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# Botanical Degradation of Dillerville Swamp, Lancaster County, Pennsylvania

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Dillerville Swamp was a well-known locality for rare plants on the northwest outskirts of Lancaster, Pennsylvania. Bayard Long (1929) referred to it as the "famous Dillerville Swamp." Another local botanist (Auxer 1929–1930) wrote it was "long famous for the great number and variety of its flowers." Apparently the swamp had a diverse flora but it was best known for the rare limestone plants found there. Today the rare plants are gone and so are many of the more common wetland plants that added to the appeal of the swamp.

During visits to the former location of the swamp in 1977 and 1979, I failed to locate any of the following rare plants previously collected there: *Carex prairea, Carex tetanica, Cladium mariscoides, Eleocharis intermedia, Epilobium strictum, Juncus balticus, Juncus brachycephalus, Juncus nodosus, Juncus torreyi, Lathyrus palustris, Lobelia kalmii, Moehringia lateriflora, Muhlenbergia glomerata, Potamogeton hillii, Rhamnus alnifolia, Rhynchospora capillacea,* and *Scleria verticillata.* These plants are now presumed extirpated from Lancaster County and possibly from all non-glaciated limestone wetlands in eastern Pennsylvania. Other plants which used to grow there include *Orontium aquaticum, Menyanthes trifoliata, Gentiana crinita,* and *Smilacina stellata* (Auxer 1929–1930).

Degradation of Dillerville Swamp was a gradual process. The last known person to make extensive collections there was A. E. Urban whose latest Dillerville Swamp collections in the herbarium of Franklin and Marshall College are dated 1919. In 1927 Bayard Long unsuccessfully searched for *Potamogeton hillii*[1] and we learn that by then the "original area whence Porter got his material has been greatly altered" (Fernald 1932). In 1929 Auxer reported "a good portion of the swamp on the north side of Manheim Pike being filled up to form a flying field for the Lancaster Aviation Club [and a] small portion is also being filled up from the south." Auxer further reports that he "found 3 specimens, none of which were very good" of the golden club. Today the area encroaching on the swamp remnants is industrialized and another portion was recently filled to construct a bus garage. The small streams between Manheim Pike and Fruitville Pike (underground in some places) have *Potamogeton pectinatus, Potamogeton pusillus,* and *Callitriche stagnalis* growing in them but little else. An herbaceous wetland in the same area near Fruitville Pike south of route 30 has a mixture of old field and common wetland plants. Wetlands are also still present between Harrisburg Pike and Marietta Avenue where *Zannichellia palustris* was recently observed in pools adjacent to Little Conestoga Creek. It is doubtful, however, that further exploration will provide anything more than degraded remnants of what things were like in the past.

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[1] Plants from Dillerville Swamp were originally described as *Potamogeton porteri* Fernald (1932).

## ACKNOWLEDGMENTS

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## REFERENCES

AUXER, WILLIAM. 1929–1930. Unpublished notes in the files of the Muhlenberg Botanical Society, North Museum, Franklin and Marshall College.

FERNALD, M. L. 1932. The linear-leaved North American species of *Potamogeton,* section *Axillares*. Mem. Amer. Acad. Arts and Sciences 17(1): 1–183.

LONG, BAYARD. 1929. Some noteworthy indigenous species new to the Philadelphia area. Bartonia No. 10: 30–52.

# Distributional History of *Lythrum salicaria* (Purple Loosestrife) in North America


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*Lythrum salicaria* L. (purple loosestrife, spiked loosestrife, long purples, or red sally) of the Lythraceae is a tall, perennial, purplish-red-flowered herbaceous plant of wetland habitats. As mapped by Hultén (1971), the species occurs in the eastern hemisphere in Eurasia, northern Africa, and Australia. Considered native to Eurasia, purple loosestrife has been known from North America since shortly after the beginning of the nineteenth century. During the late nineteenth century and first half of the twentieth century it spread into the glaciated wetlands of North America, particularly in the St. Lawrence River valley, the Hudson River valley, and the Great Lakes region. Its progression across the continent is illustrated on three maps showing the extent of its known distribution before 1900 (Fig. 1), before 1940 (Fig. 2), and to 1980 (Fig. 3).

Purple loosestrife is often cultivated in gardens from whence it escapes into nearby wetlands and becomes established along edges of rivers and ponds, in roadside and railroad ditches, and in low, wet meadows and marshes that are submerged in the spring and become dry in the summer. In certain wetland areas, the plant has become an aggressive "weed," forming massive colonies that consequently eliminate the native, sometimes rare, marshland species. This elimination of the native species was of particular concern to Fernald (1940, pp. 378–379) who wrote that from above Montreal to below Quebec in the St. Lawrence River valley, "the formerly unique and endemic flora of the estuary is being rapidly obliterated by the crowding and handsome but overwhelming . . . purple loosestrife (*Lythrum salicaria*), . . . gorgeous to look upon but unscrupulous and without mercy for the insignificant endemics, which cannot last many years longer. Similarly, on the lower Merrimac the same purple loosestrife, a joy to the artistic and unscientific eye, has obliterated the fastidious and localized endemics, which had become isolated there since the last withdrawal of the Champlain Sea." In recent reviews of the family Lythraceae in North America, little or no information has been presented on the distributional history of *L. salicaria* (Graham 1964 and 1975; Shinners 1953). Louis-Marie (1944) and Rousseau (1968) have reviewed the history of its spread in Quebec. This paper assembles data from the literature and from herbarium specimens documenting the distributional history of *L. salicaria* in North America. Although numerous varieties and forms of the species are reported in the literature, none of these variants is taken into consideration in this paper. Diagnostic characteristics of these variants are in Koehne (1903) and Louis-Marie (1944).

## DOCUMENTATION FROM NINETEENTH CENTURY MANUALS AND FLORAS

The earliest apparently reliable report of *L. salicaria* in North America is the statement "In wet meadows: Canada and New England . . . About two feet high; flowers very showy, purple" in Pursh's *Flora Americae Septentrionalis* (1814). He noted having seen the plant living. Torrey (1824) summarized the distribution of *L. salicaria* in

FIG. 1. Known distribution of *Lythrum salicaria* in northeastern United States and southeastern Canada previous to 1900 based on herbarium records and reliable literature reports. Dots inside circles represent records obtained between 1890 and 1899.

North America, saying: "Among the numerous specimens of plants I have received from various parts of New-England, I have never seen one of this; nor has it been found in North-America, to my knowledge, by any other Botanist except *Pursh*." Hooker (1829–1833) in his *Flora Boreali-Americana* cited Pursh and then wrote "abundant, in Upper Canada" based on information he had obtained from David Douglas who had traveled in western Ontario north of Lake Erie, which at that time was called Upper Canada. Macoun (1883), however, doubted Douglas' record, and suspected that it referred to swamp loosestrife, *Decodon verticillatus*. Torrey and Gray (1843) noted the species in "Wet meadows, Canada! Maine! and Massachusetts! probably native." In what appears to be the first record for the state of New York, Torrey (1843) said, "Borders of Murderer's Creek, Orange County, where it occurs in many places for several miles, and is apparently native . . . ." Herbarium records have not been seen which would verify these early reports. In the first edition of his *Manual,* Gray (1848) gave the same range as Torrey and Gray did in 1843, and also indicated that it was commonly cultivated. This same range information was retained through the next four editions of the *Manual* (Gray 1856, 1858, 1863, and 1867). Furthermore, Gray (1856–1857, p. 66) believed that purple loosestrife was native, at least in New England, but allowed that its status was "not clear from suspicion." In his *Catalogue of Canadian Plants,* Macoun (1883, 1886, and 1888) cited locations at the Quarantine Station, Island of Orleans, and Longueuil in the St. Lawrence River valley, and from a low river bank

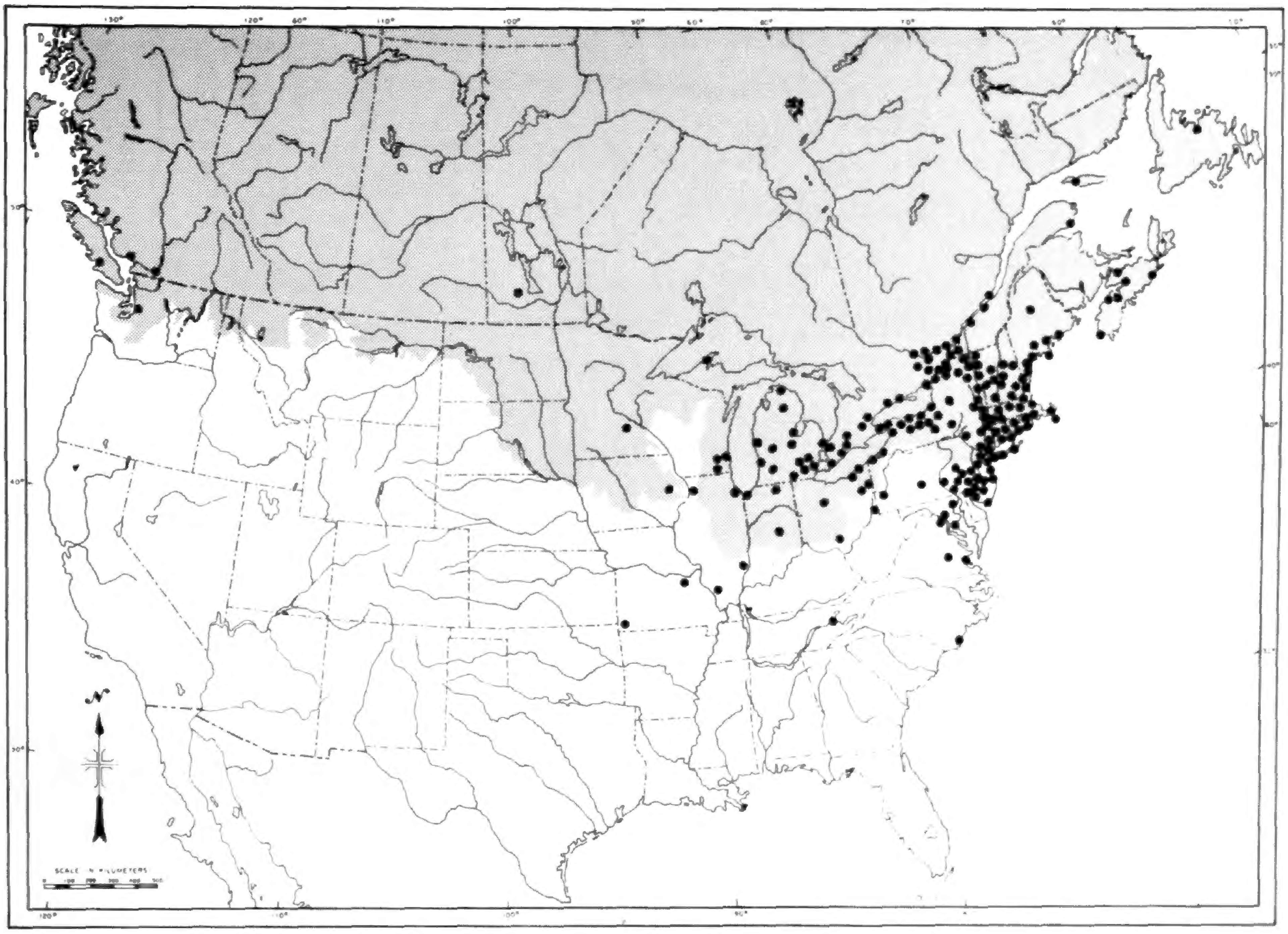

FIG. 2. Known distribution of *Lythrum salicaria* in the United States and southern Canada previous to 1940 based on herbarium records and reliable literature reports.

at Bryon near London, Ontario. He noted that the plant was abundant in meadows among the ruins of Louisburg in Nova Scotia. In all of the above publications, *L. salicaria* was treated as indigenous to North America. It was not until the sixth edition of Gray's *Manual* that the distributional information was expanded to "N. Scotia to Delaware," and that the species was treated as a non-indigenous member of the flora naturalized from Europe (Gray, Watson, and Coulter 1889). Other reports at about the same time noted a similar North American range for this European species (Barker 1891; Koehne 1885).

## Documentation from Early Herbarium Specimens and Local Literature

The earliest known herbarium specimens of *L. salicaria* are from three general areas along the northeast coast of the United States—(1) eastern Massachusetts, (2) Long Island and the Hudson River valley in New York, and (3) the Delaware River valley in Pennsylvania and New Jersey. In Massachusetts, the earliest known specimen is from the seaport city of New Bedford in Bristol County obtained in September 1831 (*Green s.n.*, NY). Later records are from Cambridge in 1844 (*without collector*, BH) and Amherst in 1867 (*Ward s.n.*, ILL). None of these specimens provides any data as to the habitat or conditions under which the plants were growing. However, herbarium records from the 1870's to the 1900's note the plants from waste ground, dumps, river banks, ponds, and meadows. By 1900, purple loosestrife was known in Massachusetts from nearly 20 localities, including Nantucket Island (Bicknell 1914), where a few

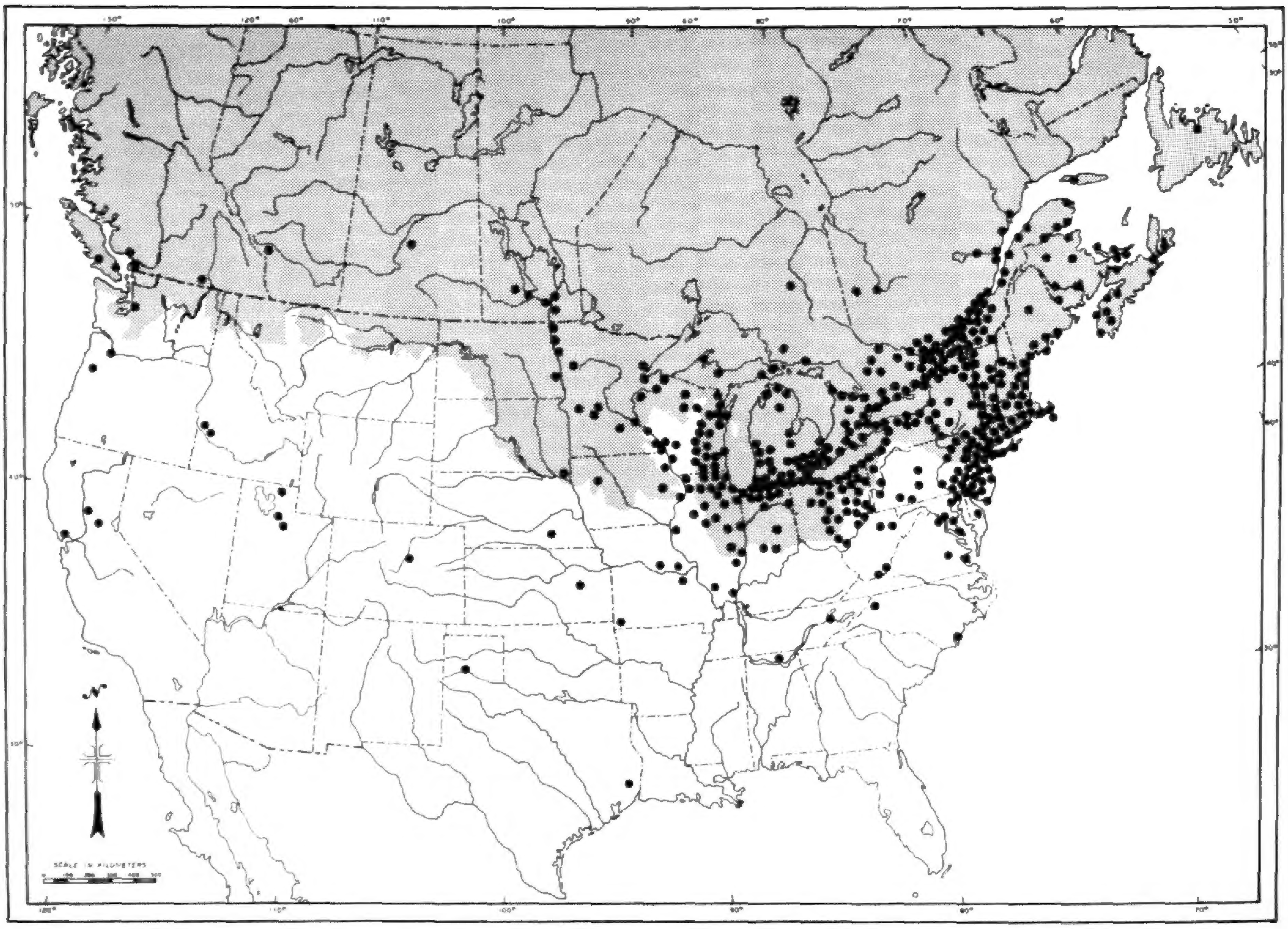

FIG. 3. Known distribution of *Lythrum salicaria* in North America previous to 1980 based on herbarium records, reliable literature reports, and other recent records received from correspondents.

plants were to be found. In later years, *L. salicaria* was reported in the Boston area as "introduced in wool-waste at many places; especially abundant along the Merrimac River . . ." (Knowlton and Deane 1921). A single plant from near Abbot's Woolen Mill at Graniteville in the upper Merrimac River valley, obtained 31 Aug 1908 (*Dickerson s.n.*, GH), provides evidence for an early introduction from a wool mill. Pellett (1944) stated that purple loosestrife was introduced in the Merrimac River valley through seed washed out of wool, and that the plants had spread down river to the point where the river water mixed with the salt water for about four miles from the ocean. The river shores and the entering streams were lined with a solid mass of purple when the plants were in bloom.

As noted by Bailey (1905), the species in Rhode Island was "scattered over the state, [but] is no where abundant." He cited locations at Little Compton, Apponaug, and South Kingston. Other records prior to the 1900's from New England are selected as follows: CONNECTICUT: [New Haven Co.]: rare, river banks, Southington, 20 Jul 1895, *Bissell 29* (ILL). NEW HAMPSHIRE: [Carroll Co.]: Conway, Aug 1875, *Jesup s.n.* (MU). [Grafton Co.]: Hanover, 20 Jul 1892, *Sargent s.n.* (GH). VERMONT: [Rutland Co.]: Clarendon, 5 Jul 1898, *Eggleston 222* (GH), 30 Jul 1902, *Eggleston 2878* (MIN, MO, NY, PH, US).

In New York, the earliest known specimen seen of *L. salicaria* is from Flushing, Long Island, taken in August 1864 (*Allen s.n.*, NYS). This record is 54 years older than the previously reported first-known record of 1918 for Long Island (Latham 1938).

Specimens from marshes along the Hudson River (*Clinton s.n.*, MICH, MSC, NY) and at Cold Spring (*Clinton s.n.*, NY) were first obtained in August 1867. By 1870, *L. salicaria* was listed for the New York City area at the railroad station in Flushing, in Orange County, and along the Hudson River (Leggett 1870). In the New York City area, purple loosestrife continued to spread and became established along the shores of the Hudson River and along railroad rights-of-way in the valley (Bicknell 1880; Merriam 1872; Rudkin 1879). From the lower Hudson valley, the species migrated northward, and by 1889 it was known from the banks of the Champlain River (*Brainerd s.n.*, GH). Four years later, the first report of the plant growing along the margin at the head of Lake Champlain was indicated (Peck 1893). This new station was then believed to be the northernmost one in the state, although a record from farther north at Saranac Lake in the Adirondack Mountains is older (Aug 1888, *Heritage s.n.*, PENN). Reports of field trips by the Torrey Botanical Club in the early 1900's noted that *L. salicaria* was well established along the shore of the Hudson River, in the valley, and in wet places in upland sites. Raymond Torrey (1929) wrote:

> Along the shore of the Hudson, the Purple Loosestrife *Lythrum salicaria* was in its usual striking display in mid-August. Upland occurrences were found in the bottom of a dried up pond in the Bear Mountain nature trail area, and in a springy spot along the road leading up from Fort Montgomery. I have usually regarded the displays of this plant in the brackish marshes along the Hudson, between Stony Point and Poughkeepsie or higher, as the most resplendent, but in coming down from the Catskills, by automobile, via the Rondout and Wallkill valleys, on the morning of the 18th, I saw larger expanses along those streams and in meadows in Orange County, ten miles west of the Hudson, which were the most glorious in massed purple that I have ever seen.

The origin of purple loosestrife's occurrence in wetlands in upland areas was of some concern, and in a later report of a field trip to the Blue Mountain Reservation southeast of Peeksill in Westchester County, Raymond Torrey (1931) explained:

> . . . The dead stems of the Purple Loosestrife, *Lythrum Salicaria*, on brooks and small swamps, high up in the preserve, at elevations 400 feet above the Hudson, indicated that this adventive plant, which has spread from whatever coastal point it was established at seventy-five or one hundred years ago, all along the Atlantic seaboard from the Gulf of St. Lawrence to the Potomac, must be spread by other means than tidal or fresh waters, for it could scarcely have been seeded in these high swamps except by birds. It is now well established on many tributaries of the Hudson, miles from their mouths and 200 to 500 feet above the river. One notices red-winged blackbirds feeding on its seeds in the brackish marshes along the Hudson where it is so common, and it seems probable that these or other birds carry it to the streams and swamps back of the river.

The migration of purple loosestrife in the Hudson River valley was the subject of an article in the New York Times, Sunday 21 Aug 1932 (Anonymous). The writer explained that the plants' "spread within the last thirty or forty years has been so swift that they have taken up entire meadows and wet fields, and brackish marshes where they were quite unknown half a century ago." The extensive article further speculates on the migration of the species in the Hudson River valley, but some of the statements are contrary to the above established facts from herbarium records.

Elsewhere in New York, *L. salicaria* was reported by Dudley (1886) from the Finger Lakes region based on two records from the shores of Cayuga Lake, one in 1869 and another in 1875 (*Hine s.n.*, CU). He noted that "the plants have continued [persisted], though not increased." At about the same time, purple loosestrife appeared along roadsides and on river banks near the south shore of Lake Ontario at Oswego (16 Aug 1877, *Sheldon s.n.*, NYS, and reported by Peck 1879), near Buffalo (Jul 1876, *Morong* *s.n.*, NY), and was known from Niagara Falls by 1884 and from near Farmers Mill by 1896 (Zenkert 1934). Before 1900, the species was rare along the shore of Irondequoit Bay in Monroe County and was present at Clyde in adjacent Wayne County (Beckwith and Macauley 1894). It was not until the early 1900's that purple loosestrife spread across New York. Taylor (1915) wrote that it "was becoming common throughout many parts of our range, especially in the Hudson and Delaware Valleys." Pellett, in a letter of 28 August 1919 to William Trelease, botanist at the University of Illinois, wrote, "rapidly spreading in the localities where it has appeared" in New York. House (1924) noted it as "Frequent or locally common across the State south of the Adirondacks, and locally northward to Lake Champlain . . . in some sections becoming very common." Later, House (1937) noted with regret that the purple loosestrife brought no protest as it marched across the state and usurped the habitat of the native marsh plants.

In the Delaware River valley, the oldest herbarium specimen seen is one from Philadelphia taken in July 1852 (*Seal s.n.*, PH). On the opposite side of the river in Camden County, New Jersey, purple loosestrife was first obtained from the gravelly shore of the Delaware River near the mouth of Cooper's Creek (10 Jul 1864, *Burk s.n.*, PH), and a year later Diffenbaugh obtained a plant from Cooper's Bridge (25 Jul 1865, PH). He noted on his specimen "First detected by Isaac Burk in 1864." The following year it was noted as "rare" on the banks of the Delaware at Pavonia (29 Jul 1866, *Parker 2212*, MIN, MO), and also in 1866 it was first recorded from Delaware at Holly Oak in New Castle County (*Canby s.n.*, NY). Diffenbaugh noted on his specimen obtained 2 Aug 1868 (PH) "From the same root as formerly. It does not appear to spread." In 1878 purple loosestrife was noted "On ships ballast at Greenwich Point, Phil[adelphia]" (16 Aug 1878, *Burk s.n.*, PH), and the following year on ballast at Camden (27 Jul 1879, *Parker s.n.*, GH). In March 1869, George Martin, M.D., of West Chester, wrote to Professor Thomas C. Porter of Easton, that he was sending a specimen of *Lythrum* that "was gathered early in August [1868] in a swampy piece of ground a short distance East of this place and I presume must have escaped from a Nursery in the neighborhood . . . There were several in the same locality." By 1900, purple loosestrife was recorded from Northampton, Bucks, Philadelphia, Chester, and Delaware counties in the Delaware valley (Porter 1903). Later, Small and Carter (1913) reported it from Columbia in Lancaster County. These fragments of information suggest that *L. salicaria* may have come into the Delaware River valley through ships' ballast or as an escape from cultivation in gardens or nurseries from whence it spread.

## Westward and Southward Spread from Northeastern North America

The arrival of *L. salicaria* in isolated localities to the west and south of its early established range in northeastern North America occurred mostly about the turn of the century. In western Pennsylvania, Shafer (1901) listed purple loosestrife at Highwood Cemetery in Allegheny County, where it had escaped from cultivation. It was planted at artificial fish ponds in Washington, D.C. (25 Jun 1896, *Steele s.n.*, MU), and was known from waste ground as far south as Wilmington, North Carolina (20 Aug 1885, *McCarthy s.n.*, US). Other known isolated occurrences to the south of Pennsylvania are in West Virginia in Monroe County at Salt Sulfur Springs (Aug 1858, *Canby s.n.*, NY), and in Ohio County at Wheeling (30 Aug 1878, *G. Gubbenburg s.n.*, NY), along the Ohio River in Kentucky (Aug 1896, *Marsh s.n.*, NY), and in Knox County, Tennessee (10 Aug 1899, *Ruth s.n.*, NY).

In the western Great Lakes region, *L. salicaria* was first reported from Michigan in Wright (1839) and listed for Michigan in Eaton and Wright's *North American Botany* (1840), but no further documentation for this record is known. This record was repeated in the catalogues of Michigan plants by Coleman (1874) and Palmer (1879). The plants were cultivated at Lansing, Michigan (15 Jun 1887, *without collector,* MSC), recorded from a cemetery in Detroit in July 1885 (McAtee 1923), and noted as "Probably an escape, near Palmer Park, Detroit" (27 Aug 1916, *Farwell 4404,* BLH, MICH), later reported by Farwell (1918). The Rev. Philip L. Schenek, late professor in the English Department at The University of Michigan, is said to have looked on with "pride and awe the spread of Purple Loosestrife which he introduced [along the Huron River northwest of Ann Arbor] from seeds brought . . . from Massachusetts" early in the 1900's (Huntley, Spurlin, and Powers 1968). Pepoon (1916) was intrigued by a single plant occurring along the Wabash railway in the Chicago area, and later, Pepoon (1927) wrote that a few plants were known in 1900 from wet ground near the Wabash railway west of Aetna, Indiana. Farther to the southwest, the plant was cultivated in St. Louis, Missouri (2 Jul 1910, *Sherff 203,* GH). These early citations certainly suggest that *L. salicaria* has had many separate, independent introductions involving various dispersal mechanisms, and that these and other phenomena have occurred at numerous unrecorded sites throughout midwestern North America.

The establishment of *L. salicaria* in the glaciated wetlands of the Great Lakes region also occurred about the turn of the century. Along the shoreline of Lake Michigan in western Michigan, the species appeared at Muskegon (1879, *Frost s.n.,* NY) and was known from a coastal marsh farther south at Saugatuck in Allegan County by 1898 (*Umbach s.n.,* MICH, MIN, US). In the Saginaw Bay area, purple loosestrife was noted at Saginaw (4 Aug 1893, *Claire s.n.,* NY) and as "frequent" in wet meadows at Bay City (2 Aug 1896, *Bradford s.n.,* MSC). At the south end of Lake Huron at Port Huron it was "plentiful" where it grew in damp places in streets on the outskirts of the city (6 Aug 1893, *Dodge s.n.,* MICH). A second specimen of Dodge's with the same date (MICH) bears the information, "Have seen only two plants & they were . . . within the limits of the city of Port Huron. This plant seems to be traveling west." Later Dodge (1900) wrote: "Appearing as a weed in the streets of the city of Port Huron now for several years." Other pre-1900 sites are known from farther north in Crawford County at Grayling (25 Aug 1897, *Jones s.n.,* NY) and in the Upper Peninsula in Houghton County at Houghton (14 Jul 1896, *Reardon s.n.,* NY). In two catalogues of the flora of Michigan (Wheeler and Smith 1881; Beal and Wheeler 1892), *L. salicaria* was not reported, but Beal (1905) in his *Flora* wrote that the species occurred from "Detroit to Bay City, Port Huron . . . ." Its occurrence and establishment inland in wetlands of southern Michigan is documented by the following selected records dated before 1930: Hillsdale Co.: A few plants only, marsh near Jonesville, 6 Aug 1927, *Moseley s.n.* (BGSU); [Ingham Co.]: In waste field on poor soil, Haslet, 15 Jul 1917, *Yuncker 414* (ILL, US); Livingston Co.: Shore of Strawberry Lake, 12 Jun 1921, *Ehlers 1485* (GH, MICH); [Wayne Co.]: Sheldon, 10 Sep 1924, *Farwell 7139* (BLH, MICH), cited by Farwell (1925) as "Occasional in roadside ditches." In the well-studied Douglas Lake region of northern Michigan, purple loosestrife was first noted as recently established along Lake Huron at the outlet of the Cheboygan River at the town of Cheboygan from records made in 1933 (*Ehlers 5344,* UMBS; *Gleason & Gleason, Jr., 321,* GH, IND, NY) and reported in Gates and Ehlers (1948).

