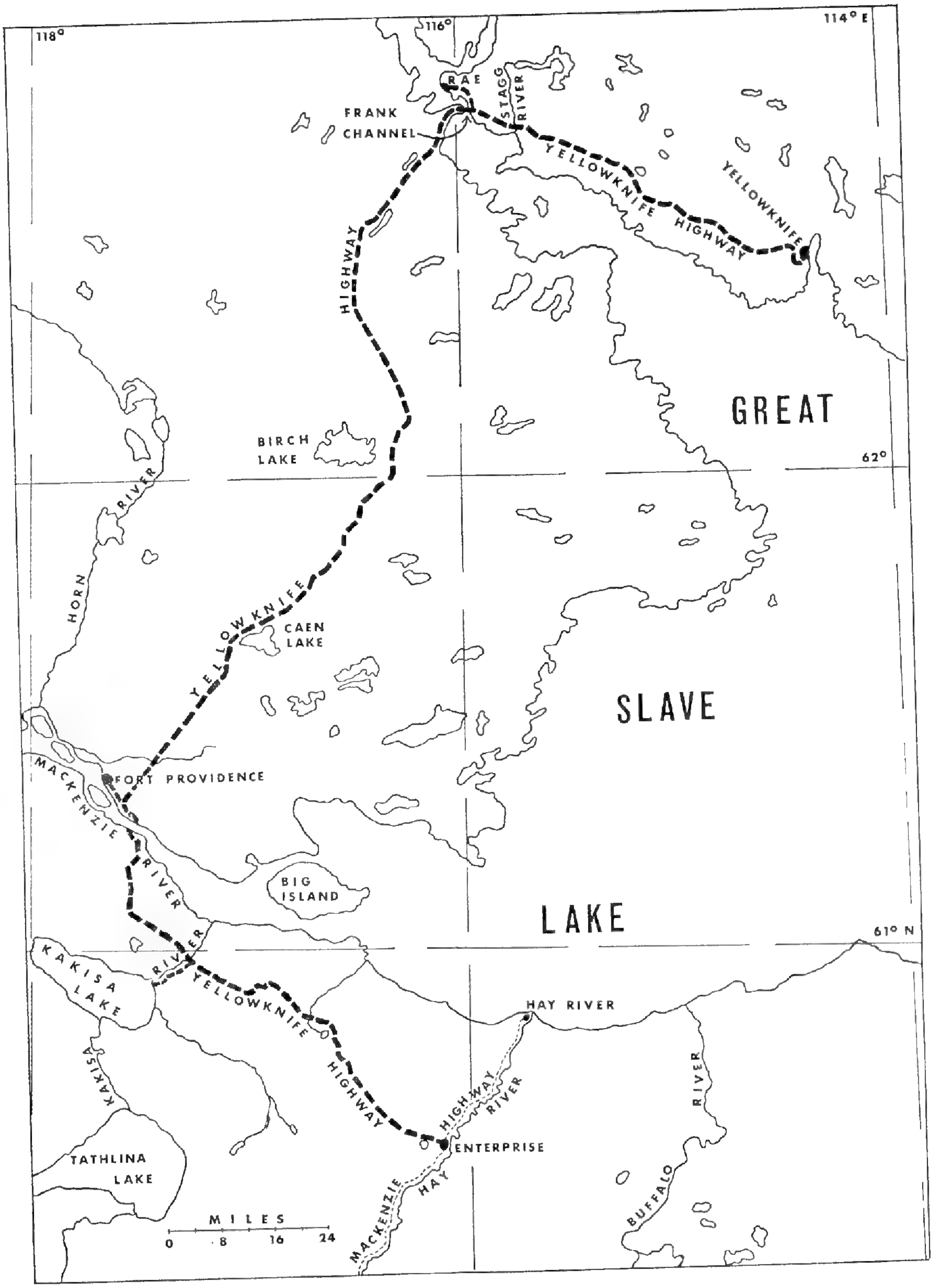

Fig. 1. The Yellowknife Highway Region, Northwest Territories, Canada

(1947) contains an annotated catalogue of the then-known flora of southwestern Mackenzie and a description, based on his field study, of flora and vegetation at Fort Simpson and at Brintnell Lake (which are west of the highway region). Since then, the only work in southwestern Mackenzie, other than the present investigation, was done by Cody (1957, 1961, 1963) and Jeffrey (1961). A part of Cody's work touched portions of the Yellowknife Highway region; his papers present significant floristic records. Jeffrey's paper contains a catalogue of the plants and a description of the vegetation along the lower Liard River (about 150 miles west of the highway).

Porsild's *Botany of Southeastern Yukon adjacent to the Canol Road* (1951) and Raup's *Botanical Investigations in Wood Buffalo Park* (1935) are important contributions pertaining to areas adjacent to southwestern Mackenzie. Each of these papers includes a description of the area investigated, a catalogue of the flora, and a primary survey of the vegetation. Other useful publications covering areas adjacent to southwestern Mackenzie are those by Cody (1960), Hulten (1941-1950), Moss (1953, 1953a, 1955, 1959), Porsild (1934), and Raup (1935, 1936, 1946).

The Yellowknife Highway lies partly in the northern Great Plains and partly in the Canadian Shield. The border between these physiographic provinces is at Frank Channel. The Frank Channel-Yellowknife section of the highway is in the Shield; the Enterprise-Frank Channel section is in the Plains. Elevation along the highway ranges between 513 feet (at the Mackenzie River) and nearly 900 feet. The region transected by the highway presents a variety of habitats for plants. These include marly lakes, muck (i.e., organic detritus) bottom lakes, rocky shores, cold swift streams, Palaeozoic carbonate (limestone) outcrops, Pre-Cambrian crystalline outcrops, sand deposits, grasslands, forests, and areas disturbed by man and fire. The flora and vegetation of the region are correspondingly diversified.

In the following catalogue the genera and species are alphabetically arranged within the families. For the most part the nomenclature used for vascular plants is that of the *Flora of Manitoba* (Scoggan, 1957); synonymy is given when a name differs from the one used there. After each species name (among the seed plants) is an indication of the life-form according to the Raunkiaer classification, employing the usual abbreviations. Then follow other pertinent data (e.g., relative abundance, typical habitat[s], phenology, etc.) and citation of representative specimens by locality and by collection number. Locality is usually given by mile number. A mile number followed by "N" indicates the Mackenzie River-Frank Channel section of the highway and refers to miles north of the river; a mile number followed by "S" indicates the Frank Channel-Yellowknife section and refers to miles from the Yellowknife airport; and a mile number alone indicates the Enterprise-Mackenzie River section and refers to miles from Enterprise. For each species, a specimen from each of the three sections is cited when such specimens are available. That a species is not ascribed to a particular section does not necessarily mean that it does not occur there. The few species seemingly limited to any one section are so designated in the text. I have included in the catalogue a few species that were not found along the Yellowknife Highway itself but were collected along the adjacent Mackenzie Highway in the Northwest Territories. Unless otherwise noted, all specimens cited have been deposited in the herbarium of Chicago Natural History Museum (F), the repository for most of the material collected during the survey.

The catalogue includes 5 algae, 35 lichens, 38 bryophytes, and 452 vascular plants. The seed plants are represented by 61 families, among which the largest are Compositae (55 species), Cyperaceae (51), Gramineae (35), Cruciferae (23), and Rosaceae (22). Among the seed plants the genera represented by 10 or more species are *Carex* (37), *Salix* (18), and *Potamogeton (10)*. The genera *Poa* and *Calamagrostis,* which are incompletely treated, are to be made the subject of separate papers at a later date.

ALGAE

CHARACEAE

Chara aspera Willd. var. *macounii* Allen. In shallow water of roadside pool, mile 110.5 N, *7728,* and of marly stream, mile 39.7 N, *8420.*

Chara contraria A. Br. In shallow water of marly lakes, mile 40.5, *5426,* mile 37, *6138.*

Chara contraria A. Br. var. *hispidula* A. Br. In shallow water of marly lake, mile 37, *6139.*

Chara globularis Thuill. In shallow water of stream, mile 75 N, *7375.*

Tolypella prolifera Leonh. In shallow water, Kakisa Lake, *5674.*

LICHENS

PELTIGERACEAE

Peltigera aphthosa (L.) Willd. Infrequent, usually growing in moss mats in rich spruce forests. Number *4519* is var. *aphthosa; 8028* is var. *variolosa* (Mass.) Thoms. Kakisa Road, *4519;* mile 125.1 N, *8028.*

Peltigera malacea (Ach.) Funck. Jack pine forest on sandy knoll, mile 123.4 N, *8071.*

CLADONIACEAE

Cladonia alpestris (L.) Rabh. Frequent to abundant as a ground cover in spruce or pine forests; common on crystalline and limestone outcrops. In the open jack pine forests around mile 120 N, the white sand is almost completely covered with this and other lichens, and the ground appears yellow. Mile 28.5, *4932;* mile 123.4 N, *8053;* mile 39.8 S, *8326.*

Cladonia alpicola (Flot.) Vainio. Crystalline outcrop, mile 39.8 S, *8325* (p.p.).

Cladonia amaurocraea (Flk.) Schaer. Black spruce forest, mile 53, *4954;* jack pine forest on sandy knoll, mile 123.4 N, *8065.*

Cladonia coccifera (L.) Willd. Jack pine forest on sandy knoll, mile 123.4 N, *8067.*

Cladonia cornuta (L.) Schaer. Spruce forest, mile 125.1 N, *8038;* crystalline outcrop, mile 39.8 S, *8325* (p.p.).

Cladonia degenerans (Flk.) Spreng. Crystalline outcrop, mile 39.8 S, *8325* (p.p.).

Cladonia gonecha (Ach.) Asahina. Spruce forest, mile 125.1 N, *8039;* jack pine forest on sandy knoll, mile 123.4 N, *8068.*

Cladonia gracilis (L.) Willd. var. *dilatata* (Hoffm.) Schaer. Jack pine forest on sandy knoll, mile 123.4 N, *8069.*

Cladonia metacorallifera Asahina. Crystalline outcrop, mile 39.8 S, *8325* (p.p.).

Cladonia mitis Sandst. Frequent in spruce or pine forests and on limestone and crystalline outcrops. Mile 12, *4869;* mile 123.4 N, *8062;* mile 43.7 S, *8315.*

Cladonia pyxidata (L.) Hoffm. var. *neglecta* (Flk.) Mass. Jack pine forest on sandy knoll, mile 123.4 N, *8069;* crystalline outcrop, mile 39.8 S. *8325* (p.p.).

Cladonia rangiferina (L.) Web. Frequent to common as a ground cover in spruce or pine forests; frequent on limestone and crystalline outcrops. Mile 12, *4868;* mile 125.1 N, *8051;* mile 39.8 S, *8327.*

Cladonia sylvatica (L.) Harm. Abundant as a ground cover in a spruce forest, Kakisa Road, *4516.*

Cladonia uncialis (L.) Web. Jack pine forest on sandy knoll, mile 123.4 N, *8063;* crystalline outcrop, mile 43.7 S, *8316.*

Cladonia verticillata (Hoffm.) Schaer. Crystalline outcrop, mile 39.8 S, *8325* (p.p.).

Stereocaulon tomentosum E. Fr. Spruce forest, mile 125.1 N, *8024.*

GYROPHORACEAE

Actinogyra muhlenbergii (Ach.) Schol. Common on crystalline outcrops. Mile 43.7 S, *8318.*

Lasallia pensylvanica (Hoffm.) Llano. Common on crystalline outcrops. Mile 43.7 S, *8319.*

LECANORACEAE

Ochrolechia inaequatula (Nyl.) Zahlbr. Limestone outcrop, mile 127 N, *8292.*

PARMELIACEAE

Cetraria crispa (Ach.) Nyl. Black spruce forest, mile 112.2 N, *8125;* jack pine forest on sandy knoll, mile 123.4 N, *8066.*

Cetraria culcullata (Bell.) Ach. Spruce forest, mile 125.1 N, *8030.*

Cetraria islandica (L.) Ach. Spruce forest, mile 125.1 N, *8040.*

Cetraria nivalis (L.) Ach. Frequent to common in spruce or pine forests and on limestone and crystalline outcrops. Mile 12, *4870;* mile 123.4 N, *8055;* mile 39.8 S, *8317.*

Cetraria tilesii Ach. Rare on limestone outcrops. Mile 22.7, *5176;* mile 127 N, *8290.*

Parmelia centrifuga (L.) Ach. Crystalline outcrop, mile 43.7 S, *8320.*

Parmelia stenophylla (Ach.) Hueg. Crystalline outcrop, mile 39.8 S, *8323.*

Parmelia sulcata Tayl. Crystalline outcrop, mile 39.8 S, *8322.*

USNEACEAE

Evernia mesomorpha Nyl. Common on bark of birches in spruce forest, mile 125.1 N, *8027.*

Thamnolia vermicularis (Sw.) Ach. Limestone outcrop, mile 127 N, *8296.*

Usnea comosa (Ach.) Röhl. Common on bark of birches in spruce forest, mile 125.1 N. *8026.*

CALOPLACACEAE

Caloplaca elegans (Link) T. Fr. Limestone outcrop, mile 127 N, *8299.*

BUELLIACEAE

Buellia papillata (Somerf.) Tuck. Limestone outcrop, mile 127 N, *8294.*

PHYSCIACEAE

Physcia muscigena (Ach.) Nyl. Spruce forest, mile 125.1 N, *8025;* limestone outcrop, mile 127 N, *8291.*

BRYOPHYTES

SPHAGNACEAE

Sphagnum balticum Russ. On sedge mats around muck bottom lakes. Mile 57.6 S, *7247.*

Sphagnum capillaceum (Weiss) Schrank var. *tenellum* (Schimp.) Andrews. Black spruce forest, mile 59.8 S, *6763.*

Sphagnum cuspidatum Ehrh. In shallow water on sedge mats and in forest pools. Mile 59.8 S, *6764.*

Sphagnum fuscum (Schimp.) H. Klinggr. Apparently the most common *Sphagnum* in the region. Usually found in hummocks in forests, principally of black spruce, where it may be the main ground cover. Mile 53, *4951;* mile 59.8 S, *6762;* mile 36 N, *7541.*

Sphagnum girgensohnii Russ. Black spruce forest, mile 126 N, *9141a.*

Sphagnum riparium Angstr. In *Ledum* muskeg, mile 44.8 S, *7222.*

Sphagnum squarrosum Pers. ex. Crome. Black spruce forest, mile 126 N, *9141.*

Sphagnum warnstorfianum DuRietz. Occasional to common, forming mounds or mats in black spruce forests and in wet muskegs. Mile 52, *5370;* mile 44.8 S, *7223;* mile 36 N, *7540.*

POLYTRICHACEAE

Polytrichum formosum Hedw. In depressions on crystalline outcrops, where it forms mats on thin soil. Mile 39 S, *7934.*

Polytrichum juniperinum Hedw. Disturbed soil, Kakisa Road, *5359;* crystalline outcrop, mile 11.5 S, *6713.*

Polytrichum juniperinum Hedw. var. *alpestre* (Hoppe) BSG. Spruce forest, Kakisa Road, *4557;* disturbed soil, mile 81.5 N, *6887.*

Polytrichum piliferum Hedw. In peaty depressions on crystalline outcrops. Mile 14.5 S, *7152.*

DITRICHACEAE

Ceratodon purpureus (Hedw.) Brid. Disturbed soil, mile 4.2 N, *6625.*

Ditrichum flexicaule (Schwaegr.) Hampe. Limestone outcrops, mile 22.7, *5176a,* mile 127 N, *8297;* spruce forest, Kakisa Road, *4763;* shrub zone around marly lake, mile 64, *6051.*

DICRANACEAE

Dicranum bergeri Bland. Shrub zone around a marly lake, mile 64, *6052;* spruce forest, mile 125.1 N, *8034.*

GRIMMIACEAE

Hedwigia ciliata (Hedw.) P.-B. Crystalline outcrop, mile 27.7 S, *7204.*

AULACOMNIACEAE

Aulacomnium acuminatum (Lindb. et Arn.) Par. Frequent to common as a ground cover in spruce forests. Kakisa Road, *5351;* mile 65.8 S, *7990.*

Aulacomnium palustre (Hedw.) Schwaegr. Frequent in spruce forests, where it may be important as a ground cover. Mile 27.7, *4936.*

Aulacomnium turgidum (Wahl. ex Web. et Mohr) Schwaegr. Limestone outcrop, mile 128 N, *6788;* crystalline outcrop, mile 8.3 S, *7134.*

MEESIACEAE

Meesia tristicha BSG. In sedge mat around lake, mile 47.2 S, *4957.*

Paludella squarrosa (Hedw.) Brid. White spruce forest, mile 62.8 S, *7979.*

BRYACEAE

Brynum lacustre Bland. Marl deposit, mile 110.5 N, *6837.*

Leptobryum pyriforme (Hedw.) Schimp. Disturbed soil, mile 2.5 S, *6672.*

HYPNACEAE

Campylium stellatum (Hedw.) Lange et C. Jens. Black spruce forests, mile 44.5, *5122*, mile 115 N, *8284;* sedge mat and shallow water of marly lake, mile 63, *5299*.

Drepanocladus aduncus (Hedw.) Warnst. var. *polycarpus* (Bland. ex Voit) Warnst. Sedge meadow, mile 23.2 S, *7906*.

Drepanocladus capillifolius (Warnst.) Warnst. In muck and shallow water of lake, mile 20.5 S, *7175;* sedge meadow, mile 11.4 S, *7833*.

Drepanocladus exannulatus (BSG) Warnst. In sedge mats and in shallow water of muck bottom lakes. Mile 44.8 S, *7218*.

Drepanocladus fluitans (Hedw.) Warnst. Shallow pool in black spruce forest, mile 59.8 S, *6765;* among rocks in shallow water, Mackenzie River, *7460*.

Drepanocladus vernicosus (Lindb.) Warnst. Shallow water of marly lake, mile 40.5, *5425*.

Hylocomium splendens (Hedw.) BSG. The common "feather moss" of the region. Especially abundant in rich white spruce forests, where it forms a dense carpet on the floor, as it may do also in certain black spruce forests. Characteristic of more mesophytic forests of jack pine, where it occurs in scattered patches. Mile 33.5, *5990;* mile 42.5 N, *6918;* mile 65.8 S, *7986*.

Hypnum bambergeri Schimp. Black spruce forest, mile 72 N, *7651*.

Scorpidium scorpioides (Hedw.) Limpr. Shallow water of marly lake, mile 54, *5079*.

Tomenthypnum nitens (Hedw.) Loeske. Frequent to common in white or black spruce forests, where it is a characteristic ground cover. Mile 66, *5268;* mile 42.5 N, *6923;* mile 62.8 S, *7979*.

THUIDIACEAE

Abietinella abietina (Hedw.) Fl. In moss mat on limestone slab, mile 128 N, *6779*.

FONTINALACEAE

Fontinalis duriaei Schimp. On rocks in boulder rapids, Kakisa River, *5701*.

PLAGIOCHILACEAE

Mylia anomala (Hook.) S. F. Gray. Among *Sphagnum fuscum* in forests, mile 113.5 N, *6822*, mile 45 S, *7941*.

PTILIDIACEAE

Ptilidium ciliare (L.) Nees. Among *Dicranum bergeri* in spruce forests, mile 125.1 N, *8035*.

MARCHANTIACEAE

Marchantia polymorpha L. Edge of roadside pool, mile 61.2 N, *7604*.

RICCIACEAE

Ricciocarpus natans (L.) Corda. In shallow water among *Carex,* Mackenzie River, *5995,* and among *Lemna minor* in small pond, mile 26 S, *9276.*

VASCULAR PLANTS

EQUISETACEAE

Equisetum arvense L. Infrequent along shores and in moist forests; locally common in disturbed areas. Kakisa River, *4539;* mile 2.5 S, *6673;* mile 24 N, *7437.*

Equisetum fluviatile L. Infrequent in shallow water, in marshes, in sedge mats, and on shores. Mackenzie River, *4239;* Kakisa Lake, *4898;* mile 85 N, *6880;* mile 3.6 S, *7798.*

Equisetum palustre L. Infrequent along shores, in shallow water, and in black spruce forests; locally frequent in disturbed areas. Mile 44, *4299;* mile 119 N, *7747a;* mile 66 S, *8019.*

Equisetum scirpoides Michx. Infrequent in sandy soil or moss mats in forests of pine or spruce; locally common in disturbed soil. Mile 123.4 N, 7294; Enterprise, 9051.

Equisetum sylvaticum L. Infrequent in peaty soil or in moss mats in moist forests, especially of black spruce; locally frequent in disturbed soil. Kakisa Road, *4508;* mile 2.5 S, *6668.*

Equisetum variegatum Schleich. Seen only once, sandy-gravelly beach of Kakisa Lake near outlet, *6096.*

LYCOPODIACEAE

Lycopodium complanatum L. Rare in dry sandy soil in pine or spruce woods. Mile 11.5, *4835;* mile 59.3 S, *6747;* Prelude Lake, *9221.*

SELAGINELLACEAE

Selaginella selaginoides (L.) Link. Rare in muskeg forests and in shrub zones around marly lakes. Mile 57.5, *5217;* mile 119 N, *7740.*

ISOETACEAE

Isoetes echinospora Dur. var. *braunii* (Dur.) Engelm. Seen only once, in shallow water, sandy bouldery bottom, Prelude Lake, *9216.*

POLYPODIACEAE

Cryptogramma crispa (L.) R. Br. var. *acrostichoides* (R. Br.) Clarke. Infrequent in shallow soil or in crevices on rock outcrops, mainly crystalline but occasionally limestone. Mile 66 S, *7257;* Horseshoe Island, Yellowknife Bay, *9492.*

Cystopteris fragilis (L.) Bernh. Infrequent in crevices on limestone outcrops. Mile 15.5, *5153;* mile 66 S, *6778.*

Cystopteris montana (Lam.) Bernh. Seen only once, in a spruce-feather moss forest on slope above Kakisa River 1.5 miles below Lady Evelyn Falls, *5350*.

Dryopteris robertiana (Hoffm.) Christensen. Seen only once, in crevices on face of limestone escarpment in white spruce forest, mile 15.5, *5156*.

Dryopteris fragrans (L.) Schott. Infrequent in crevices on crystalline outcrops. Of the collections made of this species, only *9178*, with its overlapping pinnae, approaches var. *fragrans;* the others are clearly var. *remotiuscula* Kom. Yellowknife, *9178;* mile 16 S, *9296*.

Polypodium virginianum L. Infrequent in crevices on rock outcrops, mainly crystalline but occasionally limestone. Mile 2.7 S, *6692;* mile 66 S, *7258*.

Woodsia glabella R. Br. Infrequent in crevices on limestone outcrops. Mile 26, *4336;* mile 66 S, *6775*.

Woodsia ilvensis (L.) R. Br. Frequent in rock crevices, especially on crystalline outcrops, but also on limestone. Mile 2.7 S, *6688;* mile 66 S, *7259*.

PINACEAE

Juniperus communis L. var. *depressa* Pursh. (N) Frequent in a variety of habitats, including rocky slopes, forests of most kinds, and rock outcrops (both crystalline and limestone). Although occasionally almost prostrate, common juniper usually assumes the form of a spreading decumbent shrub between 1 and 3 feet tall. The branches typically recline for about half their length and then ascend. The reclining portion of the branches usually roots. This plant is most characteristic, perhaps, of jack pine forests on sandy knolls and limestone outcrops, where it forms a distinct low-shrub stratum. Mile 70, *4246;* mile 2.7 S, *6686;* mile 96.7 N, *7699*.

Juniperus horizontalis Moench. (Ch) Frequent in a variety of habitats, including rocky slopes, forests of most kinds, and, most commonly, rock outcrops (both crystalline and limestone). Stems prostrate, to at least 20 feet long and 1.7 inch in diameter. Creeping juniper exists along the highway in two strikingly distinct forms, glaucous and green. These forms are most effectively contrasted where they grow together, as on the limestone outcrops at mile 26-28. Here, the elongate branches of many plants criss-cross each other, forming in many spots a distinctive reticulate pattern on the rock. Mile 36, *4610;* mile 96.5 N, *6868;* Yellowknife, *9187*.

Larix laricina (Du Roi) K. Koch. (Ms) Frequent in muskeg forests, although seldom forming pure stands of any extent. Larch is most commonly found in moist to wet areas, but it occasionally occurs in seemingly xeric habitats, such as atop crystalline outcrops, where it grows in crevices. The maturing cones are magenta and glaucous. Larch is the least common of the gymnospermous trees in the highway region. Trees between 26 and 32 feet tall and 3.3 to 4.9 inches DBH were found to have 24 to 29 annual rings. Mile 64, *6059;* mile 2.5 S, *6676;* mile 26.5 N, *7519.*

Picea glauca (Moench) Voss. (Mg) Common to abundant in white spruce and more mesic jack pine forests; frequent on sand plains and on rock outcrops (both crystalline and limestone). White spruce is the commonest tree on mesic sites. The largest specimen observed, in the gorge of Kakisa River about ½ mile below Lady Evelyn Falls, was 28.1 inches DBH and an estimated 129 feet tall. It showed 183 annual rings. The other tall white spruces measured by us did not exceed 67 feet in height and 15.7 inches DBH and did not show more than 91 annual rings; most were appreciably smaller and younger than this. Mile 65, *6048;* mile 74 N, *6894;* Yellowknife, *9183.*

Picea mariana (Mill.) BSP. (Ms) Common to abundant in black spruce forests; occasional on crystalline outcrops and on sand plains and ridges. Black spruce, the commonest tree in hydric sites, seldom exceeds 6 inches in diameter and 40 feet in height, and is commonly of much less stature than this. The largest tree seen by us was 9.8 inches DBH and 63 feet tall and showed 160 annual rings. Black spruce is the slowest growing tree in the highway region. A specimen 7 inches DBH and 34 feet tall showed about 212 annual rings; one 4.5 inches DBH and 31 feet tall showed about 190; one 4.3 inches DBH and 27 feet tall showed about 178; and one 3.3 inches DBH and 18 feet tall showed 56. Kakisa Road, *4576;* mile 2.5 S, *6677.*

Pinus banksiana Lamb. (Ms) Characteristic tree of sandy knolls, sand plains, and rock outcrops (both crystalline and limestone). Although most commonly found in these rather xeric habitats, jack pine can occur in many other habitats, some of them seemingly far from being xeric, such as floating "islands" in marly lakes. This species appears to reach its best development in the highway region in the open, park-like stands between miles 95 N and 130 N, where magnificent open-grown pines occur. Here are low branched trees up to 64 feet tall, 15.7 inches DBH, and 130 years old. Mile 11.5, *4833;* mile 101.1 N, *7082.*

TYPHACEAE

Typha latifolia L. (HH) Infrequent in wet places or shallow water. Most commonly observed in disturbed areas, especially roadside ditches; only infrequently seen in undisturbed areas. In a few sites cattail is a contributor to the mat around lakes in the Canadian Shield section. Mile 1, *5553;* mile 61.2 N, *7594;* mile 6.8 S, 7815.

SPARGANIACEAE

Sparganium angustifolium Michx. (incl. *S. multipeduncalatum* [Morong] Rydb.) (HH) infrequent in mud or muck of shores or roadside ditches or in still or flowing water to about 2 feet deep. As represented in our region, *S. angustifolium* is a highly polymorphic species. In the same colony can be found leaves varying from 3 to 25 mm. wide; generally the plants growing in the deepest water have the narrowest leaves. Leaves are commonly flat in the upper half and convex on the back in the lower half. Foliar characteristics and others, including size and number of pistillate heads and length of stigma, frequently used to distinguish *S. augustifolium* from *S. multipedunculatum,* appear to break down in our northern material, a conclusion reached also by Hulten (1941-1950) and Anderson (1959). Kakisa River, *5710;* mile 7.7 S, *7818;* mile 12 N, *8253.*

Sparganium minimum (Hartm.) Fries. (HH) Infrequent in mud or muck of shores or roadside ditches or in still or flowing water to about 1.5 feet deep. The material I refer to this species is rather variable but it surely represents only one taxon. Most specimens have 1, 2, or 3 pistillate heads, but a few have 4 or even 5. The mature heads vary in diameter from 8 to 12 mm. In about half the plants observed, all the pistillate heads are sessile, but in the others the lowest head(s) are peduncled, with peduncles to 23 mm. long. The peduncles are usually axillary, but occasionally one is clearly supra-axillary. The peduncle of the staminate head varies from 3 to 18 mm. long. Mile 50, *5717;* mile 30 S, *9270.*

ZOSTERACEAE

Potamogeton alpinus Balbis var. *tenuifolius* (Raf.) Ogden. (HH) Rare in still water to at least 1.5 feet deep, clay or muck bottom. Noted only in Canadian Shield section. Mile 9.7 S, *7823.*

Potamogeton filiformis Pers. (HH) Infrequent in still or flowing water to at least 1.5 feet deep, gravel, marl, or clay bottom. Numbers *7637* and *7814,* cited below, represent var. *borealis* (Raf.) St. John; *9061,* with leaves about 1 mm. wide, is best referred to var. *macounii* Morong. Mile 23.5, *9061;* mile 68.2 N, *7637;* mile 6.8 S, *7814.*

Potamogeton foliosus Raf. var. *macellus* Fern. (HH) Rare in shallow still water, clay or muck bottom. Noted only in Canadian Shield section. Mile 38.3 S, *8356.*

Potamogeton friesii Rupr. (HH) Rare in shallow still water, clay or muck bottom. Noted only in Canadian Shield section. Mile 12.7 S, *7858.*

Potamogeton gramineus L. (HH) Frequent in still or flowing water to at least 2 feet deep, gravel, clay, or muck bottom. On the specimens cited below, *5702* clearly is var. *maximus* Morong; *8372* is var. *gramineus;* and *8307* is intermediate in leaf characteristics between these varieties. Kakisa River, *5702;* Stagg River, *8307;* mile 54.4 S, *8372.*

Potamogeton pectinatus L. (HH) Seen only once, among boulders in shallow water of Mackenzie River at Fort Providence, *4232.*

Potamogeton pusillus L. (HH) Infrequent in still or flowing water to at least 2 feet deep, clay or muck bottom. Noted only in Canadian Shield section. Mile 7.7 S, *7816.*

Potamogeton richardsonii (Benn.) Rydb. (HH) Infrequent in still or flowing water to at least 4 feet deep, gravel, clay, or muck bottom.

Kakisa Lake, *5633;* mile 12 N, *8252;* mile 49 S, *8306.*

Potamogeton vaginatus Turcz. (HH) Rare in still or flowing water to at least 1.5 feet deep, gravel or sand bottom. Kakisa Lake, *4615;* Yellowknife, *9172.*

Potamogeton zosteriformis Fern. (HH) Rare in still water to at least 3 feet deep, muck bottom. Noted only in Canadian Shield section. Mile 36.4 S, *8351.*

JUNCAGINACEAE

Triglochin maritima L. (Hrr) Infrequent along rocky or sandy shores, in marshy areas, in marl deposits, and in sedge mats and shallow water around marly lakes. Mackenzie River, *4134;* mile 66, *4260;* mile 72 N, *7033;* Prosperous Lake, *9196.*

Triglochin palustris L. (Hrr) Infrequent along rocky or sandy shores, in marshy areas, in marl deposits, in sedge mats and shallow water around marly lakes, and in spruce forests. Kakisa River, *4276;* mile 72 N, *7036;* Yellowknife, *8342.*

ALISMATACEAE

Sagittaria cuneata Sheld. (HH) Infrequent in water to 1.5 feet deep, and along shores in sandy, gravelly, clayey, or mucky soil. A highly polymorphic species. In relatively deep water, the petioles and peduncles may be 20 to 24 inches long, and the leaf blades typically are floating. In shallow water and on shores, the petioles and peduncles seldom exceed 6 to 8 inches in length, and the leaf blades are erect. Kakisa Lake, *5659;* mile 49 S, *7959.*

GRAMINEAE

Agropyron cristatum Gaertn. (Hs) Seen only once, in disturbed soil, Fort Providence, *9075a.*

Agropyron latiglume (Scribn. et Sm.) Rydb. (Hs) Seen only once, in disturbed soil, mile 59, *6073.*

Agropyron repens (L.) Beauv. (Grh) Seen only once, in weedy area, Yellowknife, *7777.*

Agropyron trachycaulum (Link) Malte. (Hs) Infrequent to common along sandy or clay shores, in shallow residual soil on limestone outcrops, and in disturbed soil. Dominant, with *Muhlenbergia richardsonis, Carex atherodes,* and *Calamagrostis neglecta,* in drier grasslands near Fort Providence. *Agropyron trachycalum,* in the highway region, exists in four varieties that intergrade in morphology and that frequently occur in the same habitat. Of the collections cited below, *4229* and *5747* appear closest to var. *trachycaulum; 4136, 4308, 6093,* and *7063* are var. *novae-angliae* (Scribn.) Fern.; *4137, 7992, and 8224* are var. *glaucum* (Pease et Moore) Malte; and *7471* is best referred to var. *unilaterale* (Cassidy) Malte. Mile 17 N, *4136, 4137;* Fort Providence, *4229;* mile 41, *4308;* mile

24, *5631, 5632;* Kakisa River, *5747, 6093;* mile 86.7 N, *7063;* mile 10 N, *7471;* mile 66 S, *7992;* Mackenzie River, *8224.*

Agrostis scabra Willd. (Hs) Infrequent on outcrops, both crystalline and limestone, in marl deposits, and along mucky, marly, or sandy shores, becoming frequent to common in disturbed areas. Mile 66, *5235;* mile 66 S, *7262;* mile 110 N, *7299.*

Alopecrus aequalis Sobol. (Hs) Rare in marshes, in sedge mats around muck-bottom lakes, and along clay, gravelly, sandy, or mucky shores; becoming frequent in disturbed areas. Fort Providence, *5041;* mile 23.5, *5777;* mile 82 N, *7053;* mile 16.5 S, *7878.*

Arctagrostis latifolia (R. Br.) Griseb. (Incl. *A. arundinacea* [Trin.] Beal) (Hsr) Local in disturbed soil along highway; seen only once in an undisturbed habitat, a white spruce forest above shore of Great Slave Lake, mile 62.8 S, *7978.* Mile 7.5 N, *4215;* mile 33, *4319.*

Beckmannia syzigachne (Steud.) Fern. (Th) Rare on gravelly, muddy, or sandy shores and in marshes, becoming frequent in disturbed areas. Mile 11 N, *4223;* Kakisa River, *5210;* Prosperous Lake, *9223.*

Bromus inermis L. (Hsr) Seen only once, along Mackenzie Highway 4 miles south of Hay River, *5536.*

Bromus pumpellianus Scribn. (Hsr) Rare in dry sandy soil in pine or spruce woods and along rocky shores. Numbers *4234* and *7309* are notable for the length (up to 4.5 cm.) of their spikelets. Fort Providence, *4234;* mile 46, *5404;* mile 66 S, *7287;* mile 110 N, *7309.*

Calamagrostis. My collections of *Calamagrostis* from the highway region total 174 numbers (including many mass collections). Many are readily referrable to *C. canadensis* (Michx.) Beauv.,*C. inexpansa* Gray, *C. lapponica* (Wahl.) Hartm., *C. neglecta* (Ehrh.) Gaertn., or *C. purpurascens* R. Br. Many others cannot be convincingly referred to any of these species but appear to be intermediates. The specimens are discouragingly variable in those characteristics commonly regarded as diagnostic in *Calamagrostis.* I plan to present, in a separate paper, an analysis of this variation.

Deschampsia cespitosa (L.) Beauv. (Hs) Infrequent on rocky or sandy shores, in shallow residual soil over limestone, and in marl deposits. Kakisa River, *4014;* mile 110 N, *7306;* mile 64.6 S, *8379.*

Elymus canadensis L. (Hs) Seen only once, on gravelly shore of Hay River near mile 49 of Mackenzie Highway, *6167.*

Elymus innovatus Beal. (Hsr) Infrequent to rare in sand or in moss mats in white spruce or jack pine forests, becoming frequent in disturbed areas. Fort Providence, *5045;* mile 52, *5099;* mile 103.2 N, *7342.*

Festuca rubra L. (Hsr) Seen only once, in disturbed clay, mile 21.5 N, *6969.*

Festuca saximontana Rydb. (Hs) Infrequent in dry sandy soil, especially in pine or spruce woods, in shallow residual soil over limestone, and on crystalline outcrops, becoming frequent in disturbed areas. Mile 22.7, *5174;* mile 70.5 N, *6906;* mile 6.1 S, *7125.*

Glyceria borealis (Nash) Batch. (Hsr) Rare on muddy or sandy shores or in shallow water. Seen only in Canadian Shield section. Mile 20.5 S, *7893.*

Glyceria grandis Wats. (Hsr) Rare along muddy, sandy, or mucky shores or in shallow water. Kakisa River, *5711;* mile 20.5 S, *7900;* mile 126 N, *9139.*

Glyceria pulchella (Torr.) Trin. (Hsr) Infrequent along muddy, sandy, or mucky shores; locally abundant in marshes. Four miles northeast of Fort Providence, *4123;* mile 56, *5011;* mile 26.9 S, *7911.*

Glyceria striata (Lam.) Hitchc. (Hsr) Rare along muddy, sandy, or peaty shores. Mile 13, *5588;* mile 66 S, *8021.*

Helictotrichon hookeri (Scribn.) Henr. (Hs) Rare in shallow residual soil over limestone. Noted only south of the Mackenzie River. Mile 22.7, *5161.*

Hierochloe odorata (L.) Beauv. (Hsr) Infrequent along shores or in shallow residual soil on limestone outcrops. Kakisa River, *4730;* mile 39.7 N, *6993a.*

Hordeum jubatum L. (Hs) Infrequent in drier grasslands, on rocky shores, and in marl deposits, becoming locally frequent to common in disturbed areas. Mile 17 N, *4143;* mile 66, *5256;* mile 23.5 S, *7190.*

Koeleria cristata (L.) Pers. (Hs) Infrequent to rare in shallow residual soil over limestone. Noted only south of the Mackenzie River. Mile 28.5, *4919.*

Muhlenbergia glomerata (Willd.) Trin. var. *cinnoides* (Link) Herm. (Hsr) Rare in marl deposits or in sedge mats around marly lakes, usually growing on ant hills. Noted only south of the Mackenzie River. Mile 50, *5718.*

Muhlenbergia richardsonis (Trin.) Rydb. (Hsr) Rare on rocky shores, in shrub zones around marly lakes, and in limestone crevices; common in prairies northeast of Fort Providence, where it may be co-dominant with *Agropyron trachycaulum.* Mile 17 N, *4191;* mile 50, *5397.*

Oryzopsis asperifolia Michx. (Hs) Rare in dry peaty or sandy soil in woods, especially jack pine or white spruce. Noted only south of the Mackenzie River. Kakisa River, *4741.*

Oryzopsis pungens (Torr.) Hitchc. (Hs) Infrequent in sandy or dry peaty soil in pine or spruce woods and in shallow residual soil over limestone. Mile 33, *4318;* mile 103.5 N, *6850.*

Phalaris arundinacea L. (Grh) Infrequent along rocky or marly shores and in marl deposits. Number *9450* is notable for the length—up to 29.5 cm.—of its panicles. Mackenzie River, *4233;* mile 59.5 N, *7378;* Kakisa River, *9450.*

Phalaris canariensis L. (Th) Seen only once, disturbed soil, mile 3 N, *9434* (in herb. DAO).

Phleum pratense L. (Hs) Rare in disturbed soil. Kakisa River, *5474;* mile 21.5 N. *7503.*

Poa. The genus *Poa* is represented in the highway region by at least the following species: *P. alpina* L., *P. glauca* Vahl, *P. interior* Rydb., *P. leptocoma* Trin., *P. palustris* L., *P. pratensis* L., and *P. stenantha* Rydb. My collections total 114 numbers. They will be reported on in a separate paper.

Puccinellia distans (L.) Parl. (Hs) Seen only twice, disturbed soil, mile 16 S, *7154,* and sandy shore of Prosperous Lake, *9198.*

Puccinellia nuttalliana (Schultes) Hitchc. (Hs) Rare in marl deposits, becoming frequent in disturbed areas. Enterprise, *3898;* mile 39.7 N, *7401.*

Scolochloa festucacea (Willd.) Link. (Hsr) Locally frequent to common or even dominant in marshes, in marl deposits, and on marly shores. Four miles northeast of Fort Providence, *4065;* mile 39.7 N, *7553;* mile 67.7 N, *7627.*

Sphenopholis intermedia (Rydb.) Rydb. (Hs) Rare along sandy rocky shores and in disturbed areas. Mile 0.5, *5939;* Mackenzie River, *6001.*

Trisetum spicatum (L.) Richt. (Hs) Rare in shallow residual soil or in crevices on limestone outcrops, and in sandy soil in pine woods. Mile 23.5, *5134;* mile 110 N, *7304.*

CYPERACEAE

Carex aenea Fern. (Hs) Frequent to common in disturbed soils, especially sand; rare in seemingly undisturbed sand in jack pine woods and in peaty depressions on crystalline outcrops. Mile 50, *5111;* mile 110 N, *7298;* mile 1.8 S, *7784.*

Carex aquatilis Wahl. (Grh [HH]) Frequent to abundant in shallow water and on shores, in marl deposits, and in sedge mats; rare in moss and lichen mats on limestone and in spruce forests. This, the commonest sedge of the highway region, in co-dominant with *Carex atherodes* and *Scolochloa festucacea* in the extensive marshes north of Fort Providence. It is an important contributor to the sedge mats around both marly and muck bottom lakes. Four miles northeast of Fort Providence, *4029;* Kakisa Lake, *4651;* mile 59.5 N, *7377;* mile 7 S, *9248.*

Carex atherodes Spreng. (Grh [HH]) Frequent to abundant in shallow water and on shores in marl deposits, and in prairies. *Carex atherodes* is a co-dominant species, with *Carex aquatilis* and *Scolochloa,* in the extensive marshes north of Fort Providence, and, in the same area, is co-dominant in prairies with *Calamagrostis neglecta* and *Agropyron trachycaulum.* Four miles northeast of Fort Providence, *4027;* mile 72 N, *8269.*

Carex aurea Nutt. (Grh) Local, mostly in disturbed damp sandy, peaty, or clay soil; occurring also on marly shores and in grasslands. Kakisa River, *5339;* mile 65.6 N, *7615.*

Carex bebbii Olney. (Hs) Infrequent in residual soil over limestone and in disturbed sandy or peaty soil. Kakisa River, *5332.*

Carex buxbaumii Wahl. (Hsr [HH]) Infrequent to abundant in sedge mats, in marl deposits, and in disturbed peaty soil; noted once in a black spruce-*Hylocomium splendens* forest. *Carex buxbaumii* is, in places, an important contributor to the mat around marly lakes. Its rhizomes often extend 2 to 3 feet into open water beyond the edge of the mat. Mile 66, *4258;* mile 28.5 N, *7430.*

Carex canescens L. (Hs) Local in disturbed soil at roadside, on sedge mats and shores of muck bottom lakes, and on crystalline and limestone outcrops. Much of the material I refer here is seemingly transitional to *Carex brunnescens* (Pers.) Poir. Mile 46.6 S, *7225;* mile 35 N, *7537.*

Carex capillaris L. (Hs) Infrequent to rare on hummocks in marshes, in marl deposits, in sedge mats, in moss mats in black spruce forests, and in disturbed soil. Mile 56, *4789;* mile 110 N, *7318.*

Carex capitata L. (Hsr) Infrequent to rare in spruce-feather moss forests and in disturbed sandy, peaty, or clayey soil. Kakisa River, *4545;* mile 42.5 N, *6920;* mile 66 S, *7267.*

Carex chordorrhiza L. f. (Hsr [Ch])Rare on crystalline outcrops, where it grows in shallow peaty depressions. It rhizomes may extend out from the depression several feet over bare rock. The internodes of these "stolons" are up to 6 cm. long, and from the nodes arise leaves and flowering culms—but no roots. The "stolons" survive the winter and continue growth in length the following spring, evidencing typically chamaephytic behavior. Mile 4.7 S, *6702.*

Carex concinna R. Br. (Hsr) Infrequent to rare in moss mats in spruce forests, in shallow residual soil over limestone, in marl deposits, in grassy openings in woods, and in disturbed sandy soil. The plants are most robust in disturbed areas. The culms, especially of more vigorous plants, may bend over gracefully so that the spikes touch the ground. Kakisa River, *4522;* mile 110.5 N, *6835.*

Carex crawfordii Fern. (Hs) Seen only once, in disturbed sandy soil along road to ford over Kakisa River, *4287.*

Carex deflexa Hornem. (Hsr) Rare; observed only in disturbed situations, either sandy or peaty soil. Kakisa Road, *4514;* mile 8.3 S, *7129;* mile 110 N, *7302.*

Carex diandra Schr. (Hs) Infrequent in sedge mats around both marly and muck bottom lakes, and in marl and muck deposits. Mile 63, *5292;* mile 16.2 S, *7171.*

Carex disperma Dewey. (Grh) Infrequent to rare in marshy areas and in disturbed sandy, peaty, or clay soil. Kakisa Lake, *4627;* mile 32 N, *6975;* mile 46.6 S, *7227.*

Carex eburnea Boott. (Grh) Rare in crevices of shaded limestone outcrops. Mile 26, *4340;* mile 124.5 N, *7289.*

Carex foenea Willd. (Grh) Local in sand in dry situations, usually in pine woods; also in disturbed sand at roadside. Mile 110 N, *7301;* Yellowknife, *7775.*

Carex garberi Fern. (Grh) Infrequent along rocky or marly shores, in marl deposits, and in disturbed loam or peat soils. Mile 7, *4807;* Mackenzie River, *7458;* mile 110.5 N, *7735.*

Carex glacialis Mack. (Hs) Seen only once, in crevices in limestone cliff, mile 66 S, *7286.*

Carex gynocrates Wormsk. (Grh) Infrequent in moss mats in spruce forests and in disturbed peaty soil adjacent to these forests. Kakisa River, *5343;* mile 72 N, *7027.*

Carex interior Bailey. (Hsr) Seen only once, in sedge mat around marly lake, mile 61, *5276.*

Carex lasiocarpa Ehrh. (Grh [HH]) Infrequent to common along shores, in sedge mats around both marly and muck bottom lakes, in shallow water, and in disturbed peaty soil. *Carex lasiocarpa* is an important contributor, in places, to sedge mats. Of the collections cited below, *7459* represents var. *latifolia* (Böck.) Gleason (*Carex lanuginosa* Michx.); the others are var. *americana* Fern. Mile 44, *4303;* Mackenzie River, *7459;* mile 6 S, *7810a.*

Carex leptalea Wahl. (Hsr) Infrequent to rare in hummocks in marshes, persisting and becoming locally frequent in disturbed gravelly or peaty soil. Mile 56, *4790;* mile 35 N, *7539.*

Carex limosa L. (Grh [HH]) Rare to frequent in sedge mats around both marly and muck bottom lakes; sometimes also in shallow water beyond edge of mat. Mile 61, *5280;* mile 44.8 S, *7219.*

Carex media R. Br. (Hs) Rare in spruce-feather moss forests, becoming somewhat more common in disturbed soil. Mile 66, *5245;* mile 32 N, *6976,* mile 4.8 S, *7117.*

Carex paupercula Michx. var. *pallens* Fern. (Hs) Seen only once, on muck bottom of drained lake, mile 20.5 S, *7174.*

Carex physocarpa Presl. (Grh [HH]) Infrequent in marl deposits, in shallow water of marly lakes, and in marshes. Mile 66, *4256;* mile 41.3 N, *7003.*

Carex praticola Rydb. (Hs) Infrequent in *Calamagrostis* or *Agrophyron-Muhlenbergia* prairies northeast of Fort Providence, spreading to disturbed soil at roadside. Mile 17 N, *4202.*

Carex raymondii Calder. (Hs) Rare; seen only in disturbed soil. Mile 0.5, *5548;* mile 26.5 N, *7521.*

Carex rossii Boott. (Hs) Rare; seen only in disturbed soil. Mile 28.5, *4918;* mile 41.3 N, *7001.*

Carex rostrata Stokes. (Grh [HH]) Frequent to abundant in shallow water, marshes, along shores, in sedge mats, and in roadside ditches.

This species is occasionally dominant in marshes and sedge mats. Mile 44, *4304;* mile 24 N, *7434;* mile 9.6 S, *7821.*

Carex sartwellii Dewey. (Grh) Seen at only three stations: in disturbed peaty soil, mile 18, *5600;* in marl deposit, mile 39.7 N, *7398;* in disturbed clay, mile 21.5 N, *7496.*

Carex scirpoidea Michx. (Grh) Rare to frequent in moss mats in spruce forests, in shallow residual soil over limestone, in marl deposits, and on marly shores, persisting in disturbed areas. Not seen in Canadian Shield section. Mile 70, *4255;* mile 42.5 N, *6924.*

Carex supina Wahl. (Grh) Seen only twice: in peaty-sandy soil atop crystalline outcrop, 3.3 miles east northeast of Yellowknife, *9188;* in sand among jack pines, Yellowknife, *9240.*

Carex tenuiflora Wahl. (Hs) Rare along mucky shores and in disturbed soil in Canadian Shield section. Mile 14 S, *7142.*

Carex vaginata Tausch. (Grh) Infrequent to rare in spruce-feather moss forests and in birch thickets. Mile 70, *4250;* mile 42.5 N, *6917.*

Carex viridula Michx. (Hs) Rare in marl deposits or on marly or sandy shores. Mile 100.5 N, *7310;* mile 62, *9480;* Prelude Lake, *9220.*

Eleocharis acicularis (L.) R. et S. (Grh [HH]) Local, forming mats in shallow water or on wet shores, in clay, sand, or muck. Kakisa Lake, *5667;* mile 49 S, *7240;* Mackenzie River, *8217.*

Eleocharis palustris (L.) R. et S. (HH) Local in shallow water up to 1 foot deep or on wet shores. Kakisa Lake, *5663;* mile 73.7 N, *7662;* mile 5.7 S, *7806.*

Eleocharis pauciflora (Lightf.) Link var. *fernaldii* Svenson. (Gst) Local in wet marly soil or in sedge mats around marly lakes. Seen only along the Mackenzie River-Frank Channel section of the highway. Mile 65.6 N, *7613.*

Eriophorum angustifolium Honck. (Grh [HH]) Local and infrequent in marshes, in sedge mats and shallow water of marly lakes, and in peaty soil in depressions on crystalline outcrops. Kakisa Lake, *4679;* mile 4.2 N, *6613;* mile 40 S, *7215.*

Eriophorum brachyantherum Trautv. (Hs) Local in marshes, in wet spruce forests, and in peaty depressions on crystalline outcrops. Mile 43, *4307;* mile 4.7 S, *6699;* mile 78.3 N, *6892.*

Eriophorum chamissonis C. A. Mey. (Grh [HH]) Locally frequent to common in shallow water or sedge mats of marl or muck-bottom lakes, in marshes, and in disturbed wet soil. Mile 52, *5372;* mile 57.6 S, *7248.*

Eriophorum gracile Koch. (Grh [HH]) Rare on sedge mats or hummocks around muck-bottom lakes or in shallow water of these lakes. Seen only in the Canadian Shield section. Mile 35 S, *6741.*

Eriophorum spissum Fern. (Hs) Material seemingly best referrable here was collected once, in a peaty depression on crystalline outcrop, mile 47.9 S, *7235.*

Eriophorum viridi-carinatum (Engelm.) Fern. (Grh [HH]) Seen only once, in shallow water and sedge mat, marly lake, mile 50, *5385*.

Scirpus cespitosus L. var. *callosus* Bigel. (Hsr) Common in sedge mats and thickets around marly lakes; occasional in low spots in black spruce forests. This plant is frequently the dominant species in sedge mats, especially in firmer portions of the mat. Mile 63, *5298;* mile 113.5 N, *8113*.

Scirpus hudsonianus (Michx.) Fern. (Hs) Rare in marshes and birch thickets. Mile 86 N, *6878*.

Scirpus microcarpus Presl. (Hsr) Seen only once, at edge of sedge dominated island in Kakisa River 4 miles below highway bridge, *5678*.

Scirpus pumilus Vahl ssp. *rollandii* (Fern.) Raymond. (Grh) Seen only once, in marl deposit, mile 110.5 N, *7091*.

Scirpus validus Vahl. (HH) Infrequent along shores or in shallow water. The identity of our northern bulrush seems by no means certain. Many specimens are fairly "typical" *S. acutus;* many are fairly "typical" *S. validus* except that the scales may be conspicuously red-spotted. Between these extremes occur various intermediates. Until a more thorough study can be made of *Scirpus* section *Pterolepis* in the north, I prefer to call our material *S. validus*, the name by which all Mackenzie material has been known. Kakisa Lake, *5670;* mile 16.5 S, *7877;* mile 39.7 N, *8422*.

ARACEAE

Acorus calamus L. (HH) Seen only once, with *Potentilla palustris, Calla palustris,* and *Menyanthes trifoliata,* in the mat around a small lake, along road 3 miles south of Fort Rae, *9484*.

Calla palustris L. (HH) Frequent to common in shallow water as a contributor to the mat around lakes in the Canadian Shield section. The rhizomes may extend, just under the surface of the water, 2 to 3 feet beyond the inner edge of the mat. *Calla palustris* ranks in importance with *Menyanthes trifoliata* and *Potentilla palustris* as a mat builder. Mile 20.1 S, *7170*.

LEMNACEAE

Lemna minor L. (HH) Local in shallow still water or on mud. Noted only in the Canadian Shield section. In one pond, *Lemna minor* was growing among vast numbers of achenes of *Ranunculus gmelinii.* Mile 49 S, *7242*.

Lemna trisulca L. (HH) Locally frequent or even abundant in water to 2 feet deep, either floating just beneath the surface or forming masses, sometimes large, on the bottom. Mackenzie River, *5996;* mile 38.3 S, *8358*.

JUNCACEAE

Juncus albescens (Lange) Fern. (Hs) Rare in moss mats or peaty soil in spruce forests, and in sandy soil along streams. Kakisa River, *5320;* mile 66 S, *8015;* mile 122.6 N, *8074.*

Juncus alpinus Vill. (Grh) Infrequent in marshes, along sandy shores, in marl deposits, in moss mats and residual soil over limestone, and in disturbed soil. Most of our specimens of *Juncus alpinus* seem referrable to var. *alpinus;* several have some long-pedicelled flowers in the heads and so are best called var. *rariflorus* Hartm. Our material shows all degrees of intergradation, however, between these varieties. Mile 40.5, *5424;* Mackenzie River, *5999*; mile 39.7 N, *7555;* mile 1.8 S, *7783.*

Juncus balticus Willd. var. *littoralis* Engelm. (Grh) Locally frequent to abundant on gravelly or sandy shores, in residual soil in low places on limestone outcrops, and in gypsum and marl deposits; rare in peaty soil in muskeg forests. Kakisa River, *5509;* mile 82 N, *7674;* Great Slave Lake, mile 64.6 S, *8377.*

Juncus bufonius L. (Th) Infrequent on wet clay or sand, or in shallow water, becoming frequent in disturbed areas. Kakisa River, *4273;* Mackenzie River, *8226;* Yellowknife, *8340.*

Juncus castaneus Sm. (Hsr) Rare in wet clay or sandy soil. Mile 122.6 N, *8081.*

Juncus filiformis L. (Grh) Seen only once, in wet sand on shore of Prosperous Lake, *9227.*

Juncus nodosus L. (Gst) Rare on sandy shores. Kakisa Lake, *5656;* Mackenzie River, *8233.*

Juncus stygius L. var. *americanus* Buch. (Hs) Seen only once, in marl and shallow water at edge of lake, mile 44.5, *6114.*

Juncus vaseyi Engelm. (Hs) Rare along mucky or sandy shores. Yellowknife, *8344.*

LILIACEAE

Allium schoenoprasum L. var. *sibiricum* (L.) Hartm. (Gb) Rare along rocky shores and in residual soil over limestone. The plants are usually more robust (up to 50 cm. high, and with umbels to 4 cm. in diameter) in disturbed areas than in adjacent undisturbed areas. Collected in full bloom July 11-21; in young fruit August 10. Mackenzie River, *4131;* mile 22.5, *5623.*

Smilacina stellata (L.) Desf. (Grh) Rare along rocky shores, usually among shrubs. Collected in flower on June 25, in immature fruit July 26-28. Kakisa River, *4731;* Mackenzie River, *8236.*

Smilacina trifolia (L.) Desf. (Hsr) Rare in *Sphagnum* mounds or mats of feather moss in spruce forests, in marshy spots in spruce forests, and in peaty depressions in crystalline outcrops. In flower June 17-July 1; mature fruit in mid-August. Mile 64, *4269;* mile 36 N, *7544;* mile 39 S, *7937.*

Tofieldia glutinosa (Michx.) Pers. (Hsr) Rare in sedge mats around marly lakes and in wet peaty soil and moss mats in black spruce woods.

Collected with flower buds on June 26, in full flower on July 14-16, and with mature fruit on August 14. Mile 36, *4314;* mile 72 N, *7031.*

Tofieldia pusilla (Michx.) Pers. (Hsr) Infrequent in feather moss or *Sphagnum* mats in spruce or larch forests or in sedge mats around marly lakes. Collected in flower June 23-July 10; in mature fruit August 13. Mile 70, *4252;* mile 42.5 N, *6922.*

Zygadenus elegans Pursh. (Gb) Infrequent in loamy or sandy soil in pine, spruce, or poplar woods, in residual soil over limestone, and in disturbed peaty or sandy soil. The plants are commonly more robust and taller and have longer and more branched panicles in disturbed areas than in adjacent undisturbed ones. Collected in flower from June 26 to July 15, in maturing fruit on August 13. Mile 64, *4267;* mile 103 N, *7721.*

IRIDACEAE

Sisyrinchium montanum Greene. (Hs) Rare to locally frequent in *Agropyron-Muhlenbergia* or *Calamagrostis* grassland, in residual soil over limestone, and on sandy shores. Collected in flower from June 24 to July 8, in fruit from July 19 to August 11. Mile 17 N, *4178;* Kakisa Lake, *5647;* Mackenzie River, *8238.*

ORCHIDACEAE

Calypso bulbosa (L.) Oakes. (Gst) Rare in moist rich forests. Found in bloom and with half grown fruits as early as June 14 and with nearly mature fruits on July 13. Kakisa River, *4554;* mile 26.5 N, *6647;* mile 66.6 S, *6808.*

Corallorhiza trifida Chat. (Grh) Rare in moderately rich to rich forests. Found in bloom as early as June 19 and with half mature fruits on July 18. Mile 80, *5022;* mile 42.5 N, *6929.*

Cypripedium calceolus L. var. *parviflorum* (Salisb.) Fern. (Grh) Rare in rich woods or boggy areas, in peaty or marly soil. Collected in flower from June 19 to June 27. Kakisa Road, *4712;* mile 119.4 N, *7102*

Cypripedium guttatum Swartz. (Grh) Rare in rich spruce forests. Collected in flower from July 4 to July 15. Kakisa River, *5353;* mile 66 S, *7274.*

Cypripedium passerinum Rich. (Grh) Rare in rich spruce forests. Collected with flowers and half mature fruits in mid-July. Kakisa River, *5354;* mile 126 N, *7757.*

Habenaria hyperborea (L.) R. Br. (Grt) Rare in rich woods, muskegs, sedge meadows, and marl deposits. In flower from June 27 to July 16, and with young fruit at the latter date. Mile 52, *5368;* mile 72 N, *7642.*

Habenaria obtusata (Pursh) Rich. (Grt) Infrequent in rich woods and muskegs. In flower from mid-June to mid-July; with immature fruit in mid-July. With *Orchis rotundifolia,* the most often encountered orchid of the region. Mile 80, *5014;* mile 53.8 S, *6746;* mile 42.5 N, *6916.*

Orchis rotundifolia Banks. (Grt) Infrequent in moderately rich to rich woods, usually of spruce. Collected in flower from June 23 to July 24, in immature fruit on July 24. This and *Habernaria obtusata* are the most often encountered orchids of the region. Mile 74, *5066;* mile 60.5 N, *7016;* mile 66 S, *7998.*

Spiranthes romanzoffiana Cham. (Grt) Rare in rich woods and muskegs. In flower during July; with immature fruit on July 24. Kakisa River, *5344;* mile 35 N, *7533;* mile 66 S, *8001.*

SALICACEAE

Populus balsamifera L. (Ms) Frequent to locally common in woods, especially along shores, and, with *Populus tremuloides,* in burned over areas. The largest specimens seen were in the gorge of the Kakisa River, where balsam poplars 12 to 14 inches DBH are found. Satisfactory increment borings could not be obtained from these trees because of heartrot. With half mature fruit on June 21. Mile 11, *4826;* mile 70.5 N, *6901.*

Populus tremuloides Michx. (Ms) Frequent to common in woods, especially on drier uplands. With *Populus balsamifera,* it is characteristic of burned over areas. A tree 51 feet high and 8.7 inches DBH showed 70 annual rings. Increment borings taken of other trees were unsatisfactory because of heartrot. Mile 60, *6070;* mile 12 N, *8250.*

Salix arbusculoides Anderss. (M) Locally frequent to common along shores, in marshes, and on limestone outcrops. Especially characteristic of the flood plain of the Kakisa River just below Lady Evelyn Falls where, with *Salix bebbiana, Salix planifolia,* and *Alnus tenuifolia,* it forms the dominant vegetation. Here, *Salix arbusculoides* grows 12 to 15 feet tall and has stems 2 inches in diameter near the base. Fruit matures in mid-June. Kakisa River, *4526;* mile 29.5 S, *6733.*

Salix athabascensis Raup. (N) Local in thickets and in shrub zones around marly lakes. A low shrub to 3 feet tall. Fruit matures in early July. Mile 11, *4830.*

Salix bebbiana Sarg. (M) Frequent at edge of grasslands, along shores, in upland and lowland woods, in marshes, in thickets, in shallow residual soil over limestone, and in peaty depressions on crystalline outcrops. Attains 15 feet in height and about 2 inches in stem diameter. Fruit matures from mid-June to mid-July. Kakisa River, *4525;* Mackenzie River, *5047;* mile 34 S, *6740;* mile 101 N, *7084.*

Salix brachycarpa Nutt. (N) Occasional in marl deposits and on marly shores. Shrub to 3 feet tall. Fruit matures in July. Mile 110.5 N, *6838.*

Salix calcicola Fern. et Wieg. (N) Seen only once, in spruce-larch woods, mile 119.4 N, *7099.* With dehisced capsules on June 27.

Salix candida Fluegge. (N) Infrequent to rare at edge of grasslands, along shores, in marshes, in shrub zones around marly lakes, and in marl deposits. This willow, which grows to 5 feet tall, is conspicuous because of its silvery-green foliage. Fruit matures from mid-June to early July. Kakisa River, *4737;* mile 16.5 N, *6635.*

Salix glauca L. (M) Infrequent to frequent in pine or spruce forests, in marshes, at edge of grasslands, in marl deposits, along shores, in thickets, and in shallow residual soil over limestone. The most common willow of the highway region, *Salix glauca* is also the willow most persistent in disturbed areas. It usually grows 3 to 6 feet tall, although specimens 10 feet high are characteristic at edges of sinkholes in a white spruce-jack pine forest at mile 121.3 N. Fruit matures from mid-June through mid-August. Mile 51, *4294;* mile 2.5 S, *6662;* mile 110.5 N, *6827.*

Salix lasiandra Benth. var. *lancifolia* (Anderss.) Bebb. (M) Seen only on the beach of Kakisa Lake near the outlet into Kakisa River, *4612, 4613,* where locally it is a characteristic woody plant, and on a gravel bar in the Kakisa River, *5183.* At the latter site, this willow grows about 25 feet tall. In young fruit and with old staminate flowers on June 21.

Salix maccalliana Rowlee. (M) Infrequent at edge of grasslands, in marshes, in thickets, and along shores. Attains 10 feet in height. With mature fruit from mid-June to mid-July. Mile 54, *4720;* mile 72 N, *8266.*

Salix myrtillifolia Anderss. (N) Infrequent in forests, especially of black spruce, along shores, in marshes, and at edges of grasslands. Typically a depressed shrub, or even prostrate, less than 16 inches tall, but occasionally attaining 6 feet in height. Fruit matures mid and late June. Mile 11, *4831;* mile 23.8 N, *6643;* mile 66 S, *6798.*

Salix padophylla Rydb. (*S. pseudomonticola* Ball) (M) Seen only once, on peaty shore of lake, mile 70.5 N, *6899.* With dehisced fruit on June 22.

Salix pedicellaris Pursh. (N) Infrequent to rare in shrub zones around marly lakes, in sedge mats around both marly and muck bottom lakes, and in birch-willow thickets. Mature fruit in late June and early July. Mile 54, *5072* (var. *tenuescens* Pursh); mile 86.5 N, *6877* (var. *hypoglauca* Fern.); mile 57.6 S, *7246* (var. *hypoglauca* Fern.).

Salix petiolaris J. E. Sm. (N) Rare at edge of grasslands. Mature fruit in mid-June. Mile 16.5 N, *6633.*

Salix planifolia Pursh. (M) Infrequent to locally common on shores and in marshes. Especially characteristic on the flood plain of Kakisa River below Lady Evelyn Falls where, with other willows and with *Alnus tenuifolia,* it forms the dominant vegetation, attaining 25 feet in height and 4 inches in stem diameter. Fruit matures mid-June. Kakisa River, *4527;* mile 4.2 N, *6603;* mile 2.5 S, *6661a.*

Salix pyrifolia Anderss. (N) Rare in peaty soil on crystalline outcrops, in black spruce forests, and in birch-willow thickets. Shrub to 6 feet high. Fruit matures in late June. Mile 4.2 N, *6616;* mile 4.7 S, *6703.*

Salix reticulata L. (Ch) Local, usually growing in moss mats or in peat, in spruce forests. Mature fruit in July. Kakisa River, *4604;* mile 126 N, *7770.*

Salix scouleriana Barratt. (N) Seen only once, in marsh along Stagg

River, *7963*. With dehisced fruits on July 23.

Salix serissima (Bailey) Fern. (N) Rare to locally frequent at edges of grasslands, along shores, and in shrub zones and sedge mats around marly lakes. Fruit matures mid-July to mid-August. Mile 41.5, *5418;* mile 72 N, *8270;* mile 46 S, *9261*.

MYRICACEAE

Myrica gale L. (N) Frequent to rare along shores, in *Sphagnum* or feather moss hummocks in spruce forests, in sedge and shrub zones around marly lakes, and in marshes. Flowers appear in mid-June, and fruit ripens in mid-August. Mile 64, *4268;* mile 23.8 N, *6641;* mile 2.5 S, *6663*.

BETULACEAE

Alnus crispa (Ait.) Pursh. (M) Characteristic understory plant in white spruce and more mesic jack pine forests; frequent in peaty depressions on crystalline outcrops; infrequent to dominant locally along peaty or gravelly shores. Shrub to 10 feet tall. Kakisa River, *4524;* mile 2.4 S, *6664*.

Alnus incana (L.) Moench. *(Alnus tenuifolia* Nutt.) (M) Locally dominant, sometimes with tall willows and balsam poplar, along rocky or sandy shores. The largest specimens observed, about 18 feet high and 4 inches DBH, were on the shore of Great Slave Lake at mile 128.6 N. Kakisa Lake, *4635;* Mackenzie River, *5050;* Great Slave Lake, mile 128.6 N, *7272*.

Betula glandulosa Michx. (M) Frequent to locally abundant in willow-birch thickets, in spruce or larch woods, in sedge and shrub zones around marly lakes, in marl deposits, at edge of grasslands, and along shores. Of the 48 collections of *Betula glandulosa* made along the highway, most appear better referrable to var. *glandulifera* (Regel) Gl. than to var. *glandulosa*. Dwarf birch in our region is typically a 3-5 foot shrub, although it occasionally may be 10 feet tall and have stems to 1.5 inches in diameter near the base. Mile 17 N, *4179;* mile 56, *4797;* mile 18.8 S, *6719*.

Betula occidentalis Hook. (M) Rare at edge of grasslands and in birch-willow thickets. Attains 10 feet in height and 2 inches in stem diameter. Mile 16 N, *5035*.

Betula papyrifera Marsh. (Ms) Infrequent to frequent on limestone and crystalline outcrops, in jack pine or white spruce forests, in birch zones around muck bottom lakes, and on sand plains. Usually multiple stemmed. The largest paper birch measured was 9.9 inches DBH and 42 feet tall. No satisfactory increment borings could be obtained because of heartrot. Most of the paper birches along the highway appear best referrable to var. *humilis* (Regel) Fern. et Raup; *5603*, with pinkish brown bark, is perhaps var. *commutata* (Regel) Fern. Mile 25, *4942;* mile 19.5, *5603;* mile 2.5 S, *6685.*

URTICACEAE

Urtica dioica L. var. *procera* Wedd. (Hpr) Rare in disturbed soil Mile 30, *5525;* mile 78.3 N, *6893.*

SANTALACEAE

Geocaulon lividum (Rich.) Fern. (Grh) Rare, though sometimes common locally, in sandy soil or in lichen or moss mats in pine or spruce forests and in peaty depressions on crystalline outcrops. The flowers, which are greenish yellow and often purple tinged, bloom in mid-June; the orange or orange-red fruits mature in August. Mile 80, *5018;* mile 2.7 S, *6693;* mile 125.1 N, *8042.*

POLYGONACEAE

Polygonum achoreum Blake. (Th) Local in disturbed soil. Enterprise, *4003;* Mackenzie River, *6010;* mile 8.6 N, *8249.*

Polygonum amphibium L. (HH [Grh]) Local in marshes, along shores, and in shallow water. Four miles northeast of Fort Providence, *4036* (var. *stipulaceum* [Coleman] Fern.); Kakisa Lake, *5660* (var. *stipulaceum* forma *fluitans* [Eat.] Fern.); Kakisa Lake, *5668* (var. *stipulaceum* forma *hirtuosum* [Farw.] Fern.); mile 35 N, *7417* (var. *stipulaceum* forma *simile* Fern.); mile 20.7 S, *7904* (var. *stipulaceum).*

Polygonum aviculare L. (Th) Local in disturbed soil and along rocky and sandy shores. Enterprise, *4001;* mile 17.5 S, *7887;* mile 62 N, *8188.*

Polygonum coccineum Muhl. (HH [Grh]) Seen only once, shore of Hay River, near mile 49, Mackenzie Highway, *4362.*

Polygonum convolvulus L. (Th) Seen only once, in weedy area, Fort Providence, *9075.*

Polygonum lapathifolium L. (Th) Local in disturbed soil or along sandy and rocky shores. Number *9451* is best referred to var. *lapathifolium;* all other collections are var. *salicifolium* Sibth. Kakisa Lake, *5638;* Mackenzie River, *6002;* Prosperous Lake, *9451.*

Polygonum viviparum L. (Gst) Local in moss mats or peaty soil in spruce forests, mostly black spruce but occasionally white. In flower in mid-July. Mile 57.5, *5214;* mile 119 N, *7746a;* mile 66 S, *8002.*

Rumex maritimus L. var. *fueginus* (Phil.) Dusen. (Th) Rare in marshes, in marl deposits, and along shores. Kakisa River, *5501;* Yellowknife, *8343;* mile 39.7 N, *8412.*

Rumex mexicanus Meisn. (Hs) Rare in disturbed soil. Seen only at Enterprise, *9049a,* and Fort Providence, *9073.*

Rumex occidentalis Wats. (Hs) Infrequent in marshes and in disturbed moist soil. Mile 53, *5743;* mile 23.3 N, *8258;* mile 47 S, *8312.*

CHENOPODIACEAE

Atriplex patula L. (Th) Local in disturbed soil. All collections made along the highway are of var. *patula*. Mile 60 N, *8407*.

Axyris amaranthoides L. (Th) Seen only once, in disturbed sand, Enterprise, *9042a* (in herb. DAO).

Chenopodium berlandieri Moq. var. *zschackei* (Murr) Murr. (Th) Local in disturbed soil. Mile 21, *6152;* mile 42 S, *7938*.

Chenopodium capitatum (L.) Asch. (Th) Local in disturbed soil; seen also once on gravelly shore of Kakisa River. Kakisa River, *5746;* mile 32 N, *6983;* mile 11.4 S, *7836*.

Chenopodium glaucum L. var. *salinum* (Standl.) Boivin. (Th) Local in disturbed areas and along gravelly shores. Kakisa River, *5488;* mile 32 S, *8350*.

Chenopodium hybridum L. var. *gigantospermum* (Aellen) Rouleau. (Th) Seen only once, in gravel of road bed, mile 60, *6069*.

Chenopodium rubrum L. (Th) Local in disturbed soil. Mile 26.9 S, *7910;* mile 71.5 N, *8177*.

CARYOPHYLLACEAE

Arenaria capillaris Poir. (Ch) Rare in shallow residual soil over limestone or in sand in pine woods, becoming locally frequent in disturbed sand. Our plants are glabrous in the inflorescence and so are var. *capillaris*. Comes into bloom in late June; fruit matures from mid-July to late August. Mile 96.5 N, *6872*.

Arenaria dawsonensis Britton. (Ch) Rare in sandy soil in upland woods, along gravelly shores, in marl deposits, and in shallow residual soil over limestone, becoming locally frequent in disturbed soil. In flower the latter half of June and in early July; fruit matures from early July into August. Mile 10, *4815;* mile 96.5 N, *8162*.

Arenaria humifusa Wahl. (Ch) Seen at only 3 sites, at each of which only a few plants could be found. In marl deposit, mile 110.5 N, *7096;* in black spruce-feather moss forest, mile 72 N, *7647;* disturbed moist sand, mile 110 N, *9426*. Collected as early as June 27 with both flowers and mature fruits.

Arenaria lateriflora L. (Hpr) Rare along gravelly shores, in marl deposits, and in disturbed soil. Begins to flower in mid-June; fruits mature about 2 weeks after flowering. Kakisa River, *5485;* mile 4.2 N, *6621*.

Arenaria rubella (Wahl.) Sm. (Ch) Rare in shallow residual soil over limestone. In flower mid-June to early July; fruits mature as early as July 5. Mile 12, *4843;* mile 66 S, *6776;* mile 96.5 N, *6870*.

Cerastium arvense L. (Ch) Infrequent in shallow residual soil over limestone. Two distinct forms, glandular and non-glandular, were noted. In flower from about June 20 to the first week of July. Fruits mature during late July. Mile 12, *4857;* mile 107.1 N, *8278*.

Cerastium nutans Raf. (Th) Rare in disturbed sandy soil. Collected with both flowers and mature fruits on July 1. Kakisa River, *4900*.

Melandrium ostenfeldii Porsild. (Hs) Rare in marl deposits and on rock outcrops, both limestone and crystalline, where it grows in crevices and in shallow soil. Flowering begins in early June; some fruits have matured by mid-June. Mile 20, *4885;* mile 8.8 S, *6711;* mile 110.5 N, *6830*.

Silene menziesii Hook. (Hpr) Rare along rocky shores and in disturbed soil. Comes into flower in late June and continues until about August 1; fruits mature from July 10 until frost. Kakisa River, *4799;* mile 110 N, *7305;* Mackenzie River, 8201.

Stellaria calycantha (Ledeb.) Bong. (Hpr) Locally frequent in disturbed peaty or sandy soil, where it forms conspicuous yellowish-green loose mats. Begins to flower about mid-June, and to fruit in late June, but continues much of the summer. Mile 6, *5951;* mile 2.5 S, *6667;* mile 32 N, *6980*.

Stellaria crassifolia Ehrh. (Hpr) Local along gravelly or mucky shores, in marshes, and in sedge mats; somewhat more common in disturbed areas. In flower from mid-June until early or mid-August; mature fruit by mid-July. Mile 11, *4822;* mile 23.8 N, *6638;* mile 20.5 S, *7177*.

Stellaria longifolia Muhl. (Ch) According to Gleason (1958), *Stellaria longifolia* is ". . . closely related to the . . . northern and montane *S. longipes,* from which it was probably derived and with which it may be conspecific. The only character by which the two may be finally distinguished is the inflorescence, branched divaricately in the former and ascendingly in the latter." Of my 39 collections from the highway region that are referrable to the *S. longifolia-S. longipes* complex, many are intermediate between these two taxa in all characters and could as well be placed in one as the other. Perhaps, as Gleason suggests, *S. longifolia* and *S. longipes* may indeed be conspecific. The specimens cited below are considered to be "typical" *S. longifolia* but in reality are the extremes at one end of a series, at the other end of which is "typical" *S. longipes.* Rare in moist grassy places and thickets. In flower in late June and in fruit soon thereafter, continuing through much of the summer. Kakisa River, *5328;* mile 39.5 N, *8261;* mile 48.1 S, *8370*.

Stellaria longipes Goldie. (Ch) The taxonomy of the *S. longipes* complex is in a state of monumental uncertainty. Porsild (1955) wrote: "It seems doubtful if the taxonomy of this complex . . . group can be satisfactorily cleared up except by close study, under controlled conditions, of material grown from seed or from transplants." Until such elucidation comes about, it seems futile to try to recognize segregates from this complex, at least in the material collected by me along the Yellowknife Highway. Of these specimens, some (e.g., *5362*) have sepals that are ciliate along nearly all the margin and thus appear to be *S. ciliatosepala* Trautv.; others have a few to very few cilia on some of the sepals of some of the flowers; and still others have eciliate sepals. Rare to locally frequent in grasslands; otherwise seen only in disturbed soil. Flowers throughout much of the summer, beginning in mid-June; mature fruits appear as early as late June. Kakisa River, *4567;* mile 16.9 S, *6717;* mile 96.5 N, *6874.*

Stellaria media (L.) Cyr. (Th) Seen at only one site, garden weed, Yellowknife, *9181.*

NYMPHAEACEAE

Nuphar variegatum Engelm. (HH) Common in lakes in the Canadian Shield section. This species occupies a distinct zone, the "floating stage," in succession around these lakes. It is by far the dominant plant of the "floating stage," although species of *Potamogeton* with floating leaves and *Polygonum amphibium* may occasionally occur with it. In full flower in late June to early July; in almost mature fruit by mid-August. Mile 12.9 S, *7141.*

Nymphaea tetragona Georgi ssp. *leibergii* (Morong) Porsild. (HH) Seen only once, in a muck bottom lake, among *Nuphar,* mile 35.5 S, *8328.* In full flower on July 30.

CERATOPHYLLACEAE

Ceratophyllum demersum L. (HH) Not seen by me, but collected by Ray Murdy, United States Fish and Wildlife Service, in a 40 acre pond, mile 38.5 S, *132A* (in Herb. LAF).

RANUNCULACEAE

Actaea rubra (Ait.) Willd. (Grh) Rare in white spruce forests along the Kakisa and Mackenzie rivers. The red fruit matures in late August. Mackenzie River, *5023*; Kakisa River, *5444.*

Anemone canadensis L. (Hs) Seen only along the rocky shore of the Mackenzie River in several spots between the ferry crossing and Fort Providence. Flowering begins in early July and continues throughout the month; fruits mature as early as July 28. Mackenzie River, *7445, 8213.*

Anemone multifida Poir. (Hs) Infrequent to rare in prairies, in shallow residual soil over limestone, and in jack pine woods; becoming somewhat more common in disturbed soil. Flowers appear from mid-June to early-July; fruits mature from about the second week of July until mid-August. In about 60 per cent of the plants observed, the sepals were yellowish white, sometimes with a pink tinge; the remainder had magenta sepals. Sepals in our material measure from 7 to 13 mm. long. Mile 17 N, *4185;* mile 20, *4890*; mile 31.9 S, *6736.*

Anemone parviflora Michx. (Hsr) Rare in black spruce-feather moss or jack pine woods, in moss mats or residual soil over limestone, and in marl deposits. Flowering begins in late June and continues throughout July; earliest fruits mature in late July. In our material the glossy white sepals are sometimes, but not always, bluish tinged at the base outside. Mile 20, *4892;* mile 66 S, *6794;* mile 44 N, *6912.*

Anemone patens L. var. *wolfgangiana* (Bess.) Koch. (Hs) Local in open jack pine woods or in shallow residual soil over limestone. Flowers not seen by us (except one that bloomed, abnormally, on August 9); fruits mature as early as June 25. Mile 103.5 N, *6844.*

Aquilegia brevistyla Hook. (Hs) Rare in jack pine and in white spruce woods; becoming more common in disturbed soil. Main flowering season from about June 24 to mid-July; fruits mature as early as July 5. The petals are yellowish-white; the spurs and sepals are purple-blue. Mile 54, *4722;* mile 110 N, *7316.*

Caltha natans Pall. (HH [Hs]) Local in shallow water or in mud or muck on shores, more common in disturbed situations. Most frequently seen in Canadian Shield section. Flowering begins in mid-June and continues until mid-August; fruits mature as early as mid-July. Mile 10.2, *5577;* mile 16.9 S, *6716.*

Caltha palustris L. (Hs) Seen only once, in marshy spot, wooded, along cold swift stream, mile 16, *4866.* In full bloom on June 28.