In Ohio, *L. salicaria* was first obtained at Little Mountain in Lake County (24 Aug

1902, *Hacker s.n.*, OS) and first reported by Kellerman and Jennings (1904). Its early spread in the state apparently was slow, as it was noted 30 years later from only Lake and Cuyahoga counties in northeastern Ohio along Lake Erie (Schaffner, 1932). Subsequently, Schaffner (1937) added a record from "an old prairie, three miles west of Marion," in central Ohio (Jun 1936, *Transeau s.n.*, OS) where it probably grew along a railroad. Blackwell (1970) mapped its distribution in Ohio and considered the species to be "infrequent" in the state. Based on herbarium records, the species had spread by the late 1950's into several locations in northern Ohio. This range expansion was especially evident in certain wetlands and marshes along and near Sandusky Bay in western Lake Erie. Here, purple loosestrife became a particularly aggressive "weed" crowding out native species in unmanaged wetlands during the time of high water in Lake Erie from 1969 to 1976. Elsewhere in northern, central, and southern Ohio, *L. salicaria* occurs in small isolated colonies usually along shores of rivers and reservoirs and in roadside and railroad ditches. The species is cultivated in yards and gardens, and occasionally escapes. In central and southern Ohio, where extensive wetlands are scarce, the species is not a "weed" problem. In unglaciated Ohio, Cusick and Silberhorn (1977) listed *L. salicaria* as infrequent in disturbed wet situations from six counties.

In Indiana, *L. salicaria* apparently had spread very little from 1900, the date of the first known record, to the time that Deam (1940) wrote his *Flora of Indiana*. He noted the species from two additional counties, Elkhart and Marion. Herbarium records seen from this period are: Elkhart Co.: Middlebury, 5 Jul 1914, *Elk s.n.* (NY); [Monroe Co.]: Bloomington, 1910, *Parks s.n.* (NY); Marion Co.: Along a stream about 1 mile southeast of Irvington, July 1925, *Freisner s.n.* (IND). The latter locality was reported to have had about "30 well established clumps . . . scattered along the banks of the stream within a distance of a half mile." These plants were believed to have spread from "a single clump of depauperate plants on an old estate about a half mile up the stream . . . located on a slope which drains into the stream" (Deam 1926). Purple loosestrife is apparently more common in glaciated northern Indiana (Fig. 3).

In the glaciated portion of Illinois, *L. salicaria* was reported as an adventive in Cook, Richland, and Winnebago counties before 1950 (Fuller and Jones 1949). Later, Jones and Fuller (1955) noted it as occasional and naturalized in swamps and wet meadows from five counties in the state. Based on herbarium specimens at the University of Illinois, it appears that purple loosestrife may have begun spreading in this state in the 1950's. Swink (1969 and 1974) wrote that it is planted as a garden ornamental and "escapes to become a weed in wet places." He further noted that it was rapidly increasing in the Chicago area where it occurs in marshes, along streams, on mudbars in rivers, and in ditches. The map in Mohlenbrock and Ladd (1978) shows the species from 13 counties in glaciated Illinois. In the unglaciated southern portion of the state, purple loosestrife was reported as a "waif" from a moist ditch south of Elkville in Jackson County (Mohlenbrock 1959; Mohlenbrock and Voigt 1959). An earlier record is known from Carbondale in Jackson County (6 Aug 1903, *Fish s.n.*, NY). Its spread in southern Illinois has apparently been more recent, where it is now known from five counties (Mohlenbrock and Ladd 1978).

In Wisconsin, as summarized from Ugent (1962), *L. salicaria* is "Sporadic throughout the state, though often occurring in very large colonies, in moist or wet ground, frequently along muddy lake shores, river banks, ponds, cattail marshes, sedge meadows, and roadside or railroad ditches." Frequently cultivated and established as an escape, "it has been rapidly spreading in recent years." The first record comes from Whitefish Bay along Lake Michigan in Milwaukee County (1928, *Thorne s.n.*, MIL, WIS). A dot map with dated localities in Ugent shows that many of the records are from the 1950's. As reported by Cutright (1978), purple loosestrife is plentiful in Kletsch Park in Milwaukee with substantial populations in the northernmost part of the state in Ashland and Bayfield counties. The species is continuing to spread, and since 1970 it has been located in Bayfield, Kewaunee, Shawano, and Sawyer counties in northern Wisconsin, and in Columbia and Vernon counties in the southern part of the state, according to Cutright.

### Occurrence in Unglaciated United States and West of the Mississippi River

Although *L. salicaria* has spread extensively and has become common in the glaciated wetlands of the northern United States during the past 100 years, south of the Wisconsin glacial border the species has been reported as infrequent in Ohio and Illinois and appears to be locally isolated elsewhere. Isolated locations are reported in Pennsylvania from a roadside thicket in 1962, Bedford County (Henry 1978); as an escape in 1958, Butler County (Henry 1971); from two stations in Centre County (Westerfeld 1961); and from low land in 1961, Somerset County (Ross 1962). In Maryland the species has been noted from the marshes of the Patuxent River in Calvert County (Shreve, Chrysler, Blodgett, and Besley 1910) and in ditches near oyster shell piles in 1958 at Canton (Reed 1964). Purple loosestrife has become naturalized in wet meadows and swamps in the District of Columbia and vicinity (Hitchcock and Stanley 1919; Massey 1961). Two locations are reported for West Virginia, at Mercer Springs in Mercer County and along Indian Creek in Monroe County (McNeill 1938). Strausbaugh and Core (1973) cited it as "Frequently seen in cultivation; established as an escape, Arden, Barbour County . . . Lake Floyd, Harrison County . . . and Salt Sulphur Springs, Monroe County," the latter evidently the same locality where it was first obtained in the state a century earlier. In North Carolina, the species is reported as very rare in marshes only from Watauga County (Radford, Ahles, and Bell 1968; Beal 1977), and in Alabama, only from Madison County (Whetstone 1978). In southeastern United States, *L. salicaria* has not been reported elsewhere (Graham 1975; Jones 1975).

West of the Mississippi River, the distribution of *L. salicaria* is scattered, and the evidence suggests that the plants have mostly escaped from cultivation. In Minnesota, it is known from 12 widely-spaced localities. Two of the earliest recorded localities are: [Carver Co.]: West shore, Smith's Bay, Lake Minnesota, Jul 1938, *Hedman 73* (MIN); north shore, Brown's Bay, Lake Minnesota, Jul 1938, *Hedman 73* (MIN). Stevens Co.: A large patch growing in roadside meadow near old nursery, 1 mile southeast of Morris, 16 Aug 1946, *Moore & Huff 19052* (GH, MIN, PENN). In Iowa, data on a specimen from Cedar Rapids in Linn County noted that the species was in "several localities . . . spread after cultivation" (11 Jul 1926, *Benke 4288*, US). In Scott County, the plant has been cited as "An occasional escape from flower gardens" (Guldner 1960). Beal and Monson (1954), however, did not map *L. salicaria* for Iowa. The introduction of purple loosestrife into Buena Vista County in northwest Iowa has apparently been for the purpose of establishing a honey plant for bees. As reported by Pellett (1963), the seeds of purple loosestrife were scattered several years previously by Walter Guntren of Storm Lake along several small streams in the vicinity. The seeds germinated and the plants persisted, soon spreading in the streams and into a nearby unnamed lake. In a short time, approximately thirty acres of the marshes and wetlands around the lake became covered with purple loosestrife. In more recent years, the plants have begun to spread down the Racoon River, the main river in the county, where each year it is noted farther downstream (Pellett 1977). In an editorial reply, Hughes (1977) urged beekeepers to join with other conservationists in preventing the spread of purple loosestrife.

In Missouri, Palmer and Steyermark (1935) noted it as "Introduced in waste ground" in Franklin County. A year later, it was obtained at Neosha in Newton County from the water's edge at a fish hatchery (5 Jul 1936, *deGruchy 178*, GH). In his *Flora of Missouri*, Steyermark (1963) wrote "Planted as an ornamental garden species, rarely escaping from cultivation . . . where known from Franklin and Newton (introduced and spreading along banks of spring-fed pond, near Saginaw, August 6, 1952, *Palmer 54649*) counties." In North Dakota, Stevens (1972) wrote that the plant is "much planted and a considerable colony developed in a low, roadside area at Fargo" in Cass County. On the specimen, he noted "perhaps from plantings 15 years ago, but seems naturalized" (3 Aug 1964, *Stevens 2732*, DAO, MIN, UC). Van Bruggen (1976) stated that purple loosestrife was "Rarely escaped from plantings and becoming successfully established in moist, low areas in the eastern part" of South Dakota. In Nebraska, the species is reported from along a stream one mile east of Exeter in Fillmore County, based on a specimen obtained 9 August 1973 (Churchill, Kaul, and Sutherland 1976). They noted "So far it is not a problem in Nebraska." The only known record for Kansas is from Lyon County, based on a specimen a half mile east of the campus of Emporia State University, Emporia (8 Jul 1968, *Johncour s.n.*, KSTC). The site is a low, somewhat swampy, much disturbed area along the floodplain of the Neosha River. Perhaps the colony has not become established, as botanists in Kansas were not able to relocate the colony during field work in the summers of 1977 and 1978 (McGregor 1978). McGregor and Barkley (1977) have mapped the species from eight counties within the Great Plains as delimited in their *Atlas*. In southwestern United States, McCoy (1954) and Taylor (1977) did not report *L. salicaria* from Oklahoma, nor did Correll and Correll (1972) have it from Arizona, New Mexico, Oklahoma, and Texas. Since then, a locality has been reported from southeastern Texas in Hardin County, "almost in water of stream along roadside leading to Sour Lake" (25 Jun 1971, *Amerson & Watson 540*, SMU) as cited by Flook (1975). A more recent record is from Randall County (along Palo Duro Creek just n of Canyon, 24 Jul 1975, *Higgins 9529*, UC).

In western United States, *L. salicaria* is known from Utah, Washington, California, Oregon, Colorado, and Idaho. Since the 1940's, purple loosestrife has been identified from Utah, according to the following records: Salt Lake Co.: Margin of irrigation canal near cultivated fields, Salt Lake City, Aug 1943, *Harrison 10584* (NY, UC, US); near e end of Salt Lake City, 25 Jul 1978, *Van Norman s.n.* (UC). [Cache Co.]: 1 mi w of Logan, 26 Jul 1947, *Holmgren 7061* (NY, UC). Utah Co.: Powell's Slough on the e shore of Utah Lake ca. 2 mi w of Provo, 15 Aug 1976, *Thorn 88* (UC). In the coastal states, the records date from the 1930's, when the species evidently first appeared near the campus of the University of Washington in Seattle, based on the following records: [King Co.]: Abundantly established at boggy margins of Lake Washington near the University grounds, 18 Aug 1931, *Thompson 8004* (GH, MO, PH, UC, also cited by Thompson 1932); Lake Sammamish, 11 Aug 1933, *Eyerdam s.n.* (MIN); weed on campus, Seattle, 17 Jun 1934, *Jones 5040* (GH, ILL, NY, UC). In California, *L. salicaria* has been reported from Sonoma, Nevada, and Butte counties (Howell and True 1966;

Munz 1968). As summarized from Howell and True (1966), the earliest record, from Sonoma County, is dated 26 July 1948, and is represented by "one plant found at edge of hopfield west of Santa Rosa . . . about 1 mile west of Forest Station." In Nevada County, purple loosestrife is considered escaped from cultivation along stream banks and roadsides in the vicinity of Grass Valley to Nevada City. The species has been located south of Oroville, in Butte County, and "has become so rampant . . . as to require agricultural control since it threatens to invade rice fields." *L. salicaria* is reported as escaped from cultivation in Oregon (Howell and True 1966). One record has been seen from Polk County where the plant was in moist ground near cattails (2 Aug 1952, *Smith s.n.*, DAO, PENN). Ornduff (1962) reported that in August 1961 a small colony was in a "winter-wet depression at the edge of the industrial area on Swan Island, Multnomah County."

The known records from Colorado and Idaho are more recent. In the former state, purple loosestrife is reported from Jefferson County where it occurs "around a pond at high water line between cattail zone and grassy meadow, w of Hampden and Quincy, South Denver" (Jul 1978, *Harner* COLO 318898) as cited by Weber, Johnston, and Wilken (1979). A single plant was seen on 6 August 1979 by Thomas H. Jackson at the edge of a pond at the Federal Youth Correction Center about one mile south of Havana in northwest Denver (Daniel Q. Thompson, pers. comm.). In the latter state, the species is known from Gem County, five miles west of Emmett where it is "now widespread in farming area" (12 Aug 1972, *Albee 1076*, MO, UC) and in Ada County "in seepage pasture along Boise River near Eagle" where first seen about 1972 by William E. Hartman (Daniel Q. Thompson, pers. comm.).

## Distribution in Canada

The introduction and early history of the establishment of *L. salicaria* in the St. Lawrence River valley has been reviewed comprehensively by Louis-Marie (1944) and summarily by Rousseau (1968). They came to the conclusion that the species arrived from France sometime during the nineteenth century, based on the cited reports of Pursh in 1814 and Hooker in 1832, and other records dated in the 1850's and following years. Herbarium records I have seen mostly dated before 1900 are selected as follows and mapped (Fig. 1): QUEBEC: Isle Bouchard, St. Lawrence River, 14 Aug 1884, *Cooley 15729* (ILL); St. Lamberts [near Montreal], 16 Jul 1892, *Scott s.n.* (TRT); Hull, 12 Jul 1898, *Scott s.n.* (TRT); wet bank St. Lawrence River, below Quebec, 4 Aug 1902, *Churchill s.n.* (BH, GH). MANITOBA: Neepawa, Jul 1896, *J. Fletcher s.n.* (DAO). NOVA SCOTIA: Swamp, Grand Battery, Louisburg, 17 Jul 1883, *Burgess s.n.* (CAN, TRT). ONTARIO: [Carleton Co.]: Railway bank, Ottawa East, Aug 1888, *Scott s.n.* (DAO); Middlesex Co.: Bank of Thames, w of Byron, 1 Sep 1888, *Dearness s.n.* (DAO); Waterloo Co.: Galt, 29 Jul 1891, *Prescott s.n.* (UWO); [Lincoln Co.]: Low ground, St. Catharines, 14 Jul 1897, *McCalla 432* (US); Welland Co.: Niagara Falls, 21 Aug 1899, *Wilkes s.n.* (TRT).

At the present time, *L. salicaria* is most extensive in the St. Lawrence River valley as mapped by Rousseau (1968), and in Ontario where Montgomery (1957) wrote "widely distributed throughout southern Ontario in low wet soil and in marshes along streams and lakes; very occasional in the northern districts." In addition to herbarium records from CAN, DAO, TRT, and those cited in Groh (1944), the distribution map of *L. salicaria* in Canada (Fig. 3) has been compiled from information in Roland (1941, 1945) for Nova Scotia, Erskine (1960) for Prince Edward Island, Rousseau (1968) and

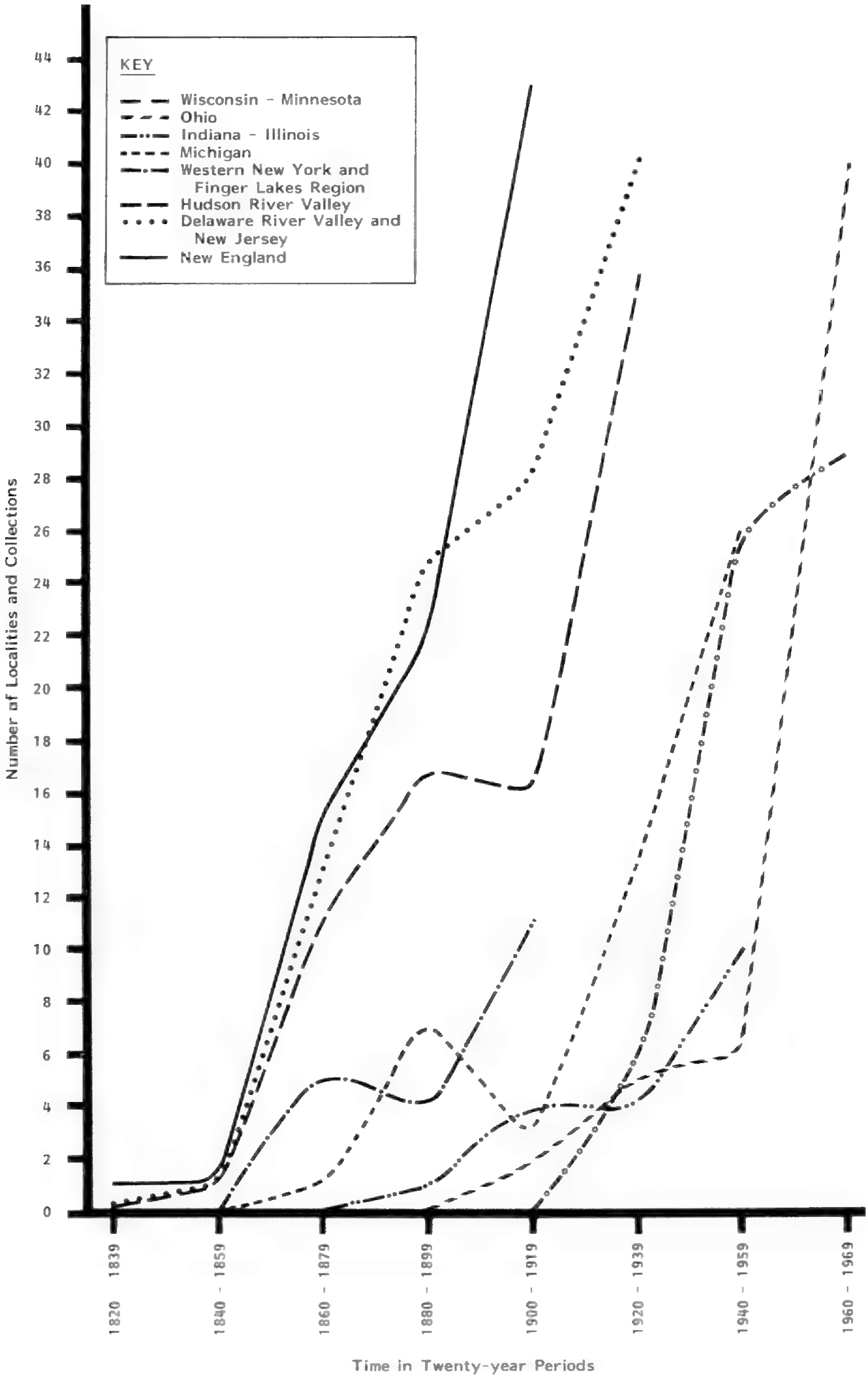


FIG. 4. The establishment and proliferation of *Lythrum salicaria* as reflected in the numbers of localities and collections correlated with time periods of 20-year intervals.

TABLE 1. The establishment and proliferation of *Lythrum salicaria* as reflected in the numbers of localities and collections correlated with time periods of 20-year intervals.

| | Number of Localities and Collections | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Time in 20-year periods | New England | Delaware River Valley and New Jersey | Hudson River Valley | Western New York and Finger Lakes Region | Michigan | Ohio | Indiana and Illinois | Wisconsin and Minnesota |
| 1960–1979 | 8 | 1 | 1 | 0 | 8 | 40 | 3 | 29 |
| 1940–1959 | 8 | 17 | 12 | 5 | 26 | 6 | 10 | 26 |
| 1920–1939 | 18 | 40 | 36 | 9 | 13 | 5 | 4 | 6 |
| 1900–1919 | 43 | 28 | 16 | 11 | 3 | 2 | 4 | 0 |
| 1880–1899 | 22 | 25 | 17 | 4 | 7 | 0 | 1 | 0 |
| 1860–1879 | 15 | 13 | 11 | 5 | 1 | 0 | 0 | 0 |
| 1840–1859 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| 1820–1839 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Scoggan (1950) for Quebec, Scoggan (1957) and Löve and Bernard (1959) for Manitoba, Moss (1959) for Alberta, and Cody (1978) for Saskatchewan.

## OVERVIEW

Although *L. salicaria* has been in North America since the early part of the nineteenth century, it had not become a troublesome "weed" until the 1930's, when it became aggressive in the floodplain pastures of the St. Lawrence River in Quebec (Louis-Marie 1944). Since then the species has formed extensive and dense populations in other river floodplain areas, such as in the lower Hudson, the Merrimac, the Delaware, and in the marshes of the Finger Lakes region and western Lake Erie, all except the Delaware located within the glaciated area of eastern North America. Elsewhere east of the Mississippi River, purple loosestrife is usually more scattered and of local occurrence. West of the Mississippi River, it is confined to a few known isolated ponds, streams, irrigation ditches, and cultivated fields. The only major river systems in western United States where the species is not yet known are the Arkansas, Colorado, and Rio Grande. As the history of its spread in North America reveals, *L. salicaria* has the ability to move rapidly, become firmly established, and eliminate other species in both natural and artificial wetland habitats. The species, therefore, has the potential to invade and become a serious problem in reclamation projects of the wetlands in the Great Plains and the far western portion of the United States.

An analysis of the distributional data related to time reveals that *L. salicaria* remains rare or very local in an area when it first invades or escapes from cultivation. Then, 20 to 40 years later, the plants proliferate and spread, often becoming quite common. At that time the plants may become a serious "weed" problem in the wetlands. Data supporting this progressive colonizational phenomenon have been tabulated (Table 1) and graphed (Fig. 4) from available herbarium specimens. Realizing the limitations and non-uniformity of these data, one can see that this distributional phenomenon has continued to repeat itself at different time periods in the several selected geographical areas. It is likely that this phenomenon will be repeated when the species invades other wetland areas.

Controlling the spread of *L. salicaria* is difficult and little studied. Some success has been demonstrated by spraying plants with chemical herbicides, cutting and pulling, water level manipulation, or a combination of these methods (Gagnon 1953; Louis-Marie 1944; McKeon 1959; L. S. Smith 1959; R. H. Smith 1964). While these control methods are most useful for small recent appearing colonies along ditches and roadsides, they generally are not practicable for use on dense and long-established populations. Biological methods of control may be useful in the future, but these methods are still to be developed because detailed basic life history studies have not yet been undertaken. Maintaining a marshland with a high diversity of species is a challenge that requires the successful prevention of the invasion and establishment of purple loosestrife. Should the species invade a marsh, successful management programs need to be developed for its control; otherwise purple loosestrife can be expected to become dominant to the exclusion of the native marsh species. The spread, impact, and control of purple loosestrife in North American wetlands is further discussed by Thompson and Stuckey (unpublished manuscript).

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## References

Anonymous. 1932. Find 'Long Purples' in Interstate Park. Visitors to Harriman Preserve Along Hudson River are Attracted by the Plant. Flower is an 'immigrant.' *Lythrum salicaria* in full blossom now in marshes and streams through the valley. New York Times. Sunday 21 August: 19.

Bailey, William Whitman. 1905. Various loose-strifes. Amer. Bot. 8: 67–69.

Barker, M. 1891. Notes from the Harvard Botanic Garden—*Lythrum salicaria*. Garden and Forest No. 180: 368.

Beal, Ernest O. 1977. A manual of marsh and aquatic vascular plants of North Carolina. With habitat data. North Carolina Agric. Exp. Sta., Raleigh, Tech. Bull. No. 247. 298 pp.

——— and Paul H. Monson. 1954. Marsh and aquatic angiosperms of Iowa. State Univ. Iowa Stud. Nat. Hist. 19(5): 1–95.

Beal, W. J. 1905. Michigan flora. Rep. Michigan Acad. (1904) 5: 1–147.

——— and C. F. Wheeler. 1892. Michigan flora. Ann. Rep. State Board Agric. Michigan (1891) 30: 471–650. (Reprinted and repaged 1–180.)

Beckwith, Florence and Mary E. Macauley. 1894. Plants of Monroe County, New York, and adjacent territory. Proc. Rochester Acad. Sci. 3: 1–150.

Bicknell, Eugene P. 1880. Some of the rarer plants of our northern suburbs [New York City]. Bull. Torrey Bot. Club 7: 51–56.

———. 1914. The ferns and flowering plants of Nantucket—XII. Bull. Torrey Bot. Club 41: 71–87.

Blackwell, Will H., Jr. 1970. The Lythraceae of Ohio. Ohio J. Sci. 70: 346–352.

Churchill, Steven P., Robert B. Kaul and David M. Sutherland. 1976. New records of native and introduced plants from Nebraska. Trans. Nebraska Acad. Sci. 3: 32–36.

CODY, WILLIAM J. 1978. The status of *Lythrum alatum* (Lythraceae) in Canada. Canad. Field-Nat. 92: 74–75.

COLEMAN, N. 1874. Catalogue of Flowering Plants of the Southern Peninsula of Michigan, with a Few of the Crytogamia [sic]. Kent Sci. Inst. Misc. Publ. 2. 49 pp.

CORRELL, D. S. AND HELEN B. CORRELL. 1972. Aquatic and Wetland Plants of Southwestern United States. Water Pollution Control Research Series. U.S. Government Printing Office, Washington, D.C. 1777 pp. (Reprinted Stanford Univ. Press, Stanford. 2 volumes, 1975.)

CUSICK, ALLISON W. AND GENE M. SILBERHORN. 1977. The vascular plants of unglaciated Ohio. Bull. Ohio Biol. Surv. New Ser. 5(4): i–x, 1–153.

CUTRIGHT, NOEL J. 1978. Purple loosestrife: Beautiful exotic, or unwanted weed? Wisconsin Natural Resources 2(5): 26–27.

DEAM, CHAS. C. 1926. Plants new or rare in Indiana—XIII. Proc. Indiana Acad. Sci. (1925) 33: 197–198.

———. 1940. Flora of Indiana. Dept. Conservation, Div. Forestry, Indianapolis. 1236 pp. (Reprinted in the series, Reprints of US-Floras, Vol. 6. Verlag von J. Cramer, Lehre. 1970.)

DODGE, C. K: 1900. Flora of St. Clair County, Michigan, and the western part of Lambton County, Ontario. Ann. Rep. State Hort. Soc. Michigan (1899) 29: 231–314.

DUDLEY, WILLIAM R. 1886. The Cayuga flora. Part I: A catalogue of the Phaenogamia growing without cultivation in the Cayuga Lake basin. Bull. Cornell Univ. 2: I–XXX, 1–132 + Additions and corrections, Index to orders and genera, i–v.

EATON, AMOS AND JOHN WRIGHT. 1840. North American Botany, Comprising the Native and Common Cultivated Plants, North of Mexico: Genera Arranged According to the Artificial and Natural Methods. 8th ed. Elias Gates, Troy, New York. 625 pp.

ERSKINE, DAVID S. 1960. The Plants of Prince Edward Island. Plant Res. Inst. Res. Branch, Canad. Dep. Agric. Publ. 1088. 270 pp.

FARWELL, O. A. 1918. Rare or interesting plants in Michigan. 19th Ann. Rep. Michigan Acad. Sci. (1917): 251–262.

———. 1925. Botanical gleanings in Michigan. Amer. Midl. Nat. 9: 1–24.

FERNALD, M. L. 1940. The problem of conserving rare native plants. Ann. Rep. Smithsonian Institution (1939): 375–391 + pls. 1–7.

FLOOK, JERRY M. 1975. Additions and corrections to the flora of Texas. Sida 6: 114.

FULLER, G. D. AND G. N. JONES. 1949. Additional notes on some Illinois plants. Amer. Midl. Nat. 41: 507–511.

GAGNON, L. P. 1953. The control of purple loosestrife in la commune at Baie du Febvre—1952. Proc. Eastern Section, National Weed Committee Canada 6: 135–136.

GATES, FRANK C. AND JOHN H. EHLERS. 1948. Additions to the annotated list of the higher plants of the region of Douglas Lake, Michigan, III. Michigan Acad. Sci. (1946) 32: 27–46.

GRAHAM, SHIRLEY A. 1964. The genera of the Lythraceae in the southeastern United States. J. Arnold Arb. 45: 235–250.

———. 1975. Taxonomy of the Lythraceae in the southeastern United States. Sida 6: 80–103.

GRAY, ASA. 1848. A Manual of Botany of the Northern United States . . . Arranged According to the Natural System . . . . James Munroe & Co., Boston & Cambridge. 710 pp.

———. 1856. Manual of the Botany of the Northern United States, including Virginia, Kentucky, and all East of the Mississippi: Arranged According to the Natural System. George P. Putnam & Co., New York. 739 pp. + XIV pls.

———. 1856–1857. Statistics of the flora of the northern United States. Amer. J. Sci. 22: 204–232; 23: 62–84, 369–403. (Reprinted in Ronald L. Stuckey, Essays on North American Plant Geography from the Nineteenth Century. Arno Press, New York. 1978).