Ranunculus aquatilis L. var. *eradicatus* Laestad. (HH) Seen only once, in mud and shallow water, Stagg River, mile 49 S, *7241.* In flower on July 3.

Ranunculus circinatus Sibth. var. *subrigidus* (Drew) L. Benson. (HH) Rare in still shallow water, to 10 inches deep, muddy or sandy bottom. With flowers and mature fruits on July 20. Kakisa River, *5658;* mile 11.4 S, *7837.*

Ranunculus cymbalaria Pursh. (Hsr) Seen only once, beach of Prosperous Lake, *9194.* Mature fruit on August 14.

Ranunculus gmelinii DC. (HH) Locally frequent in shallow water or on muddy, peaty, or sandy shores, becoming more common in disturbed areas. Flowering starts in mid-June and continues until early August; fruits mature as early as July 3. Achenes produced in great abundance. Three varieties of this species, as noted below, occur along the highway. Mackenzie River, *6018* (var. *limosus* [Nutt.] Hara); mile 16.9 S, *6715* (var. *hookeri* [D. Don] Benson); mile 78.3 N, *6891a* (var. *hookeri* [D. Don] Benson); mile 57.6 S, *7250* (var. *gmelinii).*

Ranunculus lapponicus L. (Grh) Rare in moss mats in shrub zones around marly lakes, in *Ledum* thickets, or in spruce forests. With flowers and half mature fruit on June 28; fully mature fruit on July 23. Mile 50, *5396;* mile 127 N, *7108.*

Ranunculus macounii Britton. (Hsr) Local along gravelly, sandy, muddy, or peaty shores, or in marshes; more common in disturbed soil. With flowers and half mature fruits in early July; mature fruits from mid-July on. Kakisa River, *4991;* Mackenzie River, *5052;* mile 25.5 N, *7518;* Prosperous Lake, *9237.*

Ranunculus reptans L. (Hsr) Rare along muddy or sandy shores.

Comes into flower the first week of July; with mature fruit on July 22. Of the collections cited below, *8216* and *9197* are var. *reptans;* the others are var. *ovalis* (Bigel.) Benson. Kakisa River, *5002, 5635;* Mackenzie River, *8216;* Prosperous Lake, *9197.*

Ranunculus sceleratus L. (Th) Infrequent to rare in shallow water or along gravelly, sandy, or muddy shores, in marl deposits, and in marshes; more common in disturbed areas. Flowering begins in early June; earliest achenes mature in mid-June. Mile 7, *4811;* Mackenzie River, *5053;* mile 35 N, *6653;* mile 25.7 S, *7194.*

Thalictrum venulosum Trel. (Hsr) Rare to locally common in prairies and along gravelly shores. In flower in late June and early July; fruit matures the latter half of July. A common forb in *Calamagrostis* and in *Agropyron-Muhlenbergia* grasslands at mile 14 N to 17 N. Kakisa River, *4729;* mile 16.5 N, *5037.*

FUMARIACEAE

Corydalis aurea Willd. (Hs) Seen only in disturbed soil; sometimes common where found. The golden yellow flowers begin to appear in early June and bloom throughout the summer. Fruits mature as early as the end of June. Mile 9, *4012;* mile 35 N, *6654.*

Corydalis sempervirens (L.) Pers. (Hs) Locally frequent in disturbed sandy or loamy soil; seen in seemingly undisturbed situations only in peaty depressions on crystalline outcrops, where it is rare. The pink flowers, orange-yellow tipped, begin to bloom the second week in June; fruits mature as early as July 1. Mile 66, *5250;* mile 35 N, *6660;* mile 17 S, *7164.*

CRUCIFERAE

Arabis divaricarpa A. Nels. (Hs) Infrequent in disturbed clay soil; rare in shallow residual soil over limestone. Collected in flower and young fruit on June 28. Mile 12, *4859;* mile 17 S, *7167.*

Arabis drummondii Gray. (Hs) Rare in *Calamagrostis* grassland. In flower and nearly mature fruit on July 8. Mile 13-14 N, *5029.*

Arabis hirsuta (L.) Scop. var. *pycnocarpa* (Hopkins) Rollins. (Hs) Rare in prairies, on gravelly shores, and in marl deposits; becoming more common in disturbed soil. In flower from mid-June to mid-July; earliest fruits mature about July 20. Mile 17 N, *4188;* mile 5, *5145;* mile 5.5 S, *7805.*

Arabis holboellii Hornem. (Hs) Local in disturbed soil, either sandy or peaty; rare in shallow residual soil over limestone and in peaty depressions on crystalline outcrops. Most *Arabis holboellii* observed along the highway is best referred to var. *retrofracta* (Graham) Rydb., but some of the material is close to var. *holboellii.* Enterprise, *3899;* mile 69.6 S, *6817;* mile 96.5 N, *8166.*

Barbarea orthoceras Ledeb. (Hs) Rare along muddy or mucky shores, more frequent in disturbed areas. Comes into flower in mid-June;

fruits mature as early as mid-July. Noted only in Canadian Shield section. Mile 14 S, *7143.*

Brassica campestris L. (Th) Rare in disturbed soil. With flowers and half mature fruits on July 28. Kakisa Road, *6103;* mile 39.5 N, *8260.*

Braya humilis (C. A. Meyer) Robinson. (Hs) Rare in marl deposits. Collected with flowers and half mature fruits on July 15. Sometimes apparently triennial instead of biennial. Mile 110 N, *7732.*

Capsella bursa-pastoris (L.) Medic. (Th) Rare in disturbed soil. Fruits mature as early as July 9. Enterprise, *4004;* Fort Providence, *5039.*

Cardamine parviflora L. var. *arenicola* (Britt.) O. E. Schulz. (Hs) Rare in disturbed soil. With flowers and young fruits on June 18. Mile 15.1 S, *6714.*

Cardamine pensylvanica Muhl. Infrequent on gravelly shores of Kakisa River; noted nowhere else. Flowering over by mid-July; fruits mature as early as July 12. Kakisa River, *5198.*

Descurainia richardsonii (Sweet) O. E. Schulz. (Th) Rare in disturbed soil. With flowers and half mature fruit on July 16. Mile 45, *5399;* mile 88.5 N, *7362;* mile 53.9 S, *7970.*

Descurainia sophia (L.) Webb. (Th) Locally frequent in disturbed soil. With mature fruit as early as July 13. Enterprise, *3897;* mile 3 S, *8339.*

Draba cinerea Adams. (Ch) Rare in crevices on limestone outcrops. Flowers almost gone, and some fruits half mature, on June 19. Mile 66 S, *6771.*

Draba lanceolata Royle. (Ch) Rare in shallow residual soil over limestone; becoming locally more common in disturbed areas. With flowers and half mature fruits on June 29; fruits mature as early as July 15. Mile 20, *4884;* mile 96.5 N, *8163.*

Erysimum cheiranthoides L. (Hs) Rare along gravelly and sandy shores; more common in disturbed soil. Comes into flower in late June; fruits mature in late July. Kakisa River, *5456;* Mackenzie River, *8214;* mile 30 S, *8337.*

Erysimum inconspicuum (Wats.) MacM. (Hs) Seen only once, on open, steep slope above Kakisa River below ford, *5206.* With half mature fruits on July 12.

Lepidium bourgeauanum Thell. (Hs) Rare in disturbed soil. Comes into flower in late June; fruits mature beginning mid-July. Mile 51, *5380;* mile 16 S, *7155;* mile 39.7 N, *7408.*

Lepidium densiflorum Schrad. (Hs) Rare in disturbed soil. Collected with flowers and half mature fruits as early as June 24. Kakisa Road, *4972;* mile 59.2 N, *7389.*

Lesquerella arctica (Wormsk.) Wats. var. *scammanae* Rollins. (Ch) Rare in crevices in limestone outcrops. Flowering begins in mid-June; fruits mature as early as July 4. Mile 66 S, *6773, 7284.*

Rorippa crystallina Rollins. (Hs) Rare in *Carex* marshes; found only from mile 16.5 N to mile 35 N. The collections from the highway region formed the basis of the description of *Rorippa crystallina* as a new species by Dr. Rollins in Rhodora 64:324-327. 1962. Mile 23.8 N, *6637*.

Rorippa islandica (Oeder) Borbas. (Hs) Infrequent along sandy, gravelly, muddy, or mucky shores; becoming more common in disturbed soil, especially in low areas at roadside. Comes into flower about mid-June; flowering plants can be found as late as mid-August; fruits mature as early as mid-July. Our plants have the upper leaves merely dentate (sometimes rather deeply so) rather than pinnatifid and so do not seem to be var. *islandica;* some specimens can be assigned readily to var. *fernaldiana* Butters et Abbe, and others to var. *hispida* (Desv.) Butters et Abbe. However, numerous intergrading specimens between these two extremes make the recognition of *fernaldiana* and *hispida* rather arbitrary and of little significance, at least in the highway region. Mile 30, *5526;* mile 82 N, *7054;* mile 4.8 S, *7118*.

Subularia aquatica L. (Th) Rare in shallow, clear, still water of lakes, sandy bottom. Noted only at Prelude Lake, *9215*, and Prosperous Lake, *9232*. In Prelude Lake it was associated with *Eleocharis acicularis* and *Isoetes echinospora* var. *braunii;* in Prosperous Lake, with *Eleocharis acicularis* and *Limosella aquatica*. With late flowers and all stages of fruit on August 15.

Thlaspi arvense L. (Th) Rare in disturbed soil. In mature fruit as early as July 9. Enterprise, *4000;* Fort Providence, *5040*.

DROSERACEAE

Drosera anglica Huds. (Hr) Rare in marl in shallow water and among sedges at edge of marly lakes. Comes into flower in mid-July; collected with some mature fruits on August 8. Mile 50, *5393*.

Drosera rotundifolia L. (Hr) Rare on *Sphagnum* mounds in black spruce forests and in marly bogs. Comes into flower in mid-July; not collected in fruit. Mile 64, *4264;* mile 66 S, *8012*.

SAXIFRAGACEAE

Mitella nuda L. (Hsr) Infrequent in mats of feather moss in spruce forests. The yellowish-green flowers appear in mid-June; flowers may be found until about July 10, when early fruits are mature. Mile 80.5, *5012;* mile 42.5 N, *6932*.

Parnassia multiseta (Ledeb.) Fern. (Hs) Infrequent on rocky or marly shores, on sedge mats, in low meadows, and in moss mats in spruce woods. Comes into flower about mid-July and continues until at least mid-August; fruits ripen as early as August 10. Mile 70, *4248;* mile 11.4 S, *7835;* mile 65.6 N, *8184*.

Ribes glandulosum Grauer. (N) Rare along rocky shores, in peaty depressions in crystalline outcrops, and in thickets. In full flower in mid-June; the petals are rose, and the sepals are white or yellow-white with a rose tinge. The bright red fruits, in more or less erect racemes, mature in early to mid-July. This is a sprawling or prostrate plant whose leaves, crushed, have the odor of skunk. Mile 6, *5946;* mile 2.7 S, *6690;* mile 36 N, *7552.*

Ribes hudsonianum Rich. (N) Infrequent to frequent along rocky shores, in thickets, and in black spruce forests. In flower the latter half of June; the glaucous blue-black, unpleasant tasting fruits, in erect to drooping racemes, mature late in July and early in August. *Ribes hudsonianum* is the most common species of the genus along the highway; it is the one most likely to be seen in disturbed soil. Number *4560,* cited below, with its glabrous floral bracts, bud scales, leaves, and inflorescence, has been described by me as a new form (in Canad. Field.-Nat. 75:117. 1961). Kakisa River, *4560* (forma *glabrum);* mile 5.7 S, *7809.*

Ribes lacustre (Pers.) Poir. (N) Rare in rich spruce or pine forests and along rocky shores. The leaves have a pronounced and distinctive sheen both above and below that was seen on no other member of the genus in the highway region. The flowers, with their rose madder sepals and yellow-white petals, are in full bloom in the latter half of June; the fruits mature in late July and early August. Mile 10, *4820;* mile 66 S, *8018.*

Ribes oxyacanthoides L. (N) Infrequent along gravelly shores, in shallow residual soil on limestone outcrops, in prairies, and in peaty depressions on crystalline outcrops. In flower the second half of June. The blue-black berries mature in late July and early August and are the best tasting of any *Ribes* fruit along the highway. The flowers have greenish white sepals and white (sometimes pink tinged) petals. Kakisa River, *4505;* mile 21.3 S, *6721;* mile 80.8 N, *7046.*

Ribes triste Pall. (N) Infrequent to rare in *Populus* or spruce forests or *Salix-Alnus* thickets along shores, or in spruce forests on limestone outcrops. The rose-madder flowers, in drooping racemes, appear in mid-June and, by the end of June, are dull and faded, although persistent; the translucent bright red fruits mature in late July and early August. Kakisa River, *4533;* mile 61.8 S, *6766.*

Saxifraga aizoides L. (Ch) Seen at only one site, in seepage area around cold spring, mile 122.6 N, *8076.* In bloom and with half mature fruits on July 25. The petals are yellow, but dotted with orange.

Saxifraga tricuspidata Rottb. (Ch) Infrequent to locally common, forming mats to 2 feet across, on rock outcrops, both limestone and crystalline. In flower from mid-June to early July; fruits mature by mid-August. The petals are white, and have either orange-red dots, or orange dots and red dots in about equal numbers. Mile 12, *4853;* mile 2.8 S, *6683;* mile 103.5 N, *6860.*

ROSACEAE

Amelanchier alnifolia Nutt. (N) Infrequent to frequent on rocky shores and ridges, in shallow residual soil over limestone, and in white spruce or pine woods. Comes into flower about June 20 and continues for about 7 to 10 days; the dark red fruits, "saskatoons," prized by Indians and Whites alike, mature from mid-July to early August. Fort Providence, *4225;* mile 12, *4854;* mile 101 N, *7085;* Stagg River, *7239.*

Dryas drummondii Rich. (Ch) Local in crevices in crystalline and limestone outcrops. Collected in flower on June 19; past fruiting on August 8. The flowers have erect yellow petals and a green calyx that is covered with purple gland-tipped hairs. Mile 25.1, *6150;* mile 66 S, *6770;* Yellowknife, *9186.*

Dryas integrifolia Vahl. (Ch) Local in crevices on limestone outcrops, in marl deposits, and in sandy or peaty soil in spruce or pine woods. Collected in flower on June 19-24, but plants past flowering and in young fruit were also collected on June 19; fruits mature during the second half of July. Kakisa Road, *4695;* mile 66 S, *6774;* mile 110.5 N, *6829.*

Fragaria virginiana Duch. var. *terrae-novae* (Rydb.) Fern. et Wieg. (Hrr) Infrequent to locally frequent in shallow residual soil over limestone, in pine or white spruce forests, and along shores, becoming more common in disturbed soil. Main flowering season from about June 15 to July 1; fruits mature in late July and early August. The plants are more vigorous and show much greater development of runners in disturbed areas. Kakisa River, *4550;* mile 31.9 S, *6735;* mile 103.5 N, *6859.*

Geum macrophyllum Willd. var. *perincisum* (Rydb.) Raup. (Hs) Local in grasslands, in willow thickets, and along sandy and muddy shores. Flowers from late June to late July; with mature fruit on August 4. Mile 13-14 N, *5028;* Kakisa River, *5196;* Stagg River, *7967.*

Geum triflorum Pursh. (Hrr) Locally frequent in shallow residual soil over limestone. Collected in flower and young fruit June 29; in nearly mature fruit on July 21; past fruiting in early August. Not noted north of the Mackenzie River. Mile 20, *4880.*

Potentilla anserina L. (Hrr) Local on sandy, gravelly, or marly shores. Collected with flowers from June 25 to July 19; past flowering and with mature fruit on August 8. Most *Potentilla anserina* in the highway region is forma *anserina,* but forma *sericea* (Hayne) Hayek is occasional. Kakisa River, *4897;* Mackenzie River, *7448;* mile 65.6 N, *7618.*

Potentilla arguta Pursh. (Hs) Rare in grasslands and in shallow residual soil over limestone. Collected in fruit August 3-9. Four miles northeast of Fort Providence, *4113;* mile 25.2, *5974.*

Potentilla fruticosa L. (N) A common shrub, generally distributed except in truly aquatic habitats. In bloom from mid-June to frost; fruits mature as early as August 5. One of the most conspicuous roadside wild flowers. Mile 28.5, *4929;* mile 8.8 S, *6710;* mile 119 N, *7746.*

Potentilla multifida L. (Ch) Seen only once, in crevices in crystalline outcrops, Horseshoe Island, Yellowknife Bay, *9486.* In fruit on August 30.

Potentilla nivea L. ssp. *hookeriana* (Lehm.) Hiitonen. (Ch) Infrequent in crevices in limestone and crystalline outcrops. Collected in flower from June 21 to July 2; past fruiting on August 13. Mile 20, *4879;* mile 103.5 N, *6847;* Yellowknife, *9175.*

Potentilla norvegica L. (Hs) Infrequent along gravelly, sandy, and marly shores; rare on crystalline outcrops; locally common in disturbed soil at roadside. Collected with flowers and young fruits on June 30; with flowers and mature fruits on July 20; flowering past by August 1. Kakisa River, *5212;* mile 6.1 S, *7123;* mile 98.5 N. *8167.*

Potentilla palustris (L.) Scop. (HH) Rare to locally common in marshes and in sedge mats around marly and muck bottom lakes. Collected in flower from June 30 to August 4; Mature fruit on August 7. This species is one of the main contributors to the mat around many muck bottom lakes in the Canadian Shield section. Four miles northeast of Fort Providence, *4048;* mile 6, *5562;* mile 47 S, *8313.*

Potentilla pensylvanica L. (Hs) Local in marl deposits, in drier grasslands, and on crystalline and limestone outcrops. With late flowers and mature fruits on July 21. All the material seen is best referred to var. *pensylvanica,* although it is somewhat variable. Mile 12, *5581;* mile 39.7 N, *7567;* Yellowknife, *9189.*

Prunus pensylvanica L.f. (N) Local on limestone outcrops and dry rocky slopes. In flower in late June and early July; the tasty, translucent, glossy red fruits mature in late August and are much appreciated by humans and bears alike. At mile 28 we observed a bear cub who stripped several *Prunus pensylvanica, Ribes oxacanthoides,* and *Amelanchier alnifiolia* bushes of their fruit, but who ignored completely the abundant bear-berries *(Artostaphylos uva-ursi)* there. *Prunus pensylvanica,* in the highway region, grows to 6 feet tall and has stems up to 3/4 inch thick. It was observed only south of the Mackenzie River. Mile 12, *4852.*

Prunus virginiana L. (N) Local on limestone outcrops. The fragrant flowers blooms from very late June until about July 10; the glossy dark red fruits mature at the end of August. Chokecherry, here at the northernmost known part of its range, grows to 5 feet tall. It was seen only between mile 20 and 25. Mile 20, *4886.*

Rosa acicularis Lindl. (N) A common shrub, almost generally distributed in mesic and xeric habitats. Collected in flower from June 17 until July 10; the glossy red or orange-red fruits mature from late July on. Mile 24, *5125;* mile 11.4 S, *7830;* mile 95.5 N, *8169.*

Rubus acaulis Michx. (Hpr) Local in grasslands, on peaty hummocks in marshy areas, in moss mats or litter in spruce forests, and on gravelly or marly shores. Collected in flower from June 13 to July 12; the translucent bright red fruits are ripe in early August. Mile 16, *4864;* mile 61.2 N, *7609.*

Rubus chamaemorus L. (Hpr) Infrequent in moss mats or peaty soil in black spruce forests and in peaty depressions in crystalline outcrops. Collected in flower only from June 13 to June 17; the pale orange fruits mature in mid-August. Kakisa Road, *4511;* mile 4.2 N, *6618;* mile 30 S, *8336.*

Rubus idaeus L. var. *canadensis* Rich. (N) Infrequent along shores, on crystalline outcrops, and in white spruce-balsam poplar woods. Collected in flower from June 17 to July 18; the bright red fruits mature as early as July 24. Mile 66, *5263;* mile 2.5 S, *6684;* mile 73 N, *6895.*

Rubus paracaulis Bailey. (Hpr) Specimens referrable here were seen only once, along stream in pine-spruce woods, mile 16, *4863.* In flower on June 28.

Rubus pubescens Raf. (Ch) Infrequent along rocky shores, in poplar or spruce woods, and in alder-willow thickets along rivers. In flower from about June 20 to July 10; fruits still small and green on July 18. Kakisa River, *4735;* Mackenzie River, *7449.*

LEGUMINOSAE

Astragalus alpinus L. (Ch) Observed only in disturbed soil, where it may be common locally. The plants are prostrate and form mats up to 3 feet across. Collected with both flowers and mature fruits in late June. Mile 73 N, *6896;* mile 66 S, *8003.*

Astragalus americanus (Hook.) Jones. (Hp) Infrequent to rare in white spruce, pine, larch, or poplar woods, becoming more common in disturbed areas. Comes into flower in early July and continues for about 3 weeks; collected with mature fruits as early as July 18. Kakisa River, *5471;* mile 4.7 S, *7801;* mile 122.6 N, *8072.*

Astragalus dasyglottis Fisch. (*A. goniatus* Nutt.) (Hpr) Rare in grasslands and along gravelly shores. The fragrant purple-blue flowers begin to bloom in mid-June and continue for about 2 months; fruits mature in mid-August and later. Mile 17 N, *4169.*

Astragalus eucosmus Robinson. (Hp) Seen only once, in disturbed clay at roadside, mile 4.7 S, *7800.* Mature fruits on July 18.

Astragalus striatus Nutt. (Hp) Seen only once, in sandy barrens by Yellowknife airport, *9242.* With old flowers and maturing fruits on August 16.

Astragalus tenellus Pursh. (Hp) Seen only once, gravelly shore just south of Hay River town, *6129.* With flowers and almost mature fruits on August 8.

Astragalus yukonis Jones. (Ch) Seen only in disturbed soil, where it is rare. With flowers and half mature fruits in very late June. Mile 72 N, *7035;* mile 8.3 S, *7138.*

Hedysarum alpinum L. var. *americanum* Michx. (Hp) Infrequent in thickets along shores and in spruce or pine forests. Begins to flower in mid-June and continues until about July 25; mature fruits collected in early July. Kakisa River, *4994;* mile 66 S, *6806.*

Hedysarum mackenzii Rich. (Hp) Infrequent in pine or spruce woods, in shallow residual soil over limestone, and in semi-open grasslands. In flower by June 13; some fruits mature as early as July 10. Mile 54, *4724;* mile 32 N, *6985.*

Lathyrus ochroleucus Hook. (Hpr) Infrequent in pine or spruce forests. In flower by June 18, continuing until mid-July, when fruits are about half mature. Kakisa Road, *4587.*

Melilotus alba Desr. (Hs) Rare in disturbed soil. Comes into flower in very late June; mature fruits by July 27. Mile 66, *5241;* mile 70.5 N, *7376;* mile 5.5 S, *7804.*

Melilotus officinalis (L.) Lam. (Hs) Rare in disturbed soil. Comes into flower in very late June; mature fruits by July 27. Mile 52.5, *5366;* mile 22 N, *7438;* mile 2 S, *7790.*

Oxytropis campestris (L.) DC. var. *varians* (Rydb.) Barneby. (Ch) Rare in crevices on limestone outcrops. Collected in mature fruit on August 3. Mile 23.5, *5781.*

Oxytropis deflexa (Pall.) DC. var. *sericea* T. et G. (Hs) Rare in white spruce forests; local in disturbed soil at roadside. Beginning to flower in late June; some fruits mature by mid-July. Kakisa River, *5472;* mile 74.5 N, *7040;* mile 4.8 S, *7112.*

Oxytropis splendens Dougl. (Hr) Rare in shallow residual soil over limestone; local in disturbed soil at roadside. Collected in early flower on July 5; in mature fruit by late July. Mile 107.5 N, *7330.*

Oxytropis viscida Nutt. var. *hudsonica* (Greene) Barneby. (Hr) Seen only once, in disturbed sandy soil at roadside, mile 122.6 N, *7106.* With old flowers and maturing fruits on June 27.

Vicia americana Muhl. (Hpr) Infrequent in thickets and along shores; local in disturbed sand or clay soil. Flowering begins in mid-June and continues until late July; collected with dehisced fruits on July 9. Mile 50, *5113;* mile 35 N, *6657.*

GERANIACEAE

Geranium bicknellii Britton. (Hs) Infrequent to rare on gravelly shores and in disturbed soil in waste places. Comes into bloom about mid-June, and late flowers may be found until mid-August; fruits mature from mid-July on. *Geranium bicknellii* behaves as a typical biennial in the highway region. Mile 51, *4293;* mile 107.9 N, *8385.*

LINACEAE

Linum lewisii Pursh. (Hp) Infrequent to rare in shallow residual soil over limestone and in clayey gravelly soil along shores. Comes into flower in early July, and by July 20, flowering is over; collected in mature fruit as early as July 21 and as late as August 28. The blue petals, on cloudless days, begin to drop at about 1:30 p.m.; on cloudy days they persist somewhat longer. Mile 28.5, *4928*.

CALLITRICHACEAE

Callitriche hermaphroditica L. (HH) In shallow, still or flowing water or along muddy or sandy shores. Fruit maturing in mid-August and later. Kakisa River, *4017;* Mackenzie River, *4240;* mile 20.5 S, *7901*.

Callitriche palustris L. (HH) In shallow, still or flowing water or along muddy or sandy shores. Fruit maturing in mid-August and later. Mackenzie River, *4241;* mile 16 S, *7871*.

EMPETRACEAE

Empetrum nigrum L. (Ch) Infrequent in feather moss or *Sphagnum* mats in spruce forests, in peaty depressions and crevices on crystalline outcrops, and in sand in jack pine forests or sandy barrens. In the earliest collection made, June 24, the flowers were gone and the fruits were half grown; the fruits mature in early August, turning glossy black. Mile 44, *4297;* mile 2.7 S, *6687;* mile 72 N, *7649*.

ELATINACEAE

Elatine triandra Schk. (Th) Seen only once, in mud and shallow water at edge of roadside excavation, mile 25 S, *9286*. Our plants are var. *triandra* and had mature fruits in late August.

CISTACEAE

Hudsonia tomentosa Nutt. (Ch) Rare to locally common in sand in open pine forests or in sand barrens. In flower in late June. *Hudsonia tomentosa* is especially common in the sand barrens near the Yellowknife airport, were locally it is common and may be the only plant or may be associated with *Vaccinium vitis-idaea* and *Arctostaphylos uva-ursi*. Mile 95.5 N, *7069;* Yellowknife, *7778*.

VIOLACEAE

Viola adunca Sm. (Hsr) Seen only in disturbed gravelly or sandy soil. Fruits mature early in July; not collected in flower. Mile 107.5 N, *7336*.

Viola nephrophylla Greene. (Hrr) Rare along rocky or peaty shores or in black spruce woods. Collected in flower June 20-24, in fruit July 7. Kakisa Road, *4709;* mile 66.6 S, *6812;* Mackenzie River, *7461*.

Viola renifolia Gray. (Hrr) Seen only once, in rich white spruce forest in gorge of Kakisa River just below Lady Evelyn Falls, *4535*. In flower on June 16.

ELAEAGNACEAE

Elaeagnus commutata Bernh. (N) Infrequent to rare on rocky shores, river bluffs, and beaches. The flowers appear in early July; they are heavily fragrant and have tan anthers, cream filaments, and sepals that are light yellow inside and silvery-cream outside. The silvery fruits mature in the first half of August. Fort Providence, *4226;* Kakisa River, *4784.*

Shepherdia canadensis (L.) Nutt. (N) Frequent in poplar, spruce, or pine forests, in shallow residual soil over limestone, in marl deposits, and in peaty depressions on crystalline outcrops. The light brown-yellow flowers begin to open in mid-June; the nauseous translucent red fruits mature in early August. Kakisa River, *4532;* mile 21.3 S, *6720;* mile 110.5 N, *6824.*

ONAGRACEAE

Epilobium angustifolium L. (Hpr) Rare in spruce or pine forests on sand and in peaty depressions on crystalline outcrops, but frequent to common in clearings and other disturbed areas. Most *Epilobium angustifolium* in the region is forma *angustifolium,* but *7395,* with white petals, yellowish white sepals, and whitish green ovaries, is forma *albiflorum* (Dumort.) Haussk., and *7681,* with pinkish white petals, reddish green sepals, and reddish ovaries, would appear to be forma *spectabile* (Simmons) Fern. Mile 52, *5102;* mile 46 N, *7007;* mile 17 S, *7165.*

Epilobium glandulosum Lehm. var. *adenocaulon* (Haussk.) Fern. (Hp) Infrequent in wetter grasslands, and on muddy, marly, or sandy shores, becoming locally common in damp disturbed areas. Coming into flower in mid-July and continuing until mid-August; fruits mature as early as July 26. When growing en masse, the plants are conspicuous because of their red coloration. Enterprise, *4010;* Mackenzie River, *8229;* mile 59.2 N, *7390.*

Epilobium palustre L. var. *oliganthum* (Michx.) Fern. (Hpr) Rare to infrequent in disturbed moist soil. In flower from late June until late July; fruits mature as early as July 12. Mile 76, *6029;* mile 2.5 S, *7110;* mile 61.2 N, *7598.*

HALORAGACEAE

Myriophyllum exalbescens Fern. (HH) Local in shallow, still or flowing water. Beginning to flower in mid-July and continuing to at least mid-August, at which time some fruits are nearly mature. Where *M. exalbescens* grew with the next species, the two were most distinct because of the reddish stems, bracts, and pistils of the former, these structures being green in the latter. Kakisa River, *5484;* mile 13.8 S, *7866.*

Myriophyllum verticillatum L. var. *pectinatum* Wallr. (HH) Local in shallow, still or flowing water. With flowers and young fruits on July 6; some fruits mature by August 4. Mile 75 N, *7374;* mile 7.7 S, *7819.*

HIPPURIDACEAE

Hippuris vulgaris L. (HH) Infrequent in shallow, still or flowing water (to about 18 inches deep) or along shores. The flowers, with their glistening white stigmas and purple anthers, begin to open in early June; fruits mature starting in late June. Mile 44, *4298;* mile 35 S, *6743;* mile 23.5 N, *6970.*

UMBELLIFERAE

Cicuta bulbifera L. (Hs) Rare to infrequent in sedge mats around muck bottom lakes, in sedge marshes, and in low *Salix* thickets. Collected in flower between July 20 and August 2. Mile 12.7 S, *7859;* mile 61 N, *8192.*

Cicuta douglassii (DC.) Coult. et Rose. (Hs) Rare in marshes and along gravelly, muddy, or marly shores. Fruit not fully mature by August 9. Four miles northeast of Fort Providence, *4075;* Kakisa River, *6094;* mile 16 S, *7874.*

Heracleum lanatum Michx. (Hs) Seen only once along the Yellowknife Highway, one plant, basal leaves only, on grassy muddy shore of Great Slave Lake, mile 62.7 S, *8374.* This species is frequent along shores at the town of Hay River and along the Mackenzie Highway south of Hay River.

Sium suave Walt. (HH) Rare in shallow, still to flowing water. Collected in flower and very young fruit on July 21; with mature fruit on August 15. Mile 33.5, *5994;* mile 20.5 S, *7894.*

CORNACEAE

Cornus canadensis L. (Hpr) Infrequent to frequent in thickets and in spruce or pine forests, growing in sand, litter, or moss mats. Begins to flower in mid-June and continues until early August; the bright red fruits mature in the second half of August. Mile 80-81, *5057;* mile 60.5 N, *7021.*

Cornus stolonifera Michx. (M) Infrequent along rocky shores, in thickets, in shallow residual soil over limestone, and in rich white spruce forests. Main flowering season from about June 25 to July 10; the waxy white fruits mature in August. This species is usually 2 to 4 feet tall in the highway region, but occasionally, as along the Kakisa River, it grows 8 feet tall and has stems 1 inch thick. Kakisa River, *4022;* Mackenzie River, *4129;* mile 70.5 N, *6898.*

PYROLACEAE

Moneses uniflora (L.) Gray. (Hsr) Rare in moss mats in spruce forests. Comes into flower about July 8 and continues until at least early August; mature fruits not seen. Mile 80-81, *5024;* mile 36 N, *7545.*

Pyrola asarifolia Michx. var. *purpurea* (Bunge) Fern. (Hsr) Rare in moss mats in spruce or pine forests and along sandy shores. Begins to flower in late June, continuing at least until early August. Collected with mature fruit on August 10. Mile 66, *5273;* mile 54 N, *7005.*

Pyrola grandiflora Radius. (Hsr) Infrequent to rare in moss mats in spruce forests and in peaty soil in thickets. Flowering begins about June 13 and is nearly over by mid-July; collected in fruit on August 16. Kakisa River, *4530;* mile 4.3 S, *6695;* mile 42.5 N, *6930.*

Pyrola secunda L. (Hsr) Local in moss mats, sand, or litter in spruce or pine forests. Collected in flower and with some mature fruits on July 10. Mile 64, *4263;* mile 33 N, *7527.*

Pyrola virens Schw. (Hsr) Rare in moss mats, sand, or litter in spruce and pine forests. Flowering commences about June 25 and continues for about a month; collected with mature fruit on August 14. Mile 37, *4309;* mile 83.5 N, *7057.*

ERICACEAE

Andromeda polifolia L. (Ch [N]) Infrequent to rare among sedges, mosses, or shrubs around marly lakes, in birch thickets, in rich spruce forests, and in open pine woods on sand. Collected in flower from June 19 to July 10; with mature fruits on July 26. Mile 64, *4261;* mile 4.2 N, *6624;* mile 59.6 S, *6760.*

Arctostaphylos rubra (Rehd. et Wils.) Fern. (Ch) Infrequent in moss mats, peaty soil, or litter in spruce or poplar woods. The inconspicuous flowers are past bloom by June 20, and the translucent bright red fruits mature in late July and early August and persist through the winter. Mile 70, *4253;* mile 66 S, *6797.*

Arctostaphylos uva-ursi (L.) Spreng. (Ch) Common in undisturbed mesic and xeric habitats throughout the region, but especially characteristic as a ground cover plant on limestone and crystalline outcrops and in spruce or pine woods on sand. In flower from mid-June until very early July; fruits mature in August. Specimens readily referrable to var. *uva-ursi,* var. *adenotricha* Fern. et Macbr., and var. *coactilis* Fern. et Macbr. can be found growing in close proximity, and, with them, specimens seemingly intermediate between these varieties. Mile 17 N, *4206;* mile 11.5, *4836;* mile 2.5 S, *6682.*

Chamaedaphne calyculata (L.) Moench. (N) Infrequent to locally common in sedge mats around marly and muck-bottom lakes, in moss mats in black spruce woods, in peaty depressions in crystalline outcrops, and in marshy thickets. Past flowering by June 25; mature fruit by July 22. Mile 64, *4270;* mile 4.2 N, *6615;* mile 14.5 S, *7151.*

Kalmia polifolia Wang. (Ch) Rare in open black spruce forests between mile 112 N and 119 N, where it grows among lichens (especially *Cladonia* and *Cetraria), Sphagnum* and other mosses, and other low ericads. Past flowering and with mature fruit by July 15. Mile 119 N, *7742.*

Ledum decumbens (Ait.) Lodd. (N) Frequent to common in peat or moss mounds (frequently *Sphagnum)* in spruce forests, in peaty depressions on crystalline outcrops, on peaty hummocks in boggy areas, and in litter-covered or bare sand in open pine or spruce woods. In full bloom by June 12; mature fruit by July 14. *Ledum decumbens* comes into full bloom while the flowers of *L. groenlandicum* are still in bud (although nearly ready to open). Kakisa Road, *4507*; mile 4.7 S, *6698b;* mile 67.8 N, *7024.*

Ledum groenlandicum Oeder. (N) Frequent to common in the same habitats as the above species. No consistent differences could be noted in the habitat preferences of the two species of *Ledum,* which frequently can be found growing together. *Ledum groenlandicum* comes into full flower by June 19, somewhat later than *L. decumbens;* it matures fruit by July 14. Mile 11.5, *4834;* mile 4.7 S, *6698a*; mile 119 N, *7743.*

Rhododendron lapponicum L. (N) Infrequent in rich spruce and spruce-larch woods between mile 113 N and 66 S (124 N); noted nowhere else, although said to be common on some of the islands in Yellowknife Bay and the north arm of Great Slave Lake. Past flowering and with young fruits on June 20; mature fruits by July 15. At mile 66 S, *Rhododendron lapponicum* plants are notable for their stature; they attain 30 inches (76 cm) in height (see note in Canad. Field-Nat. 76: 123. 1962). Mile 66 S, *6790.*

Oxycoccus microcarpus Turcz. (Ch) Rare on *Sphagnum* mounds in bogs and in spruce or spruce-larch forests. Collected in flower on June 24-26, in mature fruit on August 13. Mile 64, *4271;* mile 67.8 N, *7022;* mile 45 S, *7943a.*

Vaccinium uliginosum L. (N) Infrequent to frequent in moss mats or peaty soil in spruce woods, in litter-covered or bare sand in open pine or spruce woods, in birch-willow thickets, and in peaty depressions and crevices in crystalline outcrops. Past flowering by June 25; the fruits mature in late July and early August. Some of our specimens have 5-merous flowers. Kakisa Road, *4512;* mile 2.5 S, *6675;* mile 104.3 N, *8154.*

Vaccinium vitis-idaea L. var. *minus* Lodd. (Ch) Frequent to common in moss mounds or peaty soil in spruce woods, in litter-covered or bare sand in open pine or spruce woods, in sand barrens, and in peaty depressions and crevices in crystalline outcrops. Comes into flower about June 22 and continues until mid-July; the dark red fruits mature in mid-August and persist through the winter, appearing deep wine or brown purple the next spring. A characteristic ground-cover plant in pine and spruce woods on sand. Mile 64, *4265;* mile 2.5 S, *6678.*

PRIMULACEAE

Androsace septentrionalis L. (Hr) Rare in shallow residual soil or in mossy crevices on limestone outcrops, becoming more common and considerably more vigorous in disturbed areas, especially in sandy soil. Begins to flower in mid-June, and some flowers appear as late as early August; first fruits mature in early July. In the highway region, *Androsace septentrionalis* behaves as a typical biennial. Mile 25, *4945;* mile 103.5 N, *6842.*

Dodecatheon pulchellum (Raf.) Merrill. (*D. radicatum* Greene) (Hr) Rare in peaty or marly soil in black spruce woods, in shallow residual soil over limestone, and in sedge meadows on shores of marly lakes. Collected in flower on June 24, and with some mature fruits as early as July 2. Kakisa Road, *4688;* mile 67.7 N, *7631.*

Naumburgia thyrsiflora (L.) Duby. (HH) Local in shallow water or along rocky or muddy shores and in *Carex* and *Calamagrostis* meadows. Comes into flower in late June; collected in mature fruit on August 16. Kakisa River, *5178;* mile 14 S, *7145;* Stagg River, *7238.*

Primula egaliksensis Wormskj. (Hr) Seen only once, in *Betula-Myrica* thicket around marly pond, mile 113.5 N, *8120.* Past flowering, and with nearly mature fruit, on July 25.

Primula incana Jones. (Hr) Rare in grasslands, on gravelly-marly shores, and in sedge meadows and willow copses around marly lakes. In flower in mid-July, some flowers appearing until early August; fruits mature from early August on. In some colonies of this species, certain plants may have only efarinose leaves. Mackenzie River, *6000;* mile 67.7 N, *7633.*

Primula mistassinica Michx. (Hr) Rare in mossy soil along streams, in peaty soil in spruce forests, and in alder-willow thickets on lake shores. Collected in flower from June 21 to June 28. Mile 16, *4867.*

Primula stricta Hornem. (Hr) Rare in mossy clay soil in seepage areas and in disturbed peaty or clay soil in wet places. Collected in flower from June 24 to July 16. Mile 49.5, *5721;* mile 28.2 N, *6972.*

Trientalis europaea L. var. *arctica* (Fisch.) Ledeb. (Hpr) Seen only once, in peaty soil in overgrown roadway through poplar-dwarf birch-willow thicket, mile 4.2 N, *6611.* In flower on June 13.

GENTIANACEAE

Gentianella amarella (L.) Börn. ssp. *acuta* (Michx.) Gillett. (*Gentiana amarella* L. var.) (Hs) Infrequent in disturbed soil. Flowers appear in late July; fruits mature as early as August 18. Mile 0.5, *5941;* mile 121.3 N, *8090.*

Gentianella crinita (Froel.) G. Don ssp. *macounii* (Th. Holm) Gillett. (*Gentiana macounii* Th. Holm) (Th) Rare along gravelly sandy shores. Comes into flower in early August. Mackenzie River, *4132;* Kakisa River, *6092.*

Gentianella crinita (Froel.) G. Don ssp. *raupii* (Porsild) Gillett. (*Gentiana raupii* Porsild) (Th) Rare along gravelly or marly shores. Comes into flower in late July. Mackenzie River, *5998;* mile 65.6 N, *8182.*

Lomatogonium rotatum (L.) Fries. (T) Infrequent to rare in grasslands, where it becomes more common in little used wagon roads, in *Salix-Betula* thickets, and on gravelly-marly lake shores. Flowers begin to appear in late July. The corollas vary from white to light blue, with all intermediates between. Mile 65.6 N, *8399.*

Menyanthes trifoliata L. (HH) Rare in marl in shallow water of marly lakes; locally common in sedge mats around muck bottom lakes, where it may be an important contributor to the mat. Comes into flower in mid-June and continues until mid-July; fruit mature as early as July 20. Mile 44.5, *5116;* mile 35 S, *6742.*

APOCYNACEAE

Apocynum androsaemifolium L. (Hpr) Local in gravelly soil or sand in open pine woods. In flower from late June to mid-July or even later; nearly full-sized fruits seen on only one plant, on July 26. Mile 42, *5407;* mile 95.5 N, *7072;* Yellowknife, *7780.*

POLEMONIACEAE

Collomia linearis Nutt. (Th) Rare along rocky shores; locally frequent in disturbed sandy soil. Collected in early flower in mid-July, in flower and mature fruit in late July to mid-August. Fort Providence, *4224;* mile 26, *5782.*

HYDROPHYLLACEAE

Phacelia franklinii (R. Br.) Gray. (Hs) Local in disturbed soil. Begins to flower in mid-June, continuing through much of the summer. Some fruits have matured by about July 20. In the highway region, *P. franklinii* behaves as a typical biennial. Enterprise, *3895;* mile 82 N, *7050.*

BORAGINACEAE

Lappula echinata Gilib. (Th) Seen only once, in disturbed sand, Enterprise, *9051a.* Collected in mature fruit on August 7.

Lappula redowskii (Hornem.) Greene var. *occidentalis* (Wats.) Rydb. Rare in disturbed soil. Kakisa River, *5487;* mile 33 N, *7525.*

Mertensia paniculata (Ait.) G. Don. (Hs) Seen only once along the Yellowknife Highway, in spruce-poplar woods, mile 1, *7803.* In full flower on June 27. Frequent in much the same habitat along the NWT section of the Mackenzie Highway.

LABIATAE

Galeopis tetrahit L. var. *bifida* (Boenn.) Lej. et Court. (Th) Seen only once, in disturbed sand, Enterprise, *4007.*

Mentha arvensis L. (Hpr) Local along gravelly or muddy shores, in marl deposits, and in marshes, becoming more frequent in disturbed areas. Coming into flower about July 6 and continuing for about a month. Our plants are all var. *villosa* (Benth.) Stewart except *7404,* which has ovate leaves and so is best referred to var. *arvensis.* Four miles northeast of Fort Providence, *4054;* Kakisa River, *5503;* mile 39.7 N, *7404.*

Moldavica parviflora (Nutt.) Britton. (Hs) Infrequent to common in disturbed areas. Comes into flower in mid-June; with some mature fruits by July 10. Mile 52, *5082;* mile 35 N, *6656.*

Scutellaria galericulata L. var. *epilobiifolia* (Hamilt.) Jordal. (Hpr) Infrequent to rare in marshes, along rocky or muddy shores, and in marl deposits. Comes into flower about June 25 and continues until late July; fruits mature from about July 11 on. Four miles northeast of Fort Providence, *4043;* mile 9.5, *5576;* mile 72 N, *7025;* mile 20.5 S, *7897.*

Stachys palustris L. var. *nipigonensis* Jennings. (Gst) Rare on gravelly or sandy shores and in marshes. Comes into flower in late June and continues at least until early August; collected with mature fruit on August 9. Kakisa River, *5708;* mile 39.7 N, *6990.*

SCROPHULARIACEAE

Castilleja raupii Pennell. (Hp) Infrequent in grasslands, in shallow residual soil over limestone, and in thickets. Collected with flowers and nearly mature fruits on June 30, but flowers may be found throughout the summer. Mile 17 N, *4144;* mile 10, *4816;* mile 31.9 S, *6738.*

Euphrasia aff. *subarctica* Raup. (Th) Seen only once, on rocky slope above inlet on island in Mackenzie River 1 mile west of Fort Providence, *4130.* Specimens of this collection have been examined by Messrs. Yeo and Sell (Cambridge University) who comment as follows: "Specimen *4130* . . . has the general characters of *E. subarctica* Raup, but all the plants in the series seen lack glandular hairs, which usually densely cover the leaves in this species, and if they do not, are present on at least some plants in all the samples we have seen. We are therefore not able to accept these specimens as being definitely *E. subarctica,* but they might be recorded as showing affinity with that species."

Limosella aquatica L. (Th) Seen only once, in shallow water, sandy bottom, Prosperous Lake, *9233.* With mature fruits on August 15.

Pedicularis labradorica Wirsing. (Hs) Infrequent to rare in moss mats or litter in spruce or pine woods and in thickets. Comes into flower about June 22 and continues for about 2 months; mature fruits by early August. Mile 56, *5010;* mile 125.1 N, *8045.*

Rhinanthus crista-galli L. (Th) Rare in shallow residual soil over limestone, in thickets, and along rocky shores. Flowering begins in mid-July; mature fruits found on August 8. Mile 12, *5580;* Mackenzie River, *6008.*

Veronica peregrina L. var. *xalapensis* (HBK) Pennell. (Th) Rare on gravelly or sandy shores. Mature fruits on July 26. Kakisa River, *5715;* Prosperous Lake, *9234.*

Veronica scutellata L. (Hpr) Rare along shores. Collected with flowers and young fruits on July 1; with mature fruits on July 9. All our plants are forma *villosa* (Schum.) Pennell. Kakisa River, *5186;* mile 20.5 S, *7179;* mile 35 N, *7411.*

OROBANCHACEAE

Boschniakia rossica (Cham. et Schl) Fedtsch. (Gp) Seen only once, in white spruce forest, growing under *Alnus crispa* in deep mats of *Hylocomium splendens,* along Kakisa River below Lady Evelyn Falls, *4520.* Found in flower on July 16 and in mature fruit on August 27.

LENTIBULARIACEAE

Pinguicula villosa L. (Hr) Seen only once, on a *Sphagnum* mound in a black spruce-larch forest, Kakisa Road, *4701.* In flower on June 24.

Pinguicula vulgaris L. (Hr) Rare in moss mats in spruce forests, in marl or in sedge mats around marly lakes, and in wet clay soil over limestone. Collected in flower from June 26 to July 15; mature fruit in early August. Mile 44.5, *5121;* mile 72 N, *7028.*

Utricularia intermedia Hayne. (HH) Infrequent in shallow water. Collected in flower from July 10 to July 17; not found in fruit. The leafless, bladder-bearing branches are translucent white. Winter buds form as early as July 1. This species is most often seen in marly lakes. Mile 54, *5080;* Mackenzie River, *6006;* Stagg River, *7958.*

Utricularia minor L. (HH) Rare in shallow water, often growing among *Utricularia vulgaris* and *U. intermedia.* Not seen in flower or fruit. This bladderwort is easily overlooked. We were able to find it only in the Canadian Shield section. Stagg River, *8309.*

Utricularia vulgaris L. (HH) Local in shallow, still or flowing water. Comes into flower in late June, continuing until at least August 10; not seen in mature fruit. Winter buds not noted until very late July and early August. Mile 50, *5105;* mile 12.9 S, *7140;* mile 75 N, *7373.*

PLANTAGINACEAE

Plantago major L. (Hr) Infrequent along rocky shores, becoming frequent in disturbed soil. The plant of shores and the plant of waste places appear to be identical. The leaves vary from stiffly upright to almost prostrate, even in the same colony. Comes into flower in very late June and early July; fruits mature starting in mid-August. Fort Providence, *4228;* Kakisa River, *5496;* mile 60 N, *8408a.*

Plantago septata Morris. (Hr) Infrequent in shallow residual soil over limestone; in disturbed soil the plants are twice as large as in undisturbed situations. In full flower June 21; fruits mature in late July and early August, Mile 28.5, *4907;* mile 80.8 N, *7047.*

RUBIACEAE

Galium labradoricum Wieg. (Hpr) Rare in moss mats in spruce forests and among sedges at shores of marly lakes. Flowering begins in early July; fruits mature starting in early August. Mile 53, *4958;* mile 36 N, *7551.*

Galium septentrionale R. et. S. (Hpr) Infrequent to frequent along rocky shores, in drier grasslands, in shallow residual soil over limestone, and in pine, spruce, or larch woods, becoming somewhat more common in disturbed areas. Flowering season extends from about June

24 to early August; fruits mature starting early August. This plant is locally abundant on anthills in the Fort Providence grasslands. Enterprise, *3891;* mile 17 N, *4184.*

Galium trifidum L. (Hpr) Infrequent on gravelly and mucky shores and in wetter grasslands, becoming more common in disturbed soil. Collected in flower from June 24 to July 27; in fruit as early as mid-July. Kakisa River, *4992;* mile 23.5 N, *6971;* mile 14 S, *7147.*

CAPRIFOLIACEAE

Linnaea borealis L. var. *americana* (Forbes) Rehd. (Ch) Frequent in spruce or pine forests, growing either upon moss mats, in litter, or in sand. Comes into flower late in June; mature fruits appear in late August. Mile 80, *5017;* mile 60.5 N, *7020;* Yellowknife, *9244.*

Lonicera dioica L. var. *glaucescens* (Rydb.) Butt. (N) Rare in shallow residual soil over limestone, usually in pine-dominated areas. The yellow to red-orange flowers bloom during the second half of June; the fruits, translucent orange-red, mature in very late August and early September. The leaves are glaucous below. This plant, in the highway region, is a twiggy erect shrub 1 to 2 feet tall, with none of the twining tendencies it exhibits in areas further south. Mile 56, *5010a;* mile 103.5 N, *6857.*

Symphoricarpos occidentalis Hook. (N) Seen only once, in grassland, mile 17 N, *4141.* Collected in flower on August 11.

Viburnum edule Raf. (N) Frequent along gravelly shores, in poplar, spruce, or pine woods, and in peaty depressions in crystalline outcrops. Begins to flower about June 20, and flowering is over by mid-July; the translucent red fruits mature in early August and are valued by some Yellowknife people for preserves. This species may attain 5 feet in height in the highway region. Mile 11.5, *4837;* mile 21.3 S, *6724;* mile 126 N, *7760.*

CAMPANULACEAE

Campanula rotundifolia L. (Hsr) Rare to infrequent in shallow residual soil over limestone and in pine woods, becoming frequent to common in disturbed soils, where it is one of the conspicuous roadside wildflowers. Comes into bloom in very late June and continues into late August; fruits mature as early as August 1. Enterprise, *4009;* mile 66 S, *7263;* mile 110 N, *7303.*

Lobelia kalmii L. (Hs) Rare in wet marl among sedges at edge of marly lakes or depressions. Comes into flower in very late July and early August. Mile 20, *5764.*

COMPOSITAE

Achillea lanulosa Nutt. (Hsr) Frequent to infrequent in drier grasslands, on limestone outcrops, along rocky shores, and in sand or moss and lichen mats in spruce or pine forests, becoming common in disturbed soil. Collected in flower from late June until mid-August; achenes mature from mid-July on. A pink-flowered form is occasional. This species is generally much more robust and common on disturbed sites than in adjacent undisturbed ones. One of the conspicuous roadside wildflowers. Enterprise, *3892;* mile 82 N, *7049.*

Achillea sibirica Ledeb. (Hs) Rare along rocky and sandy shores and in disturbed soil at roadside. Collected in flower from July 9 to August 5; with maturing achenes in mid-August. Kakisa Lake, *6097;* mile 16.5 N, *7483;* mile 31.5 S, *7933.*

Antennaria parvifolia Nutt. (Ch) Local in grasslands, on limestone outcrops, on gravelly-marly shores, and in disturbed soil at roadside. Flowering in July. Mile 32 N, *7424.*

Antennaria pulcherrima (Hook.) Greene. (Ch) Rare in peaty soil in thickets and spruce forests; somewhat more common in disturbed peaty or sandy soil at roadside. In flower during late June and July. Mile 44.5, *5727;* mile 119 N, *7741.*

Antennaria rosea (Eat.) Greene. (Ch) Rare along sandy or muddy shores and in disturbed soil at roadside. In flower during July. Kakisa River, *4966;* mile 88.5 N, *7361.*

Antennaria subviscosa Fern. (Ch) Seen only once, in prairie, mile 17 N, *4194a.* Past flowering on August 11.

Arnica chamissonis Less. ssp. *foliosa* (Nutt.) Maguire. (Hsr) Rare along rocky shores and in meadows. Collected in flower from July 28 to August 3. Hay River, *3888*; Mackenzie River, *8242.*

Arnica lonchophylla Greene. (Hsr) Infrequent on limestone outcrops, in sand in pine forests, in crevices on crystalline outcrops, and in disturbed soil at roadside. In flower from mid-June until late July; mature achenes by July 20. Most of the material referrable here is typical *A. lonchophylla;* one collection (mile 42.5 N, *6933)* is transitional to ssp. *arnoglossa* (Rydb.) Maguire. Mile 16, *4873;* mile 4.3 S, *6694;* mile 96.8 N, *7078.*

Artemisia biennis Willd. (Hs) Local in disturbed soil. Does not come into flower until mid-August. Mile 66, *6106;* mile 34 N, *8425.*

Artemisia campestris L. ssp. *borealis* (Pall.) Hall et Clem. (Hs) Infrequent to rare in shallow residual soil over limestone. In flower during the second half of July; collected with mature achenes on August 28. Mile 13.5, *5569;* mile 96.7 N, *7965.*

Artemisia frigida Willd. (Ch) Seen only once, in disturbed sand along Kakisa Road, *9448.* Several small sterile plants were all that could be found.

Artemisia ludoviciana Nutt. var. *gnaphalodes* (Nutt.) T. et G. (Hsr) Seen only once, a large clump at roadside, mile 9.5, *6117.* Not yet in flower on August 7. Collected here in 1959; observed here in 1961 and 1962.

Artemisia tilesii Ledeb. ssp. *unalaschensis* (Bess.) Hulten. (Hpr) Local in disturbed soil, especially along shores. Comes into flower in late July. Mile 79.5, *6021;* mile 62.7 S, *8375.*

Aster alpinus L. var. *vierhapperi* (Onno) Cronq. (Hsr) Infrequent in shallow residual soil or in crevices on limestone outcrops. Comes into flower in late June; mature achenes by July 21. Mile 26, *4334;* mile 80.8 N, *6889.*

Aster brachyactis Blake. (Th) Local along shores and in marl deposits; locally common in disturbed soil at roadside. Comes into flower in very late July and early August; mature achenes in August. Mile 75 N, *8395;* Prosperous Lake, *9193.*

Aster ciliolatus Lindl. (Hsr) Rare in shallow residual soil on limestone outcrops, in grasslands, in sandy pine-spruce woods, on marly shores, and in peaty soil in black spruce woods; common locally in disturbed soil at roadside. This species is a conspicuous roadside wildflower. Comes into flower in mid-July, continuing until mid-August; with mature achenes late in August. Flowering specimens are infrequent and small in undisturbed situations thought sterile plants may abound; in disturbed soil, flowering is abundant and the plants are large and vigorous. Mile 51, *5734;* mile 13 N, *7480.*

Aster falcatus Lindl. (Hpr) Seen only once, in grassland, mile 17 N, *4149.* In flower on August 11.

Aster hesperius Gray var. *laetevirens* (Greene) Cronq. (Hpr) Seen only once, limestone crevices, Alexandra Falls, *4365.* In flower on August 15.

Aster johannensis Fern. (Hpr) Rare in marshes on shore of Great Slave Lake, mile 62.7 S, *8373,* and mile 64.6 S, *8376.* In flower on August 3.

Aster junciformis Rydb. (Hpr) Local in drier grasslands, on gravelly or sandy shores, in marl deposits, and in sedge meadows. In flower from mid-July to mid-August. Four miles northeast of Fort Providence, *4045;* mile 6, *5953;* Stagg River, *7961.*

Aster pansus (Blake) Cronq. (Hp) Local in drier grasslands, in marl deposits, and in disturbed soil at roadside. Flowers appear in late July and early August; achenes mature from late August until frost. Four miles northeast of Fort Providence, *4087.*

Aster sibiricus L. (Hpr) Rare in sandy soil in spruce or pine woods; frequent to common in disturbed soil at roadside. Comes into flower in late June and continues into August; achenes mature in August. Kakisa River, *4018;* mile 107.5 N, *7331.*

Bidens cernua L. (Th) Seen only once, along muddy shore of Stagg River, *8308.* Early flowers on July 30.

Crepis elegans Hook. (Hs) Seen only once, along road to Louise Falls on Hay River, *6153.* In flower and mature fruit on August 9.

Crepis tectorum L. (Th) Rare in disturbed soil at roadside. With flowers and mature fruit on August 3. Mile 30, *6116.*

Erigeron acris L. (Hs) Rare in marl deposits and willow thickets; frequent in disturbed soil at roadside. In flower from June 25 to early August; mature achenes collected August 3. Two varieties grow in about equal numbers along the highway; var. *asteroides* (Andrz.) DC. *(3893, 7441, 7803)* and var. *elatus* (Hook.) Cronq. *(5308, 6999, 7114)*. Enterprise, *3893;* mile 16 N, *7441;* mile 4.7 S, *7803;* Kakisa River, *5308;* mile 41.3 N, *6999;* mile 4.8 S, *7114.*

Erigeron compositus Pursh var. *glabratus* Macoun. (Ch) Rare in shallow residual soil or in crevices on limestone outcrops. In flower on June 21; past fruiting on July 14. Mile 23.5, *5961;* mile 103.5 N, *6846.*

Erigeron glabellus Nutt. var. *pubescens* Hook. (Hs) Rare in shallow residual soil on limestone outcrops and in sandy pine woods. In flower from late June until mid-July; mature achenes on July 27. Mile 28.5, *4911;* mile 28 N, *9096.*

Erigeron hyssopifolius Michx. (Hp) Infrequent in peaty soil or moss or lichen mats in spruce forests and in marl deposits. Comes into flower in mid-June; some fruits are mature by mid-July. Kakisa Road, *4569;* mile 35 N, *6659.*

Erigeron lonchophyllus Hook. (Hs) Infrequent in grasslands, on gravelly-marly shores, and in marl deposits. Begins to flower in early July; mature achenes by August 9. Some plants of *E. lonchophyllus* may be only 1.8 cm. high and bear only 1 head. Kakisa River, *6081;* mile 110.5 N, *7733.*

Erigeron philadelphicus L. (Hs) Rare on gravelly-sandy shores. In flower in mid-August. Kakisa River, *5307.*

Gnaphalium uliginosum L. (Th) Seen only once, in wet sand and shallow water of Prosperous Lake, 9238. Mature achenes on August 15.

Helenium autumnale L. (Hp) Seen only in limestone crevices, Alexandra Falls, *4378,* and in roadside ditch, 12.5 miles south of Hay River on Mackenzie Highway, *5937.* In flower and with maturing achenes on August 15.

Hieracium umbellatum L. (Hp) Infrequent in shallow residual soil or in crevices on limestone outcrops, in sandy pine forests, and along rocky shores; more common in disturbed soil at roadside. The earliest collection made, July 14, has flowers and mature fruits. Mile 24, *5629;* mile 93.5 N, *7687;* mile 17.5 S, *7888.*

Lactuca pulchella (Pursh) DC. (Hsr) Rare along rocky shores and in marl deposits. Collected in flower July 7-11; in fruit July 27. Mackenzie River, *7443;* mile 39.7 N, *7570.*

Matricaria maritima L. var. *agrestis* (Knaf) Wilmott. (Th) Seen only once, disturbed soil at roadside, mile 57 N, *9105.* In flower and with some mature achenes on August 9.

Matricaria matricaroides (Less.) Porter. (Th) Local in disturbed soil. Enterprise, *3896;* Yellowknife, *7855.*

Petasites frigidus (L.) Fries var. *nivalis* (Greene) Cronq. (*P. vitifolius*

Greene) (Grh) Rare in moist disturbed gravelly soil at roadside and in wet woods. Past flowering and with immature fruit on June 15 and June 27. Mile 7, *4810;* mile 110 N, *9428.*

Petasites frigidus (L.) Fries var. *palmatus* (Ait.) Cronq. *(P. palmatus* [Ait.] Gray) (Grh) Rare in sand in pine woods and in disturbed soil at roadside. Past flowering and with immature fruit on June 18. Kakisa River, *4562;* mile 110 N, *7319.*

Petasites sagittatus (Pursh) Gray. (Grh) Rare to locally frequent in grasslands, in marshes, in birch-willow thickets, and in disturbed soil at roadside. Past flowering and with immature fruit on June 18. Mile 17 N, *4165;* Kakisa River, *4565;* mile 23.6 S, *6727.*

Senecio congestus (R. Br.) DC. (Hs) Infrequent to locally common along shores, in marl deposits, in wet meadows, and in disturbed soil of roadside ditches. Collected in flower June 30; with early mature achenes on August 14. Mile 30, *4332;* mile 14 S, *7144;* mile 61.2 N, *7610.*

Senecio eremophilus Rich. (Hp) Seen only once, in disturbed sandy soil along road to ford over Kakisa River, *5327.* In flower on July 15.

Senecio indecorus Greene. (Hs) Infrequent in sedge meadows, in marl deposits, and in disturbed soil at roadside. Flowers in mid-July; nearly mature fruit by August 4. Mile 9, *5567;* mile 39.7 N, *7565.*

Senecio lugens Rich. (Hsr) Local in moss mats or peaty soil in black spruce woods; somewhat more common in disturbed peaty or sandy soil at roadside. Collected in flower on June 23; in nearly mature fruit on July 15. Mile 56, *4785;* mile 66 S, *8010;* mile 28 N, *9094.*

Senecio pauperculus Michx. (Hs) Rare in grasslands; locally frequent in moist disturbed soil at roadside. In flower during very late June and July; immature fruits on July 27. Two of our specimens *(5259, 5265),* collected at mile 66, are hybrids between *S. pauperculus* and *S. indecorus,* according to Dr. T. M. Barkley. Kakisa Road, *5326;* mile 81.5 N, *7371.*

Senecio plattensis Nutt. (Hs) Collected twice, in grassland, mile 13 N-14 N, *5031,* and in disturbed soil at roadside, mile 52, *5091.* In flower July 8-10.

Senecio tridenticulatus Rydb. (Hs) Local in shallow residual soil over limestone and in litter or sand in jack pine forests; local in disturbed soil at roadside. In flower June 21; in flower and fruit July 4. Our 1959 collections *(4674, 4844, 4875, 4912, 5009, 5091)* of this species were identified by T. M. Barkley. Dr. A. E. Porsild (in litt.) considers the Mackenzie plants to be *Senecio cymbalarioides* Nutt. var. *borealis* T. et. G. Mile 12, *4844;* mile 103.5 N, *6865.*

Senecio vulgaris L. (Th) Seen only once, garden weed, Yellowknife, *9301.* With mature fruit on August 19.

Solidago canadensis L. var. *salebrosa* (Piper) Jones. (Hpr) Infrequent to rare in grasslands and along sandy or rocky shores; locally common in disturbed soil at roadside. In flower in late July and early August;

achenes not yet mature on August 11. Mile 17 N, *4190;* mile 0.5, *6118;* mile 64.6 S, *8378.*

Solidago multiradiata Ait. (Hsr) Rare in moss mats or litter in spruce forests; local in disturbed soil at roadside. In flower during July; achenes nearly mature on August 3. Mile 31.5 S, *7929.*

Solidago spathulata DC. var. *neomexicana* (Gray) Cronq. *(S. decumbens* Greene var. *oreophila* [Rydb.] Fern) (Hsr) Rare in shallow residual soil over limestone and in sand in pine woods; considerably more common in disturbed soil at roadside. Begins to flower in mid-July; with nearly mature achenes on August 3. Mile 51, *4292;* mile 98.8 N, *7713;* Yellowknife, *8347.*

Sonchus arvensis L. var. *glabrescens* Guenth., Grab. et Wimm. (Hsr) Seen only once, at roadside, mile 33 N, *9439.* With flowers and very immature fruits on August 27.

Tanacetum vulgare L. (Hs) Seen only once, waste place, mile 5 N, *8428.* In flower on August 4.

Taraxacum ceratophorum (Ledeb.) DC. (Incl. *T. lacerum* Greene) (Hr) Frequent in disturbed soil at roadside; rare in crevices in limestone outcrops and in sandy pine woods. In early flower mid-June; mature achenes by June 22. Mile 23.5, *5133;* mile 35 N, *6658;* mile 6.2 S, *6709.*

Taraxacum officinale Wiggers. (Hr) Common in disturbed soil, especially about settlements. With mature fruits by June 24. Fort Providence, *6937.*

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GILIA AND IPOMOPSIS (POLEMONIACEAE) IN TEXAS

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During May, 1963, Dr. Edgar T. Wherry spent two half-days at the SMU Herbarium in connection with an account of the Polemoniaceae of Texas now in preparation. Until his visit I did not know that he had undertaken such a project, and as part of the preliminary work for my own concise flora of the state had prepared keys to the genera and species (except *Phlox)* and worked over the nomenclature a year and a half earlier. My manuscript sketch includes two new species of *Gilia* and two new nomenclatural combinations under *Ipomopsis.* It is primarily to publish these and make them available for Dr. Wherry's use (or rejection, as the case may be) that this brief paper has been prepared. Since no keys to the Texas representatives as currently understood are available, and since the listings in Gould's recent *Texas Plants* leave much to be desired, it seems worth while to include my key to the genera and notes on the species (other than *Phlox*). It has been my usual procedure to work up various groups on the basis of collections at SMU to the extent of revising the nomenclature, checking relevant publications, and preparing utility keys for identification of flowering material; then put the manuscript notes aside until additional material has accumulated, or visits can be made to other institutions, or loans obtained for further study. What is presented here is not yet in the form in which it will appear in my flora, but it includes the essential material and should be of some use. The sequence of genera is that of Verne Grant's very helpful *Natural History of the Phlox Family,* vol. 1. Technical definitions of the genera may be found there; the key below is intended merely to permit rapid identification of flowering material.

KEY TO TEXAS GENERA OF POLEMONIACEAE

1a. Leaves pinnately compound, with distinct, broad leaflets
2. *Polemonium*

1b. Leaves simple, but in some species cut into narrowly lanceolate to thread-like segments

  2a. Lower or all leaves opposite

    3a. Calyx enclosed by large, spiny-toothed, net-veined bracts
1. *Loeselia*

    3b. Calyx with entire, 1-ribbed bracts or none (subtended by upper leaves in some species)

      4a. Leaf blades linear to oblong-ovate or obovate, entire, more than 1.3 mm. wide; annuals or perennials, general distribution . .
3. *Phlox*

SIDA 1 (3): 171—179. 1963.

4b. Leaf blades linear to thread-like or cut into thread-like segments less than 1.3 mm. wide; small annuals of desert areas, Trans-Pecos . . . . 7. *Linanthus*

2b. Leaves alternate or basal

5a. Corolla appearing rotate (tube very short), or narrowly funnelform with tube flaring upward . . . . 4. *Gilia*

5b. Corolla more or less salverform, with nearly cylindrical tube longer than the lobes

6a. Calyx and upper leaves sparsely woolly, or without woolly hairs 5. *Ipomopsis*

6b. Calyx and base of upper leaves largely hidden by matted, wooly hairs . . . . 6. *Eriastrum*

1. LOESELIA. The Mexican L. SCARIOSA (Martens & Galeotti) Walpers has been reported by Standley (1937) from the Chisos Mountains, southern Brewster County. I have not seen specimens. That cited by Standley was collected in August.

2. POLEMONIUM. P. PAUCIFLORUM S. Watson (including P. *Hinckleyi* Standley, Amer. Midl. Nat. 18: 684, 1937; according to Verne Grant, 1959) occurs in the Davis Mountains, Jeff Davis County. Flowering in August.

3. PHLOX. *P. bifida* var. *induta* Shinners, S.W.Nat. 6: 50—51, 1961, is referred by Dr. Wherry to his *P. oklahomensis.* This latter is regarded by Marsh (1960) as specifically distinct from *P. bifida.* Marsh's paper appeared while my note was in press. By a similar curious coincidence, *Phlox Johnstonii* Wherry (1961) was published after Erbe and Turner's biosystematic study of annual species (1962) had been completed but before it appeared in print. *P. Johnstonii* is excessively close to *P. Drummondii* var. *McAllisteri.* Despite their use of modern techniques, the study of Erbe and Turner is more superficial than that of Dr. Eula Whitehouse (1945), which remains the classical work on the annual species. The genus is both large and very difficult in Texas, and I have not yet completed even a preliminary account.

4. GILIA and 5. IPOMOPSIS. See below.

6. ERIASTRUM. E. DIFFUSUM (Gray) H. L. Mason, Madrono 8: 76. 1945. *Gilia filifolia* var. *diffusa* Gray, Proc. Amer. Acad. 8: 272. 1870. "Fort Mohave and Nevada to New Mexico and the borders of Texas." Cited by Craig (1934) from El Paso and Fort Bliss, both in El Paso County. The following collections are at SMU. EL PASO CO.: Frontera (El Paso), hills and rocky places, *Charles Wright,* 30 March 1852. Lower slopes of Mt. Franklin, El Paso, sandy soil, *Barton H. Warnock 10349,* 19 April 1952. HUDSPETH CO.: steep rocky (igneous) slopes, north end of Quitman Mts., 8 miles W. of Sierra Blanca, *Rogers McVaugh 8026,* 21 April 1947.

7. LINANTHUS, the white-flowered L. BIGELOVII (Gray) Greene is

known from EL PASO CO.: Frontera (El Paso), *Charles Wright*, April 1852 (SMU). The yellow-flowered L. AUREUS (Nuttall) Green is said to extend east to Texas by Kearney & Peebles (1960); I have not seen specimens from the state.

KEY TO TEXAS GILIA

1a. Corolla funnelform, with well-developed, gradually flaring tube exceeding the lobes . . . . 1. *G. mexicana*

1b. Corolla appearing rotate, the inconspicuous tube much shorter than the widely spreading lobes

  2a. Lower stem leaves with long, naked petioles and wide, flat blades

  3a. Blades of lower stem leaves slightly to much longer than broad, usually pinnately compound or deeply pinnatifid or lyrate; winter annual. Edwards Plateau and Rio Grande Plain . . . . . . 2. *G. incisa*

  3b. Blades of lower stem leaves slightly shorter to slightly longer than broad, coarsely toothed or shallowly lobed; prennial with thick, woody root (but flowering the first year from seed, with slender taproot); Trans-Pecos mountains . . . . 3. *G. perennans*

  2b. Lower stem leaves (not basal ones) sessile or subsessile or with tappered, winged-petiolar basal portion, commonly with mall, spreading lobes nearly or quite to base

    4a. Calyx in flower divided about half way

      5a. Basal leaves numerous, persistent; lower stem leaves deeply pinnatifid, the 5—7 pairs of segments mostly coarsely toothed or deeply lobed; Rio Grande Plain . . . . 4. *G. ludens*

      5b. Basal leaves mostly absent at flowering time; lower stem leaves with 1—4 pairs of narrow, entire or sparingly toothed segmens; Edwards Plateau to Panhandle and Trans-Pecos

        6a. Lower stem leaves (not basal ones) sessile or ubsessile or with leaves with progressively more slender segments 5a. *G. rigidula* var. *rigidula*

        6b. Lower leaves with stiff, almost needle-like segments less than 1 mm. wide; upper leaves similar to lower 5b. *G. rigidula* var. *acerosa*

    4b. Calyx in flower divided about 3/4 or more

      7a. Calyx 10—12 mm. long, chiefly of white, scarious tissue with narrow green bands extending from base up through center of each lobe . . . . 6. *G. insignis*

      7b. Calyx 4.0—5.5 mm. long, chiefly of green tissue, the lobes with narrow, white, scarious margins . . . . 7. *G. Stewartii*

1. G. MEXICANA A. & V. Grant, Aliso 3: 255—257. 1956. Type from Arizona; cited also from New Mexico (Grant and Dona Ana counties),

and Chihuahua. There are three specimens at SMU from westernmost Texas .EL PASO CO.: Frontera (El Paso), *Charles Wright,* April, 1852. Infrequent in limestone soil, McKelligon Canyon, Franklin Mts., El Paso, *Warnock 7664,* 26 March 1948. On west, lower, limestone slopes of Franklin Mts. about 2 miles west of El Paso, *Warnock 10308,* 10 April 1952.

2. G. INCISA Bentham in DC., Prodr. 9: 312. 1845. "In Texas (Drummond coll. 3a n. 463!)." Type material not seen. Drummond collected in the area from Galveston to Victoria and Gonzales counties, and inland as far as Milam County. This area touches the southeastern limits of the range of this species as shown by collections at SMU (county names in parentheses): Eastern Rio Grande Plain (Cameron, Kleberg, Live Oak), up the coast to Aransas County, and on the Edwards Plateau (north to Travis and San Saba, west to Val Verde), at elevations between sea level and 2,000 feet. Flowering late March—early June.

3. G. **perennans** Shinners, sp. nov.. *G. incisae* peraffinis, sed perennans demum cum radice crasso lignoso, foliorum inferiorum caulinorum laminis brevioribus minus divisis; species monticola. HOLOTYPE: rock crevice, north fork, Guadalupe Mountains, north McKittrick Canyon, Culberson Co., Texas, *D. S. Correll 13958,* 18 August 1946 (SMU). "Flowers blue." The following additional specimens have been seen, all from Trans-Pecos Texas at elevations of 5,000 feet or above, all deposited at SMU. CULBERSON CO.: numerous, in a spot growing in the almost solid rock of the creek bed in north McKittrick Canyon, Guadalupe Mountains, *L. C. Hinckley & Leon Hinckley 29,* 3 June 1949. In limestone soil above Hunter Lodge, in south McKittrick Canyon of Guadalupe Mts., *Warnock 9536,* 31 August 1950. Same locality, *Warnock 10950,* 3 August 1952. JEFF DAVIS CO.: infrequent in Limpia Canyon at mouth of Wild Rose Pass, Kokernot Ranch, Davis Mts., *Warnock & F. M. Churchill 7742,* 6 April 1948.

This differs from *G. incisa* more in its biology than in its morphology, and it is only after considerable hesitation that it is named as a distinct species. In addition to the points noted in the key, the calyx averages slightly larger (4.0—4.7 mm. long vs. 3.5—4.5 mm. in *G. incisa).* The fact that all but one of the collections were made in summer, long after the normal flowering time for *G. incisa,* is partly due to accidents of collecting, since most botanists have visited during the summer, but in part it doubtless reflects the higher altitude.

4. G. **ludens** Shinners, sp. nov. Perennis? humilis (ca. 12-21 cm.) plerumque pluricaulis ramosa minute glanduloso-pubescens. Folia radicalia brevissime petiolata oblanceolata pinnatisecta incise dentata, caulina minora sessilia lobis angustioribus suprema lobis filiformibus. Flores subcongesto-cymosae; inter *G. incisam* et *G. rigidulam* ludens. HOLOTYPE: silt loam, railroad right-of-way, 4 miles west of Alice, Jim Wells Co., Texas, *Shinners 19581,* 10 April 1955. (SMU). "Corolla blue (flowers

mostly past)." PARATYPES (all SMU). DUVAL CO.: in Pleistocene gravel, State Highway 44. 7 miles east of Freer, *Rebecca M. Rodriguez 105,* 18 March 1962. In sandy loam, U.S. Highway 44, 2 miles west of San Diego, *Jesus H. Ramirez, Nick Lopez, and Wm. McCart 8767,* 10 March 1963. WEBB CO.: in light red sand, State Highway 359, 2 miles west of Bruni, *Elvira G. Garcia 137,* 16 March 1963.

Because of the prominent, flat-bladed basal leaves, I at first mistook this for *G. incisa,* despite the relatively short-pedicelled flowers. On later comparison in the herbarium, it seemed closer to *G. rigidula,* but that species lacks the prominent basal leaves and is confined to areas from the Edwards Plateau north and west. Bentham's description of the leaves of *G. incisa* (he apparently had only upper ones) as "cuneatis lanceolatis linearibus subintegris v. saepius acutissime incisis" makes it certain that he did not have the species here described.

5. G. RIGIDULA Bentham in DC., Prodr. 9: 312. 1845. "In Texas pr. Bejar (Berlandier)." This often-mentioned locality is the present San Antonio, Bexar County. The description and locality are quite sufficient to establish the identity of Bentham's plant. I follow Asa Gray in recognizing two varieties.

5a. G. RIGIDULA var. RIGIDULA. Edwards Plateau, north to Travis, Burnet, Jones, Taylor and Mitchell counties, west into eastern Trans-Pecos (Pecos, Reeves, Val Verde). Flowering late March—May, sporadically to October.

5b. G. RIGIDULA var. ACEROSA Gray, Proc. Amer. Acad. 8: 280. 1870. "North New Mexico to Arizona, Fendler, Gordon, Wright, &c." (Specimens not seen.) In the Synoptical Flora the range is extended to "borders of Texas" (p. 149). Northern Trans-Pecos (Culberson, Hudspeth, Jeff Davis) and Panhandle, southeast to Taylor County. Flowering late March (rarely) or April to September.

6 G. INSIGNIS (Brand) Cory & Parks, Cat. Fl. Texas (Texas Agr. Exp. Sta. Bull. 550) p. 85. 1938 ("1937"). *G. rigidula* ssp. *insignis* Brand, Pflanzenreich IV. 250. p. 149. 1907. "So nur in Nord-Mexiko: Coahuila Pringle n. 248; Palmer n. 843)." Specimens not seen. Verne Grant provisionally referred this and the next to *G. rigidula,* but I feel sure this was simply due to not having seen adequate material. The different calyx (as noted in the key), the very large corolla, and persistent, large basal leaves (somewhat like those of *G. ludens)* justify treating this as a distinct species. I have seen two collections, both from BREWSTER CO.: abundant especially along road; stony flats, creosote shrub association, about 3 miles S. of Persimmon Gap, *McVaugh 7831,* 5 April 1947 (SMU). Frequent along roadside near Dog Flat, *Warnock 21485,* 2 April 1938.

7. G. STEWARTII I. M. Johnston, Journ. Arnold Arb. 24: 94. 1943. Cited by Johnston from Brewster and Hudspeth counties, and from numerous localities in Mexico. I have seen the following Texas collec-

tions. BREWSTER CO.: frequent on limestone hills between Lone Mountain and Nugent Mountain, Big Bend National Park, *Warnock 7161,* 3 Sept. 1947. On alluvial fan, 6 miles north of Hot Springs, Big Bend Park, *Rose-Innes & Warnock* 546, 20 March 1941 (cited by Johnston). PRESIDIO CO.: calcareous gravel hillsides, south end of Van Horn Mts. near Porvenir, *U. T. Waterfall 4754,* 26 June 1943 (det. I. M. Johnston). Along rocky ledge e. Van Horn Creek at north end crossing, Porvenir-Chispa road in western end of county, *L. C. Hinckley 2230,* 25 Oct. 1941.

Excluded Species

G. ophthalmoides ssp. *australis* A. & V. Grant, Aliso 3: 263. 1956. Described from southern Arizona and southwestern New Mexico; reported by Gould from Trans-Pecos Texas, but I have seen no specimens.

G. ophthalmoides ssp. *flavocincta* (A. Nelson) A. & V. Grant, 1. c. 262. Cited by the Grants only from Arizona; reported by Gould for the entire western half of Texas, but I have seen no specimens.