———. 1858. Manual of the Botany of the Northern United States, including Virginia, Kentucky, and all East of the Mississippi: Arranged According to the Natural System. 3rd ed., Ivison & Phinney, New York. xxviii + 739 pp. + XIV pls.

———. 1863. Manual of Botany of the Northern United States, including Virginia, Kentucky, and all East of the Mississippi. 4 ed., Ivison, Phinney, & Co., New York. 743 pp. + XXII pls.

———. 1867. Manual of the Botany of the Northern United States, including the District East of the Mississippi and North of North Carolina and Tennessee, Arranged According to the Natural System. 5th ed., Ivison, Blakeman, Taylor & Co., New York. 703 pp. + XX pls.

———, SERENO WATSON AND JOHN M. COULTER. 1889. Manual of the Botany of the Northern United States, including the District East of the Mississippi and North of North Carolina and Tennessee. 6th ed. American Book Co., New York. 760 pp. + XXV pls.

GROH, HERBERT. 1944. Canadian Weed Survey. Second Annual Report 1943. Dominion of Canada, Department of Agriculture, Science Service, Division of Botany and Plant Pathology. Mimeographed. 74 pp.

GULDNER, LUDWIG F. 1960. The vascular plants of Scott and Muscatine counties [Iowa]. Davenport Pub. Mus. Publ. Bot., No. 1. 228 pp.

HENRY, LEROY K. 1971. An annotated list of the vascular flora of Butler County, Pennsylvania. Ann. Carnegie Mus. 43: 115–178.

———. 1978. Vascular flora of Bedford County, Pennsylvania: an annotated checklist. Carnegie Museum of Natural History, Pittsburg. 178 pp.

HITCHCOCK, A. S. AND PAUL C. STANDLEY. 1919. Flora of the District of Columbia and vicinity. Contrib. U.S. Natl. Herb. 21: 1–329 + pls. 1–42.

HOOKER, WILLIAM JACKSON. 1829–1833. Flora Boreali-Americana; or, the botany of the northern parts of British America . . . . London. Vol. I. vi, 335 pp. (Reprinted, Weinheim. 1960).

HOUSE, HOMER D. 1924. Annotated list of the ferns and flowering plants of New York state. New York State Mus. Bull. 254: 1–759.

———. 1937. A new plant joins the Hudson River flora. Torreya 37: 80–82. [Report on *Nymphoides peltatum* which mentions *L. salicaria*].

HOWELL, JOHN THOMAS AND GORDON H. TRUE, JR. 1966. Interesting plants from Nevada County, California. Leafl. W. Bot. 10: 274–278.

HUGHES, RANDY. 1977. Letter to the editor: Purple loosestrife judged a weed. Amer. Bee J. 117: 398.

HULTÉN, ERIC. 1971. The circumpolar plants. II Dicotyledons. Sv. Vet. Akad. Handl. 13: 1–463.

HUNTLEY, FRANK, PAUL SPURLIN AND LYALL POWERS. 1968. Philip L. Schenek 1879–1968 [memorial]. Faculty minutes, College of Literature, Science, and the Arts, University of Michigan: 5611.

JONES, GEORGE NEVILLE AND GEORGE DAMON FULLER. 1955. Vascular Plants of Illinois. Univ. Illinois Press, Urbana. 593 pp.

JONES, SAMUEL B., JR. 1975. Mississippi flora. IV. Dicotyledon families with aquatic or wetland species. Gulf Res. Rep. 5: 7–22.

KELLERMAN, W. A. AND O. E. JENNINGS. 1904. Report for 1902 on the State Herbarium including additions to the state plant list. Ohio Nat. 4: 59–60.

KNOWLTON, C. H. AND WALTER DEANE. 1921. Reports on the flora of the Boston District—XXXIV. Rhodora 23: 113–118.

KOEHNE, E. 1885. The Lythraceae of the United States. Bot. Gaz. 10: 269–277 + pl. opp. p. 269.

———. 1903. *Lythrum*, pp. 58–78. *In* Lythraceae. Das Pflanzenreich, Leipzig. 4(216): 1–326.

LATHAM, ROY. 1938. *Lythrum salicaria* L. on Long Island, N.Y. Torreya 38: 72.

[LEGGETT, W. H., ed.] 1870. Revised catalogue of the plants, native and naturalized, within thirty-three miles of New York. Bull. Torrey Bot. Club 1: 33.

LOUIS-MARIE, [Pere]. 1944. La Salicaire dans le Quebec. Institut Agricole d'Oka. Prov. de Quebec. 46 pp.

LÖVE, DORIS AND JEAN-PAUL BERNARD. 1959. Flora and vegetation of the Otterburne area, Manitoba, Canada. Svensk Bot. Tidskr. 53: 335–461.

MACOUN, JOHN. 1883. Catalogue of Canadian Plants. Part I—Polypetalae. Geol. Surv. Canad. 192 pp.

———. 1886. Catalogue of Canadian plants. Additions and corrections to Parts I–II. Geol. Surv. Canad.: 477–623.

———. 1888. Catalogue of Canadian Plants. Part IV—Endogens. Geol. Surv. Canad. 428 pp.

MASSEY, A. B. 1961. Virginia Flora. Virginia Agric. Exp. Sta., Blacksburg. Tech. Bull. No. 155. 258 pp.

MCATEE, W. L. 1923. Notes on interesting plants of Michigan. Pap. Michigan Acad. (1921) 1: 155–166.

MCCOY, DOYLE. 1954. The genus *Lythrum* in Oklahoma. Proc. Oklahoma Acad. Sci. (1952) 33: 156–158.

MCGREGOR, RONALD L. 1978. Letter to Ronald L. Stuckey. 12 December.

MCGREGOR, R. L. AND T. M. BARKLEY, eds. 1977. Atlas of the Flora of the Great Plains. Iowa State Univ. Press, Ames. 600 pp.

MCKEON, W. H. 1959. A preliminary report on the use of chemical herbicides to control purple loosestrife (*Lythrum salicaria*) on a small marsh. Proc. 13th Ann. Meeting, Northeastern Weed Control Conf.: 329–332.

MCNEILL, E. MEADE. 1938. Plant records from Mercer County, West Virginia, and adjoining counties. Castanea 3: 36–39.

M[ERRIAM], J[AMES] S[HELDON]. 1872. New stations . . . *Lythrum salicaria* L. . . . . Bull. Torrey Bot. Club 3: 38.

MOHLENBROCK, ROBERT H. 1959. Plant communities in Jackson County, Illinois. Bull. Torrey Bot. Club 86: 109–119.

——— AND DOUGLAS M. LADD. 1978. Distribution of Illinois Vascular Plants. Southern Illinois Univ. Press, Carbondale and Edwardsville. 282 pp.

——— AND JOHN W. VOIGT. 1959. A Flora of Southern Illinois. Southern Illinois Univ. Press, Carbondale. 390 pp.

MONTGOMERY, F. H. 1957. The introduced plants of Ontario growing outside of cultivation (Part II). Trans. Royal Canad. Inst. 32: 1–34.

MOSS, E. H. 1959. Flora of Alberta. Univ. Toronto Press, Toronto. 546 pp.

MUNZ, PHILIP A. 1968. Supplement to a California Flora. Univ. California Press, Berkeley and Los Angeles. 224 pp.

ORNDUFF, ROBERT. 1962. Additions and subtractions in the Oregon weed flora. Leafl. W. Bot. 9: 224.

PALMER, ELMORE. 1877. Catalogue of Phaenogamous and Acrogenous Plants Found Growing Wild in the State of Michigan. Dexter. 16 pp.

PALMER, ERNEST J. AND JULIAN A. STEYERMARK. 1935. An annotated catalogue of the flowering plants of Missouri. Ann. Missouri Bot. Gard. 22: 375–758 + pls. 15–21.

PECK, CHARLES H. 1879. New stations, notes and observations. Pages 51–60. *In* Report of the botanist (for 1877). 31st Ann. Rep. New York State Mus. pp. 19–60.

———. 1893. Annual Report of the State Botanist (1892). 46th Ann. Rep. New York State Mus.: 1–69.

PELLETT, FRANK C. 1944. Purple loosestrife. Amer. Bee J. 84: 57.

PELLETT, MELVIN. 1963. Purple loosestrife moves west. Amer. Bee J. 103: 450–451.

———. 1977. Purple loosestrife spreads down river. Amer. Bee J. 117: 214–215.

PEPOON, H. S. 1916. Peculiar plant distributions. Trans. Illinois State Acad. Sci. 9: 128–137.

———. 1927. An annotated flora of the Chicago area. Chicago Acad. Sci., Chicago. 554 pp.

PORTER, THOMAS CONRAD. 1903. Flora of Pennsylvania. Ginn & Co., Boston. 362 pp.

PURSH, FREDERICK. "1814" [1813]. Flora Americae Septentrionalis; or, a Systematic Arrangement and Description of the Plants of North America. 2 Volumes. White, Cochrane and Co., London. xxxvi, 751 pp. + 24 *t*.

RADFORD, ALBERT E., HARRY E. AHLES AND C. RITCHIE BELL. 1968. Manual of the Vascular Flora of the Carolinas. Univ. North Carolina Press, Chapel Hill. 1183 pp.

REED, CLYDE F. 1964. A flora of the chrome and manganese ore piles at Canton, in the port of Baltimore, Maryland and at Newport News, Virginia, with descriptions of genera and species new to the flora of eastern United States. Phytologia 10: 321–406.

ROLAND, ALBERT E. 1941. Notes on the flora of Nova Scotia—II. Rhodora 43: 337–344.

———. "1945" [1947]. The flora of Nova Scotia. Proc. & Trans. Nova Scotian Inst. Sci. 21: 95–642. (Reprinted Truro Printing & Publishing Co., Truro. 552 pp., 127 figs. 1948.)

ROSS, DEAN H. 1962. Some noteworthy plants of Somerset County, Pennsylvania. Castanea 27: 88–89.

ROUSSEAU, CAMILLE. 1968. Histoire, habitat et distribution de 220 plantes introduites au Quebec. Naturaliste Canad. 95: 49–169. Ludoviciana No. 5.

RUDKIN, W. H. 1879. *Lythrum salicaria* L. Bull. Torrey Bot. Club 6: 323.

SCHAFFNER, JOHN H. 1932. Revised catalog of Ohio vascular plants. Ohio Biol. Surv. 5: 87–215. Bull. 25.

———. 1937. Additions to the revised catalog of Ohio vascular plants, V. Ohio J. Sci. 37: 260–265.

SCOGGAN, H. J. 1950. The Flora of Bic and the Gaspe Peninsula, Quebec. Natl. Mus. Canada Bull. No. 115. 399 pp.

———. 1957. Flora of Manitoba. Natl. Mus. Canada Bull. No. 140. 619 pp.

SHAFER, JOHN A. 1901. A preliminary list of the vascular flora of Allegheny County, Pennsylvania. Ann. Carnegie Mus. 1. 127 pp.

SHINNERS, LLOYD H. 1953. Synopsis of the United States species of *Lythrum* (Lythraceae). Field & Lab. 21: 80–89.

SHREVE, FORREST, M. A. CHRYSLER, FREDERICK H. BLODGETT AND F. W. BESLEY. 1910. The Plant Life of Maryland. The Johns Hopkins Press, Baltimore. 533 pp.

SMALL, JOHN KUNKEL AND JOEL JACKSON CARTER. 1913. Flora of Lancaster County [Pennsylvania]. Published by the authors, New York. 336 pp.

SMITH, LAWRENCE S. 1959. Some experiences with control of purple loosestrife at the Montezuma National Wildlife Refuge. Proc. 13th Ann. Meeting, Northeastern Weed Control Conf.: 333–336.

SMITH, RALPH H. 1964. Experimental control of purple loosestrife (*Lythrum salicaria*). New York Fish & Game J. 11: 35–46.

STEVENS, O. A. 1972. New records of North Dakota plants. Rhodora 74: 389–396.

STEYERMARK, JULIAN A. 1963. Flora of Missouri. Iowa State University Press, Ames. 1725 pp.

STRAUSBAUGH, P. D. AND EARL L. CORE. 1973. Flora of West Virginia. Part III. 2nd ed. Univ. West Virginia Bull. (Reprinted Seneca Books, Inc., Grantsville, West Virginia. 1978.)

SWINK, FLOYD. 1969. Plants of the Chicago region. The Morton Arboretum, Lisle, Illinois. 445 pp.

———. 1974. Plants of the Chicago region. 2nd ed. The Morton Arboretum, Lisle, Illinois. 474 pp.

TAYLOR, JOHN. 1977. A catalog of vascular aquatic and wetland plants that grow in Oklahoma. Herbarium Southeastern Oklahoma State Univ. Publ. No. 1. 75 pp.

TAYLOR, NORMAN. 1915. Flora of the Vicinity of New York: A Contribution to Plant Geography. Mem. New York Bot. Gard. 5: vi, 683 pp.

THOMPSON, DANIEL Q. AND RONALD L. STUCKEY. Spread, impact, and control of purple loosestrife (*Lythrum salicaria*) in North American wetlands. Unpublished manuscript.

THOMPSON, J. WILLIAM. 1932. Notes on the flora of the state of Washington—I. Rhodora 34: 236–239.

TORREY, JOHN. 1824. A Flora of the Northern and Middle Sections of the United States; or, A Systematic Arrangement and Description of all the Plants Hitherto Discovered in the United States North of Virginia. 3 Volumes. T. and J. Swords, New York. 518 pp. + Errata in Volume First.

———. 1843. A Flora of the State of New-York, comprising full descriptions of all the indigenous and naturalized plants hitherto discovered in the state; with remarks on their economical and medical properties. Vol. II. Carroll & Cook, Albany. 572 pp. + pls.

——— AND ASA GRAY. 1843. A Flora of North America: Containing abridged descriptions of all the known indigenous and naturalized plants growing north of Mexico; arranged according to the natural system. Vol. 2, Part 3. Wiley and Putnam, New York. 393–545 pp. (Reprinted, Hafner Publishing Co., New York. 1969.)

TORREY, RAYMOND H. 1929. Field meeting of Sunday August 18. Torreya 29: 143–144.

———. 1931. Field trips of the Club. Torreya 31: 16–18.

UGENT, DONALD. 1962. Preliminary reports on the flora of Wisconsin. No. 47. The orders Thymelaeales, Myrtales, and Cactales. Trans. Wisconsin Acad. Sci. Arts and Letters 51: 83–134.

VANBRUGGEN, THEODORE. 1976. The Vascular Plants of South Dakota. Iowa State Univ. Press, Ames. 538 pp.

WEBER, WILLIAM A., BARRY C. JOHNSTON AND DIETER WILKEN. 1979. Additions to the flora of Colorado—VI. Phytologia 41: 486–500.

WESTERFELD, WALTER F. 1961. An annotated list of vascular plants of Centre and Huntingdon Counties, Pennsylvania. Castanea 26: 1–79.

WHEELER, CHARLES F. AND ERWIN F. SMITH. 1881. Michigan Flora. Ann. Rep. State Hort. Soc. Michigan (1880) 10: 427–529. (Reprinted with title page and repaged 1–105, as Catalogue of the Phaenogamous and Vascular Cryptogamous Plants of Michigan, Indigenous, Naturalized, and Adventive.)

WHETSTONE, R. DAVID. 1978. Additions to Alabama Lythraceae. Sida 7: 396–397.

WRIGHT, JOHN. 1839. Report of Doct. John Wright, Botanist of the Geological Survey. Michigan House Doc. 23: 421–442.

ZENKERT, CHARLES A. 1934. The flora of the Niagara Frontier region. Ferns and flowering plants of Buffalo, N.Y., and vicinity. Buffalo Soc. Nat. Sci. Bull. 16: i–x, 1–328.

# Five Mile Woods (Bucks County, Pennsylvania) Revisited

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Five Mile Woods is about five kilometers south southwest of Yardley in lower Bucks County, Pennsylvania. Most of the woods is on the south side of Big Oak Road where it straddles the fall line between the Piedmont Plateau and the Coastal Plain. There are over 80 hectares of forest as well as adjacent old fields and transitional areas between fields and forest. The area is poorly drained and the soil is mostly clay. Many of the plants found here are rare in Pennsylvania but are common on the Coastal Plain in New Jersey.

Over 50 years ago, Bayard Long collected extensively in the vicinity of Five Mile Woods and deposited his specimens in the herbarium of the Academy of Natural Sciences. His specimen labels consistently give the locality as one mile southeast of the hamlet of Roelofs. In his flora of Bucks County, Benner (1932) simply refers to the area as Roelofs when citing specimens.

Today many of the plants collected by Long still grow in and around Five Mile Woods. Woody plants such as *Clethra alnifolia, Leucothoë racemosa, Liquidambar styraciflua,* and *Rhododendron viscosum,* which are rare in most of the rest of Bucks County, are common. However on several trips in 1978 and 1979 (including a trip by the Philadelphia Botanical Club), I failed to find *Euonymous americanus* and *Lyonia mariana,* two shrubs previously collected by Long. One shrub not collected by him, *Myrica pensylvanica,* was found on the east and west sides of the woods, however. Herbaceous species relocated in the woods include *Arisaema triphyllum* ssp. *pusillum, Bartonia virginica,* and two stands of *Isotria verticillata. Chasmanthium laxum,* not previously known from the woods, was found by Ann Newbold on the Botanical Club's trip. In a moist open thicket adjacent to the west side of the woods, which apparently was a nursery at one time, such rarities as *Andropogon glomeratus, Bartonia paniculata, Bartonia virginica, Calamagrostis cinnoides, Eupatorium pilosum, Gentiana saponaria, Juncus debilis, Panicum longifolium,* and *Rhexia virginica* were found. Also growing in this area is a stand of the cranberry, *Vaccinium macrocarpon.* East of the woods on the north side of Big Oak Road, *Agalinus purpurea* was found in an old field. There still remain a significant number of herbaceous plants not relocated: *Bidens coronata, Carex folliculata, Lilium superbum, Linum intercursum, Linum medium, Panicum meridionale,* and *Viola primulifolia.* Some of these were probably overlooked and hopefully other botanists will look for them and find them.

Much of the area known as Five Mile Woods is now owned by Lower Makefield Township. Fortunately the township's management plans show concern for the rare plants of this unique area.

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## Literature Cited

Benner, W. M. 1932. The Flora of Bucks County, Pennsylvania. Published by the author, Philadelphia. 331 pp.

# A Check-List of the Flora of Hunterdon County, New Jersey

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Hunterdon County is not graced with the diverse habitats so many New Jersey counties possess. Almost wholly Piedmont it has no coastal plain and only a small sliver of the New Jersey Highlands creeps in along its northern border. It has no influential belt of limestone and it lacks the natural lakes and ponds of the north and south. The Wisconsin moraine tracks to the north of it and the earlier Jerseyan has left only a vague impression upon its flora. Nonetheless it has managed to garner a respectable list of plants growing within its borders, attracting the visits of field botanists from the earliest days.

The great majority of the following plant records have come from the literature and a few are present day, satisfactorily substantiated, sight records. Those plants considered alien are enclosed in brackets.

Further information may be obtained from the compiler who would appreciate hearing of errors and additions.

## PTERIDOPHYTES

LYCOPODIACEAE: *Lycopodium clavatum, flabelliforme, lucidulum, obscurum, obscurum* v. *dendroideum.*

SELAGINELLACEAE: *Selaginella apoda, rupestris.*

ISOETACEAE: *Isoëtes engelmanni, riparia* v. *canadensis.*

EQUISETACEAE: *Equisetum arvense,* × *ferrissii, fluviatile,* × *litorale, hyemale, sylvaticum.*

OPHIOGLOSSACEAE: *Botrychium dissectum, matricariaefolium, multifidum* v. *silaifolium, obliquum, oneidense, simplex* v. *tenebrosum, virginianum.*

OSMUNDACEAE: *Osmunda cinnamomea, claytoniana, regalis.*

POLYPODIACEAE: *Adiantum pedatum*; *Asplenium pinnatifidum, platyneuron, trichomanes*; *Athyrium angustum, asplenioides, thelypterioides*; *Camptosorus rhizophyllus*; *Cheilanthes lanosa*; *Cystopteris bulbifera, fragilis* v. *Mackayii* and v. *protrusa*; *Dennstaedtia punctilobula*; *Dryopteris* × *Boottii, cristata, Goldiana, intermedia, marginalis, spinulosa*; *Matteucia pensylvanica*; *Onoclea sensibilis*; *Pellaea atropurpurea, glabella*; *Phegopteris connectilis, dryopteris, hexagonoptera*; *Polypodium virginianum*; *Polystichum acrostichoides*; *Pteridium aquilinum*; *Thelypteris noveboracensis, palustris*; *Woodsia ilvensis, obtusa.*

SALVINACEAE: *Azolla caroliniana.*

## GYMNOSPERMS

PINACEAE: *Pinus pungens, rigida, strobus,* [*sylvestris*], *virginianus*; *Tsuga canadensis*; *Picea* [*abies*], *mariana* (listed by Knighton in Catalogue of Plants by N. L. Britton).

CUPRESSACEAE: *Juniperus communis, virginiana.*

GINKGOACEAE: [*Ginkgo biloba*].

## Monocots

TYPHACEAE: *Typha angustifolia, latifolia.*

SPARGANACEAE: *Sparganium americanum, eurycarpum.*

ZOSTERACEAE: *Potamogeton amplifolius,* [*crispus*], *diversifolius, epihydrus, foliosus, nodosus, pectinatus, pusillus, Robbinsii, zosteriformis.*

NAJADACEAE: *Najas flexilis.*

ALISMATACEAE: *Alisma subcordatum*; *Sagittaria australis, latifolia, rigida.*

HYDROCHARITACEAE: *Elodea canadensis, Nuttallii.*

GRAMINEAE: [*Agropyron repens*]; *Agrostis* [*alba*], *hyemalis, perennans,* [*tenuis*]; *Alopecurus* [*pratensis*]; *Andropogon Gerardi, scoparium, virginicus*; [*Anthoxanthum odoratum*]; *Aristida dichotoma, longespica, oligantha, purpurascens*; [*Arrhenatherum elatius*]; [*Avena sativa*]; *Brachyelytrum erectum*; *Bromus* [*commutatus*], [*inermis*], [*japonicus*], *latiglumis,* [*mollis*], *purgans,* [*racemosus*], [*sterilis*], [*tectorum*]; *Calamagrostis canadensis*; *Cenchrus longispinus*; *Cinna arundinacea*; [*Dactylis glomerata*]; *Danthonia compressa, spicata*; *Deschampsia flexuosa*; *Digitaria* [*ischaemum*], [*sanguinalis*]; *Echinochloa* [*crus-galli*], [*frumentacea*], *pungens*; [*Eleusine indica*]; *Elymus canadensis, riparius, villosus, virginicus*; *Eragrostis capillaris, Frankii, hypnoides,* [*megastachya*], [*multicaulis*], *pectinacea,* [*pilosa*], *spectabilis*; *Festuca elatior, obtusa,* [*ovina*], *rubra*; *Glyceria canadensis, melicaria, septentrionalis, striata*; *Holcus lanatus*; *Hordeum jubatum*; *Hystrix patula*; *Leersia oryzoides, virginica*; [*Lolium multiflorum*], [*perenne*]; *Muhlenbergia frondosa, glomerata, Schreberi, sobolifera, tenuifolia*; *Panicum agrostoides, anceps, Benneri, Boscii, capillare, clandestinum, commutatum, depauperatum, dichotomiflorum, dichotomum, lanuginosum, latifolium, linearifolium, microcarpon, oligosanthes, polyanthis, sphaerocarpon, stipitatum, villosissimum, virgatum*; *Paspalum ciliatifolium, laeve*; *Phalaris arundinacea*; [*Phleum pratense*]; *Phragmites australis*; *Poa alsodes,* [*annua*], *autumnalis,* [*compressa*], *cuspidata, nemoralis,* [*pratensis*], *sylvestris,* [*trivialis*]; [*Secale cereale*]; *Setaria* [*Faberii*], [*glauca*], [*italica*], *verticillata,* [*viridis*]; *Sorghastrum nutans*; *Spartina pectinata*; *Sphenophilis intermedia, nitida, obtusata*; *Sporobolus asper, clandestinus, vaginiflorus*; *Triodea flava*; *Tripsacum dactyloides*; *Trisetum pensylvanicum*; *Vulpia octoflora.*

CYPERACEAE: *Bulbostylis capillaris*; *Carex abdita, abscondita, aggregata, albursina, amphibola, annectens, argyrantha, artitecta, blanda, brevior, bromoides, Bushii, canescens, caroliniana, cephaloidea, cephalophora, communis, conjuncta, conoidea, convoluta, crinita, cristatella, Davisii, debilis, digitalis, Emmonsii, Emoryii, festucacea, flaccosperma, folliculata, Frankii, gracilescens, gracillima, granularis, Grayii, gynandra, hirsutella, hirtifolia, hystricina, incomperta, intumescens, Jamesii, laevivaginata, lanuginosa, laxiculmus, laxiflora, leptalea, leptonervia, lupulina, lurida, Meadii, mesochorea, molesta, Muhlenbergii, nigromarginata, normalis, oligocarpa, pallescens, pedunculata, pensylvanica, platyphylla, prasina, projecta, radiata, rosea, scabrata, scoparia, seorsa, sparganioides, Sprengelii, squarrosa, stipata, stricta, stricta* v. *strictior, Swanii, torta, tribuloides, trichocarpa, umbellata, vesicaria, vestita, virescens, vulpinoidea, Willdenowii*; *Cyperus dentatus, diandrus, esculentus, filiculmis, flavescens, inflexus, lancastriensis, ovularis, rivularis, strigosus*; *Dulichium arundinaceum*; *Eleocharis acicularis, Engelmanni, intermedia, obtusa, Smallii, tenuis, tenuis* v. *pseudoptera*; *Fimbristylis autumnalis*; *Hemicarpha micrantha*; *Rhynchospora alba, globularis* v. *recognita, capitellata*; *Scirpus atrovirens, atrovirens* × *polyphyllus,* *cyperinus, expansus, georgianus, hattorianus, pendulus, polyphyllus, pungens, Purshianus, validus, verecundus*; *Scleria triglomerata*.

ARACEAE: *Acorus calamus*; *Arisaema atrorubens, dracontium, Stewardsonii, triphyllum*; *Peltandra virginica*; *Symplocarpus foetidus*.

LEMNACEAE: *Lemna minor*; *Spirodela polyrhiza*; *Wolffia columbiana*.

COMMELINACEAE: [*Commelina communis*]; *Tradescantia virginica*.

PONTEDERIACEAE: *Heteranthera dubia, reniformis*; *Pontederia cordata*.

JUNCACEAE: *Juncus acuminatus, biflorus, bufonius, canadensis, dudleyi, effusus, marginatus, nodosus, secundus, subcaudatus, tenuis*; *Luzula acuminata, echinata, luzuloides, multiflora*.

LILIACEAE: *Allium canadense, tricoccum*, [*vineale*]; [*Asparagus officinalis*]; *Chamaelirium luteum*; *Erythronium americanum*; *Hemerocallis flava, fulva*; [*Hosta ventricosa*]; *Lilium canadense, philadelphicum*, [*tigrinum*]; *Maianthemum canadense*; *Medeola virginiana*; *Melanthium hybridum, virginicum*; [*Muscari botryoides*]; [*Ornithogalum umbellatum*]; *Polygonatum biflorum, canaliculatum, pubescens*; *Smilacina racemosa, stellata*; *Smilax glauca, hispida, herbacea, pulverulenta, rotundifolia*; *Trillium cernuum, erectum*; *Uvularia perfoliata, sessilifolia*; *Veratrum viride*; [*Yucca filamentosa*].

DIOSCOREACEAE: *Dioscorea villosa*.

AMARYLLIDACEAE: *Hypoxis hirsuta*.

IRIDACEAE: [*Belemcanda chinensis*]; *Iris* [*pseudacorus*], *versicolor*; *Sisyrinchium angustifolium, mucronatum*.

ORCHIDACEAE: *Calapogon pulchellus*; *Corallorhiza maculata, odontorhiza*; *Cypripedium acaule*; [*Epipactis helleborine*]; *Goodyera pubescens*; *Habenaria lacera, psycodes*; *Isotria verticillata*; *Liparis Loeselii*; *Orchis spectabilis*; *Pogonia ophioglossoides*; *Spiranthes cernua, gracilis*.

## Dicots

SAURURACEAE: *Saururus cernuus*.

SALICACEAE: *Populus* [*alba*], *deltoides, grandidentata, tremuloides*; *Salix* [*alba*], [*babylonica*], *Bebbiana, cordata, discolor*, [*fragilis*], *humilis, interior, lucida, nigra, rigida*.

MYRICACEAE: *Comptonia peregrina*; *Myrica pensylvanica*.

JUGLANDACEAE: *Carya cordiformis, glabra, ovalis, ovata, tomentosa*; *Juglans cinerea, nigra*.

CORYLACEAE: *Alnus serrulata*; *Betula lenta, lutea, nigra, populifolia*; *Carpinus caroliniana*; *Corylus americana, cornuta*; *Ostrya virginiana*.

FAGACEAE: *Castanea dentata*; *Fagus grandifolia*; *Quercus alba, bicolor, coccinea, ilicifolia, Muhlenbergii, palustris, prinoides, prinus, rubra, stellata, velutina*.

ULMACEAE: *Celtis occidentalis*; *Ulmus americana, rubra*.

MORACEAE: [*Broussonetia papyrifera*]; [*Maclura pomifera*]; *Morus* [*alba*].

URTICACEAE: *Boehmeria cylindrica*; *Laportea canadensis*; *Parietaria pensylvanica*; *Pilea pumila*; *Urtica* [*dioica*], *gracilis*, [*urens*].

CANNABINACEAE: *Humulus japonicus*.

SANTALACEAE: *Comandra umbellata*.

ARISTOLOCHIACEAE: *Aristolochia serpentaria*; *Asarum canadense*.

POLYGONACEAE: [*Fagopyrum sagittatum*]; *Polygonum arifolium, aviculare,* [*caespitosum*], *cilinode, coccineum,* [*convolvulus*], *cristatum,* [*cuspidatum*], *erectum, hydropiperoides, lapathifolium, pensylvanicum,* [*persicaria*], *punctatum, ramosissimum, sagittatum, scandens, tenue, virginianum*; *Rumex* [*acetosella*], [*altissimus*], [*crispus*], [*obtusifolius*], *verticillatus.*

CHENOPODIACEAE: *Atriplex patula*; *Chenopodium* [*album*], [*ambrosioides*], *boscianum,* [*botrys*]; *Roubieve multifida*; *Salsola kali.*

AMARANTHACEAE: *Acnida cannabina*; *Amaranthus albus,* [*graecizans*], [*hybridus*], [*retroflexus*], [*spinosus*]; [*Froehlichia gracilis*].

NYCTAGINACEAE: [*Mirabilis nyctaginea*].

PHYTOLACCACEAE: *Phytolacca americana.*

AIZOACEAE: [*Mollugo verticillata*].

PORTULACACEAE: *Claytonia virginica*; [*Portulaca oleracea*].

CARYOPHYLLACEAE: [*Agrostemma githago*]; *Arenaria* [*serpyllifolia*], *stricta*; *Cerastium arvense, nutans,* [*viscosum*], [*vulgatum*]; [*Dianthus armeria*], [*barbatus*]; [*Lychnis alba*], [*coronaria*]; *Moehringia lateriflorum*; [*Myosoton aquaticum*]; *Paronychia canadensis, fastigiata*; *Sagina* [*procumbens*]; [*Saponaria officinalis*]; [*Scleranthus annuus*]; *Silene antirrhina,* [*armeria*], [*cucubalus*], [*noctiflora*], *stellata*; *Stellaria alsine,* [*graminea*], *longiflora,* [*media*], *pubera.*

CERATOPHYLLACEAE: *Ceratophyllum demersum.*

NYMPHAEACEAE: *Nuphar advena*; *Nymphaea odorata.*

RANUNCULACEAE: *Actaea pachypoda*; *Anemone quinquefolia, riparia, virginiana*; *Anemonella thalictroides*; *Aquilegia canadensis,* [*vulgaris*]; *Caltha palustris*; *Cimicifuga racemosa*; *Clematis* [*dioscoreifolia*], *verticillaris, virginiana*; [*Delphinium ajacis*]; *Hepatica americana*; *Ranunculus abortivus,* [*acris*], *ambigens,* [*bulbosus*], *fascicularis,* [*ficaria*], *hispidus, micranthus, pensylvanicus, recurvatus,* [*repens*], *septentrionalis, trichophyllus*; *Thalictrum dioicum, polygamum, revolutum.*

BERBERIDACEAE: [*Berberis thunbergii*]; *Caulophyllum thalictroides*; *Jeffersonia diphylla*; *Podophyllum peltatum.*

MENISPERMACEAE: *Menispermum canadense.*

MAGNOLIACEAE: *Liriodendron tulipifera.*

ANNONACEAE: *Asimina triloba.*

LAURACEAE: *Lindera benzoin*; *Sassafras albidum.*

PAPAVERACEAE: *Adlumia fungosa*; [*Chelidonium majus*]; *Corydalis flavula, sempervirens*; *Dicentra canadensis, cucullaria*; *Sanguinaria canadensis.*

CRUCIFERAE: [*Alliaria officinalis*]; [*Alyssum alyssoides*]; [*Arabidopsis thaliana*]; *Arabis canadensis,* [*glabra*], *hirsuta, laevigata, lyrata*; *Armoracia lapathifolia*; [*Barbarea vulgaris*]; [*Berteroa incana*]; [*Brassica hirta, juncea, kaber, nigra, rapa*]; [*Capsella bursa-pastoris*]; *Cardamine bulbosa,* [*hirsuta*], *pensylvanica, pratensis*; *Dentaria diphylla, heterophylla, laciniata*; *Descurania sophia*; *Draba reptans,* [*verna*]; [*Eruca sativa*]; [*Erysimum cheiranthoides, repandum*]; [*Hesperis matronalis*]; *Lepidium* [*campestre*], [*densiflorum*], *ruderale, virginicum*; [*Nasturtium officinale*]; [*Rorippa austriaca, islandica, sylvestris*]; [*Sisymbrium altissimum, officinale*]; [*Thlaspi arvense, perfoliatum*].

DROSERACEAE: *Drosera rotundifolia.*

PODOSTEMACEAE: *Podostemum ceratophyllum.*

CRASSULACEAE: *Sedum* [*acre*], [*aizoon*], [*purpureum*], [*rupestre*], [*sarmentosum*], [*spurium*], *ternatum.*

SAXIFRAGACEAE: *Chrysosplenium americanum*; *Heuchera americana*; *Hydrangea arborescens*; *Mitella diphylla*; *Penthorum sedoides*; [*Philadelphus coronarius*]; *Ribes* [*grossularia*], *rotundifolia*, *sativum*; *Saxifraga pensylvanica*, *virginiensis*.

HAMAMELIDACEAE: *Hamamelis virginiana*; *Liquidambar styraciflua*.

PLATANACEAE: *Platanus occidentalis*.

ROSACEAE: *Agrimonia gryposepala*, *parviflora*, *pubescens*; *Amelanchier arborea*; *Crataegus calpodendron*, *macrosperma*, [*monogyna*], *phaenopyrum*, *succulenta*, *uniflora*; [*Duchesnea indica*]; *Filipendula rubra*; *Fragraria vesca*, *virginiana*; *Geum aleppicum*, *canadense*, *laciniatum*, *virginianum*; *Gillenia trifoliata*; *Physocarpus opulifolius*; *Potentilla* [*argentea*], *arguta*, *canadensis*, *norvegica*, [*recta*], *simplex*; *Prunus alleghenisis*, *americana*, [*avium*], [*cerasus*], *depressa*, *domestica*, [*persica*], *serotina*, [*spinosa*], *virginiana*; *Pyrus americana*, *arbutifolia*, [*aucuparia*], [*communis*], *coronaria*, *floribunda*, *ioensis*, [*malus*], *melanocarpa*; [*Rhodotypos scandens*]; *Rosa* [*canina*], *carolina*, [*lyoni*], [*multiflora*], *setigera*, *virginiana*; *Rubus allegheniensis*, *argutus*, *baileyanus*, *cuneifolius*, *flagellaris*, *hispidus*, *occidentalis*, *odoratus*, [*phoenicolasius*]; *Sanguisorba canadensis*; *Spirea latifolia*, *tomentosa*.

LEGUMINOSAE: *Albizzia julibrissin*; *Amorpha fruticosa*; *Amphicarpa bracteata*; *Apios americana*; *Baptisia tinctoria*; *Cassia fasciculata*, *hebecarpa*, *nictitans*; *Cercis canadensis*; [*Coronilla varia*]; *Crotalaria sagittalis*; *Desmodium canadense*, *canescens*, *ciliare*, *cuspidatum*, *glabellum*, *glutinosum*, *laevigatum*, *marilandicum*, *nudiflorum*, *perplexum*, *paniculatum*, *rigidum*, *rotundifolium*, *viridiflorum*; *Galactea regularis*; *Gleditsia triacanthos*; *Lathyrus venosus*; *Lespedeza capitata*, [*cuneata*], *hirta*, *intermedia*, *procumbens*, *repens*, [*stipulacea*], [*striata*], *stuevi*, *violacea*, *virginica*; [*Lotus corniculatus*]; [*Medicago sativa*]; [*Melilotus alba*, *officinalis*]; *Phaseolus polystachios*; *Robinia* [*hispida*], *pseudoacacia*, [*viscosa*]; *Strophostyles helvola*; *Stylosanthes biflora*; *Tephrosia virginiana*; [*Trifolium agrarium*, *arvense*, *dubium*, *hybridum*, *pratense*, *procumbens*, *repens*]; *Vicia americana*, [*angustifolia*], *caroliniana*, [*cracca*, *dasycarpa*, *sativa*, *tetrasperma*, *villosa*].

LINACEAE: *Linum medium*, *striatum*, *sulcatum*, [*usitatissimum*], *virginianum*.

OXALIDACEAE: *Oxalis corniculata*, *europea*, *stricta*, *violacea*.

GERANIACEAE: *Geranium carolinianum*, [*columbinum*], *maculatum*, *robertianum*, [*sanguineum*].

RUTACEAE: *Ptelea trifoliata*; [*Ruta graveolens*]; *Xanthoxylum americanum*.

SIMARUBACEAE: *Ailanthus altissima*.

POLYGALACEAE: *Polygala paucifolia*, *sanguinea*, *verticillata*.

EUPHORBIACEAE: *Acalypha gracilens*, *rhomboidea*, *virginica*; *Croton glandulosus*; *Euphorbia corollata*, [*cyparissias*], *dentata*, [*lathyrus*], *maculata*, [*marginata*], *supina*, *vermiculata*.

CALLITRICHACEAE: *Callitriche deflexa*, *heterophylla*, *palustris*.

LIMNANTHACEAE: *Floerkea proserpinacoides*.

ANACARDIACEAE: *Rhus copallina*, *glabra*, *radicans*, *typhina*, *vernix*.

AQUIFOLIACEAE: *Ilex verticillata*.

CELASTRACEAE: *Celastrus* [*orbiculatus*], *scandens*; *Euonymus americanus*, *atropurpureus*, [*europaeus*].

STAPHYLEACEAE: *Staphylea trifolia*.

ACERACEAE: *Acer* [*campestre*], *negundo*, *nigrum*, *pensylvanicum*, [*platanoides*], [*pseudoplatanus*], *rubrum*, *saccharinum*, *saccharum*, *spicatum*.

HIPPOCASTANACEAE: [*Aesculus glabra*, *hippocastanum*].

BALSAMINACEAE: *Impatiens capensis, pallida.*

RHAMNACEAE: *Ceanothus americanus*; [*Rhamnus cathartica*].

VITACEAE: *Parthenocissus quinquefolia*; *vitis aestivalis, labrusca, riparia, vulpina.*

TILIACEAE: *Tilia americana.*

MALVACEAE: [*Abutilon theophrasti*]; [*Althaea rosea*]; [*Hibiscus syriaca, trionum*]; [*Malva moschata, neglecta, sylvestris, verticillata*]; [*Sida spinosa*].

GUTTIFERAE: *Hypericum boreale, canadense, ellipticum, gentianoides, mutilum,* [*perforatum*], *punctatum, pyramidatum.*

CISTACEAE: *Helianthemum canadense*; *Lechea intermedia, leggettii, minor.*

VIOLACEAE: *Hybanthus concolor*; *Viola affinis,* [*arvensis*], *blanda, canadensis, conspersa, cucullata, fimbriatula, hirsutula, incognita,* [*kitaibeliana*], *lanceolata,* [*odorata*], *pallens, palmata, papilionacea, pedata, pensylvanica, primulifolia, pubescens, rostrata, rotundifolia, sagittata, sororia, striata,* [*tricolor*], *triloba.*

CACTACEAE: *Opuntia humifusa.*

ELAEAGNACEAE: *Elaeagnus angustifolia, umbellata.*

LYTHRACEAE: *Cuphea petiolata*; [*Lythrum salicaria*].

NYSSACEAE: *Nyssa sylvatica.*

MELASTOMACEAE: *Rhexia virginica.*

ONAGRACEAE: *Circea alpina, quadrisulcata*; *Epilobium coloratum, glandulosum,* [*hirsutum*], *leptophyllum*; *Gaura biennis*; *Ludwigia alternifolia, palustris*; *Oenothera biennis, laciniata, parviflora, perennis, tetragona.*

HALAGORACEAE: [*Myriophyllum exalbescens*].

ARALIACEAE: *Aralia hispida, nudicaulis, racemosa*; *Panax quinquifolius, trifolius.*

UMBELLIFERAE: [*Aegopodium podagraria*]; *Angelica atropurpurea, venenosa*; [*Anthriscus sylvestris*]; *Chaerophyllum procumbens*; *Cicuta bulbifera, maculata*; [*Conium maculatum*]; *Cryptotaenia canadensis*; [*Daucus carota*]; [*Foeniculum vulgare*]; *Heracleum maximum,* [*sphondylium*]; *Hydrocotyle americana*; *Osmorhiza claytoni, longistylis*; [*Pastinaca sativa*]; [*Pimpinella saxifraga*]; *Sanicula canadensis, gregaria, marilandica*; *Sium suave*; *Taenidia integerrima*; *Thaspium barbinode, trifoliatum*; [*Torilis japonica*]; *Zizia aptera, aurea.*

CORNACEAE: *Cornus alternifolia, amomum, florida, racemosa, rugosa, stolonifera.*

PYROLACEAE: *Chimaphila maculata, umbellata*; *Monotropa hypopithys, uniflora*; *Pyrola elliptica, rotundifolium.*

ERICACEAE: *Epigaea repens*; *Gaultheria procumbens*; *Gaylussacia baccata*; *Kalmia angustifolia, latifolia*; *Leucothoë racemosa*; *Lyonia ligustrina, mariana*; *Rhododendron maximum, nudiflorum, viscosum*; *Vaccinium angustifolium, atrococcum, corymbosum, macrocarpon, stamineum, vacillans.*

PRIMULACEAE: [*Anagallis arvensis*]; *Lysimachia ciliata,* [*nummularia*], *quadrifolia, thrysiflora*; *Samolus parviflorus*; *Trientalis borealis.*

EBENACEAE: *Diospyros virginiana.*

OLEACEAE: *Fraxinus americana, nigra, pensylvanica*; [*Ligustrum vulgare*]; [*Syringa vulgaris*].

GENTIANACEAE: *Bartonia virginica*; [*Centaurium pulchellum*]; *Gentiana andrewsii, clausa, crinita*; *Obolaria virginica*; *Sabatia angularis.*

APOCYNACEAE: *Apocynum androsaemifolium, cannabinum, medium*; [*Vinca minor*].

ASCLEPIADACEAE: *Asclepias amplexicaulis, exaltata, incarnata, purpurascens, quadrifolia, stricta, tuberosa, viridiflora.*

CONVOLVULACEAE: *Convolvulus [arvensis], sepium, spithameus; Cuscuta gronovii, pentagona; Ipomea [hederacea], pandurata.*

POLEMONIACEAE: *Phlox [divaricata], maculata, [paniculata], subulata; Polemonium reptans.*

HYDROPHYLLACEAE: *Ellisia nyctelea; Hydrophyllum virginianum.*

BORAGINACEAE: *Cynoglossum [officinale], virginianum; [Echium vulgare]; Hackelia virginiana; [Lithospermum arvense]; Mertensia virginica; Myosotis [laxa], scorpoides, sylvatica, verna; Onosmodium virginianum.*

VERBENACEAE: *Verbena hastata, simplex, stricta, urticifolia.*

LABIATAE: *Agastache nepetoides, scrophulariaefolia; Ajuga reptans; Collinsonia canadensis; Cunila origanoides; [Glechoma hederacea]; Hedeoma pulegioides; Isanthus brachiatus; [Lamium amplexicaule, purpureum]; [Leonurus cardiaca]; Lycopus americanus, [europaeus], uniflorus, virginicus; Mentha [aquatica], arvensis, [piperata], [rotundifolia], [spicata]; Monarda didyma, fistulosa, media; [Nepeta cataria]; Physostegia virginiana; Prunella vulgaris; Pycnanthemum clinopodioides, incanum, muticum, tenuifolium, verticillatum, virginianum; Salvia lyrata; Satureja vulgaris; Scutellaria elliptica, epilobiifolia, integrifolia, lateriflora, nervosa; Stachys [palustris], tenuifolia; Teucrium canadense; Trichostemum dichotomum.*

SCROPHULARIACEAE: *Castilleja coccinea; [Chaenorrhinum minus]; Chelone glabra; [Cymbalaria muralis]; Gerardia flava, paupercula, pedicularis, tenuifolia, virginica; Gratiola neglecta; Linaria canadensis, [vulgaris]; Lindernia dubia; Melampyrum lineare; Mimulus alatus, moschatus, ringens; Pedicularis canadensis, lanceolata; Penstemon digitalis, hirsutus; Scrophularia lanceolata, marilandica; [Verbascum blattaria, lychnitis, thapsus]; Veronica [agrestis], americana, [anagallis-aquatica], [arvensis], [hederaefolia], [officinalis], peregrina, [persica], scutellata, [serpyllifolia]; Veronicastrum virginicum.*

BIGNONIACEAE: *Campsis radicans; Catalpa bignonioides.*

SOLANACEAE: *[Datura stramonium]; [Lycium halimifolium]; [Nicandra physalodes]; Physalis heterophylla, subglabrata; Solanum carolinense, [dulcamara], nigrum.*

OROBANCHACEAE: *Conopholis americana; Epifagus virginiana; Orobanche uniflora.*

MARTYNIACEAE: *[Proboscidea louisianica].*

ACANTHACEAE: *Justicia americana.*

PHRYMACEAE: *Phryma leptostachya.*

PLANTAGINACEAE: *Plantago [aristata], [lanceolata], [major], rugellii, virginica.*

RUBIACEAE: *Cephalanthus occidentalis; Diodea teres; Galium aparine, asprellum, boreale, circaezans, lanceolatum, [mollugo], obtusum, pilosum, tinctorium, triflorum, [verum]; Houstonia caerulea; Mitchella repens.*

CAPRIFOLIACEAE: *Diervilla lonicera; Lonicera dioica, [japonica], [morrowii], sempervirens; Sambucus canadensis, pubens; Symphoricarpos [albus], orbiculatus; Triosteum angustifolium, aurantiacum, perfoliatum; Viburnum acerfolium, dentatum, lentago, prunifolium, racemosa, rafinesquianum, recognitum.*

CUCURBITACEAE: *Echinocystis lobata; Sicyos angulatus.*

VALERIANACEAE: *[Valerianella olitoria]; [Valeriana officinalis].*

DIPSACACEAE: *[Dipsacus sylvestris].*

CAMPANULACEAE: *Campanula americana, [rapunculoides], rotundifolia; Lobelia cardinalis, inflata, syphilitica, spicata; Specularia perfoliata.*

COMPOSITAE: *[Achillea millefolium]; Actinomeris alternifolia; Ambrosia artemisii-*

*folia, trifida*; *Anaphalis margaritacea*; *Antennaria neodioica, fallax, neglecta, parlinii, plantaginifolia*; *Anthemis arvensis, cotula*; *Arctium minus*; *Artemisia vulgaris*; *Aster cordifolius, divaricatus, dumosus, ericoides, glomeratus, laevis, lateriflorus, linariifolius, lowrieanus, macrophyllus, novae-angliae, patens, pilosus, prenanthoides, puniceus, sagittifolius, simplex, umbellatus, vimineus*; [*Bellis perennis*]; *Bidens bipinnata, cernua, coronata, frondosa, polylepis, vulgata*; *Cacalia atriplicifolia*; [*Carduus nutans*]; [*Centaurea diffusa, jacea, maculosa, nigra, nigrescens, vochinensis*]; [*Chrysanthemum leucanthemum*], [*parthenium*]; [*Cichorium intybus*]; *Cirsium* [*arvense*], *discolor, horridulum, muticum, pumilum,* [*vulgare*]; [*Coreopsis lanceolata*]; [*Crepis capillaris*]; *Eclipta alba*; *Erechtites hieracifolia*; *Erigeron annuus, canadensis, philadelphicus, pulchellus, strigosus*; *Eupatorium altissimum, aromaticum, fistulosum, hyssopifolium, maculatum, perfoliatum, purpureum, rugosum, sessilifolium*; [*Galinsoga ciliata, parviflora*]; *Gnaphalium obtusifolium, uliginosum*; *Helenium autumnale, nudiflorum*; *Helianthus* [*annuus*], *decapetalus, divaricatus, giganteus,* [*grosseserratus*], *strumosus, tuberosus*; *Heliopsis helianthoides*; *Hieracium* [*aurantiacum*], [*florentinum*], *gronovii, paniculatum,* [*pilosella*], [*pratense*], [*sabaudum*], *scabrum, venosum*; [*Inula helenium*]; *Krigia biflora, virginica*; *Kuhnia eupatorioides*; *Lactuca biennis, canadensis, floridana, scariola*; *Liatris spicata*; [*Matricaria matricarioides*]; *Mikania scandens*; [*Picris hieracioides*]; *Prenanthes alba, altissima, trifoliata*; *Rudbeckia fulgida, laciniata, serotina, triloba*; *Senecio aureus, obovatus, pauperculus*; *Sericocarpus asteroides, linifolius*; *Silphium perfoliatum*; *Solidago altissima, arguta, bicolor, caesia, canadensis, flexicaulis, gigantea, graminifolia, juncea, nemoralis, odora, patula, rigida, rugosa, speciosa, squarrosa, ulmifolia*; [*Sonchus arvensis, asper, oleraceus*]; [*Tanacetum vulgare*]; [*Taraxacum officinale*]; [*Tragopogon major, porrifolius, pratensis*]; [*Tussilago farfara*]; *Vernonia noveboracensis*; *Xanthium italicum, pensylvanicum, strumarium.*

# Asclepiadaceae of Thomas Nuttall at the Academy of Natural Sciences of Philadelphia

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According to Ewan (1971) the bulk of Nuttall's specimens (5750 species) collected after the *Genera* was published in 1818 are in the British Museum. A set of the Missouri trip of 1810 was given to Aylmer Bourke Lambert, and some of these came to the Academy in 1857 (Ewan 1971). The Gray Herbarium has some early specimens and there are also some in the Durand Herbarium in Paris, a few in the Liverpool Museum Herbarium, and some in the Elliott Herbarium in Charleston. The Academy is the repository for most of Nuttall's early collections (Ewan 1971; Graustein 1967; Stuckey 1967) and also has much of his later material.

The relationship of Nuttall to the Academy during his collection years in the United States, 1808–1841, and even after his return to England was a close one. Nuttall presented his first paper at the Academy in 1817, the year of his election to membership, and deposited much of his herbarium material there in succeeding years (Graustein 1967). Illustrating a representative example of that collection is the aim of this paper.

A study of Thomas Nuttall's specimens of the Asclepiadaceae at PH[1] can provide a sample of the quantity and quality of his collection there. The Asclepiadaceae is a family of moderate size, one which Nuttall did not single out for study in depth. The specimens at PH have been compared to Nuttall's manuscripts and publications (Smith and Thieret 1959) in which Asclepiadaceae were mentioned (Nuttall 1813, 1818, 1821, 1822, 1848, 1851; Torrey 1858).

In publications Nuttall used the names of nine genera of Asclepiadaceae: *Anantherix, Asclepias, Cynanchum, Enslenia, Gonolobus, Matelea, Periploca, Polyotus,* and *Stylandra.* In addition, there are Nuttall herbarium specimens at PH labeled as *Acerates, Ceropegia, Eustrephia, Huernia,* and *Vincetoxicum.*

In the publications noted, 42 species were listed. Seventeen new species of Asclepiadaceae were published and described by Nuttall; and one by Torrey, giving credit to Nuttall. Of these PH has eleven type specimens and one nontype specimen ticketed in Nuttall's hand. For example, *Gonolobus viridiflorus* Nuttall is described in the *Genera* as growing "on the banks of the Mississippi near St. Louis," and the label of the type specimen reads "*Gonolobus viridiflorum* (sic) Mississippi" in Nuttall's hand and "(Nuttal)" in the hand of Charles Pickering, secretary to the Academy, with whom Nuttall worked closely during his last years in the United States (Graustein 1967). The small label with minimal information and with Pickering's addition is typical.

Of the 24 remaining species mentioned in print by Nuttall, descriptions were never provided for ten. Five of these ten are not represented by specimens at PH, three relate to specimens which have insufficient information to identify a site, and two are represented by specimens which were collected at a site different from that indicated by Nuttall. Sometimes Nuttall's listings are unclear: *Asclepias purpura(scens)* is cited

[1] Abbreviation for the Herbarium of the Academy of Natural Sciences in Philadelphia.

without an author in the *Genera*, and therefore could be that of Linnaeus or of Walters. There is no specimen to illustrate Nuttall's usage. Graustein (1967), Stuckey (1967), and Ewan (1971) all indicate that Nuttall was not apt to collect specimens which had already been named.

There are specimens at PH for six of the 14 species identified by Nuttall with earlier names for which Nuttall provided descriptions. For example, *Asclepias longifolia* is well represented by specimens which are from sites other than those mentioned in the *Genera* or the 1810 diary. The former has the habitat as "in Carolina, Georgia, Illinois, and Louisiana," while in the latter Nuttall mentions seeing it (although not necessarily collecting it) near Huron and the vicinity of Detroit. The three Academy specimens are labeled "Delaware," "Arkansa" (sic), and "Red River." An example of the five which match (or do not conflict with) Nuttall's published site would be *Asclepias paupercula*, for which no site is published, although Nuttall has given a clue by putting it in synonymy with *A. floridana* Lamarck. The specimen at PH is labeled "Dr. Baldwin, Florida" with "(Nuttall's ticket)" added in Pickering's hand.

There are four specimens at PH indicated by Nuttall's asterisk on the ticket as being new genera or species, but which were never published. "*Eustrephia occidentalis" with "Nuttall" added in Pickering's hand is on the same sheet with "Vincetoxicum *america(num)[2] Ark" with "(Nutt)" again added by Pickering. Both were tentatively assigned later to *Gonolobus cynanchoides*. "Asclepias *tomentosa[2] Nuttall Lewis River, Rocky Mts." is now labeled *Asclepias speciosa* Torrey. "Gonolobus *petersi" is added in Pickering's writing to one of Nuttall's less legible labels "Gonolobus macrophyllus July 18.4 Fence corner near Versailles, Ky." Dr. Charles Wilkens Short and Robert Peter listed "Gonolobus macrophyllus?" in their *Supplementary Catalogue of the Plants of Kentucky*. This is quite possibly a specimen representing that citation.

Eleven other specimens at PH with Nuttall labels comprise a miscellaneous group, never described by Nuttall in any of his publications and with species names of various other authors. The most interesting of these came from Nuttall's herbarium or from his garden. *Asclepias linearis* is labeled "hort Nutt" in Pickering's ubiquitous hand. Did he mean "herb. Nuttall"? Another is labeled "Ceropegia Hort Nutt Cape of Good Hope." Could this be part of the 200 specimens Lambert had presented to Nuttall, which Nuttall believed to be from Masson but which Ewan has since identified as being collected by David James Niven (Karsten 1960)? Four other specimens were never identified, such as "Acerates Nuttall Arkansas" . . . a genus name which he never used in publication.

Looking at the collection from the aspect of the date of Nuttall's publications illustrates the completeness of Nuttall's collections at PH. In the 1810 diary, six *Asclepias* were cited as being seen; of these PH has two specimens which do not conflict with his information. There is no specimen for the *Gonolobus hirsutus* in Fraser's *Catalogue*. Of the 31 species of Asclepiadaceae in the *Genera*, six PH specimens match, two PH specimens do not conflict with the published information, and four PH specimens do not match the published information. Nuttall's 1819 Arkansas journal mentions only *Asclepias parviflora*, and the existing specimens mention no site. Three out of four Asclepiadaceae mentioned in the publication on the Ware collection are matched by specimens at PH. The flora of the Arkansas Territory described 16 species of Asclepiadaceae; of these six match, and there are specimens from different sites for the remaining two. The Academy herbarium does not have any of the specimens from Gambel's Rocky Mountain Flora (Ewan 1971). Torrey, in his botany of the boundary survey published Nuttall's name for *Gonolobus biflorus*, obviously using Nuttall's asterisked specimen at PH.

Nuttall has been described as having "an aptitude for observation, a quickness of eye, tact in discrimination, and a tenacity of memory" (J. Smith 1865). He early realized the numbers of new genera, as well as new species, which abounded in North America, and his pioneering collection which substantiates his observations is invaluable for a student of 19th century botany. The Asclepiadaceae are a sample of this collection. In Nuttall's writings on this family, 42 species are mentioned and 32 described. Of the taxa with descriptions PH has matching or relevant specimens for 16 (50 percent). If one includes nonmatching specimens with Nuttall's labels, there are 20 or 62 percent total. Eleven of these specimens are types that document 65% of the species of Asclepiadaceae originally described by Nuttall. It is not merely the number of specimens, but the high percentage of Nuttall's types which make his collection at PH so valuable; one hopes that there will be further studies of other families in his collection, especially in their relationship to the pioneering study of new genera and species in 19th century botany.