KEY TO TEXAS IPOMOPSIS

1a. Corolla tube 0.3—1.0 cm. long
  2a. Leaves all entire . . . . 8. *I. Wrightii*
  2b. Leaves (except uppermost) toothed or divided into linear or thread-like segments
    3a. Corolla lobes 5—7 mm. long, more than half as long as the tube 1.*I. Havardii*
    3b. Corolla lobes 1.0—4.5 mm. long, less than half as long as the tube
      4a. Annual with slender taproot, flowering April—early July; desert flats
        5a. Corolla tube 3—5 mm. long; upper leaves deeply toothed or pinnatifid, the segments short and wide . . . . 6. *I. polycladon*
        5b. Corolla tube 6—8 mm. long; upper leaves entire or cut into 3—5 thread-like segments . . . . 7. *I. pumila*
      4b. Perennial with rather stout taproot, flowering July—October; mountains
        6a. Primary axis of inflorescence with about 1—10 nodes, the lower flowering branchlets mostly subtended by reduced undivided leaves (see excluded species at end) . . . I. *multiflora*
        6b. Primary axis of inflorescence with about 10—35 nodes, the lower flowering branchlets mostly subtended by pinnatisect leaves (see excluded species at end) . . . . *I. pinnata*
1b. Corolla tube 1.2—4.5 cm. long
  7a. Inflorescence loose, open, broad; stem freely and widely branching; corolla lavender-blue to white
    8a. Corolla tube 1.2—2.0 cm. long; corolla lobes 3—6 mm. long, 1.0—3.2 mm. wide . . . . 2. *I. laxiflora*
    8b. Corolla tube 2.2—4.5 cm. long; corolla lobes 6.5—12.0 mm. long, 4—6 mm. wide . . . . 3. *I. longiflora*

7b. Inflorescence narrow, dense, elongate; stem normally simple or with few, elongate branches; corolla red or rarely yellow
  9a. Calyx lobes about as long as the tube; Trans-Pecos 4. *I. aggregata*
  9b. Calyx lobes nearly twice as long as the tube: central and eastern Texas..5. *I. rubra*

1. I. HAVARDII (Gray) V. Grant, Aliso 3: 357. 1956. *Loeselia Havardi* Gray, Proc. Amer. Acad. 19: 87. 1883. "W. Texas, on the Rio Grande near Presidio del Norte, *Dr. N. (sic) Havard,* 1881." *Gilia Havardi* Gray, Syn. Fl. 2 pt. 1 (suppl.) p. 411. 1886. I have seen only the following specimens. BREWSTER CO.: limestone soil in Avery Canyon, Big Bend National Park, *Warnock 9141,* 23 July 1950. PRESIDIO CO.: about 1 mile southeast of Greenwood ranchhouse some 50 miles south of Marfa, *L. C. Hinckley 3578,* 4 April 1946. Common along washes, rolling Rio Grande Plain, 4 miles SE of Ruidosa, *C. H. Muller 8440,* 28 July 1945.

2. I. LAXIFLORA (Coulter) V. Grant, Aliso 3: 361. 1956. *Gilia Macombii* var. *laxiflora* Coulter, Contrib. U.S. Nat. Herb. 1: 44. 1890. "Camp Charlotte (Ixion county)," (i. e. Irion County), *G. C. Nealley 311* (US; not seen). *Gilia laxiflora* (Coulter) Osterhout, Bull. Torr. Bot. Club 24: 51. 1897. Trans-Pecos (Jeff Davis, Presidio, Reeves), east in South Plains to Lubbock and Mitchell counties. Flowering late April—July.

3. I. LONGIFLORA (Torrey)V. Grant, Aliso 3: 361. 1956. *Cantua longiflora* Torrey, Ann. Lyc. N.-Y. 2: 221. 1826. "On the Canadian" (probably in the Texas Panhandle). *Gilia longiflora* (Torrey) G. Don, Gen. Hist. Dichlam. Pl. 4: 45. 1838. Widespread in Trans-Pecos, Panhandle, South Plains and Red Plains, east to Wilbarger and Stonewall counties. Flowering late March (Big Bend area) or April to October.

4. I. AGGREGATA (Pursh) V. Grant var. **texana** (Greene) Shinners, comb. nov. *Callisteris texana* Greene, Leafl. Bot. Obs. & Crit. 1: 160. 1905. "Guadalupe Mountains, western Texas, V. Havard, Sept., 1881. Type in U. S. Nat. Herb." (not seen). *Gilia aggregata* var. *texana* (Greene) I. M. Johnston, Journ. Arnold Arb. 24: 95. 1943. This is listed twice by Gould, as *Gilia texana* and as *Ipomopsis aggregata.* Common in the Trans-Pecos mountains in Brewster, Culberson, Jeff Davis and Presidio counties. Flowering July—September.

5. I. RUBRA (L.) Wherry, Bartonia 18: 56. 1936. *Polemonium rubrum* L., Sp. Pl. 1: 163. 1753. *"Habitat in* Carolinae *citerioris arenosis. B. Jussieu." Gilia rubra* (L.) Heller, Bot. Expl. S. Texas (Contrib. Herb. Franklin & Marshall College 1) p. 81. 1895. Local and uncommon in eastern counties in the Pine Belt; frequent and locally abundant on various substrates, often on dry, rocky, limestone slopes, in central Texas west to Taylor and Scurry counties and southwest to Caldwell County. Also frequent in cultivation. Flowering late May—early July, and spora-

dically to September. A semi-albino with yellow flowers has been observed in Rockwall County.

This is an example of a species first described from the Southeastern United States but relatively uncommon there, having its center of abundance west of the Mississippi River. *Mirabilis albida* and *Hedyotis nigricans* are other examples of such distribution. These are all of Southwestern and Mexican relationship; I would not agree with Verne Grant in decribing *Ipomopsis rubra* as characteristic of the Southeast.

6. I. POLYCLADON (Torrey) V. Grant, Aliso 3: 361. 1956. *Gilia polycladon* Torrey in Emory, Rept. U.S. & Mex. Boundary Survey 2: 146. 1859. "Stony hills near El Paso, March." No collector is named; the following is the only specimen seen. EL PASO CO.: Frontera (El Paso), Gravelly places, *Charles Wright,* April 1852.

7. I. PUMILA (Nuttall) V. Grant, Aliso 3: 361. 1956. *Gilia pumila* Nuttall, Journ. Acad. Nat. Sci. Phila. (ser. 2) 1: 156. 1848. "Near the first range of the Rocky Mountains of the Platte. Flowering in May. (Nuttall.)" In Texas confined to the Trans-Pecos. CULBERSON CO.: near Salt Lake on Highway 54, about 30 miles north of Van Horn, *Eula Whitehouse 11455,* 5 July 1931. HUDSPETH CO.: only four plants found in barpit at roadside about 5 miles S. Sierra Blanca, *Hinckley & Hinckley 68,* 12 June 1949. PRESIDIO CO.: sandy desert flats, 2 miles north of Porvenir; abundant, *McVaugh 7995,* 17 April 1947.

8. I. **Wrightii** (Gray) Shinners, comb. nov. (This appears as a *nomen nudum* without indication of combining author in Gould's *Texas Plants,* 1963.) *Gilia Wrightii* Gray, Proc. Amer. Acad. 8: 273. 1870. "Western frontiers of Texas, on the Rio Grande forty miles below El Paso, C. Wright, n. 496." Two collections seen, the first from the general area of the type locality. EL PASO CO.: in sandy soil along road about 15 miles north of Ysleta, *W. J. Tebeaux,* 13 Aug. 1951. Rather infrequent in deep sand along Carlsbad highway about 16 miles east of El Paso, *Warnock 10902,* 28 July 1952. Annual developing a stout taproot; Gray described the species as doubtfully perennial.

Excluded species

I. multiflora (Nuttall) V. Grant, Aliso 3: 357. 1956. *Gilia multiflora* Nuttall. Gray in 1870 (Proc. Amer. Acad. 8: 260) stated that *Collomia Cavanillesiana* occurred on "borders of W. Texas, New Mexico, Arizona and adjacent Mexico." In the first edition of the Synoptical Flora (vol. 2 pt. 1: 136, 1878), he reports it from "New Mexico and W. Texas to Arizona." In the Supplement added to the 2nd edition (p. 411, 1886), this name is given as a synonym "in part" of *Gilia multiflora,* which is stated to be "common in New Mexico and Arizona." Presumably the earlier report of Texas was found to be in error. I have seen specimens from New Mexico and Arizona, but not from Texas.

I. pinnata (Cavanilles) V. Grant, Aliso 3: 357. 1956. *Phlox pinnata* Cavanilles, Icones 6: 17, t. 528 fig. 1. 1801. "Habitat in Montevideo viciniis, . . . Phlox haec pinnata crescit etiam passim in Nova Hispania prope Real del Monte." Bentham and Gray were certainly correct in believing that the locality Montevideo was an error (cf. Gray, 1870, p. 260, where it is erroneously given as "Buenos Ayres"). *Collomia Cavanillesiana* G. Don, Gen. Hist. Dichlam. Pl. 4: 247. 1838. (Illegitimate new name based on the preceding.) *Gilia pinnata* (Cavanilles) Brand, Pflanzenreich IV. 250. p. 112. 1907. Specimens seen from Chihuahua, Durango and Zacatecas. It is not unlikely that this species may be found in the Big Bend area of Texas.

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LEPTOGLOSSIS AND NIEREMBERGIA (SOLANACEAE) IN TEXAS

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Two genera of Texas Solanaceae with salverform corollas are so strikingly similar to Polemoniaceae that at first glance they are apt to be mistaken for members of that family. Technically of course they differ in having simple style and stigma. They also differ in the conformation of the calyx, which is narrowly funnelform, so that there is considerable open space between it and the narrowly cylindrical corolla tube. In the Polemoniaceae which they resemble the calyx is appressed to the corolla tube or nearly so. It is an interesting example of recombinations of characters that *Bouchetia erecta* DC., another representative of Texas Solanaceae, has a flaring calyx closely resembling that found in the two genera here discussed, but its corolla tube also narrowly funnelform, so that the calyx fits closely against it. *Leptoglossis* and *Nierembergia* are represented in Texas by a single species each, the former native but currently passing under an incorrect name, the latter introduced and not previously reported as a wild plant for the state. They may be distinguished as follows.

Corolla tube abruptly swollen toward one side at summit; anther-bearing stamens 4, in two very unequal pairs, barely exserted; native (endemic in Val Verde County) .... *Leptoglossis*
Corolla tube narrowly cylindrical to summit; anther-bearing stamens 5, equal or subequal, prominently exserted; cultivated and escaped *Nierembergia*

LEPTOGLOSSIS TEXANA (Torrey) Gray, Proc. Amer. Acad. 12: 164. 1877. *Browallia texana* Torrey in Emory, Rept. U.S. & Mexican Boundary Survey 2: 156. 1859. "Near the mouth of the Pecos, September-October; *Bigelow, Pope.* (No. 535, *Wright.)*" (These specimens not seen, but several approximate topotypes examined: SMU, TU.) *Nierembergia viscosa* Torrey, ibid. p. 155. "Rocky hills, mouth of the Pecos, and on Devil's River, western Texas; *Bigelow.* (No. 535, *Wright.)*" (Same comment as preceding.) *Leptoglossis viscosa* (Torrey) Millan, Darwiniana 5:489. 1941. Probably it was the influence of the American Code, which accepted page priority as binding, that led to the revival of the name *Nierembergia viscosa*, by which this species has recently been called. Gray, in uniting the two Torreyan species, deliberately chose the epithet *texana* in preference to *vicosa* (l.c., p. 165), and under current rules, his choice must be followed. Millan evidently had not seen Gray's com-

SIDA 1 (3): 180—181. 1963.

ments when he excluded the species from the genus *Nierembergia.*

Leptoglossis texana is a perennial which, like so many in Texas, may flower the first year from seed. It suggests a *Phlox* with light purple or purple-pink corolla, blooming late March—early May and rarely in October. All collections examined were from Val Verde County, on limestone substrates.

NIEREMBERGIA HIPPOMANICA Miers var. CAERULEA (Miers) Millan, Darwiniana 5: 521. 1941. *N. caerulea* Miers. (For full synonymy see Millan, l.c.). The Cup Flower, native of north central Argentina (Cordoba and San Luis provinces, according to Millan), may be grown as an annual, flowering the first year from seed. In reality it is a miniature, semi-evergreen shrub, usually less than a foot high, losing its leaves in severe winters, but not dying to the ground. The flowers are produced in abundance in spring (April—June, according to time of planting) and less freely until fall. The corolla is purplish blue (rarely white) with a small, greenish white eye; the limb is shallowly cupped rather than flat, a feature not easily seen in herbarium specimens, which suggest a species of *Gilia* or *Linanthus.* As yet this is no more than a waif, but it may in time become established. There are two specimens at SMU. DALLAS CO.: Irving, on a trash pile, *Mrs. W. J. Harkey,* 14 May 1962. WILLIAMSON CO.: Georgetown, no habitat given (but collected for a wild plant), *Caroline Dormon,* April, 1958.

These comments have been based primarily on collections at SMU, supplemented by live plants of *Nierembergia* in my garden in Dallas, and specimens of *Leptoglossis* examined on a visit to the University of Texas in Austin.

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NOTES

MONANTHOCHLOE LITTORALIS (GRAMINEAE) IN LOUISIANA. — The following collection is apparently the first record of the grass *Monanthochloe littoralis* Engelm. from Louisiana: ½ mile east of mouth of Mermentau River at Hackberry Beach, Cameron Parish, Wayne G. Harris 55, July 17, 1962. The species was found to be common locally, with *Spartina patens* and *Distichlis spicata*, on the slope behind the shell beach, about 100 yards north of the gulf shore. Voucher specimens have been deposited in the herbarium of the University of Southwestern Louisiana, in the United States National Herbarium, and in the herbarium of Southern Methodist University.—*A. G. Owens, Jr. and Sam Riche, Louisiana Mosquito Control Association, Lafayette, Louisiana.*

CENCHRUS LONGISETUS M. C. JOHNSTON, NOM. NOV. (GRAMINEAE). — Based on *Pennisetum villosum* R. Brown ex Fresenius, Mus. Senckenb. Abh. 2: 134, 1837 (*fide* Hitchcock, Man. Grasses ed. 2 p. 934). Not *Cenchrus villosus* (Sprengel) Sprengel, Syst. 1: 301, 1825.—*Marshall C. Johnston, University of Texas, Austin 12.*

CENTROSEMA FLORIDANUM (BRITTON) LAKELA, COMB. NOV. (LEGUMINOSAE). — Based on *Bradburya floridana* N. L. Britton, Torreya 4: 142. 1904. Since *Centrosema* has been made a *nomen conservandum* under the International Code of Botanical Nomenclature, this transfer is required.—*Olga Lakela. (Contribution No. 4, Botanical Laboratories, University of South Florida, Tampa.)*

THE VARIETIES OF TEUCRIUM CANADENSE (LABIATAE). — Elizabeth McClintock and Carl Epling, in "A revision of *Teucrium* in the New World, with observations on its variation, geographical distribution and history" (Brittonia 5: 491—510, 1946), recognize three varieties of *T. canadense*, one with bizarrely disjunct range between Florida and Arizona, another supplied with an illegitimate new combination. After working over material of the species in connection with my proposed floras of the Southeast and Gulf Southwest, I am able to recognize three varieties also, but two of these with different circumscription and different nomenclature. They may be distinguished as follows.

1a. Calyx without glandular hairs

  2a. Leaf blades medium to moderately dark green above, grayish green to gray beneath, midrib on lower surface with hairs pointing forward, widely spreading, or very loosely retrorse; plants of wide distribution, outside the area of the next. . . . . .var. *canadense*

  2b. Leaf blades very dark green or blackish green above (medium green in a few Mississippi coast specimens), silvery beneath, midrib on lower surface with closely appressed retrore hairs in basal portion (rarely loose or spreading ni north Florida specimens) .... var. *Nashii*

1b. Calyx with glandular hairs .... var. *boreale*

1. T. CANADENSE L. var. CANADENSE. Extremely variable as to pubescence. There is a fairly marked tendency toward narrow leaves at two extremes of its range: eastern and far southwestern. I consider var. *virginicum* (var. *littorale)* and var. *angustatum* Gray to be parallel variations, insufficiently differentiated to recognize nomenclaturally. Those fond of theorizing will doubtless see in them the ancestral form which has spread to the fringes of the area of the species and been replaced by later variations toward the center. Such a theory does not explain why part of the fringe is occupied by the two named varieties here recognized, and part by no distinguishable variation at all.

1b. T. CANADENSE var. **Nashii** (Kearney) Shinners, comb. nov. *T. Nashii* Kearney, Bull. Torr. Bot. Club 21: 484, 1894. "Collected in middle Florida in 1836, by Dr. Chapman; in Duval county, Florida, by Mr. A. H. Curtiss (No. 1975) and near Eustis, Florida, in 1894, by Mr. George V. Nash (Numbers 1496, 1505 and 1516)." I have not seen the syntype material, but have examined specimens answering to the description from the following states and counties, FLORIDA. Brevard, Citrus, Duval, Franklin, Indian River, Jefferson, Madison, St. Johns, Taylor, Wakulla. GEORGIA. McIntosh. MISSISSIPPI. Harrison, Jackson. NORTH CAROLINA. Columbus. The typical and most widespread form has the leaf blades very dark green above, silvery beneath with very dense, closely appressed hairs, those on the basal portion of the midrib pointing toward the petiole. Rarely the hairs on the midrib are loose (one specimen from Taylor Co., Florida) or even spreading (one specimen from Franklin Co., Florida). In coastal Mississippi the plants have a more medium green upper surface on the leaves, approaching var. *canadense.* In all cases the leaf blades are relatively narrow, but I do not consider this justification for putting the Florida populations with the Arizona ones, as was done by McClintock and Epling. The pubescence of the latter is loose and gray, not silvery, and the blades are not strongly discolorous.

1c. T. CANADENSE var. **boreale** (Bicknell) Shinners, comb. nov. *T. boreale* Bicknell, Bull. Torr. Bot. Club 28: 171. 1901. "New Hampshire to northern New York." Type from Vermont, in Herb. N. Y. Bot. Garden." (Not examined.) *T. occidentale* var. *boreale* (Bicknell) Fernald, Rhodora 10: 85. 1908. *T. occidentale* Gray, Syn. Fl. N.A. 2 pt. 1: 349. 1878. *T. canadense* var. *occidentale* (Gray) McClintock & Epling, Brittonia 5: 499. 1946. The first available epithet in the rank of variety is *boreale,* which must be adopted when the circumscription of the variety includes both *boreale* and *occidentale.* — *Lloyd H. Shinners.*

DICERANDRA IMMACULATA LAKELA, SP. NOV. (LABIATAE).—*D. frutescenti* peraffinis differt floribus paulum brevioribus, corollis rubris vel purpurascentibus immaculatis tuba minus exserta labio superiori cristato lato claviformi, antherarum appendiculis puberulis. HOLOTYPE: numerous plants in flower; on disturbed sandscrub, west of U.S. 1, near south boundary of Indian River County, Florida, *Lakela 25440,* 30 September 1962 (USF). The species occurs also in adjacent northern St. Lucie County. The site of the type specimen is a transition yellow and white sandscrub, with remnants of *Pinus clausa, Zanthoxylum Clava-Herculis, Carya floridana* and scrub species of *Quercus.* Post-mature fruiting cymes *(Lakela 25613,* 19 January 1963) contained only a few nutlets; mildew growing on the nectary gland destroys the fruits. Plants in preanthesis *(Lakela 25221,* 29 July 1962) were collected in white sandscrub with overhead of tall *Pinus clausa,* in St. Lucie County. Fruiting cymes from this colony *(Lakela 25614,* 19 January 1963) were also infected with mildew.

Dicerandra immaculata differs from *D. frutescens* Shinners in slightly shorter flowers, color of the spotless corolla, less exserted tube, broadly clavate upper lip as outlined by dorsal crests, and puberulent anther horns. It is named for the immaculate corolla. The key given in Shinners' "Synopsis of *Dicerandra* (Labiatae)" (SIDA 1: 89—91, 1962) may be emended to accommodate the new species by deleting the reference to flower color in his couplet 2a and inserting the following couplet after it; his text may be supplemented by adding the full description of the new species given below.

Corolla white or yellowish white with purple dots; interior peninsular Florida (Highlands and Sumter counties) . . . . *D. frutescens*

Corolla peach-red or purplish or white, without dots; eastern peninsular Florida (Indian River and St. Luie counties) . . . . *D. immaculata*

DICERANDRA IMMACULATA Lakela. Aromatic, frutescent perennial 4—5 dm. tall from woody, wide-spreading roots. Stems several, branching from the base, glabrous or minutely puberulent, especially at nodes; internodes alternatingly sulcate between decurrent lines, green and sparingly punctate above, woody below with brownish exfoliating periderm with latent buds and persistent petiole bases. Leaves 2—3 cm. long, short-petioled; blades oblanceolate, essentially glabrous or minutely puberulent at base, copiously punctate, uninerved, passing into floral bracts; fascicular leaves similar but smaller. Floral axes puberulent; cymes axillary, usually 3-flowered; peduncles 3—5 mm. long, horizontal, about equalling the ascending or erect pedicels. Cayx in full anthesis 7—8 mm. long, punctate, green or often purplish, becoming whitish at the ciliate, bilabiate apex, glabrous or puberulent without, with a circle of cilia just below sinus level within the throat; upper lip red or purplish, immaculate, sparingly punctate and pubescent without; tube surpassing the calyx, densely pubescent up to level of stamen-bases within; throat funnel-shaped, ventrally saccate, slightly declinate with abruptly everted, cordate palate to 2 mm. long on the middle lobe of the spreading lower lip; upper lip notched, erect or ascending. Stamens exserted, anterior pair 10—12 mm. long, posterior 7—8 mm. long; anthers purple, horizontally oblique with subulate, puberulent horns. Style to 19 mm. long, pilose above, with equal stigmas. Fruiting calyx (dry) 8.2 mm. long; nutlets ovoid, 1.0—1.2 mm. long.

Three white-flowered plants were discovered at the type colony, with pure white corollas which on drying turned ivory or faint lavender. These are designated *D. immaculata* f. **nivea** Lakela, f. nov., corollis in vivo niveis. HOLOTYPE: from the type colony of the species, *Lakela 26,573,* 11 October 1963 (USF).—*Olga Lakela. (Contribution No. 5, Botanical Laboratories, University of South Florida, Tampa.)*

WAHLENBERGIA LINARIOIDES (CAMPANULACEAE) IN FLORIDA: A SECOND ADVENTIVE SPECIES FOR THE UNITED STATES. —*Wahlenbergia* is a genus of annual or perennial herbs comprising upwards of 100 species, mostly of the Southern Hemisphere, none native to North America. *W. marginata* (Thunb.) A. DC., from Japan, has in recent years become well established, particularly in grassy, sandy roadside rights-of-way, on the Coastal Plain from North Carolina (one report: Ahles and Radford, Journ. Elisha Mitchell Sci. Soc. 75: 145, 1959) and South Carolina (Ahles, Bell and Radford, Rhodora 60: 25, 1958) through Georgia and southern Alabama (McVaugh, Bartonia 23: 36—37, 1944, and Field & Lab. 17: 141, 1949; Thorne, Castanea 16: 45, 1951, and Amer. Midl. Nat. 52: 319, 1954) to northern Florida (Godfrey and Kral, Brittonia 10: 173—174, 1958), with a single somewhat isolated record from central Louisiana (Shinners, S.W. Nat. 2: 44, 1957). There are also unreported collections at SMU from southern Mississippi made in 1960 and 1962 (Shinners, in letter).

A second species, *W. linarioides* (Lam.) A. DC., has appeared in the weed flora of FLORIDA, Escambia Co.: sandy vacant lot, West Pensacola, *Godfrey 56689,* 17 May 1958 (FSU). Because of lack of material for comparison, and the very large number of published species of *Wahlenbergia,* I sent material of this one to Dr. Carroll E. Wood, Jr., Harvard University, who generously made the determination and stated that there are specimens in the Gray Herbarium from Argentina, Chile, Bolivia and Brazil. The principal differences between it and *W. marginata* may be summarized as follows:

Hypanthium in flower 3.5—4.5 mm. long, narrowly obconical to subcylindrical, in fruit up to 12 mm. long, subcylindrical; seeds broadly

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elliptic .... *W. linarioides*

Hypanthium in flower 1.5—3.0 mm. long, ellipsoid or ovoid, in fruit up to 7.5 mm. long, obconic-obovoid; seeds oblong .... *W. marginata*

Wahlenbergia linarioides is a perennial herb, usually with several erect, glabrous stems up to about 5 dm. tall, simple to the inflorescence. Leaves glabrous, sessile, the lower linear-oblanceolate, 2—3 cm. long, the upper gradually reduced, becoming linear to linear-subulate, with hyaline wire-like margins bearing irregularly a few sessile, knob-like glands and/or the barest suggestion of teeth. Inflorescence open-cymose, about 2 dm. long and 1.5 dm. broad; branches alternate, elongate, each terminated by a cymule of about 3—10 flowers. Hypanthium in flower narrowly obconical, glabrous, in fruit obconical to subcylindrical, ribbed, 10—12 mm. long and 3—4 mm. broad at summit; calyx lobes persistent, subulate, 3 mm. or a little more in length, stiffly erect at maturity. Corolla pale blue, funnelform above the narrow tube, the five lanceolate lobes extending to a little more than twice the length of the cayx lobes. Stamens 5, shorter than the style, with short filaments and linear-oblong anthers. Style slender-elongate at base, dilated abruptly above to an obconical, truncate stigma. Ovary 2-locular, producing numerous, broadly elliptic, lenticular, lustrous, amber seeds about 0.3 mm. long.

Expenses incurred in this study were met in part by research grant GM-06305 from the Division of General Medical Sciences, Public Health Service.—*R. K. Godfrey, Department of Biological Sciences, Florida State University, Tallahassee.*

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BOTANICAL SURVEY ALONG THE YELLOWKNIFE HIGHWAY, NORTHWEST TERRITORIES, CANADA

II. VEGETATION

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During field work along the Yellowknife Highway in 1958, 1959, 1961, and 1962 I was engaged in two major procedures: (1) the making of a plant collection to document the flora, and the recording of distributional, phenological, life-form, and other data; and (2) the carrying out of a primary survey of the vegetation, that is, recognizing and describing the major plant communities and listing their floristic composition. Part I of *Botanical Survey along the Yellowknife Highway,* also published in SIDA (Thieret, 1963), contains a brief introduction, a map of the highway region, and an annotated catalogue of the flora. The present paper contains (1) additional data to characterize the region and (2) descriptions of the following: forest vegetation; vegetation of rock outcrops; vegetation of lakes and rivers; vegetation of marl and gypsite deposits; vegetation of strands and islands; vegetation of sand plains; and vegetation of disturbed soil. I have already described grassland vegetation of the region (Thieret, 1959). Descriptions of vegetation in areas adjacent to the highway region have been published by Cody, 1960; Jeffrey, 1961; Moss, 1953a, 1953b, 1955; Porsild, 1945, 1951; Raup, 1935, 1946, 1947; and Thieret, 1961. The reader is referred to these papers for comparison with the present account.

Climatological data are given in Table 1. The climate of the highway region can best be described as northern continental, with short, dry, relatively warm summers and long intensely cold winters. The growing season is short and hazardous. Freezing and below freezing temperatures may occur even in July and August. Nevertheless, there is an average frost-free period ranging from 83 days at Fort Providence to 113 days at Yellowknife. Snowfall is heavy, but annual precipitation is low, averaging about 10 inches, of which somewhat more than half (about 5.5 inches) falls as rain. Much of the rain (about 3.6 inches) falls in July and August. More rain falls in autumn than in spring. The low annual precipitation is compensated for in part by the presence of permafrost—which retards drainage, accounting for some of the vast amount of surface water in the region—and by the relatively low summer evaporation.

SIDA 1 (4): 187—239. 1964.

Day length data for Yellowknife are given in Table 2. The length of the summer days is notable from the standpoint of plant growth. During the longest days, there is twilight illumination during the night because the sun remains just below the horizon.

Data and numerous references concerning the geology of the highway region are given by Douglas (1959) and Raup (1946, 1947) and need not be repeated here. The Yellowknife Highway lies partly in the northern Great Plains and partly in the Canadian Shield. For approximately the first 66 miles (from Enterprise) the road runs along the northern edge of the Alberta Plateau (a division of the Great Plains). Elevation ranges from about 650 to 875 feet. On the great descending steps of the plateau—and also on the risers—considerable limestone of Palaeozoic age is exposed. Marly lakes are frequent, as are extensive peat and lake marl deposits and swift, cold, clear streams with rocky or sandy beds. Sandy or gravelly soils mantle many of the ridges. One major river, the Kakisa, averaging 200 feet wide, crosses the highway at about mile 54. The Kakisa bridge is welcome as affording the only bit of paved road along the highway outside of Yellowknife. Lady Evelyn Falls on the river is 47 feet high. It and Kakisa Lake (elevation 729 feet) are accessible via "Kakisa Road," which leaves the highway at mile 53 and goes 10 miles to the lake. The lake, about 25 miles long and 8 miles wide, has, in the few places I investigated it, a low, rocky,

Table 1. SELECTED CLIMATOLOGICAL DATA FOR YELLOWKNIFE, HAY RIVER, AND FORT PROVIDENCE, N.W.T.*

	Yellowknife	*Hay River*	*Fort Providence*
Mean annual precipitation, inches	8.45 (10 years)	12.02 (29 years)	9.63 (10 years)
Mean annual rainfall, inches	5.00 (10 years)	7.34 (29 years)	5.35 (10 years)
Mean rainfall, June, July, and August, inches	2.90 (10 years)	4.06 (29 years)	4.13 (10 years)
Mean temperature, January, F	-18 (10 years)	-12 (29 years)	-17 (9 years)
Mean temperature, July, F	60 (10 years)	60 (29 years)	60 (9 years)
Extreme high temperature, F	86 (1941-1960)	96 (1893-1959)	97 (1943-1959)
Extreme low temperature, F	-60 (1941-1960)	-62 (1893-1959)	-60 (1943-1959)
Average frost-free period	113 days (10 years)	88 days (53 years)	83 days (7 years)

* Data in lines 1 through 5 from Anonymous, 1954; in lines 6 and 7 from Meteorological Branch, Department of Transport, Toronto, *in litt.;* in line 8 from Anonymous, 1956. Lengths of time on which the data are based are given under each entry.

and sandy shore. Several hundred feet from its southern shore is a high escarpment in which considerable limestone is exposed.

At mile 66 the highway leaves the plateau and descends to the Mackenzie Lowlands (also a division of the Great Plains), in which it remains until it enters the Canadian Shield at Frank Channel. The Mackenzie River, crossed by a ferry, is reached at mile 82; here it is slightly more than a mile wide and is 513 feet in elevation. After the crossing, the highway runs atop the river bluff for 4 miles and then turns northeast. At about mile 4 N, a branch road nearly 4 miles long runs to Fort Providence.

The Mackenzie Lowlands, an area of low relief, is generally poorly drained and muskeg covered. The watercourses, for the most part, are sluggish and have muddy beds. Many of the lakes have marly bottoms, and there are many small to large deposits of marl. Maximum elevation along the highway, about 900 feet, is in the area between mile 90 N and 105 N, where sand deposits, outcroppings of limestone, and numerous sinkholes occur. Gypsum is near the surface, and there are several small lakes in which gypsite has been deposited. Perhaps the most scenic portion of the highway is at about mile 120 N, where the road descends into the valley of Mosquito Creek. Here can be seen a splendid panorama of massive limestone escarpments, dense forest, and, in the distance, the waters of Great Slave Lake. Extensive sand deposits are found between Mosquito Creek and Frank Channel.

Several great Pre-Cambrian outcrops, not easily accessible from the highway, represent outliers of the Canadian Shield and can be seen from the road several miles before it enters the shield at Frank Channel. The 58 miles from the channel to Yellowknife are totally different in aspect from the remaining 222 miles of the highway. Generally low rounded outcrops of Pre-Cambrian rock with intervening lakes or marshes are the dominant feature of the landscape. In the vicinity of Yellowknife occur large sand deposits.

The Yellowknife Highway lies wholly within the boreal forest although certain limited areas along it are strikingly reminiscent of the lichen woodland of the boreal forest-tundra ecotone. The predominating vegetation is, of course, forest of various types. However, the

Table 2. APPROXIMATE TIMES OF SUNRISE AND SUNSET, AND DAY LENGTH FOR SELECTED DATES, YELLOWKNIFE, N.W.T.*

Date	*Sunrise* *Mountain Standard Time*	*Sunset*	*Day length* *Hrs.-Mins.*
May 25	3:14 AM	9:45 PM	16 - 48
June 25	2:40 AM	10:38 PM	19 - 58
July 25	3:37 AM	9:47 PM	18 - 10
August 25	5:03 AM	8:13 PM	15 - 10
September 25	6:26 AM	6:27 PM	12 - 01

* Data supplied by H. W. Murdy, United States Bureau of Sport Fisheries and Wildlife.

forest cover is by no means continuous but is broken by grasslands, rock outcrops, shrub communities, numerous lakes and watercourses, and clearings.

The flowering season is brief, lasting only about 2½ months. The first herbaceous species to bloom appear to be *Calypso bulbosa* and *Anemone patens* var. *wolfgangiana*. By the time of my earliest arrival at the highway, June 13, *Calypso* had half-mature-size fruits as well as flowers; the pasque flower was through blooming, and its fruits were about half grown. By this time, most willows are past the height of flowering, as are *Arctostaphylos rubra* and *Rhododendron lapponicum*. The peak of the flowering season is during the last week of June and the first two weeks of July. Goldenrods *(Solidago)*, beginning to bloom in mid-July, are the harbingers of a fleeting fall, which is well upon the region by August 1, when the fringed gentians *(Gentianella crinita* ssp. *macounii* and ssp. *raupii)* and *Lomatogonium rotatum* open their flowers. After these, only two species of *Artemisia*, unlikely stragglers (they may well be introductions from areas to the south), are left to bloom; they come into flower in mid-August.

During the course of the field work, and after I had gained some familiarity with the local vegetation, attention was concentrated upon what might be called the "typical" stands of certain vegetation types, and notes were made on each such stand observed. It must be emphasized that data were gathered only for readily recognizable vegetation types and that little serious attention—because of time limitations—was paid to the many stands that were not of these types and that were seemingly difficult of classification into definable communities. It is one thing to recognize and describe "typical" jack pine forest or marly-lake vegetation and to refer these to community type(s); it is another altogether to attempt to refer to community type a stand in which all tree species known in the highway region grow in close association or a stand that is a "typical" black spruce-*Sphagnum* forest in all respects except one: the trees are not black spruces but are jack pines. Such stands as these actually exist and, with many others that are of different nature but are equally or more perplexing, constitute a large percentage of the vegetation along the highway. The vegetation types described in the following pages make up perhaps a smaller percentage of the total plant cover than do the vegetation types I have not attempted to describe. The former are obviously no more important than the latter—they are merely easier to characterize and categorize.

FOREST VEGETATION

BLACK SPRUCE FOREST

The commonest type of forest in the highway region is that dominated by *Picea mariana*. Black spruce forests occupy the wettest of the forest-dominated areas, ranging from deep, peat-filled (or peat-and marl-filled) depressions to shallow depressions, slopes, and level land. The forests vary considerably in development and floristic structure. Where they occur in deep, peat-filled depressions they represent an advanced stage in hydrarch succession and may be designated as bog (or muskeg) forests; elsewhere, they develop where moisture relations favor black spruce over more mesic tree species.

The bog forest—in its wetter phase—is characterized particularly by an abundance of *Sphagnum* (especially *S. fuscum* and *S. warnstorfianum;* also *A. capillaceum* var. *tenellum*), which forms great hummocks that serve as substratum for the trees and other plants of the forest. In the wettest places *Sphagnum girgensohnii* and *S. squarrosum* may occur. Fruticose, mat-forming lichens of the genera *Cetraria* and *Cladonia* may be abundant. The forest is underlain generally by considerable peat (below which is marl in the case of succession from a marly lake). Usually a distinct low shrub stratum, composed principally of *Ledum decumbens* or *L. groenlandicum* or both, is present. In the depressions between the *Sphagnum* hummocks (where there may be standing water) can occur various plants (e.g., *Triglochin maritima, Carex aquatilis, Eriophorum chamissonis, Scirpus cespitosus* var. *callosus, Menyanthes trifoliata, Utricularia* spp.) that do not "belong" to the forest community but are remnants of preceding successional stages.

A common associate of black spruce in the bog forest is *Larix laricina*, larch, which occurs usually as isolated trees (rarely in stands of limited extent). Among other especially common or characteristic plants of the forest are: *Equisetum palustre, Selaginella selaginoides, Smilacina trifolia, Tofieldia glutinosa, Ranunculus lapponicus, Drosera rotundifolia, Parnassia multiseta, Rubus chamaemorus, Oxycoccus microcarpus, Vaccinium vitis-idaea* var. *minus, Pinguicula vulgaris,* and *Senecio lugens.*

The bog forest, in its drier phase, shows ascendancy of woodland mosses, especially *Hylocomium splendens,* over the *Sphagnum. Hylocomium* does not grow in hummocks like *Sphagnum* but produces a relatively even carpet over the forest floor. Such forests, where *Hylocomium* has become the dominant ground cover and *Sphagnum* has disappeared altogether or is restricted to isolated hummocks, may be floristically almost identical with black spruce forests that have developed on sufficiently wet shallow depressions, slopes, or level land, as described below.

Black spruce forests that develop on shallow depressions, slopes, or level land that are sufficiently wet to preclude other forest types are distinct from the wetter phase of the bog forest in their history and floristic composition; with the drier phase of the bog forest, as mentioned in the preceding paragraph, they intergrade floristically. They are characterized particularly by a continuous carpet of *Hylocomium splendens* and other woodland mosses. In some black spruce-*Hylocomium* forests, *Sphagnum* is absent; in others it occurs in scattered hummocks. The forest is underlain by a shallow layer of peat, as little as 4 inches, in contrast with the deep peat under the bog forest. An obvious low shrub stratum is generally lacking or poorly developed. The plants that are especially common or characteristic of the bog forest are uncommon or lacking in the black spruce-*Hylocomium* forest, which is floristically similar to the white spruce-*Hylocomium* forest and intergrades therewith. Species especially common or characteristic in the black spruce-*Hylocomium* forest (in contrast to the bog forest) are: *Peltigera aphthosa, Juniperus communis* var. *depressa, Zygadenus elegans, Mitella nuda, Rosa acicularis, Rubus pubescens, Hedysarum* spp., *Moneses uniflora,* and *Linnaea borealis* var. *americana.*

The many stands of black spruce along the highway include not only excellent examples of typical bog forests and typical black spruce-*Hylocomium* forests but also, as has already been indicated, every degree of intergradation between the two. One of these examples of intergradation is worth mentioning. Near mile 120 N is a black spruce stand that floristically is a fine example of a bog forest—but which has not developed through hydrarch succession: the *Sphagnum* hummocks rest upon only about 6 inches of peat that, in turn, overlies white sand (the sand here is at least 5 feet deep, as can be seen in the nearby road cut). The site is on a slight rise, which only adds to the perplexity.

Higher plants (in addition to *Picea mariana)* observed in black spruce forests are listed here (those followed by (S) were seen only in bog forests; those followed by (H) were seen only in black spruce-*Hylocomium* forests; the others were observed in both types): *Equisetum arvense, E. palustre* (S), *E. scirpoides, E. sylvaticum, Selaginella selaginoides* (S), *Juniperus communis* var. *depressa* (H), *J. horizontalis* (H), *Larix laricina, Triglochin maritima* (S), *Calamagrostis neglecta* (H), *Oryzopsis pungens* (H), *Carex buxbaumii* (H), *C. scirpoidea* (H), *C. vaginata* (H), *Eriophorum chamissonis* (S), *Scirpus cespitosus* var. *callosus* (S), *Smilacina trifolia* (S), *Tofieldia glutinosa* (S), *T. pusilla, Zygadenus elegans* (H), *Calypso bulbosa* (H), *Corallorhiza trifida* (H), *Cypripedium calceolus* var. *parviflorum* (S), *C. guttatum* (H), *Habenaria hyperborea, H. obtusata, Spiranthes romanzoffiana, Salix candida, S. glauca, S. myrtillifolia, Myrica gale, Betula glandulosa, Geocaulon lividum, Polygonum viviparum, Arenaria humifusa* (H), *Anemone parviflora, Ranunculus lapponicus* (S), *Drosera rotundifolia* (S), *Mitella nuda* (H), *Parnassia multiseta, Ribes hudsonianum, Dryas integrifolia, Potentilla fruticosa, Rosa acicularis* (H), *Rubus acaulis* (H), *R. pubescens* (H), *Hedysarum alpinum* var. *americanum* (H), *H. mackenzii* (H), *Empetrum nigrum, Viola nephrophylla* (H), *Shepherdia canadensis, Cornus canadensis, Moneses uniflora* (H), *Pyrola asarifolia, P. grandiflora* (H), *P. virens* (H), *Andromeda polifolai, Arctostaphylos rubra, A. uva-ursi* (H), *Chamaedaphne calyculata, Kalmia polifolia* (H), *Ledum decumbens, L. groenlandicum, Rhododendron lapponicum, Oxycoccus microcarpus* (S), *Vaccinium uligi-*

nosum, *V. vitis-idaea* var. *minus*, *Castilleja raupii* (H), *Pedicularis labradorica*, *Pinguicula vulgaris* (S), *Galium labradoricum* (H), *Linnaea borealis* var. *americana* (H), *Viburnum edule* (H), *Antennaria pulcherrima* (S), *Erigeron hyssopifolius*, *Senecio lugens* (S), and *Solidago multiradiata*.

WHITE SPRUCE FOREST

White spruce *(Picea glauca)* forests occur generally on the mesic forest-occupied sites, and especially on moist well-drained uplands and along watercourses. In young stands that have arisen following fire, the trees are small and closely spaced, the floor is shallowly covered with litter, and the associated plants are few in species and numbers, e.g., scattered lichens, *Rosa acicularis*, *Shepherdia canadensis*, *Epilobium angustifolium*, *Cornus canadensis*, *Pyrola secunda*, *Arctostaphylos uva-ursi*, *Vaccinium vitis-idaea* var. *minus*, and *Linnaea borealis* var. *americana*. Travel through such stands is difficult because of the dense growth and the brule.

Quite another picture is presented by a mature white spruce forest, of which the finest example to be seen along the highway is on the steep slope above Kakisa River about ½ mile below Lady Evelyn Falls. The trees are large, the biggest seen being 28.1 inches DBH, about 129 feet tall, and about 183 years old. They cast a dense even shade. The floor is deeply carpeted with *Hylocomium splendens* into which the walker sinks 3 or 4 inches at every step. The moss and peat layer is thick enough so that, when I was trying to dig through it in several places, I struck frozen peat (about 16 inches down in mid-July) before I was able to reach mineral soil. Reproduction of the spruce is good. *Cladonia rangiferina* occurs in small scattered patches, and *Peltigera apthosa* is common. *Alnus crispa*, to about 8 feet tall, forms a more or less definite understory. Parasitic on the roots of the alder, and very rare, is *Boschniakia rossica*, the only Orobanchacea known in the region. Other plants in the forest are much scattered and include the shrubs *Juniperus communis* var. *depressa*, *Rosa acicularis*, *Shepherdia canadensis*, *Arctostaphylos rubra*, *Ledum groenlandicum*, *Vaccinium vitis-idaea* var. *minus*, *Linnaea borealis* var. *americana*, and *Viburnum edule;* and the herbs *Cystopteris montana*, *Carex concinna*, *Corallorhiza trifida*, *Cypripedium guttatum*, *Geocaulon lividum*, *Actaea rubra*, *Hedysarum mackenzii*, *Mitella nuda*, *Moneses uniflora*, *Pyrola asarifolia*, and *P. grandiflora*.

On the slope above the south shore of the Mackenzie River (mile 80-81) the white spruce forest is younger than the Kakisa stand, being composed of trees 45-55 years old. Balsam poplar is frequent. About 75 per cent of the floor is covered with deep litter (3 to 5 inches), the rest with mats of *Hylocomium splendens* about 5 inches thick and a few small patches of *Cladonia*. The moss cover is more complete in the most densely shaded part of the forest, where *Hylocomium* and *Cladonia* are the only plants other than the trees. In addition to the plants seen in the Kakisa stand(but with the exception of *Boschniakia rossica)*, the following were observed here: *Calypso bulbosa, Habenaria obtusata, Salix myrtillifolia, Ribes lacustre, Fragaria virginiana* var. *terraenovae, Rubus acaulis, Lathyrus ochroleucus, Empetrum nigrum, Pyrola virens,* and *Pedicularis labradorica.*

The white spruce forest richest in secondary species, and the most open one seen, is on the slope above Mosquito Creek. The floor is densely carpeted with *Hylocomium splendens; Tomenthypnum nitens* is frequent, as are *Peltigera aphthosa* and *Cladonia. Sphagnum* hummocks are occasional. Considerable brule, well decayed, is present. The following secondary species, none common, were observed here: *Equisetum arvense, E. scirpoides, Juniperus communis* var. *depressa, J. horizontalis, Carex capillaris, C. capitata, C. gynocrates, C. vaginata, C. scirpoidea, Tofieldia pusilla, Zygadenus elegans, Calypso bulbosa, Corallorhiza trifida, Cypripedium passerinum, C. guttatum, Habenaria obtusata, Orchis rotundifolia, Salix glauca, S. myrtillifolia, S. reticulata, Myrica gale, Geocaulon lividum, Anemone parviflora, Dryas integrifolia, Potentilla fruticosa, Rosa acicularis, Hedysarum alpinum* var. *americanum, Empetrum nigrum, Shepherdia canadensis, Moneses uniflora, Pyrola grandiflora, P. virens, Andromeda polifolia, Arctostaphylos rubra, Ledum groenlandicum, Oxycoccus microcarpus, Rhododendron lapponicum, Vaccinium uliginosum, Vaccinium vitis-idaea* var. *minus, Castilleja raupii, Pedicularis labradorica, Linnaea borealis* var. *americana, Viburnum edule,* and *Solidago multiradiata.*

The Kakisa and Mackenzie stands of white spruce are typical of most stands of white spruce of similar age that are to be seen along the highway; the Mosquito Creek stand is distinctly atypical because of its openness and relatively large number of secondary species. Many stands of white spruce are closely similar to mature stands of jack pine except for the presence or relatively greater abundance of *Hylocomium splendens.* White spruce forests, then, are characterized typically by a ground cover of *Hylocomium splendens* or of this moss and thick litter; by relatively dense shade; and by a low number of secondary species—and of individuals of these species. Many of them have scattered balsam poplars. In stands of white spruce other than those previously mentioned, the following additional species were found: *Rhytidium rugosum* (common as ground cover, with *Hylocomium splendens*, at mile 22.7; this species, inadvertently omitted from the *Catalogue*, was determined by William D. Reese), *Cladonia alpestris, Elymus innovatus, Ribes triste, Astragalus americanus, Arctostaphylos uva-ursi, Lonicera dioica* var. *glaucescens,* and *Galium septentrionale.*

Those examples of mature white spruce forest examined by me appeared to be self-perpetuating, i.e., good reproduction of spruce was shown and no other tree species appeared as invaders. Following fire, the spruce may regenerate itself, or its place may be taken by jack pine or aspen. White spruce may form pure stands, or forests of this species may contain few to many individuals of other tree species, notably jack pine, aspen, and poplar, but also larch and black spruce. Similarly, white spruce may occur in forests that are primarily of other species.

JACK PINE FOREST

Dry sandy or gravelly ridges and flatlands are typically covered with forests in which *Pinus banksiana*, jack pine, is the sole or by far the commonest tree species. Many acres, relatively recently burned, are dominated by a scrubby growth of pine on mineral soil. Here, walking may be exceedingly onerous because of the brule and the dense growth of young trees. Such sites may be barren of plants except for the pines or there may be occasional *Rosa acicularis, Shepherdia canadensis, Epilobium angustifolium, Arctostaphylos uva-ursi, Vaccinium vitis-idaea* var. *minus,* and *Linnaea borealis* var. *americana.* As such forests age, there is gradually increasing mesophytism. Woodland lichens, herbaceous plants, and shrubs return and increase in abundance; a litter and humus layer accumulates; many of the pines die out. Well developed jack pine forests that are approaching maturity are parklike in aspect and are characterized by rather widely spaced trees that are 35-55 feet tall, at least 40 years old, and, for the most part, even-aged. The undergrowth in such forests is scanty. The floor may be covered largely with litter or with litter and humus or it may show extensive development of lichens, especially fruticose *Cetraria* and *Cladonia*. The most common and characteristic low woody plants are *Rosa acicularis, Shepherdia canadenis, Arctostaphylos uva-ursi,* and *Vaccinium vitis-idaea* var. *minus*. The *Arctostaphylos* and *Vaccinium* are common to abundant as ground-cover plants. *Calamagrostis purpurascens* and *Elymus innovatus* are characteristic grasses. In places, *Alnus crispa,* to about 8 feet tall, forms a definite understory. Jack pine appears not to reproduce well in the shade, so young pines are not to be found in the forest.

Jack pine forest of this type occupies the upper parts of ridges and the most xerophytic of the flatlands. In such sites it may be regarded as an edaphic or pyric climax, being maintained not only by the xerophytism of the habitat but also by recurrent fires. In such a habitat I found no jack pine forest more than 70 years old. It is not uncommon to see, on one part of a sandy ridge, a mature pine forest as just described and, on an adjacent part of the ridge, a burned-over area with still-standing dead trees and a dense growth of small young pines. These trees may bear cones when they are only 3 feet tall.

On more mesophytic sites (e.g., the lower flanks of ridges) the successional trend is obviously toward the replacement of jack pine by white spruce. As the pine forest matures, the litter and humus layer deepens, woodland mosses (especially *Hylocomium splendens)* appear in scattered patches, and *Picea glauca* becomes established. In such a forest there are no young pines, but a lower stratum of young white spruces is a frequent sight. Barring fire, one may expect ascendancy of the spruce at the expense of the pine. In a well developed white spruce forest, it is not unusual to see large, old, and plainly dying pines—the remnant of the pine forest that once occupied the site. Young pine forests that are burned appear most commonly to be succeeded by an abundant and immediate regrowth (from seed) of pine; burned mature pine forests appear to be succeeded commonly by aspen.

The following plants were collected or observed in jack pine forests: *Equisetum scirpoides, Lycopodium complanatum, Juniperus communis* var. *depressa, J. horizontalis, Bromus pumpellianus, Calamagrostis purpurascens, Elymus innovatus, Festuca saximontana, Oryzopsis asperifolia, O. pungens, Carex aenea, C. foenea, Zygadenus elegans, Calypso bulbosa, Corallorhiza trifida, Populus balsamifera, P. tremuloides, Salix bebbiana, S. glauca, Alnus crispa, Betula glandulosa, B. papyrifera, Geocaulon lividum, Arenaria capillaris, Anemone multifida, A. patens* var. *wolfgangiana, A. parviflora, Aquilegia brevistyla, Ribes lacustre, Amelanchier alnifolia, Fragaria virginiana* var. *terrae-novae, Potentilla fruticosa, Rosa acicularis, Astragalus americanus, Hedysarum alpinum* var. *americanum, H. mackenzii, Lathyrus ochroleucus, Oxytropis splendens, Empetrum nigrum, Hudsonia tomentosa, Shepherdia canadensis, Epilobium angustifolium, Cornus canadensis, Pyrola asarifolia, P. secunda, P. virens, Arctostaphylos uva-ursi, Ledum groenlandicum, Vaccinium vitis-idaea* var. *minus, Apocynum androsaemifolium, Pedicularis labradorica, Galium septentrionale, Linnaea borealis* var. *americana, Lonicera dioica* var. *glaucescens, Viburnum edule, Campanula rotundifolia, Arnica lonchophylla, Aster ciliolatus, A. sibiricus, Erigeron glabellus* var. *pubescens, Hieracium umbellatum, Senecio tridenticulatus,* and *Solidago spathulata* var. *neomexicana.*

DECIDUOUS FORESTS

Three species of deciduous trees occur in the highway region: *Betula papyrifera, Populus balsamifera,* and *P. tremuloides.* The first of these, *Betula papyrifera* (paper birch), typically occurs scattered among *Picea glauca* and *Pinus banksiana;* locally on sand plains it may form small pure stands. In contrast, the two species of *Populus* occur not only as scattered individuals among other trees but they also may form extensive pure stands.

Populus tremuloides (aspen) stands appear to arise primarily following burning of more or less mature jack pine or white spruce forests. It is not at all unusual to find an island of unburned pine or spruce that is surrounded by burned forest in which a vigorous stand of young aspens is developing. Among the aspens the secondary flora may contain many of the species found in the adjacent unburned forest, e.g., *Elymus innovatus, Geocaulon lividum, Fragaria virginiana* var. *terrae-novae, Rosa acicularis, Rubus pubescens, Shepherdia canadensis, Cornus canadensis, Vaccinium vitis-idaea* var. *minus,* and *Viburnum edule. Epilobium angustifolium* is generally frequent to common, as are shrubby willows, especially *Salix bebbiana.* Typically there is little reproduction of aspen, but young white spruces—frequently with a mixture of *Populus balsamifera*—may be common. A mature aspen woods is floristically similar to a mature jack pine woods. It may contain large old pines, which apparently are trees that survived the fire that destroyed the original pine forest. *Populus balsamifera,* poplar, forms pure stands on flood plains, where a poplar stage immediately precedes white spruce. Such stages can be seen along the Hay River, which parallels the Mackenzie Highway in northern Alberta and in the Northwest Territories. Along the Yellowknife Highway a "typical" flood plain (but one of quite limited area) was seen only along the Kakisa River just below Lady Evelyn Falls. Otherwise, poplar occurs generally in mixture with white spruce; it may locally be dominant or may form pure stands of limited extent. Along streams in white spruce forests, poplar may be especially common. The flora of poplar dominated areas is similar to the flora of the adjacent areas that are dominated by white spruce.

VEGETATION OF ROCK OUTCROPS

LIMESTONE OUTCROPS

Along the Enterprise-Frank Channel section of the highway many outcroppings of limestone occur. The exposures may be vertical only—as on the faces of the gorge immediately below Lady Evelyn Falls—or both vertical and horizontal—as in many places between miles 10 and 28 where the descending great limestone "stairs" of the northern edge of the Alberta Plateau are exposed over large areas. Outcrops occur also between miles 80 N and 107 N—here the exposures are largely horizontal or gently inclined—and in the cliffs near mile 127 N, where the slope below the limestone cliff is littered with small to huge limestone blocks and slabs. My notes on the flora of limestone outcrops were derived principally from investigation of horizontal exposures at miles 20 to 28, 80.8 N, 96.5 N, 103.5 N, and 107 N.

Limestone outcrop areas are characterized by much exposed rock and, in places, by the presence of a fine, dark brown, residual, non-calcareous soil. The soil may be confined to crevices or may exist in a shallow layer (typically 1 to 4 inches deep) over the rock. A large percentage of such soil is typically bare of plant cover. In some areas, a litter layer up to about 1 inch deep may accumulate. Lichens are common to abundant in outcrop areas, both on bare rock and on soil. The most apparent species are the fruticose *Cladonia alpestris, C. mitis, C. rangi-*

ferina, and *Cetraria nivalis.* An occasional patch of *Cetraria tilesii* is conspicuous because of its bright yellow color.

Trees, when present, are typically widely spaced. *Pinus banksiana* and *Populus tremuloides* are the commonest species; *Picea glauca* is less common; and *Picea mariana, Populus balsamifera,* and *Betula papyrifera* are uncommon. Many outcrop areas have no trees on them. Especially characteristic of the outcrops is the conspicuousness of the chamaephytes *Juniperus horizontalis, Saxifraga tricuspidata,* and *Arctostaphylos uva-ursi.* In many places the long (up to 20 feet) prostrate branches of *Juniperus horizontalis* criss-cross each other, forming a distinctive network on the rock. *Saxifraga tricuspidata* forms circular mats up to 2 feet across, often with the innermost portion of the mat dead. The prostrate branches of *Arctostaphylos uva-ursi* reach 6 feet in length. Of the erect shrubs on limestone outcrop areas, *Juniperus communis* is the most common; it forms on many sites a distinct low-shrub stratum. Other common shrubs are *Amelanchier alnifolia, Potentilla fruticosa, Prunus pensylvanica, Rosa acicularis,* and *Shepherdia canadensis. Prunus virginiana,* notable because it is here at the northermost known portion of its range, is local, forming thickets or occurring as isolated shrubs.

On the limestone cliffs at Lady Evelyn Falls, and on the moist faces of limestone escarpments between miles 10 and 28, the ferns *Cystopteris fragilis, Dryopteris robertiana* (seen only at mile 15.5) and *Woodsia glabella* are found and may be common locally. The *Cystopteris* and the *Woodsia* occur also at the Mosquito Creek cliffs, along with *Cryptogramma crispa* var. *acrostichoides, Polypodium virginianum,* and *Woodsia ilvensis* (the last-named three, however, are much more common on Pre-Cambrian rocks). On the Mosquito Creek cliffs the few trees are *Picea glauca, P. mariana,* and *Betula papyrifera. Salix glauca,* to about 8 feet tall, is present. The most common plant there is *Dryas integrifolia,* which forms mats on both vertical and horizontal rock faces. Two crucifers, *Draba cinerea* and *Lesquerella arctica* var. *scammanae,* and a sedge, *Carex glacialis,* found in crevices, were collected only at Mosquito Creek.

Vascular plants collected or observed on limestone outcrops are: *Cystopteris fragilis, Dryopteris robertiana, Polypodium virginianum, Woodsia glabella, W. ilvensis, Juniperus communis* var. *depressa, J. horizontalis, Picea glauca, P. mariana, Agropyron trachycaulum, Agrostis scabra, Calamagrostis inexpansa, C. neglecta, C. purpurascens, Deschampsia cespitosa, Elymus innovatus, Festuca saximontana, Helictotrichon hookeri, Koeleria cristata, Oryzopsis pungens, Poa alpina, P. canbyi, P. glauca, P. interior, Carex bebbii, C. concinna, C. glacialis, C. scirpoidea, Juncus alpinus, J. balticus* var. *littoralis, Allium schoenoprasum* var. *sibiricum, Zygadenus elegans, Sisyrinchium montanum, Populus tremuloides, Salix arbusculoides, S. bebbiana, S. glauca, Betula* *papyrifera, Arenaria capillaris, A. dawsonensis. A. rubella, Cerastium arvense, Melandrium ostenfeldii, Anemone multifida, A. parviflora, A. patens* var. *wolfgangiana, Arabis divaricarpa, A. holboellii, Draba cinerea, D. lanceolata, Lesquerella arctica* var. *scammanae, Ribes oxyacanthoides, Saxifraga tricuspidata, Amelanchier alnifolia, Dryas drummondii, D. integrifolia, Fragaria virginiana* var. *terrae-novae, Geum triflorum, Potentilla arguta, P. fruticosa, P. nivea* ssp. *hookeriana, P. pensylvanica, Prunus pensylvanica, P. virginiana, Rosa acicularis, Hedysarum mackenzii, Oxytropis campestris* var. *varians, O. splendens, Linum lewisii, Shepherdia canadensis, Cornus canadensis, C. stolonifera, Arctostaphylos uva-ursi, Androsace septentrionalis, Dodecatheon pulchellum, Gentianella amarella* ssp. *acuta, Castilleja raupii, Rhinanthus crista-galli, Plantago septata, Galium septentrionale, Lonicera dioica* var. *glaucescens, Campanula rotundifolia, Achillea lanulosa, Antennaria parvifolia, Arnica lonchophylla, Artemisia campestris* ssp. *borealis, Aster alpinus* var. *vierhapperi, A. ciliolatus, A. hesperius* var. *laetevirens, Erigeron compositus* var. *glabratus, E. glabellus* var. *pubescens, Helenium autumnale, Hieracium umbellatum, Senecio tridenticulatus, Solidago spathulata* var. *neomexicana,* and *Taraxacum ceratophorum.*

PRE-CAMBRIAN OUTCROPS

Along the Frank Channel-Yellowknife section of the highway Pre-Cambrian outcrops become a dominant feature of the landscape. These outcrops, with perpendicular to gently sloping sides and with rounded to more or less flat or undulating summits, rise several to about 300 feet (average 100 feet) above the surrounding terrain. Some of them ascend in a series of stair-like levels. The bases of the outcrops are overlain with mineral soil (principally silt and clay, but also some sand and gravel). Clothing the soil are pure or mixed stands of *Picea glauca, P. mariana, Populus tremuloides,* and *Betula papyrifera,* and thickets of *Salix* spp., *Alnus crispa, Rosa acicularis, Shepherdia canadensis,* and *Viburnum edule.*

The rock composing the outcrops is largely granite-gneiss, granodiorite, and granite except in the Yellowknife area, where volcanic, sedimentary, and metasedimentary rock types occur. The outcrops show a wide range of colors, including pink, dark green, dark grey, and almost black. The natural color of the rock is, however, obscured by weathering and, even more important, by an abundance of saxicolous lichens. Of these the pale dull greens and yellows of *Cladonia* and *Cetraria,* the ashy grey of *Parmelia,* and the blacks of *Actinogyra* and *Lasallia* are the most characteristic. The rock tripes (i.e., *Actinogyra* and *Lasallia),* black when dry, become a dark olive when they get wet. Outcrops covered with rock tripe become markedly different in aspect during the first few minutes of a rainfall: they change slowly—but most perceptibly—from black to dark olive as the lichens absorb moisture. On outcrops covered with other lichens, the colors become more intense during a rain. Lichens collected on Pre-Cambrian outcrops include: *Cladonia alpicola, C. cornuta, C. degenerans, C. metacorallifera, C. mitis, C. pyxidata, C. rangiferina, C. uncialis, C. verticillata, Actinogyra muhlenbergii, Lasallia pensylvanica, Cetraria nivalis, Parmelia centrifuga, P. stenophylla,* and *P. sulcata.*

Crustose lichens and rock tripe are best represented on cliff faces, slopes, and the most exposed level places; fruticose lichens tend to be most abundant in more sheltered places, especially shallow depressions, where a few inches to several square feet may be covered by an unbroken mat of *Cladonia* and *Cetraria.* In somewhat deeper depressions, xerophytic matted moses (especially *Polytrichum formosum, P. juniperinum, P. piliferum,* and *Hedwigia ciliata)* tend to be dominant over lichens. A layer of fine, dark brown, peaty soil, to about 2 inches thick, can be observed under such moss and lichen mats. Soil accumulation under mosses appears to be greater than under lichens. Such soil serves as a seed bed for higher plants.

The vascular flora of Pre-Cambrian outcrops is poor in species and, for the most part, in individuals. The outcrops offer two types of habitats for vascular plants: (1) rock crevices, and (2) depressions. The commonest trees are *Pinus banksiana, Picea mariana,* and *Betula papyrifera; Picea glauca* and *Larix laricina* are infrequent. These trees grow either in crevices (where jack pine, white spruce, and white birch are commonest) or in peaty depressions (where black spruce and larch are commonest). The trees are typically small and stunted, ranging between 6 and 20 feet tall, although larger specimens can be found (e.g., the largest jack pine found by me on a Pre-Cambrian outcrop was about 40 feet tall and 13 inches DBH; it had 135 annual rings). In the most exposed situations, only jack pine and black spruce are found; here they are gnarled, sometimes almost prostrate or with all but the lowest branches killed.

In rock crevices wherein a little soil has accumulated, the commonest vascular plants are *Cryptogramma crispa* var. *acrostichoides, Dryopteris fragrans, Polypodium virginianum, Woodsia ilvensis, Juniperus communis* var. *depressa, J. horizontalis, Saxifraga tricuspidata, Empetrum nigrum, Arctostaphylos uva-ursi,* and *Vaccinium vitis-idaea* var. *minus;* less common to rare are *Festuca saximontana, Carex canescens, C. supina, Melandrium ostenfeldii, Potentilla multifida, P. nivea* ssp. *hookeriana,* and *P. pensylvanica.* These are also the first of the higher plants to become established in lichen and moss mats in depressions. It is not unusual to see a moss- or lichen-dominated depression (with a well-formed soil layer under the mat) in which just one or two species of herbaceous vascular plants (and often only one or two individuals) are growing, e.g., *Agrostis scabra, Calamagrostis canadensis, Poa interior, Carex aenea, C. chordorrhiza, Eriophorum, angustifolium, E. brachy-*

antherum, Smilacina trifolia, Geocaulon lividum, Corydalis sempervirens, and *Arabis holboellii.* A considerable layer of peaty soil (2 feet in one site investigated) can accumulate in these depressions, and a shrub or shrub-tree community develops therein. The most common dominant shrubs are *Ledum decumbens, L. groenlandicum,* and *Chamaedaphne calyculata.* Less common to rare shrubs are *Salix bebbiana, S. pyrifolia, Alnus crispa, Ribes glandulosum, R. oxyacanthoides, Amelanchier alnifolia, Dryas drummondii, Potentilla fruticosa, Rosa acicularis, Rubus idaeus* var. *canadensis, Shepherdia canadensis, Vaccinium uliginosum,* and *Viburnum edule.* The most common tree is *Picea mariana.* Among other plants found in such depressions are *Equisetum sylvaticum, Rubus chamaemorus, Epilobium angustifolium, Artemisia campestris* ssp. *borealis,* and *Solidago spathulata* var. *neomexicana.*

VEGETATION OF LAKES AND RIVERS

MARLY LAKES

Along several sections of the Great Plains portion of the highway are many small lakes that are notable because of the large amount of lake marl ($CaCO_3$) precipitated from their water and because of the consequent deposit of marl that develops on the bottom. Many of these marly lakes were studied between miles 40 and 66 and between miles 40 N and 90 N. The marly lakes occur in areas where calcareous bedrock is exposed. Carbonates dissolved from the rock by streams passing over it are carried into the lakes. Precipitation in the lakes is brought about by plant life, which uses carbon dioxide, causing supersaturation. A sample of marl from a small drained lake at mile 66 was sent to the Geological Survey of Canada for analysis. Dr. J. Terasme informed me that the sample was 90% or a little more acid soluble and that it contained a rich diatom flora, including, among the many genera and species, *Navicula tuscula, Achantidium flexellum, Pinnularia, Eunotia, Cymbella, Nitzschia angustata, Stauroneis,* and *Fragilaria lapponica.* Also in the sample were fragments of pelecypods and gastropods and many kinds of pollen and spores. *Pinus banksiana* was the predominating pollen (80-90%); others included *Picea glauca* (15-20%), *P. mariana* (1-3%), various Cyperaceae, and *Shepherdia canadensis.* Spores included *Selaginella, Lycopodium, Equisetum,* and *Sphagnum* and other mosses.

For the purpose of this discussion, I recognize two types of marly lakes: (1) those around which a sedge mat develops; and (2) those with gravelly-marly beaches.

The marly lakes found between miles 40 and 66 exhibit the development of a sedge mat. Open water in these lakes varies from only a few square feet in the nearly obliterated lakes to several acres in the larger ones. The water is crystal clear, and, even in the largest lakes, only a foot or less of this water overlies the marl on the "bottom." Actually, the marl on the "bottom" is far from solid; it is, in contrast, loosely suspended in the water. It offers little resistance to the passage of objects (stick, stone, hand, etc.) through it. In some lakes, the deposit of marl is about 3 feet thick; in others, I was unable to reach the underlying layer with an 8 foot pole. Underlying the marl (at least those deposits whose bottom I was able to reach with a pole) is a hard layer, probably limestone.

The vegetation around marly lakes can be grouped into four more or less concentric zones: (1) vegetation of open water; (2) a sedge zone, i.e., the foremat, which is dominated solely by sedges; (3) a shrub zone, the next older portion of the mat, which is dominated by various low shrubs; and (4) a typical muskeg forest of black spruce.

In the marly lakes the following plants were found free-floating in shallow water beyond the edge of the mat: the mosses *Campylium stellatum* and *Scorpidium scorpioides; Utricularia intermedia,* and *U. vulgaris.* Plants rooted, albeit loosely, in marl in shallow water beyond the mat were: *Equisetum palustre, Sparganium minimum, Potamogeton filiformis* var. *borealis, Triglochin maritima, T. palustris, Carex aquatilis, C. lasiocarpa, C. limosa, C. physocarpa, Eriophorum angustifolium, E. chamissonis, E. viridi-carinatum, Scirpus validus, Juncus stygius* var. *americanus, Drosera anglica,* and *Menyanthes trifoliata.*

The mat is built up primarily through the activity of rhizomatous species of *Carex,* especially *C. aquatilis, C. buxbaumii,* and *C. lasiocarpa. Carex limosa* is important in places. The rhizomes of these species may extend 2 to 3 feet into open water beyond the edge of the mat. The mats may extend themselves quite rapidly over open water: in August of 1959, the inner edge of a mat at mile 44 was 37 feet from a marked small tree of *Larix laricina;* in August of 1961 it was 40 feet away from the tree. In most marly lakes it is possible to walk—or rather to wade—to within 4 or 5 feet of the leading edge of the mat without breaking through the hummocky tangle of rhizomes, roots, culms, and leaves comprising the mat. The mat becomes considerably firmer in its older portions because of the build-up of organic matter and the continued precipitation and accumulation of marl under the mat. *Scirpus cespitosus* var. *callosus* may become dominant in older portions of the mat.

In addition to the dominant sedges, relatively few plants can be found in the sedge zone. These grow either in the shallow water between the hummocks or on the hummocks themselves. The mosses *Campylium stellatum* and *Drepanocladus vernicosus* may be common. *Eriophorum chamissonis* is locally an aspect dominant. Other plants, infrequent to rare, are *Triglochin maritima, T. palustris, Muhlenbergia glomerata* var. *cinnoides* (on anthills), *Carex capillaris, C. diandra, C. interior, C. rostrata, Eriophorum angustifolium, E. viridi-carinatum, Tofieldia glutinosa, T. pusilla, Parnassia multiseta, Potentilla palustris,* *Andromeda polifolia, Pinguicula vulgaris, Utricularia intermedia, U. vulgaris, Galium labradoricum,* and *Lobelia kalmii.*

The woody plants that dominate the shrub zone typically begin to appear as isolated individuals in the sedge zone, especially toward the outer edge of this zone. *Myrica gale* is generally the most common invader, although *Salix athabascensis, S. candida,* and *S. serissima* occur also. In the shrub zone itself, the commonest species are *Myrica gale, Betula glandulosa,* and *Potentilla fruticosa;* less common are the willows *Salix athabascensis, S. candida, S. pedicellaris,* and *S. serissima.* The sedges of the preceding zone persist to some degree, but the plants are for the most part scattered and not vigorous, especially in the older parts of the shrub zone. The shrubs grow on peaty hummocks (which were, of course, formed by the sedges), and the hummocks themselves are underlain by several inches of additional peat; below the peat is marl. Other than the shrubs, relatively few plants grow in the shrub zone. Probably the most common are mosses, of which I collected four species: *Ditrichum flexicaule, Dicanum bergeri, Campylium stellatum,* and *Tomenthypnum nitens.* Occasional clumps of *Sphagnum* occur in the older parts of the zone, as do occasional small trees of *Larix laricina* and *Picea mariana.*

Succeeding the shrub zone is typically a muskeg forest of *Picea mariana,* perhaps with some *Larix laricina.* The transition between the shrub zone and the muskeg forest is generally a rather abrupt one. At the outer edge of the shrub zone the moss mounds of the forest rise 1 to 2 feet. One literally steps up into the muskeg forest. The mounds may be largely of *Sphagnum,* especially *S. fuscum* and *S. warnstorfianum,* or of other mosses, of which *Tomenthypnum nitens* appears to be common.

At about mile 65 N and miles 37 and 64 are marly lakes that do not exhibit the formation of a sedge mat, but have, in contrast, wide marly-gravelly beaches. The water in these lakes is deeper and the bottom is firmer than in the sedge-mat lakes. In shallow water along the shore of these lakes the plants noted were *Chara contraria, C. contraria* var. *hispidula, Potamogeton filiformis* var. *borealis,* and *Scirpus validus.* On the lower beach grew *Triglochin maritima, T. palustris, Scolochloa festucacea, Carex aquatilis, C. atherodes, Eleocharis pauciflora* var. *fernaldii,* and *Scirpus validus.* On the upper beach were collected *Calamagrostis neglecta, Carex aurea, C. garberi, C. scirpoidea, C. viridula, Salix brachycarpa, S. candida, Betula glandulosa, Rumex maritimus* var. *fueginus, Ranunculus sceleratus, Parnassia multiseta, Potentilla anserina, Rubus idaeus* var. *canadensis, Cicuta douglasii, Epilobium glandulosum* var. *adenocaulon, Dodecatheon pulchellum, Primula incana, Gentianella amarella* ssp. *acuta, Gentianella crinita* ssp. *raupii, Lomatogonium rotatum, Mentha arvensis* var. *villosa, Castilleja raupii, Aster* *brachyactis, A ciliolatus, A. junciformis, Erigeron lonchophyllus, Senecio congestus,* and *S. pauperculus.*

MUCK-BOTTOM LAKES

The commonest type of lake along the Canadian Shield section of the highway is characterized by a bottom of muck (i.e., organic detritus), by the usual presence of a mat in which *Carex* spp., *Drepanocladus* spp., *Calla palustris, Potentilla palustris,* and *Menyanthes trifoliata* are important components, and by the abundance of *Nuphar variegatum.*

In open water beyond the edge of the mat the most obvious plant is *Nuphar variegatum,* whose relatively large leaves, floating on the surface, may cover a significant percentage of the water. *Nuphar* grows in water up to 5 feet deep. *Nymphaea tetragona* var. *porsildii* was found by me among *Nuphar* in only one lake, although Ray Murdy tells me that in 1963 he observed the species "here and there" in almost all of the medium to large lakes he studied along the highway from mile 10 S to 39 S. Other rooted aquatics with floating leaves are infrequent but may be locally prominent: *Polygonum amphibium, Caltha natans,* and *Potamogeton gramineus.* Submerged aquatics, inconspicuous but sometimes abundant, include *Potamogeton alpinus* var. *tenuifolius, P. foliosus, P. friesii, P. pusillus, P. richardsonii, P. zosteriformis, Ceratophyllum demersum, Myriophyllum exalbescens, M. verticillatum* var. *pectinatum, Utricularia intermedia, U. minor, and U. vulgaris.* The mosses *Drepanocladus capillaceus* and *D. exannulatus* are common to abundant on the mucky bottom. Locally, *Lemna trisulca* forms great masses just below the surface of the water, and *Lemna minor* is common. Emergent aquatics, generally found in the shallow water just beyond the edge of the mat, are few, the most common being *Equisetum fluviatile, Sparganium angustifolium, S. minimum, Hippuris vulgaris,* and *Menyanthes trifoliata.* Others are *Sagittaria cuneata, Alopecurus aequalis, Scirpus validus, Cicuta douglasii,* and *Senecio congestus.*

The mat around muck bottom lakes is composed largely of rhizomatous species of *Carex,* especially *C. aquatilis, C. lasiocarpa, C. limosa,* and *C. rostrata.* The mosses *Drepanocladus aduncus, D. capillifolium, D. exannulatus,* and *Meesia tristicha* are also common to abundant. In many sites, a conspicuous zone of *Calla palustris, Potentilla palustris,* or *Menyanthes trifoliata* occurs at the leading edge of the mat and is sharply distinct from sedges of the mat because of its different color and coarser foliage. These three species, where they occur, are most important contributors to the mat. Their thick tangled rhizomes extend 2 to 3 feet into open water, as do those of the sedges. *Calamagrostis canadensis* is common, especially but not solely in the firmer portions of the mat. Locally, certain other rhizomatous plants are important: *Equisetum fluviatile, Typha latifolia, Eriophorum angustifolium, Eleoch-*

aris palustris, Glyceria grandi, G. pulchella, Eriophorum angustifolium, E. chamissonis, E. gracile, Acorus calamus, and *Hippuris vulgaris.* Other plants collected on sedge mats around muck bottom lakes are: *Carex canescens, C. diandra, Polygonum amphibium, Rumex occidentalis, Stellaria crassifolia, Ranunculus sceleratus, R. gmelinii, Parnassia multiseta, Cicuta bulbifera, C. douglasii, Epilobium glandulosum* var. *adenocaulon, Naumburgia thyrsiflora, Scutellaria galericulata* var. *epilobiifolia, Aster junciformis,* and *Senecio congestus.* In at least some of the lakes, permafrost is only a foot or so below the mat, even in late summer.

Succession beyond the sedge mat appears to culminate in either a white spruce-*Hylocomium* forest (infrequently) or a black spruce-*Sphagnum* forest (commonly). In succession to white spruce, the sedge mat is invaded first by shrubs, commonly *Myrica gale, Chamaedaphne calyculata,* or willows *(Salix bebbiana, S. glauca, S. planifolia, S. scouleriana,* or a mixture of these.) *Alnus tenuifolia* occurs occasionally. Thickets of these shrubs may occupy extensive areas around shield lakes. The shrub stage is succeeded by or intermingled with a stage in which *Betula papyrifera* is dominant but in which some *Populus tremuloides* may occur. In the *Betula* stage (and sometimes in the shrub stage), young white spruces appear. The succeeding white spruce stage is characterized by an abundance of woodland mosses (especially *Hylocomium splendens)* and by the presence of such "typical" plants as *Equisetum arvense, Alnus crispa, Salix glauca, Mitella nuda, Ribes triste, Empetrum nigrum, Cornus canadensis, Moneses uniflora,* and *Pyrola grandiflora.* In succession to white spruce, bog mosses *(Sphagnum)* do not appear to enter into the sere as they do in succession to black spruce.

Succession to black spruce is characterized mainly by the invasion of the mat by *Myrica gale, Chamaedaphne calyculata, Ledum groenlandicum,* and sometimes *Betula glandulosa,* and, in addition, usually by *Sphagnum* spp. Encroaching upon this shrub stage are mounds of *Sphagnum* that support "typical" black spruce forest vegetation.

Almost every conceivable variant of the above seres can be observed. One of the commonest is the invasion of the mat by willows and the encroachment upon the willows by the black spruce-*Sphagnum* community. *Sphagnum* does not appear here until it is seen in the *Sphagnum* mounds of the forest stage.

The water level of many of the lakes adjacent to the highway has been lowered by ditching; some lakes have been drained completely. In addition to the submerged plants that are thus left stranded to die, and to the emergent plants that may persist, the following were observed on such exposed and drying muck: *Agrostis scabra, Carex canescens, C. diandra, C. paupercula, Eleocharis acicularis, Juncus vaseyi, Salix* sp. (seedlings), *Rumex maritimus* var. *fueginus, R. occidentalis, Ranunculus gmelinii, R. sceleratus, Stellaria crassifolia, Barbarea orthoceras, Rorippa islandica, Potentilla norvegica, Potentilla palustris,* and *Galium trifidum.*

Many muck-bottom lakes in the Mackenzie River-Frank Channel section of the highway show vegetation similar to that of muck-bottom lakes in the Canadian Shield section, i.e., a sedge mat followed by a shrub stage and finally a black spruce-*Sphagnum* forest. Conspicuously lacking, however, are *Calla palustris* and *Nuphar variegatum; Potentilla palustris* and *Menyanthes trifoliata*, moreover, are much less important than they are in lakes on the shield.

SANDY- OR MUDDY-BOTTOM LAKES AND RIVERS

In the highway region, aquatic vegetation is especially luxuriant in the Stagg River (mile 49 S). Here, in still or slowly flowing clear water, the following plants were observed: *Potamogeton gramineus, P. richardsonii* (in water to 4 feet deep), *Sagittaria cuneata, Sparganium angustifolium, Eleocharis acicularis, Lemna minor, L. trisulca* (forming great masses on the bottom), *Ranunculus aquatilis* var. *eradicatus, Callitriche hermaphroditica, C. palustris, Naumburgia thyrsiflora, Utricularia intermedia, U. minor, U. vulgaris,* and *Bidens cernua.*

In still, protected areas along the shore of Kakisa Lake and Kakisa River, *Potamogeton gramineus, P. richardsonii, P. vaginatus,* and *Hippuris vulgaris* occur in water up to 2.5 feet deep. In shallower water shoreward are found *Equisetum fluviatile, Potamogeton filiformis, Sparganium angustifolium, Sagittaria cuneata, Phalaris arundinacea, Carex aquatilis, C. rostrata, Eleocharis palustris, Scripus validus, Polygonum amphibium, Ranunculus circinatus* var. *subrigidus, Callitriche hermaphroditica, C. palustris, Myriophyllum exalbescens, Sium suave,* and *Utricularia vulgaris.* At the outlet of Kakisa Lake into Kansas River the water is choked with masses of *Potamogeton.*

Three aquatics were collected only in the vicinity of Yellowknife: *Isoetes echinospora* var. *braunii* (in Prelude Lake), *Subularia aquatica* (in Prelude and Prosperous lakes), and *Limosella aquatica* (in Prosperous Lake). Additional aquatics observed in the highway region in sandy or muddy substrata include *Sparganium minimum, Glyceria borealis, G. pulchella, G. grandis, G. striata, Scolochloa festucacea, Juncus bufonius, J. filiformis, Polygonum lapathifolium, Potentilla palustris,* and *Myriophyllum verticillatum* var. *pectinatum.*

MAN-MADE EXCAVATIONS

In roadside ditches and man-made pools, all of which are yet relatively new, only a few species can be found, and generally only a few individuals of each. Observed in such habitats were *Typha latifolia, Sparganium angustifolium, S. minimum, Potamogeton alpinus* var. *tenuifolius, P. filiformis, P. pusillus, Sagittaria cuneata, Arctagrostis latifolia, Lemna minor, Ranunculus circinatus* var. *subrigidus, R. gmelinii, Caltha natans, Polygonum amphibium, Callitriche hermaphroditica, C. palustris, Elatine triandra, Myriophyllum exalbescens, M. verticillatum* var. *pecti-*

natum, Hippuris vulgaris, and *Senecio congestus.* Of these, *Typha latifolia* is the commonest. Many roadside pools have nothing but a colony of cattails in them. Most of the excavations that contain water have bottoms of mud—exceedingly soft mud.