## Asclepiadaceae Cited by Nuttall

*[2]*Anantherix *decumbens* (1836) description[3], site[4]—at least one specimen at PH matching one citation.

*Anantherix *paniculatus* (1836) description, site—at least one specimen at PH matching one citation.

*Anantherix *viridis* (1818) description, site—at least one specimen at PH matching one citation. (1836) description, site—at least one specimen at PH matching one citation.

*Asclepias amoena*[5] (1951)[6] no description, site—no specimen at PH. (1818) no description, no site—no specimen at PH.

*Asclepias amplexicaulis* (1818) description, no site—specimen does not contradict citation.

*Asclepias cinerea* Walt. (1818) description, site—no specimen at PH.

*Asclepias debilis* Michx. (1818) no description, no site—specimens at PH from location not visited before 1818. (1836) no description, site—specimens at PH from location not cited.

*Asclepias incarnata* "Willd." (1818) no description, no site—insufficient data on specimens. (1822) no description, site assumed[7]—specimens at PH from location not cited.

*Asclepias *lanuginosa* (1818) description, site—no specimen at PH.

*Asclepias longifolia* (1951) no description, site—specimens at PH from location not cited. (1818) meager description, site—specimens at PH from location not cited.

*Asclepias *macrophylla* (1848) description, site—no specimen at PH.

*Asclepias nivea* (1818) no description, no site—no specimen at PH.

*Asclepias obtusifolia* Michx. (1818) no description, no site—no specimen at PH. (1836) no description, site assumed—no specimen at PH.

*Asclepias parviflora* "Willd." (1818) no description, no site—insufficient data on specimen. (1821) no description, site—insufficient data on specimen. (1836) no description, site—insufficient data on specimen.

*Asclepias paupercula* (1818) description, no site—specimen does not contradict citation.

*Asclepias *periplocaefolia* (1818) description, site—no specimen at PH.

*Asclepias phytolaccoides* (1818)[8] description, site—no specimen at PH.

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[2] The asterisk (*) was used by Nuttall in publications and on his labels to indicate a new species or genus.

[3] Indicates that a description of the species was included in the publication.

[4] Indicates that at least the general locality where the species was found growing was mentioned.

[5] Where Nuttall listed no author, none is mentioned. Few were named in publications prior to 1822; we have assumed the *Genera* author where one is given in later publications.

[6] *A. amoena* Brong. = *A. incarnata* L. "which is common in this area" (Graustein 1951, p. 64).

[7] The site of the species cited in the 1813 publication is assumed "Upper Louisiana" etc., that of the 1822 publication is assumed to be Florida, that of the 1836 publication is assumed to be Arkansas when the only information is a listing of species name.

[8] Stuckey (1967) cites this as an example of 14 species of Nuttall's Ohio plants in the *Genera* under already existing names which are not represented by specimens at PH.

*Asclepias purpurascens* (1951) no description, site—no specimen at PH.
*Asclepias quadrifolia* Jacq. (1951) description, site—no specimen at PH. (1818) description, no site—no specimen at PH. (1836) no description, site—no specimen at PH.
*Asclepias syriaca* (1951) no description, site—no specimen at PH. (1818) brief description, no site—no specimen at PH.
*Asclepias tuberosa* (1951) no description, site—insufficient data on specimen. (1818) no description, no site—insufficient data on specimen.
*Asclepias variegata* "Willd." (1836) description of color only, site—insufficient data on specimen. (1818) description, no site—no specimen at PH. (1836) no description, site—no specimen at PH.
*Asclepias verticillata* L. (1951) no description, site—specimens at PH from location not cited. (1818) description, no site—specimens do not contradict citation, and collected before 1818. (1822) no description, site assumed—specimen matches assumed site. (1836) no description, site assumed—specimens at PH from locations not cited.
*Asclepias viridiflora* Raf. (1818) description assumed by naming author. No site—no specimen at PH.
*Asclepias viridis* (1818) no description, no site—specimens at PH from location not visited before 1818.
*Cynanchum angustifolium* (1818) description, site—at least one specimen at PH matching one citation.
*Cynanchum laeve*? (1818) description, no site—more than one specimen for same citation or location.
*Cynanchum *scoparium* (1822) description, site assumed—at least one specimen at PH matching one citation.
**Enslenia albida* (1818) description, site—specimens at PH from location not cited. (1836) no new description, site—specimens at PH from location not cited.
*Gonolobus *carolinensis* (1818) description, site—more than one specimen for same citation or location.
*Gonolobus hirsutus* Michx. (1813) no description, site assumed—no specimen at PH.
*Gonolobus macrophyllus* (1818) no description, no site—no specimen at PH.
*Gonolobus *viridiflorus* (1818) description, site—at least one specimen at PH matching one citation.
*Gonolobus *biflorus* (Torrey) (1858) description, site—more than one specimen for same citation or location.
*Matelea *laevis*? (1822) description, site assumed—at least one specimen at PH matching one citation.
*Periploca graeca* (1818) description, no site—no specimen at PH.
*Polyotus *angustifolius* (1836) description, site—more than one specimen for same citation or location.
*Polyotus *heterophyllus* (1836) description, site—at least one specimen at PH matching one citation.
*Polyotus *lanuginosus* (1836) description, site—no specimen at PH.
*Polyotus *longifolius* (1836) description, site—at least one specimen at PH matching one citation.
*Polyotus *obovatus* "a dubious species" (1836) description, site—no specimen at PH.
**Stylandra pumila* (1818) description, site—no specimen at PH (1836)[9] description, site—no specimen at PH.

## Undescribed, Unpublished Taxa Considered New[10]

*Asclepias *tomentosa*
**Eustrephia occidentalis*
*Gonolobus *petersii*
*Vincetoxicum *americanum*

## Undescribed, Unpublished Taxa Not Considered New

"*Acerates* Arkansas"
"*Ascl[epias] arbor[escens]* Hort Nuttall"
"*Asclepias decumbens* Arkansas"
"*Asclepias linearis* Hort. Nutt."
"*Asclepias pedicellata* fruct(us) long . . . H . . . yellow tubrous St. Mary's Dr. B."[11]
"*Ceropegia* Hort. Nuttall Cape of Good Hope"
"*Cynanchum erectum* fl. alb. (June–Aug) W. Indies Nutt. Hort."
"*Gonolobus* Nuttall Arkansas"
"*Huernia* Hort. Nuttall (one unnamed bit from the garden)"

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[9] It is possible that Dr. Baldwin's specimen of "*Asclepias pedicellata*" which is listed below under "undescribed species" is authentic material for this. In the *Flora of Arkansas Territory,* Nuttall cites "*Asclepias pedicellata,* Walt. . . . near St. Mary's, Dr. Baldwin," in his description of *S. pumila.*
[10] We have no intention here of publishing his names.
[11] See footnote 9.

"*Vincetoxicum*? Nuttall N. Holl?"[12]
"(*Vincetoxicum officinale*) (Nuttall) Siberia"[13]

## Acknowledgments

This paper would not have been possible without the thoughtful guidance and kind encouragement of Dr. James Mears, head of the Botany Department at PH, for which the author is extremely grateful.

## Literature Cited

Ewan, Joseph. 1971. Editor's Introduction. *In* the facsimile reprint of Thomas Nuttall, The Genera of North American Plants. Hafner Publishing Co., New York. pp. (1)–xxxvii.

Graustein, Jeannette E. 1967. Thomas Nuttall Naturalist: Explorations in America 1808–1841. Harvard University Press, Cambridge, MA. 481 pp.

Karsten, Mia C. 1960. Francis Masson, a gardener-botanist who collected at the Cape. J. S. African Bot. 26: 9–15.

Nuttall, Thomas. 1813. A catalogue of new and interesting plants collected in Upper Louisiana, and principally on the River Missourie, North America. Fraser's Nursery, London. 1890. Reprinted in Pittonia 2: 116–119.

———. 1818. The Genera of North American Plants and a Catalogue of the Species, to the Year 1817. 2 Vol. Printed for the author by D. Heartt, Philadelphia.

———. 1821. A journal of travels into the Arkansa Territory during the year 1819, with occasional observations on the manners of the aborigines. Thos. M. Palmer, Philadelphia. Travels 1748–1846. Vol. 13. Arthur H. Clark Co., Cleveland.

———. 1822. A catalogue of a collection of plants made in east-Florida, during the months of October and November, 1821, [Nathaniel] A. Ware, Esq. Amer. J. Sci. Arts 5: 286–304.

———. 1836. Collections toward a flora of the Territory of Arkansas. Trans. Amer. Philos. Soc. n. ser. 5: 139–203 (for date of publication see Foster, R. C., 1944, Rhodora 46: 156–157).

———. 1848. Descriptions of plants collected by Mr. William Gambel in the Rocky Mountains and upper California. Proc. Acad. Nat. Sci. Philadelphia Ser. 1: 149–189.

———. 1951. Nuttall's travels into the old Northwest. An unpublished 1810 diary. Edited by Graustein, J. E., Chron. Bot. 14: 1–88.

Short, Charles Wilkens and Robert Peter. 1834. A supplementary catalogue of the plants of Kentucky. Transylvania J. Med. Assoc. Sci. 8, No. 4, 598–600.

Smith, C. Earle, Jr. and John W. Thieret. 1959. Thomas Nuttall (1786–1859): An evaluation and bibliography. Leafl. W. Bot. 9: 33–42.

Smith, J. Jay. 1865. Foreword to F. Andrew Michaux, North American Sylva 1: 9–10.

Stuckey, Ronald L. 1967. The "lost" plants of T. Nuttall's 1810 expedition into the old Northwest. Michigan Bot. 6: 81–94.

Tatnall, Robert R. 1940. Nuttall's plant collections in Southern Delaware. Bartonia 20: 1–6.

Torrey, John C. 1858. Botany of the boundary. *In* Emory, William H., Report on the U.S. and Mexican boundary survey 2: 30–27. Cornelius Endell, Washington.

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[12] Probably a Robert Brown specimen from Hooker or Lambert (Mears, pers. comm.).
[13] Probably a Pallas specimen from Hooker or Lambert (Mears, pers. comm.).

# Additions to the Check-List of the Flora of Montgomery County, III

Mariana McCabe
*803 N. Franklin St.*
*Pottstown, PA 19464*

and

Ann Newbold
*R.D. 1, Bechtelsville, PA 19505*

Three new species of Montgomery County flora (see Edgar T. Wherry's *Check-List* in Bartonia 41: 71–84 and Ann Newbold's *Additions* in Bartonia 45: 15 and 46: 49) bring the current county total of recorded taxa with herbarium specimens to 1840, of which 1236 are presumed to be indigenous and 604 introduced.

While *Betula lutea* Michx. has long been known in Berks County just a few miles across the western border of Montgomery County, no naturally growing specimen has heretofore been found in the county. A good size tree has been identified in the woods comprising part of the Upper Perkiomen Valley Park at Green Lane.

*Euphorbia dentata* Michx., known in waste places and dry railroad banks from New York to Mexico has been found growing profusely on the dry railroad banks along the Reading Railroad Company's Pottstown Station.

*Hibiscus palustris* L. has been collected from the marshy area just west of the beginning of the Philadelphia Water Supply's reservoir off Route 663, New Hanover Township. In view of the difficulty experienced collecting the specimen, it can be presumed that it was not planted there by human hand.

# Status of Some North Jersey Wet Habitats


VINCENT ABRAITYS
*Sergeantsville, NJ 08557*


The article in this issue on the deterioration of Dillerville Swamp has encouraged a status assessment of our better known north Jersey botanical sites. While Dillerville Swamp has suffered directly at the hands of man, other than our *Ledum groenlandicum* which is buried beneath a parking lot, New Jersey's problems have been more of an indirect nature. Within the past decade famous Johnsonburg bog has been flooded by beavers with consequent damage to its shoreline and inner sphagnum mat. Removal of the beaver and destruction of their dam has halted the process but a number of plants have yet to return. The only plus factor we have at Johnsonburg is the flowering of *Utricularia minor,* surely but a sometime thing. Ominously beaver are moving in at the south end of Mt. Lake bog and smaller bogs near Newton.

Atop the Kittatiny a sadder story unfolds. Below Culver's Gap between Mecca Gap and Donkey's Corner headwater bogs and swamps have disappeared taking large colonies of *Listera cordata* and *Malaxis unifolia.* High Point Park and Stokes Forest are overrun with beaver work on even the smallest stream. Famous Mashipacong's 'Lost Lake' is beginning to get competition from them. In fairness it should be said that while the *Eriophorum spissum* of the Mt. Hope bogs near Dover has succumbed to filling, the Mashipacong station for it has disappeared for reasons unknown.

The limestone areas have another problem in the general lowering of the water table. All ponds and wet areas are affected. Old reliable Howell's Pond has been dry for some years now. A small sinkhole west of Andover which had been a good source of *Scirpus torreyi* has had grass growing over its bottom for the past six years. The same may be said for the interesting sinkhole which carried *Sparganium minimum.* Mountain Lake bog is growing heavier with tall trees and shrubs and the opening which housed *Cypripedium candidum* can no longer be found. Openings in Budd's Lake bog seem to have disappeared, too. A *Triglochin* meadow near Newton has not had the plant for many years. *Sagittaria cuneata* sink holes are diminishing. The above list could be expanded but it ought to be noted that the fast disappearing *Cypripedium reginae* departs with certain trowel bearing humans.

Lest this article end on too gloomy a phrase, let it be known that *Listera smallii* is faring well and younger field botanists have added new stations for *Habenaria hookeri* and *Habenaria orbiculata.*

**Wayside Simples and Grateful Herbs** by Vincent Abraitys and illustrated by Phoebe Gaughan. 228 pp. Paper. Columbia Publishing Company, Inc. Frenchtown, NJ. 1980. $8.95.

Vincent Abraitys writes an informal account of those plants which were once a real comfort to our forebears as an ever present source of medical aid or of varied flavors to enhance their meagre choice of foods. His book results not only from thorough research into the history of plant uses but also from extensive experience afield in hunting and identifying them. Readers in all parts of the country will enjoy the book because of his wide choice of plants from all areas where each will meet some familiar species and discover interesting facts about "old friends."

For each of the 75 plants, Abraitys, with a light touch, shares an anecdote of his first finding it or pictures it in its usual haunts, vividly describing the wild habitat and the plant's manner of growth. A short glossary of botanical and medicinal terms is included and is very helpful, especially with the medical terms now seldom in common use.

The author clearly and repeatedly expresses the view that these plants "not only are dangerous to use but are endangered in their existence" and recommends that "no plants be touched, idly or otherwise." It is this approach which makes the book unique in its field and of real importance to everyone. It frees the author to convey to the reader the plant's own worth, just as it is, for its own sake, as a part of the world, to be appreciated and left where it is.

Identification of each plant is made easy with the illustrations by Phoebe Gaughan who uses plain, simple, strong lines to accurately depict characteristics. Descriptions are brief and usable. The historical significance of both common and scientific names is given. The lore connected with the plant's use is always given with care to remind any reader that today's population pressure could easily cause extinction were we to try out these uses widely today.

The bibliography could be very helpful for anyone who becomes interested in knowing more about plants, historical uses, and plant hunters. The index is particularly useful as the sequence of herbs described seems to be entirely random.

Altogether, this is a book which leads you on to more and more delightful encounters while it lets you share the author's information on the outdoor world. E. MARIE BOYLE.

**Atlas of the Flora of Pennsylvania** by Edgar T. Wherry, John M. Fogg, Jr., and Herbert A. Wahl. xxx + 390 pp. Paper. Morris Arboretum of the University of Pennsylvania. Philadelphia, PA. 1979. $9.95.

The ATLAS has long been awaited by the botanical community in Pennsylvania. Started in the mid-1930's it was nearly published in the 1960's. Unfortunately the project met with some delays until the early 1970's. The Morris Arboretum reactivated the project and produced a published work. This is the first comprehensive treatment of the state's plant life since Porter's FLORA in 1903.

The introduction to the ATLAS provides the user with a short course in the flora of Pennsylvania. A synonymy section is provided, comparing the ATLAS to GRAY'S MANUAL, 8th Ed.

The body primarily contains dot maps illustrating the known distribution of over

1200 native and naturalized plants known to occur in Pennsylvania up to 1970. The basis for the information appearing as a map dot are specimens housed in the five major herbaria of Pennsylvania. Usually there are 8 maps/page. Each county will have a maximum of 12 collection localities. Above each map the scientific name appears. Maps are grouped by families using the Engler-Prantl sequence. The family name is found at the top outer edge of the page. Genera, species, and varieties are listed alphabetically. GRAY'S MANUAL OF BOTANY, 8th Edition, by M. L. Fernald is largely followed.

Overall the ATLAS provides good basic data concerning plant distributions in the state. Although this publication eases the work necessary to survey a particular species occurrence in the state, for critical applications it should not be utilized in place of specimen records. The data are at least 10 years old, and additions or deletions are inevitable.

The only criticism by this writer is the, at times, confusing nomenclature. Synonymy is detailed in the introduction, but occasionally appears with the name above the map. A standardized nomenclatural format should have been adopted and followed to the letter within the body of the text.

The ATLAS is a long needed addition to Pennsylvania's regrettably sparse botanical literature. It is hoped that this is just the first of many botanical volumes addressing the whole of the state. In addition, this work should be a guide for the field botanist to further investigations of species occurrence in Pennsylvania. PAUL G. WIEGMAN.

**Rare and Endangered Vascular Plant Species in Pennsylvania** by Paul G. Wiegman. 94 pp. Paper. The U.S. Fish and Wildlife Service. Newton Corner, MA. 1979.

Spurred by the Congressional Endangered Species Act of 1973 which resulted in a published list of extinct and endangered plants within the United States, a number of states have issued their own assessments. Fortunately for naturalists in Pennsylvania, Paul Wiegman of the Western Pennsylvania Conservancy has prepared an attractive pamphlet, a fine addition to the increasing list of state guides.

The initial task of this survey was to review for the United States Fish and Wildlife Service the 17 species occurring within Pennsylvania as listed in the Federal Register (Vol. 40, No. 127, July 1975). Wiegman's Survey indicates those species which should remain on the Federal List as well as those species which, due to a better assessment of their frequency, should be deleted. Moreover, an important aspect of the Survey was to review all species uncommon to Pennsylvania. Useful as the Federal List can be, often it does not include plants rare to a region but common elsewhere. For example, the disjunct *Carex geyeri* is common in the western Cordillera, but is known in eastern North America only from a calcareous rocky outcrop in Centre County, Pennsylvania. In brief, the "purpose of this list is to catalogue the status and distribution of native vascular plants believed to be rare, vulnerable, or declining in Pennsylvania."

Wiegman's Survey was based on a careful review of unpublished lists by Buker (1975) and Wherry and Keener (1977). In addition to checking the records for the *Atlas of the Flora of Pennsylvania* held at the Morris Arboretum, Wiegman studied recently collected voucher material at Carnegie Museum. A refined second draft was circulated to a number of reviewers, some of whom attended a meeting on 25 January 1979 convened to discuss the proposed species list. Moreover, Wiegman conducted field surveys in 1979 to determine the status of the 17 species on the Federal List plus 8 selected additional species. As a consequence, these 25 species have been assessed critically to determine the known occurrence of each within Pennsylvania including recommendations concerning their status. Wiegman's study recommends that, of the 17 species on the Federal List, several need further review, 6 should be deleted, 5 are considered endangered, and 2 are considered presently extirpated within Pennsylvania (*Cypripedium candidum* Muhl., *Micranthemum micranthemoides* (Nutt.) Wettst.).

Most of Wiegman's list is devoted to assessing 340 taxa of vascular plants. In general, the Survey includes only those species generally occurring in not more than 2 counties. For each taxon, Wiegman has included the distribution by counties, a category of classification (extirpated, endangered, threatened, disjunct, endemic, restricted, vulnerable), followed by various remarks about habitats, extra-Pennsylvania ranges, etc. The arrangement of the families and the nomenclature for the most part follow M. L. Fernald's *Gray's Manual of Botany,* Eighth Edition.

Undoubtedly, Wiegman's Survey will aid considerably in our assessment of the flora of Pennsylvania. With over 3000 taxa of vascular plants occurring within the Commonwealth, this Survey accounts for about 11 percent. The Survey should alert concerned naturalists to those species especially deserving protection. And with an increased public consciousness, one may hope that a number of species may be spared from extinction.

Unfortunately, the Survey is marred by a number of errors and omissions. A number of species names lack authors (nearly all synonyms), some authors are misspelled (Ait., p. 38), many lack proper punctuation (Willd., not Willd, p. 45), and Michaux appears both as Michaux (p. 49) and Michx. (p. 50). In the "Remarks" column "Threatened" is repeatedly abbreviated "Thdt.," although in the "Categories-Definitions" section (p. 11) and in the final pages of the Survey, it is abbreviated "THTD." In referring to the Eighth Edition of *Gray's Manual,* "Gray reports" (p. 40) should have been "Fernald reported." And it's difficult to understand how a species which is reported from Dauphin County, "just reaches w. Pa." (p. 44). "Porter" County (p. 58) could refer to Potter County, but *Potentilla tridentata* Ait., just does not occur there. My own name is cited twice as Kenner.

Finally, one might quibble endlessly with a list of this type. Certainly, Wiegman's Survey represents a solid, painstaking contribution to an assessment of the flora of Pennsylvania. Occasionally, some counties seem to be omitted (Franklin, Mifflin and Huntingdon counties for *Sida hermaphrodita* (L.) Rusby) or certain species not included (e.g., I would include *Clematis viorna* L. and *Delphinium exaltatum* Ait.). But along with the *Atlas of the Flora of Pennsylvania* by Wherry, Fogg, and Wahl, Wiegman's Survey represents the beginning of what promises to be an invigorating decade of floristic study within Pennsylvania. CARL S. KEENER.

## NEWS AND NOTES

LOBLOLLY PINE IN SALEM COUNTY, NEW JERSEY. In 1967 while exploring an area of Salem County, New Jersey little known to me I chanced upon a stand of the Loblolly Pine, *Pinus taeda* L., which appears to have been overlooked or unreported. Its site far out on the salt marshes at the terminus of a road and nowhere near habitation or cultivation makes for small likelihood that this is a planted stand. On a revisit in early 1980 the trees were still there in healthy condition, reproducing well as evidenced by stems in all stages of growth. This is the farthest north known stand in the state today.

The station is southwest of Canton. One section stretches along an old dune ridge traversed by the remains of an old lane. The second is almost a solid growth on a small hummock completely surrounded by wet salt marsh. This second grove only a short distance from the first was not checked in 1980 for any other species of *Pinus* but in binoculars all trees looked to be Loblolly.

This statement is made since a few years after the initial discovery I showed the stand to the late Joseph Jacobs, the Osprey bander and D.V.O.C. member. He introduced Dale Coman to it who had a good acquaintanceship with the outdoors of south Jersey and wrote a nature column for the Philadelphia Evening Bulletin. Coman felt that there were some Pond Pines (*P. serotina*) with the Loblolly. Since my rather cursory visits to this area did not disclose this species, should any Club member encounter it here I would be pleased to know about it. VINCENT ABRAITYS.

*NELUMBO PENTAPETALA* IN SOUTHERN NEW JERSEY. Mr. and Mrs. C. L. Richardson of Pennsville, New Jersey, recently collected specimens of *Nelumbo pentapetala* (Walt.) Fern. (given the epithet *lutea* in many manuals) in Salem County, New Jersey. They report that the population covers about a hectare in a tidal marsh along Mannington Creek about 6.3 kilometers northeast of Salem. Very likely, this is the same population where Rodney H. True collected this species in 1938. His specimens in the University of Pennsylvania's herbarium are labeled as being, "In shallow water near bridge over Mannington Creek near Salem." Previous collections of the American lotus from southern New Jersey in herbaria at the Academy are from Bordentown (undated), Camden (1853), Woodstown (1875), Sharpstown (1890, 1893, 1894, and 1895), and Auburn (1923 and 1925).

The flowers of the Mannington Creek population are white except for the outermost green perianth segments and the yellow androecium and gynoecium. Ordinarily the flowers of *Nelumbo pentapetala* are pale yellow. A similar situation occurs in *Gratiola neglecta,* which according to Gray's Manual, ed. 8, has "milk-white" corollas when growing in tidal mud instead of the ordinarily "honey-color to creamy-white" ones. This suggests there is a similar relationship between tidal action and flower color in these species. ALFRED E. SCHUYLER.

THE 1980 LAWRENCE MEMORIAL AWARD. The Award Committee of the Lawrence Memorial Fund is pleased to announce the selection of Mr. James M. Affolter of the University of Michigan as recipient of the 1980 Lawrence Memorial Award. A student of Dr. William R. Anderson, Mr. Affolter is investigating the taxonomy, evolution and phytogeography of the genus *Lilaeopsis* (Umbelliferae). He will be using the proceeds of the Award in travel to Australia and Tasmania for field studies.

The Lawrence Memorial Fund has been established at the Hunt Institute for Botanical Documentation, Carnegie-Mellon University to commemorate the life and achievements of Dr. George H. M. Lawrence, founding Director of the Institute. Proceeds from the Fund are used to make annual awards of $1,000 to outstanding doctoral candidates for travel in support of dissertation research in any of Dr. Lawrence's fields of special interest: systematic botany or horticulture, or the history of the plant sciences, including bibliography and exploration. The Fund has been constituted initially by contributions from the Lawrence family and The Hunt Foundation, augmented by donations from many of Dr. Lawrence's friends and colleagues. Additional contributions are welcomed. T. D. JACOBSEN.

## 1979 FIELD TRIPS

April 21: Skunk Hollow, Radnor Twp., Delaware Co., PA. This is a hilly, wooded area especially good for the observation of spring flowering species such as: *Asarum canadense, Hepatica americana, Dicentra cucullaria, Smilacina racemosa, Mitchella repens, Mertensia virginica, Phlox divaricata,* and *Erythronium americanum.* Also evident were *Thalictrum dioicum* and *polygamum, Anemonella thalictroides, Hydrophyllum canadense* and *virginianum, Dentaria laciniata* and *heterophylla, Saxifraga virginiensis,* and *Staphylea trifolia.* Leader: Norma Mawhinney

May 19: Willow Oak Nature Area and Marsh River, Vineland, NJ. P.B.C. members Stephen Field and Theresa Filippi maintain extensive trails through the Willow Oak Nature Area. The morning was spent compiling a long list of the species growing there before switching over for a briefer visit to the Marsh River area. Most notable were: *Aronia arbutifolia*; *Kalmia latifolia* and *angustifolia*; *Leucothoë racemosa*; *Rhododendron viscoscum*; *Quercus phellos, coccinea, velutina,* and *alba*; *Nyssa sylvatica* and *biflora*; *Amelanchier canadensis*; *Populus grandidentata* and *tremuloides*; *Chamaecyperus thyoides*; *Clethra alnifolia*; *Myrica pensylvanica*; one flourishing exotic specimen of *Acer pensylvanicum*; *Habenaria lacera*; *Cypripedium acaule*; *Vicia tetrasperma, grandiflora,* and *angustifolia*; and *Hypochaeris radicata.*

June 3: Mertztown, Berks Co., PA. Member John Scott has a large scale fern and conifer planting scheme. This trip coincided with visits by the Fern Society and the Rock Garden Club. The following are among some of the naturally growing plants noted at the site: *Viola primulifolia, blanda, cucullata, rotundifolia,* and *hastata*; *Liparis lilifolia*; *Aristolochia serpentaria*; *Pentstemon digitaria*; *Aralia nudicaulis*; *Cornus amomum, racemosa,* and *florida*; *Aster divaricatus, undulatus,* and *lateriflorus*; *Cerastium vulgatum, brachypetalum,* and a probable exotic tentatively identified as *semidecandrum.*

June 25–27: Glassboro State College, Glassboro NJ. Three day joint field meeting of the Northeastern Section of the Botanical Society of America, the Torrey Botanical Club, and the Philadelphia Botanical Club with trips as follows:

June 25: New Jersey pine barrens. Louis and Eileen Hand, with help from Betty Woodford and Ted Gordon, led a trip through natural and historic areas of Batsto State Park where *Schizaea, Lophiola, Lachnanthes, Eriocaulon compressum, Pogonia, Polygala lutea, Utricularia fibrosa* and *purpurea,* three species of *Drosera,* and many other characteristic pine barrens' plants were seen. The Cranberry-Blueberry Research Station of Rutgers University and the pine plains were also visited. At the latter stop, *Corema* was seen.

June 26: Tyler Arboretum, Nottingham barrens, and Longwood Gardens. After a brief stop at the Tyler Arboretum, Lima, PA where we were welcomed by Robert Montgomery, Director, and saw the largest Giant Sequoia in the east and an outstanding specimen of Cedar of Lebanon the group proceeded to Nottingham County Park, Nottingham, PA. After eating lunch the group was lead through an area of serpentine barrens in the park by Robert Gordon, Jesse Grantham, and Donald Huttleston. Among a number of characteristic serpentine plants seen were *Talinum teretifolium* and *Senecio smallii.* The last stop of the day was at Longwood Gardens where, in the brief time allowed, the group dispersed to various parts of the grounds but most visited the wildflower area where an attempt is being made to provide ecological conditions to satisfy plants native within a 100-mile radius.