VEGETATION OF MARL AND GYPSITE DEPOSITS

During the course of construction of the highway, a number of marly lakes, both south of the Mackenzie River and in the Mackenzie River-Frank Channel section, were partly or completely drained, exposing sizeable marl deposits. Certain marl deposits, such as the extensive one at mile 39.7 N, apparently were exposed by natural lowering of lake water level. A drained lake above the highway at mile 119 N has in its bed a deposit of gypsite at least 3 feet thick. The deposit is surrounded by a fine example of bog forest; in the gypsite itself, only one plant *(Juncus balticus* var. *littoralis)* was growing, probably because of the short time the lake had been drained.

In marl deposits the plants occur in very open associations. In the deposit at mile 30, recently exposed by draining, a rather weedy flora has developed and is confined to the periphery of the deposit where the marl is driest. Toward the center of the deposit is standing water. Walking on the drier marl is much like walking on a firm, thick, sponge-rubber mattress; the walker sinks in the wetter marl. The following plants were observed here: *Calamagrostis canadensis, Hordeum jubatum, Carex diandra, C. media, Eleocharis palustris, Scirpus validus, Juncus alpinus, Urtica dioica* var. *procera, Arenaria dawsonensis, A. lateriflora, Ranunculus gmelinii, R. sceleratus, Arabis hirsuta* var. *pycnocarpa, Descurainia sophia, Rorippa islandica, Potentilla norvegica, Hippuris vulgaris, Epilobium glandulosum* var. *adenocaulon, Phacelia franklinii, Campanula rotundifolia,* and *Senecio congestus.* Of these, the *Epilobium* was by far the commonest plant, giving to the band of vegetation rimming the deposit a reddish cast because of its anthocyanous stems and leaves.

As an example of a marl deposit in a long-naturally-drained lake bed, the one at mile 110.5 N may be offered. The marl is much fissured, and large areas are bare of plants. Occasional pieces of gypsum occur in the marl. The most obvious plants are low, scattered shrubs: *Salix brachycarpa, S. candida, S. glauca, Betula glandulosa, Potentilla fruticosa, Shepherdia canadensis,* and *Arctostaphylos uva-ursi.* Other plants are relatively many in species but few in numbers of individuals of each species: *Bryum lacustre, Equisetum arvense, Triglochin maritima, T. palustris, Deschampsia cespitosa, Poa interior, Carex aquatilis, C. atherodes, C. capillaris, C. concinna, C. garberi, C. scirpoidea, C. viridula, Scirpus cespitosus* var. *callosus, S. pumilus* var. *rollandii, Habenaria hyperborea, Arenaria humifusa, Melandrium ostenfeldii, Anemone parviflora, Braya humilis, Dryas integrifolia, Castilleja raupii, Erigeron* *hyssopifolius, E. lonchophyllus,* and *Solidago spathulata* var. *neomexicana.*

Additional plants observed in other marl deposits are: *Calamagrostis neglecta, Phalaris arundinacea, Poa glauca, P. pratensis, Puccinellia nuttalliana, Scolochloa festucacea, Carex physocarpa, C. sartwellii, Atriplex patula, Rumex maritimus* var. *fueginus, Lepidium bourgeauanum, Potentilla norvegica, P. pensylvanica, Lomatogonium rotatum, Mentha arvensis* var. *villosa, Scutellaria galericulata* var. *epilobiifolia, Achillea lanulosa, Antennaria parvifolia, Aster brachyactis, A. ciliolatus, A. junciformis, A. pansus, Lactuca pulchella, Senecio indecorus, S. pauperculus,* and *Taraxacum ceratophorum.*

VEGETATION OF STRANDS AND ISLANDS

KAKISA RIVER

Along the rocky shore of the Kakisa River and on gravel bars and islands in the river, four zones of vegetation may be distinguished: (1) a fore zone, characterized by the absence of woody plants and by local dominance of sedges (especially *Carex aquatilis), Calamagrostis,* or *Phalaris arundinacea,* and by scattered other herbaceous plants; (2) a shrub zone, characterized by dominance of *Salix, Cornus stolonifera,* and *Alnus tenuifolia;* (3) a deciduous-tree zone, characterized by dominance of *Populus balsamifera;* and (4) an evergreen-tree zone, characterized by *Picea glauca* and developing into a typical white spruce forest community. These zones intergrade somewhat, and all of them are not necessarily present at every site.

Detailed study was made of three low rocky islands in the Kakisa River about 3 miles below Lady Evelyn Falls. One of these islands supported only herbaceous vegetation of the "fore zone"; one, somewhat higher, had a central zone of shrubs in addition to the fore zone; the third, the highest, had a fore zone and a central shrub zone and, in this, a central band of *Populus balsamifera* in which several young white spruces (ca. 3 feet tall) were growing.

On island I, and at the periphery (fore zone) of the other two islands, were collected or noted all of the taxa of herbaceous plants that I found elsewhere in similar habitats along the river. Locally, in the fore zone vegetation, *Carex aquatilis, Calamagrostis canadensis, C. neglecta,* and *Phalaris arundicnacea* grew in large patches. Other plants of this zone, typically much scattered and in several cases represented by only one or two individuals, were: *Equisetum fluviatile, E. palustre, Typha latifolia, Agropyron trachycaulum, Beckmannia syzigachne, Deschampsia cespitosa, Poa glauca, Carex rostrata, Juncus balticus* var. *littoralis, Chenopodium capitatum, C. glaucum* var. *salinum, Polygonum aviculare, P. lapathifolium, Rumex maritimus* var. *fueginus, Arenaria dawsonensis, Stellaria crassifolia, S. longipes, Ranunculus macounii, R. reptans, R. sceleratus, Corydalis aurea, Arabis hirsuta* var. *pycnocarpa, Cardamine* *pensylvania, Erysimum cheiranthoides, Rorippa islandica, Potentilla anserina, P. norvegica, P. palustris, Geranium bicknellii, Cicuta douglassii, Sium suave, Epilobium glandulosum* var. *adenocaulon, Hippuris vulgaris, Naumburgia thyrsiflora, Gentianella crinita* ssp. *macounii, Mentha arvensis* var. *villosa, Stachys palustris* var. *nipigonensis, Veronica peregrina, V. scutellata, Plantago major,* and *Galium trifidum.*

The shrub zones on islands II and III were dominated by a dense growth of *Salix bebbiana, S. candida, S. lasiandra, S. planifolia, Alnus tenuifolia,* and *Cornus stolonifera.* Among the shrubs grew only a few herbs: *Zygadenus elegans, Arenaria lateriflora, Parnassia multiseta, Geum macrophyllum* var. *perincisum, Hedysarum alpinum* var. *americanum, Cornus canadensis, Castilleja raupii,* and *Aster junciformis. Rosa acicularis* occurred on island III. The shrubs formed a dense thicket and ranged from 4 to 25 feet tall (the latter height being reached only by *Salix lasiandra* and *S. planifolia*). The poplars on island III were growing among tall willows and were about 35 feet high and 8 inches DBH.

Similar stages of vegetation can be observed in many places along the Kakisa River. Just below Lady Evelyn Falls, the lower part of the "flood plain" is dominated by willows and alder; in this zone can be found small balsam poplars. The upper part of the plain is occupied by a typical white spruce-*Hylocomium* forest. The transition area between the willow-alder zone and the spruce forest exhibits particularly lush growth of shrubs and herbs, including *Actaea rubra, Aquilegia brevistyla,* three species of *Ribes, Amelanchier alnifolia, Cornus canadensis, Cornus stolonifera* (to 8 feet tall), *Pyrola grandiflora,* and *Viburnum edule* (to 5 feet tall).

MACKENZIE RIVER

The bank of the Mackenzie River at Fort Providence and at mile 4 N (where the road to Fort Providence leaves the highway) is steep and is strewn with small to huge, more or less rounded boulders between which is sandy silt. At the lower part of the bank, the silt is damp and may be moss covered; higher up it is drier and may exhibit cracks. The habitat offered for plants is a rigorous one subject to much ice and water erosion; yet a surprising variety of plants grows on the river banks. In places, seemingly every available bit of space between the boulders is occupied by plants. The most obvious plants are shrubs, of which the following were noted: *Salix myrtillifolia, S. serissima, S. bebbiana, S. planifolia, Alnus tenuifolia, Ribes oxyacanthoides, Amelanchier alnifolia, Potentilla fruticosa, Rosa acicularis, Rubus pubescens, Elaeagnus commutata,* and *Cornus stolonifera.* Some small *Populus balsamifera* occur on the bank. The herbaceous flora, richer toward the base of the bank, contained the following taxa: *Equisetum arvense, Agropyron trachycaulum, Agrostis scabra, Beckmannia syzigachne, Cal-*

amagrostis canadensis, C. inexpansa, Hordeum jubatum, Poa leptocoma, P. palustris, Sphenopholis intermedia, Carex aquatilis, C. atherodes, C. garberi, Eleocharis acicularis, Juncus balticus var. *littoralis, J. alpinus, J. bufonius, Allium schoenoprasum* var. *sibiricum, Smilacina stellata, Sisyrinchium montanum, Arenaria lateriflora, Silene menziesii, Polygonum aviculare, Rumex maritimus* var. *fueginus, Anemone canadensis, A. multifida, Ranunculus macounii, R. reptans, R. sceleratus, Thalictrum venulosum, Erysimum cheiranthoides, Capsella bursa-pastoris, Rorippa islandica, Fragaria virginiana* var. *terrae-novae, Potentilla anserina, P. norvegica, Vicia americana, Viola nephrophylla, Epilobium glandulosum* var. *adenocaulon, Naumburgia thyrsiflora, Gentianella crinita* var. *raupii, Collomia linearis, Stachys palustris* var. *nipigonensis, Euphrasia* aff. *subarctica, Rhinanthus crista-galli, Plantago major, Galium septentrionale, Achillea lanulosa, A. sibirica, Arnica chamissois, Aster junciformis, Hieracium umbellatum, Lactuca pulchella,* and *Solidago canadensis* var. *salebrosa.*

SANDY OR GRAVELLY BEACHES

Sandy gravelly beaches were observed only at Kakisa Lake and in the vicinity of Yellowknife. Such habitats are hazardous ones for plants because of ice accumulation and movement and because they are subject to flooding during high water in spring and to drying out later in the growing season.

At Kakisa Lake no woody plants were noted on the fore beach: the following herbaceous plants were seen: *Equisetum fluviatile, E. variegatum, Triglochin maritima, Calamagrostis inexpansa, Deschampsia cespitosa, Eleocharis acicularis, E. palustris, Scirpus validus, Juncus alpinus, J. balticus* var. *littoralis, J. bufonius, J. nodosus, Sisyrinchium montanum, Chenopodium glaucum* var. *salinum, Polygonum amphibium* (stranded), *P. lapathifolium, Ranunculus gmelinii, R. reptans, R. sceleratus, Erysimum cheiranthoides, Rorippa islandica, Potentilla anserina, P. norvegica, Epilobium glandulosum* var. *adenocaulon, Sium suave, Gentianella crinita* var. *macounii, Veronica scutellata, Plantago major, Achillea sibirica, Aster junciformis,* and *Erigeron philadelphicus.* These plants are all much scattered, except for the rhizomatous grasses and sedges, which form small colonies. The upper beach is characterized by the presence of low willows, *Salix lasiandra* and *S. planifolia,* and by a more continuous cover of grasses and sedges, especially *Carex aquatilis* and *Calamagrostis.* Above the upper beach is a zone of tall willows and *Alnus tenuifolia* in which an occasional poplar occurs and in which *Smilacina stellata, Zygadenus elegans, Thalictrum venulosum, Hedysarum alpinum* var. *americanum,* and woodland mosses were noted.

On sandy beaches of Prosperous and Prelude lakes, Frame Lake, and Yellowknife Beach (all near Yellowknife) the following taxa were noted: *Sparganium minimum* (stranded), *Triglochin maritima, T. palustris, Sagittaria cuneata, Eleocharis acicularis, Scirpus validus, Juncus* *alpinus, J. bufonius, J. filiformis, J. vaseyi, Alopecurus aequalis, Beckmannia syzigachne, Glyceria borealis, G. grandis, Puccinellia distans, Carex aquatilis, C. rostrata, Polygonum lapathifolium, Rumex fueginus, Ranunculus cymbalaria, R. macounii, R. reptans, Sium suave, Veronica peregrina, Plantago major, Aster brachyactis,* and *Gnaphalium uliginosum.*

VEGETATION OF SAND PLAINS

Occurring in the vicinity of Yellowknife and also just west of the shield margin at Frank Channel are areas that may be designated "sand plains." Here, on white or tan sand, the trees are *Pinus banksiana, Picea glauca, P. mariana,* and *Betula papyrifera.* In places, these species may all grow together; in other places, each may form pure stands. The trees are widely spaced and low branched, producing a parklike aspect. Considerable areas on the plains may be devoid of any vegetation or litter; some of these plant-free sites are blowouts. In other areas, the sand is covered with litter or, more commonly, with a dense greenish yellow mat of fruticose *Cladonia* and *Cetraria.* The plains that are dominated by such lichen woodland are strongly reminiscent of the parklike timber nearer to the continental limit of trees to the northeast.

Shrubby and herbaceous plants on the sand plains are few. The most common and characteristic shrubs are *Arctostaphylos uva-ursi, Ledum decumbens, L. groenlandicum,* and *Vaccinium vitis-idaea* var. *minus.* These may occur together or, more frequently, as isolated plants or small colonies. *Vaccinium vitis-idaea* var. *minus* appears to be the first woody plant to become established in blowouts. Other shrubs collected on sand plains are *Salix glauca, Rosa acicularis, Empetrum nigrum, Shepherdia canadensis, Hudsonia tomentosa,* and *Vaccinium uliginosum.* Of these, *Empetrum nigrum* and *Hudsonia tomentosa* are the most frequently encountered. *Empetrum* forms mats up to 3 feet across; *Hudsonia* is especially characteristic of the sand plains near the Yellowknife airport, where locally it is common, growing alone in otherwise bare sand or with *Arctostaphylos uva-ursi* or *Vaccinium vitis-idaea* var. *minus.*

Herbaceous plants collected on sand plains are *Equisetum sylvaticum, Lycopodium annotinum, Calamagrostis purpurascens, Festuca saximontana, Geocaulon lividum, Cornus canadensis, Astragalus striatus, Carex foenea, C. supina, Apocynum androsaemifolium,* and *Linnaea borealis* var. *americana.*

VEGETATION OF DISTURBED SOIL

In the highway region, areas disturbed through the activity of man are mainly in the vicinity of the settlements (Enterprise, Fort Providence, Fort Rae, and Yellowknife) and along the highway right-of-way. To me, the outstanding characteristics of the vegetation of these sites are two: (1) the small number of introduced plants present; and (2) the persistence of native plants after disturbance.

Of all the species collected in disturbed habitats, only the following are certainly introduced: *Agropyron cristatum, A. repens, Bromus inermis, Phalaris canariensis, Phleum pratense, Puccinellia distans, Polygonum aviculare, Polygonum convolvulus, Axyris amaranthoides, Chenpodium glaucum* var. *salinum, Stellaria media, Brassica campestris, Capsella bursa-pastoris, Descurainia sophia, Erysimum cheiranthoides, Thlaspi arvense, Melilotus alba, M. officinalis, Lappula echinata, Galeopsis tetrahit* var. *bifida, Crepis tectorum, Matricaria maritima* var. *agrestis, Senecio vulgaris, Sonchus arvensis* var. *glabrescens, Tanacetum vulgare,* and *Taraxacum officinale.* These taxa, comprising about 5.5% of the total vascular flora, are decidedly uncommon along the highway right-of-way; indeed, finding one of them there is somewhat of an "event." Some of them, notably *Polygonum aviculare* and *Taraxacum officinale,* become more frequent in the vicinity of settlements. With the exception of *Puccinellia distans, Polygonum aviculare, Chenopodium glaucum* var. *salinum,* and *Erysimum cheiranthoides,* which grow sometimes in undisturbed habitats and appear native, all of them were found only in disturbed soil. It is to be expected, of course, that as time passes, these weeds will become more common along the highway (the oldest sections of which had been completed only five years when I last worked along them). Many of them are common to abundant along the older Mackenzie Highway.

What might be called the "settlement" flora is well represented at Enterprise (mile 0). Here, in disturbed sandy soil, occur many species of weedy plants, some native, some introduced. A similar flora can be found in waste places around each of the settlements. At Enterprise the species observed were: *Equisetum scirpoides, Agropyron trachycaulum, Agrostis scabra Hordeum jubatum, Oryzopsis pungens, Phleum pratense, Poa pratensis, Puccinellia nuttalliana, Carex aenea, Zygadenus elegans, Axyris amaranthoides, Chenopodium berlandieri* var. *zschackei, C. capitatum, Polygonum achoreum, P. aviculare, Rumex mexicanus, Cerastium nutans, Silene menziesii, Stellaria longipes, Aquilegia brevistyla, Corydalis aurea, Arabis holboelii. Capsella bursa-pastoris, Descurainia sophia, Erysimum cheiranthoides, Lepidium, densiflorum, Thlaspi arvense, Fragaria virginiana* var. *terrae-novae, Potentilla norvegica, Melilotus alba, Vicia americana, Geranium bicknellii. Epilobium angustifolium, E. glandulosum* var. *adenocaulon, Phacelia franklinii, Lappula echinata, L. redowskii* var. *occidentalis, Galeopsis tetrahit* var. *bifida, Moldavica parviflora, Campanula rotundifolia, Galium septentrionale, Achillea lanulosa, Aster ciliolatus, Aster sibiricus, Matricaria matricarioides, Crepis tectorum, Solidago canadensis* var. *salebrosa,* and *Taraxacum officinale.*

To list all the native plants that persist—and often do well indeed—in disturbed areas would require considerable space, for such a list would contain perhaps 90% of the species. Some of these just "manage to survive," being of reduced vigor in disturbed soil, e.g., *Smilacina trifolia.*

Calypso bulbosa, and *Spiranthes romanzoffiana,* which can be found on mounds of disturbed peat in clearings. Many others, in contrast, do exceedingly well and respond to their altered habitat with vigor. Outstanding examples are: *Allium schoenoprasum* var. *sibiricum, Zygadenus elegans, Arabis divaricarpa, Fragaria virginiana* var. *terrae-novae, Potentilla norvegica, Androsace septentrionalis, Campanula rotundifolia, Achillea lanulosa, Aster ciliolatus, Solidago multiradiata,* and *S. spathulata* var. *neomexicana.* These species are generally more to much more robust and abundant in disturbed areas than in adjacent undisturbed ones, where they may be rare and depauperate by comparison. The *Potentilla, Campanula, Achillea, Aster,* and two species of *Solidago* are in many places locally abundant in the right-of-way and are quite conspicuous when they are in flower.

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PLATE I

(Upper) The Yellowknife Highway, mile 11. Forest of *Pinus banksiana* and *Picea glauca*. Limestone is just below the surface here, as is evidenced by tripod telephone poles (holes could not be dug to set poles).

(Lower) *Picea mariana-Hylocomium* forest along Kakisa Road, with road right-of-way in foreground.

PLATE II

(Upper) *Picea glauca-Hylocomium* forest with scattered *Populus tremuloides*, mile 76. Highway in foreground.

(Lower) Interior of above forest, showing thick carpet of *Hylocomium splendens.*

PLATE III

(Upper) Young *Pinus banksiana* forest, mile 30. Highway right-of-way in foreground.

(Lower) Mature *Pinus banksiana* forest, mile 34. *Elymus innovatus*, *Calamagrostis purpurascens*, and lichens *(Cladonia*, *Cetraria)* common.

PLATE IV

(Upper) Edge of limestone outcrop area, mile 24. *Juniperus communis, J. horizontalis,* and *Arctostaphylos uva-ursi* common to abundant. *Picea glauca-Pinus banksiana* forest in background.

(Lower) *Juniperus horizontalis* on limestone, mile 24.

PLATE V

(Upper) Limestone cliff, with talus, mile 66 S. Trees mainly *Picea glauca*.

(Lower) Pre-Cambrian outcrop about 10 miles east-northeast of Yellowknife. Trees are *Picea glauca*, *P. mariana*, *Pinus banksiana*, and *Betula papyrifera*. Lichens abundant.

PLATE VI

(Upper) Pre-Cambrian outcrop, mile 37 S. Top of outcrop darkened by lichens *(Actinogyra* and *Lasallia)*.

(Lower) Upper portion of above outcrop. *Pinus banksiana* on left, *Betula papyrifera* to left of center. Lichens (especially *Cladonia, Cetraria, Actinogyra,* and *Lasallia)* abundant.

PLATE VII

Marly lake, mile 44, showing floating islands. Muskeg forest in background.

PLATE VIII

(Upper) Muck-bottom lake adjacent to Canadian Shield section of highway. *Nuphar variegatum* common and in flower. Photo courtesy H. W. Murdy, United States Fish and Wildlife Service.

(Lower) Extensive sedge mat around muck-bottom lake, Canadian Shield section of highway. Photo courtesy H. W. Mudry, United States Fish and Wildlife Service.

PLATE IX

Low island in Kakisa River just above highway bridge. Dominant plants are *Carex aquatilis*, *Calamagrostis canadensis*, and *Phalaris arundinacea.*

PLATE X

Sandy gravelly beach of Kakisa Lake near outlet into Kakisa River. On mid-beach are willows; behind these is dense growth of taller willows and *Alnus tenuifolia*.

PLATE XI

(Upper) Bouldery shore of Mackenzie River 4 miles east of Fort Providence. Shrubs are mainly willows and *Cornus stolonifera.*

(Lower) Extensive deposit of lake marl, mile 39.7 N.

PLATE XII

(Upper) "Sand plain," mile 128 N. *Pinus banksiana* on right, *Betula papyrifera* on left. The white sand floor is carpeted with mounds of lichens, especially *Cladonia* and *Cetraria*.

(Lower) Close-up of lichen carpet on the "sand plain" pictured above.

PLATE XIII

(Upper) Edge of "sand plain" near Yellowknife. Low plant on sand in foreground is *Hudsonia tomentosa;* trees in background are *Pinus banksiana* and *Picea glauca.*

(Lower) *Calamagrostis* grassland (prairie) with adjacent *Salix-Populus* woods, mile 16 N.

SYSTEMATIC STATUS OF AMMOPURSUS OHLINGERAE (COMPOSITAE)[1]

OLGA LAKELA

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Lacinaria Ohlingerae was described by Dr. Blake (Bull. Torr. Bot. Club 50: 203-204, pl. 9, 1923) from sand-scrub of central Florida. Dr. Small, upholding the endemic as generically distinct, defined its limits under the binomial *Ammopursus Ohlingerae* (l. c. 51: 392-393, 1924). Dr. Robinson, following adoption of *Liatris* as a *nomen conservandum* under the International Code, reinstated sand-torch in the large genus of the blazing-stars as *Liatris Ohlingerae* (Contrib. Gray Herb. 104: 49, 1934). This treatment was followed by Dr. L. O. Gaiser in her scholarly work on the genus *Liatris* (Rhodora 48: 373-375, 1946).

The underground parts of *Liatris*, regardless of whether stems or roots, have been described without uniformity by different authors. Thickened underground stems characterize all species of *Liatris* as defined by Gaiser (Rhodora 48: 168-169). Contrary to this assertion (though it is correct), the term root appears in descriptions of *L. Ohlingerae* and *L. Garberi*. Since circumstances encouraged detailed study of these Florida species, it was deemed worth while to observe seedling growth.

Fruits of *Ammopursus Ohlingerae*, collected near Frostproof, Polk County, were planted in flats of white sand from the habitat of the parent plant on the 6th of November, 1961. They were freely watered and placed in the slath house of the university nursery. Seedlings in process of germination were noted on the 22nd of November. The fruit coat, cast off laterally between the ribs, free from the intervening tissue, appeared fusiform, with a firm attachment of the ribs to the stipe-like tapering base and the intact pappus. The seedlings with oblanceolate cotyledons and a single encircling band of roothairs just below the soil line, were potted in deeper sand and placed under glass without artificial heat.

The period of dormancy was surprisingly short. An effort was made to find some evidence of correlation in natural environment. On the 14th of January 1962, the white sand-scrub of Josephine Creek, Highlands Co., was thoroughly searched for viable fruits for a chromosome record. The tufts of faded florets clinging to receptacles were sterile; in the fallen ones caught in the lichens a few ripe achenes were found. During hours of search over a large area, three seedlings with expanded cotyledons were observed. They were somewhat younger than the ones under cultivation, in which the tip of the first radical leaf was appearing between the cotyledons.

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[1] Contribution No. 9, Botanical Laboratories, University of South Florida.

SIDA 1 (4): 240--247. 1964.

The growth of the planted seedlings was continuous, without well defined cluster of radical leaves. Caulescence appeared early; the plants in May were returned to the slath house open to rains, but reduced light intensity. By September the tallest one had attained the height of 1.6 dm., including the panicle of 12 heads. The plants, six in all, flowered the first year.

Fruits of *Liatris Garberi* were discovered on the 4th of January 1962, in a colony of a few individuals, along margin of flat pineland and saw-palmetto, north of the International Airport, Tampa. They were promptly planted in pots of peaty sand and placed under glass with *Ammopursus*. Seven seedlings appeared in March. Each developed radical leaves at the crown of the taproot. Six became caulescent and flowered the first year; one remained in rosette stage developing a terminal bud in true *Liatris* fashion; its underground parts consisted of 9 thickened secondary roots. Cross sections revealed a pentarch xylem, and 2 rings of growth in the secondary xylem. The plants in each series, were transferred to the greenhouse garden, where they flowered through October.

Dr. Small described the root of *Ammopursus* as "long perpendicular, fleshy tap-root." (Man. S. E. Fl. 1933). Actually, it is a chain of segments formed by thickening of the secondary roots in succession, singly or in multiples. Two-three segments were formed during the first year of growth. The crisp, fleshy segments are fragile at joints. The root of an older plant with two flowering stems, as depicted in Pl. 1, is seldom seen intact; two scars indicate the places of chains of segments lost in collecting. One's groping fingers may feel the whole, suspended in the mesh of rootlets of *Sabal Etonia*, in porous, sun-heated sand, but on exposure only detached parts may be at hand.

The root featured in Pl. 1 was collected in white sand-scrub near Frostproof, Polk County, 23rd of November 1961. Dr. J. B. Carlson, University of Minnesota, Duluth, executed the illustrations with interpretation. The freehand sections were stained in safranin and traced under microprojector.

Section A represents an unthickened root with tetrarch primary xylem; in section B, the primary tissues become disorganized; the secondary phloem, mostly of parenchyma, includes patches of sieve tubes. Similarly, the secondary xylem consists mostly of parenchyma with isolated vessels. Except for a small increase in size, sections B-F are essentially the same as to structural content. No rings of growth are apparent. Section G is a stem, the base of the hypocotyl.

The floral structures have been adequately described in previous works. Annotations with photographs may emphasize differentiating characters. Up to 25 florets are borne on the truncate, clavate receptacle. The 4-5 -seriate inner phyllaries are crowded on an axis barely 2 mm. long, between the glandular, deeply alveolate apex and the persistent outer phyllaries (Pl. 2 A & B). Plane and thin, barely thickened at the base, they readily spread and dissever from the slender connections with the axis. The loose-appearing head is in sharp contrast with compact heads of *L. cymosa* and *L. cylindracea.* In these the outer phyllaries are convex on the back, thick and gibbous at base with broad rhomboidal attachment. They are persistent, strongly imbricated and appressed against the axis, 4-5 mm. long. The receptacle is convex with florets on more than one plane. The two above species with *L. Ohlingerae* constitute Series Cylindraceae as defined by Gaiser. In character of the receptacle, they are fundamentally unlike. So is *L. scariosa* with a broadly convex receptacle which in Dr. Blake's concept is closely related to *L. Ohlingerae.*

The generic limits as defined by Dr. Small include floral characteristics. The photographs (Pl. 3 and Pl. 4A) bring out clearly zygomorphy of the urceolate corolla and included stamens. The blue-violet anthers, only 2 mm. long on subulate filaments about the same length, are exceedingly short for a floret up to 30 mm. long in life. The pale apices of anther connectives are 0.1 mm. long. The proportionately longer anthers, often with conspicuous connectives, exsert in *Liatris,* or at least come close to the sinus level of the corolla throat. The stipe-like base of mature fusiform achene disarticulates from the connecting bundle at the bottom of an alveolus (Pl. 4B). The fruit coat with ribs tapers to the point and remains attached through germination. In *Liatris* the achene base tapers less with looser attachment of the fruit coat. The dorsiventrally compressed bristles of the pappus to 30 in number, attenuate from the 0.1-0.2 mm. wide base, to filiform apices. The lateral cilia of variable length are not more than 2-5 times the diameter of the setae, as measured under micro-projector. Thus, the pappus is barbellate, as described by Dr. Small. Moreover, fleshiness or succulence of the roots and the foliage were manifestly conclusive characters of *Ammopursus;* he regarded the genus on a par with *Garberia* and *Carphephorus.* Short period of dormancy, continuous growth of the seedling without notable formation of rosette leaves and the distinctive structure of the achene are herewith added as delimiting characters for upholding the systematic status of *Ammopursus.*

The chromosome pattern, $2n=20$ is recorded in a root tip cell. (Pl. 4C). The same number has been recorded for species of *Trilisa, Eupatorium* and *Liatris.*

ACKNOWLEDGEMENTS

The author wishes to extend thanks to Dr. J. B. Carlson for preparing the figures in Pl. 1, and to Dr. Peter Raven for determining the chromosome record, which appear here through their courtesy.

PLATES

I. Root of *Ammopursus Ohlingerae*. All cross sections are X 4.44. (See text, p. 239.)

II. Head of *Ammopursus Ohlingerae*. A Receptacle and phyllaries. B. Flowering head. (Slightly enlarged.)

III. Flowers of *Ammopursus Ohlingerae*. (Slightly enlarged.)

IV. Ammopursus Ohlingerae. A. Single corolla and stamens. B. Achene. (About four times natural size.) C. Chromosomes, from root-tip cell.

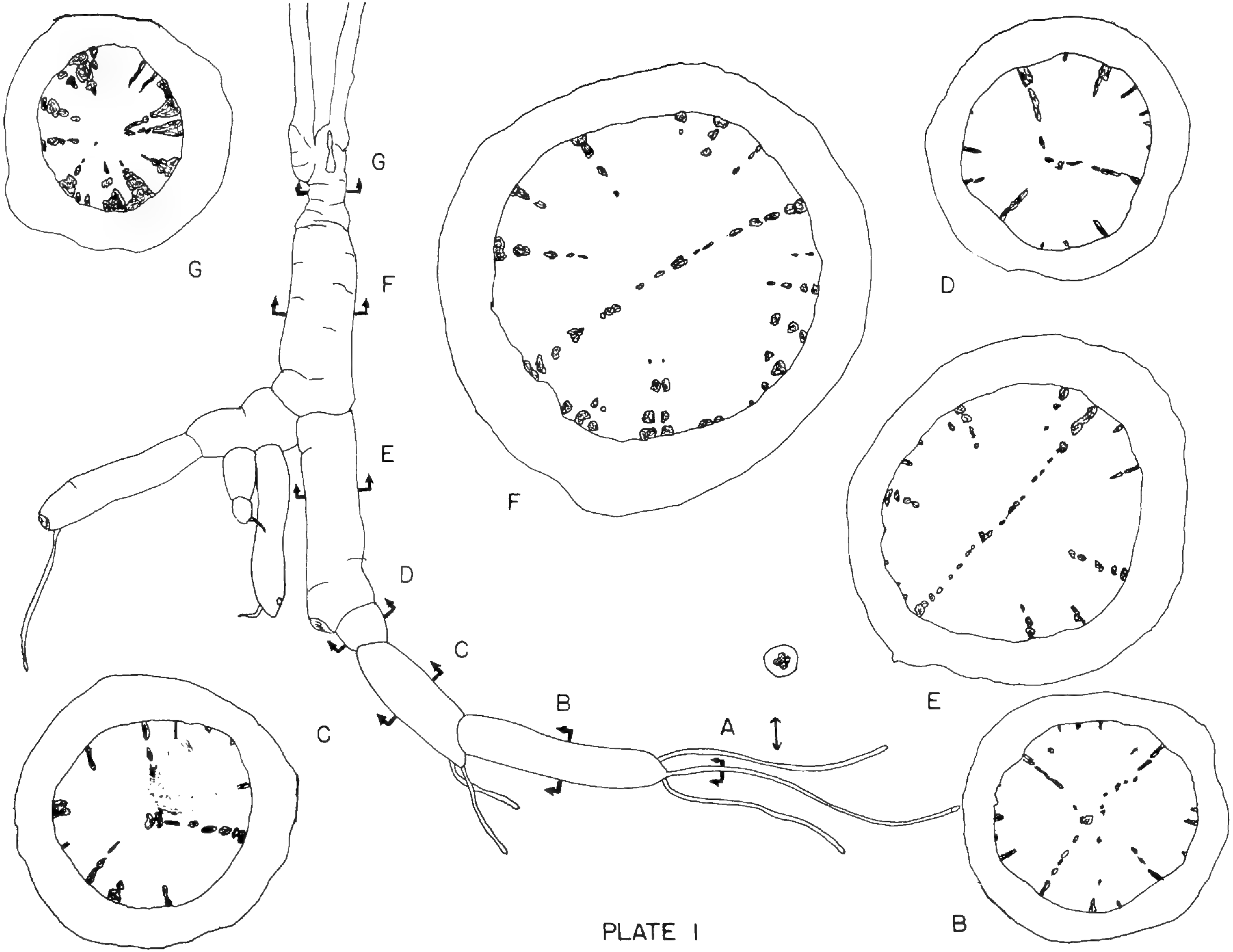

PLATE I

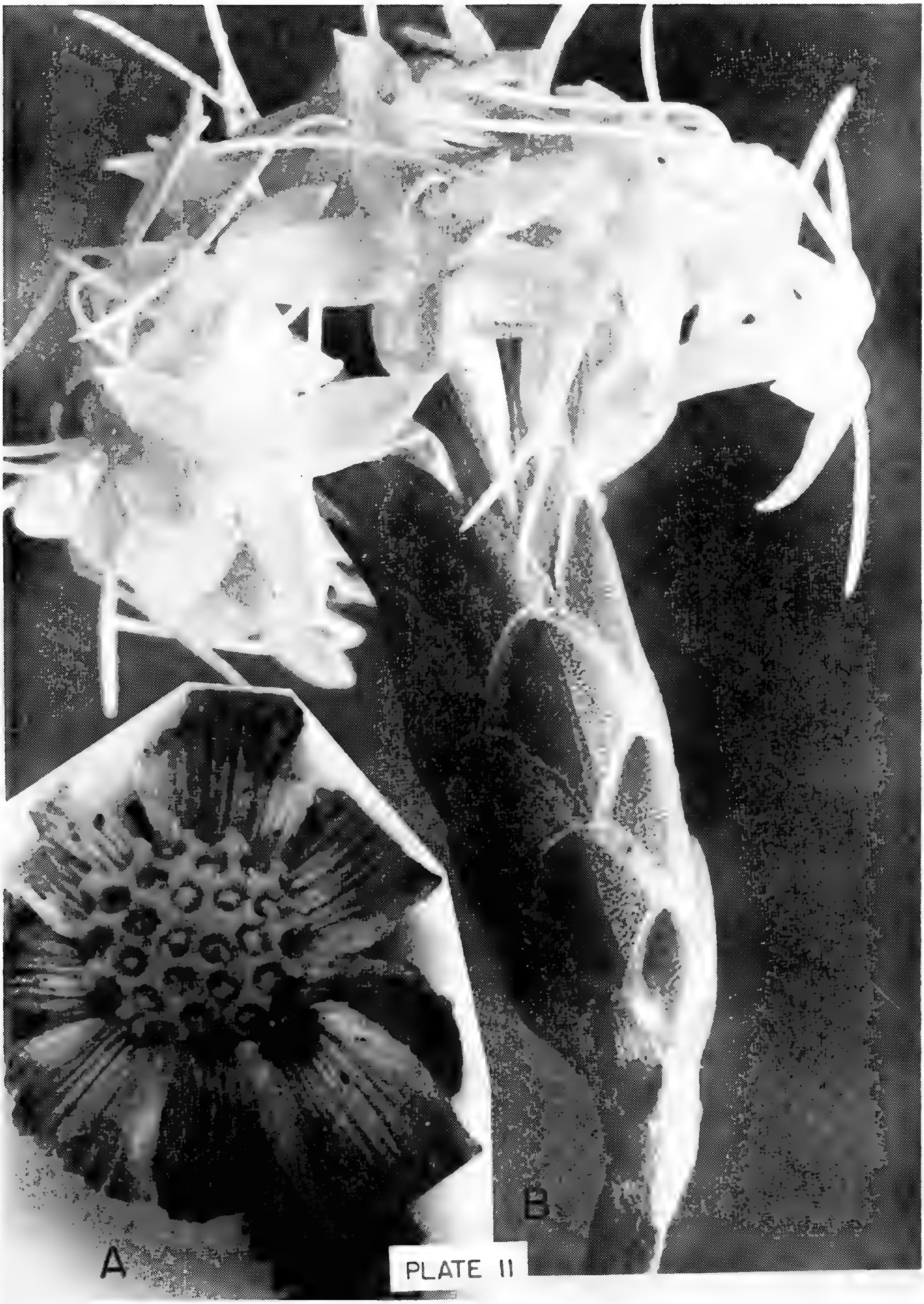

PLATE II

PLATE III

PLATE IV

NOTES

FATOUA VILLOSA (MORACEAE) IN LOUISIANA: NEW TO NORTH AMERICA.—In habit, *Fatoua villosa* (Thunb.) Nakai *(F. pilosa* Gaud.), an eastern Asiatic species, is disturbingly reminiscent of the Urticaceae. In the Lafayette area the plant behaves as an annual and occurs as a weed in greenhouses and in flower and vegetable gardens. I first noted it in flower beds and among shrubs on the campus of the University of Southwestern Louisiana. Seedlings were frequent on the campus this past spring, even following the severe winter of 1962-63, when the temperature in Lafayette dropped to 15 degrees F. Dr. Joseph Ewan of Tulane University informs me that the plant has been found in New Orleans as a weed for at least 15 years. I am indebted to Dr. Carroll E. Wood, Jr., of the Arnold Arboretum, for the identification of our material and for various data concerning it. *Fatoua villosa* is a most aberrant member of the Moraceae in being herbaceous, in having one style arm so reduced that it is easily overlooked, and in having a rather cymose pistillate inflorescences that looks urticaceous. It has in its leaves punctate cystoliths that are especially prominent in dried specimens. Some Urticaceae have such cystoliths; apparently *only* punctate cystoliths are found in the Moraceae. Voucher specimens, bearing my field numbers *10219, 10221,* and *10227,* have been deposited in the herbaria of the University of Southwestern Louisiana, of Southern Methodist University, and of Harvard University.—*John W. Thieret, University of Southwestern Louisiana, Lafayette.*

AMARANTHUS MICROPHYLLUS SHINNERS, SP. NOV. (AMARANTHACEAE).—*A. album* floribus seminibusque, *A. blitoideum* habitu prostrato accedit; ab ambobus recedit magnitudine minore, foliis perparvis brevissime petiolatis, tepalis enervibus. Monoica parva prostrata ramosa caulibus 5—16 cm. longis glabris vel parce minute puberulis. Folia maiora 1.0—1.6 cm. longa glabra subsessilia vel brevipetiolata petiolis 1—5 mm. longis laminis obovatis vel elliptico-oblanceolatis albonervosis obtusis mucronatis. Flores axillares crebri parvi bracteis 1.3—2.5 mm. longis lanceolatis subscariosis vel scarioso-marginatis aristato-acuminatis. Florum marium tepala 3 hyalina ad 2 mm. longa ovata concava enervia breviter aristato-acuminata; antherae 1 mm. longae. Florum foemineorum tepala 1 vel 2 hyalina 0.6—1.1 mm. longa lanceolata vel ovata aristato-acuminata; styli 3. Fructus compressus laevis circumscissilis. Semina nigra 1.0—1.2 mm. longa. HOLOTYPE: silty soil, dried bottom and edges of pond, Hueco Tanks, Hueco Mountains, El Paso Co., Texas, *U. T. Waterfall 6620,* Aug. 20, 1946 (SMU). PARATYPE: edge of gravel pit north of Waterton River, Transition zone, elev. 4250 feet, Waterton Lakes National Park, Alberta, Canada, *August J. Breitung 17588,* Aug. 16, 1953 (SMU). Both collections had been referred

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to *A. blitoides* S. Watson (for which Fernald, followed by most American authors, mistakenly adopted the name *A. graecizans* L., which properly belongs to a Mediterranean species). In its prostrate habit *A. microphyllus* suggests a small form of that species, but it does not have the expectable 5 tepals, short floral bracts, or large seeds. In floral features it is very close to *A. albus,* in which the pistillate flowers have 3 tepals, at least the two larger with midrib, and the floral bracts usually greatly exceeding the tepals. The new species is distinctive in having only 1 or 2 ribless tepals in the pistillate flowers, and seeds intermediate in size between those of the other two (0.7—1.0 mm. in *A. albus,* 1.3—1.8 mm. in *A. blitoides).*—*Lloyd H. Shinners.*

LYSIMACHIA JAPONICA (PRIMULACEAE) AND CLINOPODIUM GRACILE (LABIATAE) IN LOUISIANA: NEW TO THE UNITED STATES.—These two rather weedy species seemingly have not been recorded before from the United States or, indeed, from the New World. Voucher specimens of each have been placed in the herbaria of the University of Southwestern Louisiana and of Southern Methodist University.

Lysimachia japonica Thunb. St. Landry Parish: common for about 200 feet in narrow strip of ground between edge of dirt road and roadside ditch, in woods just southeast of Washington, *John W. Thieret 16120,* 3 July 1963. The plant was first collected here in November 1962 by Mr. Edward L. McWilliams. For the specific determination we are indebted to Dr. Lloyd H. Shinners. A second collection extends the range of this species to Iberia Parish: rare in disturbed area along oil pipeline right-of-way through upland woods, Avery Island, *Thieret 16380,* 27 Sept. 1963. According to Bentvelzen (in Flora Malesiana, Ser. I, vol. 6 (2): 183, 1962), *Lysimachia japonica* is known from "Kashmir to Yunnan, Siam, Eastern China, Formosa, Ryukyu Is., Japan, also in Australia (N. S. Wales, introduced?); in Malaysia: Sumatra, Java." My field notes for no. 16120 are as follows: "Corolla rotate, bright yellow, ca. 8—9 mm. wide when fully open. Petals as long as sepals. Capsule globose, light brown. Pedicels reflexed in fruit. Some stems erect, some elongate prostrate." The plant suggests a small, pubescent form of the well-known *Lysimachia nummularia* L.

Clinopodium gracile (Benth.) O. Kuntze. Lafayette Parish: weed around greenhouses, USL Horticulture Farm, Lafayette, *Thieret 15856,* 29 April 1963. Iberia Parish: in center of little used dirt road through woods, Jefferson Island, *Thieret 15943,* 23 May 1963. St. Martin Parish: at edge of willow dominated depression along Highway 90 about 7 miles south of Broussard, *Thieret 17063,* 3 April 1964. This *Hedeoma*-like plant is frequent on the campus of the University of Southwestern Louisiana and in gardens and open woodlands in the Lafayette area.

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It was determined by Dr. Lloyd H. Shinners; our material compares favorably with specimens of *C. gracile* that we received on loan from the Gray Herbarium. Dr. Shinners' determination was verified (as *Calamintha gracilis* Benth.) by Dr. A. Borissova of the Botanical Institute of the Academy of Sciences of the U.S.S.R., Leningrad. An illustration can be found in Makino's An Illustrated Flora of Japan (enlarged edition, 1959), p. 169. My field notes for no. 15856 are as follows: "Calyx 3.0—3.5 mm. long; corolla light pinkish, with a red-purple blotch at base of each of the 3 lower lobes, 3.5—4.0 mm. long; corolla lobes directed forward." This Asiatic species is quite inodorous.—*John W. Thieret, University of Southwestern Louisiana, Lafayette.*

NEW COMBINATIONS IN TEXAS POLEMONIACEAE. — In the preparation of a treatment of the family Polemoniaceae in Texas, nomenclatorial changes of three taxa have proved desirable. The category of subspecies, though interpreted in diverse ways by different workers, and even discarded by some, is deemed by the writer useful for taxa which are moderately distinct in morphology and geography, yet not sufficiently so to justify species segregation. On this basis the following combinations are proposed:

GILIA RIGIDULA Benth. subsp. **acerosa** (Gray) Wherry, stat. nov. *Gilia rigidula* var. *acerosa* Gray, Proc. Amer. Acad. 8: 280, 1870, basionym; (*G. acerosa* (Gray) Britt., Man. Bot. NE. St. 761, 1901; *Giliastrum acerosum* (Gray) Rydb., Fl. Rocky Mts. 699, 1917.) This taxon intergrades too freely with the species-type to accept the Britton-Rydberg view of species independence, but in northern Texas and adjacent states the reduction of its leaf-segments to subacerose filiform outline does become consistently extreme.

PHLOX DRUMMONDII Hook. subsp. **johnstonii** (Wherry) Wherry, stat. nov. *Phlox johnstonii* Wherry, Wrightia 2: 198, 1961, basionym. While the copious glandularity and elongate corolla-tube distinguish this taxon from all the other annual Phloxes, and it is endemic in a small area in northwest Texas—having been recognized in two counties adjacent to Kent since its original discovery—it seems after all insufficiently differentiated to merit species independence, so reduction in status is here proposed.

PHLOX DRUMMONDII Hook. subsp. **tharpii** (Whiteh.) Wherry, comb. nov. *Phlox tharpii* Whitehouse, Amer. Midl. Nat. 34: 399, 1945, basionym. (*Phlox glabriflora* (Brand) Whiteh., subsp. *tharpii* (Whiteh.) Wherry, Gen. Phlox 62, 1955; *Phlox drummondii* Hook. subsp. *drummondii* var. *tharpii* (Whiteh.) Erbe, Amer. Midl. Nat. 67: 280, 1962). Recent study of some hundreds of herbarium sheets of annual Phloxes in several herbaria has led the writer to change his view as to the relationship of this taxon, and instead of following Whitehouse in grouping it close to taxon *glabriflora*, the Erbe and Turner plan of placing

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it under taxon *drummondii* is favored. At the same time, it is deemed to deserve the higher status previously assigned, so is herewith published in the corresponding new combination.—*Edgar T. Wherry, University of Pennsylvania, Philadelphia.*

SCUTELLARIA THIERETII (LABIATAE), A NEW SPECIES FROM COASTAL LOUISIANA.—Among some Louisiana collections sent by Dr. John W. Thieret for determination was a *Scutellaria* evidently allied to *S. Drummondii* Bentham, a very common and variable species in Texas (though not in the easternmost counties), extending into Oklahoma, New Mexico, and northern Mexico. Additional material supplied by Dr. Thieret showed that the Louisiana plant also was rather variable, despite its restriction to a very small geographic area. Although the variations make it extremely difficult to find usable key differences, individuals of similar size and age of the Louisiana plant and of *S. Drummondii* could easily be distinguished. The most tangible differences were in the smaller and rather long-petioled lower leaves of *S. Drummondii* (unfortunately not present except early in the season), and the marked reduction of the uppermost ones to floral bracts much shorter than the flowers (not plainly evident until fairly late in the season). There was no difference in nutlets, such as distinguishes *S. muriculata* Epling. The Louisiana plant is considered to be one more in a group of very closely related species, and in honor of an energetic and productive collector it is named

SCUTELLARIA **Thieretii** Shinners, sp. nov. Annua ex affinitate *S. Drummondii,* differt caule crassiore, foliis inferioribus majoribus sed brevipetiolatis, foliis superioribus minus reductis, supremis flores excedentibus vel eis paulum brevioribus. HOLOTYPE: roadside, in shell sand, Pecan Island, Vermilion Parish, Louisiana, *John W. Thieret 16162,* 18 July 1963 (SMU; isotype, USL). PARATYPES, all from LOUISIANA. CAMERON PARISH: grazed meadow-like area south of highway at Grand Chenier, *Thieret 8774,* 6 July 1962 (USL). VERMILION PARISH: few plants on shell ridge in brackish marsh, vic. of U.S.L. Biology Lab, Redfish Point, west side of Vermilion Bay, *William D. Reese 2296,* 29 July 1959 (USL); same locality, *Reese 4167, 4187,* 30 April 1961 (both USL). Roadside, Pecan Island, *Thieret 8682,* 23 June 1962 (USL). Shell ridges in vicinity of USL field station, south side of Redfish Point, western shore of Vermilion Bay, *Dr. Norden's Estuarine Biology Class,* 15 July 1962 (SMU, USL).

Annual with a taproot. Stems solitary or much less commonly several, simple or freely branched, 7—65 cm. tall, rather stouter than in *S. Drummondii* of equivalent size, densely pubescent with mixed short to medium long (0.2—1.0 mm.), glandless or partly inconspicuously gland-tipped hairs, these either straight and spreading at right angles

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or slightly retrorsely curved. Lower leaves (soon withering) relatively short-petioled, the petioles 3—10 mm. long, shorter than the blades; blades oblong-ovate to oblong-elliptic, 6—12 mm. wide by 12—25 mm. long, obtuse, shallowly crenate or subentire, the base widely tapered or subtruncate but with wide V-attachment to the petiole, rather strongly pinnately veined, rather densely pubescent on both surfaces, the hairs on the upper surface erect, those on the lower suberect to low-spreading or subappressed. Middle and upper leaves (floral bracts) progressively shorter-petioled to sessile, with gradually reduced, narrower, more entire blades, the uppermost prominent, extending to 3/4 the length of the flowers or beyond. Flowers borne in upper 1/2—5/6 of plant. Calyx and corolla densely pubescent outside with short, erect hairs. Calyx in flower 2.5—4.0 mm. long. Corolla 7—14 mm. long; tube white, limb purple-blue, lower lip with purple-blotched white center.

Scutellaria Thieretii is the easternmost representative of the Southwestern and Mexican Section *Resinosae*, separated by a small gap from the main area of the group. It is also notable as an addition to the extremely small number of endemics in the Louisiana flora. I am indebted to Dr. Thieret for supplying the two SMU collections, and for the loan of mounted specimens from the University of Southwestern Louisiana. —*Lloyd H. Shinners.*

MICRANTHEMUM GLOMERATUM (CHAPMAN) SHINNERS, COMB. NOV. (SCROPHULARIACEAE). — Based on *Micranthemum Nuttallii* var. ? *glomeratum* Chapman, Fl. S. U.S. ed. 2 (2nd issue) Suppl. 2 p. 690. 1892. *Hemianthus glomeratus* (Chapman) Pennell, Proc. Acad. Nat. Sci. Phila. 71: 248. 1920. The second issue of the second edition of Chapman's Flora is evidently very rare, there being no copy even at the Library of Congress. It is of considerable importance since the Second Supplement occupies pages 675—703 inclusive and contains a number of new names as well as many new records. A copy was kindly loaned by the Library of the University of Virginia, for which I am very grateful.—*Lloyd H. Shinners.*

TEXAS EVAX TRANSFERRED TO FILAGO (COMPOSITAE).—It has recently been pointed out that on the basis of the originally included species and source of the name (adopted by Linnaeus from Loefling), *Filago* belongs to those species later segregated by Gaertner under the name *Evax* (Josf Holub and Jindrich Chrtek, Zur Nomenklatur des Gattungsnames *Filago* L. 1753. TAXON 11: 195—201, 1962). All the plants treated in my brief account of the Texas species of *Evax* (Field & Lab. 19: 125—126, 1951) must have new names under *Filago*, as follows.

FILAGO **candida** (T. & G.) Shinners, comb. nov. *Calymmandra can-*

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dida T. & G., Fl. N.A. 2: 262—263. 1842. *Evax candida* (T. & G.) Gray, Syn. Fl. N.A. 2 pt. 1: 230. 1878.

FILAGO **Nuttallii** Shinners, nom. nov. *Evax prolifera* Nuttall ex DC., Prodr. 5: 459. 1836. *Diaperia prolifera* Nuttall, Trans. Amer. Philos. Soc. n.s. 7: 337. 1840. *Filago prolifera* (Nuttall) Britton, Mem. Torr. Bot. Club 5: 329. 1894. (Not *Filago prolifera* Pomel, 1874.)

FILAGO **verna** (Rafinesque) Shinners, comb. nov. *Evax verna* Rafinesque, Atlantic Journal 1: 178, 1833 (according to Merrill, Index Rafinesquianus; not seen); also Herbarium Rafinesquianum p. 24. 1833. *Evax multicaulis* DC., Prodr. 5: 459. 1836. *Diaperia ? multicaulis* (DC.) Nuttall, Trans. Amer. Philos. Soc. n.s. 7: 338. 1840. *Filago multicaulis* (DC.) Heller, Contrib. Herb. Franklin & Marshall College (Bot. Expl. S. Texas) 1: 102. 1894. (Not *Filago multicaulis* Lamarck, 1778.) *Filago nivea* Small, Bull. Torr. Bot. Club 24: 333. 1897. *Evax nivea* (Small) Cory, Rhodora 38: 407. 1936.

FILAGO VERNA var. **Drummondii** (T. & G.) Shinners, comb. nov. *Filaginopsis Drummondii* T. & G., Fl. N.A. 2: 263—264. 1842. *Evax multicaulis* var. *Drummondii* (T. & G.) Gray, Syn. Fl. N.A. 2 pt. 1: 229. 1878.—*Lloyd H. Shinners, Southern Methodist University, Dallas 22, Texas.*

VERBESINA WALTERI SHINNERS, NOM. NOV. (COMPOSITAE).—Based on *Athanasia paniculata* Walter, Fl. Carol. p. 201. 1788. (Not *Verbesina paniculata* Poiret, 1808.) *V. Coreopsis* var. *alba* Michaux, Fl. Bor.-Am. 2: 135. 1803. "In Carolina maritima." *Actinomeris alba* (Michaux) T. & G., Fl. N.A. 2: 335. 1842. (Not *Verbesina alba* L., 1753.) *Actinomeris paniculata* (Walter) Small, Fl. S.E. U.S. pp. 1271, 1340. 1903. *Ridan paniculatum* (Walter) Small, Man, S.E. Fl. pp. 1445 (as *paniculata*), 1509. 1933. I prefer to treat *Actinomeris* as part of the diversified genus *Verbesina*, under which Walter's plant requires a new name.—*Lloyd H. Shinners.*

REVIEW

FLORA OF HENRY COUNTY, ILLINOIS, AN ANNOTATED LIST OF THE VASCULAR PLANTS. Raymond J. Dobbs. 350 pp., 2 pl., map (folded, inside back cover). Natural Land Institute, 303 Penfield Place, Rockford, Illinois. 1963. $5.00.

Henry County, Illinois, scarcely ranks as a botanical paradise. Located in the northwestern part of the state (close to but not on the Mississippi River, three counties south from the Wisconsin border), it is a typical glaciated prairie county, largely under cultivation. The difference in elevation between the lowest and highest points within its 826 square miles is just 315 feet. The only major physical feature is the Rock River, and this only for a short distance at the northwest corner, where it forms the boundary for some 20 miles. The few woodlands have mostly been cleared; marshes and bogs have been drained. The author tells us that he worked for some years as a naturalist in California, including a tour of duty in Yosemite National Park, and traveled extensively throughout the United States and Canada to observe plants. One would think that any leisure hours back in Geneseo would be spent looking at pictures of more interesting places. Instead, for 22 years, Mr. Dobbs made systematic and intensive botanical trips up and down his home county, both by car and on foot. He says of his Flora, "It was made solely as a scientific contribution, at the personal expense of the author, and under no official auspices." One would like to devise a special medal to award those who do not demand inflated N.S.F. grants, a pack of assistants, and the ballyhoo and flummery that have become a routine part of American science, but who calmly, objectively, and conscientiously devote themselves to straightforward accomplishment of straightforward scientific tasks. Its recipients would be rare birds indeed.

Mr. Dobbs speaks in the introduction of his friendship with C. C. Deam, and the first title in his list of references is Deam's *Flora of Indiana*. Perhaps the best compliment one can give the *Flora of Henry County* is that Deam would certainly have approved. It immediately invites comparison with Egbert W. Fell's recent (1955) *Flora of Winnebago County, Illinois*, another excellent local flora which evidently served as a model. Both are annotated catalogues without keys, reproduced from typescript with non-justified margins, and bound in hard covers. For the Dobbs book, the type has not been reduced in size, and scientific names are in capital letters rather than lower case underlined; the resulting page appearance is, I think, more pleasing. Mr. Dobbs gives a rather full account of glacial history and soils, but in contrast with the Winnebago *Flora*, says very little about vegetation types. But then there is hardly a great deal to be said about natural vegetation in the

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county described as "Hog Capital of the World." There are 1,073 species accepted as members of the flora (Winnebago County has 1,210). Notes on medicinal plants and those poisonous to livestock have been supplied from other publications. More valuable to the taxonomist are notes on the distinctness of different varieties as represented in the area. There are two full-page illustrations: a photo of *Pedicularis canadensis* var. *Dobbsii* Fernald as frontispiece, and on page 147 a drawing of *Rubus Dobbsii* L. H. Bailey, here newly described from manuscript supplied by Dr. Bailey. Nomenclature mainly follows that of Fernald's 8th edition of Gray's *Manual;* the author makes numerous acknowledgments of assistance with determinations given by Fernald. Some collections have been deposited at the Gray Herbarium; the principal set is at the State Natural History Survey in Urbana.

In reviewing Jones and Fuller's *Vascular Plants of Illinois* several years ago (S.W. Nat. 1: 44—47, 1956), I commented on the impressive progress the state has made toward the kind of complete coverage which exists for the British Isles. It is of interest to make a few comparisons between the *Flora of Henry County* and a recent English county flora, the privately published *A Flora of Nottinghamshire,* by R. C. L. Howitt and B. M. Howitt (1963). Nearly identical in size with Henry County (844 square miles), Nottinghamshire is described by the authors as almost "the average English county. . . . There is nothing spectacular, no mountains or torrents, no seaboards, no natural lakes." The most conspicuous difference between it and the Illinois county is the presence of a large industrial city and of coal mines. The most conspicuous botanical difference is in the original vegetation, which was forest. In almost incredible contrast with what has happened to original vegetation in Illinois, substantial portions of Sherwood Forest, of Robin Hood fame, still exist. There are 79 persons listed as recorders who have contributed information about the flora (in addition to the two authors), over a period of more than 300 years, starting about 1650—different indeed from the strictly modern, one-man performance of Mr. Dobbs.

The Nottinghamshire *Flora* suggests some comforting things about the American scene. Two very familiar cliches applied to European settlement in America are "taming the wilderness" and "the raw frontier." The two reveal a subconscious awareness that crude destruction is not exactly the same as refined civilization. The land is to be lived in rather than off, and familiarly known and loved. In Winnebago County there are forest preserves, and the *Flora* was sponsored by The Nature Conservancy—hopeful omens for the future. Henry County of course cannot boast any remnants of a Sherwood Forest, but enough survives to have kept an energetic naturalist occupied for 22 years. Now we have something that records what is there, and in so doing makes us more aware of it. We can hope that those who live in Henry County will acquire greater appreciation of the land and the plants around them.

Mr. Dobbs has given us a book that is not only a solid contribution to science, but a significant step in cultural progress as well.—*Lloyd H. Shinners.*

SIDA CONTRIBUTIONS TO BOTANY

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HOW TO STUDY THE FLORIDA FLORA[1]

LLOYD H. SHINNERS

Herbarium, Southern Methodist University, Dallas, Texas 75222

The British Isles are the most thoroughly botanized area in the world, and may well be taken as an ideal model. The new edition of Clapham, Tutin and Warburg's *Flora of the British Isles* (1962) is the culmination of nearly 450 years of activity by British botanists. In addition to the usual keys, recent synonymy, and full descriptions, the book contains a wealth of geographical and biological information, including chromosome numbers and pollinating agents. Add to this fine flora the companion series of *Illustrations* (three parts so far published), H. Godwin's *The History of the British Flora* (1956), and the *Atlas of the British Flora* by F. H. Perring and S. M. Walters (1962), and we are indeed well supplied with information about the British flora.

Although the combined area of the British Isles is a little more than twice that of Florida, their flora is much smaller, owing to the far northern latitude and history of total glaciation. For purposes of comparison we may take the total of 1,511 "good" (or Linnaean) native species given in J. E. Dandy's *List of British Vascular Plants* (1958). We have no accurate information as to the total in Florida except that it is very large, including on the one hand members of the cool-temperate Appalachian flora and tropical species on the other, together with one of the most notable concentrations of endemics in the continental United States. Considering all this floral wealth, and the rate at which new native species are still being found, I think it reasonable to estimate that the total native flora will run close to three times that of the British Isles, or not far from the totals known for Texas and for California.

Botanical knowledge cannot be accumulated without botanists, whether professional or amateur. The second edition of Britten and Boulger's *A Biographical Index of Deceased British and Irish Botanists* (by A. B. Rendle, 1931) lists more than 2,700 names. The first need for our ideal Florida Flora then is some 8,100 dead botanists. Time is required as well as manpower, and even though we deduct from the indicated 1,350 years the past 180 (stretching things some, for many of those years saw little or no progress at all with work on Florida plants), we are still left with more than a millennium of time as our second need. Floras are always tacitly assumed to refer to living plants, but as a practical working matter, they are primarily based on herbarium specimens. With these Britain is abundantly supplied: Kew reports 6 million, the British Museum has released no figures but is also huge, and Edinburgh claims

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[1] All notes are at end of article.

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2 million. A combined total of more than 10 million would be a low estimate for the three principal institutions alone. A majority of these, to be sure, came from outside the British Isles. But it was necessary to have a world sample in order to delimit and organize the orders and families, and to establish the correct identity of species, while the constant influx of aliens means an ever-growing need for large collections of exotics. Since the organization of the world flora into orders and families has been reasonably well done for us, we may need much less than the indicated 30 million for the preparation of our ideal Florida Flora. But we still require vastly more than the combined total of less than 1/3 of a million currently held by the three principal herbariums in the state.

My calculations may seem unrealistic, but the facts behind them are worth citing to emphasize how very much needs to be done. We do not have even a simple list, still less an adequate manual for identification, while an encyclopedic reference work with everything down to the latest chemocytophylesis is hardly to be thought of at this stage. Where to begin? We may turn again to the British Isles for illumination.[2]

In the 1520's William Turner, a young medical student at Cambridge, undertook to describe wild herbs from direct observation, rather than accepting the authority of the Continental herbalists. Thus began the scientific study of the British flora. A century later, in the summer of 1629, a group of men led by Thomas Johnson made excursions from London to observe wild plants. Though most of them had some professional connection with medical practice, their trips had no specifically utilitarian purpose, but were made rather for the satisfaction of idle curiosity. Botany as a pure science had been born in Britain. By 1670 John Ray, Puritan divine and gifted amateur naturalist, was able to publish his *Catalogus Plantarum Angliae et Insularum Adjacentium*. The posthumous third edition of its successor, *Synopsis Methodica Stirpium Britannicarum*, in 1724, represents the high-water mark of pre-Linnaean botany. In 1762 William Hudson's *Flora Anglica* introduced Linnaean classification and binomial nomenclature. These were made available in the English language in 1776 in *A Botanical Arrangement of All the Vegetables Growing Naturally in Britain*, by William Withering.[3] James Sowerby's *English Botany*, in 36 volumes (1790—1814; text by J. E. Smith, whose name does not appear in the earliest volumes), provided the first completely illustrated flora. In 1829 John Lindley's *A Synopsis of the British Flora* established the Natural System. For over a century afterward British botanists were to have available to them at all times a choice of several current floras, prepared by such men as the two Hookers, Bentham, and Babington, running through as many as eleven editions. With the publication of H. C. Watson's *Outline of the Geographical Distribution of British Plants* in 1832, particular attention was focussed on local studies, largely carried out by amateurs. In 1873

Watson's work was to appear in expanded form as his famous *Typographical Botany,* which in 1932 was replaced by G. C. Druce's *Comital Flora of the British Isles.* In 1928 E. J. Salisbury proposed a biological flora of Britain, but publication did not begin until 1941, as a series of papers in the Journal of Ecology, contributed by numerous authors. This is still in continuation and far from completion. The epoch-making first edition of Clapham, Tutin and Warburg's *Flora of the British Isles* in 1952 provided not only an up-to-date manual in the established tradition, but (so far as the limits of a compact, 1-volume work allowed) a biological flora as well, with details of distribution, habitat, life form, flowering time, abundance, pollination, and chromosome number. An abridged companion work, *Excursion Flora of the British Isles,* was published in 1959.

Most noteworthy is the fact that British botany begins with direct field study, and this remains a major feature of it down to the present. Not merely collecting specimens, but continuing observation, checking what is stated in books and filling in gaps in knowledge. This broad and solid factual foundation is something greatly to be envied—and a lesson to be taken to heart. Also enviable is the gradual and easy progress from simple to very complex and detailed investigation. In this respect we are not fortunate: we are confronted with the entire gamut of methods from the most elementary to the most advanced all at once. But there is something of a lesson for us here too. The best advanced work must have a solid basis on which to rest; until we have that basis, we must concentrate on producing it. So-called "alpha taxonomy" should come first; more specialized studies can follow. (I do not use the term "biosystematics" for the latter, since it by no means includes all the possibilities; furthermore it is a term offensively misused by too many present-day American botanists who imagine that only those who use cytology or cytogenetics really know the biology of plants. The "old-fashioned" taxonomist employing data from ecology, geography, and phenology along with phenotype variations is in fact taking into account a broader range of biological information than many biosystematists do.) Historically suggestive also is the way in which one thing leads to another. For example, the floras of Hudson and Withering provided easy tools for local botanists to study the flora. If one looks over the list of British county and local floras, it is immediately clear that they do not begin to be produced in numbers until these pioneer floras have opened the door, and they later appear in flood proportions when a variety of manuals is available, with the added stimulus of H. C. Watson's and Druce's attention to geographical distribution. To be sure, economic and social factors were also involved—industrialization, rise in population, increasing wealth, greater ease of travel—but the existence of utility manuals was certainly a key factor in the great increase in local studies, which in turn made possible better general floras, along with promoting an atmosphere favorable to giving both public and private support to professional botanists.

Perhaps at this point we ought to say something about what a flora is, or ought to be. It is first, and above all, a record of facts. What plant grows where, and when, is information wanted and need by agriculturists, horticulturists, field zoologists, conservationists, nature-lovers, geologists, biochemists, and a host of others. Floras do not exist merely for the attention of professional botanists. Their purpose is not to provide material for the diversion of phylogenists, or to gratify the disdain of biosystematists. It is a basic reference which serves a great variety of needs.

Writing a flora is a tedious and laborious job. We have seen what a stupendous amount of background activity precedes the writing of a really good one. Taxonomists are prone to seek relief from the strain, and "go a-whoring after strange gods." A recent illustration is C. W. James's paper, "Endemism in Florida" (Brittonia 13: 225—244, 1961). On the basis of selected, very incomplete evidence, the author seeks to explain Florida endemics and relics[4] as immigrants from Appalachia.[5] This was Fernald's naive theory of the origin of the Coastal Plain flora. Anyone who has studied the Texas flora realizes very quickly that such an explanation is quite inapplicable in the Gulf Southwest, and Florida and Texas have too much in common to suppose that an explanation unworkable for the one can be accepted for the other.[6] One can only regret that the time spent by Dr. James in developing ill-founded speculations was not devoted instead to developing more foundations. His strictly taxonomic papers show that he is well able to do this. He has been too influenced in his thinking by the eastern Manual Ranges and the limited outlook of their dominating authors.

We may conclude that the best way to study the Florida flora is to begin by being a Texas botanist.

NOTES

[1] Based on a talk given to the Life Sciences Seminar of the University of South Florida, Tampa, 13 December 1962. I wish to thank Drs. James D. Ray and Robert W. Long, who bravely invited me to speak, and heroically refrained from imposing any restrictions. I wish also to express my appreciation to Dr. Jerome O. Krivanek, who made a very spirited and able defense of Dr. James. It was a pleasure to have lively audience participation.

[2] There are very readable summaries of British botanical history in *British Botanists*, by John Gilmour (1946), and in *Wild Flowers: Botanising in Britain*, by John Gilmour and Max Walters (new edition, 1955; see especially Chapter 2, "How Our Flora Was Discovered"). See also Nicholas Polunin's "British Floras Ancient and Modern," Rhodora 55: 209—224, 1953.

[3] To whom, it is said, this punning tribute was paid while he lay dying: "The Flower of British botany is Withering."

[4] A *relict* in good English means a widow; in Clementsian ecological gobbledygook it is a later homonym for *relic*.

[5] It has been suggested that isolated colonies of Coastal Plain species within the Appalachian highland represent ancestral stocks. I think a more likely explanation is just the reverse: they are late emigrants *from* the Coastal Plain. We know from geological evidence that the close of the Pleistocene was a period of vast flooding and erosion, with the develop-

ment of flood plains and terraces outside the glaciated area. It seems to me highly probable that the predominantly weedy Coastal Plain species were rapid invaders, spreading far out of the Coastal Plain itself (the handful of Coastal Plain species about the western Great Lakes are well known illustrations), to be replaced more gradually in succession by the Appalachian flora. The endemic *Conradina verticillata,* confined to a few spots on eroding stream banks in Kentucky and Tennessee, may represent a more ancient occurrence of the same thing. It is one of five shrubby species comprising the genus, all the rest of which are confined to the outer Coastal Plain.

[6] There have been shore lines and hence coastal plains, however small, for as long as sea and land have been differentiated. I see no reason to imagine that typical Coastal Plain plants ever had to exist anywhere else. In Texas such extreme endemics as the monotypic genera *Vaseyochloa* (Gramineae) and *Thurovia* (Compositae) must be very ancient, yet they occur on the very youngest sediments, and there is nothing to relate them to the Appalachian or Ozarkian or Sierra Madrean or any other upland flora. There are exactly comparable endemics in Florida, as well as such striking disjuncts as *Bonamia villosa,* occurring in both states. I consider the so-called Orange Island hypothesis, espoused by Woodson, not only possible and logical, but necessary.

NOTES ON THE VEGETATION OF THE MEXICAN STATE OF MORELOS

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During the summers of 1949 and 1950 the author and his students were privileged to make extensive observations and collections in the Mexican State of Morelos. The work was carried on as part of the summer field courses under the joint sponsorship of the departments of Wildlife Management and Biology of the Agricultural and Mechanical College of Texas. Some additional collections were made by the author in August of 1960.

The state of Morelos is located south of the Federal District in central Mexico. It is bounded on the north by the state of Mexico, and the Federal District, on the east by Pueblo, by Oaxaca on the south and Guerrero on the west. There is a variation of altitude within the state from approximately 17,800 ft. in the northeast to approximately 2,700 ft. in the southwest. The state boundary extends from the peak of the volcano Popocatepetl to the edge of the Balsas Basin.

The vegetation zones of Mexico as presented by Leopold (1959), and his terminology will be followed in general in this paper.

The flora of the state is divisible into two major types, temperate and tropical. Four of Leopold's vegetation types are found within the political limits of Morelos.

The temperate zone includes vegetational types: Pine-Oak Forest, Boreal Forest, and Alpine-Meadow. These vegetational types are found in the northern one-third of the state.

The Mixed Forest type or Pine-Oak Forest is characterized by open scattered stands of woodlands dominated by pines or oaks. Apparently dependent on the elevation and available moisture, either the pines or the oaks may assume dominance in any particular area and occasionally they are distributed almost equally. It is interesting to note that no distinct zone of oak-shrub was observed by the author in Morelos where this type merged with some of the more xeric types at lower elevations of approximately 9,000 and 6,500 ft.

The dominant members of the flora of the Pine-Oak Forest are: *Pinus montezumae, Pinus lawsonii, Pinus teocote, Quercus spp.* Other important members of the flora included in this type are: *Arbutus glandulosa, Ceanothus azureus, Buddleia americana.*

The Boreal Forest type is found in rather limited areas in the north portion of the state. It is characterized by coniferous forests with a

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bunch grass or sacaton *(Festuca tolucensis)* ground cover. A humid environment is associated with this vegetational type and limits it in Morelos between the elevations of approximately 9,000 and 13,000 ft. Canyons at lower elevations which are subject to frequent fog conditions also exhibit this type of vegetation.

The more important species of this vegetational type include: *Pinus lawsonii, Pinus ayacahuite, Pinus leiophylla, Pinus teocote, Pinus montezumae, Pinus hartwegii, Abies religiosa, Festuca tolucensis.*

The third temperate vegetational type is the Alpine Meadow. To my knowldge it is found in Morelos only in the small area where the state line extends up the side of the volcano Popocatepetl. In this area, which is normally above timberline, there are extensive meadows of sacaton *(Festuca* spp.) with robust herbs such as *Lupinus* and *Castilleja.*

The tropical vegetation type found in the state is the Tropical Deciduous Forest with some variations. This type covers approximately the southern two-thirds of the state and is usually found below elevations of 6,500 ft.

This Tropical Deciduous Forest as observed in Morelos exhibits two rather distinct forms. One form is typical of that outlined by Leopold and the other, a more arid type, seems related to his Arid Tropical Shrub.

The typical Tropical Deciduous Forest type is found on the lower mountain slopes from approximately 6,500 to 4,000 ft. and in canyons at lower altitudes that have higher available moisture.

This type is predominantly composed of low, shrub-like trees and some of the larger cacti. The trees are usually leafless during the dry season, but are more abundant and larger than those of the more arid type.

The more important members of this type include the following: *Ipomea arborea, Juliana adstrungens, Bursera* spp., *Pseudosmodingium* spp., *Comocladia* spp., *Parchycereus marginata, Cephalocereus* spp.

The more arid form of the Tropical Deciduous Forest is usually found at elevations below 4,000 ft. It is characterized by sparse, thorny, low shrubs and cacti. The more important members of this type include the following: *Acacia farnesiana Acacia* spp., *Pithecolobium* spp., *Opuntia* spp., *Cephalocereus* spp., *Crescentia* spp., *Dodonaea viscosa, Lippia* spp., *Lantana* spp.

In the riparian associations along stream beds and in marsh lands the vegetation exhibits marked variations and includes such forms as: *Persea americana, Taxodium distichum, Ficus* spp., *Astianthus viminalis, Guazuma ulmifolia.*

Due to the extremes in ecological conditions as expressed through both altitudinal and moisture variations, Morelos exhibits remarkable variation in vegetation and as such presents a very interesting problem in floristics.

The following list of species is based on specimens collected in Morelos by the author and his students. Most of the determinations were made by the author using the facilities at the University of Michigan Herbarium. All species of the Verbenaceae were verified or determined by Dr. H. N. Moldenke. Dr. Rogers McVaugh verified the author's determinations of many species in the Leguminosae. It is hoped that this list will contribute to the sparse knowledge of the distribution of the Mexican flora.

For simplicity the species are arranged alphabetically by families, genera, and species. After each species the town nearest the collection site is listed plus a number in parenthesis indicating vegetation type. 1. Alpine Meadow; 2. Boreal Forest; 3. Pine-Oak Forest; 4. Tropical Deciduous Forest. Specimens on which these determinations were made are deposited at one or more of the following herbaria: S. M. Tracy Herbarium, Texas A. and M. College; The Herbarium, the University of Michigan; The Herbarium, Southern Methodist University.