June 27: New Jersey tidal wetlands. Ralph Good and A. E. Schuyler, with help from Michael Kachur, Joseph Arsenault, and Barry Frasco, led the group to tidal marshes near Salem, Woodbury, and Manahawkin. The marsh near Salem had a diverse assemblage of plants indicative of a transition from freshwater to saltwater: *Spartina alterniflora, Zizania aquatica, Lilaeopsis chinensis,* and *Sagittaria calycina* among others. Near Woodbury, large stands of *Zizania, Nuphar,* and *Typha angustifolia* were seen. In the Manahawkin marshes, extensive stands of short *Spartina alterniflora* gave the aspect of a prairie. Many species (even *Vaccinium macrocarpon*) were seen as the marsh became transitional to a red maple swamp. *Zannichellia* and *Ruppia* were flowering in a creek (Cedar Run) flowing through the marsh.

July 15: Five Mile Woods, Bucks Co., PA (see article by A. E. Schuyler in this issue).

August 25: Glen Flora Pond Preserve, Montgomery Co., PA. Ann Newbold has developed this 18 acre wild flower preserve which supports over 800 native and naturalized species, nearly a quarter of that number being in flower during August. This is the time of year when the composites begin to reenact their glory as can be seen by the following which were in bloom: *Bidens bipinnata*; *Helenium autumnale* and *nudiflorum*; *Helianthus decapetalus, divaricatus,* and *strumosis*; *Heliopsis helianthoides*; *Eupatorium album, altissimum, atropurpureum, fistulosum, hyssopifolium, perfoliatum, pilosum,* and *rotundifolium*; *Picris hieracioides*; *Rudbeckia fulgida* and var. *sullivantii, hirta, laciniata* and var. *hortensis, speciosa,* and *triloba*; *Silphium perfoliatum*; *Vernonia novaboracensis*; *Aster divaricatus, gracilis, macrophyllus, schreberi, spectabilis,* and *umbellatus*; and *Solidago gigantea, juncea,* and *odorata.*

Most evident among the non-composites were: *Saururus cernuus, Nuphar advena, Cabomba caroliniana, Adlumia fungosa, Rhexia virginica, Jussiaea uruguayensis, Mimulus alatus* and *ringens, Campanula aparinoides* and *rotundifolia,* and *Jasione montana.*

September 22: Stafford Forge, Ocean Co., NJ. This is a particularly good pine barrens site, as is evident from the fact that the P.B.C. group never progressed beyond the first of a series of ponds. Everyone who was along on the trip agreed that it should be rescheduled. Some of the finds included: *Panicum virgatum, Agrostis alba, Triodia flava, Cladium mariscoides, Juncus pelocarpus* and *biflorus, Sagittaria engelmanniana, Xyris congdoni, Utricularia inflata, Isoëtes* sp., *Drosera filiformis, rotundifolia,* and *intermedia, Brasenia schreberi, Calamovilfa brevipilis, Myriophyllum humile, Trichostema dichotomum, Polygonella articulata, Liatris graminifolia,* and *Eupatorium leucolepis.* Leader: Joe Arsenault.

## MEMBERSHIP LIST 1980

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## Program of Meetings 1979–1980

| *1979* | *Subject* | *Speaker* |
|---|---|---|
| 25 Jan. | Preservation of Prairies | Edmund C. Bray |
| 22 Feb. | The Role of an Urban Arboretum | William Klein, Jr. |
| 22 Mar. | Microscopic Observations on Plants at the Academy of Natural Sciences, 1812–1881 | Thomas Peter Bennett |
| 26 Apr. | Confessions of an Environmental Research Consultant | Robin Hart |
| 24 May | Illustrated Report of the Local Flora Monitoring Committee | |
| 27 Sept. | Members' Report on Summer Activities | |
| 25 Oct. | Islands in the Sand: Growth and Structure in *Arenaria caroliniana* | Albert List |
| 15 Nov. | Cytotaxonomic Problems of Local Sedges | Alfred E. Schuyler |
| 20 Dec. | Local Flora and Geology | John M. Fogg, Jr. |
| *1980* | | |
| 24 Jan. | Environmental History of the Lower Metedeconk Region New Jersey Pine Barrens | Michael H. Levin |
| 28 Feb. | English Eighteenth Century Gardens, and American Plant Introductions | Elizabeth P. McLean |
| 27 Mar. | Cinematographic Study of Dehiscing Fern Sporangia | Luzern Livingston |
| 24 Apr. | Through the Seasons in the Carolina Blue Ridge | Ralph Sargent |
| 22 May | Illustrated Report of the Local Flora Monitoring Committee | |

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# Vegetation and Flora of Hog Island, a Brackish Wetland in the Mullica River, New Jersey

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The vegetation and vascular flora of river and estuary systems of the Outer Coastal Plain of New Jersey have not been investigated extensively. Some studies of primary productivity (Durand and Nadeau 1972), and flora (Ferren and Schuyler 1980) have been conducted. In these systems three types of tidal wetlands occur: saltwater, brackish, and freshwater. The first of these typically occurs in the lower estuary where environmental factors such as salinity and elevation are conducive to their perpetuation. Saltwater tidal marshes of New Jersey are dominated by three species: *Spartina alterniflora* Loisel, *S. patens* (Ait.) Muhl., and *Distichlis spicata* (L.) Greene. The freshwater type of wetland occurs in riverine and upper estuarine areas where river flows have significantly diluted the salt content of inundating tidal water. Freshwater tidal marshes usually are dominated by a number of species including *Peltandra virginica* (L.) Schott. & Endl., *Bidens laevis* (L.) BSP., *Zizania aquatica* L., *Nuphar luteum* (L.) Sibth. & Smith, and *Sagittaria latifolia* Willd. Brackish wetlands occur in areas where fresh- and saltwater mix. In these tidal marshes dominant species typically are *Typha angustifolia* L., *Spartina cynosuroides* (L.) Roth., *Scirpus americanus* Pers. (*olneyi* Gray), and others.

An unusual convergence of these three wetland types takes place in the Mullica River–Great Bay Estuary system of southern New Jersey (Fig. 1). Saltwater species extend far upriver and freshwater species extend far downriver, converging in the narrow brackish water zone. The area of convergence is at Hog Island, an island of about 52 ha, located approximately 17 km upriver from the mouth of the estuary. Hog Island displays vegetational characteristics of each marsh type and supports narrowly restricted plants and plant associations. Our objectives in this study are twofold: (1) to describe the vascular plant dominance types on Hog Island and their pattern of distribution with relation to substrate salinity and inundation, and (2) to report on the floristic composition of the island.

## SITE DESCRIPTION

Hog Island (Fig. 1) is separated from the mainland by a shallow river channel on the northeast and the deeper main river channel on the southwest; each is approximately

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250 m wide. These two channels meet and form the northwestern boundary, whereas the southeastern boundary is a narrow channel separating the island from a smaller downriver island.

The island, although located some distance upriver, is subjected to substantial tidal inundation twice daily, with an amplitude between 4 and 5 feet. Salinities of inundating waters vary from near zero to 15‰, depending on seasonal changes in river flow and tide levels. Surface water salinities taken from the main channel of the Mullica River in 1968 and 1969 ranged from less than one to greater than 15‰ (Durand and Nadeau 1972) and in 1971 and 1972 ranged from 0.05 to 12.05‰ (Durand and Denmark, pers. comm.). The wetlands of Hog Island can be classified as estuarine or brackish because the salinity of inundating water during the period of average annual low flow exceeds 0.5‰ (Cowardin et al. 1979).

Elevations are generally higher at the downriver end of the island than at the upriver end and are higher along the shoreline than towards the middle of the island resulting in irregular flooding in these areas. Lower marginal sites and the vicinity of interior streams receive regular flooding daily. Substrates at the downriver end are higher in organic matter and lower in silt than at the upriver end of the island. Substrates along the midline of the island (NE by SW) are intermediate.

## Methods

SALINITY. From August 1974 to February 1976 substrate salinities were measured at least monthly from 9 stations on Hog Island. Each station was located in one of several plant dominance types that occur on the island. Surface (0–5 cm) substrate samples were collected at each site and returned to the laboratory where wet weights were recorded. The samples were then dried at 100°C for 48 hours and dry weights were recorded. Dried samples were ground with a mortar and pestle, placed in 150 ml of distilled–deionized water for 48 hours, filtered, and the specific conductance of the filtrate was measured using a Beckman RB4-250 Solu-Bridge. Substrate salinities were estimated by converting conductivity readings to salinity according to the method of Tiphane and St.-Pierre (1962).

VEGETATION AND FLORA. During the summer and fall of 1974 Hog Island was staked out into 100 $m^2$ quadrats using a surveying transit. In the spring of 1975 selected stakes were marked with white styrofoam squares (13 $cm^2$). These stakes were used as markers when aerial photographs were taken in June and August of 1975 at 500 and 1000 ft (167 and 333 m). Vegetation maps were drawn using these photographs corroborated by ground truth. Between June of 1974 and August of 1979 collections were made of all plants found on the island. Voucher specimens are deposited in the Rutgers University, Camden College of Arts and Sciences Herbarium and in the Herbarium of the Academy of Natural Sciences of Philadelphia.

## Results and Discussion

SALINITY. Substrate salinities on Hog island show an increase from the upriver end of the island to the downriver end. Salinities are usually between 2 and 3‰ at the upriver end, 3 and 5‰ in the middle, and 4 and 7‰ at the downriver end. The highest salinity (13.22‰) recorded for any date was at the downriver end, and this station also displayed the highest average salinity (6.20‰) for any of the 9 sites. A station at the upriver end of the island had the lowest salinity (1.41‰) for any date and the lowest average salinity (3.07‰) for any of the 9 sites. Salinities at the downriver end never

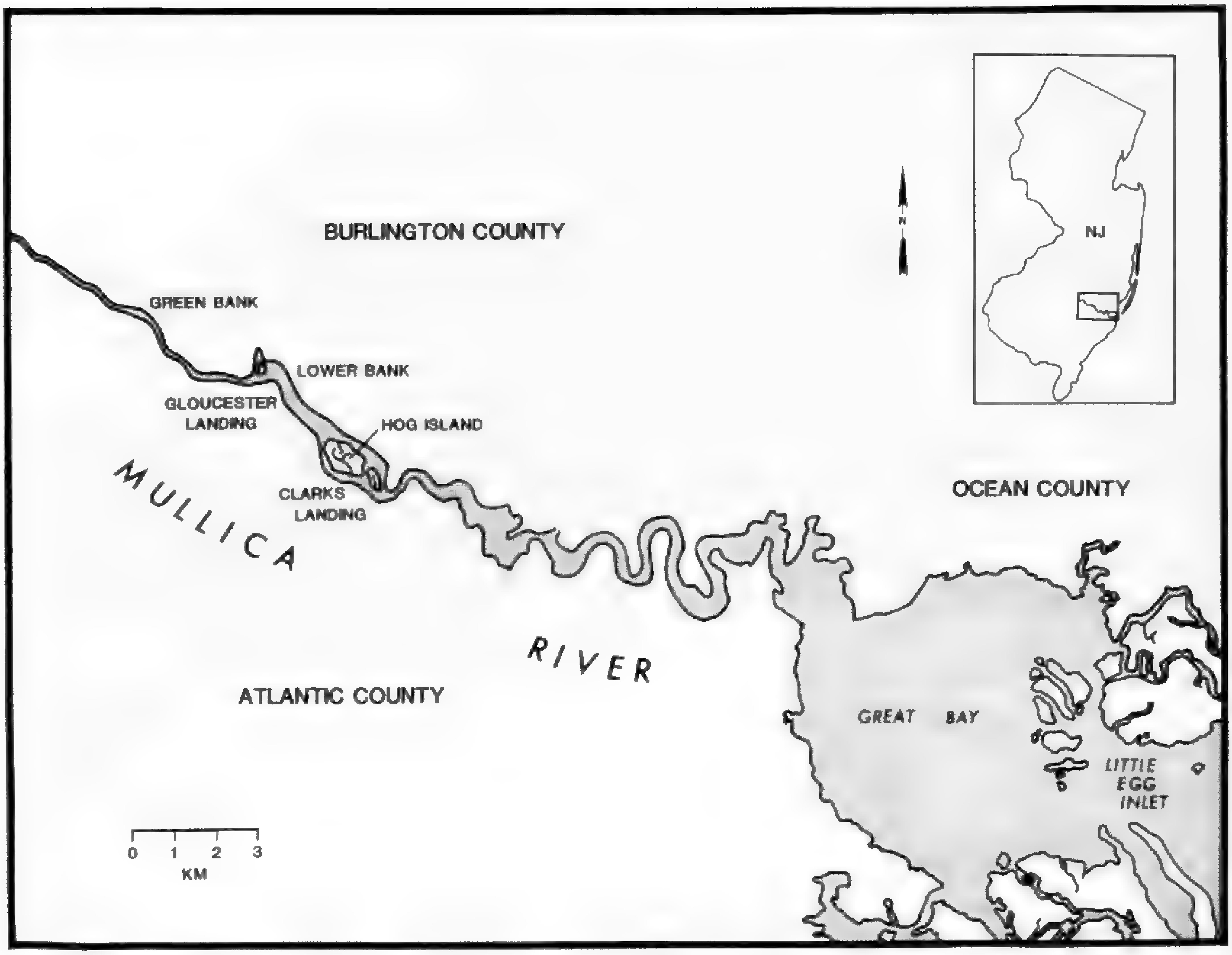


FIG. 1. The Mullica River and Estuary System showing the location of Hog Island in relation to Great Bay and the Atlantic Ocean.

went below 2‰ while salinities at the upriver end only exceeded 5‰ 12% of the time. The middle section of the island had the widest range of salinities, ranging from less than 1 to 10.65‰. Overall, the substrates of Hog Island can be classified as brackish, supporting oligohaline (0.5–5‰) wetlands toward the upriver end and mesohaline (5–18‰) wetlands toward the downriver end.

The lower salinities at the upriver end of Hog Island are attributed to the strong influence of river flow in this area and the lower elevation which results in regular flooding. The higher salinities at the downriver end are the result of strong tidal influences and the higher elevations which result in less frequent flooding. The wide-ranging salinity values occurring in the middle of the island are due to the absence of a regular strong influence from either river flow or tidal waters.

VEGETATION. As indicated by substrate salinities, the vegetation of Hog Island can be described generally as a brackish marsh. According to the wetlands classification by Cowardin et al. (1979) this area contains several elements of the Estuarine Wetland System, as follows: (1) SUBSYSTEM INTERTIDAL: Class Emergent Wetland, Subclass Persistent and Nonpersistent, Water Regime: regularly and irregularly flooded, Water Chemistry: oligohaline to mesohaline, and Soil: mineral (mud) and organic (peat); and Class Aquatic Bed, Subclass Rooted Vascular, Water Regime: intermittently exposed; and (2) SUBSYSTEM SUBTIDAL: Class Aquatic Bed, Subclass Root-

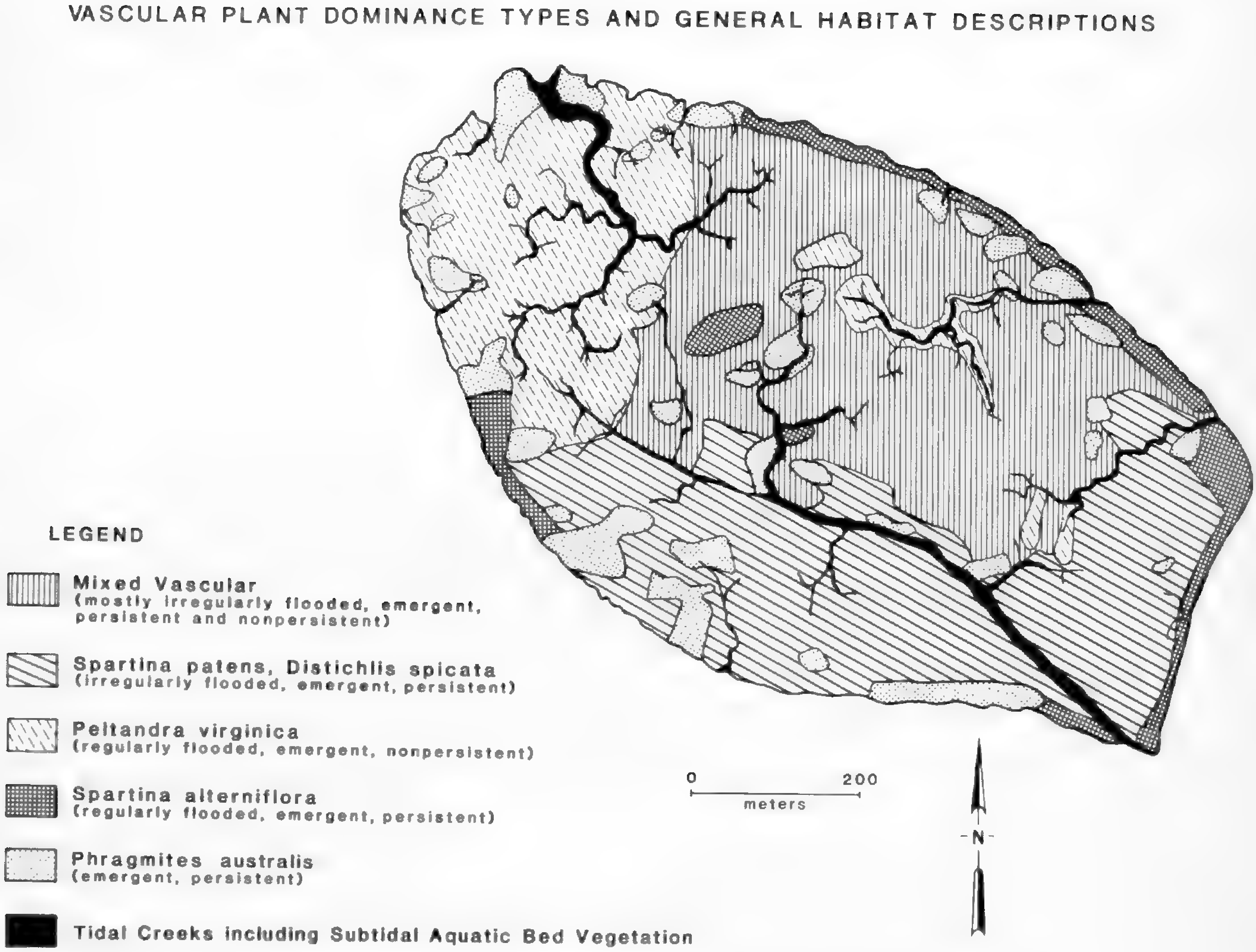


FIG. 2. General map of the habitat/dominance types on Hog Island.

ed Vascular. Figure 2 illustrates the distribution of these wetlands on Hog Island. Dominance types are listed below in order of decreasing coverage. Descriptions accompanying the dominance types are based on Cowardin et al. (1979).

1. Mixed Vascular
   A. *Eleocharis ambigens, Carex hormathodes, Spartina patens, Scirpus* spp., *Hibiscus moscheutos, Kosteletzkya virginica* (emergent; persistent; irregularly flooded; peat substrates)
   B. *Sagittaria calycina, Eleocharis olivacea, Cyperus* spp., *Pluchea odorata* (emergent; nonpersistent; irregularly flooded; mud substrates)
2. *Spartina patens, Distichlis spicata* (emergent; persistent; irregularly flooded; peat substrates)
3. *Peltandra virginica* (emergent; nonpersistent; regularly flooded; mud substrates)
4. *Phragmites australis* (emergent; persistent; regularly and irregularly flooded; peat and mud substrates)
5. *Spartina alterniflora* (emergent; persistent; regularly and irregularly flooded; peat and mud substrates)
6. *Typha angustifolia* (emergent; persistent; regularly and irregularly flooded; peat and mud substrates)
7. *Eleocharis parvula, Vallisneria americana, Potamogeton* spp., *Zannichellia pa-*

*lustris* (subtidal and intermittently exposed intertidal; aquatic bed; rooted vascular)

The Mixed Vascular dominance type covers the largest area on Hog Island and is the most floristically complex. Approximately one third of the island is covered by this type which extends from the northeastern shore inland to a creek which drains the central and much of the downriver portions of the island. It is bordered on the northwest by the *Peltandra virginica* type and on the southeast by the *Spartina patens–Distichlis spicata* type. Pioneer stands of species with freshwater affinities such as *P. virginica* and of species with saltwater affinities such as *S. alterniflora* are in this area, supporting the view of its transitional nature.

The *Spartina patens–Distichlis spicata* dominance type occurs on the highest parts of the island and thus is irregularly inundated. This vegetation extends along the southwestern side of the island and up along the southeastern edge. Depressions in this area near the upriver end of the island have been colonized by *Phragmites,* while depressions toward the downriver end of the island have been colonized by *Scirpus* (*S. americanus* × *pungens*). Patches of *Scirpus* within this dominance type exhibited the highest salinities for any of the stations on the island (ca. 13‰). Although the patches of *Phragmites* did not exhibit the lowest salinities, the values obtained were about 2–3‰ less than the patches of *Scirpus*.

The *Peltandra virginica* dominance type occupies the upriver one quarter of the island where salinities are lowest. This species is characteristic of various freshwater intertidal wetlands in the state (Good and Good 1975; McCormick and Ashbaugh 1972; Whigham and Simpson 1976) where it usually occurs as a codominant with other freshwater species. At Hog Island *P. virginica* forms monotypic dominance stands. However, it is occasionally interrupted by pockets of *Phragmites* and *Spartina alterniflora*. The area of coverage is bounded on the northwest, southwest, and northeast by the river channel and on the southeast by the Mixed Vascular type. It generally is regularly inundated, is supported by mud substrates with oligohaline salinities, and is drained by a number of small creeks which feed into one large creek that empties into the river channel at the northwest end.

*Phragmites australis* stands are scattered throughout the island within the other major dominance types. Stands vary in size from only 10 $m^2$ to 50 $m^2$. The stands are found at the upriver, downriver, and middle regions of the island, attesting to this species' wide tolerance of salinity. Generally, no other species are found within the *Phragmites* type, but along its edges occur species from one of the other dominance types it has invaded. *Phragmites* appears to be a late colonizer of the island because of its patchy distribution and small stand size. Individuals were observed to invade a suitable area on the island and then radiate out into the neighboring types through extension of the rhizome system.

The *Spartina alterniflora* dominance type is primarily along the intertidal shores on the northeastern and southwestern sides of the island. A few pockets of this species also occur in depressed areas bordering the Mixed Vascular type to the northwest. This dominance type has an affinity for regularly flooded areas with salinities of about 4–5‰ on the island. It has become well established on the neighboring island where elevations are lower and salinities slightly higher.

*Typha angustifolia,* like *Phragmites,* occurs in small stands scattered in various situations. Its total area is small; it occurs mostly at irregularly flooded sites.

TABLE 1. Vascular plants of Hog Island arranged by family and habitat; r = regular occurrence; d = growing on debris; s = a single observation; FW = freshwater affinities; BW = brackish water affinities; MS = mud substrate, brackish; PS = peat substrate, brackish; AB = aquatic bed, stream channel.

| | Regularly Flooded | | Irregularly Flooded | | Subtidal |
|---|---|---|---|---|---|
| Vascular Plants* | FW | BW | MS | PS | AB |
| Dicotyledones | | | | | |
| Amaranthaceae | | | | | |
| *Amaranthus cannabinus* (L.) J. D. Sauer | r | r | r | r | |
| Apiaceae | | | | | |
| *Lilaeopsis chinensis* (L.) Ktze. | | r | r | | |
| *Ptilimnium capillaceum* (Michx.) Raf. | | r | r | | |
| *Sium suave* Walt. | r | | r | r | |
| Asclepiaceae | | | | | |
| *Asclepias incarnata* L. var. *pulchra* (Ehrh.) Pers. | | | | r | |
| Asteraceae | | | | | |
| *Aster novibelgii* L. | ds | | | | |
| *A. subulatus* Michx. | | | | r | |
| *A. tenuifolius* L. | | | | r | |
| *Bidens connata* Muhl. | | | rs | | |
| *Mikania scandens* (L.) Willd. | | | | d | |
| *Pluchea odorata* (L.) Cass. | r | r | r | r | |
| Balsaminaceae | | | | | |
| *Impatiens capensis* Meerb. | r | r | r | | |
| Chenopodiaceae | | | | | |
| *Atriplex patula* L. var. *hastata* (L.) Gray | | | r | r | |
| Convolvulaceae | | | | | |
| *Convolvulus sepium* L. var. *repens* (L.) Gray | d | | | | |
| Hypericaceae | | | | | |
| *Hypericum virginicum* L. | r | | | | |
| Lythraceae | | | | | |
| *Lythrum lineare* L. | | | | r | |
| Malvaceae | | | | | |
| *Hibiscus moscheutos* L. | | | r | r | |
| *Kosteletzkya virginica* (L.) Presl. | | | | r | |
| Onagraceae | | | | | |
| *Oenothera fruticosa* L. var. *fruticosa* | | | | r | |
| Polygonaceae | | | | | |
| *Polygonum prolificum* (Small) Robins. | | | | r | |
| *P. punctatum* Ell. | r | | r | r | |
| Primulaceae | | | | | |
| *Samolus floribundus* HBK. | | | r | | |
| Rosaceae | | | | | |
| *Rosa palustris* Marsh | ds | | | | |
| Urticaceae | | | | | |
| *Boehmeria cylindrica* (L.) Sw. | ds | | | | |

TABLE 1. Continued.

| Vascular Plants* | Regularly Flooded FW | Regularly Flooded BW | Irregularly Flooded MS | Irregularly Flooded PS | Subtidal AB |
|---|---|---|---|---|---|
| Monocotyledones | | | | | |
| Alismataceae | | | | | |
| *Sagittaria calycina* Engelm. | | r | r | | |
| Araceae | | | | | |
| *Peltandra virginica* (L.) Schott. & Endl. | r | | r | r | |
| Cyperaceae | | | | | |
| *Carex hormathodes* Fern. | | | | r | |
| *Cyperus filicinus* Vahl | r | | r | | |
| *C. odoratus* L. | | | rs | | |
| *C. rivularis* Kunth | r | | r | | |
| *Eleocharis ambigens* Fern. | r | r | r | r | |
| *E. olivacea* Torr. var. *olivacea* | r | | r | | |
| *E. parvula* (R. & S.) Link | | r | r | | |
| *E. rostellata* Torr. | | | r | r | |
| *Scirpus americanus* Pers. (*olneyi* Gray) | | | | r | |
| *S. americanus* × *S. pungens* Vahl | | | r | r | |
| *S. pungens* Vahl | r | r | r | r | |
| *S. robustus* Pursh | r | r | r | r | |
| *S. tabernaemontanii* Gmel. (*validus* Vahl) | r | | r | r | |
| Iridaceae | | | | | |
| *Iris versicolor* L. | | | rs | | |
| Hydrocharitaceae | | | | | |
| *Vallisneria americana* Michx. | | | | | r |
| Juncaceae | | | | | |
| *Juncus acuminatus* Michx. | r | | | | |
| *J. gerardii* Loisel | | | | r | |
| Poaceae | | | | | |
| *Agrostis palustris* Huds. | | | r | r | |
| *Distichlis spicata* (L.) Greene var. *spicata* | | | | r | |
| *Echinochloa walteri* (Pursh) Nash | r | | r | r | |
| *Leersia oryzoides* (L.) Sw. | r | | r | | |
| *Panicum virgatum* L. | | | | r | |
| *Phragmites australis* (Cav.) Trin. ex Steud. | r | r | | r | |
| *Spartina alterniflora* Loisel | r | r | r | r | |
| *S. cynosuroides* (L.) Roth. | | | | r | |
| *S. patens* (Ait.) Muhl. var. *monogyna* (M. A. Curtis) Fern. | | | | r | |
| *S. patens* (Ait.) Muhl. var. *patens* | | | r | r | |
| *S. pectinata* Link | | | | r | |
| *Zizania aquatica* L. var. *aquatica* | rs | | | | |
| Potamogetonaceae | | | | | |
| *Potamogeton perfoliatus* L. | | | | | r |
| *P. pusillus* L. | | | | | r |
| Typhaceae | | | | | |
| *Typha angustifolia* L. | r | | r | | |
| Zannichelliaceae | | | | | |
| *Zannichellia palustris* L. | | | | | r |

* Voucher specimens deposited at PH and RCAM. Additional plants reported from Hog Island include: *Erechtites hieracifolia* (L.) Raf., *Galium* sp., *Pilea pumila* (L.) Gray, and *Pontederia cordata* L.

The Aquatic Bed type is dominated primarily by submerged aquatics and occurs in subtidal and intermittently exposed intertidal areas. It is also relatively small in total area but is quite distinctive. The species listed may occur singly or in various combinations along creek sides. The subtidal dominance type consists of *Potamogeton perfoliatus* L., *P. pusillus* L., *Vallisneria americana* Michx., and *Zannichellia palustris* L. in stream channels, particularly the stream which drains the upriver end of the island. Along intermittently exposed portions of stream channels *Eleocharis parvula* (Pers.) Link also occurs. Similarly, in soft, open substrates of marsh depressions and other irregularly exposed areas of the upriver and central portions of Hog Island, *E. parvula* occurs with *Zannichellia palustris*.

FLORA. Fifty nine vascular plant taxa from 25 families were collected on Hog Island (Table 1). Families represented by the greatest number of taxa were the Cyperaceae, Poaceae, and Asteraceae, containing 12, 12, and 6 taxa, respectively. *Eleocharis, Scirpus,* and *Spartina,* the largest genera, were each represented by 4 species. This intrageneric species diversity is characteristic of transitional brackish marshes where species with freshwater or brackish water affinities occur together.

Several taxa are of particular interest. For example, 6 taxa of *Spartina* occur in the Mullica River and Estuary system, five of which grow on Hog Island (Table 1). An additional taxon, *Spartina* × *cespitosa* A. A. Eat. (*S. patens* × *pectinata*), has been collected at Clarks Landing (*Ferren 1484*) on the southwestern shore of the Mullica River opposite Hog Island and has been reported from New Jersey previously (Mobberley 1956). The diversity of *Spartina* taxa in the vicinity of Hog Island is apparently the highest reported for New Jersey.

Two taxonomic/ecological problems exist in the genus *Scirpus* represented on Hog Island. In the Mullica system *Scirpus americanus* is generally restricted to brackish marshes, whereas *S. pungens* occurs in both freshwater and brackish water marshes. Hybrids between these two species occur on Hog Island and are more common than either parent. Further investigation is needed to determine the parameters that favor the hybrid over the parents.

Flowering material of *Scirpus robustus,* a salt marsh plant, has been obtained from Hog Island, but only vegetative material has been tentatively identified as *S. cylindricus,* a species of brackish marshes that does occur in the vicinity of Hog Island at Clarks Landing and Gloucester Landing (Ferren and Schuyler 1980). Further observations may confirm the occurrence of this plant on Hog Island.

*Eleocharis ambigens* in the region of the Mullica River and Estuary also needs investigation. On Hog Island considerable variability in culm height, thickness, color, and density appears to be related to degree of substrate flooding. For example, various stands growing in wetter areas tend to have longer, thicker, greener culms that are less fertile and that are spaced more widely along rhizomes than do stands growing in irregularly flooded areas with firmer substrates. This morphological variability is apparently a function of habitat variability. However, among plants that produce achenes there also is much variability in achene morphology including shape, size, and color of achene body and size and shape of achene tubercle.

FLORISTIC TRANSITION AND CHANGE. The tidal riverine, palustrine, and estuarine portions of the Mullica System extend along the Mullica River from the vicinity of Pleasant Mills downriver to and including Great Bay. Tidal riverine wetlands with sand and gravel shores are characterized by *Eriocaulon parkeri* Robins., *Isoëtes riparia* Engelm., *Hypericum mutilum* L., *Juncus pelocarpus* Mey., *Gratiola aurea* Muhl., and others; while in the tidal palustrine wetlands the emergent portions are characterized by *Zizania aquatica, Peltandra virginica, Pontederia cordata* L., *Nuphar luteum,* and others and the scrub/shrub portions by various Ericaceae, *Cephalanthus occidentalis* L., *Rosa palustris,* and others. In the vicinity of Lower Bank, just upstream from Hog Island, these freshwater wetland types are at high elevations in the intertidal zone, whereas species with brackish affinities such as *Spartina alterniflora, Lilaeopsis chinensis,* and *Scirpus cylindricus* are lower. Downstream from Hog Island extensive salt marshes occur, including emergent types dominated by *Spartina alterniflora, Distichlis spicata,* and *Spartina patens*; and scrub/shrub types dominated by *Baccharis halimifolia* L. and *Iva frutescens* L. The flora of Hog Island is lacking plants of both upriver wetlands (e.g., *Eriocaulon parkeri, Isoëtes riparia, Cephalanthus occidentalis,* and *Nuphar luteum*) and downriver wetlands (e.g., *Baccharis halimifolia, Iva frutescens, Salicornia* spp., *Limonium carolinianum* (Walt.) Britt., and *Solidago sempervirens* L.) but contains others unique to the transition zone (e.g., *Sagittaria calycina* and *Lilaeopsis chinensis*).

The floristic diversity of Hog Island is accompanied by floristic instability because the transition zone is subjected to periodic drastic changes in salinity which eliminate some species but provide suitable habitats for others. For example, *Zizania aquatica* has been collected only rarely from the upriver portion of Hog Island. Likewise, *Aster tenuifolius,* a plant characteristic of salt marshes, is rare at the downstream portion of the island. Both species may have a periodic occurrence on the island correlated with changes in salinity.

In contrast to the almost annual change in the flora because of the presence or absence of some species of peripheral occurrence, other changes occur gradually and represent a change in the relative frequency of various species. For example, stands of *Peltandra virginica* are being gradually replaced by *Spartina alterniflora* at the upriver end of the island. Such a trend also results in a shift of the percent cover of various dominance types. In the above example an emergent, nonpersistent, estuarine wetland dominated by a species with freshwater affinities (*P. virginica*) is being replaced by an emergent, persistent, estuarine wetland dominated by a species with saltwater affinities (*S. alterniflora*).

## Acknowledgments

The authors acknowledge financial assistance for this study from the Marine Sciences Center, Rutgers University (now the Center for Coastal and Environmental Studies), the New Jersey Department of Environmental Protection, and the Academy of Natural Sciences of Philadelphia. Various field data were obtained or provided by J. B. Durand, Barry Frasco, and Roy Denmark. We also acknowledge Alfred E. Schuyler for assistance with plant identifications and Norma F. Good for editorial assistance.

## Literature Cited

Cowardin, L. W., V. Carter, F. C. Golet, and E. T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Fish and Wildlife Service, Washington, D.C.

Durand, J. B. and R. J. Nadeau. 1972. Water resources development in the Mullica River Basin, Part 1: Biological evaluation of the Mullica River–Great Bay Estuary. New Jersey Water Resources Research Institute, Rutgers–The State University, New Brunswick.

Good, R. E. and N. F. Good. 1975. Vegetation and production of the Woodbury Creek–Hessian Run freshwater tidal marshes. Bartonia 43: 38–45.

Ferren, W. R. and A. E. Schuyler. 1980. Intertidal vascular plants of river systems near Phildelphia. Proc. Acad. Nat. Sci. Philadelphia 132: 86–120.

McCormick, J. and T. Ashbaugh. 1972. Vegetation of a section of Oldmans Creek tidal marsh and related areas in Salem and Gloucester Counties, New Jersey. Bull. N.J. Acad. Sci. 17: 31–37.

Mobberley, D. G. 1956. Taxonomy and distribution of the genus *Spartina*. Iowa State Coll. J. Sci. 30: 411–474.

Tiphane, M. and J. St.-Pierre. 1962. Tables for sea water salinity determination by electrolytic conductivity. Beckman Manual. Beckman, Cedar Grove, NJ 07009.

Whigham, D. and R. L. Simpson. 1976. The potential use of freshwater tidal marshes in the management of water quality in the Delaware River. Pages 173–186 *in* J. Tourbier and R. W. Pierson, Jr. (eds.). Biological Control of Water Pollution. Univ. Pennsylvania Press, Philadelphia.

## Postscript

The study area in this paper is included within the **Pinelands Mullica River Estuary** which has recently been named as a component of the EXPERIMENTAL ECOLOGICAL RESERVE (EER) network composed of 96 sites distributed among the coastal, freshwater, and terrestrial ecosystems of the United States.

Bartonia No. 48: 11, 1981

# Additions to the Flora of Hunterdon County, New Jersey

VINCENT ABRAITYS
*Sergeantsville, NJ 08557*

The following additions to the list in Bartonia 47: 23–30 (1980) are taken largely from Britton's Catalogue of 1889 and a gleaning of Academy specimens. The balance consists of the writer's observations and specimens. It should be noted that the records of Dr. Best and Rev. Schuh listed in Britton have not been examined.

Surprising is the *Sagittaria subulata* collected by Bayard Long at Lewis Island off Lambertville in the Delaware on September 29, 1932. *Agrimonia microcarpa* is the writer's specimen from the base of the Milford Bluffs in 1975. A great display is unfolded annually by *Bunias orientalis* along the highways in the vicinity of Clinton Point. This mostly unknown crucifer has been here for a number of years and is spreading into Warren County in the Oxford area. A questionable *Penstemon laevigatus* is the writer's responsibility from near Lambertville.

Of the large number of plants listed for the County over the years a considerable list can be made of plants not now known to grow here. *Paspalum psammophilum* and *Eupatorium serotinum* have appeared in 1980 to offset this list decline.

ZOSTERACEAE: *Zannichellia palustris*. ALISMATACEAE: *Sagittaria subulata*. GRAMINEAE: *Paspalum psammophilum*. CYPERACEAE: *Carex lasiocarpa* var. *americana*. LILIACEAE: *Allium cernuum*. ORCHIDACEAE: *Liparis lilifolia*. SALICACEAE: *Populus × gileadensis*. ULMACEAE: *Celtis tenuifolia*. MORACEAE: *Morus rubra*. FAGACEAE: *Castanea pumila*. POLYGONACEAE: *Rumex orbiculatus*. PORTULACACEAE: *Portulaca* [*grandiflora*]. CARYOPHYLLACEAE: [*Herniaria glabra*]. RANUNCULACEAE: *Ranunculus reptans*. CRUCIFERAE: [*Bunias orientalis*]. ROSACEAE: *Agrimonia microcarpa*. LEGUMINOSAE: *Lathyrus palustris, Strophostyles umbellata, Lespedeza* [*thunbergii*]. CELASTRACEAE: *Euonymus* [*fortunei*]. VIOLACEAE: *Viola latiuscula*. ARALIACEAE: *Aralia spinosa*. PRIMULACEAE: *Samolus parviflorus*. POLEMONIACEAE: *Phlox pilosa*. BORAGINACEAE: *Cynoglossum* [*officinale*], *Mertensia virginica*. LABIATAE: [*Galeopsis tetrahit*], *Stachys hyssopifolia*. SOLANACEAE: *Nicotiana* [*longiflora*], [*Petunia axillaris*], *Physalis* [*alkekengi*]. SCROPHULARIACEAE: *Penstemon laevigatus, Veronica scutellata*. RUBIACEAE: [*Sherardia arvensis*]. VALERIANACEAE: *Valerianella radiata*. COMPOSITAE: *Aster infirmus, Eupatorium serotinum*.

Bartonia No. 48: 12–18, 1981

# Temperature Relations of Seed Germination and Ecological Implications in *Galinsoga parviflora* and *G. quadriradiata*

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*Galinsoga parviflora* Cav. and *G. quadriradiata* Ruiz & Pavon (=*G. ciliata* (Raf.) S. F. Blake) are annual composites that grow in most temperate and subtropical areas of the New World, Europe, and Africa. In addition, *G. parviflora* is found in Asia and Australia, and *G. quadriradiata* is found in Nepal, Japan, and the Philippines (Canne 1977). These weedy composites grow in a variety of disturbed sites including agricultural soils and can cause serious problems in low-growing summer vegetable crops (Canne 1977; Ivany and Sweet 1973). Canne (1977) believes that, ". . . *Galinsoga* originated in the mountainous areas of west-central Mexico"; however, within the last 150 years *G. parviflora* and *G. quadriradiata* have spread over much of the world. The migration of *G. quadriradiata* into the northeastern United States and adjacent Canada has been traced by Shontz and Shontz (1970), and similarly the spread of *G. parviflora* and *G. quadriradiata* in Europe has been documented by many botanists (Canne 1977).

Both species of *Galinsoga* are day-neutral with regard to flowering (Ivany and Sweet 1973), and throughout their ranges plants flower all year or until the first killing frost ends the growing season (Canne 1977). In Michigan, plants of *G. quadriradiata* flowered from 26 May to 2 November (McWilliams and Ludwig 1972), and in the Chicago, Illinois region they flowered from 17 June to 8 October (Swink 1952). In New York plants of both species flowered within 24 to 30 days after germination when grown under both 8- and 16-h photoperiods of 16 Klx of light in a greenhouse (Ivany and Sweet 1973). In Washington, D.C., plants of *G. quadriradiata* in a garden were 41 to 60 days old at the time of first flowering, the flowering period for each head was 4 to 5 days and the period between flowering and seed (achene) dissemination was 4 to 6 days (Pladeck 1933). In New York seeds of both species germinated in the field from early May until frost (Ivany and Sweet 1973), and in Japan seeds of *G. parviflora* germinated from March to early November (Usami 1976).

Since *G. parviflora* and *G. quadriradiata* are important weedy species whose geographical distributions have increased dramatically in historic times, it was of interest to know more about the seed germination characteristics of these two species in relation to their life cycle ecology. In this study we tested germination of freshly-harvested, stratified, and laboratory-stored seeds in light and darkness over a range of alternating temperatures and made phenological observations on the timing of germination of seeds planted in autumn and exposed to natural seasonal temperature changes. Results from these studies were extrapolated to the field situation.

## METHODS

*Germination phenology.* In late August 1978, one population each of *G. parviflora* and *G. quadriradiata* were located in community garden plots in Fayette County, Kentucky. From 4 September until 15 December 1978, phenological observations were made on flowering, seed dispersal and germination, and on seedling survival.

To study the timing of germination of seeds exposed to natural temperatures, ripe seeds of *G. parviflora* and *G. quadriradiata* were collected on 4 and 9 October 1978, respectively, and planted the following day on soil in an unheated greenhouse. Three replications of 300 seeds each of both species were planted in small greenhouse flats. From the time of planting until 1 May 1979 the soil was watered daily, except when it was frozen during the winter. From 1 May until the study was terminated on 3 September 1979, the soil was watered to field capacity once each week to simulate soil moisture conditions that could occur in the field during summer. The flats were examined at weekly intervals, and newly germinated seeds were counted and removed. However, on 20 November 1978, 43 seedlings of *G. quadriradiata* and 16 of *G. parviflora* were marked, by placing a plastic toothpick in the soil beside them, and left to grow in the flats.

GERMINATION EXPERIMENTS. Seeds of *G. parviflora* and *G. quadriradiata* were collected on 4 and 23 October 1978, respectively, and incubated in temperature- and light-controlled incubators over a range of (12/12-h) alternating temperature regimes. The temperatures simulate those that occur in central Kentucky during the growing season: March, 15/6; April, 20/10; May, 25/15; June, 30/15; July and August, 35/20; September, 30/15; October, 20/10; and November, 15/6°C (Jerry Hill, Advisory Agricultural Meteorologist, pers. comm.). These temperatures would apply to much of the temperate region although the month in which a given thermoperiod applies would vary with latitude. The 30/15 and 35/20°C thermoperiods would apply to warm tropical regions. At each thermoperiod seeds were incubated in light (14-h photoperiod) and continuous darkness. Seeds incubated in light were exposed to 14-h of 2.1 Klx cool, white fluorescent light each day, and the photoperiod extended from 1-h before the beginning of the high temperature regime to 1-h after it ended. Three replications of 50 seeds each were used in each treatment, and seeds were placed in 5.5 cm petri dishes on sand moistened with distilled water. All dishes were wrapped with plastic film, and those incubated in darkness also were wrapped with two layers of aluminum foil. Germination tests were terminated after 15 days, and all germination percentages were rounded off to the nearest whole number.

Effect of low winter temperatures on germination requirements of seeds were determined by stratifying seeds and then incubating them in light and darkness over the range of alternating temperatures. Seeds of *G. parviflora* and *G. quadriradiata* collected on 4 and 23 October 1978, respectively, were placed on moist sand and stored in a refrigerator at 5° ± 1°C for 12 weeks. Two sets (one set = 18 dishes) of seeds received a 14-h daily photoperiod of 1.0 Klx of cool, white fluorescent light, and two sets were in continuous darkness. At the end of 12 weeks of stratification, 85 to 100% of the seeds in each dish in the light had germinated. Consequently, only seeds stratified in darkness were transferred to the five incubation temperatures. At each temperature seeds were incubated in both light and darkness. When seeds were transferred from the refrigerator to the incubators, seeds that had been stored dry in the laboratory at 25° ± 2°C for 12 weeks were plated out and placed at each temperature regime in light and darkness. All germination tests were terminated after 15 days. Germination percentages were rounded off to the nearest whole number.

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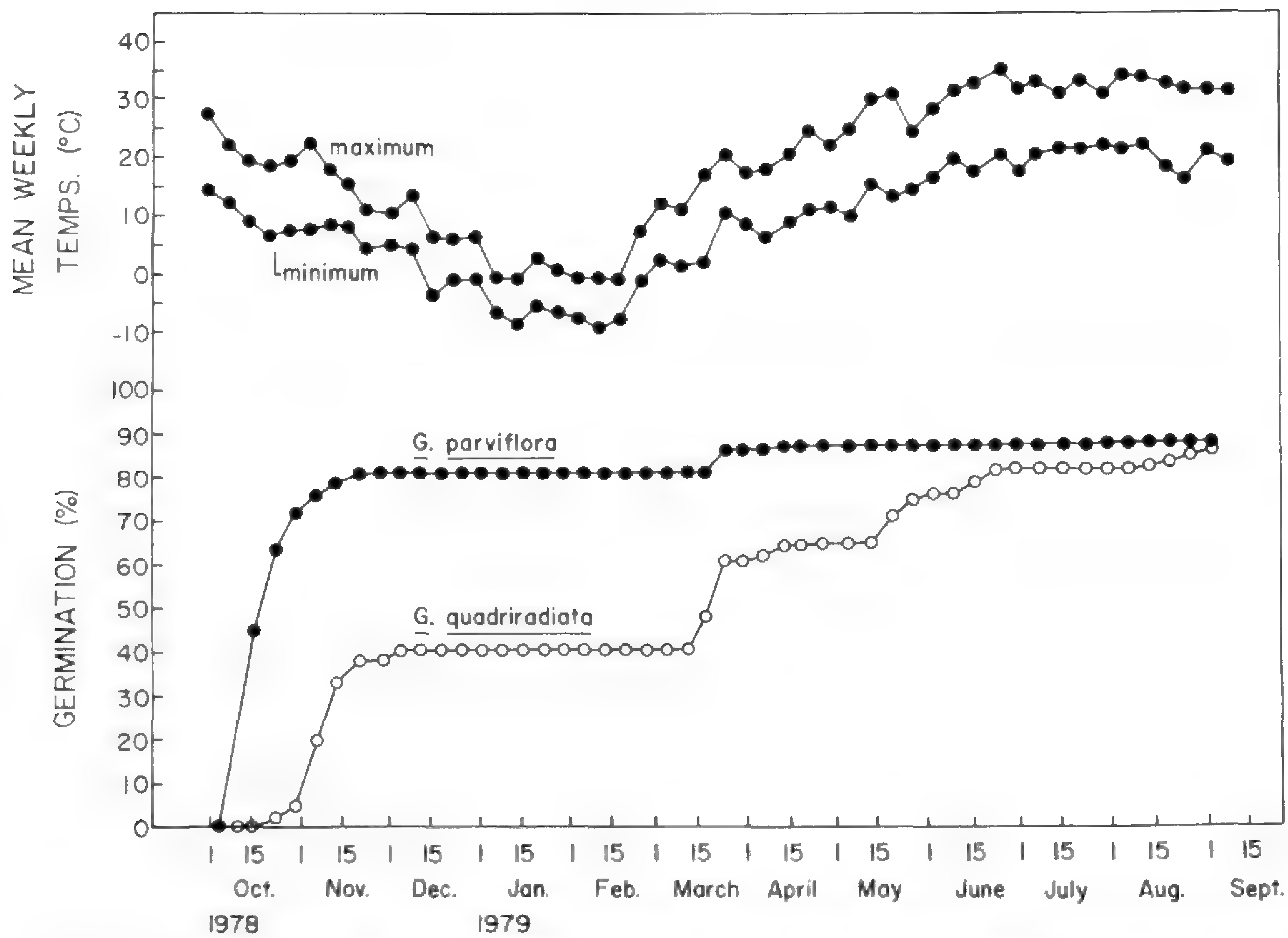


FIG. 1. Germination of *G. parviflora* and *G. quadriradiata* seeds planted on soil in a unheated greenhouse on 5 and 10 October 1978, respectively. Temperatures were recorded in the greenhouse.

killed by low temperatures in late November and early December. By mid-September, a few heads on some plants of both species had ripe seeds, but it was not until early October that enough seeds could be collected for germination tests. As soon as the seeds were mature they were shed from the plants, and within a few days many of them had germinated. Newly-germinated seedlings were found on various dates from 4 October through 5 December, but none of them were alive on 15 December, regardless of the time of germination.

Seeds of both species planted in the unheated greenhouse germinated in autumn as well as the following spring and summer (Fig. 1). Although final germination percentages were essentially the same (89 and 86%) for both species the patterns of germination were different. Whereas 81% of the *G. parviflora* seeds germinated in autumn, only 41% of the *G. quadriradiata* seeds germinated during this period. An additional 45% germination occurred in *G. quadriradiata* the following spring and summer. In *G. parviflora* and *G. quadriradiata* the last germination in autumn was recorded on 20 November and 4 December, respectively. Mean daily maximum and minimum temperatures for the week of 14 to 20 November were 13.2 and 6.5°C, respectively, while during the week of 28 November to 4 December they were 12.0 and 5.9°C, respectively. In the spring the first germination was recorded for *G. quadriradiata* on 18 March; mean daily maximum and minimum temperatures for the week preceding this date were 17.0 and 2.1°C, respectively. The first germination was recorded for *G. parviflora* on 24 March, and mean daily maximum and minimum temperatures for the week preceding this date were 23.4 and 10.7°C, respectively (Fig. 1).

TABLE 1. Percent germination of freshly-harvested, stratified, and laboratory-stored seeds of *Galinsoga parviflora* and *G. quadriradiata*.

| Treatment | Stratified in | Incubated in | Germination temps. (°C) | | | | |
|---|---|---|---|---|---|---|---|
| | | | 15/6 | 20/10 | 25/15 | 30/15 | 35/20 |
| *G. parviflora* | | | | | | | |
| Freshly-harvested | | Light | 10 | 99 | 100 | 96 | 99 |
| | | Dark | 0 | 0 | 0 | 0 | 0 |
| Stratified | Dark | Light | 94 | 100 | 97 | 60 | 82 |
| | Dark | Dark | 0 | 0 | 0 | 0 | 0 |
| Lab-stored | | Light | 57 | 92 | 96 | 99 | 99 |
| | | Dark | 21 | 1 | 0 | 0 | 0 |
| *G. quadriradiata* | | | | | | | |
| Freshly-harvested | | Light | 3 | 99 | 99 | 99 | 97 |
| | | Dark | 0 | 0 | 0 | 0 | 0 |
| Stratified | Dark | Light | 99 | 99 | 99 | 99 | 97 |
| | Dark | Dark | 0 | 0 | 0 | 0 | 0 |
| Lab-stored | | Light | 99 | 99 | 100 | 99 | 98 |
| | | Dark | 0 | 2 | 2 | 7 | 0 |

All seedlings marked in the nonheated greenhouse on 20 November 1978 died in mid-December when temperatures dropped below freezing for several consecutive nights.

*Germination experiments.* Freshly-matured seeds of both species germinated to near 100% in light at all temperatures, except at 15/6°C, where only 10 and 3% of the *G. parviflora* and *G. quadriradiata* seeds, respectively, germinated (Table 1). No seeds of either species germinated in darkness at any temperature. At all incubation temperatures, stratified seeds of both species germinated to 60–100% in light and to 0% in darkness. After 12 weeks of dry laboratory storage, seeds of *G. parviflora* germinated to 57% at 15/6 and to 92% or more at the other temperatures in light. There was no germination in darkness, except for 21 and 1% germination at 15/6 and 20/10°C, respectively. Seeds of *G. quadriradiata* stored dry for 12 weeks gave 98–100% germination in light and 0–7% germination in darkness at all temperatures.

## DISCUSSION

Fresh seeds of both species of *Galinsoga* germinated to near 100% in light at temperatures from 20/10 to 35/20°C (Table 1), whereas stratified seeds germinated to high percentages over the range of thermoperiods from 15/6 to 35/20°C. This means that seeds can germinate to high percentages in northcentral Kentucky (and other areas with similar monthly temperatures) from late March through November, when soil moisture and light are nonlimiting. These germination results agree with those of Ivany and Sweet (1973) who obtained 92% or more germination of both species in light at thermoperiods of 30/20 and 20/10°C and with those of Shontz and Shontz (1972) who obtained near 100% germination for *G. quadriradiata* seeds in light at thermoperiods of 24/10 and 24/18°C. Although only 3–10% of the fresh seeds incubated in light at the simulated March and November temperature regime (15/6°C) germinated, some seeds of both species germinated in the field in late November, and seeds germinated in the unheated greenhouse in November and in March. In the unheated greenhouse the maximum and minimum temperatures for the week preceding the day when the last germination was recorded for *G. parviflora* in autumn were 13.2 and 6.5°C, respectively, and those for the week preceding the day when the first germination was recorded in spring were 20.4 and 10.4°C, respectively. Correspondingly, for *G. quadriradiata* the autumn temperatures were 12.0 and 5.9°C and spring temperatures were 17.0 and 2.1°C (Fig. 1). Although seeds of both species can germinate at low (15/6°C) temperatures, they require a long incubation period. Whereas 3–10% of the seeds incubated in light at 15/6°C germinated within 15 days, nearly 100% of the seeds in light at 5°C germinated during the 12-week stratification period. It is possible that many more seeds would germinate in the field in November and March if days with above freezing temperatures were not separated by days when temperatures were at or below freezing. Thus, seeds of the two *Galinsoga* species can germinate from frost to frost, but the rate and percentage of germination are greatly reduced near the beginning and the end of the growing season.

Low winter temperatures did not cause seeds of the two species to enter dormancy, nor was there a reduction in their ability to germinate over the range of temperatures (Table 1). In fact, as a result of stratification and dry laboratory storage, germination at 15/6°C was increased. Seeds of *G. parviflora* and *G. quadriradiata* given 12 weeks of stratification germinated to 94 and 99%, respectively, in light at 15/6°C while seeds stored dry in the laboratory for 12 weeks germinated to 57 and 99%, respectively (Table 1). The physiological change(s) that allowed seeds to germinate to over 90% at 15/6°C happened at both 5 and 25°C for *G. quadriradiata* and at 5°C for *G. parviflora*. (Dry laboratory storage was only partially effective for *G. parviflora*.)

In the winter annuals *Phacelia dubia* (L.) Trel. var. *dubia* McVaugh, *Torilis japonica* (Houtt.) DC., *Sedum pulchellum* Michx., and *Thlaspi perfoliatum* L., low winter temperatures caused nondormant seeds to enter dormancy. Thus, the seeds are unable to germinate in spring and must receive a period of after-ripening during summer, before they can germinate the following autumn (Baskin and Baskin 1973a, 1975, 1977, 1979). In contrast, low temperatures do not cause seeds of the weedy annual composite *Helenium amarum* (Raf.) H. Rock to enter dormancy. As is true for the *Galinsoga* species, stratified seeds of *H. amarum* germinated to a higher percentage at 15/6°C than freshly-matured seeds; 61 vs. 36% (Baskin and Baskin 1973b). Seeds of *H. amarum* are matured and dispersed from July to November. Seeds dispersed in summer and early-mid autumn germinate if they are in light, and the resulting plants overwinter as rosettes. These plants flower the following summer, thus exhibiting a winter-annual type of life cycle. Seeds dispersed in late autumn fail to germinate because temperatures are below those required for germination. These seeds germinate in spring, and the plants flower in summer, thus exhibiting a summer-annual type of life cycle (Baskin and Baskin 1973b). In temperate regions, seeds of *G. parviflora* and *G. quadriradiata* are dispersed from June to late November. Many of the seeds dispersed from June to September germinate if light and soil moisture conditions are favorable, and the plants complete their life cycles before frost. Usami (1976) reported that three to four generations of *G. parviflora* can be completed in a single growing season in Japan. Seeds also germinate from September to late November, but the number decreases as the temperatures decrease until finally temperatures are too low for any germination. Plants from seeds that germinate in autumn are killed by freezing temperatures before they have time to flower and produce seeds. Unlike *H. amarum,* the *Galinsoga* species can not overwinter as plants and then flower the following growing season. Seeds of *Galinsoga,* however, are able to tolerate temperatures below freezing, and those that are dispersed after temperatures are too low for germination overwinter in or on the soil surface and germinate the following spring. Thus, *Galinsoga* behaves strictly as a summer annual.