ALISMATACEAE	
Sagittaria lancifolia L.	Cuautla (4)
AMARYLLIDACEAE	
Allium glandulosum Link and Otto	Cuautla (4)
Nothoscordum fragrans (Vent.) Kunth	Tres Cumbres (2)
Pancratium littorale Jacq.	Axochiapan, Cuernavaca (1)
APOCYNACEAE	
Haplophytum cimicidum A. DC.	Yautepec (1)
ASCLEPIADACEAE	
Asclepias grandiflora Fourn.	Yautepec (1)
BIGNONIACEAE	
Astianthus viminalis (H.B.K.) Baill.	Amacusac (1)
BOMBACACEAE	
Waltheria americana L.	Cuautla (1)
CARYOPHYLLACEAE	
Arenaria decussata Willd.	Lagunas de Zempoala (2)
COMMELINACEAE	
Commelina coelestis Willd.	Cuautla, Tlacotepec, Tres Cumbres, L. de Zempoala (2, 3)
Tradescantia commelinoides R. & S.	Lagunas de Zempoala (2)
COMPOSITAE	
Achillea millefolium L.	Lagunas de Zempoala (2)
Ageratum corymbosum Zucc.	Yautepec, Cuautla, Axochiapan (4)
Aphanostephus pachyrrhizus Shinners	Cuautla (4)
Aster Lima Lindl.	Axochiapan (4)
Conyza filaginoides (DC.) Hieron.	Cuautla (4)

Conyza sophiaefolia H.B.K.	Cuautla (4)
Dyssodia pinnata (Cav.) Robinson	Cuautla (4)
Erigeron maximus Link & Otto	Lagunas de Zempoala (2)
Erigeron scaposus DC.	Huitzilac, Cuautla, Tres Cumbres (2, 3)
Florestina pedata (Cav.) Cass.	Cuautla, Yautepec (4)
Florestina trifida DC.	Cuautla (4)
Florestina tripteris DC.	Cuautla, Yautepec, Axochiapan (4)
Galeana hastata Llave & Lex.	Tiacotepec (4)
Galinsoga aristulata Bicknell	Progreso (4)
Heterotheca inuloides Cass.	Cuautla (4)
Lagascea rubra H.B.K.	Cuautla (4)
Melampodium oblongifolium DC.	Axochiapan, Yautepec (4)
Melampodium paludosum H.B.K.	Yautepec, Cuautla (4)
Otopappus robustus Hemsley	Axochiapan (4)
Pectis latisquama Schultz	Cuautla (4)
Pinaropappus roseus Less.	Cuautla (4)
Sanvitalia procumbens Lam.	Axochiapan, Tlacotepec, Cuautla (4), Yautepec (4)
Sclerocarpus divaricatus (Bentham) B. & H.	Yautepec, Axochiapan (4)
Sclerocarpus uniserialis B. & H.	Axochiapan (4)
Spilanthes americana var. parvula (Rob.) A. H. Moore	Axochiapan (4)
Stevia serrata Cav.	Cuautla (4)
Tagetes filifolia Lag.	Cuautla (4)
Tagetes jaliscana Greenm.	Cuautla (4)
Tagetes lucida Cav.	Cuautla (4)
Tridax coronopifolia Hemsley	Cuautla Yautepec (4)
Tridax procumbens L.	Axochiapan (4)
Zexmenia aurea B. & H.	Tres Cumbres (2)
Zexmenia crocea Gray	Yautepec (4)
Zexmenia helianthoides (DC.) Gray	Yautepec (4)
Zinnia multiflora L.	Yautepec, Axochiapan, Cuautepec (4)
CRUCIFERAE	
Eruca sativa Mill.	Cuautla (3, 4)
CYPERACEAE	
Eleocharis nodulosa (Roth) Schultes	Cuautla (3)
ERICACEAE	
Vaccinium leucanthum Schlecht.	Lagunas de Zempoala (2)
HYPERICACEAE	
Hypericum pauciflorum H. B. K.	Cuautla (3)

LEGUMINOSAE

Acacia angustissima (Mill.) Kuntze	Yautepec (4)
Acacia farnesiana (L.) Willd.	Axochiapan (4)
Acacia paniculata Willd.	Axochiapan (4)
Aeschynomene virginica (L.) B. S. P.	Progresso (4)
Astragalus strigulosus H. B. K.	Cuautla (4)
Brongniartia podalyrioides H. B. K.	Yautepec (4)
Calliandra grandiflora (L'Her.) Bentham	Cuautla (4)
Calliandra houstoniana (Mil.) Standley	Yautepec (4)
Calliandra penduliflora Rose	Yautepec (4)
Cassia occidentalis L.	Axochiapan, Cuautla (4)
Cassia uniflora Mill.	Axochiapan, Yautepec (4)
Cologania procumbens Kunth	Axochiapan (4)
Crotalaria mollicula H. B. K.	Yautepec (4)
Crotalaria pumila Ortega	Cuautla, Progresso (4)
Crotalaria vitellina Ker	Cuautla, Axochiapan (4)
Eysenhardtia polystachya (Ortega) Sarg.	Huitzilac, Cuautla (3)
Lupinus elegans H. B. K.	Lagunas de Zempoala (2)
Mimosa albida H. & B.	Yautepec (4)
Mimosa benthami Macbride	Cuautla (4)
Mimosa caerulea Rose	Cuautla (4)
Nissolia fruticosa Jacq.	Yautepec (4)
Nissolia hirsuta DC.	Cuautla (4)
Pachyrrhizus erosus (L.) Urban	Yautepec, Axochiapan (4)
Phaseolus atropurpureus Bentham	Yautepec (4)
Phaseolus coccineus L.	Cuautla (4)
Phaseolus heterophyllus Willd.	Cuautla (4)
Pisum sativum L.	Cuautla (4)
Rhynchosia pyramidalis (Lam.) Urban	Yautepec (4)
Tephrosis nicaraguensis Oerst.	Yautepec (4)
Trifolium amabile H. B. K.	Cuautla, Tres Cumbres (2, 3)
Zornia diphylla (L.) Pers.	Cuautla (3)

LILIACEAE

Anthericum aurantiacum J. G. Baker	Yautepec (3, 4)
Bessera elegans Schult.	Yautepec (4)
Milla biflora Cav.	Cuautla (4)

LOASACEAE

Mentzelia aspera L.	Yautepec, Cuautla (4

MALPIGHIACEAE

Bunchosia palmeri S. Watson	Yautepec, Axochiapan, Cuautla (4)

MALVACEAE	
Anoda cristata (L.) Schl.	Cuautla, Axochiapan, Yautepec (4)
Anoda hastata Cav.	Progresso (4)
Malvastrum coromandelianum (L.) Garcke	Yautepec, Axochiapan (4)
Sida procumbens Sw.	Yautepec (4)
MARTYNIACEAE	
Martynia annua L.	Yautepec (3, 4)
MORACEAE	
Dorstenia drakena L.	Yautepec (4)
ONAGRACEAE	
Lopezia mexicana Jacq.	Cuautla (4)
POLYPODIACEAE	
Adiantum concinnum H. & B.	Cuautla, Yautepec, Axochiapan (4)
Adiantum kaulfussi Kunze	Cuautla (3)
Adiantum poireti Wikstr.	Cuautla (3)
Bommeria pedata (Swartz) Fournier	Cuautla (3)
Cheilanthes angustifolia H. B. K.	Cuautla (3)
Cheilanthes cucullans Fee	Cuautla (3)
Cheiloplecton rigidum (Swartz) Fee	Yautepec (4)
Notholaena aurea (Poir) Desv.	Cuautla (3)
Pellaea skinneri Hooker	Axochiapan (4)
Polypodium polypodioides (L.) A. S. Hitchcock var. aciculare Weatherby	Cuautla (3)
PONTEDERIACEAE	
Heteranthera limosa (Sw.) Willd.	Axochiapan (4)
RANUNCULACEAE	
Clematis drummondii T. & G.	Cuautla (3)
RHAMNACEAE	
Karwinskia umbellata (Cav.) Schlecht.	Amacusac (4)
RUBIACEAE	
Bouvardia ternifolia (Cav.) Schlecht.	Cuautla (3)
Cephalanthus salicifolia H. & B.	Cuautla (3)
Diodia tetracocca Hemsley	Cuautla (3)
Galium asperrimum Gray	Cuautla (3)
Paederia pringlei Greenman	Yautepec (topotype) (4)
Spermacoce haenkeana Hemsley	Cuautla (3)
Spermacoce patula M. & G.	Cuautla, Axochiapan, Huitzilac (3, 4)
SAPINDACEAE	
Cardiospermum halicacabum L.	Axochiapan (4)
Dodonaea viscosa Jacq.	Yautepec (4)

SCROPHULARIACEAE	
Castilleja pringlei Fern.	Lagunas de Zempoala Tres Cumbres (2)
Castilleja scorzoneraefolia H. B. K.	Cuautla, Lagunas de Zempoala (2, 3)
Castilleja tenuiflora Bentham	Cuautla, Huitzilac (3)
Mimulus glabratus (L.) Wettst.	Lagunas de Zempoala (2)
Pedicularis mexicana Zucc.	Lagunas de Zempoala (2)
Penstemon campanulatus Willd.	Yautepec, Cuautla, Tres Cumbres (3, 4)
Veronica americana (Raf.) Schwein.	Lagunas de Zempoala (2, 3)
SELAGINELLACEAE	
Selaginella pallescens (Pres.) Spring	Yautepec (4)
SOLANACEAE	
Nicotiana glauca Graham	Cuautla (3, 4)
Solanum bicolor Willd.	Cuautla (3)
Solanum nigrum L.	Lagunas de Zempoala (2)
STERCULIACEAE	
Ayenia montana Rose	Yautepec (4)
Melochia pyramidata L.	Cuautla (3, 4)
Physodium dubium Hemsley	Yautepec, Axochiapan (3, 4)
TURNERACEAE	
Turnera ulmifolia L.	Cuautla (4)
VERBANACEAE	
Bouchea prismatica (L.) Ktze.	Axochiapan (3)
Lantana achyranthifolia Desf.	Yautepec, Axochiapan, Cuautla (3, 4)
Lantana camara L.	Cuautla, Yautepec, Axochiapan (3, 4)
Lantana hispida H. B. K.	Yautepec (3, 4)
Lantana velutina H. B. K.	Cuautla, Axochiapan, Tlacotepec (3, 4)
	Yautepec (4)
Lippia berlandieri Schauer	Yautepec (4)
Vitex mollis H. B. K.	Cuautla (4)
VITACEAE	
Cissus subtruncata Rose	Yautepec (4)

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THE IDENTITY OF SAGITTARIA ISOETIFORMIS (ALISMATACEAE)[1]

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Shortly after publishing a revision of the North American species of *Sagittaria*, J. G. Smith (1895a) received specimens of an undescribed species of that genus from Florida. Plants of this species, which he named *S. isoetiformis* (1859b), were said to be common along sandy lake margins where they formed extensive patches in the shallow water, their slender interlacing stolons bearing tufts of leaves and rooting at the nodes. The type specimen (Fla., Lake Co., *Nash*, March 22, 1894, MO) possesses slender, attentuate to only slightly dilated phyllodia about 1-2 mm wide—a distinctive feature which apparently suggested to Smith the leaves of *Isoetes* (hence the specific epithet). Smith (1895b) considered *S. isoetiformis* to be more closely related to *S. graminea* Michx. than to any other species.

The identity and specific distinctness of *Sagittaria isoetiformis* long went unquestioned. Recently, however, Bogin (1955) interpreted this taxon merely as an ecological variant of *S. graminea* var. *graminea*, the variant said to occur in lakes having a marked seasonal drop in water level. Beal (1960), in treating the Alismataceae of the Carolinas, made no reference to *S. isoetiformis*, but he distinguished material from the Carolinas as *S. teres* S. Watson and considered it specifically distinct from *S. graminea*. Bogin (op. cit.) had considered *S. teres* as a variety of *S. graminea* with a range from Cape Cod to southern New Jersey. We identify the Carolina plants called *S. teres* by Beal with *S. isoetiformis*, the latter ranging from southeastern North Carolina to peninsular Florida and southern Alabama, and consider *S. teres* distinct from both *S. isoetiformis* and *S. graminea* var. *graminea*.

Fernald (1950) says in part of *Sagittaria teres*: ". . . leaves erect, all represented by terete, attenuate, often nodose phyllodia; those of terrestrial plants slender and elongate (up to 6 dm long), those of deep water shorter, very thick, spongy and digit-like; . . . achenes . . . with strongly rounded crenate dorsal keel, the faces (when fully ripe) rugose and irregularly 2-4 (or more) keeled; . . ."

The terete, attenuate, nodose phyllodia characteristic of the New England *Sagittaria teres* specimens are unlike the phyllodia of material from the Carolinas southward. Note particularly Fernald's statement that those of *S. teres* are erect, slender and elongate if the plants are

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Fig. 1. a-c: *Sagittaria teres*. a. Habit, deeper water form. b. Habit, on shore form. c. Achene. d-e: *Sagittaria graminea*. d. Habit, form with submersed winter rosette and emersed leaves. e. Achenes.

terrestrial (Fig. 1b), shorter, very thick, spongy and digit-like in deep water (Fig. 1a). In lakes and ponds of the Southeast, terrestrial (on shore) plants of *S. isoetiformis* have short (0.5-1.0 dm) phyllodia, flattened dorsally, some, at least, of the phyllodial tips slightly dilated and laminar (Fig. 2b). In water the phyllodes are lax and very much longer (to at least 4-5 dm), flattened and strap-like, and with gradually attenuate tips (Fig. 2a). Rarely the phyllodia of submersed plants are slightly dilated at their apices (Fig. 2c). Both *S. teres* and *S. isoetiformis* have slender rhizomes (Figs. 1a, b and 2a, b). The surface of the achene of *S. teres* has an irregularly crenate dorsal keel and 2-4 (or more) prominent, rugose or irregularly knobby facial keels with no oil glands apparent in the facial view (Fig. 1c). The surface of the achene of *S. isoetiformis* has a somewhat irregularly crenate to entire dorsal keel and three or more low, non-rugose or non-knobby facial keels between which the oil glands are conspicuous (Fig. 2f).

Sagittaria graminea var. *graminea* forms stout, horizontal rhizomes from which shoots of the season emerge. If the rhizomes are submersed (in Florida, at least), prominent rosettes of broad flat phyllodia occur during winter. In spring, at about the time inflorescence scapes are produced, new leaves arise which have elongate petioles and emersed laminae (Fig. 1d). If the rhizomes are not submersed during winter, rosettes of flat phyllodia are not produced and the spring leaves are of the same type as the spring leaves of submersed plants. Both *S. teres* and *S. isoetiformis*, as indicated above, have very slender, elongate rhizomes. In regard to the winter rosette phyllodia of *S. graminea* var. *graminea*, it is important to emphasize that they exhibit much variability in size, particularly length. They range from a few centimeters long in shallow water to about 6 dm long in deeper water. Fluctuation of water depth in places inhabited by this plant frequently varies markedly in short periods of time. Thus plants which formed rosettes in shallow water may have short phyllodia at a given time even though the water may have recently become fairly deep owing to recent rains. On the other hand, plants which have been submersed in fairly deep water all winter have long phyllodia.

The achenes of *S. isoetiformis* and *S. graminea* var. *graminea* are much alike with respect to keels and oil glands. We have not attempted to examine and compare large numbers of them to ascertain whether or not thy have subtle distinctive features of systematic value.

In conclusion, *Sagittaria isoetiformis* is considered specifically distinct from *S. graminea*, var. *graminea* and from *S. teres*. The former occurs in the coastal plain from southeastern North Carolina to peninsular Florida and westward to southern Alabama. The latter occurs from eastern Massachusetts to southern New Jersey (to eastern Maryland according to Fernald, op. cit.), *S. graminea* var. *graminea* is widespread in eastern and central North America.

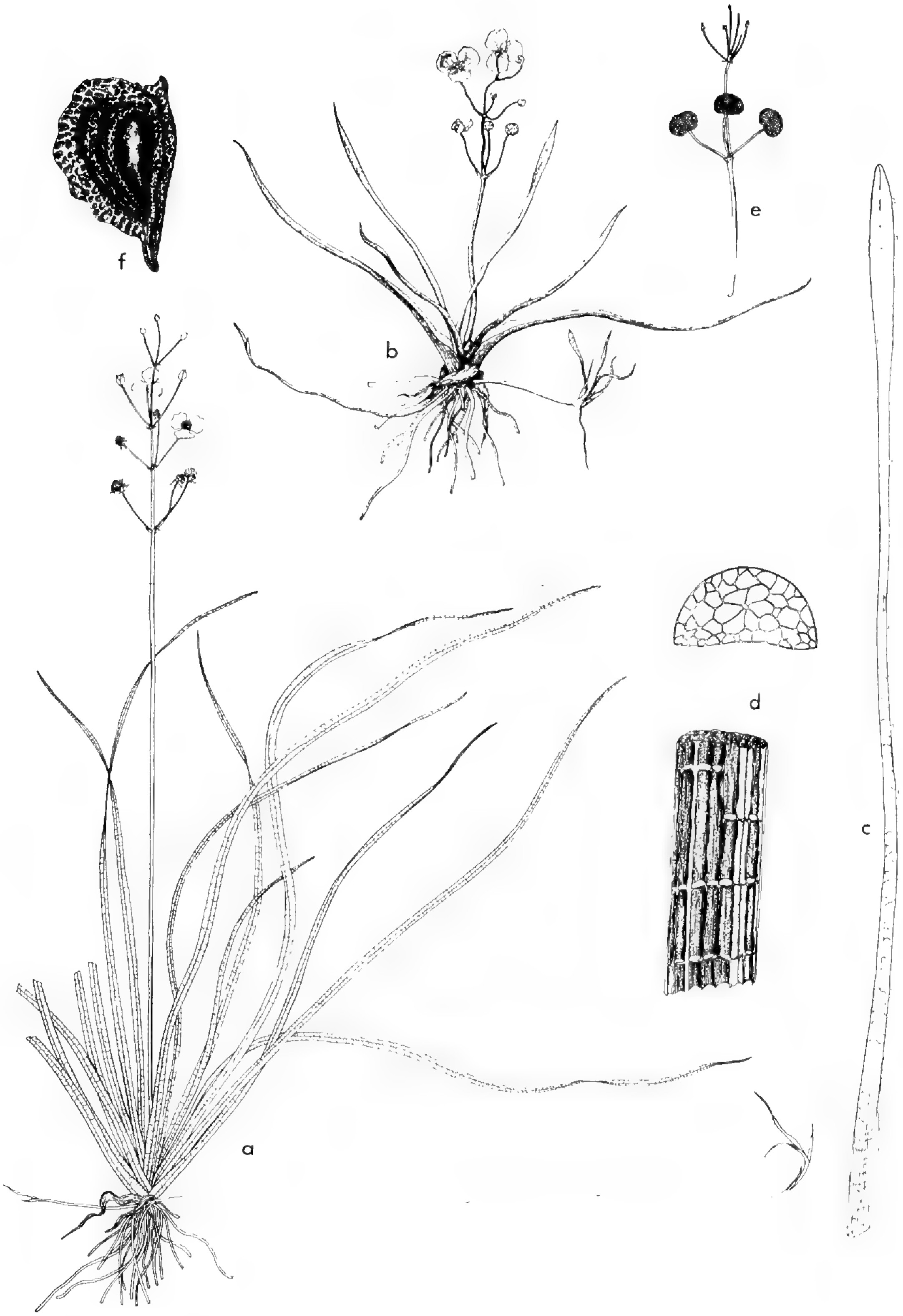

Fig. 2. *Sagittaria isoetiformis.* a. Habit, submersed plant. b. Habit, on shore plant. c. Unusual leaf of submersed plant. d. Cross and longitudinal sections of phyllode of emersed plant. e. Enlargement of fruiting inflorescence. f. Achene.

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MEIOTIC CHROMOSOMES IN AFRICAN COMMELINACEAE

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Following a limited study of Ethiopian Commelinaceae[14][*] an opportunity existed to expand the chromosomal survey to other parts of Africa. Such an attempt seemed warranted for a number of reasons. Early evidence indicated that basic numbers of genera had been misinterpreted, that polyploidy and aneuploidy, but rarely both, were characteristic of different genera, and that infraspecific polyploidy and aneuploidy were widespread and also typical of certain genera. I supposed that a study of these features might lead to a clearer understanding of their roles in speciation and significance in phylogeny. Not least among my considerations were the varying definitions of commelinaceous subdivisions, perhaps best illustrated by Brenan's[2] discussion on assigning his newly described *Triceratella* to a tribe. Preliminary counts in Africa in conjunction with existing data disclosed a marked similarity of basic chromosome numbers for associated genera which in some degree corresponded to major subdivisions of the Commelinaceae. All these trends needed exploration and to this end the study was undertaken.

MATERIALS AND METHODS

Immature flower buds and herbarium specimens of *Cyanotis* (Tradescantieae), and *Aneilema*, *Commelina*, and *Murdannia* (Commelineae), were collected in east, central, and south Africa during September-December, 1962. Buds were fixed in 4 parts chloroform, 3 parts absolute ethanol, and 1 part glacial acetic acid; as soon as possible thereafter, usually up to 10 days, the vials were airmailed to England for storage at −40°C. Buds were examined for PMC meiosis in 2% acetic-orcein and satisfactory squash preparations were mounted in euparal for future reference. No difficulty in staining was experienced even after 9 months of fixation and presumably if needed buds could be kept satisfactorally at this temperature for longer periods of time. Whenever possible collections from more than 1 plant were examined and these results are indicated in parenthesis following my collection numbers in tables listing the chromosome numbers. It is regrettable, particularly in view of the marked frequency of infraspecific aneuploid and polyploid races in most genera, that this procedure is not followed elsewhere. The importance of knowing how many plants have a particular number under these circumstances can not be overemphasized.

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[*] Superscript numerals refer to list of references at end of article.

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Although useful meiotic plates were found for most collections, about 20% of those collected failed to show meiosis even when a wide range of buds had been fixed. By referring to my field notes, I found that by and large such buds had been fixed between 11 a.m. and 3 p.m. on clear days in more or less exposed localities. On the other hand, meiosis was found rapidly in buds fixed from 8-11 a.m. and from 3-5 p.m. on clear days without shade or at any time during the day if cloudy or if the plants were growing in the shade providing the 'correct' size had been preserved. These plants appear to have a decreased meiotic activity during mid-day under hot, exposed, often dry conditions, whereas this decrease was not demonstrable either earlier or later in the day. Similar daily 'meiotic cycles' have been noted in collections of Linaceae, Polygalaceae, and Rubiaceae from Mexico and the southwestern U. S.

A complete set of voucher specimens has been deposited at the Royal Botanic Gardens, Kew (K); duplicates are in the U. S. National Museum (US) and the Missouri Botanical Garden (MO). As the systematic study of the African Commelinaceae proceeds at Kew, the unnamed collections listed here will eventually be associated with binomials.

CYANOTIS

For 5 species listed in Table 1, basic numbers of $x=11$, 12 and 13 are reported with the $x=13$ line new to *Cyanotis*. When these data are combined with other African reports,[5,14] $x=12$ is the most common basic number for species native to that continent.

Generally the meiotic process was regular. An exception was the nondisjunction noted in about 20% of the anaphase plates of 1 plant of *C.* sp. (Fig. 4) giving cells with 11+13 rather than the normal complement of 12 chromosomes. Otherwise the plates were normal in appearance. Unequal distribution of chromosomes during anaphase has recently been reported for *Setcreasea*.[16] From a casual observation of pollen, I found only a small number of hollow and shrivelled grains, no more than for those plants with normal disjunction, suggesting that the loss or gain of 1 chromosome had no deleterious effect on the new haploid cells.

Even the infrequent occurrence of nondisjunction in *Cyanotis* could explain, at least in part, the fairly high incidence of aneuploidy within species populations. For example, among a sample of 6 plants from the Transvaal (Table 1), the homomorphic *C. speciosa* was found with 3 cytotypes: typical plants with 13_{II} (Fig. 5) as well as those with $13_{II}+1_{I}$ and 15_{II} (Fig. 6). The anticipated trivalent and quadrivalent configurations were not observed. Infrequently the extra chromosome in the $2n=27$ plants lagged at anaphase and these might have been excluded from the usual groupings of 13+14 found. It is not inconceivable that these hyperaneuploids had their origins from nondisjunction forming aneuploid races without, as yet, recordable morphological

TABLE 1.

GAMETIC CHROMOSOME NUMBERS IN AFRICAN *CYANOTIS*

Species	*n*	Voucher & locality
Basic number $x=11$		
C. barbata D. Don	11	KENYA: Rift Valley Prov., Navasha Dist., 2 miles W of west entrance to Aberdare National Park, *Lewis 5927* (1), Figs. 1-2.
Basic number $x=12$		
C. longifolia Benth. (dwarf form)	12	N. RHODESIA: N W Prov., Mwinilunga Dist., Mujileshi River, ca.4 miles E of Angola-N.R. border, *Lewis 6133* (2).
(tall form)	12	N. RHODESIA: N W Prov., Mwinilunga Dist., Zambesi River, 4 miles N of Kalene mission, *Lewis 6206* (2).
C. sp.	12	N. RHODESIA: N W Prov., Mwinilunga Dist., 3-4 miles SE of Angola-N.R. border & 1-4 miles SW of Mujileshi River, *Lewis 6147* (2). Figs. 3-4.
Basic number $x=13$		
C. foecunda Hassk.	13	KENYA: Rift Valley Prov., Trans Nzoia Dist., ENE slope of Mt. Elgon, *Lewis 5964* (1).
C. speciosa (L.f.) Hassk.	13	N. RHODESIA: N W Prov., Mwinilunga Dist., 1-4 miles E of Angola-N.R. border, *Lewis 6134* (1); 3-4 miles SE of Angola-N.R. border & 1-4 miles SW of Mujileshi River, *Lewis 6157* (1). S. AFRICA: Natal, Hlabisa Dist., Charters Creek, *Lewis 6304* (2).
	$13,+1_{I},2_{II}$	S. AFRICA: Transvaal, Pretoria Dist., Pretoria, Wonderboom, *Lewis, 6344* (3,13_{II}; 2,$13_{II}+1_{I}$;1,15_{II}), Figs. 5-6.

differences. Other examples of infraspecific aneuploidy have been observed in more heteromorphic species than *C. speciosa*. The present count of $n=11$ for *C. barbata* from Kenya confirms the report from Ethiopian populations,[14] but Sharma and Sharma[24] found $n=12$ for an Indian collection. It would be interesting to know how widespread the $n=12$ race is in Asia and whether or not *C. barbata* is multibasic according to a continental distribution. It is well worth noting that the interpretation of meiosis at diakinesis is often confusing in *Cyanotis* and other Commelianaceae and this factor can not be overlooked in explaining some of the diversity in recorded chromosome numbers. As an example, I can cite the meiosis of *C. barbata* in which the nucleolus resembles a bivalent having 2 chiasmata during mid-diakinesis. Thus the meiotic number for the PMC illustrated in Fig. 2 might be given as $n=12$ (and was by a cytologist who examined the cell), but later diakinesis on the same slide clearly shows PMCs with only 11 bivalents and a more faint nucleolus (Fig. 1). This discussion does not imply an error in the report of Sharma and Sharma for they also examined later stages of meiosis; it does, however, stress the danger of drawing too hasty a conclusion from diakinesis alone. Kammathy and Rolla[12] found a $n=11$ race for *C. arachnoidea* C.B.Cl., a species typically having $n=12$[12, 25, 26], and 'fragments' were noted by Islam and Baten[10] for *C. cristata* Schult.f.*

When the results for 18 Afro-Asian species with known chromosome numbers are summarized, we find: 1 species with $n=8$; 2 species with $n=10$; 1 species with $n=11$; 2 species with $n=11$ and 12; 9 species or 50% with $n=12$, 24, 36; 2 species with $n=13$; and 1 species with $n=14$. By far the most frequent basic number is therefore $x=12$ predominantly at the diploid level but including the only known polyploids (*C. adescendens*, $4x$[21] and *C. tuberosa*, $2x$, $4x$, $6x$[12, 21, 26]). This trend is not likely to be altered as more species are studied and $x=12$ should remain the central focus of chromosomal differentiation in the genus.

How does this number fit those of other genera usually grouped with *Cyanotis?* If one follows Brückner,[3] who included *Cyanotis* in the Subfamily Tradescantieae, Tribe Hexandrae, then *Tradescantia*, *Leptorrhoeo, Setcreasea,* and *Zebrina* are the 4 genera most closely associated. The most frequent basic number for *Tradescantia* is $x-6$, for *Setcreasea* $x=6$, for *Zebrina* $x=12$, and none is known for *Leptorrhoeo.* If one follows Clarke,[4] who placed *Cyanotis* in the Tribe Tradescantieae, the only definite count known for those genera listed near *Cyanotis* is $n=12$ for *Floscopa.*[12] Although the data are incomplete, the evidence reveals basic numbers of $x=6$ and 12 for genera associated with *Cyanotis* by Brückner and Clarke. It also supports the inclusion by Clarke and Woodson[28] of *Floscopa* in the Tradescantieae since these numbers are very rare in the Commelineae where Brückner placed *Floscopa.* This suggests that $x=6$ is an original basic complement for these genera, and perhaps for the Tradescantieae, and that the $x=12$ is a polyploid derived from such a prototype having become widespread as a basic number for several genera in this circle of affinity. A significant example would be *Cyanotis,* the largest genus in the Tradescantieae.

* Two species of '*Cyanotis*' considered by Islam and Baten need clarifying. Reference is made to *Cyanotis zenonii* of Darlington(6) which Darlington(7) long ago corrected to *Campelia zanonia* HBK. Secondly they refer to "*C. spironema fragrans*," presumably from the legend on p. 80 of Darlington,(6) which is simply "C." for the third figure of the plate illustrating not the chromosomes of *Cyanotis* but rather of *Spironema fragrans* (= *Callisia fragrans* (Lindl.) Woodson).

Five minor lines of descent, $x=8$, 10, 11, 13, and 14, are each represented in *Cyanotis* by only 1 or 2 species. These could have formed by a gain or loss of chromosomes from $x=12$ in a similar way to the examples of infraspecific hypo- and hyper-aneuploidy outlined above except that they have reached a morphological differentiation recognizable at the rank of species. Probably *C. somaliensis* C.B.Cl. with $n=14$[5] has not yet attained such a level. According to Brenan (oral communication), this species may represent but a part of the *C. foecunda* complex ($n=13$) and as such *C. somaliensis* may eventually be recognized merely as an infraspecific aneuploid race.

Based on chromosome numbers and frequencies, a hypothetical evolution of *Cyanotis* has been constructed (Fig. 7). Some alterations in the figure are anticipated as the cytotaxonomic analysis of the genus proceeds (e.g., changing the $x=14$ basic line represented by *C. somaliensis* to $x=13+1$), but these are not expected to alter the principal features illustrated.

I have ignored chromosome size largely because meiotic chromosomes are inexact for comparative purposes and most research has been confined to meiosis. Exceptions are 2 photomicrographs of pretreated somatic cells illustrated by Shetty and Subramanyan.[26] From these I estimate the chromosomes of *C. axillaris* (L.) R. & S. to be 3.2-5.5 microns in length and for *C. arachnoidea* C.B.Cl. only 1.8-2.8 microns. In the same paper Shetty and Subramanyan described bivalents of *C. papilionacea* as "larger" than and those of *C. arachnoidea* as "smaller" than the other species studied which included *C. axillaris*, *C. cristata* (L.) D. Don, *C. fasciculata* R. & S., *C. tuberosa* R. & S., and *C. villosa* R. & S. Their bivalents would be considered as more or less intermediate in size. On comparing these results with the meiotic plates of *C. barbata*, *C. speciosa*, and an undescribed species (Fig. 1-6), I find the bivalents and chromosomes approximately intermediate in size and quite comparable with the majority illustrated by Shetty and Subramanyan. These sketchy data suggest that mitotic chromosomes and bivalents of *Cyanotis* species are predominantly of an intermediate size (e.g., 3.2-5.5 microns in *C. axillaris)* with a few species having smaller (e.g., *C. arachnoidea)* or larger (e.g., *C. papilionacea)* chromosomes.

When the anaphase I chromosomes of *C.* sp. (Fig. 3-4), *Commelina benghalensis* (Fig. 10-11), and *C. diffusa* (Fig. 14) are measured, the meiotic chromosomes of *Cyanotis* average 3.0 microns while those of the *Commelina* species are smaller at 2.6 and 2.1 microns, respectively. Apparently *Cyanotis* chromosomes on the average are somewhat larger than are those of *Commelina* and also *Murdannia* (see further discussion below).

ANEILEMA

The 5 species of *Aneilema* examined (Table 2, Fig. 8-9) are grouped

TABLE 2.
GAMETIC CHROMOSOME NUMBERS IN AFRICAN *ANEILEMA*

Species	n	Voucher & locality
Basic number $x=9$		
A. sp. aff. *pedunculosum* C.B.Cl.	9	KENYA: Rift Valley Prov., Trans Nzoia Dist., ENE slope of Mt. Elgon, *Lewis 5973* (2), Fig. 8.
Basic number $x=13$		
A. tacazzeanum Hochst.	13	UGANDA: E Prov., Teso Dist., 1.8 miles W of Wera, *Lewis 5999* (2), Fig. 9.
A. welwitschii C.B.Cl.	26(+1?)	CONGO: Katanga Prov., Lualaba Dist., 15 miles NNW of Kalene mission, *Lewis 6229* (1); N. RHODESIA: N W Prov., Mwinilunga Dist., Mujileshi River, 4.5 miles E of Angola-N.R. border, *Lewis 6143* (1).
Basic number $x=15$ or 10		
A. aequinoctiale (P.Beauv.) Kunth	30	KENYA: Central Prov., Meru Dist., 8 miles NE of Runyenje's, *Lewis 5911* (1); S. AFRICA: Natal, Durban Dist., Durban, *Lewis 6279* (1).
Basic number $x=16$ or 8		
A. johnstonii K. Sch.	16	N. RHODESIA: N Prov., Abercorn Dist., Chilunoma River, nr. Abercorn, *Lewis 6113* (3).

under 4 newly reported basic numbers, $x=9$, 13, 15 (or 10), and 16 (or 8). To these can be added the counts of $n=14$ for *A. montanum* Wight[12, 25, 26] giving 5 basic complements for a sample of only 6 species. (Many species with established chromosome numbers have been published under *Aneilema*, but all are referrable to *Murdannia.)* The genus is a rather large one and until more data are accumulated, little can be noted regarding chromosomal trends other than that aneuploidy and polyploidy have apparently played significant roles in the evolution of *Aneilema* giving rise to a multibasic group of species at several levels of ploidy.

COMMELINA

From a sample of 37 populations involving at least 26 taxa, basic numbers of $x=11$, 13, 14, and 15 are reported for *Commelina* (Table 3, Fig. 10-16). Those species with $x=15$ are in the majority, about 70% of the total; species with $x=14$ and 13 are infrequent, and the $x=11$ series is represented solely by *C. benghalensis.* Infraspecific polyploidy is reported for *C. africana* with $2x$, $4x$, and $8x$ races and for *C. beng-*

halensis with $2x$ (Fig. 10) and $4x$ (Fig. 11) races. The results also add a diploid race (Fig. 12) to the report of $n=30$ ($4x$) for *C. imberbis.*[14] No infraspecific aneuploid is recorded and regular meiosis was characteristic throughout (ignoring clumping and various adhesions attributed to fixation).

In a strict sense, $x=13$ is a newly reported basic number. The related *Commelinantia* is known with $n=13$[1] and its transfer to *Commelina* by Woodson[28] is now supported by the existence of similar complements in typical commelinas. However, Rowley[22] reported *Commelinantia* as having pollen with 3 colpi rather than the single colpus found for all other Commelinaceae studied; hence it might be argued that this unique micromorphological feature, together with certain gross characters, is worthy of generic recognition.

Seven species listed in Table 3 have been examined previously, all but one by Morton[18] from west African material. His results for these species are summarized in Table 4 together with those for the present study and for others. Morton's counts are based on $x=14$ in contrast to mine and most others which are characteristically $x=15$. The exception is $x=11$ for *C. benghalensis* having diploids widely distributed in India and both diploids and tetraploids frequent in Africa. The $n=$ca.24 count by Anderson and Sax[1] and $2n=$ca.68 by Darlington[5] suggest $4x$ and $6x$ races; unfortunately original localities were not given. But Morton's data are not similar. Possibly infraspecific aneuploidy exists for all these species, yet I think it peculiar that this mechanism should be largely confined to west African populations. It is clearly infrequent elsewhere. Regrettably my collections based on $x=14$ must for the present remain unnamed; among these a verification of some of Morton's numbers may be possible.

At least three suggestions regarding the original basic number of *Commelina* have been proposed. Certainly the oddest is found in an abstract by Deodikar[8] in which no evidence is given to corroborate the statement that "there are two polyploid series in primary and secondary chromosomal balance with 8 and 16 as their respective monoploid number." Not only does this quotation lack meaning to me, but $n=8$ has yet to be found in the genus. Unquestionably this abstract is to be ignored until some results are published to support the conclusions. On the basis of associations of groups of bivalents, Sharma[23] has suggested $x=4$ as the basic number of *Commelina.* I find the evidence inconclusive based as it is on the very questionable premise of bivalent association and then for only 2 species. Perhaps it is noteworthy that in a later paper Sharma and Sharma[24] fail to make further use of such associations in deriving basic numbers and evolutionary groups in the family. Morton[18] has proposed $x=7$, but I have shown that his results are not characteristic of *Commelina* as known today. In short, I find little evidence to support $x=4$, 7, or 8 as basic numbers.

TABLE 3.
CAMETIC CHROMOSOME NUMBERS IN AFRICAN *COMMELINA*.

Species	n	Voucher & locality
Basic number $x=11$		
C. benghalensis L.	11	KENYA: Rift Valley Prov., Trans Nzoia Dist., ENE slope of Mt. Elgon, *Lewis 5961* (1), Fig. 10.
	22	UGANDA: N Prov., Karamoja Dist., base of Mt. Moroto, nr. Moroto, *Lewis 5996* (1), Fig. 11.
Basic number $x=13$		
C. *eckloniana* Kunth	13	N. RHODESIA: N Prov., Abercorn Dist., Chilunoma River, nr. Abercorn, *Lewis 6112* (3).
C. cf. *eckloniana* Kunth	13	N. RHODESIA: N W Prov., Mwinilunga Dist., Mujileshi River, 4.5 miles E of Angola-N.R. border, *Lewis 6142* (2).
	13(+1?)	CONGO: Katanga Prov., Lualaba Dist., 19 miles SSW of Mutschatsha, *Lewis 6142* (2).
Basic number $x=14$		
C. sp. 1	14	N. RHODESIA: N W Prov., Mwinilunga Dist., 1 mile E of Ikelengi, *Lewis 6189* (4).
C. sp. 2	14	N. RHODESIA: N W Prov., Mwinilunga Dist., Mujileshi River, 5-6 miles SE of Angola-N.R. border, *Lewis 6170* (4).
C. sp. 3	14	N. RHODESIA: N W Prov., Mwinilunga Dist., Zambesi River, 4 miles N of Kalene mission, *Lewis 6196* (3), Fig. 13.
C. sp. 4	28	N. RHODESIA: N W Prov., Mwinilunga Dist., 3-4 miles SE of Angola-N.R. border & 1-4 miles SW of Mujileshi River, *Lewis 6146* (2).
Basic number $x=15$		
C. *africana* L. var. *africana*	15	S. AFRICA: Natal, Hlabisa Dist., Charters Creek, *Lewis 6305* (1). UGANDA: W Prov., Toro Dist., Queen Elizabeth National Park, *Lewis 6011* (2).
var. 1	30	S. AFRICA: Natal, Hlabisa Dist., 4.3 miles W of Charters Creek, *Lewis 6309* (1).

TABLE 3 (cont.)

Commelina africana		
var. 2	30	S. AFRICA: Natal, Estcourt Dist., Drakensberg Mts., base of Mt. Champagne, *Lewis 6266* (1).
var. 3	60	S. AFRICA: Transvaal, Pretoria Dist., Pretoria, Wonderboom, *Lewis 6345* (2).
C. diffusa Burm.f.	15	S. RHODESIA: Wankie Dist., Victoria Falls, *Lewis 6247* (1), Fig. 14. UGANDA: W Prov., Bunyoro Dist., 12 miles S of Victoria Nile on road to Masindi, *Lewis 6004* (2).
C. imberbis Ehrenb. ex Hassk.	15	TANGANYIKA: Tanga Region, Tanga Area, 6.3 miles W of Tanga, *Lewis 6062* (2), Fig. 12.
C. purpurea C.B.Cl.	15	KENYA: Rift Valley Prov., Trans Nzoia Dist., ENE slope of Mt. Elgon, *Lewis 5960* (1).
C. scaposa C.B.Cl.	15	N. RHODESIA: N W Prov., Mwinilunga Dist., 2 miles W of Ikelengi, *Lewis 6193* (1), Fig. 15.
C. sp. 5	15	N. RHODESIA: N W Prov., Mwinilunga Dist., 3-4 miles SE of Angola-N.R. border & 1-4 miles SW of Mujileshi River, *Lewis 6148* (3).
C. sp. 6	15	N. RHODESIA: N W Prov., Mwinilunga Dist., Zambesi River, 4 miles N of Kalene mission, *Lewis 6197* (3).
C. sp. 7	15	S. AFRICA: Transvaal, Pretoria Dist., Pretoria, Wonderboom, *Lewis 6347* (1).
C. elgonensis Bullock	30	KENYA: Rift Valley Prov., Trans Nzoia Dist., ENE slope of Mt. Elgon, *Lewis 5974* (1).
C. gerrardii C.B.Cl.	30	S. AFRICA: Natal, Durban Dist., Durban, *Lewis 6281* (1); Isipingo Beach, *Lewis 6283* (1) & *6285* (1); Hlabisa Dist., Charters Creek, *Lewis 6300* (1).
C. livingstonii C.B.Cl.	30	S. AFRICA: Natal, Hlabisa Dist., Charters Creek, *Lewis 6296* (2); Transvaal, Pretoria Dist., Pretoria, Wonderboom, *Lewis 6346 (1)*. S. RHODESIA: Salisbury Dist., Salisbury, *Lewis 6259* (1).
C. welwitschii C.B.Cl.	30	S. RHODESIA: Salisbury Dist., Salisbury, Cranborne, *Lewis 6252* (1).

C. sp. 8	ca.30	KENYA: Rift Valley Prov., Trans Nzoia Dist., Kitale, *Lewis 5981* (1).
C. sp. 9	30	N. RHODESIA: N W Prov., Mwinilunga Dist., nr. Mujileshi River, 4 miles E of Angola-N.R. border, *Lewis 6185* (1); 7 miles NW of Kalene mission, *Lewis 6226* (3), Fig. 16.
C. sp. 10	30	TANGANYIKA: S Highlands Region, Mbeya Area, Mbeya Range (ca.8 miles NE of Mbeya), *Lewis 6085* (2).
C. sp. 11	ca.45	N. RHODESIA: N W Prov., Mwinilunga Dist., 3-4 miles SE of Angola-N.R. border & 1-4 miles SW of Mujileshi River, *Lewis 6145* (1).

In an attempt to offer an alternate suggestion, I have summarized the gametic numbers known for *Commelina* in Table 5 together with frequencies of cytotypes. Each cytotype corresponds to a species excepting the infraspecific polyploids and rarely aneuploids. These are represented once for each race. The most obvious fact is the predominance of the $x=15$ line totaling 75% of all cytotypes. For this group almost twice as many polyploids as diploids are known and these are to a level of $10x$. Minor lines of descent account for the remaining cytotypes with basic numbers of $x=$ 11, 12, 13, 14, and 16, chiefly of diploids, infrequently of tetraploids, and of only one questionable hexaploid race. The table does not reveal the infraspecific polyploidy now known for 8 species or 20% of those species studied. Nearly one-half of these, such as *C. africana*, *C. benghalensis*, and *C. obliqua* Ham., each have 3 races at different levels of ploidy. When one considers that many species have only 1 recorded number from a single plant, the incidence of infraspecific polyploidy becomes even more remarkable and obviously this percentage can be expected to increase as more counts are accumulated. As I have noted above the definite examples of infraspecific aneuploidy are much less notable. Collections originally published under *C. nudiflora* L. were found with primarily $n=15$ and $2n=30$[23] with $2n=28$ and 56,[24] all from India, and with $2n=56$ by Darlington[5] without indication of source (not by Anderson and Sax[1] from North American material as Morton[18] reported). These give *C. nudiflora* 2 primary numbers of $n=15$ and 14 with the latter having a tetraploid race. If *C. diffusa* is considered a part of this complex, then, as I recorded in Table 4, the $n=15$ complement is by far the most common and probably the $n=14$ line arose by hypoaneuploidy from plants with $n=15$. This is the only verified example of aneuploidy within a species of *Commelina;* I expect that when the reports of Morton can be more fully explored and when my collections based on $x=14$ are named more cases with a pattern similar to *C.*

TABLE 4.

PRESENT CHROMOSOME NUMBERS IN *COMMELINA* AND PREVIOUS COUNTS

Species	Lewis	Morton[18]	Others
C. africana	$n=15,30,60$	$2n=28$	$n=15$(14)
C. diffusa	$n=15$	$2n=28$	$n=15$(14,21); $2n=30$(12,13,27)
C. forskalaei	$n=15$	$2n=28$	$n=14$(15); $n=15$(12,14,21); $n=15$ & $2n=30$(25,26)
C. imberbis	$n=15$		$n=30$(14)
C. gerrardii	$n=30$	$2n=56$	
C. livingstonii	$n=30$	$2n=56$	
C. benghalensis ($2x$)	$n=11$	$2n=28$	$n=11$(12,14); $n=11+\mathrm{o}-2\mathrm{B}$(15); $n=11$ & $2n=22$(9,23,25,26)
(polyploid)	$n=22$	$2n=56$	$n=22$(14); $n=\text{ca.}24$(1); $2n=\text{ca.}68$(5)

nudiflora may come to light. Undoubtedly, however, the contribution of aneuploidy to speciation in *Commelina* is secondary to the role of polyploidy.

Do these facts and trends suggest an original chromosome number for *Commelina*? The $x=15$ line is certainly of secondary origin and as such gives no direct answer to this question. But consider *Commelina* in relationship with *Murdannia* (Table 6), a genus having a characteristic basic number of $x=10$. Except for *Aneilema,* these are the only large genera in the Commelineae and they are probably indicative of the tribe as a whole. The dominance of $x=10$ and 15 in the tribe suggests an ancient basic number of 5 giving rise by polyploidy to the widespread occurrence of multiples of this number today.

In referring briefly to chromosome size in *Commelina*, a topic already introduced under *Cyanotis,* I should mention again that a discussion based solely on meiotic figures is not satisfactory. However, Anderson and Sax[1] noted small chromosomes for *C. benghalensis* and mitotic chromosomes illustrated for *C. diffusa*[13] measure 1.9-3.7 microns in length. In meiosis there is not much difference between the anaphase I chromosomes of *C. benghalensis* (Fig. 10-11) and *C. diffusa* (Fig. 14). These chromosomes as well as the bivalents of *C. imberbis* (Fig. 12), *C. scaposa* (Fig. 15), and *C.* sp. (Fig. 16) would all be described as more or less small. Yet the bivalents of an unnamed *Commelina* with $n=14$ (Fig. 13) are of intermediate size and not unlike the majority figured for *Cyanotis.*

TABLE 5.

CYTOTYPES REPORTED IN *COMMELINA* WITH FREQUENCY OF PLOIDY*

$n=$	Ploidy					Total
	$2x$	$4x$	$6x$	$8x$	$10x$	
11	1	1	1(?)			3
12		1				1
13	3					3
14	4	2				6
15	12	18	9	2	1	42
16		1				1

* Excluding results of Morton,[18] several circa counts, and the meiotically irregular $5x$ *C. salicifolia.*[23]

MURDANNIA

All plants from 5 populations of *M. simplex* (Vahl) Brenan were found with $n=20$ and regular meiosis. These include collections from: N. RHODESIA—N.W. Prov., Mwinilunga Dist., 3-4 miles SE of Angola-N.R. border & 1-4 miles S.W. of Mujileshi River, *Lewis 6156* (1), 5-6 miles SE of Angola-N.R. border, *Lewis 6172* (2), 4-5 miles SE of Angola-N.R. border, *Lewis 6179* (1) (Fig. 17); TANGANYIKA—E Region, Kilosa Area, 6 miles SW. of Mikumi, *Lewis 6065* (1); and SWAZILAND—Komati River by Forbes Reef-Piggs Peak Rd., *Lewis 6329* (1). This number verifies the reports from India by Shetty and Subramanyam,[25, 26] the first under *M. sinicum* (Lindl.) Brückn. The $4x$ race is more widespread than are the hexaploid[12, 21] and octoploid[20] races which are known only from Asia.

A total of 24 cytotypes have been published for 15 species of *Murdannia* (see excellent review by Shetty and Subramanyam). Six species are known to have 2 or 3 levels of ploidy although several of these may be attributed to misidentification, but at most a fraction. When the n numbers are summarized according to frequency and level of ploidy (Table 6), the most obvious feature is the high frequency (71%) of the basic complement of $x=10$. This frequency is comparable to the 75% for $x=15$ in *Commelina.* In addition more than one-half of all cytotypes are polyploids, multiplied to the $8x$ level in 1 or possibly 2 lines, and this too is parallel to the situation in *Commelina.* Although the range of aneuploid cytotypes is extensive, each aneuploid line has few species and 3 'lines' are known only as infraspecific numbers as indicated by the footnote in Table 6. The most frequent number in these species is usually questionable as for *M. semiteres* (Dalz.) Santapau with $n=7$,[21] 10,[21] 12,[12] and 20,[21] but possibly multiples of 10 will be found most frequently for this species. For the present discussion, it is clear that

TABLE 6.
CYTOTYPES REPORTED IN *MURDANNIA* WITH FREQUENCY OF PLOIDY

$n=$	Ploidy				Total
	$2x$	$4x$	$6x$	$8x$	
7[3]*	1				1
8(?)*				1(?)	1
9	1				1
10	6	6	4	1	17
11	1	1			2
12[1]	1				1
15	1				1

* Known only as infraspecific aneuploids.

$n=7$ and 12 can not represent lines of descent or basic numbers. This leaves $x=9$, 11, and 15, each having 1 species. The origin of $x=9$ by the loss of a chromosome pair and of $x=11$ by a similar increase from $x=10$ are reasonable speculations, but the origin of $x=15$ offers several possibilities. Assuming that the number of $2n=30$ for *M. keisak* (Hassk.) Hand. Mazz.[17] is not that of a naturally occurring triploid, the species could have formed by a succession of chromosomal gains from $n=10$, 11, etc., but this is a long route beset with many gaps. Alternately *M. keisak* could have arisen from stocks of 10 and 5 or 5, 5, and 5. This hypothesis also has major drawbacks (not least among them is the absence of a species with $n=5$); even so the known chromosome numbers in the genus, the high frequency of polyploidy, and the low frequency of aneuploidy all strongly suggest this origin. I might note that the relationship of *Murdannia* and other Commelineae to the Tribe Pollieae needs further study and it should not be overlooked that *Pollia* is known with $n=5$.[7]

In summary, I propose that $x=5$ is an ancient, probably extinct, basic number for *Murdannia* represented today by a dominant $x=10$ line composed of species with $n=10$, 15, 20, 30, and 40.

In regard to chromosome size, the bivalents of *M. simplex* (Fig. 17) are smaller than those illustrated for *Cyanotis* and *Aneilema* and about equal or smaller in size than those of *Commelina*. Bivalents of *M. elata* (Vahl) Brückn.[12] are similar to *M. simplex*.

CONCLUSIONS

1. Basic numbers of $x=8$, 10, 11, 12, 13, and tentatively 14 are known for *Cyanotis*. This large genus is thought to have arisen from a $x=6$ prototype and to have had its chromosomal differentiation from a $n=12$ stock foremost by aneuploidy and secondarily by polyploidy. Infra-

specific aneuploidy is widespread while infraspecific polyploidy is restricted.

2. The most common basic numbers for *Cyanotis* and the Tradescantieae as a whole are $x=6$ or 12.

3. Basic numbers of $x=9$, 13, 14(7), 15(10), and 16(8) have been found for *Aneilema*. Results from the few species examined suggest a fertile area for additional study.

4. Species with a basic number of $x=15$ form the dominant line of descent in *Commelina*. Based on frequency, all other lines are of minor importance as is infraspecific aneuploidy. In contrast, the majority of known species are polyploids and many have polyploid races.

5. The dominant line of descent for *Murdannia* is $x=10$. All others are of lesser significance and, as for *Commelina*, most species are polyploids with infraspecific polyploidy more common than infraspecific aneuploidy. This parallel chromosomal pattern of speciation in *Murdannia* and *Commelina* is opposed to the major role of aneuploidy and minor contribution of polyploidy in the speciation of *Cyanotis*.

6. Although the common basic numbers of *Commelina* and *Murdannia* differ, i.e., $x=10$ and 15, prototypes of $x=5$ are suggested for both genera.

7. Small chromosomes typify *Commelina* and *Murdannia*, those of *Aneilema* are somewhat larger, while those of *Cyanotis* range from small to large with a majority intermediate in size.

8. The most frequent basic number encountered in the Tradescantieae is $x=6$ or multiples of it, while the most frequent numbers found in the Commelineae are multiples of 5. Probably the prototypes of the tribes differed, the Tradescantieae from a stock based on $x=6$ and the Commelineae on $x=5$. A consideration of typical basic chromosome numbers in the classification of the Commelinaceae will undoubtedly contribute to a more natural grouping of genera than has been heretofore possible.

ACKNOWLEDGEMENTS

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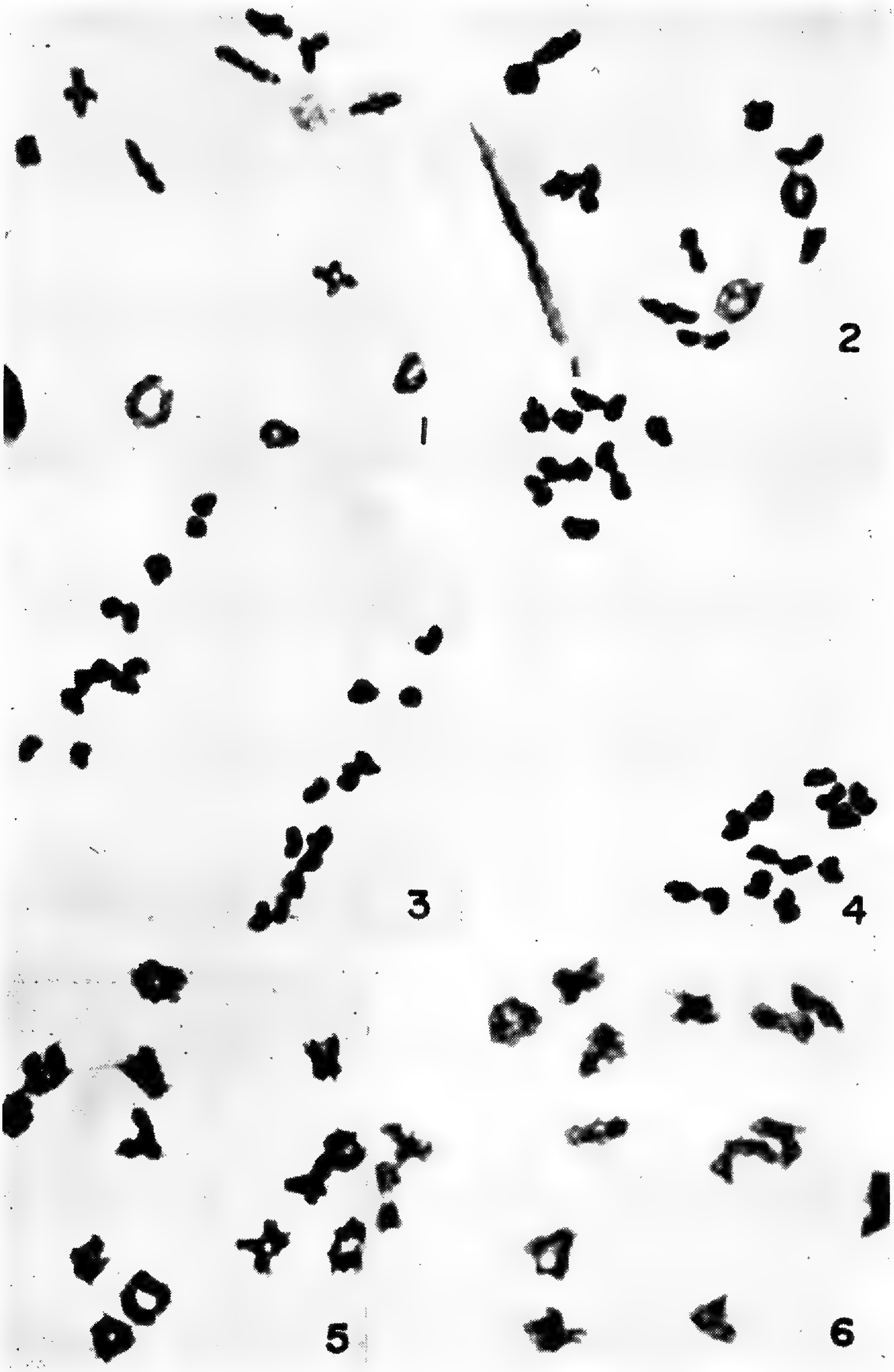
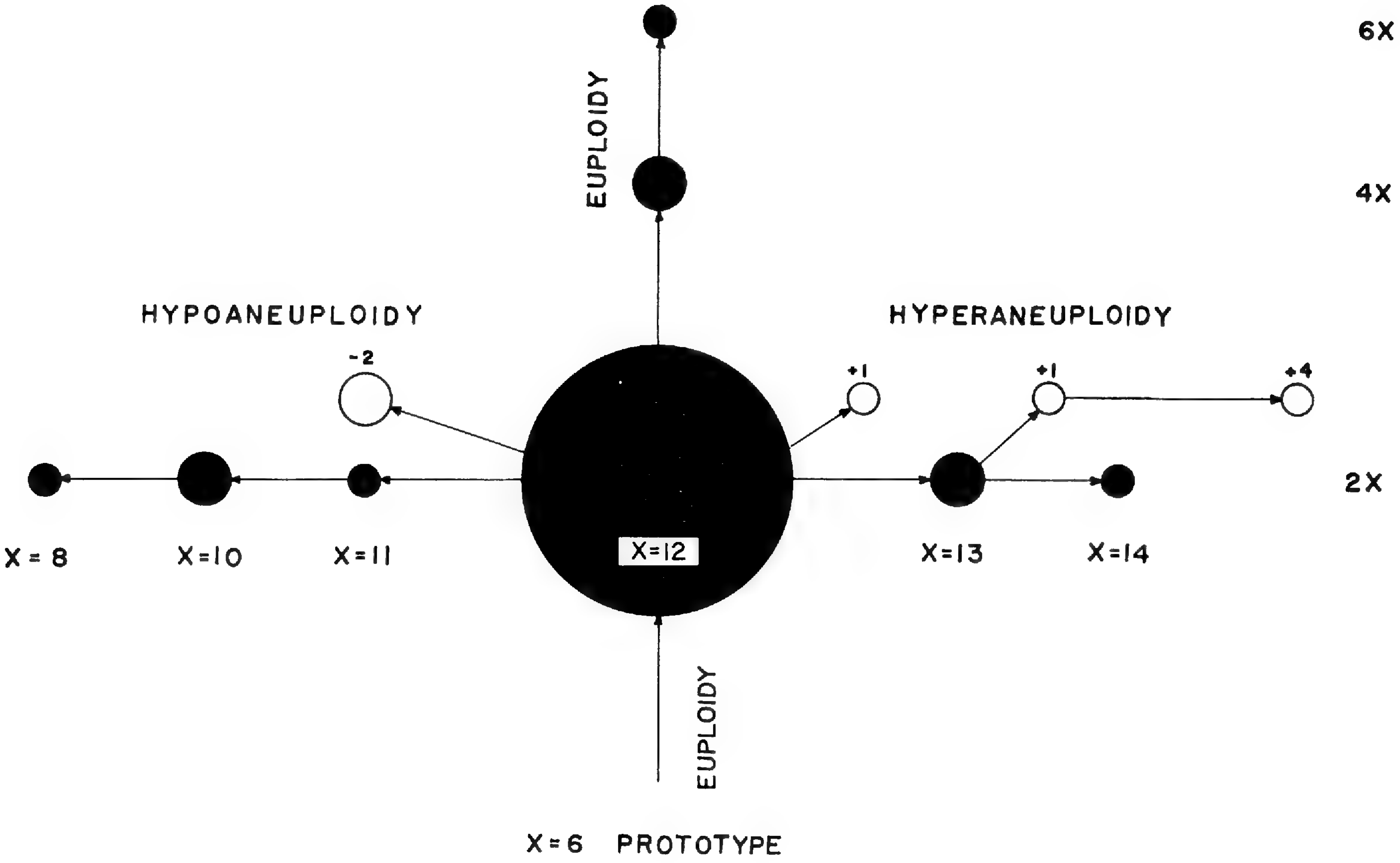


Fig. 1-6. Meiosis in *Cyanotis*. 1300X. Fig. 1-2. *C. barbata,* 11_{II} with the nucleolus in Fig. 2 resembling a bivalent, *5927*. Figs. 3-4. *C. sp.,,* 12+12 and 11+13, *6147*. Fig. 5-6. *C. speciosa,* 13_{II} and 15_{II}, *6344*.

Fig. 7. Hypothetical representation based on chromosome number of the evolution of *Cyanotis* from a $x=6$ prototype to a dominant extant group with $x=12$. From this stock it is suggested that cytotypes have evolved by hypoaneuploidy, hyperaneuploidy, and euploidy giving rise to a genus multibasic at the $2x$ level and (as presently known) unibasic at the $4x$ and $6x$ levels. Euploidy is vertically illustrated, aneuploidy horizontally as interspecific (solid circles) or infraspecific (hollow circles). The smallest circle represents one cytotype and is equivalent to one species excepting the infraspecific aneuploids (small circle for each cytotype). Other circles to scale.


6X
EUPLOIDY
4X
HYPOANEUPLOIDY
HYPERANEUPLOIDY
-2
+1
+1
+4
2X
X = 8
X=10
X=11
X=12
X=13
X=14
EUPLOIDY
X=6 PROTOTYPE

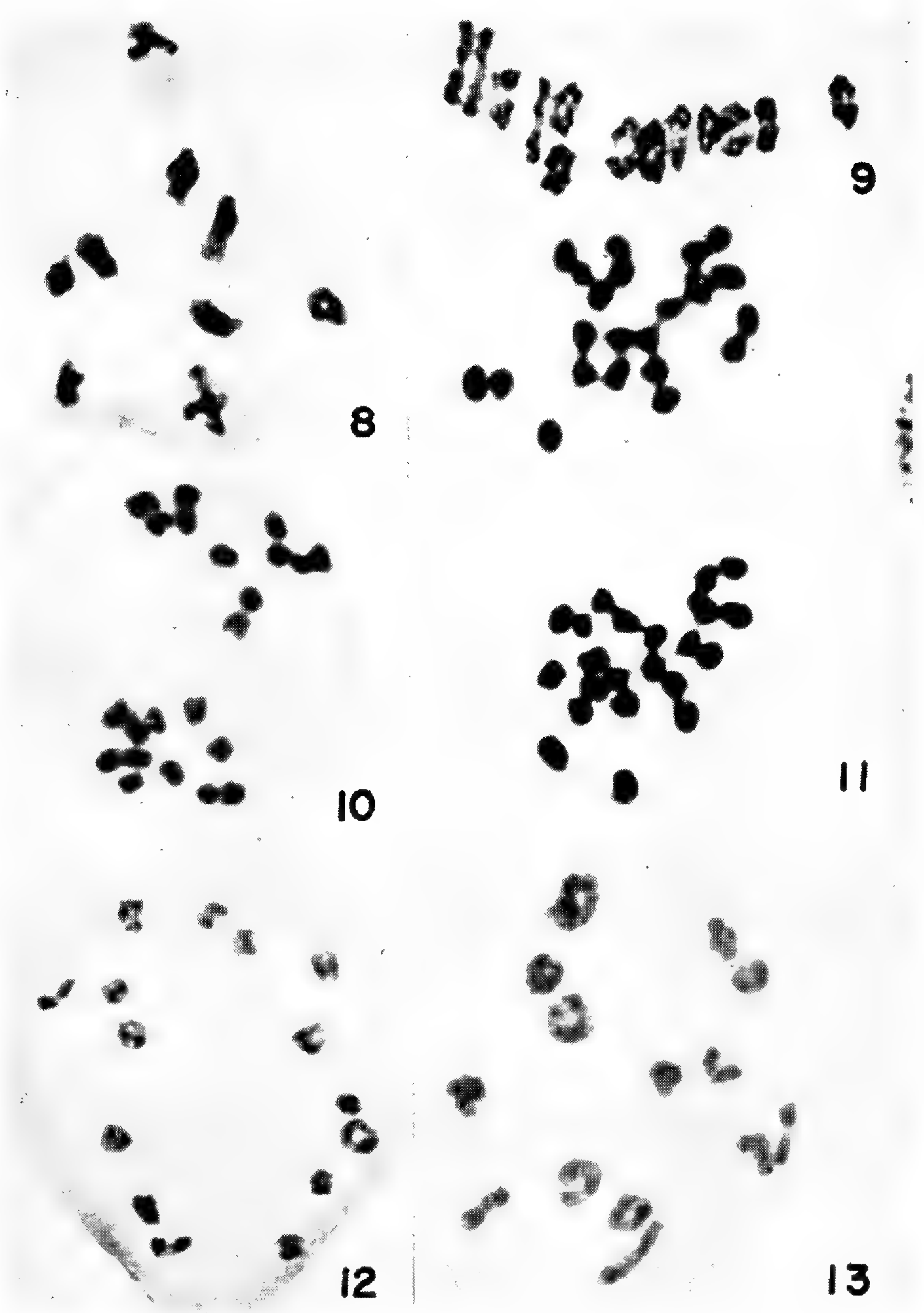


Fig. 8-13. Meiosis in *Aneilema* and *Commelina*. 1300X, 1550X for Fig. 10-11. Fig. 8. *A.* sp. aff. *pedunculosum,* 9_{II}, *5973*. Fig. 9. *A tacazzeanum,* 13_{II}, *5999*. Fig. 10-11. *C. benghalensis,* 11+11, *5961,* and 22+22, *5996*. Fig. 12. *C. imberbis,* 15_{II}, *6062*. Fig. 13. *C.* sp., 14_{II}, *6196*.

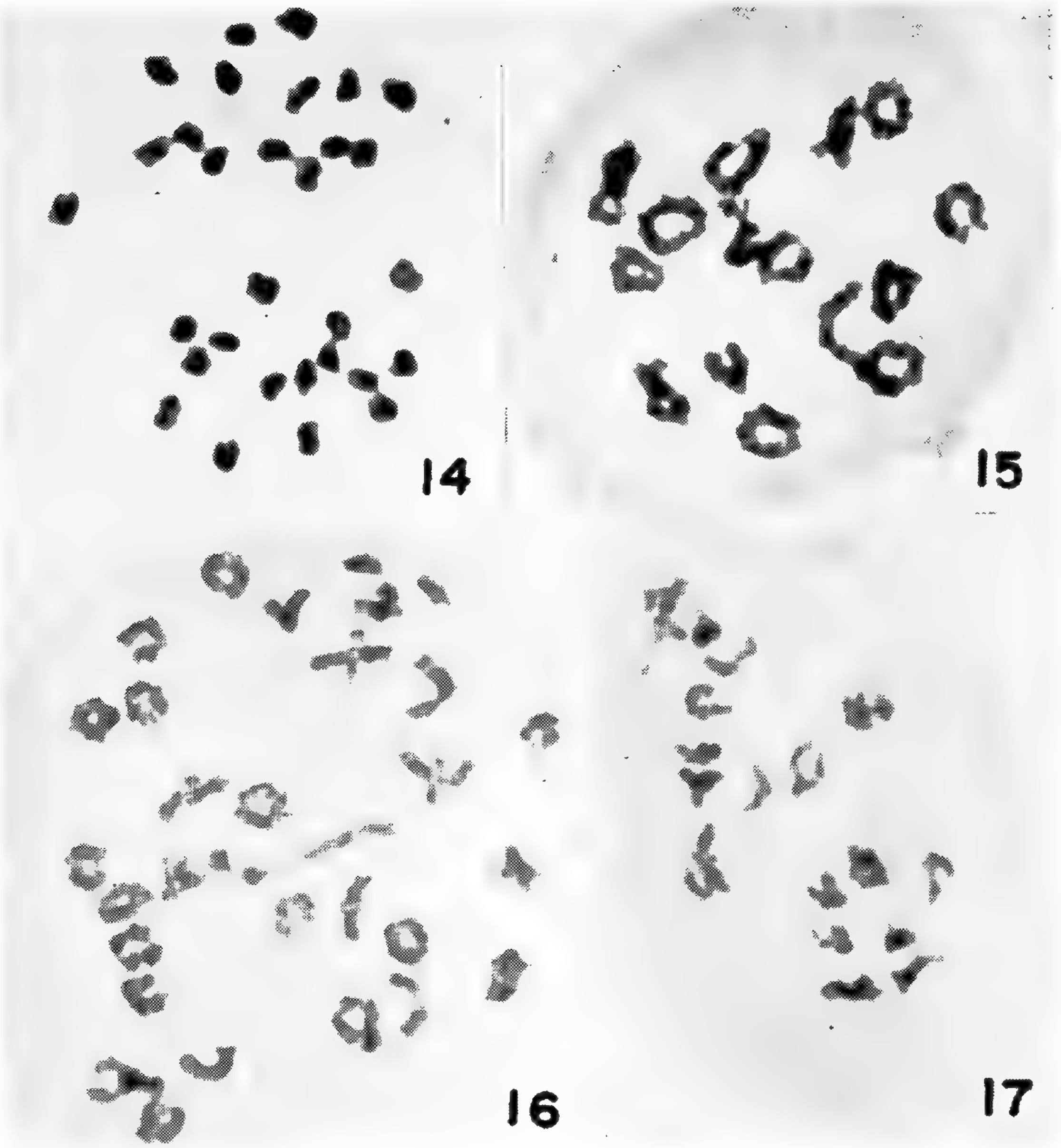


Fig. 14-17. Meiosis in *Commelina* and *Murdannia*. 1550X. Fig. 14. *C. diffusa*, 15_{II}, *6247*. Fig. 15. *C. scaposa*, 15_{II}, *6193*. Fig. 16. *C.* sp., 30_{II}, *6226*. Fig. 17. *M. simplex*, 20_{II}, *6179*.

NOTES

MORE ADDITIONS TO THE LOUISIANA FLORA.—The following taxa apparently represent new records for the state of Louisiana. Voucher specimens are deposited in the herbaria of the University of Southwestern Louisiana (LAF) and (except for *Cyperus uniflorus)* of Southern Methodist University (SMU).

Bulbostylis barbata (Rottb.) C. B. Clarke. Iberia Parish; locally common in sandy soil in sugarcane field, Weeks Island, *John W. Thieret and William D. Reese 9703*, 15 October 1962.

Cyperus difformis L. Lafayette Parish: in fallow rice field 13 miles west southwest of Lafayette near Acadia Parish border, *A. J. Delahoussaye 71*, 23 October 1963.

Cyperus oxylepis Nees. Cameron Parish: back ridge along Gulf of Mexico about 2 miles east of Holly Beach, *Thieret 8818*, 7 July 1962. Lafayette Parish: disturbed soil at edge of swamp about 3 miles northeast of Broussard, *Thieret 16728*, 20 November 1963. St. Mary Parish: disturbed soil in clearing in upland woods, Cote Blanche Island, *Thieret 16316*, 14 September 1963.

Cyperus uniflorus Torr. et Hook. Grant Parish: Pollock, *John Lynch s.n.*, 9 September 1938.

Cypselea humifusa Turp. St. Landry Parish: in drying mud of cow path in clearing about 4 miles northwest of Grand Coteau, *Thieret 16462*, 5 October 1963.

Drymaria cordata (L.) Willd. Lafayette Parish: among grasses at edge of grazed field, southwest side of Lafayette, *Thieret 16594*, 28 October 1963.

Phyllanthus urinaria L. St. Mary Parish: locally common in bed of little-used dirt road through upland woods, Cote Blanche Island, *Thieret 16712*, 15 November 1963.

Abutilon hulseanum (Torr. et Gray) Torr. ex Chapm. St. Mary Parish: disturbed soil near salt mine, Cote Blanche Island, *Thieret 15876*, 7 May 1963.

Bowlesia incana Ruiz et Pavon. St. Martin Parish: locally common at edge of willow dominated depression along highway 90, about 6.8 miles south of Broussard, *Thieret 17063*, 3 April 1964. Although credited to Louisiana in Small's *Manual* ,*Bowlesia incana* is cited as occurring "from Texas to California" by Mathias and Constance in their treatment of Umbelliferae in *North American Flora.*

Facelis retusa (Lam.) Sch.-Bip. East Feliciana Parish: disturbed soil at roadside just west of Jackson, *Thieret 17255*, 10 May 1964. St. Helena Parish: roadside 3 miles east of Pine Grove, *Thieret 17318*, 15 May 1964. Vermilion Parish: shell ridge in vicinity of University of Southwestern Louisiana Field Station, Redfish Point, west side of Vermilion Bay, *Reese 4183*, 30 April 1961.

Mikania cordifolia (L.) Willd. Iberia Parish: along dirt road in upland woods, Weeks Island, *Thieret 16566,* 25 October 1963. Lafayette Parish: abundant in clearing in woods near Vermilion River, south side of Lafayette, *Reese 6804,* 7 October 1963. St. Landry Parish: edge of clearing in woods about 4 miles northwest of Grand Coteau, *Thieret 16494,* 14 October 1963. St. Mary Parish: at roadside in upland woods, Cote Blanche Island, *Thieret 16703,* 15 November 1963. This species, first recognized in the Lafayette area by Dr. Robert Kral, is locally common here.—*John W. Thieret, University of Southwestern Louisiana, Lafayette, Louisiana 70506.*

TIGRIDIA PURPUREA (HERBERT) SHINNERS, COMB. NOV. (IRIDACEAE). — Based on *Nemostylis? purpurea* Herbert, Bot. Mag. 66: t. 3779 (in text, p. 3). 1840. *Eustylis purpurea* (Herbert) Engelmann & Gray, Boston Journ. Nat. Hist. 5: 236 (Pl. Lindh. I, repr. p. 27). 1845. *Tigridia buccifera* S. Watson, Garden & Forest 2: 412. 1889. Watson's generic assignment for this species was surely correct. He erroneously gave the origin of his supposedly new species as Jalisco, Mexico, cultivated at Cambridge from corms sent by Pringle. Pringle in his diary (ed. Helen Burns Davis, 1936, p. 65) records a trip made expressly to collect quantities of the plant from August 9 to 12, 1889. It was obtained at Pena station, 70 miles east of Laredo, Texas. The plant's name is misspelled as *Tigridia vaccata* in the entry for Aug. 9, but appears correctly in that for Aug. 11. Its identity with *Eustylis purpurea* was noted by Small in 1937 (Addisonia 20: 13). Foster excludes it from *Nemastylis* (Contrib. Gray Herb. 155: 44, 1945), leaving it in *Eustylis,* but in his keys to the indigenous American genera of Iridaceae (l.c. 52—54), the latter genus does not appear. With its deeply cupped and crimped inner tepals and deeply bifid style-arms, this species runs quite satisfactorily to *Tigridia.* It is the northernmost representative of that genus, occurring from extreme southern Texas northeastward to central Louisiana and extreme southern Arkansas (Union Co.: Norphlet, *A. J. Hoiberg 496,* 13 June 1954 (SMU); "open sandy pine woods"). —*Lloyd H. Shinners.*

MACHAERANTHERA PINNATIFIDA (HOOKER) SHINNERS, COMB. NOV. (COMPOSITAE). — Based on *Diplopappus pinnatifidus* Hooker, Fl. Bor.-Am. 2: 22. 1834. *Amellus spinulosus* Pursh, Fl. Am. Sept. 2: 564. 1813 ("1814"). (Not *Machaeranthera spinulosa* Greene, 1899.) *Starkea ? pinnata* Nuttall, Gen. 2: 169. 1818. (Illegitimate since *Amellus spinulosus* Pursh is given as synonym, but the specific epithet not adopted.) *Machaeranthera pinnata* (Nuttall) Shinners, Field & Lab. 18: 41. 1950. Since Hooker's epithet is both legitimate and available, it must be adopted in place of Nuttall's. I am indebted to Dr. Marshall C. Johnston for bringing this to my attention. — *Lloyd H. Shinners.*

REVIEW

ROADSIDE FLOWERS OF TEXAS. Paintings by Mary Motz Wills, text by Howard S. Irwin. 295 pp. University of Texas Press, Austin. 1961. $5.75

Texas' botanical wealth has never received the attention it deserves, aesthetically or scientifically or even commercially. But there are signs of improvement. This book has a fly-leaf announcement signed by the President of the University of Texas, and the Humble Oil and Refining Company recently offered it at a reduced price to credit-card holders. Like several predecessors (Whitehouse's *Texas Flowers in Natural Colors,* Schulz's (Mrs. Quillin's) *Texas Wild Flowers,* Casey's *101 American Wild Flowers),* it provides illustrations of a selection of the many flowering plants found wild in the state. It goes beyond any predecessor in having a text supplied by a botanist who makes a serious effort to provide notes on a broad sample and includes keys to those illustrated.

Primary basis for the book is a group of watercolor paintings by Mary Motz Wills of Abilene. Most of them do not depict whole plants, but small portions, such as one might have gathered for a miscellaneous bouquet on a casual walk. The impression of fragmentariness is accentuated by their having been reduced to fit four on a page. The scale varies greatly, at times to a misleading degree. The huge trumpets of *Datura Wrightii* appear little larger than the blossoms of *Heliotropium convolvulaceum* on the facing page, whereas the former are actually nearly ten times as large as the latter. The medium of watercolor does not lend itself well to depicting such botanically significant features as hairs on stem or leaves; the illustration labelled *Astragalus mollissimus* is hardly recognizable as that densely hairy plant. But the paintings were not made with the expectation of publishing them in a book, especially in association with technical botanical information, so criticism from such a technical viewpoint is really not fair. The pictures will be quite serviceable aids to the recognition of many common wild flowers of Texas, and that after all is the chief purpose of the book.

Following the 64 pages of illustrations are 185 pages of keys and descriptions, with brief notes on additional species related to those illustrated, information on distribution within the state, and items of special interest. Compiling all this for a state which had no complete published flora and not even an up-to-date checklist was no small task. When one recalls that the author of the text was at the time only a graduate student, and a newcomer to Texas to boot, it must be acknowledged a really amazing performance. Three pages of line drawings to illustrate botanical terms, a glossary, and separate indexes for common and scientific names conclude the book.

In an introductory "Note to the Amateur Botanist," Dr. Irwin addresses hopefully "the intelligent lay botanist who is interested in enlarging his knowledge of the flora around him," and who is willing to tackle botanical keys and botanical terminology. If my experience with my *Spring Flora of the Dallas-Fort Worth Area* is any indication, he is addressing some exceedingly rare animals.[1] The self-discipline and patient effort needed for the pursuit of Linnaeus's "harmless science" are simply out of tune with the spirit of the region. If you want to get something done, you throw your weight around or you throw your money around and expect results in a hurry. In this part of the world, things that can't be handled that way aren't worth bothering with. Still there are always just a few freaks or misfits who are willing to attempt a little cultivation of mind. For them especially this combination of attractive colored illustrations and a well-done, serious, technically respectable (but still quite elementary) text should prove a boon.

With no desire whatever to belittle Dr. Irwin's achievement, it has to be stated that some of the illustrations cannot be positively identified, because too incomplete or not showing certain important technical details, and a number of others have names attached to them which are definitely not the correct ones. Perhaps the originals are sufficiently superior to the reproductions to allow more confident identifications. To my eye, at least, the illustrations designated as *Iris hexagona, Mirabilis nyctaginea* (as *nyctagineus), Lepidium virginicum, Brassica juncea, Draba platycarpa, Astragalus mollissimus, Castilleja latebracteata, C. indivisa, Plantago Helleri, Liatris punctata, Gutierrezia dracunculoides, Solidago nemoralis, S. altissima, Aster oblongifolius, A. praealtus* (as *prealtus), A. subulatus* var. *ligulatus, Senecio plattensis,* and *Pyrrhopappus multicaulis* are not positively identifiable as those species, and I am unable to state with certainty what they are. The names listed below are definitely not correct; when possible I have given what I believe to be the correct names in capital letters.

PLATE 1. *Sagittaria latifolia.* S. LONGILOBA. Projecting leaf-bases distinctly longer than the apical portion.

PLATE 3. *Yucca Treculeana.* The whole plant at left may be this species, though the leaves seem too narrow. The portion of inflorescence at right definitely is not; it may be Y. ARKANSANA or Y. ANGUSTI-

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[1] Not a single book store within the area of the *Spring Flora* regularly carries it in stock, and only three have ever ordered it, one of these just one copy in the more than 6 years since its publication. When the garden editor of a major newspaper asked that a copy be purchased for the paper's reference library, the request was refused. In all fairness, it should be mentioned that the Dallas Public Library has purchased a total of 17 copies. But public demand for the book in an area making loud claims to cultural superiority is hardly impressive. Even sales for use in teaching go overwhelmingly to cities outside the area, some of them several hundred miles away. No copy has every been sold for this purpose in Fort Worth, and the only such sales in Dallas in more than a year have been at the high school level.

FOLIA.—*Yucca arkansana.* The whole plant at left is probably Y. PALLIDA or its close relative Y. RUPICOLA. The portion of inflorescence at right I do not recognize.

Plate 11. *Clematis reticulata.* C. PITCHERI. The former has thick, stiff, heavily veiny leaf blades.

PLATE 26. *Viola missouriensis.* V. VILLOSA. The leaf-blades of *V. missouriensis* are triangular-pointed and its flowers are definitely on the blue side.

PLATE 33. *Asclepias oenotheroides.* A. LATIFOLIA. *A. oenotheroides* has petioled leaves.

PLATE 39. *Verbena pumila.* V. TENUISECTA. The flowers of *V. pumila* are extremely small and are not elevated on naked peduncles in the manner shown.

PLATE 41. *Brazoria scutellarioides.* SCUTELLARIA RESINOSA. The *Brazoria* is annual, with a very slender taproot, and the flowers are smaller and paler.

PLATE 42. *Salvia farinacea.* S. AZUREA var. GRANDIFLORA. In *S. farinacea* the calyx is white-woolly.

PLATE 55. *Aster laevis.* Not identifiable. This species is northern and does not occur in or near Texas.

PLATE 56. *Aster sagittifolius.* A. TEXANUS. The former also is a northern species not known from Texas.

PLATE 59. *Thelesperma simplicifolium.* Probably HELENIUM BADIUM. The *Thelesperma* has a rather flat, yellow center to the head.

PLATE 61. *Helenium latifolium.* H. FLEXUOSUM. The former (usually referred to *H. autumnale)* also has heads with yellow center.

PLATE 64. *Krigia virginica.* Not too accurately depicted but almost certainly K. OCCIDENTALIS, with shorter pappus in proportion to the body of the achene (which is partially obscured by the pappus scales in the illustration).

In one case there is discord between the common name and the Latin one: "Old Plainsman" for *Hymenopappus artemisiaefolius.* This is mainly an East Texas species, not one of the prairies or plains, though it has relatives occurring there.—*Lloyd H. Shinners.*

SIDA CONTRIBUTIONS TO BOTANY

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SIDA Contributions to Botany volume 1 number 6 pages 299—417

FEWER FLORIDA RARITIES: CHANGING FLORA OF PINEOLA GROTTO, CITRUS COUNTY[1]

OLGA LAKELA

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The limestone grotto near Pineola has been searched for ferns ever since its discovery by A. H. Curtiss in 1881. Roland M. Harper (1916) graphically recounted this eventful discovery of an unspoiled fern flora, thitherto unknown to botanists. Curtiss' discovery of previously unreported species in the United States, aroused interest among his contemporary botanists. J. D. Smith, 1883, journeyed to Pineola, finding a few species not noticed by Curtiss. Harper's own expedition, 1915, resulted in an annotated list of 12 species, inclusive of all the previously recorded ones which he observed and 2 of his own finding. The list was increased to 14 species by J. K. Small (1920A) who journeyed to the area in 1918.

The physical aspects and the vegetation of the grotto are eloquently narrated by Curtiss, Harper and Small. In Small's own words, "we found ourselves in a veritable amphitheater, surrounding a cypress swamp. On entering through rocky wall we found ourselves among boulders, chasms, canons, natural bridge, and caves of eroded limestone. Everything was partly or completely covered with fern growth of at least a dozen different kinds of ferns . . . an enhancing grove of both conifers and broad-leaved trees over-shadowed the grotto, altogether a grove and a grotto that would have been a delight to the devotees of the worship of Baal; but this sanctuary had already been profaned. . . . After nature has built and adorned this grotto beyond power of words to describe, man has recently started the task of utterly destroying it." At the edge of the grotto a mill was pulverizing the rock for commercial liming of cultivated fields.

The excavated site, an extensive pit overgrown with weeds and introduced grasses, remains. Just south of it, the part that escaped utter destruction, curves its crescentic contour toward Withlacoochee River marsh. This—the present day Pineola Fern Grotto—features no caves and canon, only terrain sufficiently disrupted and precarious to justify utmost precaution in maintaining a stable foothold. Boulders, cliffs and ledges, are all more or less covered with mats of lichens, mosses, ferns and flowering herbs, beneath high-flung canopy of the hammock tree association of primeval times. Even this remnant of a natural area is being despoiled by grazing herds. As a part of a fenced and posted ranch-land for decades, the natural vegetation along hammock margins and on the lower rocks of the grotto has been replaced by invading forbs and local weeds.

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[1] Contribution 12, Botanical Laboratories, University of South Florida.

SIDA 1 (6): 299—305. 1964.

To this grotto, the author, aided by Mr. and Mrs. James A. Lassiter of Tampa, has made several collecting and study trips during the past two years. It is hoped that the appended enumeration of species of an area whose botanical history dates back to 1881, is deemed worthy of placing on record.

Although the number of species of ferns in the present list is greater than that of the previous ones, the populations in a given area are less concentrated and widely dispersed. The rarest of the rare spleenworts, the species most sought, have become decimated to the verge of extinction. In 1962 *Asplenium abscissum* was no longer in evidence; *A.* × *Curtissii* was represented only by three known plants. All the species of trees previously reported in hammock associations have been observed with exception of *Acer rubrum*, *Persea borbonia* and *Cornus florida*. They are frequently encountered off the immediate area; it is assumed that the record refers to the destroyed hammock association. In addition, vigorous and prolific *Sapindus marginatus* has been observed in various stages of growth.

The loss of a natural area in the keeping of man is regrettable. Even after decades of misuse, if the causes of destruction could be removed, restoration of the grotto by nature's creative forces lies within possibility. The Pineola Fern Grotto is worthy of preservation.

PSILOTACEAE

Psilotum nudum (L.) Beauv. Sight record of 1 plant; epiphyte.

SCHIZAEACEAE

Anemia adiantifolia (L.) Sw. Sight record of 1 sterile colony, on low rocks.

OPHIOGLOSSACEAE

Botrychium dissectum Spreng. var. *tenuifolium* (Underw.) Farw. 26404. Few plants noted on a rocky margin of hammock.

OSMUNDACEAE

Osmunda regalis L. 26416. A sterile plant noted in margin of swamp, Withlacoochee River. One leaf collected.

POLYPODIACEAE

Adiantum tenerum Sw. 25462. Occasional.

Asplenium abscissum Willd. 25468. Not noted since 1962. Apparently exterminated.

A. × *Curtissii* Underw. 25470. Almost completely decimated.

A. heterochroum Kunze, 25468. Very rare.

A. resiliens Kunze, 26812. Rare, low rocks.

A. verecundum Chapm. 26021. Rare.

Dryopteris ludoviciana (Kunze) Small. 26043. Vigorous growth.

Polypodium dispersum ined. 26808. Rare.

P. pectinatum L. 26499. Rare.

P. plumula HBK. 26446. Rare.

P. polypodioides (L.) Watt. Sight record, epiphytic.

Pteris cretica L. 27395. Two plants noted. Rare.

P. vittata L. 25469. Local; rare.

Tectaria heracleifolia (Willd.) Underw. 25460. Shady limestone slopes; young ferns noted; rare.

Thelypteris dentata (Forsk.) E. St. John, 25471. Rare.

T. normalis (C. Chr.) Mox. 25476. Occasional.

T. reptans (J. F. Gmel.) Morton. 25461. Frequent on shady sloping limestone.

T. Torresiana (Gaud.) Alston. 25467. (*T. setigera* (Blume) Kuntze).

T. tetragona (Sw.) Small, 26394. Rare.

TAXODIACEAE

Taxodium distichum (L.) Rich. Sight record. The swamp-facing side of the grotto.

GRAMINEAE

Oplismenus setarius (Lam.) R. & S. 25455. Frequent in thin soil over limestone.

Panicum anceps Michx. 25456. Few tufts noted, in gravelly soil of grotto margin.

P. joorii Vasey, 26032. Few plants in vernal phase; among marginal grasses.

Paspalum conjugatum Berg. 26443. Among grasses, escaped from cultivation. Bottom of grotto.

P. Langei (Fourn.) Nash. 26393.

Uniola sessiliflora Poir. 26444. Few plants with wood ferns, grotto bottom.

PALMAE

Rhapidophyllum Hystrix (Fraser) Wendl. 25443. Few over rocks.

Sabal minor (Jacq.) Pers. 26421. Marginal area of grotto facing the river.

Serenoa repens (Bartr.) Small, sight record; margin of hammock.

ARACEAE

Arisaema Dracontium (L.) Schott, 26423A. Grotto bottom between rock walls. Occasional.

BROMELIACEAE

Tillandsia simulata Small. 26050. Occasional.

T. usneoides L. Sight record. Frequent.

COMMELINACEAE

Callisia cordifolia (Sw.) Anders. & Woods. 25473. Over low mossy rocks.

LILIACEAE

Smilax auriculata Walt. 26053. Frequent.

AMARYLLIDACEAE

Crinum americanum L. 26420. Soft soil of grotto margin, facing the river swamp.

IRIDACEAE

Sisyrinchium rosulatum Bicknell. 26048. Crevices of low rocks; uncommon.

ORCHIDACEAE

Habenaria quinqueseta (Michx.) Sw. 26389. Several plants along fence of pasture adjoining the grotto hammock.

PIPERACEAE

Peperomia leptostachya (Nutt.) Chapm. 26392. Thriving colony over crumpled lichen-coated rocks.

CORYLACEAE

Carpinus caroliniana Walt. Frequent; sight record.

FAGACEAE

Quercus Michauxii Nutt. 26040. Very large trees in grotto hammock; specimen from fallen branch.

Q. Shumardii Buckl. 26391. Spec. from fallen branch. Very large trees over grotto.

Q. virginiana Mill. Sight record. Very large trees with expansive crowns over grotto and in hammock.

ULMACEAE

Celtis laevigata Willd. 26027. Embankment of the excavated grotto site.

Ulmus floridana Chapm. Sight record. Large trees in hammock and margin of grotto.

URTICACEAE

Boehmeria cylindrica (L.) Sw. 25925. Frequent in grotto.

Parietaria floridana Nutt. 25933. Frequent in moist shady hollows of grotto.

Urtica chamaedryoides Pursh. 25452. Persisting in rock clefts, shady moist soil.

PHYTOLACCACEAE

Petiveria alliacea L. 25453. Few plants in shade over grotto rocks.

Rivina humilis L. 26034. Slender shrubs in rock clefts. Infrequent.

CARYOPHYLLACEAE

Arenaria lanuginosa (Michx.) Rohrb. 25474. Local. Stems trailing from rock walls.

Drymaria cordata (L.) Willd. Sight record. Low moist hollows with Stellaria.

Stellaria media (L.) Cyrill. Low moist clefts, floor of grotto. Anthers 5, red.

RANUNCULACEAE

Clematis reticulata Walt. 26041. One vine noted base of grotto wall.

HAMAMELIDACEAE

Liquidambar Styraciflua L. 26051. Frequent over rocks and in hammock.

SAXIFRAGACEAE

Decumaria barbara L. 26396. Stems creeping in mosses and lichen at grotto walls, and twining high on tallest trees. Local, abundant.

ROSACEAE

Rubus trivialis Michx. Sight record; on low rocks of grotto.

LEGUMINOSAE

Amphicarpa bracteata (L.) Fern. 26422. In soil-filled clefts of low rocks; flowers bluish-lavender; uncommon.

Cassia occidentalis L. 25441. Oak and palm grove adjoining grotto terrace. Infrequent.

Desmodium cuspidatum (Muhl.) Loud. 1 plant noted.

D. paniculatum (L.) DC. 26386. In shade over low rocks, and swamp margin adjoining the grotto.

Galactia Macreei M. A. Curtis. 26036. Grassy margin of trail to grotto entry.

RUTACEAE

Citrus aurantium L. 26806. Several trees noted; eastern part of hammock.

Zanthoxylum Fagara (L.) Sarg. 26409. Small, sterile shrubs; few on high rocks.

MELIACEAE

Melia Azedarach L. 26027. Few trees on the rim of the old pit.

ANACARDIACEAE

Rhus Toxicodendron L. Sight record. Fairly general in grotto floor.

ACERACEAE

Acer Negundo L. 25916. Frequent over grotto rocks; trees large with full, leafy crown.

SAPINDACEAE

Sapindus marginatus Willd. 26039. Frequent over rocks in hammock.

RHAMNACEAE

Sageretia minutiflora (Michx.) Trel. 26023. Young shrubs at base of rock wall.

VITACEAE

Parthenocissus quinquefolia (L.) Planch. 26026. High climbing over tree on rim of the old pit.

Vitis rotundifolia Michx. High climbing; in oaks. Sight record.

TILIACEAE

Tilia floridana Small. 26045. Large tree, margin of grotto hammock, on trail.

MALVACEAE

Pavonia spinifex (L.) Cav. 25475. Locally frequent over grotto on rocks.

VIOLACEAE

Viola floridana Brainerd. 26803. In moist soil of shady hammock and grotto rocks.

LYTHRACEAE

Decodon verticillatus (L.) Ell. 26441. Shallow water on cypress pond, margin of grotto hammock.

NYSSACEAE

Nyssa biflora Walt. 26054. Young shrubs in abundant fruit, swampy tract adjoining the grotto hammock.

MELASTOMACEAE

Rhexia mariana L. var. *exalbida* Michx. 26047. Swamp margin with Decodon.

UMBELLIFERAE

Ptilimnium capillaceum (Michx.) Raf. 25923. In moist rock clefts of grotto.

Sanicula canadensis L. 25934. Common on grotto rocks.

PRIMULACEAE

Samolus parviflorus Raf. 25922. Wet soil of swamp, grotto margin. Few.

ASCLEPIADACEAE

Cynanchum palustre (Pursh) Heller. 25928. Frequent over grotto trees.

CONVOLVULACEAE

Ipomoea trichocarpa Ell. 26438. Luxuriant colony in grotto and hammock margin.

VERBENACEAE

Callicarpa americana L. 26025. Occasional. Plants rooted in clefts of rocks.

LABIATAE

Hyptis mutabilis (A. Rich.) Briq. 26024. Few plants noted in grassy area.

Leonotis nepetaefolia R. Br. 26423. Open shade of Carya along trail to grotto.

Salvia coccinea Juss. 26022. Frequent in grotto over rocks.

S. lyrata L. 26804. Rosettes only noted. Openings of vegetation along trail.

SOLANACEAE

Capsicum frutescens L. 25447. One small shrub in abundant fruit, in grotto.

Solanum floridanum Shuttlw. 26415. Occasional in rock clefts.

SCROPHULARIACEAE

Bacopa coroliniana (Walt.) Robins. 26388. Shallow water of cypress pond, adjoining grotto hammock.

BIGNONIACEAE

Campsis radicans (L.) Seem. Sight record.

ACANTHACEAE

Dicliptera assurgens (L.) Kuntze. 26439. Over high rocks, scattered. Infrequent.

Dyschoriste humistrata (Michx.) Kuntze. 25919. Wet soil of swamp border along grotto.

Ruellia carolinensis (Walt.) Steud. 25918. Frequent, in thin soil of rock ledges.

RUBIACEAE

Galium pilosum Ait. var. *laevicaule* (Weath.) Blake. 25932. Occasional among shady boulders.

Mitchella repens L. 25926. Few plants noted, among ferns.

Psychotria nervosa Sw. 26037. Occasional in rocky holes and on top of rocks.

VALERIANACEAE

Valeriana scandens L. 25924. Well established in low fissures of limestone.

CUCURBITACEAE

Melothria pendula L. 26922. Frequent over grotto herbs and grasses.

CAMPANULACEAE

Lobelia homophylla F. E. Wimmer. 26319. Small colony in shade, low rocks.

COMPOSITAE

Ambrosia elatior L. 26319. Weedy.

Aster pinifolius Alexander, 26400.

Bidens bipinnata L. 25921. Weedy throughout low rocks.

Bidens pilosa L. 26399. Few plants noted, in grassy areas, among rocks.

Cirsium sp. Sight record of rosettes only.

Elephantopus carolinianus Willd. 25452. Well established in undergrowth.

Eupatorium coelestinum (L.) DC. 26031. One colony noted.

Haplopappus divaricatus (Nutt.) Gray. 26397. Open ranchland adjoining the grotto.

Pyrrhopappus carolinianus (Walt.) DC. 26030. One plant noted in hammock adjoining grotto.

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———— 1938. Ferns of the Southeastern States.

CYTOLOGICAL STUDIES IN PASPALUM, GROUP SETACEA (GRAMINEAE)[1]

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The *Setacea* group of the genus *Paspalum* consists of a network of closely related taxa which are taxonomically difficult. Chase (1929) recognized 10 species in the group but acknowledged that they are poorly defined and appear to intergrade. This study was made to obtain information to be used in a toxonomic revision of the group. The names used for the taxa are according to Chase's concept. My concept of the taxa is to be published in another paper.

CHROMOSOMES

Immature inflorescences were collected in the field or from greenhouse transplants, killed in a 3:1 alcohol-glacial acetic acid solution, and the anthers squashed in aceto-carmine. The chromosome counts were usually made at diakinesis in pollen mother cells. Photomicrographs were made of microsporocytes with chromosomes distributed so that they were countable. Some slides representing each taxon were made permanent by McClintock's (1929) method. Voucher specimens are deposited in the University of Georgia and the Stephen F. Austin State College herbaria.

A summary of chromosome counts made during this study and by previous investigators is given in Table 1. In all the plants that I studied the microspores contained 10 chromosomes and meiosis appeared normal. Differences in chromosome size and morphology within or between taxa were slight. Drawings made by tracing photomicrographs of chromosomes of each species (sensu Chase, 1929) are shown in Figures 1 to 10.

Chromosome counts, all gametic, for *P. debile* Michx., *P. longepedunculatum* LeConte, *P. propinquum* Nash, *P. psammophilum* Nash, *P. rigidifolium* Nash, and *P. stramineum* Nash are presented for the first time. Somatic counts previously reported for *P. ciliatifolium* Michx., *P. pubescens* Muhl., *P. setaceum* Michx., and *P. supinum* Bosc varied from 20 to 80 with different counts for the same species (see Table 1).

Darlington and Wylie (1955) reported the basic chromosome numbers 10 and 12 for *Paspalum*. Forbes and Burton (1961) suggested the base number 10 may have been derived from some lower ancestral base number, possibly 5 or 6, because of strong secondary associations of bivalents noted in their investigations with *P. almum* Chase. Some of

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[1] Contribution No. 58 from the Stephen F. Austin State College Department of Biology. This paper is based partly on a dissertation submitted to the Graduate Faculty of the University of Georgia. The investigation has been aided by two National Science Foundation Summer Fellowships for Graduate Teaching Assistants, an NSF Research Participation Project for College Teachers at the University of Texas, Department of Botany, and a faculty research grant, Stephen F. Austin State College. Thanks are due Dr. Wilbur H. Duncan, who served as my major professor during portions of this study.

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my preparations suggested secondary associations. Additional studies are required to confirm this suggestion. This study disclosed no chromosomal data that I consider to be useful in distinguishing between the *Setacea* taxa.

EMBRYO SAC DEVELOPMENT

A better concept of the taxa might be possible if the mode of reproduction could be determined. Apomixis, which occurs in some *Paspalum* species, was suspected in *Setacea* because of morphological uniformity within its component taxa where they grow sympatrically and because of similarity of progeny to the maternal parents in some progeny tests. The following study was conducted to determine whether or not the *Setacea* taxa reproduce by apomixis.

Immature inflorescences collected in the field or greenhouse were killed and fixed in a 3:1 absolute alcohol-glacial acetic acid solution. The material was stored in 70% alcohol at 5°C until dehydration was begun. Dehydration was completed with a tertiary butyl alcohol series. The material was infiltrated with paraffin, sectioned at thicknesses of 15 to 17 microns with a rotary microtome, and stained with safranin-fast green. Twelve to twenty spikelets per plant were sectioned. Twenty-two plants representing the ten taxa were studied. The slides were examined microscopically to ascertain whether or not multiple embryo sacs were present.

None of the material studied showed more than one embryo sac. Embyro sac development in *Setacea* is the *Polygonum* type except the antipodals usually form several cells rather than three.

Apomixis was reported in *Paspalum* by Burton (1948), Smith (1948), Bashaw and Holt (1958), Brown and Emery (1958), Forbes (1960), and Snyder (1957, 1961). Brown and Emery (1958) reported normal embryo sac development for *P. pubescens*, the only *Setacea Paspalum* which apparently had been investigated prior to this study.

The type of apomixis detected in *Paspalum* thus far is somatic apospory followed by pseudogamy. Usually one or more nucellar cells adjacent to the megaspore mother cell begins to enlarge and one of the cells usually develops into a functional embryo sac. A nucellar embryo sac may consist of an egg, two synergids, two polars, and several antipodals as in *P. secans* Hitchc. and Chase (Snyder, 1957) or the synergids and antipodals may be absent as in *P. dilatatum* Poir. (Bashaw and Holt, 1958). Fertilization of the polar nuclei is believed to be necessary for the development of endosperm, but the embryo develops from an unreduced, unfertilized egg.

The failure to detect multiple embryo sacs in *Setacea* suggest that they reproduce sexually, although stages representing actual fertilization of the egg or polars were not observed. The formation of a single embryo sac by generative apospory, however, is not precluded by my data; but since the chromosome studies indicated meiosis to be normal, and since the taxa appear to be diploid, sexual reproduction, rather than apomixis, seems likely. If apomixis is dismissed as a possible mode of reproduction, the similarities of offspring to maternal parents in some progeny tests are best explained by suggesting self-fertilization as the usual method of reproduction. Further investigations are needed to establish the method of reproduction.

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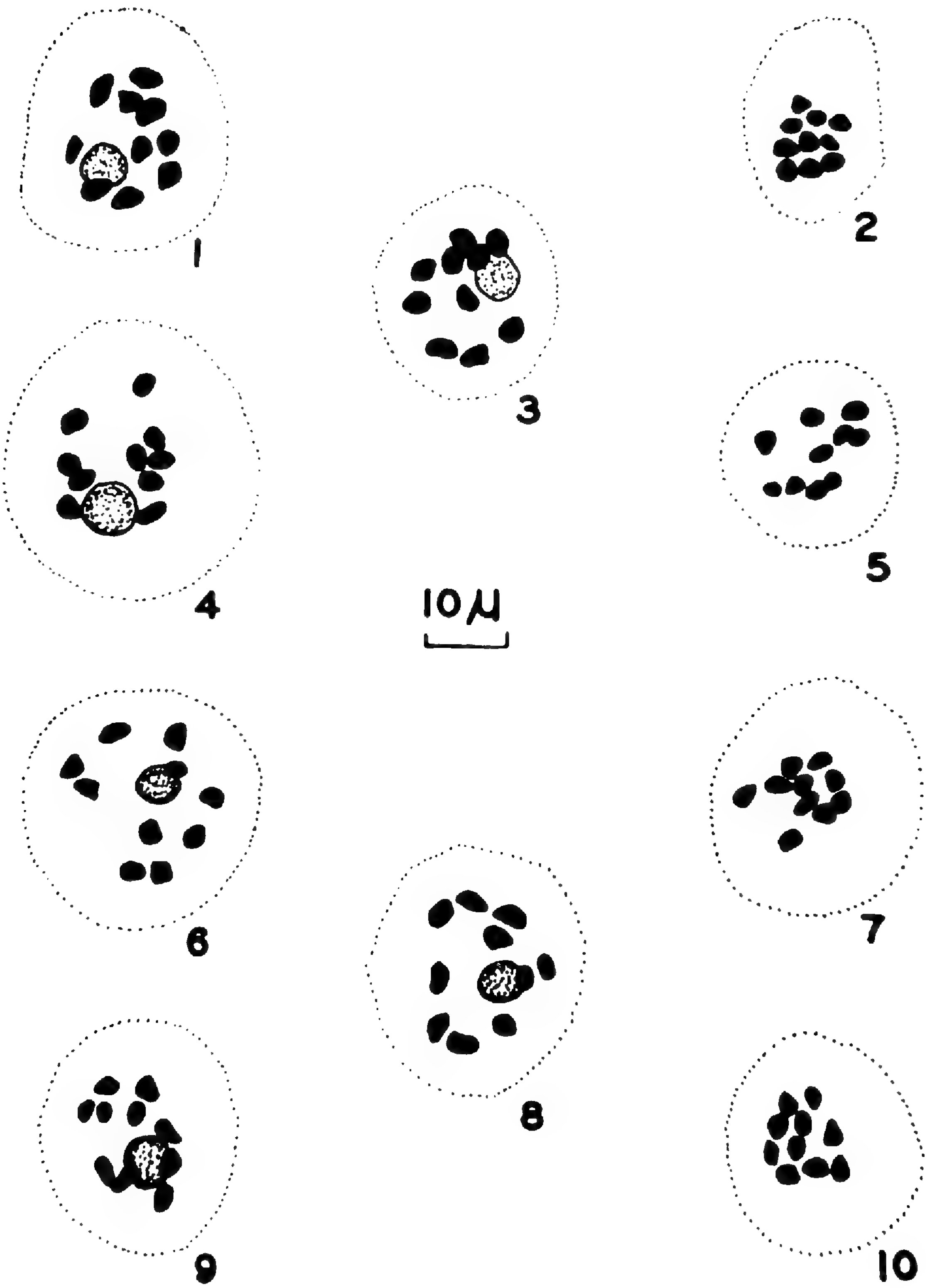

Fig. 1-10. Chromosomes of *Setacea* species (sensu Chase, 1929) at diakinesis.—Fig. 1. *P. ciliatifolium,* Banks 1339.—Fig. 2. *P. debile,* Banks 1625.—Fig. 3. *P. longepedunculatum,* Banks 891.—Fig. 4. *P. propinquum,* Banks 1726.—Fig. 5. *P. psammophilum,* Banks 1507.—Fig. 6. *P. pubescens,* Banks 1525.—Fig. 7. *P. rigidifolium,* Banks 1314.—Fig. 8. *P. setaceum,* Banks 1451.—Fig. 9. *P. stramineum,* Dwyer 16 Aug. 1961.—Fig. 10. *P. supinum,* Banks 906.

TABLE 1

SUMMARY OF CHROMOSOME NUMBERS OF THE *SETACEA* PASPALUMS

Species (Sensu Chase, 1929)	Gametic	Somatic	Investigator	Plants examined for this study[1] All gametic chromosome numbers were 10
ciliatifolium[2]		20	Burton (1940)	L-65, Glynn Co., Ga.; 933, 934, Jefferson Co., Fla.; 954, Taylor Co., Fla.; 964, Alachua Co., Fla.; 984, Wheeler Co., Ga.; 1339, Columbia Co., Fla.; 1412, Cooke Co., Tex.; 1413, Warren Co., Miss.; 1570, Taylor Co., Ga.; 1630, Santa Rosa Co., Fla.; W. H. Duncan 21888, Monroe Co., Fla.; D. G. Randolph R-2, Jack Co., Tex.
		20	Brown (1948)	
debile				832, Santa Rosa Co., Fla.; 912, Leon Co., Fla.; 1160, Hardee Co., Fla.; 1440, Camden Co., N. C.; 1616A, 1619, 1625, Santa Rosa Co., Fla.; 1713, Bay Co., Fla.; 1747, Levy Co., Fla.; 1885, Travis Co., Tex.; 3670, Brooks Co., Tex.

[1] Numbers are my collections except where otherwise indicated.

[2] Darlington and Wylie (1955) listed *P. epile* without author, as $2n=80$, as determined by Saura (1941). *P. epile* Nash is a synonym of *P. ciliatifolium.* The plant determined by Saura was *P. epile* Parodi (*P. parodianum* Hennr.) and is not synonymous with *P. ciliatifolium.*

TABLE 1 (Continued)

Species (Sensu Chase, 1929)	Gametic	Somatic	Investigator	Plants examined for this study[1] All gametic chromosome numbers were 10
longepedunculatum				891, Bay Co., Fla.; 1145, 1146, Lake Co., Fla.; W. H. Duncan, 21844, Collier Co., Fla.
propinquum				1726, Taylor Co., Fla.; 1733, Dixie Co., Fla.
psammophilum				1459, Burlington Co., N. J.; 1507, 1516, Camden Co., N. J.
pubescens[3]	10 10		Church (1929) Gould (1958)	L-25, L-31, L-35, Laurens Co., Ga.; 974, Putnam Co., Fla.; 994, Oglethorpe Co., Ga.; 1017, Clarke Co., Ga.; 1437, Martin Co., N. C.; 1439, Camden Co., N. C.; 1452, Gloucester Co., N. J.; 1525, Dinwiddie Co., Va.; 1531, Nash Co., N. C.; 1898, Nacogdoches Co., Tex.
rigidifolium				1158, Polk Co., Fla.; 1314, Marion Co., Fla.; 1746, Levy Co., Fla.; 1773, Pinellas Co., Fla.

[3] Brown (1948) reported $2n=60$ for *P. pubescens*. His voucher specimen (2605), which I examined in the Herbarium of the University of Texas, is really *P. longipilum* Nash.

TABLE 1 (Continued)

Species (Sensu Chase, 1929)	Gametic	Somatic	Investigator	Plants examined for this study[1] All gametic chromosome numbers were 10
setaceum		50	Kirshnaswamy (1940)	L-19, Wilkinson Co., Ga.; L-24, Laurens Co., Ga.;
		40	Brown (1948)	L-146, Taylor Co., Ga.; 770, Pike Co., Ala.; 870, Okaloosa Co., Fla.; 908, Leon Co., Fla.; 1430, Onslow Co., N. C.; 1451, Gloucester Co., N. J.; 1460, Burlington Co., N. J.; 1524, Dinwiddie Co., Va.; 1536, Baldwin Co., Ga.; 1682, Baldwin Co., Ala.; 1790, Putnam Co., Fla.
stramineum				1411, 1815, Payne Co., Okla.; 1886, 1889, Travis Co., Tex.; 1895, Burnet Co., Tex.; D. Dwyer Aug. 16, 1961, Payne Co., Okla.
supinum		20	Burton (1942)	906, Leon Co., Fla.; 953, Taylor Co., Fla.; 1620, Santa Rosa Co., Fla.; 1668 Jackson Co., Miss.

CHROMOSOME NUMBERS OF SOME NORTH AMERICAN SPECIES OF ASTRAGALUS (LEGUMINOSAE)

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Astragalus, with nearly two thousand species, is one of the largest genera of the flowering plants. It is widespread in both Old and New World but it is most abundant in the northern hemisphere. In the Old World, where there are some 1,600 species, the greatest number of taxa occur in southwest Asia with gradual decrease westward around the Mediterranean in both Europe and Africa and north and east through Asia to the Bering Strait. In the New World there are some 300 species concentrated in the western United States with a few extending into Mexico or into Canada and Alaska. There are no species in tropical America but there are about ninety species in the high western parts of South America.

Ledingham (1960) speculates that *Astragalus* is at least biphyletic since New and Old World species have different chromosome numbers. Old World species have a basic haploid chromosome number of eight (Senn, 1938; Darlington and Wylie, 1955, Löve and Löve, 1961) and show a high percentage of polyploidy. New World species have haploid chromosome numbers of 11, 12 or 13 (Vilkomerson, 1943; Head, 1957; Turner, 1956) and show less than one per cent of polyploidy. The nine South American species of *Astragalus* so far counted have either 11 or 13 as gametophyte chromosome number (Ledingham, 1960) so they seem to be a part of the New World phylogenetic line.

Since some species of *Astragalus* and *Oxytropis* are circumpolar, occurring in both New and Old World (Yurtsev, 1963), it would seem that the geographic barrier in the Bering Strait region is relatively recent. The circumpolar species are all 8-chromosome species or polyploids of these so evidently it was the Old World group which was able to use the migration route and invade the New World. There are no known cases of 11- or 12-chromosome species which have spread into the Old World. The decreasing abundance of 8-chromosome species as one moves from Alaska south and east supports the idea that a number of Old World species entered the New World by this route. Some of these naturally spread farther than others.

The North and South American species of *Astragalus* are now separated by a wide tropical zone which acts as an effective geographic barrier. The species are closely related but none of them occurs in both regions (Johnston, 1947). The absence of common species would indicate that the barrier has been present relatively longer than the barrier in

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the Bering Strait region, giving time for the evolution of different forms. The fact that there still is considerable morphological and chromosome number similarity would indicate that *Astragalus* species in North and South America, though separated for a considerable length of time, are actually a part of the same phylogenetic line and they are more closely related than New World species are to the 8-chromosome Old World species.

Since Old World species of *Astragalus* and *Oxytropis,* including a few which have spread recently into northern North America, have consistently 8 chromosomes or some multiple of 8, and since New World species have $n=11$, 12 or 13, they must be two different phylogenetic lines (Ledingham and Rever, 1963). If the divergence occurred after the origin of the genus then we may still find some species with chromosome numbers which will explain how the evolution took place. If the divergence occurred before the evolution of the ancestral *Astragalus* then the explanation of the relationship may be found in other genera of the Leguminosae. Turner and Fearing (1959) suggest that there was a split in the Caesalpinoideae giving evolutionary lines with higher or lower chromosome numbers and that these provided two origins for species and genera of the Papilionoideae. If this theory proves tenable then the Papilionoideae, and *Astragalus* in particular, provide a remarkable example of parallel evolution, and the origin of the divergence of the two phylogenetic lines of *Astragalus* would have to be sought in the Caesalpinoideae. This hypothesis seems improbable.

Ledingham (1960), finding that *Astragalus somalensis* Taub. ex Harms had the intermediate chromosome number $2n=20$, thought that the phylogenetic split must have occurred early in the evolution of the genus and he hoped to find other species with intermediate chromosome number. Since our plants of *A. somalensis* winterkilled without giving flowering or fruiting material we germinated more seeds. The material had been obtained from the Grassland Research Station, Kitale, Kenya, East Africa. The count $2n=20$ was confirmed (Ledingham and Rever, 1963) and the voucher plants were watched as they grew. The leaflets were conspicuously veiny and the arrangement of the leaflets in the bud was not like other *Astragalus* species we had seen. We were not surprised when Gillett (1963) revised this species, along with two others from East Africa, and placed them in the genus *Galega.*

This paper reports 69 counts on 49 species including 28 species and 6 varieties not previously reported. There are now over 310 species of *Astragalus* counted. The additional counts reported here emphasize again that the chromosome number in this complex of species is stable and further support the contention that New and Old World species of *Astragalus* belong in different phylogenetic lines.

MATERIALS AND METHODS

The species reported in this paper, except for five Old World species which came as seed from botanical gardens, were collected in their native habitats by people interested in the Leguminosae. The specimens, most of which are available in the University of Saskatchewan, Regina Campus herbarium, have in many cases been identified by Mr. R. C. Barneby, New York Botanical Garden. Mature seeds were removed and germinated in petri dishes to give root tips for chromosome counts. Some seeds have also been germinated to give additional study material and voucher specimens. Since these species are mostly slow growing perennials, flowering and fruiting vouchers are not yet available from our cultivated stocks. The root tips used for chromosome counts were pretreated with 8-hydroxyquinoline before fixation and staining. The standard procedure for the Feulgen stain was used in making the root tips squashes.

RESULTS

Chromosome counts for species of *Astragalus* and *Oxytropis* studied here during the summer of 1963 are presented in Tables I and II. Table I reports somatic chromosome numbers (22, 24 and in two cases 26) and collection data for 39 collections representing 28 species of New World *Astragalus*. Table II reports somatic chromosome numbers (16, 32, 48 and 42) for 30 collections (15 of which were made in North America) of 21 Old World species of *Astragalus* and *Oxytropis*.

The typical New World species of *Astragalus* listed in Table I were collected in their natural habitats in the western parts of United States, except for one species which was collected in Canada. There are voucher herbarium specimens, mostly in the herbarium of the University of Saskatchewan, Regina Campus, for each of the collections. One collection. *A. coccineus,* is represented only by fruits and a single dried flower, but the long crimson petals provide convincing evidence of the identity of the species. Some of the collections were badly parasitized and contained only a few viable seeds so that a sufficient number of good counts could not always be made; the chromosome number is reported in four cases with some reservation. Examination of Fig. 12, *A. calycosus*, 2n=22, shows that it is not easy to be sure whether the count is 2n=22 or 24. A quick count of this group may give 24, for there is a conspicuous nonstaining area, eg. lowest chromosome on the left, in one pair of chromosomes. Other cells in this same slide may, however, look more like Fig. 5 which is a typical chromosome group from *A. johannis-howellii.* Fig. 9, *A. whitneyi,* 2n=22, also shows this appearance of an extra pair of small chromosomes which may lead to some disagreement between counts of New World species of *Astragalus.*

Three species counts of 2n=24 confirm previous counts. *A. kentrophyta,* 2n=24 was reported by Ledingham (1960), but that report gives the wrong author for the species. *A. preussii,* 2n=24, was reported in 1943 by Vilkomerson. The earlier reports on these two species did not identify the variety counted. *A. spatulalus,* 2n=24, was reported by Ledingham (1957).

TABLE I. SOMATIC CHROMOSOME COUNTS FOR NEW WORLD ASTRAGALI

Species	Seed no.	Collection no.	Origin	2n chr. no.	Fig.
A. amphioxys Gray					
var. *amphioxys*	6424	Rever 72	Arches Nat. Monument, Utah	22	2
”	6439	Rever 67	Crystal Geyser, Utah	22	
A. *argophyllus* Nutt.					
var. *martini* Jones	6430	Rever 54	Castlegate, Utah	22 ?	
A. *calycosus* Torr.	6402	DeDecker 1522	White Mts. California	22	12
A. *ceramicus* Sheld.					
var. *ceramicus* Sheld.	6304	Barneby 13,121	Escalante, Utah	22	
var. *imperfectus* Sheld.	6455	Porter 3954	Gillette, Wyoming	22	7
A. coccineus Bdg.	6386	DeDecker 22/7/62	Inyo Mts., California	22	6
A. cymboides Jones	6429	Rever 58	Wellington, Utah	24	10
”	6453	Rever 83	Huntington, Utah	24	
A. desperatus Jones					
var. *desperatus* Jones	6418	Rever 78	Moab, Utah	24	1
”	6423	Rever 71	Arches Nat. Monument, Utah	24	
A. eastwoodae Jones	6299	Barneby 13,064	Gypsum Gap, Colorado	26	
A. flavus Nutt.					
var. *flavus*	6416	Rever 81	Moab, Utah	26	

A. inyoensis Sheld.	6403	DeDecker 1519	Inyo Mts., California	22	3
A. johannis-howellii Barn.	6404	DeDecker 1505	Crowley Lake, California	22	5
**A. kentrophyta* Gray					
var. *coloradensis* Jones	6308	Barneby 13,115	Glen Canyon City, Utah	24	
**A. lentiginosus* Dougl.					
var. *palans* Jones	6425	Rever 73	Arches Nat. Monument, Utah	22	
var. *palans* Jones	6427	Rever 76	Moab, Utah	22	
var. *fremontii* (Gray) Wats.	6387	DeDecker 1484	Santa Rita Flat, California	22	4
A. miguelensis Greene	6507	Raven 18,012	San Clemente Island, California	22	11
**A. miser* Dougl. var.					
serotinus (Gray) Barn.	6499	Turner 11,180	Pocahontas, Alberta	22	
**A. mollissimus* Torr. var.					
thompsonae (Wats.) Barn.	6417	Rever 80	Moab, Utah	22	
"	6426	Rever 75	Devil's Garden, Utah	22	
**A. nuttallianus* DC. var.					
micranthiformis Barn.	6302	Barneby 13,110	Coconino Co., Arizona	24	
A. oophorus Wats.	6390	DeDecker 488	Badger Flat, California	24	
A. plattensis Nutt.	6289	Porter 8385	Cook Co., Wyoming	22 ?	

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* These species counted previously; details in text.

**A. preussii* Gray					
var. *preussii*	6419	Rever 66	Green River, Utah	24	
”	6428	Rever 79	Moab, Utah	24	
**A. purshii* Dougl. var.					
glareosus (Dougl.) Barn.	6414	Rever 111	Boise, Idaho	22	8
”	6440	Rever 112	Boise, Idaho	22	
lectulus Jones	6406	DeDecker 1,525	Coyote Ridge, California	22	
longilobus Jones	6393	DeDecker 1,472	Harkless Flat, California	22	
A. ravenii Barn.	6394	DeDecker 1,112	Sawmill Pass, California	24	
A. serenoi (Kuntze) Sheld.	6389	DeDecker 1,469	Harkless Flat, California	24 ?	
A. shortianus Nutt.	6285	Porter 8,460	Albany Co., Wyoming	24 ?	
**A. spatulatus* Sheld.	6307	Barneby 13,234	Biddle, Montana	24	
A. utahensis (Torr.) T.&G.	6457	Rever 35	Pocatello, Idaho	22	
A. whitneyi Gray	6407	DeDecker 1,535	Coyote Flat, California	22	9
A. zionis Jones	6298	Barneby 13,111	Coconino Co., Arizona	22	

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* These species counted previously; details in text.

The previous report of chromosome number of *A. miser* var. *serotinus* gives 2n=24 (Ledingham, 1958). Since our 1963 study shows 2n=22, we suspect that our original report is in error. Ledingham (1960) reported 2n=22 for *A. nuttallianus* var. *nuttallianus* but the present study shows 2n=24 for var. *micranthiformis*. The varieties of *A. nuttallianus* are both quick growing annuals and it is possible that both counts are correct.

In *Astragalus lentiginosus* there have been previous reports of 2n=22 reported for var. *palans* (Vilkomerson, 1943), var. *lentiginosus* (Head, 1957) and var. *variabilis* (Ledingham, 1960). This paper confirms the previous count of var. *palans* (two collections) and reports 2n=22 for var. *fremontii*.

In *A. purshii*, Head (1957) reported counts of 2n=22 for var. *purshii* and var. *glareosus*. This paper confirms the count for var. *glareosus* and reports 2n=22 for var. *lectulus* and var. *longilobus*. The chromosome number seems stable for the many varieties of the highly variable species *A. purshii* and *lentiginosus*.

The remaining species, for which there was a previous chromosome count, is *A. mollissimus*. The present report for var. *thompsonae* agrees with Ledingham's (1960) report for var. *earlei*. Previously Head (1957) had reported 2n=24 for var. *earlei*.

No attempt was made to obtain Old World material for the 1963 studies but some seed samples did become available and routine chromosome counts were made. These counts are reported in Table II even though voucher specimens are not available for every collection. Each of these Old World species, except one, obviously belongs to an 8-chromosome series in which diploids are common but tetraploids and hexaploids frequently occur. Different chromosome numbers may be present in the same species. Table II includes some species of Old World *Astragalus* and *Oxytropis* which have migrated into northwestern North America. It should be pointed out that eleven of the fifteen North American collections reported in Table II were made in Canada or Alaska whereas in Table I only one of the 39 collections was made north of the Canada-U.S.A. border.

The chromosome numbers of 13 of the 21 taxa listed in Table II have been reported before. In all cases except two the present report agrees with previous reports and details need not be given again here. *Astragalus odoratus* was previously reported as having 2n=64 by Ledingham (1960). When this material was finally grown out it proved to be *A. cicer*. The seed packet had been wrongly identified and Ledingham had made his report before verifying the identity of his material. *A hamosus* is reported (Darlington and Wylie, 1955) as having 2n=48. We are convinced that this number is not correct but we found these chromosomes very difficult to separate and count and give a tentative count of 2n=ca 42.

Table II gives chromosome counts of four samples of *A. alpinus*, two identified as var. *brunetianus*. The collection from Churchill, Manitoba

TABLE II. SOMATIC CHROMOSOME COUNTS FOR OLD WORLD ASTRAGALI

Species	Seed no.	Collection no.	Origin	2n chr. no.	Fig.
**A. alpinus* L.	6230	cultivated	Acad. Science, Leningrad	16	
”	6243b	E. Beckett	Churchill, Manitoba	32	
var. *brunetianus* Fern.	6399	A. Dechamplain 2/7/58	Rimouski, Quebec	16	
”	6400	Dutilly & Lepage 30/7/58	Missinaibi, Ontario	16	
A. angustifolius Lam.	6442	O. Tosun	Ankara, Turkey via USDA.	32	16
**A. eucosmus* Robins	6396	J. G. Dickson 11/8/56	Big Delta, Alaska	32	
**A. hamosus* L.	6002	V. Tackholm	Egypt	ca 42	
”	6273	N. Feinbrun	Peleponese, Greece	ca 42	
” (as *A. Bucesas*)	6438	cultivated	Madrid Botanical Garden	ca 42	18
A. hololeios Bornum	6493	cultivated 4309	Universitatis Bergensis, Norway	16	19
A. micropteris Fisch.	6446	O. Tosun	Ankara, Turkey via USDA.	32	14
**A. monspessulanus* L.	6361	E. Müller 22/8/61	Tiefenkastel, Switzerland	16	
**A. odoratus* Lam.	6445	O. Tosun	Ankara, Turkey via USDA.	16	13
A. ovalis Boiss.	6443	O. Tosun	Ankara, Turkey via USDA.	16	17

* These species previously counted; cases of disagreement discussed in the text.

**A. sesameus* L.	6505	cultivated	Madrid Botanical Garden	16	
A. spinosus Muschl	6436	J. Mandaville 20/4/63	Saudi Arabia	16	15
**A. uliginosus* L.	6160	cultivated	Vladivostok, USSR.	16	
**A. umbellatus* Bunge	6397	J. G. Dickson 26/8/56	Glenn Highway, Alaska	16	
**A. vulpinus* Willd.	6503	cultivated	Russia	16	20
**Oxytropis campestris* (L.) DC					
var. *gracilis* (A. Nels.) Barn.	6500	G. H. Turner 15/8/60	Fort Saskatchewan, Alberta	32	
**O. deflexa* (Pall.) DC.	6502	cultivated	Udaipur, India	16	
var. *sericea* T. & G.	6496	G. H. Turner 24/7/60	Fort Saskatchewan, Alberta	16	
"	6497	G. H. Turner 10/8/60	Fort Saskatchewan, Alberta	16	
**O. halleri* Bunge	6384	cultivated	Inst. Alpin du Lautatet, France	16	
O. monticola A. Gray	6506	cultivated	Kamploops Expt. Farm, B.C.	48	22
O. multiceps Nutt.	6286	C. L. Porter 8322	Albany Co., Wyoming	16	
O. parryi Gray	6408	M. DeDecker 1523	Mono Co., California	16	21
"	6409	M. DeDecker 1534	Inyo Co., California	16	
**O. sericea* Nutt.	6288	C. L. Porter 8458	Albany Co., Wyoming	48	
var. *spicata* (Hook.) Barn.	6498	G. H. Turner 11071	Jasper Nat. Park, Alberta	48	

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* These species previously counted; cases of disagreement discussed in the text.

has 2n=32 while the collections from Ontario, Quebec and Russia have 2n=16. Professor C. Favarger in personal conversation at the IXth International Botanical Congress in Montreal in 1959 said that he had found both 2n=16 and 2n=32 in some Switzerland collections of *A. alpinus.* Ledingham (1960) reported on four collections, three from Alberta, Manitoba and Saskatchewan having 2n=16 and one from Yukon having 2n=32. The count of 2n=ca 56 listed in Darlington and Wylie (1955) is considered erroneous.

It should be pointed out that although the present chromosome count 2n=32 for *O. campestris* var. *gracilis* agrees with some of the previous reports for this species there are also reports of 2n=48. Ledingham (1957, 1960) reports 2n=32 for six Saskatchewan and one Alberta collection. Jalas (1950) for ssp. *sordida* and Ledingham (1960) for one Old World and Ontario and British Columbia material report 2n=48.

Plates I and II give some camera lucida drawings of chromosomes of representative species of New World and Old World *Astragalus.* These drawings are all done with the same apparatus and at the same magnification. Although it seemed as if New World species had smaller chromosomes which were more difficult to separate and count this is not supported by the drawings. Plate I illustrates chromosomes of New World species and Plate II shows chromosomes of Old World species of *Astragalus.*

DISCUSSION

This paper reports chromosome counts for 28 species of *Astragalus* not previously reported. Twently of these counts are of New World species (Table I and Figs. 1-12) and they form an aneuploid series with n=11, 12, or 13. Eight new counts are reported for Old World species, 5 in *Astragalus* and 3 in *Oxytropis,* (Table II and Figs. 13-22) and these have 2n=16, 32 or 48, i.e. are diploids, tetraploids or hexaploids of the 8-series.

These 28 counts together with additional counts for 21 other species for which there have been previous reports further support the conclusion (Ledingham, 1960) that there are two main phylogenetic lines in *Astragalus.* There are now counts for 109 New World species and all have n=11 (53 species), 12 (38), 13 (14), 14 (3) or 22 (*A. grayi,* the only New World tetraploid). There are counts for 202 Old World species of *Astragalus* and *Oxytropis* and they have n=8 (146 species), 16 (21), 24 (18), 32 (8), 40 (1), 48 (2), ca 80 (1) and others (5).

In an earlier paper Ledingham (1960) gave a count of n=10 for *Astragalus somalensis* and suggested that species with the intermediate chromosome numbers n=9 and 10 might form part of the aneuploid series which includes both Old and New World *Astragalus.* No further evidence has been found to support this idea, and since Gillett (1963) has removed *A. somalensis* to *Galega,* it seems less likely. There are now no known species with n=9 or 10 in the *Astragalus* complex.

The suggestion has been made (Turner, 1959) that the $n=14$, 13, 12 and 11 of New World species of *Astragalus* are derived hypoploids from an ancestral $n=16$ tetraploid species. There are, however, no tetraploids in North America except for a few circumpolar species which are actually a part of the Old World phylogenetic line. There are several species in the Old World which may be hypoploids, e.g. the annual conspicuously self-fertile species *A. boeticus*, $2n=30$.

Our counts of $2n=$ca 42 for *A. hamosus* make us suspicious of the previous report of $2n=48$ for this species. Our suggestion for the moment is that *A. hamosus* does not really belong in *Astragalus*. It seems likely that *A. hamosus* is a hexaploid in some $n=7$ phylogenetic line. Tetraploids in this line may include *A. pentaglottis*, $2n=28$ (Senn, 1938; Ledingham, 1960) and *A. bubaloceras*, $n=$ca. 14-15 (Senn, 1938). Diploids of this $n=7$ line are unknown. There is, then, little evidence of hypoploids in Old World *Astragalus* and it seems very unlikely that New World *Astragalus* has arisen by chromosome loss from tetraploid ($2n=32$) plants of the Old World line.

Although we do not yet have enough information to reconstruct the evolutionary history of the Leguminosae, or more specifically of *Astragalus* and *Oxytropis*, it is clear that chromosome numbers can be used with considerable confidence to show true relationship in this family. This paper further establishes that New World and Old World species of *Astragalus* have had a different evolutionary history and must be considered as different subgenera or genera if taxonomy is to reflect true relationships. The chromosome evidence would indicate that *Oxytropis* is closely related to, or is a part of, the Old World *Astragalus*. It is now clearly established that chromosome number can be used as a significant character in this family. The relationships of species with anomalous counts should be studied critically.

ACKNOWLEDGMENTS

It would be impossible to list all of the many persons and institutions who have helped with our research. We would like, however, to give special thanks to the following who provided material for this study: Mr. R. C. Barneby, Miss M. Belcher, Mrs. E. Beckett, Mrs. M. DeDecker, Prof. R. J. Davis, Dr. A. Dutilly, Prof. N. Feinbrun, ptre. E. Lepage, Mr. J. P. Mandaville, Jr., Dr. E. Müller, Prof. C. L. Porter, Miss B. M. Rever, Prof. V. Tackholm, and Dr. G. H. Turner. We would like, also, to acknowledge our debt to Mr. R. C. Barneby who has kindly identified our herbarium specimens.

We are grateful to the National Research Council, Ottawa, Canada for the financial aid which has been given to this project.

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PLATE I

Figs. 1-12—Somatic chromosomes of New World species of *Astragalus* drawn with the aid of a camera lucida originally at x 2250 reduced by 50% in reproduction.

Fig. 1 *A. desperatus* var. *desperatus*, 2n=24, Rever 78.
Fig. 2. *A. amphioxys* var. *amphioxys*, 2n=22, Rever 72.
Fig. 3. *A. inyoensis*, 2n=22, DeDecker 1519.
Fig. 4. *A. lentiginosus* var. *fremontii*, 2n=22, DeDecker, 1484.
Fig. 5. *A. johannis-howellii*, 2n=22, DeDecker, 1505.
Fig. 6. *A. coccineus*, 2n=22, DeDecker, July 22, 1962.
Fig. 7. *A. ceramicus* var. *imperfectus*, 2n= 22, Porter 3954.
Fig. 8. *A. purshii* var. *glareosus*, 2n=22, Rever 111.
Fig. 9. *A. whitneyi*, 2n=22, DeDecker 1535.
Fig. 10. *A. cymboides*, 2n=24, Rever 58.
Fig. 11. *A. miguelensis*, 2n=22, Raven 18012.
Fig. 12 *A. calycosus*, 2n=22, DeDecker 1522.
Origin of material given in Table I.

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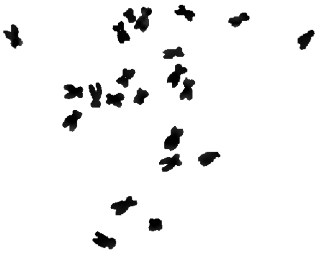

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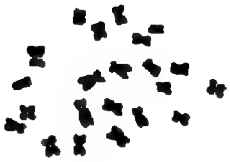

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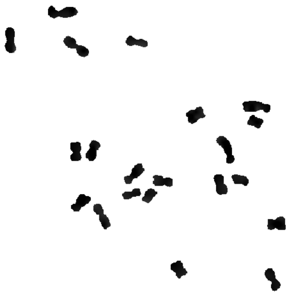

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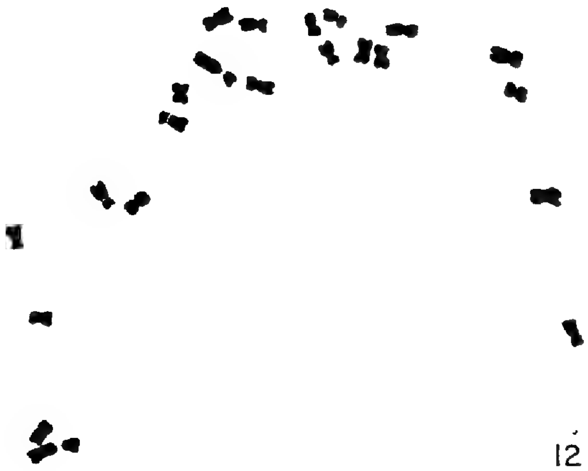

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PLATE II

Figs. 13-22. Somatic chromosomes of Old World species of *Astragalus* and *Oxytropis* drawn with the aid of a camera lucida originally at x 2250 reduced by 50% in reproduction.

Fig. 13. *A. odoratus*, 2n=16, O. Tosun.

Fig. 14. *A. micropteris*, 2n=32, O. Tosun.

Fig. 15. *A. spinosus*, 2n=16, J. P. Mandaville, April 20, 1963.

Fig. 16. *A. angustifolius*, 2n=32, O. Tosun.

Fig. 17. *A. ovalis*, 2n=16, O. Tosun.

Fig. 18. *A. hamosus*, 2n=ca. 42, Ledingham 2805.

Fig. 19. *A. hololeios*, 2n=16, Universitatis Bergensis 4309.

Fig. 20. *A. vulpinus*, 2n=16, Russia.

Fig. 21. *O. parryi*, 2n=16, DeDecker 1523.

Fig. 22. *O. monticola*, 2n=48, Kamloops 1939.


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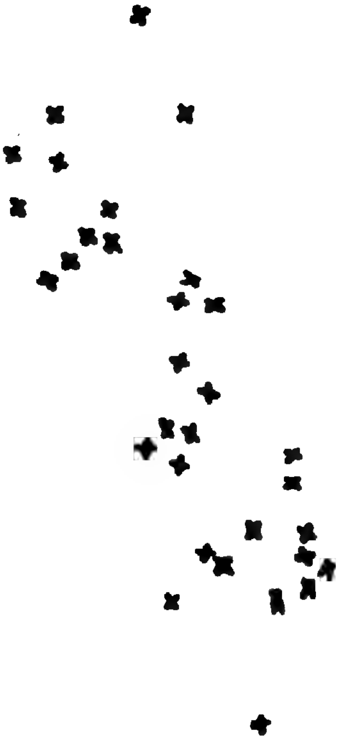
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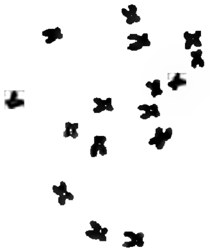
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YELLOW-FLOWERED LINUM (LINACEAE) IN TEXAS[1]

C. MARVIN ROGERS

Department of Biology, Wayne State University, Detroit, Michigan

During the course of some studies of the genus *Linum,* I have had the opportunity to examine a large number of specimens from Texas. Since the state is of interest in having far more species than any other and since, henceforth, attention will not be given particularly to the Texas taxa, it seems profitable to bring together at this time some of the accumulated data. Some collections from the state have not yet been seen and these no doubt would reveal some more county records, but it seems unlikely that the distribution patterns which have emerged will be greatly changed.

The features used to distinguish the various taxa, especially in the *L. rigidum* group, will be discussed further at a later date. The characters used in the key are certainly not necessarily the most significant. Living material of most of the Texas species is now at hand and it may be that cytological and genetic studies of these plants will result in some modification of the species and varieties as treated here, but a sufficient amount of material has been examined that the present interpretation should provide a basic framework for the field identification and recognition of the Texas taxa.

For the ranges of some of the plants described here, collections from about 45 herbaria were examined, but for species of the *L. rigidum* group *(L. alatum, L. aristatum L. australe, L. puberulum, L. rigidum* and *L. vernale)* distributional data comes principally from the collections of the United States Museum, the Gray Herbarium, the New York Botanical Garden, the Missouri Botanical Garden, the Chicago Museum of Natural History, Southern Methodist University, the University of Texas and the Lundell Herbarium, while for *L. rupestre* and *L. schiedeanum* the records come mainly from the last three. To the curators of all of these collections thanks are gratefully given.

The features of the genus as found in the state (excluding the two or three blue flowered species) may be summarized as follows:

Glabrous or occasionally pubescent annual or perennial herbs; leaves simple, sessile, entire or the upper glandular-toothed, alternate, opposite or rarely whorled on the lower part of the stem, alternate above; stipular glands present or none; inflorescence a terminal scorpioid cyme; flowers regular; sepals 5, imbricate, all or only the inner commonly with glandular-toothed margins; petals 5, convolute, separate, yellow, fugacious;

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SIDA 1 (6): 328—336. 1964.

stamens 5, united basally, with or without diminutive intervening staminodia; ovary superior, 5-carpelled, but becoming more or less completely 10-locular through the intrusion of false septa, dehiscing into 5 or 10 segments; seeds 10; styles 5, separate or united; stigmas capitate.

KEY TO THE SPECIES AND VARIETIES

1a. Styles separate or nearly so; fruit ultimately dehiscing into 10 one-seeded segments
  2a. Outer sepals entire
    3a. Fruit pyriform, longer than broad; pollen about 10-colpate . . . . 1. *L. floridanum*
    3b. Fruit spheroidal, as broad or broader than long; pollen 3-colpate.
      4a. Margins of inner sepals with conspicuous stalked glands; mature fruit in dried specimens usually adhering to the plant; leaves narrowly lanceolate or oblanceolate 2. *L. medium* var. *texanum*
      4b. Margins of inner sepals glandless or with very inconspicuous glands; mature fruit in dried specimens usually soon shattering; leaves elliptic to oblanceolate or obovate . . . 3. *L. striatum*
  2b. Sepals all with glandular teeth
    5a. Perennial; styles completely separate; pollen 3-colpate
      6a. Leaves lanceolate or oblanceolate or broader, some of the lower ones in whorls of four . . . . 4. *L. schiedeanum*
      6a. Leaves linear, the lower ones alternate or opposite . . . . 5. *L. rupestre*
    5b. Annual; styles united at the base; pollen with about 20 germ pores . . . . . . 6. *L. sulcatum*

1b. Styles united to above the middle; fruit dehiscing along the false septa into 5 two-seeded segments
  7a. Sepals entire or fringed, not glandular-toothed
    8a. Upper leaves and bracts sparsely, but conspicuously ciliate-margined; cartilaginous portion of false septa conspicuously wider toward the base of carpel . . . . 7. *L. imbricatum*
    8b. Upper leaves and bracts not ciliate-margined; cartilaginous portion of false septa uniformly narrow or absent throughout . . . . 8. *L. hudsonioides*
  7b. Sepals glandular-toothed
    9a. Plants grayish puberulent throughout . . . 9. *L. puberulum*
    9b. Plants glabrous or nearly so throughout
      10a. Outer sepals ovate, the broad, scarious margins irregularly crenate, each of the coarse teeth bearing a delicate gland . . . . 10 *L. alatum*
      10b. Outer sepals lanceolate or narrower, the margins not scarious or narrowly so, regularly, though sometimes sparsely, serrate with gland-tipped teeth
        11a. False septa incomplete, the inner margin terminating in a loose fringe; sepals persistent in fruit . . . 11. *L. vernale*

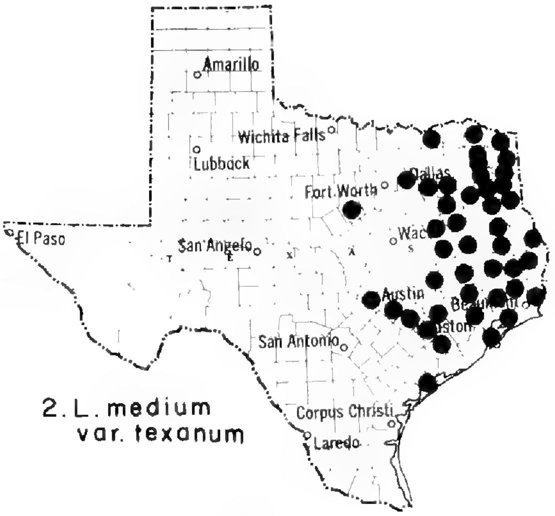
11b. False septa complete; sepals usually deciduous in fruit
  12a. Leaves small, the lower tending to be hidden among the branches; plant broomlike, bushy with long, slender stiffly spreading-ascending, few-flowered branches . . . . 12. *L. aristatum*
  12b. Leaves quite evident; plants not broomlike, rather few-branched at the base or in the inflorescence

13a. Stipular glands absent
  14a. Styles 6—10 mm. long
    15a. Stigmas pale; sepals green
      16a. Fruit thin-walled (dark seeds commonly evident through the wall), elliptic, the base rounded. . . . . 13a. *L. rigidum* var. *rigidum*
      16a. Fruit thick walled, opaque, broadly ovoid, tapering abruptly at the flattened base . . . . 13b. *L. rigidum* var. *berlandieri*
    15b. Stigmas black; sepals grayish or purplish. . . . . 13c *L. rigidum* var. *filifolium*
  14b. Styles 3—4 mm. long . . . .13d. *L. rigidum* var. *compactum*
13b. Stipular glands present (sometimes on the lower part of plant only)
  17a. Styles more than 6 mm. long; petals more than 10 mm. long
    18a. Sepals green; stigmas pale . 13b. *L. rigidum* var. *berlandieri*
    18b. Sepals grayish or purplish; stigmas black. . . . . 13c. *L. rigidum var. filifolium*
  17b. Styles less than 6 mm. long; petals less than 10 mm. long
    19a. Stipular glands present only near the base of the plant . . . . 14a. *L. australe* var. *australe*
    19b. Stipular glands present and prominent throughout . . . . 14b. *L. australe* var. *glandulosum*

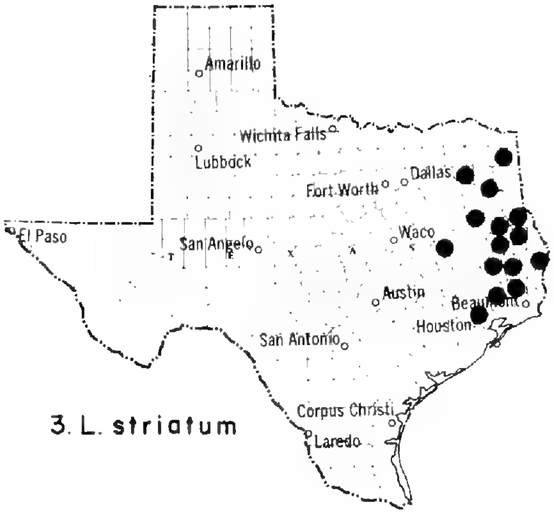
1. LINUM FLORIDANUM (Planch.) Trel. var. FLORIDANUM. This, with the next two, is a part of a series of seven perennials, all confined to eastern North America. (See Brittonia 15: 47-122, 1963, for further discussion of these two species.) Though differing from the next in perhaps a dozen qualitative and quantitative characters, this variety is closely related to *L. medium* var. *texanum*, and is thought to hybridize with it. Several collections from eastern Texas appear to involve *L. floridanum* as a parent and it is possible that additional collecting in that part of the state will show it to be more widespread there. It is a fairly common plant in pine and pine-palmetto woodlands throughout much of the southern Atlantic and Gulf Coastal Plains, but is presently known in Texas from a single specimen from Hardin County.

2. LINUM MEDIUM (Planch.) Britton var. TEXANUM (Planch.) Fern. The typical variety of this species is confined to Ontario, but variety *texanum* ranges throughout most of eastern United States, westward to southeastern Iowa and eastern Texas, where it is a species of open woods, meadows and grassy roadsides.

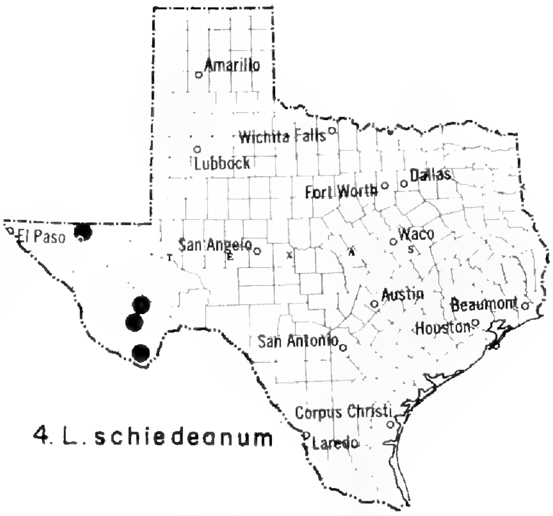
1. L. floridanum



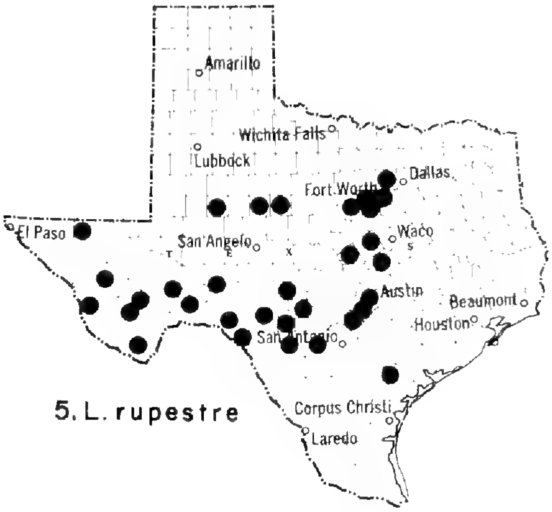
2. L. medium var. texanum



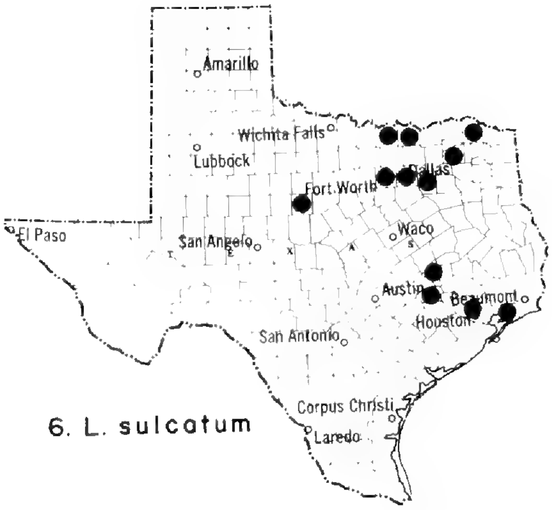
3. L. striatum



4. L. schiedeanum



5. L. rupestre



6. L. sulcatum

3. LINUM STRIATUM Walt. This species is also widely distributed in eastern United States, mostly in the nonglaciated regions in moist situations along the borders of ponds, streams and roadside ditches. Perhaps two dozen collections from scattered localities in 15 counties in eastern Texas have been seen.

4. LINUM SCHIEDEANUM Schlecht. and Cham. This and the next are part of a complex of taxa, principally Mexican, of which the identity and relationships are far from completely clear. It seems fairly certain that the Texas plants included here belong to a very widely distributed species, correctly interpreted as *L. schiedeanum*. As such, it is found mostly in calcareous soil from southern Mexico northward to the Chisos, Del Norte, Glass and Guadalupe Mountains of western Texas and southern New Mexico.

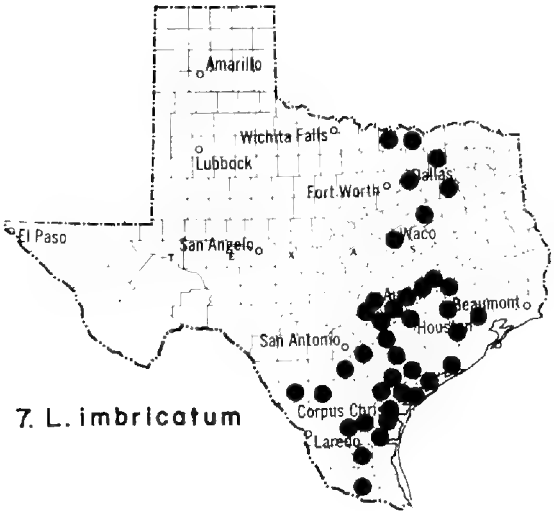
5. LINUM RUPESTRE (A. Gray) Engelm. This variable species occupies about the same range and habitat as the last and the two are found together over much of their ranges. *Linum rupestre* is found throughout most of Mexico, with central and western Texas constituting the northernmost limit of its range.

6. LINUM SULCATUM Riddell. This species is found in prairies and prairie like areas throughout central and northeastern United States and southern Canada, but is infrequently collected in the southern part of the range. It is of special interest in the genus, since it combines traits of the primitive *L. rupestre* and the highly specialized *L. rigidum* groups.

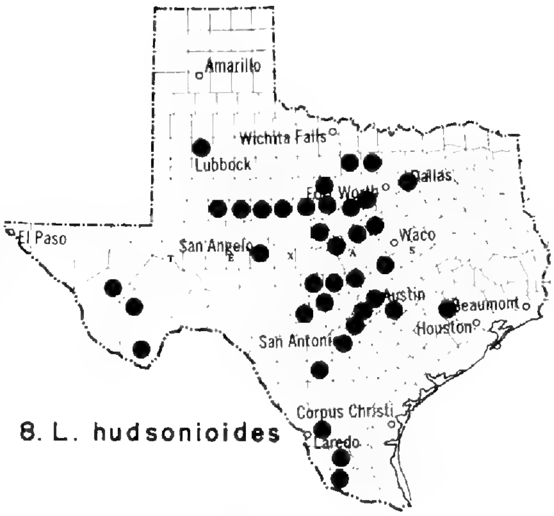
7. LINUM IMBRICATUM (Raf.) Shinners. This and the next species resemble one another and have not generally been separated. (See Rhodons 65: 50-55, 1963, for further discussion of these three species.) They are small plants of distinctive habit with many, small imbricate leaves and few-flowered inflorescences. Though specimens have come from along both the Oklahoma and Mexico boundaries, the known range lies entirely within Texas, where it is a plant mostly of sandy soil throughout much of the east central part of the state.

8. LINUM HUDSONIOIDES Planch. Along with *L. imbricatum*, this is closely allied to the *L. rigidum* group which follows. It is found principally in sandy or gravelly, sometimes calcareous soil in the west central part of the state, with outlying stations in the trans-Pecos region of west Texas and southern New Mexico, the Wichita Mountains and perhaps in central Kansas.

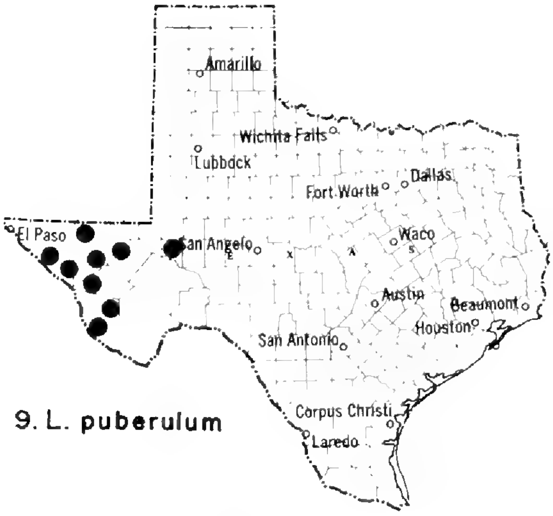
9. LINUM PUBERULUM (Engelm.) Heller. This is easily recognized as the only densely pubescent species in the region. It is closely related to *L. australe* and occupies about the same range as that species at low and medium elevations in the mountains from southeastern Wyoming to Utah, south into northern Mexico and eastward through the trans-Pecos region of western Texas where it is found in rocky, sandy or occasionally calcareous situations.



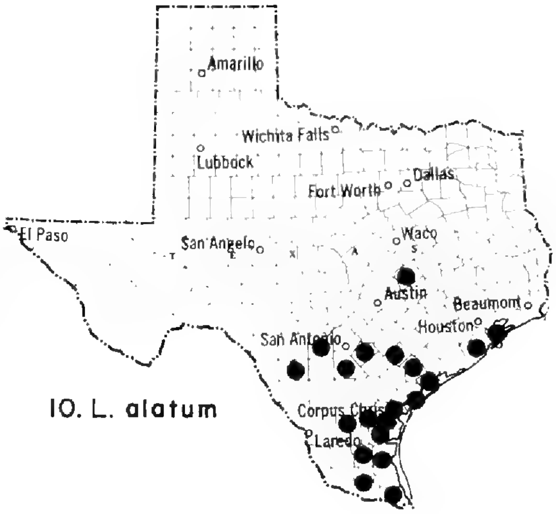
7. L. imbricatum



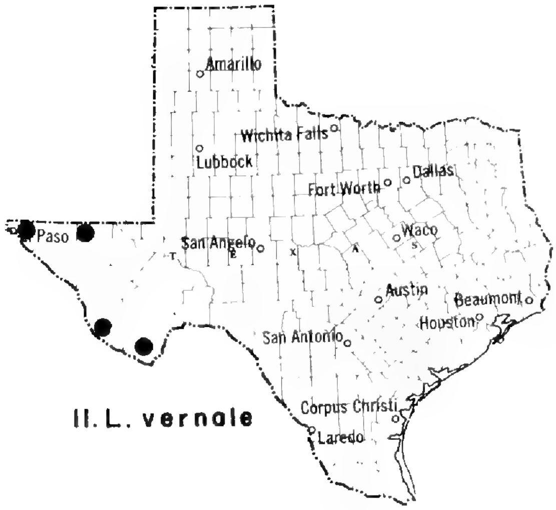
8. L. hudsonioides



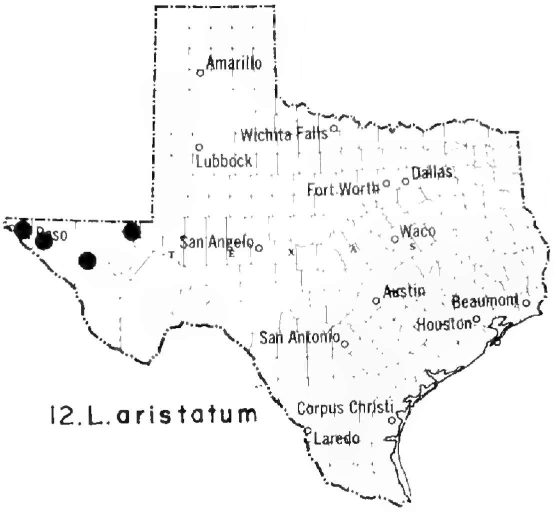
9. L. puberulum



10. L. alatum



11. L. vernale



12. L. aristatum

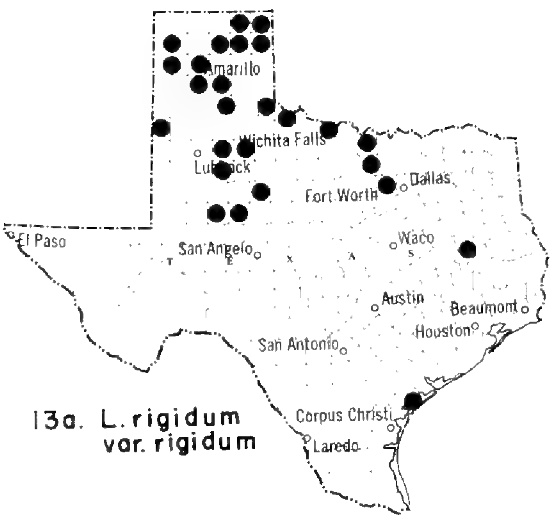
10. LINUM ALATUM (Small) Winkler. Like the previous species, this may be quite readily recognized, in this case by the unique sepals. Though it differs in other ways from *L. rigidum* var. *berlandieri*, it is surely closely related to that plant. The ranges of the two overlap, but there does not appear, in the specimens examined, evidence of hybridism. *Linum alatum* is found in sandy soil, sometimes along the beach, in southeastern Texas, with a collection or two from Tamaulipas, Mexico, near the Rio Grande and from western Louisiana.

11. LINUM VERNALE Wooton. The poorly developed false septa and the tendency for the sepals to persist, together with several other features such as fruit shape and texture, indicate that this may be one of the more primitive species of the *L. rigidum* group. The species is found on stony, commonly limestone hills in the trans-Pecos region of Texas, adjacent New Mexico and northern Mexico.

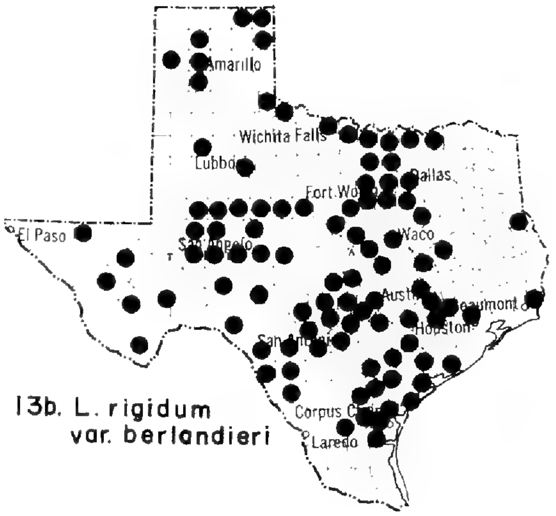
12. LINUM ARISTATUM Engelm. This is a distinctive species, though certain of its features do not lend themselves to precise description. In addition to the characters indicated in the key, it has unique pale, narrowly elliptic, thin walled, easily crushed capsules. It is a species of sandy soil, ranging from eastern Utah and western Colorado south to northern Mexico and eastward into west Texas.

13a. LINUM RIGIDUM Pursh var. RIGIDUM. *Linum rigidum* ranges from southern Canada to central Mexico, with the Mexican populations, partly because of the scarcity of good collections, being poorly known. Long a source of confusion, the complex of which this is a part is the subject of some studies now in progress. In Texas the species appears to consist of four varieties which, though tending to intergrade somewhat in some areas, are sufficiently distinct that nearly every plant can be readily named. What is usually interpreted as the typical variety (the type has not been located) is a plant of the plains, ranging from north central Texas (one specimen from Aransas County) northward to Alberta and Manitoba. It is the tallest variety (average about 30 cm.) with an open, few flowered inflorescence, relatively large floral parts and no stipular glands.

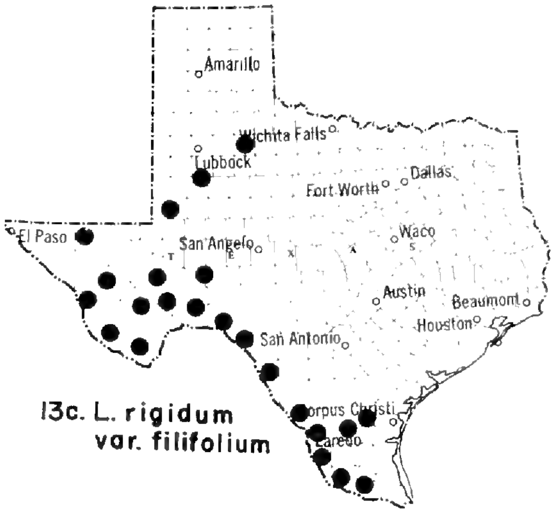
13b. L. RIGIDUM var. BERLANDIERI (Hook.) T. & G. This is a showy plant, with some reason often considered a separate species. It is generally shorter (average 15-20 cm.) and more compact than var. *rigidum*, with leaves averaging twice as wide (2 mm.) and with sepals and floral bracts tending to be coarser and 3-nerved rather than 1-nerved. In the northern part of the range, where it overlaps that of var. *rigidum*, a number of collections appear to be intermediate. In southern Texas there is an interesting form with comparatively few, large marginal glands on the sepals, while in the northern part of the range is found a short, bushy branched, leafy variation which probably warrants further study. While the key is designed to include plants without stipular glands, they are present in nearly 90% of the specimens examined of this and



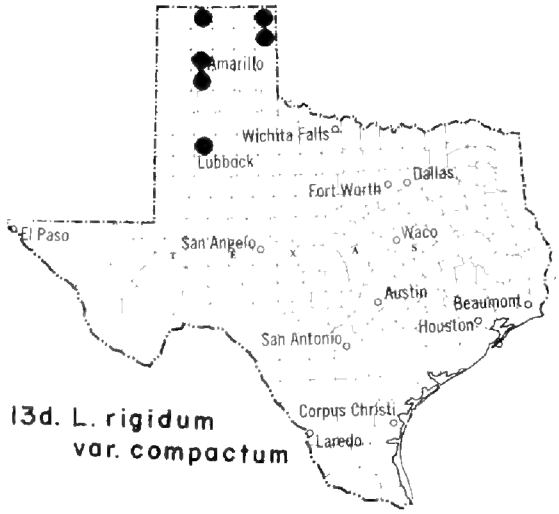
13a. L. rigidum var. rigidum



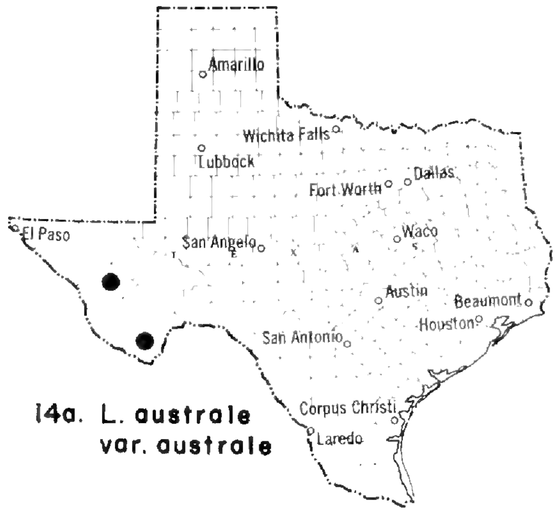
13b. L. rigidum var. berlandieri



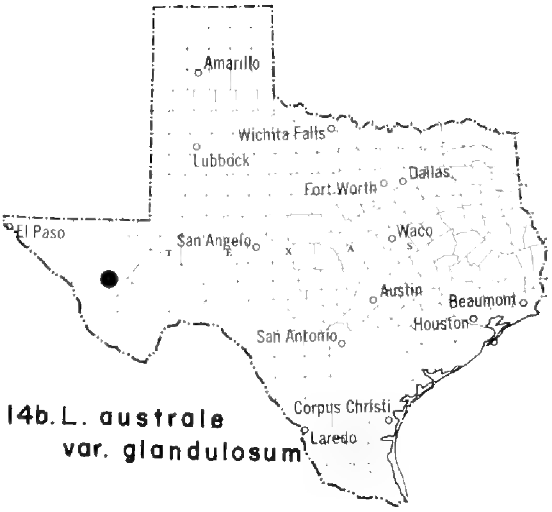
13c. L. rigidum var. filifolium



13d. L. rigidum var. compactum



14a. L. australe var. australe



14b. L. australe var. glandulosum

of variety *filifolium*. Variety *berlandieri* is found pretty much throughout the state and as far north as southeastern Colorado and central Kansas.

13c. L. RIGIDUM var. FILIFOLIUM Shinners. As interpreted here, var. *filifolium* is a rather variable population. Most collections have come from sandy, rocky or sometimes calcareous soil in west Texas, but a few puzzling plants included here come from the southern plains country, while southeastward near the Mexico boundary, there is a gradual transition toward plants which are often perennial and possess long, slender sepals. These have been called *L. elongatum*. More study is necessary to determine the relationship of the west Texas plants to those found from Webb to Hidalgo Counties, as well as to some anomalous collections from northern Mexico.

13d. L. RIGIDUM var. **compactum** (Nelson) Rogers, comb. nov. *(L. compactum*, Nelson, Bull. Torr. Bot. Club 31: 241, 1904). This, as the name indicates, is a short, compact plant (average about 15 cm.) with small floral parts, no stipular glands and with rather coarse foliage and fruit somewhat as in var. *berlandieri*. Like var. *rigidum*, this is a plant of the plains, being found from northern Texas to southern Canada.

14a. LINUM AUSTRALE Heller var. AUSTRALE. *Linum australe* is a plant of low and medium elevations in the Rocky Mountains, most closely allied to *L. puberulum*, but also very likely related to *L. rigidum*. In Texas two varieties may be recognized. The typical variety, which has been collected in the Chisos and Davis Mountains, is found from northern Mexico to Alberta.

14b. L. AUSTRALE var. **glandulosum** Rogers, var. nov. Differt a var. australi,quod stipulas glandulosas atque clarissimas, flores paulo maiores, fructum paulo minorem hebet. HOLOTYPE: *Palmer 465*, Otinapa, Durango, Mexico (US; isotypes F, GH, MO, NY).

This differs from var. *australe* in the possession of very conspicuous stipular glands, these often being found at the base of the sepals as well as the bracts and leaves, and in the somewhat larger floral parts and smaller fruits. It is found from southern Arizona and the Davis Mountains in western Texas, south to Pueblo, Mexico.

CALYLOPHUS (OENOTHERA IN PART: ONAGRACEAE) IN TEXAS

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Dr. Raven's new look at *Oenothera* and its allies is sure to win adherents, though it will take some time to become adjusted to the unfamiliar nomenclature. Among the species conservatively included in *Oenothera,* those with entire or subentire stigma and widely flaring summit on the calyx tube form a very well-marked group. Users of the floras of Small and Rydberg have known them as *Meriolix* and *Galpinsia,* but the first generic name published with description was *Calylophus.* All the species recognized variously by Munz and Raven occur in Texas, as do most of the infraspecific taxons. Because a monographic treatment by Dr. Raven is not likely to be ready in time for one local and two state floras now in active preparation, this brief review has been prepared. It is based on 308 specimens in the S.M.U. Herbarium (205 of them from Texas), plus original descriptions of species and varieties previously published, and a few notes on type specimens given by Munz (1929).

Just as among the genera there are almost no differentiating characters that hold throughout, so every promising character for separating species and varieties breaks down in at least a few specimens, and the exceptional ones often do not seem to fall into any clear geographic pattern. For example, extremely short sepal-tips on the flower buds are typical of C. *Hartwegii* var. *lavandulaefolius,* but rarely a plant typical in other respects may have long sepal-tips. This conceivably could result from introgression with var. *Hartwegii* in the rather large area in which both occur. But in southern Trans-Pecos Texas the reverse variation is found, var. *Hartwegii* rarely showing extremely short sepal-tips, here outside the range of var. *lavandulaefolius.* I believe that the basic variation pattern, and chief cause of taxonomic difficulty, is one of homologous mutations, appearing especially in pubescence and leaf-form. Introgression also occurs (to a limited extent among the varieties of C. *Hartwegii,* more extensively between those of C. *serrulatus*), and along with seasonal variation, helps to complicate the picture. All this makes construction of dichotomous keys most difficult. Those given here are intended for identification, not definition, and are for use with plants in flower. When leaf dimensions are used, they are those of leaves on flowering stems. In the text are mentioned additional features which, though commonly present and helping to define the varieties, break down too often to be really useful in a working key.

SIDA 1 (6): 337—345. 1964.

Additional synonymy is to be found in the two publications of Munz (1929, 1944). I have cited only what was necessary to establish the nomenclature here adopted and to indicate the principal departures from the treatments of Munz. It would be most easy to add a long, speculative discussion of the history and relationships of the recognized taxons, but I do not feel that present knowledge justifies it.

KEY TO SPECIES

1a. Sepals with prominent raised midrib or low keel, flower buds 4-ribbed or 4-ridged, especially toward summit . . 1. *C. serrulatus*
1b. Sepals without prominent midrib or keel, flower buds smooth
  2a. Calyx tube funnelform in upper 2/3 or more, 6—30 mm. long (above ovary) . . . . 2. *C. tubicula*
  2b. Calyx tube funnelform in upper 1/2 or less, 15—55 mm. long . . 3. *C. Hartwegii*

1. C. SERRULATUS (Nuttall) Raven, Brittonia 16: 286. 1964. Two varieties are recognized for Texas, with intermediates due partly to introgression, but also due partly to variation trends not related to introgression. More intensive study may justify recognition of the large-flowered southern phase of var. *serrulatus*, occurring mainly outside the range of the even larger-flowered var. *spinulosus*. Both varieties show more or less clinal variation, var. *serrulatus* in flower size, var. *spinulosus* in leaf-width, but the extremes are not considered worthy of nomenclatural recognition. A single specimen from Arizona combines the small flowers, short leaves, and pubescence of var. *serrulatus* with the narrow leaf-dimensions of var. *spinulosus*, but is outside the range of both. I consider this as belonging to a third variety, illustrating independent mutation or recombination of characters derived from a remote ancestor.[1]

KEY TO VARIETIES OF C. SERRULATUS

1a. Leaves 3½—9 times as long as wide . . . . . . var. *serrulatus*
1b. Leaves (except lowest) 9—40 times as long as wide . . . . . . var. *spinulosus*.

1a. C. SERRULATUS var. SERRULATUS. *Oenothera serrulata* Nuttall, Genera 1: 246—247. 1818. "From the river Platte to the mountains, on dry hills; flowering in June. . . . Stem simple, slender, 8 to 12 inches high, foliose; leaves a little more than an inch long, 2 to 3 lines wide, attenuated downwards, distinctly serrulate, not toothed. . . ." *O. serrulata* var. *Nuttallii* T. & G., Fl. N. A. 1: 501. 1840. (Based on the preceding, equivalent to what we now call var. *serrulata.)* *O. serrulata* var. *Drummondii* T. &. G., l. c. 502. "Low, minutely puberulent; stems simple;

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[1] CALYLOPHUS SERRULATUS var. **arizonicus** Shinners, var. nov. Ad var. *serrulatum* statura minore, foliis et floribus parvis, pubescentia cinerea praecipue partium juniorum, ad var. *spinulosum* foliis perangustis (e.g. 27 × 2.2 mm. 28 × 2.8 mm.) accedit. HOLOTYPE: 4 miles upstream from White River on the White River, Navajo Co., Arizona, *S. J. Preece, Jr. & B. L. Turner 2692,* 25 June 1951 (SMU). "Dry sandy river bank; silty-sandy soil. Plant 1 foot or less high. Petals yellow. Tap-root woody."

leaves linear-spatulate or spatulate-oblong . . . ; flowers larger; capsules puberulent . . . Texas, *Drummond!*" (Based on *Calylophus Drummondii* Spach, whose description I have not seen, but the different form of the epithet makes it a new name rather than a new combination, and the citation of a specimen seen by T. & G. could also justify treating it as an entirely new and independent though synonymous name.) This name has been used by Munz chiefly for var. *spinulosus*, but the original description clearly indicates the larger-flowered phase of var. *serrulatus* common in southern Texas, while var. *spinulosus* is absent from the counties botanized by Drummond.

Plant low-growing, more or less gray pubescent, with short, subentire or rather bluntly and inconspicuously toothed leaves and small to moderately large flowers. Variations in Texas which may be due to introgression with var. *spinulosus* include plants with tall stems, or largely glabrate, or with large, prominently spinulose-toothed leaves, or in some cases large flowers, or combinations of these features. Probably most of the variation in toothing of leaves represents spontaneous mutations. At least in the southern part of the range, I believe that plants with large flowers and/or dark stigmas, represent homologous variations or descent from a remote ancestor, since they are prevalent outside the area of var. *spinulosus*. In Munz's treatments all large-flowered plants were treated under var. *Drummondii*, but flower size does not correlate well with leaf-dimension, which I believe permits a better geographic separation.

Panhandle to Grand Prairie (Denton and Tarrant counties), south and southeast to the lower Rio Grande Plain and Coastal Bend (east to Milam, Brazos, Jackson, and San Patricio counties), southwest to Loving, Ward, Val Verde, and Webb counties; absent from the Trans-Pecos. Two very narrow-leaved plants from the lower Rio Grande Plain are considered aberrant forms of this variety on grounds of locality (well outside the range of var. *spinulosus*), dwarf stature, and short leaves. KENEDY CO.: Yturria Ranch near Willacy Co. line, *Lundell & Lundell 8735*, 6 May 1940. (Leaves 31 X 3.1 mm., 27 X 3 mm., 26 X 3.2 mm.; plant apparently normal. Other collections from the region very similar to it have slightly wider leaves.) KLEBERG CO.: 12 miles southwest of Riviera, infrequent on sandy roadside, *Cory 55259*, 31 March 1949. (Leaves 30 X 1.1 mm., 25 X 2 mm.; an injury form, with small, slender shoots from apparently mowed and perhaps burned plants.)

1b. C. SERRULATUS var. **spinulosus** (Nuttall, ined.; ex T. & G.) Shinners, comb. nov. *Oenothera serrulata* var. *spinulosa* (Nutt., ined.) T. & G., Fl. N.A. 1: 502. 1840. "Taller, often branching, almost glabrous; leaves linear, elongated, acute (sometimes obtuse), spinulose-serrate; flowers rather large; capsules minutely pubescent.—OE. spinulosa, *Nutt.!* ined. . . . Arkansas, *Nuttall! Dr. Leavenworth!*" The locality refers to the Arkansas Territory of that time, including eastern Oklahoma which almost certainly was the actual type of locality; I have seen no specimens from Arkansas. Reference is made to Hooker, Exotic Flora 2 t. 140, 1825, which shows the upper portion of a plant of this variety as here understood, the form with pure yellow flowers. As mentioned above, the plants treated by Munz as *Oenothera serrulata* var. *Drummondii* chiefly belong here.—*Oenothera serrulata* var. *pinifolia* Engelm. ex Gray, Boston Journ. Nat. Hist. 6 (Pl. Lindh. 2): 189. 1850. "Rocky prairies, New Braunfels. April.—This is just the OE. serrulata var. spinulosa, except that the leaves are extremely narrow." (See also Heller's comment, quoted under the next.)—*Meriolix melanoglottis* Rydb. ex Small, Fl. S.E. U.S. 846 and 1335. 1903. Type collection *Heller 1600*, about Kerrville, Kerr Co., Texas, 12—19 June 1894. There are two sheets of this number at S.M.U., apparently belonging to what had been two different collections, later combined under one distribution number. One is a whole plant 24 cm. tall, with root, in early flower, with linear-oblanceolate leaves, a representative one measuring 45 × 4.5 mm. The other has a piece of stem almost 11 cm. long with 7 branches up to 40 cm. long, bearing a few flower buds, and lance-linear leaves, a representative one measuring 43 × 2.5 mm. The original description covers both forms. Heller himself gave these comments in his *Botanical Explorations in Southern Texas* (Contrib. Herb. Franklin & Marshall College 1: 71, 1895): "Plentiful about Kerrville, especially along the Guadalupe and Town Creek, usually in gravelly or stony ground. Not only the throat of the calyx and the disk-shaped stigma are dark black-purple, but also the throat of the corolla. Of the hundreds of flowers seen, hardly half a dozen were without this marking. The variety *pinifolia* is merely a very narrow leaved form of this species. Both forms grow together and there is no other character to distinguish them."

Plant rather tall, glabrate, with long, very slender, spinulose-toothed leaves and moderately to very large flowers. Variations perhaps due to introgression with var. *serrulatus* are lower, or with more pubescence, or shorter leaves with less prominent teeth, or smaller flowers, or combinations of these features. Variation plainly due to spontaneous mutation is that in leaf form, running to the extreme which was named var. *pinifolia*, concentrated about the Edwards Plateau. I believe that dark pigmentation in the center of the flower, found in the southern part of the range, also represents spontaneous mutation.

Edwards Plateau, Grand Prairie and Blackland Prairie, extending west to Taylor and Val Verde counties, east in the northern part of its range to Prairie Border (Van Zandt Co.). Found north and northeast through Oklahoma and Kansas to Iowa, Minnesota, and Wisconsin (where perhaps introduced; the one specimen seen is from along railroad in Waukesha Co.). On the basis of the description given in Steyermark's *Flora of Missouri* (1963, p. 1102), it is this variety which is reported from that state as *Oenothera serrulata*. It occurs also in Coahuila.

Caroline Dormon, in *Flowers Native to the Deep South* (1958, pp. 84—85), speaks of *Meriolix melanoglottis* as "entirely distinct" (from *Oenothera spinulosa),* "and in the author's humble opinion it deserves specific rank. A perfect rock-garden plant, it has spreading wiry stems and linear leaves with a few scattered teeth. The lovely bright yellow flowers, about 1½ inches across, have many tiny folds, giving them a 'crepy' look. They open out flat and remain open all day, as do those of Cream-cups. The most distinctive feature of the flower is the litle black 'tongue' (stigma) . . . In the Deep South it is really a tiny shrublet, which remains green all winter. . . . Texas and southwestern Louisiana." I have not seen Louisiana material, but the supposedly distinguishing features described by Miss Dormon can be found in Texas in various combinations among plants of what I would consider perfectly typical *spinulosus.* The variability at the type locality for *Meriolix melanoglottis* observed by its original collector has already been mentioned. At Dallas the plant puts out slender, trailing to ascending, almost vine-like shoots with small leaves that are green over winter, just as Miss Dormon describes.

2. C. TUBICULA (Gray) Raven, Brittonia 16: 286. 1964. (The epithet is not in available dictionaries. Presumably it is an atypical diminutive of *tuba,* but the case of *radicula* and *radula,* words unrelated to each other, raises doubts.) *Oenothera tubicula* Gray, Smithsonian Contrib. 3 art. 5 (Pl. Wright. 1): 71. 1852. "Prairies beyond the Pecos; Aug.," *Wright 197.* "Also gathered in much larger and much better specimens in the collection of 1851." Including var. *demissa* Gray, ibid. 71—72. "On the Guadalupe Mountains; Oct.," *(Wright 197 (partim)).*

Northeastern Trans-Pecos and adjacent counties just east of the Pecos; specimens seen from Brewster, Culberson, Pecos, Presidio, Reeves, Terrell, and Ward counties, in flower from March to September. Annual or short-lived perennial with rather short, broad leaves; large-flowered forms are extremely similar superficially to *C. Hartwegii* var. *Hartwegii* (particularly those forms of the latter which have been treated as *Oenothera Hartwegii* var. *Fendleri)).*

3. C. HARTWEGII (Bentham) Raven, Brittonia 16: 286. 1964. A troublesome assemblage of forms, most of them wide-ranging and overlapping geographically. The extremes appear quite distinct, but there is so much variation that races cannot be sharply defined. I recognize five varieties in Texas; a sixth occurs in Arizona.[1]

All have an extended blooming season from spring to fall. Two contrasting patterns of variation are shown by those in Texas, two varieties having prevailingly broader, shorter leaves than var. *Hartwegii,* while two are consistently very narrow-leaved.

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[1] C. HARTWEGII var. **Toumeyi** (Small) Shinners, comb. nov. *Galpinsia Toumeyi* Small, Bull. Torr. Bot. Club 25: 317. 1898. *Oenothera Hartwegii* var. *Toumeyi* (Small) Munz, Amer. Journ. Bot. 16: 708. 1929.

KEY TO VARIETIES OF C. HARTWEGII

1a. Leaves (except lowest) abruptly narrowed to truncate or slightly clasping at base, narrowly ovate or ovate-oblong to oblong or oblong-elliptic . . . . 3c. var. *pubescens*

1b. Leaves gradually narrowed at base or extremely narrow throughout, filiform or linear to lanceolate, oblanceolate, or elliptic-lanceolate

  2a. Leaves 2½—5 times as long as wide, widely spreading to slightly reflexed or occasionally ascending, sharply dentate or occasionally sub-entire; plants of lower Rio Grande Plain (also northeastern Mexico) . . . . 3b. var. *Maccartii*

  2b. Leaves 5—40 times as long as wide, ascending or rarely spreading, entire or occasionally sharply dentate (frequently so in Mexico); plants found west and north of lower Rio Grande Plain

    3a. Leaves linear to oblanceolate or elliptic-lanceolate, 1.3—13.0 mm. wide, 5—20 times as long as wide (narrowest dimensions on summer or fall shoots of var. *lavandulaefolius* with dense, gray pubescence)

      4a. Leaves linear-lanceolate to oblanceolate or elliptic-lanceolate, glabrous to sparsely pubescent (rarely rather densely and minutely pubescent with hairs up to 0.3 mm. long in plants from outside Texas) . . . . 3a. var. *Hartwegii*

      4b. Leaves linear or linear-lanceolate, gray with dense, mostly appressed hairs up to 0.6 mm. long . 3d. var. *lavandulaefolius*

    3b. Leaves filiform to linear, 0.5—2.0 mm. wide, 12—40 times as long as wide, green, inconspicuously puberulent and glandular-viscid; plants of gypsum outcrops, northern Trans-Pecos (also adjacent New Mexico) . . . . 3e. var. *filifolius*

3a. C. HARTWEGII var. HARTWEGII. *Oenothera Hartwegii* Bentham, Pl. Hartw. 5—6. 1839. From central Mexico; precise locality not known. The entire original description is quoted below; the first two lines appeared on p. 5, the rest on p. 6.

> 10. OENOTHERA Hartwegii, sp. n., suffruticosa, humilis, decumbens, foliis linearibus, lanceolatisve integris v. sinuato-dentatis glabriusculis, calycix parte libera ovario cylindrico sub-4-ies longiore apice infundibuliformi-inflato, laciniis ovato-lanceolatis glabriusculis longiuscule subulato-acuminatis, antheris stigma 4-partitum aequantibus.—Calycix tubus ultra 2 poll. longus. Corolla purpurea?

Oenothera Greggii Gray, Mem. Amer. Acad. 4 pt. 1 (Pl. Fendl.): 46. 1849. "Fruticulosa, ramossissima, erecta, undique minutissime viscido-puberula; foliis parvis (3—6 lin. longis) spathulatis vel oblanceolatis integerrimis sessilibus seu in petiolum pl. m. attenuatis; floribus parvulis; tubo calycis apice breviter obconico filiformi ovario sextuplo laciniisque triangulari-lanceolatis cuspidatis petala rhomboidea subaequantibus quintuplo longiore; capsula sessili oblongo-prismatica.—Hill southeast of Pelayo, in Chihuahua, *Dr. Gregg;* May, 1847. 'A very small semi-shrub; flower yellow.' The specimens are about 8 inches high, very bushy; the petals turn to rose-color in drying, as in the allied species, and are one third of an inch in length. Capsules scarcely half an inch long." Munz (1929, pp. 709—710) makes these comments. "Gray's type is the smallest and most glabrate plant that I have seen, his variety *pubescens* being based on a type more like the other plants I have included under *Greggii* var. *typica*. But his var. *pubescens* is not worth varietal rank, the type of the variety *typica* being pubescent but more minutely so. *O. Greggii* var. *typica* intergrades freely with var. *lampasana*." On the basis of leaf shape, *Greggii* definitely belongs with var. *Hartwegii*, while *pubescens* and *lampasana* belong together but not with var. *Hartwegii*.—*Oenothera Greggii* var. *Pringlei* Munz, Amer. Journ. Bot. 16: 711. 1929. "Leaves and stems strigose-canescent; leaves 1—3(4) cm. long, 1—3(4) mm. wide, wavy-margined and denticulate." Type (not seen) from Bachimba Canyon, Chihuahua, *Pringle 224*. Description and locality definitely place this with var. *Hartwegii* as I understand it.—*Oenothera Fendleri* Gray, Mem. Amer. Acad. 4 pt. 1 (Pl. Fendl.): 45—46. 1849. "Minutissime pulverulento-glandulifera, glabra; caulibus e radice lignosa decumbentibus; ramis brevibus adsurgentibus; foliis lanceolatis oblongisve sessilibus subintegerrimis; calycis tubo apice infundibulari-inflato ovario prismatico sessili laciniisque triangulari-lanceolatis cuspidatis 3—4-plo longiore; petalis rhombei-obovatis stylo paulo longioribus.—Sunny hillsides at Santa Fe, and on the Rio del Norte; also (chiefly a narrow-leaved form) from Rock Creek eastward to the Cimarron River; May to August," *Fendler 230*. *O. Hartwegii* var. *Fendleri* Gray, Smithsonian Contrib. 5 art. 6 (Pl. Wright. 2): 58. 1853.

This is the most widespread and the most heterogeneous variety. Uncommon in Texas; known from the Panhandle, east in the Red Plains to Wilbarger Co., and from the Trans-Pecos, east to Uvalde and Val Verde counties. Until late in my study I attempted to maintain var. *Fendleri* as a more northern, more glabrous race with broader and more entire leaves (despite the inclusion of narrow-leaved forms in the original), but the separation proved far too weak to maintain. Stem glabrous or variously pubescent with short hairs only. One specimen from Reeves Co. (Lake Toyah, *Cory 52099*) has stems with short, erect hairs and some medium long ones, approaching var. *pubescens*, possibly due to introgression with the latter. A form with finely gray-pubescent leaves, superficially resembling var. *lavandulaefolius* but with shorter hairs, occurs in Mexico, well south of the range of the latter; I believe it should be regarded as a homologous mutation. I have not seen Texas specimens of this form.

3b. C. HARTWEGII var. **Maccartii** Shinners, var. nov. Folia plerumque patentia vel subreflexa, petiolata vel basi angustata, laminis denticulatis (rarius subintegris) oblanceolatis vel oblongo-lanceolatis pro ratione brevibus (ca. 10—38 mm. longis × 2—8 mm. latis). HOLOTYPE: U.S. Highway 83, 6 miles northwest of Rio Grande (City), Starr Co., Texas, *Rosa Ena Benavides 91,* 24 March 1963. "In mesquite savannah." Two additional U.S. collections seen, both from Duval Co.: State Highway 44, 7 miles east of Freer, *Rebecca M. Rodriguez 104,* 18 March 1962. State Highway 359, 10 miles southwest of Benavides, *Elvira G. Garcia 113,* 22 March 1963. Found also in nearby parts of Mexico. NUEVO LEON. 108 km. (65 mi.) no. (sic! i.e. south) of Nuevo Laredo, on road to Monterrey, *T. C. & E. M. Frye 2369,* 19 April 1939. Highway 85, 45 miles south of Nuevo Laredo, *Juan G. Rivas, Platon Ostos & Wm. L. McCart 8133,* 17 March 1962. Villaldama Road, 16 km. west of Sabinas Hidalgo, *Martha Dominguez M. & Wm. McCart 8255,* 7 April 1962. Highway 85, 17 miles northwest of Sabinas, *Juan Jorge Rodriguez 70,* 20 March 1963. TAMAULIPAS. 20 miles east of the International Highway, by the Ribereña Road, *Lorenzo Escalante 55,* 24 April 1962.

Named in honor of William Larrey McCart, Head of the Science Department, Laredo Junior College, for his long and continuing services as an energetic collector of the Texas flora. Lest some hasty pedant accuse me of misspelling, it should be stated that the extra *a* has been added deliberately because it makes a better Latin form of the name. Records of *Oenothera Greggii* var. *Pringlei* from the Rio Grande Plain given by Munz (1944) probably belong here. The leaf dimensions he gives, apparently quoted from the original description, do not apply, but he notes that the Texas plants "are not quite so closely strigose, nor so narrow-leaved as plants from Coahuila and farther south, but they do approach the latter."

3c. C. HARTWEGII var. **pubescens** (Gray) Shinners, comb. nov. *Oenothera Greggii* var. *pubescens* Gray, Smithsonian Contrib. 3 art. 5 (Pl. Wright. 1): 72. 1852. "Pilis mollibus patentibus villosa.—Dry hills beyond the Pecos; Aug.," *Wright 199.* "Leaves oblong, 2—4 lines long." Though Munz refers to this in his discussion of *O. Greggii,* already quoted, he nowhere cites it in his lists of synonyms.—*O. lampasana* Buckley, Proc. Acad. Sci. Phila. 13 (1861): 454—455. 1862. "Caule subprostrato, glanduloso-pilosa; foliis numerosis, ovato-lanceolatis, integris, subsessilibus, acutis, glanduloso-pubescentibus . . . Prairies, Lampasas County." *O. Greggii* var. *lampasana* (Buckley) Munz, Amer. Journ. Bot. 16: 710. 1929.

Stems with long, widely spreading hairs together with short, erect, gland-tipped or glandular hairs and very short, incurved, glandless ones. Occasional plants have few or no glandular hairs, or only short, erect hairs; one specimen from Taylor Co. (east edge of Abilene, *Norlan C. Henderson 63-376*) has every dense pubescence of short to medium-long, mostly non-glandular hairs. Leaves usually short and rather wide; narrow-leaved forms might indicate introgression with other varieties, but the others are so uncommon or localized within the area of var. *pubescens* that spontaneous mutation seems a more likely explanation. This is much the most common variety in Texas, from the Panhandle and Red Plains to the West Cross Timbers (Erath Co.), south to the northern Edwards Plateau, and southwest through the Trans-Pecos.

3d. C. HARTWEGII var. **lavandulaefolius** (T. & G.) Shinners, comb. nov. *Oenothera lavandulaefolia* T. & G., Fl. N.A. 1: 501. 1840. "Plains of the Platte, *Dr. James! Nuttall!* ('near Scott's Bluffs.') . . . Very nearly allied to the Mexican OE. Hartwegii, *Benth.,* which is a more glabrous plant, with narrower leaves, a more slender calyx tube, and subulate-acuminate segments." *O. Hartwegii* var. *lavandulaefolia* (T. & G.) S. Watson, Proc. Amer. Acad. 8: 590. 1873. *O. Hartwegii* var. *glandulosa* Munz, Amer. Journ. Bot. 16: 705. 1929. *Calylophus lavandulifolius* (T. & G.) Raven, Brittonia 16: 286. 1964. (I do not favor the half-baked pedantry of the Code recommendation—not rule—that the spelling be altered. Many Linnaean epithets were adapted from polynomials and are actually hyphenated words from which the hyphen had been dropped; they are not exactly the same as compound words, which the epithet here would become if spelled *lavandulifolius* instead of *lavandulaefolius.*)

Relatively uniform in having very narrow, densely gray-pubescent leaves (narrower than a majority of plants of var. *Hartwegii,* contrary to the statement in the original description), and nearly always with extremely short free tips to the sepals in bud, but these features are hardly sufficient to justify regarding it as a distinct species. The most northerly of the recognized varieties; as already noted under var. *Hartwegii,* occasional gray-pubescent forms from Mexico are better regarded as parallel mutations under that variety and not properly placed here. Frequent in the Texas Panhandle, south to Garza Co.; one record from the northern Trans-Pecos (northern Culberson Co.).

3e. C. HARTWEGII var. **filifolius** (Eastwood) Shinners, comb. nov. *Oenothera tubicula* var. *filifolia* Eastwood, Proc. Calif. Acad. (ser. 3) 1: 72. 1897. (This reference not seen; taken from Munz and the Gray Herbarium Card Index.) Type from White Sands, New Mexico. *O. Hartwegii* var. *filifolia* (Eastwood) Munz, Amer. Journ. Bot. 16: 707. 1929.

The most uniform of the accepted varieties, confined to gypsum outcrops in the Trans-Pecos and immediately adjacent counties; specimens seen from Culberson, Hudspeth, and Ward counties.

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TAXONOMY AND HETEROSTYLY OF NORTH AMERICAN GELSEMIUM (LOGANIACEAE)

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According to available floras the genus *Gelsemium* is represented in North America by two species. One is *G. rankinii* Small which occurs within 120 miles of the seacoast from North Carolina to Louisiana and the other *G. sempervirens* (L) Ait. f., which is known in the United States from Virginia to Arkansas and eastern Texas, Mexico, and Guatemala (Standley, 1924). Both species are woody evergreen vines with attractive yellow funnelform corollas. Another species occurs in eastern Asia.

Although *G. sempervirens* was known by Linneaus (1753) and to earlier authors as well (e.g., Gronovius, 1739), *G. rankinii* apparently was not recognized in literature until Nuttall (1818) referred to a variety of *Gelsemium* with inodorus flowers. Much later Small (1928) described it as a species. The description and accompanying illustrations clearly indicate the dimorphic nature of its flowers. Dimorphism in *G. sempervirens* is well illustrated by Alexander (1929). The first reference to the dimorphic nature of *Gelsemium* flowers that is known to us is that by Walter (1788). In his description of *G. sempervirens* he states, "Varietates, staminibus longioribus; stylo longiore." This may be the earliest report of heterostyly for any species. The earliest observation of heterostyly reported by Darwin (1884) is that by Persoon in 1794.

Some aspects of the dimorphism and the apparent intergradation of certain diagnostic characters prompted the present study which included extensive field research and breeding experiments as well as studies of herbarium specimens. Problems attacked included the possible correlation of certain morphological and cytological features with the species and heterostylic type involved, some genetical aspects of the heterostyly, the value of characters reported to be of diagnostic value, the distribution of the species, and the extent of any regional variation in the species. Although some questions have not been answered it is appropriate to report what has been learned.

STUDIES OF GROSS CHARACTERISTICS

According to the descriptions and keys given by Small (1933) the two species differ in several gross characteristics, i.e., those that ordinarily are used in manuals and in descriptions of species. Our observations have led to the following conclusions. The flowering shoots of *G. sempervirens* are more likely to be green and those of the *G. rankinii* red-tinged, than

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the reverse which is given by Small. The dilation of corolla tubes of the two species is so frequently similar that this character is of little use diagnostically. The body of the capsules of both species is generally veined, in *G. sempervirens* slightly more veined, this apparently being somewhat correlated with the size of the capsules. The species have nearly the same range in length of corolla and corolla tube instead of those of *G. rankinii* being clearly the shorter. The lengths of stamens and pistils in pin types, and also in thrum types of flowers, are essentially the same for both species.

Observations on many fresh flowers over a wide geographic range in the field east of Mississippi indicate that *G. sempervirens* always has odorous flowers and that *G. rankinii* usually does not. Several populations of the latter, however, have been found to have faintly to strongly odorous flowers, a condition apparently not reported in literature. In these populations the possibility of introgression with *G. sempervirens* was considered but was concluded to be improbable because features characteristic of *G. sempervirens* were mostly lacking on those plants with odorous flowers. More information about the possibility of introgression will be found later in our discussion of leaf base angles, pollen sizes, pollen fertility, and chromosomal studies.

Leaf bases in *G. sempervirens* are reported by Small (1933) to be narrowed at the base and those of *G. rankinii* rounded. Our data show that this is only generally true and that the species often cannot be separated by angles of the leaf bases. Angles were measured from special collections from the field and supplemented by others from herbarium specimens. The widest angle and the narrowest angle encountered on each collection were recorded. The maximum angle of the leaf bases for *G. sempervirens* was from 70° to 150° and for *G. rankinii* from 110° to 180°. The minimum angles were from 40° to 100° and 80° to 160° respectively. Those collections of *G. sempervirens* with any leaf base over 110° were examined for other characters typical of *G. rankinii*. None was found, the other characters definitely being those of *G. sempervirens*. In the case of those collections of *G. rankinii* having a maximum leaf base angle under 150° examination was made for other characteristics of *G. sempervirens*. None was found except that three collections with angles of 120°, 130°, and 135°, respectively, had odorous flowers. This is of no great significance, however, for there are more collections of otherwise typical *G. rankinii* having as small or smaller angles of the leaf base and there were five odorous flowered collections having larger angles (to 180°).

Leaf length and width for the two species were also studied. Data from over a hundred leaves of each species when averaged, plotted in a scatter diagram, and otherwise analyzed, show that the leaves of *G. sempervirens* average less in width and more in length, but only generally have a larger length-width ratio than those of *G. rankinii*.

Ratios for the former were from 2.9 to 5.1 and for the latter 1.0 to 3.9.

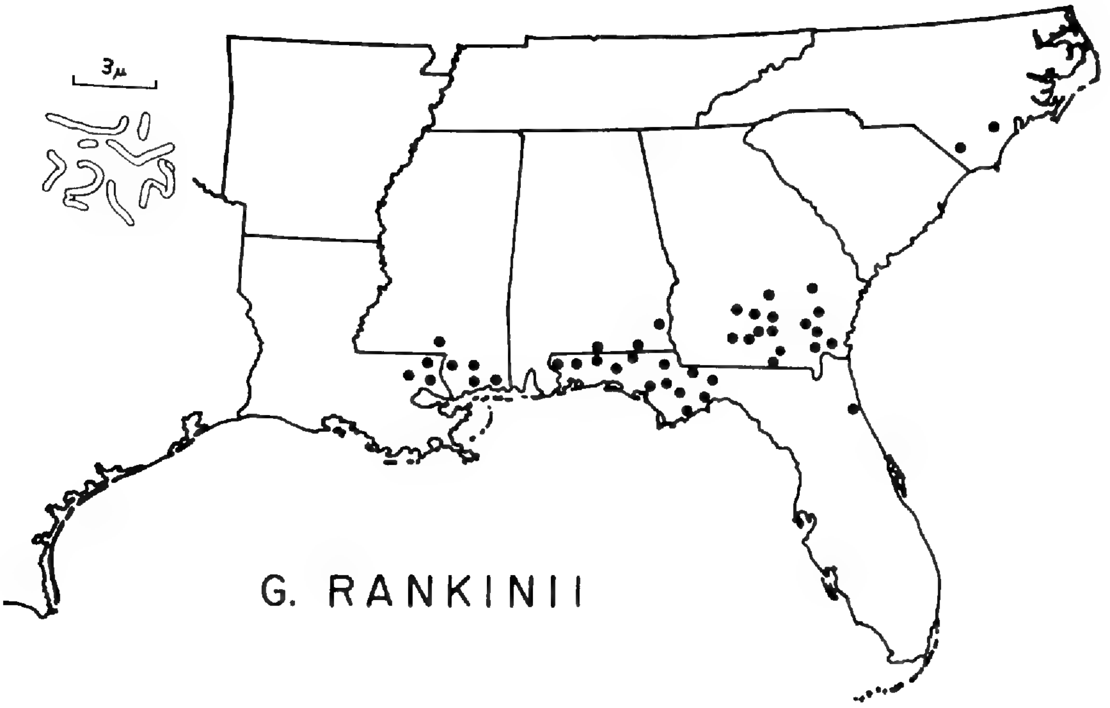
Observations were made in the field during anthesis on the colors of the corollas of fresh flowers of the two species. The two species could often be distinguished on this basis, the colors of the flowers of *G. rankinii* usually being the darker. The colors for *G. sempervirens* were: brilliant yellow (2.5Y-9/9 of the Nickerson Color Fan, published by the Munsell Color Co., 1957) to moderate orange yellow (10YR-8/10). For *G. rankinii* they were: vivid yellow (2.5Y-8/12) to strong orange yellow (7.5YR-7/11). The inner part of the corolla tube of both species, and especially of *G. rankinii,* was darker than the remainder of the corolla.

On the basis of the characters discussed above many herbarium specimens or plants in the field, especially those without flowers or fruits, would be difficult to place to a taxon. There also might be some doubt about maintaining two species. Such doubt is dispelled by other gross characters, these of the flower and fruit. The sepals, which appear not to be united, are obtuse to broadly pointed in *G. sempervirens* and acute to usually acuminate in *G. rankinii.* Pedicels in the former are scaly throughout (an occasional one may be partially naked), whereas in the latter the upper part of the pedicel is naked (an occasional pedicel will have a single scale reaching the base of the calyx, this being less frequent for fruits and mature flowers than for flowers just having opened). The body of the mature fruit of the former is 14.0 to 23.0 mm long and 8.0 to 11.0 mm wide, the beak being 1.3 to 3.0 (5.4) mm long. For the latter the data are 9.0 to 12.5 mm, 5.5 to 8.0 mm, and (2.4) 3.0 to 4.3 mm, respectively. Beak measurements for *G. rankinii* under 3.0 mm were fruits of the previous year, the shortness apparently being due to disintegration during the winter. For *G. sempervirens* measurements over 3.0 mm are uncommon and include a part or all of the upper portion of the style. This portion apparently falls off later as a unit, for beaks were either under 3.1 mm or over 5 mm long. In the latter case a region of dehiscense was usually evident. The seeds readily distinguish the two species for those of *G. sempervirens* are winged and those of *G. rankinii* not.

The possibility of correlation of pin and thrum flower types with gross characters was also studied. The characters included length of corolla and corolla tube, color of corolla, leaf dimensions, and fruit dimensions. No correlation was found.

DISTRIBUTIONAL STUDIES

Observations in the field and data accompanying herbarium specimens show that *G. rankinii* grows in moist to wet situations and is confined to the Coastal Plain of the southeastern United States (Fig. 1). Although *G. sempervirens* occasionally occurs in moist situations, it only rarely grows in wet habitats. In the southern United States it is found abundantly in drier situations, including shallow soils of granite outcrops and being associated with scrub oak vegetation of sandhills as far inland



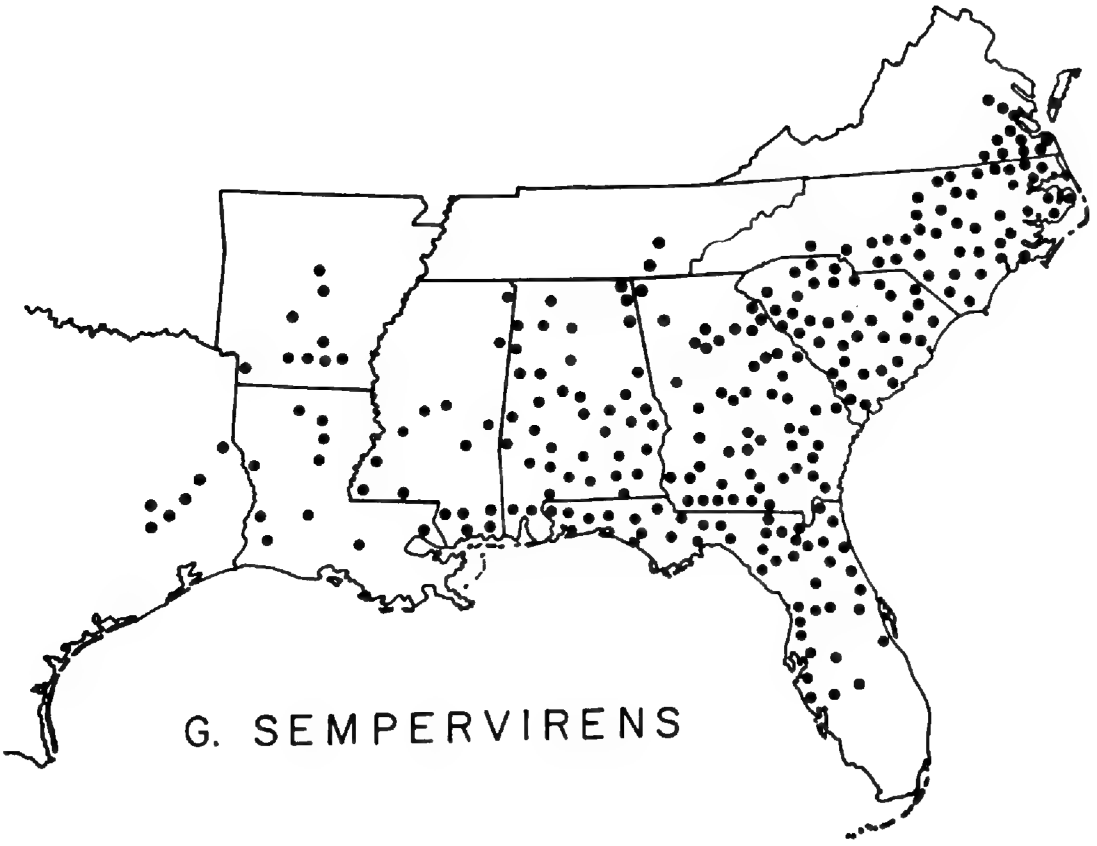


Fig. 1. TOP. Distribution of *Gelsemium rankinii* as indicated by herbarium specimens. Insert: Drawings of somatic metaphase chromosomes in a root cell of *G. rankinii*. BOTTOM. Distribution of *G. sempervirens* as indicated by herbarium specimens.

as the Fall Line. This species has a much wider geographic distribution than the former. The known distribution except for Mexico and Guatemala is also given in Fig. 1. Records for Alabama and Virginia include those reported by Harper (1928) and Massey (1961), respectively. *G. sempervirens* has been reported for Oklahoma by Vines (1960). We made no special effort to locate specimens to authenticate this report, but *Gelsemium* is not included in Waterfall's (1960) flora of Oklahoma. We believe, therefore, that the genus does not occur in that state. Coulter (1891) includes this species in his Botany of West Texas (west of 97th meridian), but we find no specimens to verify its occurrence in that region. Data from Standley (1924) and Martinez (1959) place *G. sempervirens* in Mexico (states of Chiapas, Oaxaca, Puebla, Veracruz) and Guatemala. The northernmost station appears to be Hanover Co., Virginia.

EPIDERMAL STUDIES

Microscopic studies were made of the lower epidermis of the two species by using herbarium mounting plastic in a technique very similar to that described by Sinclair and Dunn (1961) in their method A. The number of stomates per .0926 sq mm varied from 20 to 34 in *G. sempervirens* and 34 to 46 in *G. rankinii*. These data were based on the average of two counts made from peels from a leaf from each of twenty specimens of each species. Stomatal size was evaluated by measuring ten imprints on a plastic peel from a leaf from each of twenty specimens of each species. Distances measured for length and width values were between the ends of the guard cells and between their distant sides. These data are presented in Fig. 2, a scatter diagram. It is obvious that the measurements of stomates of *G. sempervirens* are usually the larger. There was no significant difference in respect to measurements of size and density of stomates between plants bearing pin and thrum type flowers.

Larger stomatal size and a lesser number of stomates per unit of area have been shown by Celarier and Mehra (1958), Stone (1961), and others to be associated with a higher degree of polyploidy when comparing species of a given genus. Our guard cell data, therefore, suggest that *G. rankinii* has a lesser number of chromosomes than *G. sempervirens*.

The surface of the lower epidermis, much more abundantly in *G. rankinii* than *G. sempervirens*, appears to be finely grooved in lines oriented along the sides of the stomates. These lines and other features of the epidermis need further studies which should include cross sections of leaves.

STUDIES OF POLLEN

The sizes of pollen grains have been known to differ in pin and thrum types of flowers at least since Darwin's (1862) studies of dimorphism in *Primula*. Also, larger sizes of pollen grains have been shown by many to be associated frequently, although not invariably, with a higher degree

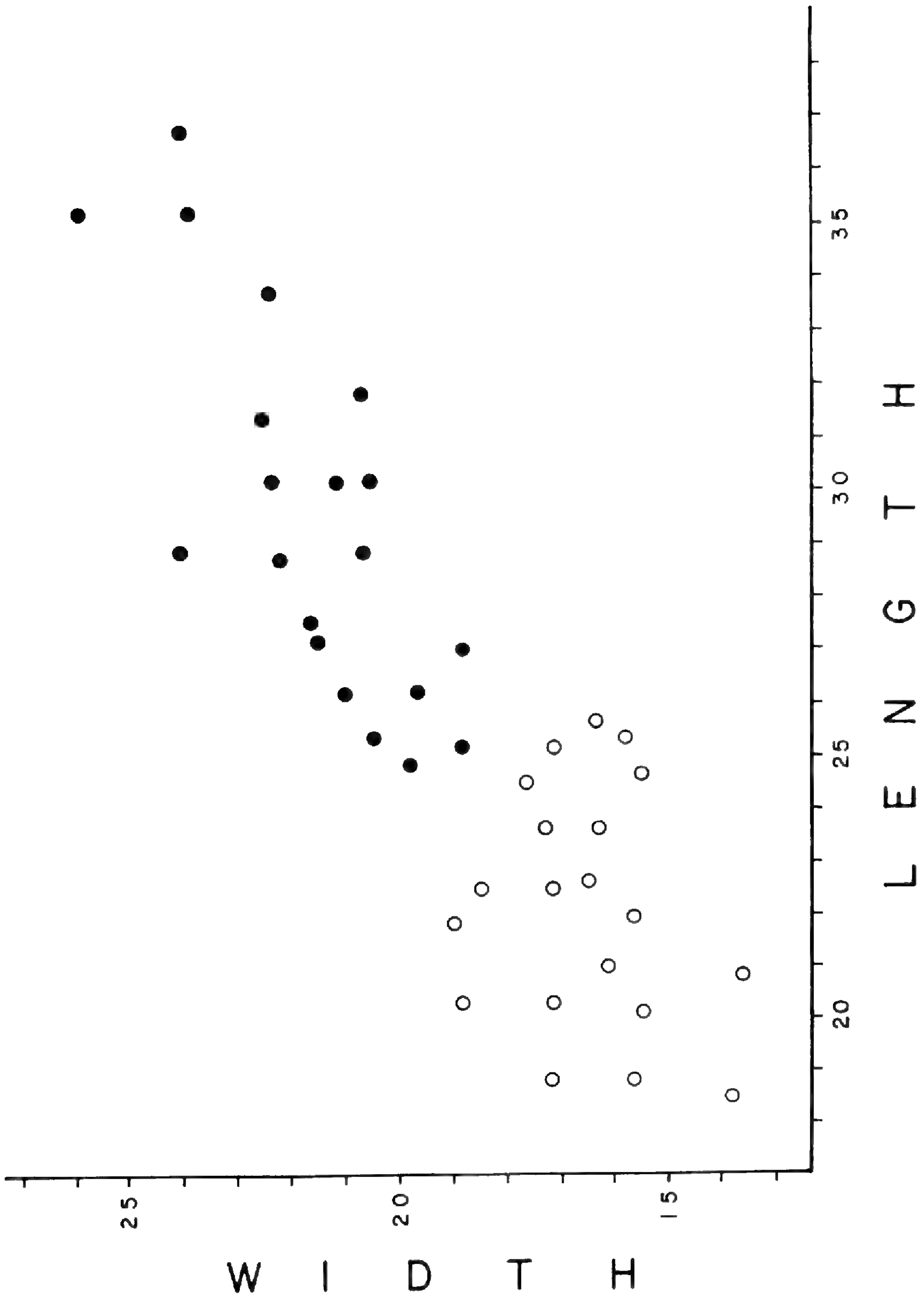


Fig. 2. Scatter diagram of measurements of stomatal size in *Gelsemium rankinii* (circles) and *G. sempervirens* (dots).

of polyploidy. A recent study describing such a situation is that of Stone (1963) in a study of *Carya* species. A study of pollen sizes in *Gelsemium*, therefore, seemed desirable.

The pollen studied was obtained from dried specimens from herbaria and supplemented by specimens collected for this purpose in the field and dried in presses over electric driers along with other herbarium specimens. A single anther was removed from a flower of each collection to be studied, dissected in water, and then observed under a microscope at 430X. The diameters of ten apparently normal pollen grains were recorded for each collection.

The data obtained on pollen size are summarized in Table 1.

TABLE 1. *AVERAGE POLLEN SIZES*[a]

Flower Type	*G. rankinii*	*G. sempervirens*
Pin		
No. of samples	21	30
Minimum	31.3	34.0
Maximum	36.7	42.2
Mean	34.3	38.1
Thrum		
No. of samples	20	29
Minimum	34.4	35.7
Maximum	43.9	45.6
Mean	40.8	41.5

[a] Expressed as diameter in microns. Based on measurements of ten pollen grains from each collection.

It may be seen that the average diameter measurements of pollen of thrum type flowers are larger than those of pin type, a situation reported by Ray and Chisaki (1957) for two species of *Amsinckia*, Translating the measurements into volume of the pollen, that of the thrum would be 67% larger than that of the pin in *G. rankinii* and 29% in *G. sempervirens*. These volume differences between thrum and pin types might be associated with the different distances the derived pollen tubes would need to grow to allow fertilization of the eggs.

A comparison of average measurements of pollen for the two species (Table 1) shows that they are larger for *G. sempervirens* in both the pin and the thrum types of flower. Pollen size data, therefore, as well as stomatal size and density, indicate a lower number of chromosomes for *G. rankinii*.

Shape differences in pollen grains also have been known to be associated with heterostyly, e.g., Johnston (1952). In both species of *Gelsemium* the pollens seemed to be of uniform size except for shrunken grains. Counts were made of the number of these per hundred grains. The numbers varied from 0 to 70 and were not associated with style type. Since shrunken grains are indicative of abortion and abortion is often present in hybrids, we investigated the possibility of relation of the numbers of such grains to possible hybridization between the two species. The specimen with 70% "aborted" pollen was of *G. sempervirens*. Although this was from a locality only a few miles from where *G. rankinii* was known to grow, the specimen exhibited no other evidences of hybridization between the two species. It was also noted that relatively high percentages of "aborted" pollen were frequently found on specimens of *G. sempervirens* that were from localities a hundred miles or more from where *G. rankinii* is known to occur. The evidence from our pollen studies, therefore, does not indicate that hybridization occurs between the two species.

PHENOLOGICAL STUDIES

There is evidence that the flowering periods of the two species of *Gelsemium* differ. Small (1928) stated that Mr. H. A. Rankin wrote that in the vicinity of Hallsboro, N. C., *G. rankinii* bloomed 20 days later than *G. sempervirens*. On 30 Mar. 1963 in Echols and nearby counties in Georgia the senior author observed the latter species to be nearly past flowering while the former was just approaching maximum flowering. During the Spring of 1964 *G. rankinii* plants transplanted to the senior author's premises did not begin to blossom until after those of the other species planted there had ceased flowering.

When data from herbarium specimens throughout the entire range of both species were analyzed no appreciable difference in flowering time was discernable. When data were confined to specimens from areas where both species occur (omitting the small disjunct area in North Carolina), it was found that the Spring flowering period of *G. sempervirens* was from 1 Feb. to 1 Apr. and *G. rankinii* essentially from 16 Feb. to 19 Apr. One specimen of the latter species in flower on 29 Jan. was collected about 10 miles south of St. Augustine, St. Johns Co., Fla. This early flowering date may be associated with the close proximity of the plants to the ocean. Both species occasionally flowered in October and there is one record for *G. rankinii* on 27 Sept. A plant of *G. sempervirens* brought in from the woods nearby and cultivated in Chapel Hill, N. C. is recorded (specimen No. 31472 in U.N.C. Herbarium) as blooming every Fall, almost as abundantly as in the Spring. Herbarium records indicate that from 30° 30′ southward, flowering of *G. sempervirens* begins 1 Feb. and is essentially completed by 1 Apr. In the Coastal Plain of Ga. and Ala. the period is from 19 Feb. through 14 Apr. In S. C., N. C., and Va. and in the Piedmont of Ga. and Ala. flowering occured almost entirely between 16 Mar. and 1 May.

Attention was also given to the possibility of differences in flowering time between pin and thrum types of flowers. Field observations and analysis of data on herbarium specimens gave no evidence of any difference in the flowering time of these two types.

GENETICAL STUDIES

Several years ago plants of *G. sempervirens* from two widely separated colonies in Clarke Co. and from one colony in Oglethorpe Co., Georgia were transplanted for observation to the senior author's premises east of Athens, Georgia. Plants from all three colonies grew in close proximity and have flowered yearly since 1955. All had pin type flowers. No other *Gelsemium* plants are known nearer than four miles. None of the plants planted east of Athens produced fruits for eight years. On 1 April 1963 pollen from thrum type flowers was placed on the stigmas of about 50 pin type flowers of these plants. That Fall many more than 50 fruits were harvested, several of these from plants whose flowers had received no introducd pollen from the hands of the senior author. Presumably insects had carried the introduced thrum type pollen from stigma to stigma. No artificial pollinations were attempted during 1964 and again no fruits developed.

Also on 1 April 1963 branches bearing thrum type flowers in a colony of *G. sempervirens* south of Athens were carefully pruned of all opened flowers and developing fruits and enclosed in plastic bags. On the following day bags were removed and opened flowers were tagged and treated as follows: five were self pollinated, and ten received pollen from pin flowers of the isolated plants east of Athens. The bags were replaced and left on the branches until the corollas of the pollinated flowers had dropped off. That Fall six fruits had developed on flowers that had received pollen from pin type flowers and no fruits on the self-pollinated thrum type flowers.

We believe that the above data indicate that pin type plants of *G. sempervirens* are self sterile in nature and cross fertile to pollen from thrum type flowers, and possibly that thrum type flowers are self sterile and cross fertile. The latter two conclusions need to be checked by further experiments. The senior author plans to grow progeny of the isolated plants that had received pollen from the thrum type flowers in order to determine ratios of the F_1 generation for that cross. It is hoped to make additional reciprocal crosses and successful selfing experiments in order to determine the genetics of heterostyly in the two species of *Gelsemium.*

Some studies were also made of the ratio in nature of plants bearing pin and thrum type flowers. Several large population samples taken in limited areas gave quite varied results, the flowers sometimes being largely of one type or the other. Since *Gelsemium* reproduces abundantly vegetatively, a sampling was made in the field at broader intervals. No sample was taken nearer than a mile to another. They were made 27-30 March 1963 from McDuffie and Baldwin Cos., Ga. south to Duval and Suwanee Cos., Fla. For *G. sempervirens* there were 34 pin type and 38 thrum type flowers and for *G. rankinii* 10 pin and 9 thrum type. These indicate a 1:1 ratio.

Counts from herbarium specimens strongly indicate the same ratio. Specimens borrowed from other herbaria were utilized and all duplicates eliminated. All flowering specimens of *G. rankinii* were tabulated as to type. The results were 21 pin and 20 thrum type (see Table 1). Counts from herbarium specimens of *G. sempervirens* gave 111 pin and 108 thrum type. Nine pin type specimens were omitted from the above number. They were the nine available collections from Orange Co., N. C., all of which had pin type corollas. After studying the accompanying herbarium labels and discussing the data with someone familiar with the localities involved, we concluded that all nine specimens were most likely propagated from the same clone.

As has been pointed out by Crosby (1949), Ray and Chisaki (1957), and others, a 1:1 ratio, or close to it, indicates self sterility of pin and thrum type flowers and an entirely outcrossing population. Our studies of ratios, therefore, confirm the conclusions of our breeding studies that both pin and thrum type flowers are self sterile and are cross fertile.

CHROMOSOMAL STUDIES

A chromosome number of $2n=16$ has been reported for *G. sempervirens* by Moore (1947). After vain attempts to repeat Moore's method using leaf tips, root tips were taken of rooting sections of stems and the $2n$ number of 16 was verified for this species by using a Feulgen squash method.

The chromosome number for *G. rankinii* is unreported in literature. The Feulgen squash method was tried with inconclusive results on root tips from roots of layered stems of this species. It was, however, determined that active mitotic division occurred about 11:00 P.M. At this point in the studies we turned to cross sectioned root tips. Root tips were placed in a modification of Navashin's Fluid Fixitive described by Sass (1958), sectioned, stained by a modification of Newton's Gentian Violet-Iodine method described by Johansen (1940), and mounted in balsam.

From root tip material collected during the latter part of June, 1964, mitotic metaphase counts of $2n=8$ were obtained. A voucher specimen (Duncan 22020) is on deposit in the University of Georgia Herbarium (sheet No. 74279). A sample chromosome plate is shown in the inset of Fig. 1. The chromosomes are approximately 1 to 3 μ in length. Occasionally cells with approximately 16 (in the outer three rows of root cells) and rarely with 9 or 10 chromosomes were seen. Moore (1947) reported for *G. sempervirens* chromosomes 1.3-3 μ in length and occasional polyploid cells and cells with intermediate numbers in leaf smears.

Indications from stomatal and pollen data presented earlier that *G. rankinii* had a smaller number of chromosomes are thus confirmed by the determination of a $2n$ number of 8.

CONCLUSION

Our studies show that there are two distinct species of *Gelsemium* in North America and that there is probably no introgression between them. Hybrids were not detected and should not be expected in abundance since one species is diploid and the other is tetraploid.

The determination of the chromosome number of $2n=8$ for *G. rankinii* lowers the known n numbers for the Longaniaceae and the basic number for *Gelsemium* to 4. Darlington and Wylie (1955) had reported the basic number for *Gelsemium* as 8. Moore (1947) had previously cited a report of $n=6$ for two species of *Fagraea* which belongs to the same subfamily as *Gelsemium*. He suggested on the basis of cytological evidence that *Gelsemium* might have a genetic link with one branch of the Apocynaceae which are characterized by a haploid number of 8. Moore also suggested that *Gelsemium* may have diverged from an ancient line which produced the Apocynaceae. The basic chromosome number of 4 for *Gelsemium* seems to support Moore's suggestion that divergence may have occurred at such a distant time that *Gelsemium* can not be regarded, on morphological grounds, as a true member of the Apocynaceae.

Our cytological evidence indicates that *G. sempervirens* was derived more recently and probably from *G. rankinii*. Distributional data in the southern United States also indicate such a relationship. *G. rankinii* is confined to wet habitats of a limited area of the Coastal Plain (Fig. 1), while *G. sempervirens*, being a tetraploid and probably more vigorous, occurs in a variety of habitats (wet to very dry) and occupies a much wider area (Fig. 2). The reported occurrence of *G. sempervirens* in the disjunct Mexican-Guatemalan region and the apparent absence of *G. rankinii* from there could be taken to indicate that the former species is the ancestral one. Before serious conclusions involving distributions in the Mexican-Guatemalan region are made, however, the identity of all collections of *Gelsemium* from there should be checked and the absence of *G. rankinii* verified by additional studies. Most persons dealing with the flora of that region are probably unfamiliar with *G. rankinii*.

Although pin type plants are generally heterozygous and the thrum type homozygous recessive (Ray and Chisaki, 1957; et al.), we have no evidence that this is the case in *Gelsemium*. Additional breeding experiments are needed to determine the genetic makeup of the two forms as well as the extent of self sterility, especially for thrum type plants.

Our studies also have added to those known situations in which stomatal size and density, and size of pollen are correlated with ploidal levels.

We wish to thank those curators who permitted examination of collections at his herbarium, loaned specimens to us, and provided information for the study. The junior author, who worked on this study for ten weeks during the summer, 1962, received support from National Science Foundation Grant (G-20468). Martha Gordon and William L. Cleeg, who made studies of the epidermis and pollen, received support from National Science Foundation Grant (G-20296). The help of Wesley Walraven in making chromosomal studies of *G. rankinii* is appreciated.

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TEXAS ASCLEPIADACEAE OTHER THAN ASCLEPIAS

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Woodson's drastic reduction in the number of genera of Asclepiadaceae in 1941 was certainly welcome. But for the botanist having to make routine identifications or attempting local or regional studies within the United States, the years since have been a time of continuing frustration. Only the original, highly technical key to the revised genera using inconvenient pollen characters, has been available; the genera themselves were listed without descriptions, and only two *(Asclepias* and *Sarcostemma)* have been monographically treated; several needed nomenclatural changes have remained unpublished; and, for Texas in particular, a new species and a new variety have gone undescribed. This paper has been prepared in order to clear up some of the loose ends and to provide a working guide for identification. It is based chiefly on collections in the S.M.U. Herbarium and in that of the University of Texas; for the loan of the latter I am indebted to Drs. B. L. Turner and Marshall C. Johnston. Some additional material was examined on visits to the Missouri Botanical Garden, and several critical specimens were kindly loaned by Mr. Fred B. Jones of Corpus Christi, Texas, from his personal herbarium.

Supplementing the account of the Texas representatives, I have added some routine new combinations for plants found outside the state, a key to Southeastern *Cynanchum* (owing to lack of adequate flowering material I have not yet completed one for *Matelea* in the same region; *Sarcostemma clausum* (Jacquin) Roemer & Schultes in southern Florida is the only Southeastern member of that genus), and a finding-list of generic names. The key to genera given below can also be used for the Southeast except that the introduced *Cryptostegia grandiflora* R. Brown, established in southern Florida, must be added. This is immediately separable from all the other genera by its extremely large flowers, with funnelform corolla 4—6 cm. long; in the rest the corolla (or its lobes, if spreading or reflexed) is 0.2—2.0 cm. long.

KEY TO GENERA

1a. Stamen column or its base surrounded by 5 separate, fleshy-inflated or fleshy-thickened, erect or spreading appendages
  2a. Stems prostrate to erect, not twining; base of corolla not with fleshy disk under the separate appendages
    3a. Leaves not both cordate and petioled; corolla green to white, yellow, orange, red, brown, or purple; wild or cultivated . . . . . 1. *Asclepias*

SIDA 1 (6): 358—367. 1694.

3b. Leaves both cordate and petioled; corolla lavender-blue; cultivated . . . . 2. *Oxypetalum*

2b. Stems twining, at least toward tips; corolla with a fleshy disk at base under the appendages . . . . 4. *Sarcostemma*

1b. Stamen column or its base with 1 or 2 rows of flat, thin appendages, or a single, entire or lobed, fleshy disk or cup

4a. Appendages thin and flat, in 2 rows, or a single, entire or lobed, fleshy disk or cup . . . . 5. *Matelea*

4b. Appendages thin and flat, in 1 row

5a. Corolla funnelform or campanulate, 2.0—6.2 mm. long; wild herbaceous vines (sometimes weeds in gardens) . . 3. *Cynanchum*

5b. Corolla rotate, its narrowly oblong lobes about 10 mm. or more long; cultivated woody vine . . . . 6. *Periploca*

1. ASCLEPIAS, with about 32 species, will not be discussed further here; no new names are required for Texas representatives, so far as known. 2. OXYPETALUM has only one infrequently cultivated species in the state, *O. caeruleum* Decaisne, with densely soft-pubescent leaves; native of Argentina.

3. CYNANCHUM.

Small to large twining vines. Corolla white to yellowish or yellow-green, rather small. Five species.

1a. Leaf blades with cordate base

2a. Appendages nearly as long as the corolla, deeply divided into linear segments (resembling staminodes) . . . . . 1. *C. laeve*

2b. Appendages less than 2/3 as long as the corolla, broadly oblong with toothed or lobed summit . . . . 2. *C unifarium*

1b. Leaf blades with narrowed to rounded-truncate base

3a. Flowers rather numerous, terminating naked peduncles longer than the pedicels; corolla lobes glabrous within; leaf blades linear-lanceolate, the larger 4—9 cm. long . . . . . . 3. *C. palustre*

3b. Flowers solitary or few, peduncles very short or absent; corolla lobes pilose or pubescent within; leaf blades lanceolate to oblong-elliptic, 1—4 cm. long

4a. Corolla lobes conspicuously pilose within; appendages lance-linear to linear-filiform, 1½—2 times as long as the stamen column

5a. Corolla 3.6—5.2 mm. long . 4a.*C. barbigerum* var. *barbigerum*

5b. Corolla 2.8—3.2 mm. long . 4b. *C. barbigerum* var. *breviflorum*

4b. Corolla lobes rather minutely pubescent within; appendages narrowly lanceolate to ovate-acuminate, slightly longer than the stamen column . . . . 5. *C. Maccartii*

1. C. LAEVE (Michaux) Persoon. *Enslenia albida* Nuttall. *Ampelamus albidus* (Nuttall) Britton. In a north-south belt a little east of the center of the state, from Clay, Cooke, and Grayson counties south to Matagorda County. Flowering August—September. In Gould's Texas Plants this is listed both as *Ampelamus* and as *Cynanchum*, and assigned

two entirely different distributions. It is absent from the extreme eastern part of the state, where limestone is absent. Its preferred natural habitat is low ground in limestone areas; it is frequently a weed in flower beds.

2. C. UNIFARIUM (Scheele) Woodson. *Rouliniella unifaria* (Scheele) Vail. Including *Roulinia Palmeri* S. Watson, *Cynanchum Watsonianum* Woodson. The slight difference in size and toothing of the appendages hardly justifies recognition of a second species. Very similar in general appearance to the preceding. Edwards Plateau to Trans-Pecos and Rio Grande Plain, north to Parker and Taylor counties, southeast locally to Brazos (in shrubbery on Texas A. & M. campus, possibly introduced), Bastrop, and San Patricio counties; also in northeastern Mexico. Flowering mid May—October. In alluvial habitats, like *C. laeve,* but also in drier ground, often in rocky or sandy soils.

3. C. PALUSTRE (Pursh) Heller. *Lyonia palustris* (Pursh) Small. *Seutera palustris* (Pursh) Vail. Local along the Gulf Coast; specimens seen from Aransas, Galveston, and Kenedy counties. Flowering April—September.

4. C. BARBIGERUM (Scheele) Shinners, Field & Lab. 19: 65. 1951. *Metastelma barbigerum* Scheele. Type from New Braunfels, Comal Co.

4a. C. BARBIGERUM var. BARBIGERUM. Common on the southern Edwards Plateau from Travis, Llano, Mason, and Terrell counties south, and on the Rio Grande Plain, east to Karnes and Refugio counties; apparently rare in the Trans-Pecos (Brewster Co.), but the two specimens seen from that area, with somewhat small flowers (corolla 3.6 and 3.7 mm. long), may prove to be only exceptional forms of the next variety. Also in northeastern Mexico. Flowering March (in extreme south) or April—September.

4b. C. BARBIGERUM var. **breviflorum** Shinners, var. nov. Corolla minor 2.8—3.2 mm. longa (vice 3.6—5.2 mm.). HOLOTYPE: Big Bend National Park, Chisos Mountains, granite peak in center of Basin, alt. 5500 ft.; common, twining over low shrubbery; corolla white, *Grady L. Webster 4340,* 15—19 July 1952 (SMU). Largely if not wholly replacing var. *barbigerum* in the Trans-Pecos, mainly in igneous rock areas; also in Chihuahua. Flowering June—August.

5. C. **Maccartii** Shinners, nom. nov. Based on *Metastelma Palmeri* S. Watson, Proc. Amer. Acad. 18: 115. 1883. *Cynanchum Palmeri* (S. Watson) Shinners, Field & Lab. 19: 65. 1951. (Not *C. Palmeri* (S. Watson) Blake, 1917, based on *Pattalias Palmeri* S. Watson.) Very similar in general appearance to *C. barbigerum,* especially the small-flowered var. *breviflorum.* Type collected "at Laredo on the Rio Grande." Rather rare, Rio Grande Plain (Duval Co.) north and west to Uvalde and Val Verde counties; also in northeastern Mexico. Named for William Larrey McCart, Head of the Science Department, Laredo Junior College.

4. SARCOSTEMMA.

Small to moderately large twining vines (small plants twining only at tips of stems). Flowers umbellate, terminating naked peduncles. Corolla shallowly campanulate, medium large (lobes 6—11 mm. long), greenish to creamy white, pink, purple-green or purple. Three species.

1a. Sepals narrowly lanceolate, more than 3 times as long as wide . . . . 1. *S. crispum*
1b. Sepals lanceolate to ovate, less than 3 times as long as wide
  2a. Sepals 4—6 mm. long, pubescent on both surfaces; stems usually densely pubescent . . . . 2. *S. Torreyi*
  2b. Sepals 2—3 mm. long, pubescent on back only; stems globrous or sparsely pubescent
    3a. Leaf blades (except smallest) 1—3 times as long as wide . . . . 3a. *S. cynanchoides* var. *cynanchoides*
    3b. Leaf blades 3—12 times as long as wide . . . . 3b. *S. cynachoides* var. *Hartwegii*

1. S. CRISPUM Bentham. Including *S. lobatum* Waterfall, Rhodora 51: 58. 1949. *Philibertella crispa* (Bentham) Vail. *Funastrum crispum* (Bentham) Schlechter. Glabrous or inconspicuously pubescent. Leaf blades narrowly triangular-lanceolate with deeply cordate base, varying to linear-lanceolate with abruptly narrowed base, the margin usually (but not aways) ruffled or crisped. Frequent in Trans-Pecos, occasional east and northeast on Edwards Plateau to Travis and McLennan counties, in the Panhandle, Red Plains, and West Cross Timbers (Callahan and Palo Pinto counties); collected at West Dallas by Reverchon, noted as "local and very rare," not found there recently. Flowering late April—early August.

2. S. TORREYI (Gray) Woodson. *Philibertella Torreyi* (Gray) Vail. *Funastrum Torreyi* (Gray) Schlechter. Trans-Pecos, rather rare; known from Brewster and Presidio counties, Flowering June—August. Very similar in general appearance to *S. cynanchoides* var. *cynanchoides*, with slightly larger flowers.

3. S. CYNANCHOIDES Decaisne. *Philibertella cynanchoides* (Decaisne) Vail. *Funastrum cynanchoides* (Decaisne) Schlechter. The commonest species, with two intergrading varieties.

3a. S. CYNANCHOIDES var. CYNANCHOIDES. Leaf blades triangular-ovate with cordate base. Frequent from Trans-Pecos to lower Rio Grande Plain, Edwards Plateau, Panhandle, and Red Plains, rare in West Cross Timbers (Parker) and along Red River to Grayson County. Flowering June—September.

3b. S. CYNANCHOIDES var. **Hartwegii** (Vail) Shinners, comb. nov. *Philibertella Hartwegii* Vail, Bull. Torr. Bot. Club 24: 308. 1897. *Sarcostemma cynanchoides* ssp. *Hartwegii* (Vail) R. Holm, Ann. Mo. Bot. Gard. 37: 530. 1950. The epithet heterophyllum has been applied to this plant, in various combinations; according to Dr. Holm, its type specimen is actually a form of *S. crispum*. Leaf blades lanceolate to linear with an abruptly wider hastate or cordate base, or without wider base. Frequent in the Trans-Pecos. Flowering April—September.

5. MATELEA.

Plants herbaceous, prostrate to suberect and rather small, or small to large twining vines, nearly glabrous or variously pubescent or pilose. Flowers small to medium large; corolla green to yellowish, brown-red, or purple-brown. Eleven species.

1a. Stems prostrate to suberect, not at all twining
  2a. Peduncles absent (pedicels attached directly in leaf axils); stamen column with a single, lobed, fleshy disk around base
    3a. Pedicels shorter than or equalling the adjacent petioles . . . . 1. *M. biflora*
    3b. Pedicels (except lowest) exceeding the adjacent petioles . . . . 2. *M. cynanchoides*
  2b. Peduncles well-developed; stamen column surrounded by a double row of thin appendages
    4a. Outer appendages wider than long, slightly shorter to slightly longer than the stamen column, truncate to shallowly 3-lobed at summit . . . . 3. *M. brevicoronata*
    4b. Outer appendages longer than wide, slightly to much longer than the stamen column, prominently 2-pronged or 2-pointed at summit or rarely some of them single-pointed . . . . 4. *M. parviflora*
1b. Stems twining, at least toward tips
  5a. Flowers at middle and upper leaf axils on peduncles shorter than the pedicels, or without peduncles; plants small, semi-trailing or low-climbing
    6a. Corolla lobes 3—4 mm. long . . . . 5. *M. parvifolia*
    6b. Corolla lobes 7—12 mm. long
      7a. Peduncles absent; flowers solitary or paired, short-pedicelled
        8a. Crown (appendage around stamen column) saucer-shaped, entire; Trans-Pecos mountains (Jeff Davis Co.) . . . . 6. *M. sagittifolia*
        8b. Crown cup-shaped or short-cylindric, the margin 5-parted; Rio Grande Plain west to Val Verde Co. . . 7. *M. Woodsonii*
      7b. Peduncles present except in uppermost leaf axils, 1—5 flowered . . . . 8. *M. producta*
  5b. Flowers all on elongate peduncles; medium to large climbing vines
    9a. Corolla lobes oblong-lanceolate to linear, not reticulate-veined
      10a. Sepals glabrous or sparsely hispid . . . . 9. *M. gonocarpa*
      10b. Sepals both hispid and short-pubescent . . 10. *M. decipiens*
    9b. Corolla lobes ovate, finely reticulate-veined on upper surface . . . . 11. *M. reticulata*

1. M. BIFLORA (Rafinesque) Woodson. *Vincetoxicum biflorum* (Rafinesque) Heller. Common on the Blackland Prairie of north central Texas, west and south to Lubbock, Sutton, Travis, Gonzales, and Bastrop

counties; on clayey, rocky, or less often sandy soils. This is another of the species originally described from "Arkanzas," meaning the Arkansas Territory, actually collected in present Oklahoma, persistently credited to the present state of Arkansas, where so far as I know it does not occur. Flowering April—June, rarely September.

2. M. CYNANCHOIDES (Engelmann) Woodson. *Vincetoxicum cynanchoides* (Engelmann) Heller. In northern and central Texas, from western part of Pine Belt (Upshur Co.) west to West Cross Timbers (Young Co.), south to Goliad Co., in sandy soil; frequent. Flowering April—August.

3. M. BREVICORONATA (B. L. Robinson) Woodson. *Gonolobus parviflorus* var. *brevicoronatus* B. L. Robinson. *Vincetoxicum brevicoronatum* (B. L. Robinson) Vail. Type collected at Laredo by Pringle. Rare, in lower Rio Grande Plain, in sandy or gravelly soils; specimens seen from Hidalgo, Kenedy, and Webb counties. Flowering March—September. Found wholly within the range of the next species, and distinguishable from it only by the appendages within the flower. Robinson says that it also differs in having a corolla that is not reflexed, but he must have seen flowers that were not yet fully developed; at full maturity the corolla is distinctly reflexed.

4. M. PARVIFLORA (Torrey) Woodson. *Vincetoxicum parviflorum* (Torrey) Heller. Frequent in Rio Grande Plain, northeast to Karnes County, west to Webb County, in sandy or gravelly soils. Flowering late March—October. A pathological plant from Dimmit Co. (west of Artesia Wells, *Harold Gentry 1479;* SMU) has much-branched inflorescences with mostly malformed flowers, some proliferous, a pedicel or branch arising from the flower center.

5. M. PARVIFOLIA (Torrey) Woodson. *Gonolobus parvifolius* Torrey in Emory, Rept. U.S. & Mex. Bound. Surv. 2 (Botany): 166. 1859. "Sides of hills, cañon of the Rio Grande, below Mt. Carmel, October; *Parry.*" (A second specimen cited from "near the Limpia," Wright; this was later referred by Gray to the next species.) The Sierra del Carmen is in Coahuila, and it is most probable that Parry collected this plant on the Mexican side, as he did the type of *Chaetopappa Parryi;* it was merely Gray's ignorance of local geography that led him to specify "Texas" in the Synoptical Flora. I have seen no specimens of this, either from Texas or elsewhere; it is included in the Kearney & Peebles *Arizona Flora* and the Munz & Keck *California Flora.*

6. M. **sagittifolia** (Gray) Woodson in herb., ined. *Gonolobus sagittifolius* Gray, Proc. Amer. Acad. 12: 77. 1876. Type from "Rio Limpio," Jeff Davis Co., Texas, *Wright.* Described as having single, saucer-shaped, entire crown. As long ago as 1942 Dr. Woodson used the binomial *Matelea sagittifolia* in identifying plants from the Rio Grande Plain, geographically remote from the type locality and differing in critical details of the crown. The name is not among the numerous transfers made by him

in 1941, and it has remained unpublished until now. The species is evidently very rare; I have seen no specimens, but the original description is quite clear.

7. M. **Woodsonii** Shinners, sp. nov. E descriptione *M. sagittifoliae* peraffinis sed corona cupulata vel brevicylindrica margine 5-fida. HOLOTYPE: 8 miles northeast of Rio Grande City, Starr Co., Texas, *Lundell & Lundell 9926,* 3 April 1941 (SMU). "Herbaceous vine, corolla green. In scrub on sand." Two other collections seen, both from Texas. Kleberg Co.: about 5 miles southeast of Ricardo, *Fred B. Jones 2816,* 9 March 1959 (in private herb. Fred B. Jones). "On sandy slope near ravine. Twining on Castela. Fls. greenish yellow." Val Verde Co.: rocky (limestone) hills above dam at foot of Devils Lake, about 20 miles N.N.W. of Del Rio, *Rogers McVaugh 7727,* 31 March 1947 (SMU, TEX). "Scarce; woody vine; corolla yellow-green." It is this species which is reported as *M. producta* in *Flowering Plants and Ferns of the Texas Coastal Bend Counties* by Jones, Rowell and Johnston (1961, pp. 10—11).

8. M. PRODUCTA (Torrey) Woodson. *Vincetoxicum productum* (Torrey) Vail. Leaf blades triangular-ovate, deeply cordate, soft-pubescent, mostly 2—7 cm. long (two to four times as long as those of the two preceding species). Rocky slopes, confined to the Trans-Pecos; specimens seen from Brewster, El Paso, and Jeff Davis counties. Flowering April—August.

9. M. GONOCARPA (Walter) Shinners, Field & Lab. 18: 73. 1950. *Vincetoxicum gonocarpos* Walter. *Gonolobus gonocarpos* (Walter) Perry. In a nearly north-south belt a little east of the center of the state, from Cooke, Parker, and Dallas counties south to Comal, Karnes, and Brazos counties, in steam-bottom thickets. Flowering late May—August.

10. M. DECIPIENS (Alexander) Woodson. *Odontostephana decipiens* Alexander. *Gonolobus decipiens* (Alexander) Perry. Occasional in eastern part of north central Texas (specimens seen from Grayson, Henderson, Hunt, and Wood counties), in sandy woods. Flowering April—May.

11. M. RETICULATA (Engelmann) Woodson. *Vincetoxicum reticulatum* (Engelmann) Heller. Rather common from West Cross Timbers (Palo Pinto Co.) south through the Edwards Plateau and Rio Grande Plain, east in the middle parts of its range to Bastrop and San Patricio counties, west to the eastern Trans-Pecos (Brewster and Pecos counties); also in northeastern Mexico. In thickets or brush, rocky or silty ground. Flowering March (far south), April, or May (at northern limits) to October.

6. PERIPLOCA.

P. GRACEA L. is rarely cultivated and may persist, as indicated by the following collection. Dallas Co.: from yard in White Rock area, Dallas. Plant originally found on fence line near house at an old farm on Gus Thomasson Road, now real estate development. Blackland soil, flowers purple. *Anne Estelle Orr 297,* 4 May 1958. (SMU). Fernald in the

8th edition of Gray's *Manual* reports this as escaped in the northeastern United States and as far southwest as Oklahoma.

SUPPLEMENTARY TRANSFERS AND NOTES

CYNANCHUM **arizonicum** (Gray) Shinners, comb. nov. *Metastelma arizonicum* Gray, Proc. Amer. Acad. 19: 85. 1883.

CYNANCHUM **Blodgettii** (Gray) Shinners, comb. nov. *Metastelma Blodgettii* Gray, Proc. Amer. Acad. 12: 73. 1877.

CYNANCHUM **Wigginsii** Shinners, nom. nov. *Metastelma ? angustifolium* Torrey in Emory, Rept. U.S. & Mex. Bound. Surv. 2 (Botany): 159. 1859. *Melinia angustifolia* (Torrey) Gray, Proc. Amer. Acad. 12: 70—73. 1876. *Basistelma angustifolium* (Torrey) Bartlett, Proc. Amer. Acad. 44: 632. 1909. Not *Cynanchum angustifolium* Persoon, 1806. Named in honor of Dr. Ira L. Wiggins, indefatigable student of the flora of the Sonoran Desert.

KEY TO SOUTHEASTERN CYNANCHUM

1a. Leaf blades (at least middle and lower) with cordate base
  2a. Appendages deeply divided into linear segments nearly equalling the corolla . . . . *C. laeve*
  2b. Appendages forming a short crown with rounded lobes . . . . *C. cubense*
1b. Leaf blades tapered to rounded-truncate at base
  3a. Corolla lobes glabrous within or nearly so
    4a. Calyx lobes triangular-ovate, obtuse . . . . . *C. scoparium*
    4b. Calyx lobes lanceolate, acute . . . . *C. palustre*
  3b. Corolla lobes pubescent or pilose within
    5a. Corolla about 3 mm. long, the lobes pilose within toward tip; leaf blades linear-lanceolate, 1—4 mm. wide . . *C. Blodgettii*
    5b. Corolla about 4 mm. long, the lobes densely pubescent within; leaf blades oblong-lanceolate or oblong-elliptic, 6—18 mm. wide . . . . *C. Northropiae*

C. laeve and *C. palustre* are included with the Texas species; the new combination *C. Blodgettii* (Gray) Shinners is published above; authorities for the other species are *C. cubense* (Grisebach) Woodson, *C. Northropiae* (Schlechter) Alain, *C. scoparium* Nuttall.

SARCOSTEMMA BILOBUM Hooker var. **Lindenianum** (Decaisne) Shinners, comb. nov. *S. Lindenianum* Decaisne in DC., Prodr. 8: 541. 1844. *S. bilobum* ssp. *Lindenianum* (Decaisne) R Holm, Ann. Mo. Bot. Gard. 37: 519. 1950.

MATELEA **albomarginata** (Pittier) Shinners, comb. nov. *Exolobus albomarginatas* Pittier, Contrib. U.S. Nat. Herb. 13: 108. 1910. *Gonolobus Albomarginatus* (Pittier) Woodson, Ann. Mo. Bot. Gard. 28: 242. 1941.

MATELEA **aristolochiaefolia** (Brandegee) Shinners, comb. nov. *Fischeria aristolochiaefolia* Brandegee, Univ. Calif. Publ. Bot. 6: 190. 1915. *Gonolobus aristolochiaefolius* (Brandegee) Woodson, l.c.

MATELEA **arizonica** (Gray) Shinners, comb. nov. *Lachnostoma arizonicum* Gray, Proc. Amer. Acad. 20: 296. 1885. *Gonolobus arizonicus* (Gray) Woodson l.c. 243.

MATELEA **calycosa** (J. D. Smith) Shinners, comb. nov. *Fimbristemma calycosa* J. D. Smith, Bot. Gaz. 16: 196. 1891. *Gonolobus calycosus* (J. D. Smith) Woodson, l.c. 242.

MATELEA **chiapensis** (Brandegee) Shinners, comb nov. *Vincetoxicum chiapense* Brandegee, Univ. Calif. Publ. Bot. 6: 190. 1915. *Gonolobus chiapensis* (Brandegee) Woodson, lc.

MATELEA **cteniophora** (Blake) Shinners, comb. nov. *Vincetoxicum cteniophorum* Blake, Contrib. Gray Herb. 52: 84. 1917. *Gonolobus cteniophorus* (Blake) Woodson, l.c. 243.

MATELEA **Greenmanii** Shinners, nom. nov. *Lachnostoma gonoloboides* Greenman, Proc. Amer. Acad. 39: 84. 1903. *Gonolobus gonoloboides* (Greenman) Woodson, l.c. 243. Not *Matelea gonolobides* (Robinson & Greenman) Woodson, 1941.

MATELEA **Johnstonii** Shinners, nom. nov. *Gonolobus stenopetalus* Gray, Proc. Amer. Acad. 21: 398. 1886. *Matelea stenopetala* (Gray) Woodson, l.c. 231. Not *M. stenopetala* Sandwith, Kew Bull. 1931: 485. The type of Gray's species was collected by Pringle at Chihuahua, but the epithets obviously suggested by collector and locality are both already used in the genus. I have therefore renamed it in honor of Dr. Marshall C. Johnston, energetic collector and keen student of the floras of both Texas and Mexico.

MATELEA **lasiostemma** (Hemsley) Shinners, comb. nov. *Lachnostoma lasiostemma* Hemsley, Biol. Centr.-Am. Bot. 2: 335. 1882. *Gonolobus Lasiostemma* (Hemsley) Woodson *(sic)*, l.c. 243.

MATELEA **oblongifolia** (J.D. Smith) Shinners, comb. nov. *Trichostelma oblongifolium* J. D. Smith, Bot. Gaz. 48: 296. 1909. *Gonolobus oblongifolius* (J. D. Smith) Woodson, l.c. 243.

MATELEA **Smithii** Shinners, nom. nov. *Fimbristemma stenosepala* J. D. Smith, Bot. Gaz. 18: 208—209. 1893. *Gonolobus stenosepalus* (J. D. Smith) Woodson, l.c. 243. Not *Matelea stenosepala* Lundell, 1942.

MATELEA **stenantha** (Standley) Shinners, comb. nov. *Vincetoxicum stenanthum* Standley, Field Mus. Publ. Bot. Ser. 4: 255. 1929. *Gonolobus stenanthus* (Standley) Woodson, l.c. 243.

FINDING-LIST OF GENERIC NAMES

The following list is of the generic names used in Gray's *Synoptical Flora*, Small's *Flora of the Southeastern United States* and *Manual of the Southeastern Flora*, and Kearney & Peebles' *Arizona Flora*. A few of the names are only in the sense used in one or more of these floras, not as to proper type. The names in CAPITALS are those finally adopted by Woodson, with the minor emendation of reducing *Gonolobus* to another synonym of *Matelea*. The introduced Old World genera *Cryptostegia* and *Periploca* were not among those discussed by Woodson.

Acerates=ASCLEPIAS
Ampelamus=CYNANCHUM
Amphistelma=CYNANCHUM
Anantherix=ASCLEPIAS
ASCLEPIAS (incl. Acerates, Anantherix, Asclepiodella, Asclepiodora, Biventraria, Gomphocarpa, Oxypterix, Podostigma, Schizonotus)
Asclepiodella=ASCLEPIAS
Asclepiodora=ASCLEPIAS
Astephanus=CYNANCHUM
Basistelma=CYNANCHUM
Biventraria=ASCLEPIAS
CRYPTOSTEGIA
Cyclodon=MATELEA
CYNANCHUM (incl. Amphistelma, Astephanus, Basistelma, Epicion, Lyonia, Melinia, Mellichampia, Metalepis, Metastelma, Roulinia, Rouliniella, Seutera, Vincetoxicum in part)
Edisonia=MATELEA
Epicion=CYNANCHUM
Funastrum=SARCOSTEMMA
Gomphocarpa=ASCLEPIAS
Gonolobus=MATELEA
Himantostemma=MATELEA
Lachnostoma=MATELEA
Lyonia=CYNANCHUM
MATELEA (incl. Cyclodon, Edisonia, Gonolobus, Himantostemma, Lachnostoma, Odontostephana, Pherotrichis, Rothrockia, Vincetoxicum in part)
Melinia=CYNANCHUM
Mellichampia=CYNANCHUM
Metalepis=CYNANCHUM
Metastelma=CYNANCHUM
Odontostephana=MATELEA
OXYPETALUM
Oxypteris=ASCLEPIAS
PERIPLOCA
Pherotrichis=MATELEA
Philibertella=SARCOSTEMMA
Philibertia=SARCOSTEMMA
Podostigma=ASCLEPIAS
Rothrockia=MATELEA
Roulinia=CYNANCHUM
Rouliniella=CYNANCHUM
SARCOSTEMMA (incl. Funastrum, Philibertia, Philibertella)
Schizonotus=ASCLEPIAS
Seutera=CYNANCHUM
Vincetoxicum=CYNANCHUM (Gray's species), MATELEA (Small's species)

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NEW OR OTHERWISE INTERESTING COREOPSIDINAE (COMPOSITAE) FROM NORTHWESTERN SOUTH AMERICA

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Recently I was sent for examination a small lot of herbarium specimens from the Smithsonian Institution, Washington, D.C. The lot was found to contain one new species and one new variety of *Bidens* L. and one new species and one new variety of *Coreopsis* L., also specimens representing a range extension of one previously described species of *Coreopsis*, and one specimen representing an isotype (or type?) of *C. holodasya* Blake. For the privilege of examining these specimens, I must express here my indebtedness to Dr. Lyman B. Smith, Curator of the Division of Phanerogams at the Smithsonian Institute. To assist me in surveying all the known taxa in the genus *Coreopsis* for South America, I have been particularly fortunate in being permitted to borrow all the mounted photographs (79 herbarium sheets in all) belonging to the Chicago Natural History Museum and representing South American taxa in *Coreopsis*. For this privilege, I take pleasure in expressing my gratitude to Mr. E. Leland Webber, Director of the Chicago Natural History Museum, and to Mr. J. R. Millar of the Department of Botany in that institution.

BIDENS HOLWAYI Blake & Sherff, var. **colombiana** var. nov.—Frutex, scandens, magnus, demum probabiliter saltem 5-10 m. altus; caule ramisque tetragonis sulculatisque, glabratis. Folia petiolata petiolis gracilibus 1.5-4.5 cm. longis basi connatis et hispido-ciliatis, petiolo adjecto 6-15 cm. longis pinnatim 3- vel 5-partita, foliolis membranaceis lanceolatis rarius ovato-lanceolatis apice attenuato-acuminatis, lateralibus subsessilibus vel tenuiter petiolulatis petiolulis usque ad 7 mm. longis, supra dense viridibus et sparsim adpresso-hispidulis, infra subgriseis densius longiusque hispidis, marginibus acriter serratis dentibus acerrime mucronulatis. Capitula subcorymbose ad ramorum fines (pedunculos tenues glabros sulculatos usque ad 2 dm. longos) adgregata, radiata, pansa ad anthesin, ±4 cm. lata et 2-2.3 cm. alta. Involucri patellati viridisque basaliter glabrati vel subdense reflexo-hispidi bracteae exteriores patentes vel demum reflexae 10-14, elongatae, 1-2.2 cm. longae, oblonge lineares basim versus sensim angustatae apice acutae, longitudinaliter 1- vel 3-7-nerviae marginibus ciliatae faciebus subglabratae; interiores fere dimidio breviores, oblongo-lanceolatae, extus glabrae vel apice pubescentes, multistriatae. Flores ligulati ±3 (sine dubio saepius circ. 5), flavi, ligula lineares, circ. 10- vel 12-nervii, ±1.5 cm. longi, apice acriter angusteque circ. 3-denticulati. Paleae angustae, lineares, tenerrimae, striatae, sub 1 cm. longae. Achaenia obcompressa, anguste linearia, corpore 16-22 mm. longa et 1-1.3 mm. lata, atra, faciebus glabra et angustissime sulculata marginibus acriter setuloso-ciliata, apice recte setosa et biaristata aristis gracilibus divergentibus circ. 5-6 mm. longis, fulvis, retrorsum hamosis.

Specimens examined: *José Cuatrecasas & R. Romero Castaneda* 25156, "climber, leaves dark green, involucre green," Andean forest and bushes, 2700-2800 m. alt., Quebrada de Floridablanca, Sierra de Perijá, Magdalena, Colombia, Nov. 9, 1959 (2 topotype sheets, US, where label on one sheet reads "corolla lilac," surely an error; rays, which doubtless are meant, are lacking, but *cf.* description for no. 25223 *sequ.); Cuatrecasas & Castaneda* 25223, climbing shrub; leaves green above, grayish beneath; ligules yellow, florets yellow; Andean forest and bushes, 2700-2800 m. alt., same locality, Nov. 11, 1959 (1st type sheet, herb. no. 2339578, US; 2nd type sheet, herb. no. 2339577, US).

The first type specimen bears four flowering heads, these slenderly and elongately pedunculate (peduncles 12-20 cm. long). The ligules appear to have been indeed yellow when fresh, as stated on the label for the second type sheet, not "lilac" as recorded for one of the two topotypes examined.

Appears to differ from the var. *holwayi* of southwestern Guatemala (Quezaltenango) in its smaller flowering heads, these about 4 cm., not about 6 cm. across; outer phyllaries 10-14, not 8 or 9, and measuring longer, about 1-2.2 cm. instead of 9-15 mm. long; ligules only about 1.5 not 2.3-3 cm. long, etc. In my revision of the genus *Bidens* (Bot. Ser. Field Mus. Nat. Hist. 16: 1-709. 1937), this variety would trace at once to the fourth letter *g* on page 56. From the two species included thereunder, *Bidens segetum* and *B. squarrosa*, var. *colombiana* differs sharply in its longer achenial bodies, these 16-22 mm. not 6-13 mm. long, also in in larger flowering heads, with outer phyllaries 1-2.2 cm. not 3-7 mm. long, etc.

BIDENS **pusilla** sp. nov.—Herba pusilla, perennis, omnino hispidula, caulibus patentibus numerosisque vix 6-10 cm. longis internodiis gracillimis tantum 4-16 mm. longis, usque ad circ. 1 mm. crassis, apicem versus lateraliter subantrorsumque ramosis ramis terminaliter in pedunculos gracillimos monocephalicosque productis. Folia opposita, minima, petiolo adjecto tantum 4-7 mm. longa, petiolo subplano ±1-2 mm. longo, lamina plus minusve tripartita, lobis (foliolis) lateralibus 1 jugo, sessilibus, cuneato-obovatis apice irregulariter acriterque 2- vel 3-dentatis, lobo (foliolo) terminali tripartito segmentis varie simplicibus vel rursus sectis cuneato-oblongis setis magis conspicuis sed paucioribus. Capitula radiata, pansa ad anthesin 1.5-2 cm. lata et circ. 5 mm. alta. Involucri bracteae exteriores circ. 5 vel 6, oblongo-lineares, circ. 3 mm. longae, apice calloso subobtusae, extus subglabrescentes sed marginibus conspicue ciliatae; interiores purpureo-atrae, lanceolato-oblongae vel elliptico-oblongae, extus conspicue sed subsparsim elongato-setulosae, quam exteriores usque ad duplo longiores. Flores ligulati 7 vel 8, flavi, sub 1 cm. longi, ligula anguste oblongi apice minutissime denticulati longitudinaliter lineati. Paleae tenerrimae anguste lineari-oblongae apice atro-aurantiacae acutaeque circ. 6-7 mm. longae. Achaenia obcompressa, anguste linearia, exalata, inferne sensim angustata, utraque facie 2-sulculatis, corpore atra ±4.3 mm. longa, basi apiceque flavida, glabra vel apicem versus aegre suberecteque setulosa, apice biaristata aristis ±1 mm. longis rectisque, apicem versus retrorsum paucibarbatis.

Specimens examined: *Harriet G. Barclay & Pedro Juajibioy* 7986, herb with spreading stems and finely divided leaves; heads with wide, yellow rays; disk flowers yellow; very common; large, open, grassy páramo, alt. circ. 3700 m., western side of range above Pujilí, west of Latacunga, campsite, disturbed roadside, Páramo de Milín, Cordillera Occidental, Prov. Cotopaxi, Ecuador, July 15-16, 1959 (US, type, herb. sheet no. 2372755).

In the entire genus *Bidens* L., this species is equaled by no other species in the miniature size of its remarkably small leaves. The entire plant on the type sheet bears a superficial resemblance to *Bidens anthemoides* (DC.) Sherff of southern Mexico, a species with more decompound leaves, measuring over all 1-5 or even to 7.5 cm. in length. In the key given in my revision of the genus *Bidens* (Bot. Ser. Field Mus. Nat. Hist. 16: 57. 1937) this species would trace to the final letter *g* on page 57, except that its ligulate florets are scarcely 1 cm. long. From all taxa included under the final *g*, however, *B. pusilla* differs at once in its diminutive leaves.

COREOPSIS **piurana** sp. nov.—Frutex parvus, erectus, sine dubio sub 1 m. altus, supra corymbose ramosus et ±25-capitulatus, caule subangulato et sulculato demum atro-brunnescente et±3.5 mm. crasso, internodiis glabris et ±3.5 cm. longis; ramis conspicue suberectis, tetragonis, sub 1.5 mm. crassis, internodiis plerumque 2-3 cm. longis, glabris vel inferne medianeque adpresse obsoletissimeque setulosis, superne in corymbos parvos pauci-capitulatos abeuntibus; pedicellis tenuibus perspicue irregulariterque albo-tomentosis 2-3 (-5) cm. longis. Capitula radiata, erecta, pansa ad anthesin circ. 2.5-3 cm. lata et vix 1 cm. alta. Involucrum obconico-hemisphaericum, superne glabrum inferne manifeste albo-tomentosum, bracteis exterioribus 8-10, ovatis vel oblongis vel etiam oblanceolato-oblongis, adpressis, ±4 mm. longis, 1-nerviis, apice subacutis vel subobtusis; interioribus oblongo-ovatis, exsiccatis subatris, margine anguste diaphanis, apice irregulariter acutis vel obtusis 8-9 mm. longis, numerosissime striatis. Flores ligulati circ. 8 vel 9, aurei, circ. 1.5 cm. longi; ligula elliptico-oblonga, numerose striata, apice constricta et plus minusve denticulata. Paleae lineari-oblongae, tenuissimae, striatae, dorso mediane sursum setosae, ±6 mm. longae. Achaenia obcompressa, exalata, corpore oblongo-oblanceolato, nigro ±4.5 mm. longo et (superne) vix 2 mm. lato, tergo glabrato, facie ventrali marginibusque sursum albo-setoso (setis summis plus minusve fasciculatis); apice biaristato aristis rectis ±1.5 mm. longis atro-stramineis, densissime antrorso-setosis.

Specimens examined: *J. Soukup* H662, near Huancabamba, Dept. of Piura, Peru (extreme northwestern part of), May, 1958 (type, US; herb. sheet no. 2426294). In the key given in my Revision of the Genus Coreopsis (Bot. Ser. Field Mus. Nat. Hist. 11: 279-475. 1936), this species would trace without difficulty to the first letter *l* on page 292: "*l*. Achaenia villoso-ciliata dorso sub palea glabra sed ad ventrem villosissima. 37. *C. Pickeringii.*" That species, however, is a plant of very different habit, having solitary heads on long and slender peduncles measuring up to 1.5 (more rarely to 2.3) dm. long. In *C. piurana*, by contrast, the peduncles are clustered in groups of three or so, and are so short and slender that they might better be termed pedicels, as given in the above description.

COREOPSIS SUAVEOLENS var. **ecuadoriensis** var. nov.—Frutex forsitan altior, usque ad 2 m. altus, similiter odore *Covilleae divaricatae* (Cav.) Vail suaveolens. Capitula (non solitaria) ±3-adgregata ad fines ramulorum pedicellis gracilibus circ. 1.2-2.5 cm. longis, sparsim brevissimeque glanduloso- hispidulis.

Specimens examined: *Harriet G. Barclay and Pedro Juajibioy* 8563, shrub to 2 m. tall, growing up through other shrubs. Leaves finely divided into linear segments. Involucral bracts green with darker vein in center. Ligulate florets few, broad, deep yellow. Below true páramo on south side of high, flat páramos; north of Río León. Shrubs similar south side of Río León above Oña. Alt. ca. 3000 m., Nudo de Cordillera Occidental y Cordillera Oriental, Páramos de Silván, Prov. Azuay, Ecuador, July 30, Aug. 3, 1959 (type, US, herb. sheet no. 2372899).

Coreopsis suaveolens Sherff (Bot. Gaz. 89: 369. 1930; Revision of the Genus Coreopsis, Bot. Ser. Field Mus. Nat. Hist. 11: 336. 1936) was founded upon a single collection, *Erich Werdermann* 1114, at alt. of about 3,800 meters, Cordillera de Lallinca, Prov. Tarapacá, Dept. Tarapacá, Chile, March, 1926, represented by four specimens, GH (type, my photograph no. 2152) and (isotypes) F, S (my photograph no. 2029), and UC. As remarked at the time, the species possessed a habital appearance strongly similar to that of *C. fasciculata* Wedd. An easily distinguishing character, however, was the pleasant odor of the dried herbarium specimens, these having the fragrance characteristic of the well known creosote-bush of the Southwestern United States, *Covillea divaricata* (Cav.) Vail. The same agreeable odor is pronounced in the lone specimen, *Barclay & Juajibioy* 8563, cited above from Ecuador for the type of a new variety.

In *C. suaveolens* proper (*i.e.*, var. *suaveolens*) the heads are solitary, terminating the supernally naked branches (slender peduncles). In var. *ecuadoriensis*, they are clustered mostly in threes on slender pedicels about 1.2-2.5 cm. long.

COREOPSIS WOYTKOWSKII Sherff, Revision of the Genus Coreopsis, Bot. Ser. Field Mus. Nat. Hist. 11: 326. 1936.—An extension of range.—This species was based upon a single collection: *Felix Woytkowski* 24, on rocky hills at altitude of 2625 m., vicinity of Celendin, Dept. Cajamarca, Peru, June 5, 1936 (type, F, my photograph no. 3179; Chicago Natural History Museum photograph no. 49160, of two fragments of type). Shortly afterwards a collection was made in the Department of Chachapoyas, Peru: *Christopher Sandeman* 17, alt. 7000 ft., Chachapoyas, Peru, August, 1938 (K, my photograph no. 3454). Among the specimens of *Coreopsis* and related genera recently sent me from the Smithsonian Institution (US) is an excellent specimen from still a third collection: *J. J. Wurdack* 1147, shrub 1 m. tall, on dry cliff face. Rays and disk yellow; summit of Puma-urcu southeast of Chachapoyas, alt. 3100-3200 m., Prov. of Chachapoyas, Dept. of Amazonas, Peru. It is seen then, that *Sandeman* 17 and *Wurdack* 1147 extend the geographic range of *C. woytkowskii*, known heretofore only from the Department of Cajamarca, into the Department of Amazonas, immediately to the northeast of the Department of Cajamarca.

COREOPSIS HOLODASYA Blake, Kew Bull. 15: 373. 1962.—In my above cited Revision of the Genus Coreopsis, this little-known species, unknown till two years ago, would trace in the analytical key there given to the first letter c on page 290, "Folia 0.5-2 cm. lata." Underneath that step are listed three species, the first two, *C. oblanceolata* and *C. woytkowskii* grouped under the step *d*, and having the leaves oblanceolate and 0.5-1.5 cm. wide; the third species, *C. irmscheriana*, standing under the second *d*, and having the leaves narrowly ovate-lanceolate, and 1-2 cm. wide.

In *C. holodasya*, the leaves are neither oblanceolate nor narrowly ovate-lanceolate, but instead narrowly elliptic-oblong, and under 1 cm. wide. In my recently published Annotated List of My Botanical Writings (Illinois Wesleyan Univ., Bloomington, Ill., May, 1964), no mention unfortunately was made of this species, which at the time was unknown to me. It should have been provided for, of course, on page 18 of that work, with the direction to include its mention on page 290 of the Revision of the Genus Coreopsis, as above provided for. (In passing, we may note a misprint of the word breviora in line 28 of page 290.)

NEW NAMES AND RECORDS FOR TEXAS COMPOSITAE

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When I agreed to contribute a summary of the Compositae for F. W. Gould's *Texas Plants — a Checklist and Ecological Summary* (cover page date June 1962; actually published January 1963), I fully expected to have time to get the new names validly published in good time, and even dreamed of throwing in keys to at least some of the genera for good measure. But the distractions of moving with a large herbarium to a new building, and subsequently of ill health, shattered the dreams and delayed publication until now. This brief paper is intended primarily to validate several names that appeared in the Checklist as *nomina nuda;* some other name changes and new species or new records which have turned up since completion of the Checklist account are also included. They do not, alas, represent a final word. New names in *Echinacea* and *Thelesperma* await publication of revisions of those genera which have been completed by others. After becoming better acquainted with *Brickellia,* I am satisfied that it cannot be maintained as a genus distinct from *Kuhnia,* but the Herculean task of providing more than 100 new names in the latter genus is temporarily postponed. Southeastern species of *Eupatorium* badly need revision; only two of a number of inevitable name changes are indicated here. *Solidago* needs much more collecting in eastern Texas. Somed puzzling, localized forms of *Aster* cannot be disposed of until better material is available. And so on. But despite its shortcomings, I believe the Checklist summary represents very substantial progress with our knowledge of the largest family of plants in Texas.

The following are entirely new records to be added: *Eupatorium scabridum, Machaeranthera brevilingulata, M. tenuis, M. texensis, Nothocalais cuspidata, Solidago petiolaris* var. *petiolaris, Thelesperma curivcarpum.* The following should replace the Checklist names given in parentheses: *Bahia dissecta (B. biternata), Cirsium Engelmanii (C. terrae-nigrae), Erigeron superbus (E. speciosas* var. *australis), E. lobatus* var. *Warnockii (E. Warnockii), Eupatorium glaucescens (E. cuneifolium* var. *semiserratum), Machaeranthera annua (M. phyllocephala* var. *annua), M. Boltoniae (Psilactis asteroides), M. pinnatifida (M. pinnata.* The name *Erigeron tenuis* var. *minor* should be deleted altogether. The confused status of the names *Evax* and *Filago* is noted under the latter.

ACHILLEA MILLEFOLIUM L. var. OCCIDENTALIS (Rafinesque, ined.) DC., Prodr, 6: 24. 1837. "Frequens a Pensylvania ad reg. Illinoen-

SIDA 1 (6): 373—379. 1964.

sem." Including *A. gracilis* Rafinesque, Herb. Raf. p. 22. 1833. Locality not specified, but this is species no. 12 under the heading "Florula Texensis . . . New Dicotyle Plants of Texas and Arkansas." *A. Millefolium* var. *gracilis* (Rafinesque) DC., l.c. "Agro Kentuckiensi." Though *A. gracilis* was published earlier, in the rank of variety the two epithets appeared simultaneously, and I have chosen *occidentalis* as the more appropriate. This earlier name for what is commonly known as *A. lanulosa* or *A. Millefolium* var. *lanulosa* has generally been overlooked.

ARTEMISIA LUDOVICIANA Nuttall var. **albula** (Wooton) Shinners, comb. nov. *A. albula* Wooton, Contrib. U.S. Nat. Herb. 16: 193. 1913. *A. ludoviciana* ssp. *albula* (Wooton) Keck, Proc. Calif. Acad. Sci. (ser. 4) 25: 446. 1946.

ARTEMISIA LUDOVICIANA var. **redolens** (Gray) Shinners, comb. nov. *A. redolens* Gray, Proc. Amer. Acad. 21: 393. 1886. *A. vulgaris* ssp. *redolens* (Gray) Hall & Clements, The Phylogenetic Method in Taxonomy (Carnegie Inst. Washington Publ. 326): 75. 1923. *A. ludoviciana* ssp. *redolens* (Gray) Keck, Proc. Calif. Acad. Sci. (ser. 4) 25: 454. 1946.

BAHIA DISSECTA (Gray) Britton. This name should replace *B. biternata* in the list; see Ellison, Rhodora 60: 190—199, 201—204, 1964.

BAHIA NEOMEXICANA Gray. After seeing specimens of the South American *Schkuhria multiflora* Hooker & Arnott, I agree with Heiser's view that the North American plant is the same (see Ann. Mo. Bot. Gard. 32: 274—275, 1945). Ellison agrees with Heiser in leaving the species under *Schkuhria*, but I am not wholly persuaded. If retained under *Bahia*, a new combination based on the Hooker & Arnott name is required.

BAHIA WOODHOUSII Gray. At different times Gray treated this under three different generic names, always spelling the eponymous epithet with the double *i*, as here given. He obviously thought it a better Latin form than *Woodhousei*. He did not misspell the name, as Warnock implies (Wrightia 2: 74, 1960). Ellison also uses the illegitimately "corrected" spelling in his revision.

CENTAUREA SOLSTITIALIS L. Long known from California and more recently from Oklahoma, this Old World species had not previously been reported from Texas. DALLAS CO.: Belt Line Road 0.3 mile west of U.S. Highway 67, Cedar Hill, *David Flyr*, 6 June 1962 (SMU). "Also seen about one mile north of Cedar Hill."

CHRYSOTHAMNUS VISCIDIFLORUS (Hooker) Nuttall var. **ludens** Shinners, var. nov. Folia glabra vel scabro-puberula lineari-oblanceolata, majora 2.0—2.5 cm. longa, 2—3 mm. lata. Capitula pauca congesta ramos erectos terminantia. Involucra 5.0—5.5 mm. alta. Corollae profunde divisae lobis angustis 2—3 mm. longis. Achaenia glabra vel ad angulos parcissime appresse hirsutula. HOLOTYPE: Guadalupe Mts. above Pine Springs Station, Culberson Co., Texas, *Shinners 9063*, 15 Aug.

1946 (SMU). "On higher slopes, elev. about 6000 ft. Shrubs ½—1 m. tall, virgate; bark blackish to gray-brown." PARATYPE: Infrequent perennial in limestone soil above Hunter Lodge, in South McKittrick Canyon, Guadalupe Mts., alt. 9499 feet (*sic!* collection number by error repeated for altitude; highest point in the range is 8751 ft.), Culberson Co., *Barton H. Warnock 9499,* 13 Aug. 1949 (SMU). This somewhat isolated representative of the *C. viscidiflorus* complex is named in allusion to the fact that it will not fit any of the possible choices in the key to subspecies given in the Hall & Clements monograph (The Phylogenetic Method in Taxonomy, Carnegie Inst. Washington Publ. 326: 181, 1923), and because of the glabrous or glabrate achenes will hardly even fit in the key to species (l.c. 175). A similar but judging from the description distinct plant has just been described from New Mexico as *C. spathulatus* L. C. Anderson, Madrono 17: 226—227, 1964.

CIRSIUM ENGELMANNII Rydberg, Fl. Rocky Mts. 1013 and 1069. 1917. Based on *C. virginianum* var. *filipendulum* Engelmann ex Gray, Man. ed. 2 p. 233. 1856. (Not *C. filipendulum* Lange, 1861.) *C. terrae-nigrae* Shinners, Field & Lab. 17: 27—29. 1949. Purposely based on a different type, but taxonomically identical with the preceding. Rydberg's name is as to type, not as to plant described; the Blackland Prairie thistle does not extend even as far as the High Plains, let alone the Rocky Mountains. It is confined to a narrow belt from south central Oklahoma to central Texas, with an outlying southern station in Harris County, Texas. I am indebted to Dr. R. J. Moore of the Plant Research Institute, Canada Department of Agriculture, Ottawa, for calling my attention to my oversight in providing another name for the species.

ENCELIA SCAPOSA Gray var. **stenophylla** Shinners, var. nov. A var. *scaposa* recedit foliis angustissimis 1.0—3.5 mm. latis (vice 3—7 mm.). HOLOTYPE: 9 1/3 miles east of Dryden, Terrell Co., Texas, *V. L. Cory 43870,* 28 March 1944 (SMU). A second sheet, probably a duplicate but numbered 43869 (it was Mr. Cory's practice at that time to number every sheet rather than every collection), is designated PARATYPE, same place and date (SMU). *E. scaposa* var. *scaposa* occurs farther west at higher elevations, in Hudspeth and Jeff Davis counties.

ERIGERON SUPERBUS Greene. This name should replace *E. speciosus* var. *australis* in the list. The only Texas specimen seen (Davis Mts., Jeff Davis Co., *M. S. Young,* 13 Sept. 1918, TEX) has distinctly ciliate leaves as in *E. speciosus,* but otherwise seems definitely to belong with *E. superbus,* which was reported from the same locality by Cronquist (Brittonia 6: 150—151, 1947).

ERIGERON TENELLUS DC., Prodr. 5: 288. 1836. "In Mexico circa Tamaulipas in campis Matamoros legit cl. Berlandier martio flor." This species seems to have been completely overlooked since its original description. In above-ground parts it greatly resembles *E. tenuis* T. & G., and Texas collections have been referred to that species. But *E. tenellus* is an annual with a slender taproot, while *E. tenuis* is perennial with fibrous roots from a stubby crown. The following three collections from Cameron Co., close to the type locality just over the border in Mexico, may be cited (all SMU). About 8 miles west of Boca Chica, *Lundell & Lundell 10778,* 17 March 1942. Yard in Brownsville, *J. F. Brenckle 47-325,* 3 April 1947. Along Highway 106 E. of Harlingen at Harlingen Air Force Base, *Alfred Traverse 1018,* 21 April 1959.

ERIGERON **Traversii** Shinners, sp. nov. (Sect. *Phalacroloma.) E. strigoso* peraffinis, sed foliis infimis saepe pinnatim dentato-lobulatis vel sublyratis sicut in *E. tenui,* praecox (Marte-Maio florens), formosior, ligulis latioribus (0.8—1.2 mm., vice 0.5—1.0 mm.) candidis vel rarissime carneis. HOLOTYPE: Off U.S. 59, about 8 miless south of Nacogdoches, Nacogdoches Co., Texas, *Lundell & Lundell 11093*, 11 April 1942 (SMU). Pine Belt of eastern Texas and adjacent Louisiana, flowering two to four weeks ahead of *E. strigosus,* a showier plant easily distinguished in the field though not in the herbarium. The following additional collections have been seen. TEXAS. Jasper Co.: 6 miles southeast of Jasper, *Shinners 18,402,* 9 April 1954 (SMU). Nacogdoches Co.: 15 miles south of Nacogdoches, *B. L. Turner 4377,* 12 April 1958 (TEX). "Dark pink-flowered form among a population of white-flowered types. Only plant of this color seen in the vicinity." Newton Co.: 3 miles west of Newton, *Shinners 18,387,* 9 April 1954 (SMU). Panola Co.: 4.3 miles southeast of Tatum, *Shinners 18,503,* 9 April 1954 (SMU). Sabine Co.: 12 miles southeast of Patroon, *Eula Whitehouse 20,861,* 18 March 1949 (SMU). 4 miles south of San Augustine, *Shinners 18,450,* 9 April 1954 (SMU). Shelby Co.: 10 miles southeast of Center, *Shinners 7618,* 10 May 1945 (with many empty receptacles, the flowers fallen) (SMU). LOUISIANA. Sabine Parish: 4.8 miles south of Many, *Shinners 22,772,* 23 April 1956 (SMU).

When Dr. Traverse brought me specimens of *Erigeron tenellus* for identification, I at first intended to name that species for him, recognizing it as different from any previously known from the United States. When it proved to have been named from Mexico, this species was used instead, in appreciation for the many excellent collections made by him in the Gulf States from Texas to Florida.

ERIGERON LOBATUS A. Nelson var. **Warnockii** Shinners, var. nov. A var. *lobato* differt pedunculis strigosis subeglandulosis. HOLOTYPE: Brewster Co., Texas (without precise locality), *Warnock 424,* 15—23 March 1941 (TEX). The only collection seen. *E. lobatus* var. *lobatus,* of Arizona, has peduncles with widely spreading instead of mostly appressed hairs and moderately to densely glandular.

EUPATORIUM GLAUCESCENS Elliott, Sketch Bot. S.C. & Ga. 2: 297. 1822. *E. cuneifolium* Willdenow, Sp. Pl. (ed. 4) 3 pt. 3: 1753. 1803. (Illegitimate name: the earlier *E. Marrubium* Walter is cited as synonym without qualification, but not adopted.) *E. semiserratum* DC., Prodr. 5:

177. 1836. *E. cuneifolium* var. *semiserratum* (DC.) Fernald & Griscom, Rhodora 37: 179. 1935. *E. parviflorum* var. *lancifolium* T. & G., Fl. N.A. 2: 85. 1841. *E. semiserratum* var. *lancifolium* (T. & G.) Gray, Syn. Fl. N.A. 1 pt. 2: 98—99. 1884. The complex to which these names relate is a most difficult one. Size of involucre, uesd by both Fernald and Cronquist to distinguish this from *E. linearifolium* and related plants, is not a reliable character. I have adopted the oldest valid name as species. Unless var. *lancifolium* and var. *semiserratum* can be shown to be taxonomically separable, the former name must replace the latter. My studies have not progressed sufficiently for me to state any conclusions.

EUPATORIUM SCABRIDUM Elliott, Sketch Bot. S.C. & Ga. 2: 299—300. 1822. *E. rotundifolium* var. *scabridum* (Elliott) Gray, Syn. Fl. N.A. 1 pt. 2: 99. 1884. This is another of those species which, although originally described from the Southeast, is rather rare there, but is widespread and common west of the Mississippi River, especially in Arkansas and Louisiana. Local in TEXAS. Newton Co.: State Forest No. 1, 5 miles east of Kirbyville, *Cory 49,775*, 30 Sept. 1945 (SMU). Smith Co.: Swan, *J. Reverchon 3302*, 17 Sept. 1902 (SMU). Wood Co.: 6 miles south of Quitman, *Shinners 11,706*, 11 Sept. 1948 (SMU). I have seen two specimens from Florida and one from South Carolina agreeing with Elliott's description. Leaves smaller than in *E. rotundifolium*, with distinctly cuneate bases.

FILAGO. The following new names were recently published for the Texas plants previously listed under *Evax: F. candida* (T. & G.) Shinners, *F. Nuttallii* Shinners *(Evax prolifera* Nuttall, not *Filago prolifera* Pomel), *F. verna* (Rafinesque) Shinners *(Evax multicaulis* DC., a later name than *E. verna* Rafinesque), and *F. verna* var. *Drummondii* (T. & G.) Shinners. There was a belated attempt to conserve the name *Filago* in the previous sense by the questionable device of typifying it with a species added in the Appendix to Species Plantarum rather than one given in the main text. Presumably the proposal has been acted upon by the Edinburgh Congress, but as this goes to press I do not know what was decided. If *Filago* is thus conserved, there will have to be another new combination for the last-mentioned variety under *Evax verna.*

HELIANTHUS ANNUUS L. var. **texanus** (Heiser) Shinners, comb. nov. *H. annuus* ssp. *texanus* Heiser, Amer. Midl. Nat. 51: 299. 1954.

HELIANTHUS **ludens** Shinners, sp. nov. Annua? (radix deest) parva erecta 32—43 cm. alta hispidulo-pubescens suprene corymboso-ramosa. Folia petiolata laminis lanceolatis integris vel leviter sinuato-dentatis triplinervibus. Capitula pauca mediocria involucris 7 mm. altis phyllariis lanceo-linearibus sub-3-seriatis subaequalibus subappressis discum vix aequantibus. Flores radii et disci flavi. HOLOTYPE: Lobo Flat, 19 miles east of Van Horn, Culberson Co., Texas, *Turner, Tharp & Warnock 53-543*, 28 Aug. 1953 (SMU). "Ditch beside cotton field." In aspect more like a *Verbesina* or *Viguiera*, but the achenes and pappus are definitely those of *Helianthus*.

IVA AUGUSTIFOLIA Nuttall var. **latior** Shinners, var. nov. Folia caulina laminis lanceolatis ad 50 × 12 mm., suprema laminis anguste lanceolatis nec lineari-filiformibus. HOLOTPYE: south of Falfurrias, in sandy oak region, Brooks Co., Texas, *Lundell & Lundell 11947*, 15 Sept. 1942 (SMU). Even the reduced leaves in the inflorescence are distinctly lanceolate, not "linear to linear-filiform" as described in R. C. Jackson's revision (Univ. Kansas Sci. Bull. 41: 805, 1960) and as found in specimens of var. *angustifolia*. Stem leaves of the latter, as described by Jackson, are 5—10 times as long as wide. A second specimen referred to the new variety is divided at base into three stems, the central one with a branch just above base, and has lost the middle and lower leaves; the upper ones are 5—6 times as long as wide. Goliad Co.: 9.5 miles south of Goliad, *Shinners 25,206*, 13 Oct. 1956 (SMU). Both collections are from southwest of the range of var. *angustifolia* as understood here.

MACHAERANTHERA **annua** (Rydberg) Shinners, comb. nov. *Sideranthus annuus* Rydberg, Bull. Torr. Bot. Club 31: 653. 1904. *Haplopappus phyllocephalus* ssp. *annuus* (Rydberg) Hall, The Genus Haplopappus (Carnegie Inst. Washington Publ. 389): 58. 1928. *Machaeranthera phyllocephala* var. *annua* (Rydberg) Shinners, Field & Lab. 18: 40. 1950. An erect annual, resembling a small *Prionopsis ciliata*, quite distinct from the coastal *M. phyllocephala*.

MACHAERANTHERA BOLTONIAE (Greene) Turner & Horne, Brittonia 16: 328. 1964. This name should replace *Psilactis asteroides* in the list; transfer of the latter is prevented by *Machaeranthera asteroides* Greene, a different species.

MACHAERANTHERA BREVILINGULATA (Schultz-Bipontinus) Turner & Horne, l.c. 324. *Psilactis brevilingulata* Schultz-Bipontinus ex Hemsley. This species should be added to the list as NAW from Region 10.

MACHAERANTHERA PINNATIFIDA (Hooker) Shinners, Sida 1: 295. 1964. This name should replace *M. pinnata* in the list.

MACHAERANTHERA TENUIS (S. Watson) Turner & Horne, Brittonia 16: 326. 1964. This species should be added to the list as NAW from regions 6 and 10.

MACHAERANTHERA **texensis** (R. C. Jackson) Shinners, comb. nov. *Haplopappus texensis* R. C. Jackson, Rhodora 64: 142—143. 1962. This species should be added to the list as NPW from Region 6.

NOTHOCALIS CUSPIDATA (Pursh) Greene. *Troximon cuspidatum* Pursh. *Agoseris cuspidata* (Pursh) Steudel. *Microseris cuspidata* (Pursh) Schultz-Bipontinus. This Great Plains species has been known from as far south as Oklahoma; it occurs also in the Texas Panhandle, in Lipscomb, Ochiltree, and Roberts counties, where it was collected by Charles S. Wallis in 1960. The nomenclature follows that of Kenton L.

Chambers (see Contrib. Dudley Herb. 5: 66—67, 1957). It should be added to the list as NPC from Region 9.

SENECIO SPARTIOIDES T. & G. var. **Parksii** (Cory) Shinners, comb. nov. *S. Riddellii* var. *Parksii* Cory, Rhodora 45: 164. 1943.

SENECIO **Warnockii** Shinners, sp. nov. Species gypsogena *S. spartiodeo* affinis. Perennis sublignosa humilis 10—30 cm. alta multicaulis plus minusve floccoso-albescens. Folia crebra angustissime linearia carnosa 3—7 cm. longa ca. 1 mm. lata integerrima. Capitula, involucra, floresque ut in *S. spartioideo*. HOLOTYPE: 40 miles north of Van Horn, alt. 4000 ft., Culberson Co., Texas, *Turner & Warnock 202,* 16 Sept. 1948 (SMU). When the troublesome *S. spartioides* complex is revised this may be reduced in status, but with its dwarf stature and crowded, entire leaves, it is a much more extreme departure from the type than any of the other variants included under that binomial. Three additional collections have been seen. TEXAS. Culberson Co.: gyp soil along pipeline between Texline and Orla, *Warnock 10,276,* 7 Oct. 1951 (SMU). County not determined: 2 miles south of Rustlers Springs, *Parks & Cory 30830,* 20 Oct. *1938 (SMU).* NEW MEXICO. Eddy Co.: 13 miles S.W. of White City (S. of Carlsbad), *David B. Dunn 8732,* 12 Oct. 1952 (SMU). "Arid alkaline grassland. Caliche beds exposed. El. 3800 ft."

SOLIDAGO PETIOLARIS Aiton var. PETIOLARIS. This was inadvertently omitted from the list. It should be included as NPW from Region 1.

THELESPERMA CURVICARPUM Melchert, S.W. Nat. 8: 179. 1963. This should be added to the list as NAC from Region 7.

Grateful acknowledgment is due Dr. B. L. Turner for the long-term loan of critical specimens from the University of Texas, and to the National Science Foundation, whose 5-year grant (1956—1960) in support of field work preliminary to a Flora of the Gulf Southwest permitted much additional collecting and field observation of Compositae as well as other groups in the region.

NOTES

DIGITARIA ISCHAEMUM (GRAMINEAE) IN MISSISSIPPI AND TEXAS.—Although the second edition of Hitchcock's *Manual of Grasses of the United States* (1952) assigns the introduced *Digitaria Ischaemum* Schreber an all-inclusive range ("Quebec to Georgia, west to Washington and California"), the map (p. 578) shows no records for most of the southernmost states. The obviously expectable spread of the weed to two more of those states can now be reported. MISSISSIPPI. Clarke Co.: south side of Quitman, *Shinners 29,074,* 26 Oct. 1960. Coahoma Co.: Clarksdale, *Shinners 25,587,* 29 Oct. 1956. Wayne Co.: 5 miles southeast of Waynesboro, *Shinners 29,062,* 26 Oct. 1960. TEXAS. Camp Co.: 4.4 miles north of Pittsburg, *Shinners 16,140,* 16 Sept. 1953. Cass Co.: 4½ miles east of Hughes Springs, *Eula Whitehouse 20,247,* 26 Sept. 1948. Shelby Co.: 2 miles west-northwest of Joaquin, *Shinners 22,351,* 10 Oct. 1955. (All collections at SMU.) This more or less northern species is exceedingly similar to the pantropical (believed to be originally Asian) *D. violascens* Link, which is widespread and common in the Gulf states. Descriptions and keys treating these two in Hitchcock's *Manual* and in Henrard's *Monograph of the Genus Digitaria* (1950) are partly contradictory and not reliable. After much effort, the best separation I can make for them is as follows, based on 57 specimens of *D. Ischaemum* (47 U.S., 9 European, 1 Asian) and 31 of *D. violascens* (30 U.S., 1 West Indian).

Width of racemes 1.3—2.0 mm. (smallest measurements on short racemes of small plants); spikelets 1.7—2.3 mm. long, mostly attached in 2's or 3's (singly near base and tip of raceme) . . . *D. Ischaemum*
Width of racemes 0.8—1.5 mm. (largest measurements on long racemes of large plants); spikelets 1.3—1.8 mm. long, mostly attached singly or in 2's, but often in 3's near middle of racemes . . . . *D. violascens*

Much is made by Henrard of difference in type of hairs on the spikelets, *D. Ischaemum* being characterized by capitellate hairs, *D. violascens* by verrucose ones. With the usual magnifications of up to 10 diameters it is impossible to make out this difference, and even with magnifications up to 30 diameters I could not make a satisfactory separation of available material. Spikelet pubescence varies in abundance and length in both species, and according to Henrard himself, even in kind in *D. violascens* (he notes that some spikelets on the type specimen have ordinary, non-verrucose hairs). This feature seems to me to be a matter of minor genetic variation, not a character so fundamental that it can be used to define entire sections of the genus. In his comments under *D. violascens,* he states that *D. Ischaemum* (which he places in a different section) differs in "longer, thicker spikelets, about 2½ mm. long,

SIDA 1 (6): 380—381. 1964.

glabrous pedicels. . . ." But under the latter species he accepts as valid a var. *asiatica* Ohwi with spikelets only 1.5—1.9 mm. long. I have seen no spikelets as large as 2.5 mm. among the 57 sheets of *D. Ischaemum* examined, nor are the pedicels always glabrous, but commonly variously scabrous or puberulent at summit or throughout. In *D. violascens*, according to Henrard, the spikelets are "scarcely 2 mm. long, mostly 1.6—1.8 mm. . . . with scabrous pedicels." The range in spikelet size for the 31 specimens examined was 1.3—1.8 mm., as stated in the key, and the pedicels are variously scabrous or puberulent as in *D. Ischaemum*. In Hitchcock's *Manual*, *D. Ischaemum* is keyed as having spikelets 2 mm. long, 1 mm. wide, the hairs "or most of them" capitellate, while *D. floridana* Hitchcock and *D. violascens* are separated on the basis of spikelets 1.5 to 1.7 mm. long, about 0.6 mm. wide, the hairs not capitellate. The two latter are then differentiated as "Sterile lemma with 5 distinct nerves; spikelets sparingly pubescent, 1.7 mm. long" (but in the description stated to be 1.5 to 1.7 mm.); "fertile lemma light brown; racemes, if more than 2, not digitate" for *D. floridana*, "Sterile lemma with 3 distinct nerves; spikelets distinctly pubescent, 1.5 mm. long; fertile lemma dark brown, racemes usually all digitate" for *D. violascens*. For the 31 sheets of *D. violascens* examined, none of these characters will stand up. Henrard, who saw fragments of the type and only known collection of *D. floridana* (from Hernando Co., Florida), adds that it shows only non-verrucose hairs, and refers it to still another section of the genus. I strongly suspect that *D. floridana* is merely a form of *D. violascens* in which the non-verrucose hairs, conceded by Henrard himself to be present with the verrucose ones, are the predominant or exclusive type.

Grateful acknowledgment is due the National Science Foundation for two grants in support of field work in the Gulf Southwest, under which many of the specimens used in this study were collected.—*Lloyd H. Shinners, Southern Methodist University, Dallas, Texas 75222.*

CHROMOSOMES OF TWO MORAEA (IRIDACEAE) FROM SOUTHERN AFRICA.—A new basic number of $x=6$ in *Moraea* has recently been reported for 2 South African species by Riley (Canad. J. Genet. & Cytol. 4: 50-55, 1962). Two additional species can now be assigned to this line.

M. erici-rosenii Fries — $n=6$, $2n=12$ (from 6 plants). N. RHODESIA: Mwinilunga Dist., Zambesi River rapids, 4 miles N of Kalene mission, 10 Nov. 1962, *Lewis 6224* (K, US, MO). "Collected at the base of massive granite outcrops among islands of grasses and sedges in black, shallow, wet soil; almost indistinguishable among other monocots until tepals open daily at 4 p.m. till dark." The species has been found sporadically throughout southern Africa, but its rarity can be at least partially attributed to late afternoon flowering for at other times of the day plants are very difficult to locate. Mitotic chromosomes from untreated cells of immature flower buds have submedian to subterminal centromeres and vary from 10.3 μ for the shortest pair to 18.2 μ for the longest pair.

M. setacea Ker. — $2n=12$ (from 2 plants). S. AFRICA: Natal, Hlabisa Dist., Charters Creek, 5 Dec. 1962, *Lewis 6306* (K, US, MO). 'Sloping grass field in sandy soil just above ocean.' The chromosomes found in untreated root-tip cells are comparable with those of *M. erici-rosenii*, viz., submedian and subterminal ranging from 10.8-19.9 μ in length.

On measuring the chromosomes from pretreated cells of *M. polystachya* illustrated by Riley, I estimate their lengths to vary from 12.1-15.4 μ while the chromosomes of *M. spathulata* appear to be only about one-half as long. Riley noted that the chromosomes of *M. polystachya* had subterminal and submedian centromeres. Thus in both chromosome length and centromere position the chromosomes of *M. polystachya* are similar to those of *M. erici-rosenii* and *M. setacea*.

Plants from both collections are in cultivation at the Royal Botanic Gardens, Kew. I appreciate the help of Mrs. Susan Holmes of Kew in determining these species.—*Walter H. Lewis, Missouri Botanical Garden, and Department of Botany, Washington University, St. Louis, Missouri.*

ERIOGONUM ANNUUM (POLYGONACEAE) BIENNIAL IN NEBRASKA. The life-form of *Eriogonum annuum*, occurring in the United States from North Dakota and Montana south to Texas and New Mexico, is commonly described as therophyte (annual). I have observed this species over a two year period in Holt and McPherson counties, Nebraska, where it behaves as a typical biennial. Its seeds germinate in the spring, and a rosette is produced. The rosette overwinters, and the following year a leafy, flowering shoot develops, seeds are matured, and the plant dies. At least in parts of Nebraska, then, *Eriogonum annuum* is not a therophyte but is a hemicryptophyte of the semi-rosette type. —*John W. Thieret, University of Southwestern Louisiana, Lafayette.*

A DECEIVING AQUATIC NEPTUNIA (LEGUMINOSAE) IN CENTRAL AMERICA.—*Neptunia prostrata* is a distinctive and fantastic species, particularly as one would scarcely expect to find a strictly aquatic plant among the Mimoseae. The prostrate stems, lying just below the surface in warm pools, are jointed and spongy-thickened, white (one might use Vachel Lindsay's term "fish-belly white"), soft and fleshy, reminding one of a great worm; the leaves are held up in the air and are sensitive, folding when touched; the flowers resemble those of *Mimosa*. It is rather unexpected, then, to find another species of *Neptunia*, usually terrestrial, invading the water and so closely simulating *N. prostrata* as to masquerade frequently under that name in the herbarium.

NEPTUNIA PLENA (L.) Bentham f. **lumbricoides** Fassett, f. nov. Planta aquatica caulibus incrassatis spongiosis prostratis submersis, eis *N. prostratae* simulantibus. EL SALVADOR: Dept. La Paz, floating in Laguna Nahualapa, 6 km. S.W. of El Rosario de la Paz, *Fassett 28323*, 21 October 1950 (HOLOTYPE F; ISOTYPES GH, MO, US, WIS). Cornfield, now muddy but recently flooded, Maquigua, 17 km. west of La Union, 13 January 1951, *Fassett 28625* (F, GH). HONDURAS: boggy spot in Crescentia savanna, Choluteca, 31 October to 9 November 1949, Standley 24588 (F.). MEXICO: Acapulco, Guerrero, October 1894 to March 1895, *Palmer 284 (GH)*. In a pond-llano, Gutzalama, Cuyuca District, Guerrero, 25 August 1943, *Hinton 6495* (F, GH). BRAZIL: in shallow water and on margins of Acude Columinjuba, Municipio de Maranguapa, 9 October 1935, *Drouet 2580* (GH). Lagoa Mecejana, Municipio de Fortaleza, 18 July 1935, *Drouet 2143* (GH).

The two collections from El Salvador are extreme, and in appearance exactly simulate *N. prostrata.* They are distinguished from that species by the longer fruit with sometimes as many as 18 seeds (4—8 in *N. prostrata),* and by the gland at the summit of the petiole. (See Standley & Steyermark, Flora of Guatemala, Fieldiana: Botany 24 pt. 5: 65, 1946.) The aquatic phase of *N. plena* has recently been discussed in relation to its occurrence in Texas (B. L. Turner, Revision of United States species of *Neptunia,* Amer. Midl. Nat. 46: 84, 1951). The one collection of that species from Texas appears to be f. *lumbricoides.—Norman C. Fassett, University of Wisconsin, Madison.*

EDITOR'S NOTE. The above was one of the last manuscripts completed by Dr. Fassett before his untimely death in 1954. Evidently intended to be part of a series, it was originally titled "Studies of aquatic plants in Central America. 2. A deceiving *Neptunia.*" It has been submitted by Dr. Hugh H. Iltis in order to make the herbarium name available for use by another botanist now monographing the genus.

A HEXAPLOID LINUM (LINACEAE) FROM EASTERN ETHIOPIA.— In Africa south of the Sahara, *Linum* is scarcely represented. No species, for example, is listed for the Flora of West Tropical Africa and only 2 are recorded from the region of the Flora Zambesiaca (by Robson, 2: 91—99, 1963). During a recent trip in Ethiopia, I was able to collect 1 species listed in the latter flora, *L. holstii* Engler ex Wilczek. Plants were found infrequently in Harar Prov., 7.4 km E of Giggiga *(Lewis 5889,* 24 Aug. 1962) on a short grass plateau at 5000 ft. Immature flower buds were fixed and air mailed to England for storage at -40°C. At the same time, herbarium vouchers were collected and these are deposited at K, US, and MO.

Seven months later, whole buds were squashed in 2% acetic-orcein. Diakinesis in PMCs of 2 plants of *L. holstii* showed $n=27$ with the 27 bivalents illustrating a strong tendency for early terminalization of chiasmata. The average size of chromosomes at diakinesis was 2.85 μ. The species is thus a hexaploid in the $x=9$ series, a series common to the eastern North American species of *Linum*, but then only to the tetraploid level (Osborne & Lewis, Sida 1: 63—68, 1962). The number is unique to the genus and the species is to my knowledge the first example of an indigenous hexaploid flax.—*Walter H. Lewis, Missouri Botanical Garden, and Department of Botany, Washington University, St. Louis, Missouri.*

CAYRATIA JAPONICA (VITACEAE) IN SOUTHEASTERN LOUISIANA: NEW TO THE UNITED STATES.—Among some collections made at the Delta Regional Primate Research Center of Tulane University by Michael Kent Rylander and sent to me for determination was a strange-looking plant obviously in the Vitaceae, with pedately compound leaves, unlike any North American species known to me. The tetramerous flowers in short, wide, long-peduncled cymes indicated *Cissus,* and the plant was first tentatively identified as *C. japonica* (Thunb.) Willd. (included in Bailey's *The Standard Cyclopedia of Horticulture,* but not in his *Manual of Cultivated Plants),* then more positively as *Cayratia japonica* (Thunb.) Gagnepain, Notulae Systematicae 1: 349, 1911 (more fully treated by that author, with description and figures of flower details, in Lecomte's *Flore Générale de l'Indo-Chine* 1: 983—984 and Pl. XXVI, 1912). There are illustrations of the plant in Makino's *An Illustrated Flora of Japan* (enlarged edition), p. 341, 1956 (as *Cissus),* and Steward's *Manual of Vascular Plants of the Lower Yangtze Valley, China,* p. 233 (text account, p. 240), 1958. Both show rather obtuse terminal leaflets. In the specimen these are acute, and Gagnepain's description refers to them as acuminate. The species is a herbaceous weed, widely distributed in southeastern Asia from Japan to Java and India. The first United States collection, so far as known, is *Rylander 167,* 8 July 1963, from "damp, deciduous river bottoms; near ground," Primate Research Center, Covington, St. Tammany Parish, Louisiana (SMU). It possibly represents an escape from cultivation.—*Lloyd H. Shinners.*

THREE NEW VARIETAL NAMES IN SPHAERALCEA (MALVACEAE).—In Thomas H. Kearney's "The North American species of *Sphaeralcea* subgenus *Eusphaeralcea*" (Univ. Calif. Publ. Bot. 19: 1—128, 1935), the author follows the American Code usage of undesignated trinomials which are subspecies; he so refers to them repeatedly in the text. Later, in a joint paper with Robert H. Peebles publishing new names for Arizona plants, he included a paragraph replacing the subspecies with new combinations as varieties (Journ. Washington Acad. Sci. 29: 486, 1939). In three cases the epithet used for a variety is not the earliest available in that rank. The correct combinations are supplied herewith.

S. EMORYI var. **californica** (Parish) Shinners, comb. nov. *S. Fendleri* var. *californica* Parish, Zoe 5: 71—72. 1900. *S. Emoryi* ssp. *variabilis* (Cockerell) Kearney, Univ. Calif. Publ. Bot. 19: 39. 1935. *S. Emoryi* var. *variabilis* (Cockerell) Kearney, Journ. Washington Acad. Sci. 29: 486. 1939.

S. ANGUSTIFOLIA var. **oblongifolia** (Gray) Shinners, comb. nov. *S.*

incana var. *oblongifolia* Gray, Smithsonian Contrib. 5 art. 6 (Pl. Wright. pt. 2): 21. 1853. *S. angustifolia* var. *lobata* S. Watson, Smithsonian Misc. Coll. 15 (Bibl. Index): 143. 1878. (Illegitimate new name based on the preceding. Not included by Kearney in his list of synonyms.) *S. lobata* Wooton, Bull. Torr. Bot. Club 25: 306—307. 1898. (Not based on *S. angustifolia* var. *lobata* S. Watson; the use of the epithet was evidently a coincidence.) *S. angustifolia* ssp. *lobata* (Wooton) Kearney, Univ. Calif. Publ. Bot. 19: 69. 1935. *S. angustifolia* var. *lobata* (Wooton) Kearney, Journ. Washington Acad. Sci. 29: 486. 1939. (Illegitimate as a later homonym of *S. angustifolia* var. *lobata* S. Watson.)

S. DIGITATA var. **angustiloba** (Gray) Shinners, comb. nov. *S. pedata* var. *angustiloba* Gray, Proc. Amer. Acad. 22: 292. 1887. *S. tenuipes* Wooton & Standley, Contrib. U.S. Nat. Herb. 16: 148. 1913. *S. digitata* ssp. *tenuipes* (Wooton & Standley) Kearney, Univ. Calif. Publ. Bot. 19: 91. 1935. *S. digitata* var. *tenuipes* (Wooton & Standley) Kearney, Journ. Washington Acad. Sci. 29: 486. 1939.

It should be noted that although not designated as new and not entered in the Gray Herbarium Card Index, *S. angustifolia* ssp. *cuspidata* (Gray) Kearney, Univ. Calif. Publ. Bot. 19: 67, 1935, was a new combination based on *S. angustifolia* var. *cuspidata* Gray. In the 1939 list of new varietal combinations, *S. axillaris* var. *violacea* (Rose) Kearney appears by a slip of the pen as var. *rosacea*.—*Lloyd H. Shinners.*

NEW VARIETAL NAMES FOR NEW WORLD LUDWIGIA (ONAGRACEAE).—For the sake of uniformity in my several projected floras, new combinations in varietal rank are needed for plants recently treated by Peter Raven as subspecies. For completeness all those occurring in the New World are included. I see no benefit whatever in discarding the rank of variety in favor of that of subspecies. Indeed, such a proceeding is not in accord with the present International Code of Botanical Nomenclature, for the two are not identical in status. It is also highly impractical, for it will require an astronomical number of new names. I prefer the lesser by far of two evils.

LUDWIGIA OCTOVALVIS (Jacquin) Raven, Kew Bull. 15: 476. 1962. The automatic var. *octovalvis* applies to those plants treated by Munz as *Jussiaea suffruticosa* (including var. *ligustrifolia* and var. *octofila)* and by Hara as *Ludwigia pubescens.*

L. OCTOVALVIS var. **macropoda** (Presl) Shinners, comb. nov. *Jussiaea macropoda* Presl, Rel. Haenk, 2: 35. 1835. *J. suffruticosa* var. *macropoda* (Presl) Munz, Darwiniana 4: 239. 1942. *Ludwigia octovalvis* ssp. *macropoda* (Presl) Raven, Kew Bull. 15: 476. 1962.

L. OCTOVALVIS var. **sessiliflora** (Micheli) Shinners, comb. nov. *Jussiaea octonervia* f. *sessiliflora* Micheli in Martius, Fl. Bras. 13 (2): 171. 1875. *J. octonervia* var. *sessiliflora* Micheli, ibid. 180 and pl. 35. *Ludwigia octovalvis* ssp. *sessiliflora* (Micheli) Raven, Kew Bull. 15: 476. 1962.

LUDWIGIA PEPLOIDES (H.B.K.) Raven, Reinwardtia 6: 393. 1964. The automatic var. *peploides* applies to those plants treated as *Jussiaea repens* var. *peploides* by Munz and as *Ludwigia adscendens* var. *peploides* by Hara.

L. PEPLOIDES var. **glabrescens** (Kuntze) Shinners, comb. nov. *Jussiaea repens* var. *glabrescens* Kuntze, Rev. Gen. Pl. 1: 251. 1891. *Ludwigia peploides* ssp. *glabrescens* (Kuntze) Raven, Reinwardtia 6: 394. 1964.

L. PEPLOIDES var. **montevidensis** (Sprengel) Shinners, comb. nov. *Jussiaea montevidensis* Sprengel, Syst. 2: 232. 1825. *J. repens* var. *montevidensis* (Sprengel) Munz, Darwiniana 4: 276. 1942. *Ludwigia peploides* ssp. *montevidensis* (Sprengel) Raven, Reinwardtia 6: 395. 1964.

Further synonymy is supplied by P. A. Munz, "Studies in Onagraceae XII. A Revision of the New World Species of Jussiaea," Darwiniana 4: 179—284, 1942; Hiroshi Hara, "*Ludwigia* versus *Jussiaea*," Journ. Jap. Bot. 28 (10): 289—294, 1953; Peter H. Raven, "The Old World Species of *Ludwigia* (Including *Jussiaea)*, with a Synopsis of the Genus (Onagraceae)," Reinwardtia 6: 327—427, 1964.—*Lloyd H. Shinners.*

NOTES ON CALYSTEGIA (CONVOLVULACEAE) IN THE CAROLINAS.—In the forthcoming "Guide to the Vascular Flora of the Carolinas" two species of *Calystegia* are included on the basis of single collections. *Calystegia* **sericata** (House) Bell, comb. nov. based on *Convolvulus sericatus* House (Torreya 6:150, 1906), was collected in June 1940, by H. L. Blomquist, "about 8 miles north of Salem, Oconee Co., S. C." *(Duke No. 61054)*. This area, just across the border from the area in Georgia which is the type locality for this species, was visited in June 1964, but no trace of the plant could be found. A second species, *Calystegia soldanella (*L.) R. Br., previously known in North America only from west coast collections, was collected in May 1963 by Sue F. Moore (No. 268) on the Atlantic side of the sand dunes between Kill Devil Hill and Duck, in Dare Co., N. C. Both of these species represent additions to the flora of the Carolinas as treated by previous manuals. —*C. Ritchie Bell, University of North Carolina, Chapel Hill, N. C.*

TWO YOUNGIAS ("CREPIS JAPONICA": COMPOSITAE) INTRODUCED IN THE SOUTHEASTERN UNITED STATES.—Under the name *Crepis japonica* (L.) Bentham, a common annual weed of tropical to warm-temperate regions, originally from southeastern Asia, was first reported from the United States in Small's *Manual of the Southeastern Flora* in 1933 (p. 1495) as follows: "Roadsides, waste places, and meadows, S La. Nat. of Japan.—(W.I.)—All year." Fernald's 8th edition of Gray's *Manual* (1950, p. 1559) records it from a widely disjunct area: "Fields, locally abundant, Pa. to Va. Apr.-June. (Adv. from Asia.)" It is not mentioned in the *New Britton & Brown Illustrated Flora* (1952). As *Youngia japonica* (L.) DC., it is given incidental mention in the companion *Manual* of Gleason and Cronquist (1963, p. 759), apparently quoting Fernald: "reported to be locally established from Pa. to Va." There are a dozen sheets from the United States in the S.M.U. Herbarium referred to this species, but representing two strikingly different forms. In *The Genus Youngia* by Babcock and Stebbins (Carnegie Inst. Washington Publ. 484: 94—100, 1937) they are identifiable as Y. *japonica* ssp. *genuina* and Y. *japonica* ssp. *Elstonii*. Despite the lack of obvious technical characters to separate them, and the scantiness of the material seen, I am inclined to regard them as distinct species. Because the synonymy of Babcock and Stebbins disregards the type method, the correct name for the second subspecies in the rank of species is wrongly listed under ssp. *genuina*. If treated as varieties, a new combination will be needed. Partly to avoid this, the two are discussed below under their valid binomials.

YOUNGIA JAPONICA (L.) DC., Prodr. 7: 194. 1838. Y. *lyrata* Cassini, Ann. Sci. Nat. (ser. 1) 23: 88. 1831. Type from the island of Mauritius. (I am indebted to Dr. George B. Van Schaack for the information that Cassini's species, the type of the genus, was not based on *Prenanthes lyrata* Thunberg, a point not made clear in Babcock and Stebbins' treatment. Without knowing that this was the case, I could not tell that Y. *Thunbergiana* DC. was indeed validly named.) Plant rather small (8—75 cm. tall), usually with only 1 or 2 (rarely 3—5) well-developed stem leaves; ligules about 1 mm. wide; another-tube 1.75 mm. long (measurements from Babcock and Stebbins). Chiefly in gardens or parks in cities, Florida to Texas. The following collections have been seen. FLORIDA. Lake Co.: weed around buildings, at Alexander Springs, *R. K. Godfrey & Richard D. Houk 62791*, 11 May 1963. Seminole Co.: escape in our garden, Altamonte Springs, *Dr. Paul O. Schallert 8262*, 10 May 1958. Garden weed, same locality, *Schallert 8262 (bis)*, 1 March 1962. LOUISIANA. Lafayette Parish: weed in motel yard, Lafayette, *Shinners 282,012*, 16 April 1960. Orleans Parish: frequent around small pond at western end of Audubon Park, New Orleans, *V. L. Cory 58,524*, 11 March 1951. Audubon Park, New Orleans, *Shinners 25,708*, 2 Nov. *1956*. St. Tammany Parish: old field, Primate Research Center, Covington, *Michael Kent Rylander 215*, 16 May 1964. MISSISSIPPI. Jackson Co.: courthouse lawn, Pascagoula, *F. H. Sargent 7844*, 17 Oct. 1961. TEXAS. Dallas Co.: Northaven gardens, northern Dallas, weed under lathe, *Shinners 29,153*, 6 Nov. 1960. (On later visits, after an abnormally severe winter, it was not found.) Galveston Co.: Friendswood, Bales Nursery, in plant bed under lathing cover, *Alfred Traverse 2622*, 1 Nov. 1961. The height of the involucre in these specimens varies from 4.0 to 5.7 mm.; in 5 Asiatic specimens also seen (1 from Ceylon, 4 from Pakistan) it varied from 4.2 to 6.0 mm., considerably exceeding the limit of 5 mm. given by Babcock and Stebbins and others.

YOUNGIA THUNBERGIANA DC., Prodr. 7: 192. 1838. Based on *Pre-*

nanthes lyrata Thunberg, Fl. Jap. p. 303. 1784. (Not *Youngia lyrata* Cassini, 1831.) According to Babcock and Stebbins, type material in the Thunberg Herbarium "is apparently the same as certain slender forms" of their *Y. japonica* ssp. *Elstonii,* but because specimens in the De Candolle Herbarium named *Y. Thunbergiana* were actually *Y. japonica* ssp. *genuina,* the binomial is placed in synonymy under the latter without the qualification that it was as to plant described, not as to type, which of course is that of Thunberg's species.—*Chondrilla lyrata* (Thunberg) Poiret, Encycl. Meth. Bot. Suppl. 2: 332. 1811. Also misleadingly cited by Babcock and Stebbins as a synonym of *Y. japonica* ssp. *genuina*—*Crepis japonica* var. *Elstonii* Hochreutiner, Candollea 5: 340—341. 1934.—*Youngia japonica* ssp. *Elstonii* (Hochreutiner) Babcock & Stebbins, Carnegie Inst. Washington Publ. 484: 98. 1937. Plant generally much more robust than *Y. japonica,* half to over a meter in height, with leafy stem, the leaves gradually reduced upward; ligules 0.5—0.6 mm. wide; anther-tube 0.75—1.0 mm. long. Having seen only two specimens, I am unable to say how well the measurements given by Babcock and Stebbins stand up. It is curious that the more robust plant should have markedly smaller flower parts. Hochreutiner found this and *Y. japonica* growing together in Hawaii, but with no intermediates. Only the following two collections have been seen. DISTRICT OF COLUMBIA. Washington, Kensington at Connecticut Ave. and Rock Creek, along wood road, apparently an old dumping ground, *F. H. Sargent s. n.,* 19 May 1951. (Plant 70 cm. tall, in early flower; involucre 5.5 mm. high.) NORTH CAROLINA. Pasquotank Co.: roadside, 1.3 miles north of Knobbs Creek on U.S. 17-158 then 0.1 mile east (north of Elizabeth City), *Harry E. Ahles (With R. P. Ashworth) 40082,* 10 May 1958. (Plant 80 cm. tall, fruiting; involucre 5.3 mm. high.) In both specimens the leaves are pinnatifid with rather sharply pointed lobes and teeth. In those of *Y. japonica* the leaves are more strongly lyrate, the terminal lobe much larger than the fewer lateral ones, commonly rounded or blunt but occasionally rather sharp-pointed.

The restriction of *Y. japonica* to the Gulf States, and its apparent inability to withstand the continental winter climate of Dallas, suggest that it is less cold-resistant than *Y. Thunbergiana.* If that is the case I would expect the reports of *Crepis japonica* from Pennsylvania and Virginia to belong rather to *Youngia Thunbergiana. Lloyd H. Shinners.*

REVIEW

WEBSTER'S THIRD NEW INTERNATIONAL DICTIONARY OF THE ENGLISH LANGUAGE, UNABRIDGED. C. & L. Merriam Co., Springfield, Massachusetts. 1961.

Many have been the reviews, not all of them friendly, of Webster's Third New International Dictionary, Unabridged. The present general, but not exhaustive, survey of the way in which botany fares in this tome does not inspire supreme confidence. (At least the work is vastly better than the cheap pocket dictionary I once saw, which defined "electricity" merely as "a subtle force"; one assumes that its editors were never struck by lightning!)

The advertisement at the very end of the dictionary emphasizes its easy "crisp" definitions, whereas I would say that its major scientific, if not literary, fault is a very lack of crispness. Instead of the clear, concise, definitive statements which one would expect in a dictionary, there is too often a marked tendency to stray deep into the citation of examples and other non-definitive material. If the editors desired to make brief entries of an encyclopedic nature, this material might better have been placed in separate sentences. (Sentences, however, are scrupulously avoided by the editors, who do not even end the entries with a period.)

As one of the best (worst) examples, the entry for "enzyme" may be cited: "any of a very large class of complex proteinaceous substances (as amylases or pepsin) that are produced by living cells, that are essential to life by acting like catalysts in promoting at the cell temperature usu. reversible reactions (as hydrolysis and oxidation) without themselves undergoing marked destruction in the process but frequently requiring the presence of activators (as metal ions) or of coenzymes, and that can act also outside of living organisms and therefore are useful in many industrial processes (as fermentation, tanning of leather, and production of cheese)." In this example, the problem is not conveying of misinformation; the statement at its beginning is a basically good and comprehensive one, albeit a complex one to read ("crisp"?). But why tack onto a *definition* two more clauses of non-definitive matter and a list of industrial processes which are made possible by the fact that enzymes may act outside of living organisms?

Another fine example of "definition" by confusing example or use with directness is found under "diastase": "a mixture of amylases obtained usu. as a yellowish white amorphous powder from malt and used chiefly in desizing textiles and converting starch to maltose." Similarly, the treatment of "neurospora": "a genus of ascomycetous fungi (family Sphaeriaceae) used extensively in genetic research, having black peri-

SIDA 1 (6): 389—392. 1964.

theciae [*sic;* the singular perithecium is properly listed elsewhere in the volume] and persistent asci, and including some forms that have salmon pink or orange spore masses and cause severe damage in bakeries." Apart from the fact that the nature of the damage (whether to the bakery furniture or to its products) is left entirely to the imagination, we find no use of the word "conidia" nor implication that they are characteristic of the genus. Note also that the countless names of genera are not capitalized as main entries, necessitating insertion of "*cap.*" each time; when a word is always begun with an initial capital it might have saved space and promoted clarity and good usage to enter it that way.

A matter of style which is grammatically careless as well as potentially misleading, especially to persons outside the relevant field—those who most need the dictionary, is the very frequent fuzziness in relative pronouns ("that" seems for some reason decidedly preferred to "which"). These often do not follow their antecedents; e. g., under "ovary": ". . . basal portion of the pistil or gynoecium of an angiospermous plant that bears the ovules . . ." [is it the portion, the pistil, the gynoecium, or the plant which bears the ovules?]. Or, under "chondriosome": "any of a class of . . . lipoprotein complexes in the cytoplasm of most cells that are thought to function . . ." [what is thought to function?].

In the rapidly growing areas of cellular and physiological biology, the editors had reasonable success in keeping up with new words, although they sometimes seem to have been unable to crystallize the primary definitive features and hence there is much "beating around the bush." While "respiration" is quite well treated, "digest" and "digestion" are rather too much defined in terms of each other, and with no clear indication of any applicability in the plant kingdom. "Ribosome" is not included at all (although the prefix "ribo-" is), and mitochondrion is defined as a granular or globular (rather than the more frequent rodlike) chondriosome, the primary entry being the much more archaic latter word. The definition of auxin does not make clear that it is a *naturally occurring* substance in plants (merely that it promotes growth or causes other effects). There is a very verbose and unsatisfactory definition of so important a word as "gene," implying that genes are in some way enzymatic, comparing them to viruses (rather than the other way around), and making no mention of nucleic acid. The discussion of "nucleic acid" omits the important new idea of a duplex molecule but does devote half its words to material irrelevant to the *definition*. (The hydrolysis products of polynucleotides would better be discussed in a separate sentence.)

The common word "mold" is not very lucidly treated. The first definition is exceedingly broad ("a superficial often woolly growth . . .") with no implication that the growth *causes* the decay on which it is "esp." found; the second definition attempts a narrowing down "esp."

to the order Mucorales—thus omitting a great many of the plants usually called molds, a term without much taxonomic significance.

Names of families and orders of plants are freely listed, and the editors cannot be blamed for the inherent problem of assigning families to orders when there is so little agreement among botanists on definitions of the latter. Sometimes (as with "Amentiferae" but not with "Parietales") there is a suggestion that the category has standing only "in some classifications." In a basically modern approach, the dictionary accepts the widely used Tippo classification of Tracheophyta and its subdivisions. It is to be hoped that good practice will be promoted among users of the dictionary by its clear indication that the names of higher categories are *plural* in form. Good botanical usage does not accept undesignated trinomials (lacking insertion of the ultimate rank, whether variety or subspecies) and it is unfortunate that such trinomials regularly appear when such taxa are cited. It is welcome to see made the distinction between preferred usage of "phylum" in the animal kingdom and "division" in the plant kingdom. Overall, the editors are to be congratulated upon freeing themselves from the influences of the "American Code" of nomenclature, which permeated the Second Edition. Tautonyms are apparently avoided, and family names are more generally acceptable.

The scientific names of plant species referred to seem reasonably up to date, a conspicuous exception being *"Rhus toxicodendron"* for the poison ivy "common in the eastern and central U. S." At least it is stated how one contracts poison ivy, while the statement under poison hemlock and many other poisonous plants makes no reference to the part of the plant which is poisonous nor to defining the nature of "poisonous"—whether upon mere contact or only actual ingestion. Nor is there reference to the colored plate (not identical with that in the Second Edition) of poisonous plants (some 17 pages after the "poison" entries). Skunk cabbage is pictured on this plate, but no mention of any sort of poison (unless one counts "offensive-smelling") is given in the definition of skunk cabbage—which is seldom if ever considered an important poisonous plant. The function of the plate of so-called poisonous plants thus seems chiefly ornamental, for correlation with definitions is minimal. Another lack of correlation between text and illustration is under "nasturtium," which is properly considered in the light of its two widely differing applications *(Tropaeolum* and a cruciferous genus). However, the drawing of "Nasturtium" does not state which of the two definitions it illustrates and hence is rather useless.

"Adder's-tongue" comes in for confusion almost as bad as that described by Fernald (Rhodora 46: 313—314.. 1944) in reviewing another dictionary. After the first definition *(Ophioglossum)*, the new Webster's brings in *Achillea, Arum, Erythronium, Geranium, Orchis,* and *Peramium,* "having leaves or flower or fruiting spikes suggesting the fruiting spikes of adder's-tongue fern." Botanists familiar with these plants will raise their eyebrows; there is no need to elaborate on the general lack of resemblance of these plants to the fertile frond of *Ophioglossum* nor on the fact that of the plants named only *Erythronium* is commonly called adder's-tongue.

General words with precise biological applications sometimes fare very well; "nomenclature" and "publication," for example, are given their specialized meanings. The new and exceedingly popular word "taxon" is duly included, its origin indicated as "ISV" [International Scientific Vocabulary"—words with no positive evidence that they were coined in English]. An acceptable definition of "polygamous" in its botanical sense is included. Inconsistently, "polygamodioecious" is given a very poor definition ("having some plants polygamous and some dioecious in the same species"), while "polygamomonoecious" is not listed at all. "Species" is given a modern definition in that there is emphasis on relationship to evolutionary process, but there is too much stress on sexual reproduction and no reference to the possibility of asexual species (which are not uncommon in the plant kingdom).

Attention should perhaps be called to the fact that this edition omits both the gazetteer and biographical portions which had considerable usefulness in its predecessor.

The only actual typographical error I happen to have encountered (unless "peritheciae," mentioned above, is considered one) is "Aramanthaceae" (for Amaranthaceae) under "Caryophyllales."

In summary, the dictionary has been generally successful in including new words, but has regressed in often including both definitive and supplementary material (examples, etc.) in a single, complex, decidedly "uncrisp" statement. To persons outside a field, wading through terminology which may be unfamiliar, this practice is likely to lead to further confusion in selecting the really essential definitive points—a matter in which the editors themselves seem sometimes confused. All this is not to deny that there are many excellent, fully acceptable, and helpful definitions ("flower" is a good example). But one would hope for a higher percentage of such definitions in a work which has gone to considerable trouble to include the words.

I am indebted to Dr. A. S. Sussman, chairman of the Department of Botany, University of Michigan, for his helpful advice in evaluating the treatment of words in the areas of physiological and cellular biology. —*Edward G. Voss, Herbarium, University of Michigan, Ann Arbor.*

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Names of contributing authors are in capital letters. New scientific names are in boldface followed first by page on which formally published (in some cases this is not the first page on which mentioned). Synonyms are in italics. Optional capitalization of specific names is uniformly adopted here though not used by most of the contributing authors. Illustrations are indexed only by captions, in some cases not on the same page.