Freshly-harvested and stratified seeds of *Galinsoga* failed to germinate when incubated in darkness over the range of temperatures. However, after 12 weeks of dry laboratory storage, seeds of *G. parviflora* germinated to 21% in darkness at 15/6°C, and seeds of *G. quadriradiata* germinated to 2, 2, and 7% at 20/10, 25/15, and 30/15°C, respectively (Table 1). Seeds of *G. parviflora* collected in Venezuela and incubated at 25°C germinated to 82% in light and 0% in darkness. These seeds were strongly light sensitive and showed a rapid red–far red reversibility (van Rooden, Akkermans, and van der Veen 1970). Seeds of *G. parviflora* collected in East Africa and incubated in a greenhouse (28/14.5°C) germinated to 93% in light, 3% in darkness, 0% under the shade of a banana leaf, and 80% under neutral shade created by several layers of white paper (Fenner 1980). Seeds of *G. quadriradiata* collected in Massachusetts germinated to nearly 100% at a 12-h photoperiod but to 0% in darkness (Shontz and Shontz 1972), and seeds collected in Connecticut germinated to 94–98% in light but to only 1–15% in darkness (Kahl and Ashley 1977). In contrast, Ivany and Sweet (1973) obtained 92.5 and 77.5% germination of *G. parviflora* seeds in light and darkness, respectively, at 30/20°C and 93.3 and 92.3% germination of *G. quadriradiata* seeds in light and darkness, respectively. These high germination percentages for seeds incubated in darkness do not correspond with the data these authors obtained for seeds buried in soil. When they covered seeds of both species with 0.5 cm of soil, only 3.2 and 1.0% of the seeds of *G. quadriradiata* and *G. parviflora,* respectively, germinated, indicating that the seeds required light for germination.

Both *G. parviflora* and *G. quadriradiata* possess a number of characteristics that predispose them toward weediness. Plants flower after a short period of vegetative growth (Ivany and Sweet 1973), are day-neutral with regard to photoperiodic requirement for flowering (Ivany and Sweet 1973), flower for long periods of time (Pladeck 1933), are self- and cross-fertile (Canne 1977), produce large numbers of dormant seeds (Jaques 1926; Ivany and Sweet 1973; Usami 1976; Table 1), and ungerminated seeds can remain viable for several years (at least 20 for *G. parviflora*) during burial in the soil (Ødum 1970). In addition to these characteristics, the migration of the species out of the mountainous areas of west-central Mexico was greatly facilitated by the disturbance of large areas of land by agricultural and road building activities which created new habitats for the species (Canne 1977) throughout much of the temperate and tropical areas of the world. However, if the seeds were intolerant of freezing temperatures, the species could not have migrated into temperate regions. On the other hand, if seeds required a stratification treatment to overcome dormancy the species could not have migrated into tropical regions.

## Summary

Germination characteristics of *Galinsoga parviflora* Cav. and *G. quadriradiata* Ruiz & Pavon were investigated to better understand what controls the timing of germination in the field. In light, fresh seeds germinated to near 100% at 20/10, 25/15, 30/15, and 35/20°C but to only 3–10% at 15/6°C. After 12 weeks of stratification at 5°C in darkness nearly 100% of the seeds subsequently incubated in light at 15/6°C germinated, while

those stratified in light germinated to near 100% during stratification. Little or no germination occurred in darkness at any temperature in either fresh or stratified seeds. Thus, seeds can germinate in light throughout the year in tropical and subtropical regions and throughout the growing season in temperate regions, where three to four generations of plants can be produced in a single growing season. In temperate regions plants from seeds that germinate very late in the growing season are killed by frost before they flower, but those that fail to germinate in autumn do so the following spring. Although seeds can germinate at temperatures simulating those in the tropics and subtropics and those in the temperate regions during the growing season, the species would have been unable to spread into the tropics if seeds required a stratification treatment for germination or into temperate regions if seeds were unable to tolerate freezing.

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## Literature Cited

Baskin, J. M. and C. C. Baskin. 1973a. Delayed germination in seeds of *Phacelia dubia* var. *dubia*. Can. J. Bot. 51: 2481–2486.

———. 1973b. Ecological life cycle of *Helenium amarum* in central Tennessee. Bull. Torrey Bot. Club 100: 117–124.

———. 1975. Ecophysiology of seed dormancy and germination in *Torilis japonica* in relation to its life cycle strategy. Bull. Torrey Bot. Club 102: 67–72.

———. 1977. Germination ecology of *Sedum pulchellum* Michx. (Crassulaceae). Amer. J. Bot. 64: 1242–1247.

———. 1979. The ecological life cycle of *Thlaspi perfoliatum* and a comparison with published studies on *Thlaspi arvense*. Weed Res. 19: 285–292.

Canne, J. M. 1977. A revision of the genus *Galinsoga* (Compositae: Heliantheae). Rhodora 79: 319–389.

Fenner, M. 1980. Germination tests on thirty-two East African weed species. Weed Res. 20: 135–138.

Ivany, J. A. and R. D. Sweet. 1973. Germination, growth, development, and control of *Galinsoga*. Weed Sci. 21: 41–45.

Jaques, H. 1926. The prolificness of some common weeds. Proc. Ia. Acad. Sci. 33: 135–136.

Kahl, D. J. and R. A. Ashley. 1977. The effect of light on *Galinsoga ciliata* achene germination. Proc. Northeast. Weed Sci. Soc. 31: 141–143.

McWilliams, E. L. and L. K. Ludwig. 1972. Floral phenology at the Matthaei Botanical Gardens: 1969–1971. Mich. Bot. 11: 83–114.

Ødum, S. 1970. Dormant seeds in Danish ruderal soils. Royal Vet. and Agric. Univ. Horsholm Arboretum DK 2970, Horsholm, Denmark. 247 pp.

Pladeck, M. 1933. Report of the sub-committee on time of flowering and viability of weed seeds. Assoc. Off. Seed Anal. N. Amer. Proc. 26: 249–254.

Shontz, N. N. and J. P. Shontz. 1970. *Galinsoga ciliata* (Compositae): its arrival and spread in the northeastern United States. Rhodora 72: 386–392.

———. 1972. Rapid evolution in populations of *Galinsoga ciliata* (Compositae) in western Massachusetts. Amer. Midl. Natur. 88: 183–199.

Swink, F. A. 1952. A phenological study of the flora of the Chicago region. Amer. Midl. Natur. 48: 758–768.

Usami, Y. 1976. Ecological studies on weeds in Mulberry fields. 2. Auto-ecology of *Galinsoga parviflora* Cav. Weed Res. (Japan) 21: 76–80.

van Rooden, J., L. M. A. Akkermans, and R. van der Veen. 1970. A study on photoblastism in seeds of some tropical weeds. Acta Bot. Neerl. 19: 257–264.

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# Raunkiaer's Life Form Classification in Relation to Fire

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Raunkiaer (1934) defined the life form of a plant by the position and degree of protection of its perennating bud. His system provided a means of classifying floras that focused on the natural selection of vegetative organs in response to environmental pressures and the ultimate morphological adaptations that enable the plant to survive unfavorable conditions.

Raunkiaer's life form system has been used previously to type the climatic regions of the world by the vegetation characteristic of these regions (Cain 1950; Cain and Castro 1959). The location of the perennating bud(s) has been used as an index of the degree of protection from adverse environmental conditions (Raunkiaer 1934; Cain and Castro 1971). Raunkiaer's system has been found useful in classifying vegetation of biomes and the recognition of vegetative zones along altitudinal gradients (Allen 1937; Buell and Wilbur 1948; Cain et al. 1956; Beaman and Andresen 1966; Cain and Castro 1971; Shimwell 1971; Mueller-Dombois and Ellenberg 1974; Feoli-Chiapella and Feoli 1977; Holland 1978; Tyler 1979; and Whittaker et al. 1979).

Application of the system to predict the mode of regeneration of plants in response to fire has been made for Mediterranean vegetation (Le Houerou 1973; Naveh 1973, 1975). Naveh found that plants of similar morphologies responded similarly to disturbance by fire and that plants with rhizome systems exhibited rapid regeneration of vegetative parts and were best adapted to fire. An attempt to predict plant response to fire in temperate forest regions, such as New England, has apparently never been made.

This research was conducted as part of a research project developed by the Institute of Natural and Environmental Resources, University of New Hampshire, concerned with prescribed fire in the northeast, particularly as it relates to forest management. Concurrent with a study by Trotta (1980) which considered the effects of prescribed burning upon tree and shrub regeneration and growth, our study focused primarily on the effects of prescribed burning on ground cover vegetation and only secondarily on phanerophytes.

Fire tends to select against those low growing species with exposed buds while plants with buds fully protected are least affected. Thus, adaptation of species to surviving unfavorable seasons might also contribute to a pre-adaptation to fire survival. One might expect chamaephytes to be most affected, hemicryptophytes moderately, and geophytes least affected by fire. Thus, when using prescribed burning as a management tool, it seems reasonable that utilization of Raunkiaer's life form system may provide a measure of predicting the effect of a prescribed burn on the vegetation.

## Study Area

The study was conducted in a second growth woodland in southeastern New Hampshire with two principal forest types, 1) a 40 to 50 year old White Pine/Mixed Hardwood stand and 2) a 50 to 70 year old White Pine stand. A small stream bisects the two forest sites. The entire area is approximately 2.5 hectares. The two forest sites were previously farmland, abandoned during the 19th century. Selective cutting took place during this century on the White Pine/Mixed Hardwood Forest.

The White Pine/Mixed Hardwood Forest canopy consists of a mixture of *Pinus strobus, Quercus rubra,* and *Acer rubrum.* The understory of tall shrubs and saplings includes *Corylus cornuta, Viburnum* spp., *Prunus serotina,* and in more moist places, *Ilex verticillata* and *Vaccinium corymbosum.* The low shrub/tall herb layer includes *Kalmia angustifolia, Aralia nudicaulis, Gaylussacia baccata,* and *Vaccinium angustifolium.* In moist pockets and depressions are *Osmunda cinnamomea, O. regalis, Dryopteris noveboracensis,* and *Dryopteris thelypteris.* The low herb layer is dominated by *Maianthemum canadense* and in more moist sections *Coptis groenlandica* is present. The forest floor has a deep litter and humus layer averaging 5 to 14 cm in thickness above the mineral soil.

The White Pine Forest canopy is made up of *Pinus strobus* with several individuals of *Populus grandidentata, Quercus rubra,* and *Acer rubrum.* The shrub layer consists of *Corylus cornuta, C. americana, Viburnum cassinoides,* and in moist sections, *Vaccinium corymbosum* and *Lyonia ligustrina* occur. Saplings of *Quercus alba, Quercus rubra,* and *Prunus serotina* are also present. The low shrub/tall herb layer includes species such as *Kalmia angustifolia, Vaccinium angustifolium, Aralia nudicaulis,* and *Pteridium aquilinum.* The low herb layer is dominated by *Maianthemum canadense, Gaultheria procumbens, Lycopodium clavatum, L. complanatum,* and *L. obscurum.*

## Methods

Floristic inventories of the area and a detailed analysis (Ross 1978) of the change in percent cover of each species were made during the growing seasons prior to and following burning (1976–1977). Nomenclature of species follows Fernald (1950). All plant species present in the study area were classified according to Raunkiaer's (1934) life form system. Observations were made of habit and phenology of each species before and after burning. Both forests were subdivided into three 0.4 h plots; plots selected randomly for a fall or a spring prescribed burn, or as a control area. Fire lanes were formed by raking leaves 30 cm from the perimeter of the plots to be burned. In each forest type one plot was burned in the fall (October 19, 1976) and a second in the spring (April 12, 1977) under conditions which produced relatively cool surface-running headfires, fires moving in the direction of the wind. After burning, observations of plant regeneration and recovery were made during the following growing season. Twelve species were selected to illustrate the four general categories of Raunkiaer's life form system represented in the ground cover vegetation.

## Results

Both fall and spring prescribed burns produced relatively cool fires which consumed only the surface litter layer. Consequently, the F-layer (fermentation layer) of decaying leaves was not burned. Scorch of overstory vegetation was limited to less than 2 m and flame heights were no greater than 50 cm. Post-burn inventories revealed that no

TABLE 1. Pre- and post-burn comparison of species present on fall and spring prescribed burn plots in conifer and mixed hardwood forest in southeastern New Hampshire (+ = present, − = absent).

| | Forest Site | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | White Pine/Mixed Hardwood | | | | | | White Pine | | | | | |
| Burn Date: | Fall 76 | | Control | | Spring 77 | | Fall 76 | | Control | | Spring 77 | |
| Strata Species | 76 | 77 | 76 | 77 | 76 | 77 | 76 | 77 | 76 | 77 | 76 | 77 |
| Canopy | | | | | | | | | | | | |
| *Acer rubrum* | + | + | + | + | + | + | + | + | + | + | + | + |
| *Pinus strobus* | + | + | + | + | + | + | + | + | + | + | + | + |
| *Quercus alba* | + | + | + | + | + | + | + | + | + | + | + | + |
| *Quercus rubra* | + | + | + | + | + | + | + | + | + | + | + | + |
| *Betula populifolia* | + | + | + | + | − | − | + | + | + | + | + | + |
| *Carya ovata* | + | + | + | + | + | + | − | − | + | + | + | + |
| *Populus tremuloides* | − | − | − | − | − | − | + | + | + | + | + | + |
| *Populus grandidentata* | − | − | − | − | − | − | + | + | + | + | − | − |
| *Acer saccharum* | − | − | − | − | + | + | − | − | − | − | − | − |
| *Tsuga canadensis* | + | + | − | − | − | − | − | − | − | − | − | − |
| *Prunus serotina* | + | + | + | + | + | + | + | + | + | + | + | + |
| *Prunus virginiana* | − | − | − | − | − | − | − | − | + | + | + | + |
| Small Trees/Shrubs/Woody Vines | | | | | | | | | | | | |
| *Crataegus* sp. | + | + | + | + | + | + | + | + | + | + | + | + |
| *Corylus americana* | + | + | + | + | + | + | + | + | + | + | + | + |
| *Amelanchier stolonifera* | + | + | + | + | + | + | + | + | + | + | + | + |
| *Amelanchier laevis* | − | − | + | + | + | + | − | − | − | − | − | − |
| *Amelanchier canadensis* | − | − | + | + | − | − | − | − | + | + | − | − |
| *Corylus cornuta* | + | + | − | − | + | + | + | + | + | + | + | + |
| *Carpinus caroliniana* | − | − | − | − | − | − | + | + | + | + | + | + |
| *Ilex verticillata* | + | + | + | + | − | − | − | − | − | − | − | − |
| *Ostrya virginiana* | − | − | − | − | − | − | − | − | + | + | + | + |
| *Hamamelis virginiana* | − | − | − | − | + | + | − | − | − | − | − | − |
| *Pyrus aucuparia* | − | − | − | − | − | − | − | − | + | + | − | − |
| *Kalmia angustifolia* | + | + | + | + | + | + | + | + | + | + | + | + |
| *Vaccinium angustifolium* | + | + | + | + | + | + | + | + | + | + | + | + |
| *Vaccinium corymbosum* | + | + | + | + | + | + | + | + | + | + | + | + |
| *Viburnum cassinoides* | + | + | + | + | + | + | + | + | + | + | + | + |
| *Viburnum recognitum* | + | + | + | + | + | + | − | − | + | + | + | + |
| *Lyonia ligustrina* | + | + | + | + | + | + | + | + | + | + | − | − |
| *Gaylussacia baccata* | + | + | + | + | + | + | − | − | − | − | + | + |
| *Pyrus floribunda* | − | − | + | + | + | + | − | − | + | + | + | + |
| *Pyrus arbutifolia* | + | + | − | − | + | + | − | − | − | − | − | − |
| *Smilax rotundifolia* | + | + | − | − | + | + | + | + | − | − | + | + |
| *Cornus alternifolia* | − | − | − | − | − | − | + | + | + | + | + | + |
| *Rubus* sp. | − | − | − | − | + | + | + | + | − | − | + | + |
| *Rubus hispidus* | + | + | + | + | + | + | + | + | + | + | + | + |
| *Rubus flagellaris* | − | − | − | − | + | + | + | + | + | + | + | + |
| *Vaccinium corymbosum* × *V. angustifolium* | + | + | − | − | − | − | − | − | + | + | + | + |
| *Viburnum acerifolium* | − | − | − | − | + | + | + | + | + | + | − | − |
| *Rhododendron canadensis* | − | − | + | + | − | − | − | − | − | − | − | − |
| *Rosa virginiana* | − | − | − | − | − | − | + | + | − | − | − | − |
| *Spiraea latifolia* | − | − | − | − | − | − | − | − | + | + | − | − |
| *Diervilla lonicera* | − | − | + | + | − | − | + | + | − | − | + | + |
| *Rhus radicans* | − | − | − | − | − | − | + | + | − | − | − | − |

TABLE 1. Continued.

| | Forest Site | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | White Pine/Mixed Hardwood | | | | | | White Pine | | | | | |
| Burn Date: | Fall 76 | | Control | | Spring 77 | | Fall 76 | | Control | | Spring 77 | |
| Strata Species | 76 | 77 | 76 | 77 | 76 | 77 | 76 | 77 | 76 | 77 | 76 | 77 |
| **Herbs/Subshrubs** | | | | | | | | | | | | |
| *Aralia nudicaulis* | + | + | + | + | + | + | + | + | + | + | + | + |
| *Cornus canadensis* | + | + | + | + | + | + | + | + | + | + | + | + |
| *Cypripedium acaule* | + | + | + | + | + | + | + | + | + | + | + | + |
| *Gaultheria procumbens* | + | + | + | + | + | + | + | + | + | + | + | + |
| *Maianthemum canadense* | + | + | + | + | + | + | + | + | + | + | + | + |
| *Mitchella repens* | + | + | + | + | + | + | + | + | + | + | + | + |
| *Panax trifolium* | + | + | + | + | + | + | + | + | + | + | + | + |
| *Uvularia sessilifolia* | + | + | + | + | + | + | + | + | + | + | + | + |
| *Clintonia borealis* | + | + | + | + | + | + | + | + | − | − | + | + |
| *Coptis groenlandica* | + | + | + | + | + | + | + | + | − | − | + | + |
| **Viola* sp. (stemless) | − | + | + | + | + | + | + | + | + | + | + | + |
| *Lysimachia quadrifolia* | − | − | + | + | + | + | + | + | − | − | + | + |
| *Prenanthes altissima* | − | − | − | − | + | + | + | + | + | + | + | + |
| *Pyrola rotundifolia* | − | − | − | − | + | + | + | + | + | + | + | + |
| *Solidago rugosa* | − | − | − | − | + | + | + | + | + | + | + | + |
| *Apocynum androsaemifolium* | − | − | − | − | − | − | + | + | + | + | + | + |
| *Epigaea repens* | + | + | + | + | − | − | − | − | + | + | − | − |
| *Medeola virginiana* | + | + | + | + | + | + | − | − | − | − | − | − |
| **Galium triflorum* | − | − | − | − | − | + | − | + | − | − | − | + |
| **Anemone quinquifolia* | + | + | − | − | + | + | − | + | − | − | − | − |
| *Aster acuminata* | − | − | − | − | − | − | + | + | + | + | − | − |
| *Aster macrophyllus* | − | − | − | − | − | − | − | − | + | + | + | + |
| *Glechoma hederacea* | − | − | + | + | + | + | − | − | − | − | − | − |
| *Solidago caesia* | + | + | − | − | − | − | + | + | − | − | − | − |
| *Solidago ulmifolia* | − | − | − | − | − | − | + | + | − | − | + | + |
| *Aster* sp. | − | − | − | − | − | − | + | + | − | − | + | + |
| **Erechtites hieracifolia* | − | + | − | − | − | − | − | − | − | − | − | − |
| *Goodyera tesselata* | − | − | − | − | − | − | − | − | + | − | − | − |
| *Iris prismatica* | − | − | + | + | − | − | − | − | − | − | − | − |
| *Monatropa hypopithys* | − | − | − | − | − | − | + | + | − | − | − | − |
| *Monatropa uniflora* | − | − | − | − | − | − | − | − | + | + | − | − |
| *Potentilla simplex* | − | − | − | − | − | − | + | + | − | − | − | − |
| *Solidago squarrosa* | − | − | − | − | − | − | + | + | − | − | − | − |
| **Houstonia caerulea* | − | + | − | − | − | − | − | − | − | − | − | − |
| **Graminids** | | | | | | | | | | | | |
| *Carex pensylvanica* | + | + | + | + | + | + | + | + | + | + | + | + |
| *Oryzopsis asperifolia* | + | + | + | + | + | + | + | + | + | + | + | + |
| *Oryzopsis racemosa* | − | − | − | − | − | − | + | + | + | + | + | + |
| **Luzula multiflora* | − | − | + | + | − | − | − | + | − | − | − | − |
| *Carex brunnescens* | − | − | + | + | − | − | − | − | − | − | − | − |
| Undetermined grass | + | + | + | + | + | + | − | − | − | − | + | + |
| **Ferns and Fern Allies** | | | | | | | | | | | | |
| *Lycopodium clavatum* | + | + | + | + | + | + | + | + | + | + | + | + |
| *Lycopodium complanatum* | + | + | + | + | + | + | + | + | + | + | + | + |
| *Lycopodium obscurum* | + | + | + | + | + | + | + | + | + | + | + | + |
| *Osmunda cinnamomea* | + | + | + | + | + | + | + | + | + | + | + | + |
| *Pteridium aquilinum* | + | + | + | + | + | + | + | + | + | + | + | + |

TABLE 1. Continued.

| Strata Species | Burn Date: White Pine/Mixed Hardwood Fall 76 76–77 | White Pine/Mixed Hardwood Control 76–77 | White Pine/Mixed Hardwood Spring 77 76–77 | White Pine Fall 76 76–77 | White Pine Control 76–77 | White Pine Spring 77 76–77 |
|---|---|---|---|---|---|---|
| *Osmunda regalis* | + + | + + | + + | – – | – – | + + |
| *Athyrium filix-femina* | – – | + + | – – | + + | – – | + + |
| *Dryopteris spinulosa* | – – | – – | – – | + + | – – | + + |
| *Dennstaedtia punctilobula* | – – | – – | – – | + + | – – | – – |
| *Dryopteris noveboracensis* | – – | + + | – – | – – | – – | – – |
| *Onoclea sensibilis* | – – | – – | – – | – – | – – | + + |
| *Osmunda claytoniana* | – – | – – | – – | – – | – – | + + |
| *Dryopteris thelypteris* | – – | + + | – – | – – | – – | – – |
| *Lycopodium lucidulum* | – – | – – | – – | – – | – – | + + |

Pre-burn Species Total = 95, post-burn Species Total = 97.
Species marked with an asterisk (*) appeared only after the plot had been burned.

species were eliminated due to the prescribed burns (Table 1), while three species, *Houstonia caerulea, Galium triflorum,* and *Erechtites hieracifolia,* were added to the inventory of the study area.

The ground cover flora in the study area consisted of chamaephytes, hemicryptophytes, and geophytes. The Life Form Spectra were only slightly changed after burning (Table 2). The number of hemicryptophytes increased (through germination of dormant seed) in both forest types and there was the addition of one therophyte (*Erechtites hieracifolia*) in the White Pine/Mixed Hardwood Forest. The response of a selected number of species to burning is described under each life form.

### SUFFRUTICOSE CHAMAEPHYTES

**Aralia nudicaulis** L. (Wild Sarsaparilla) Araliaceae

Regeneration in *A. nudicaulis* has been found to be predominantly vegetative (Bawa and Keegan 1977), although, buried seeds from forest sites have been germinated under

TABLE 2. Life Form Spectra of Mixed Hardwood and White Pine Forest sites in southeastern New Hampshire, based upon species presence before and after burning 1976–1977.

| Life Form | Mixed Hardwood Before burn no. species | % | Mixed Hardwood After burn no. species | % | White Pine Before burn no. species | % | White Pine After burn no. species | % |
|---|---|---|---|---|---|---|---|---|
| Phanerophytes | 27 | 38.6 | 27 | 37.0 | 31 | 40.8 | 31 | 39.7 |
| Chamaephytes | 7 | 10.0 | 7 | 9.6 | 8 | 10.5 | 8 | 10.2 |
| Hemicryptophytes | 25 | 35.7 | 27 | 36.9 | 26 | 34.2 | 28 | 36.0 |
| Geophytes | 11 | 15.7 | 11 | 15.1 | 11 | 14.5 | 11 | 14.1 |
| Therophytes | 0 | 0.0 | 1 | 1.1 | 0 | 0.0 | 0 | 0.0 |
| Total number of species | 70 | | 73 | | 76 | | 78 | |

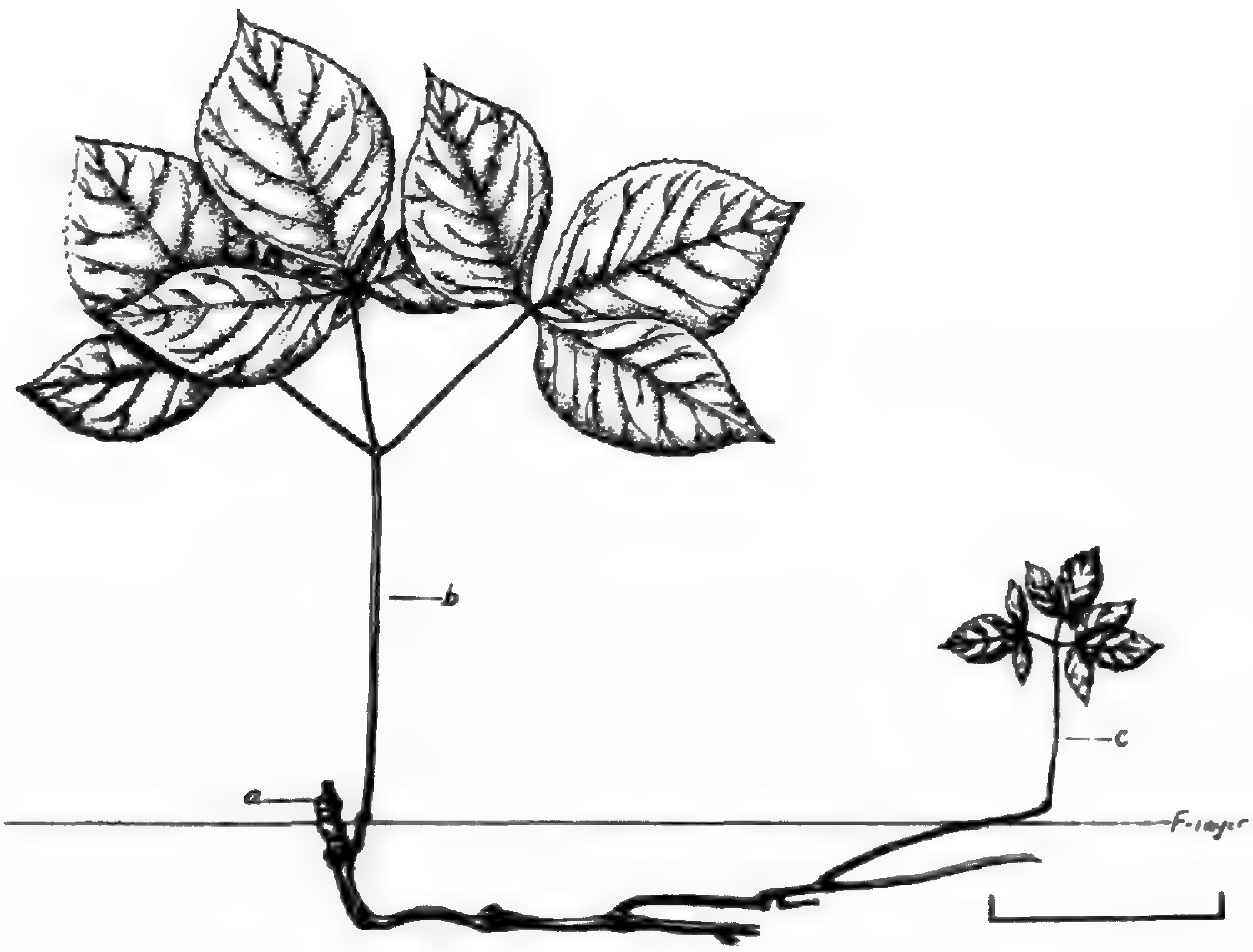


FIG. 1. *Aralia nudicaulis*: **a.** burned caudex; **b.** new growth from dormant buds below burned caudex; **c.** growth from new rhizomes. Rhizomes approximately 2–4 cm beneath F-layer. Scale = 10 cm.

experimental conditions (Graber and Thompson 1978). Perennating vegetative and floral buds are formed in late summer on a woody caudex that protrudes several centimeters above the forest floor. Rhizomes with viable reproductive buds occur primarily in mineral soil at a mean depth of 6 cm below the litter-F-layer interface (Flinn and Wein 1977). Rhizomes of *Aralia nudicaulis* in the present study occasionally reached this depth but seemed to occur mainly in the humus layer.

The fire affected both sterile and fertile shoot reproduction of *A. nudicaulis* (Fig. 1). The perennating vegetative and flowering buds found on the exposed woody caudex above the F-layer were both destroyed. Thus regeneration occurred by the activation of dormant buds located on subsurface rhizomes and protected portions of the woody caudex. Normally, leaves and flowering stalks emerge in the early spring (May) and anthesis occurs by mid-June. However, all plants observed on all burned plots were sterile and usually smaller in size. Seedlings of *A. nudicaulis* were not found to occur on any of the plots, burned or unburned.

## ACTIVE CHAMAEPHYTES

**Vaccinium angustifolium** Ait. (Lowbush Blueberry) Ericaceae

Reproduction through seeding of *V. angustifolium* is rare, though germination and survival of seedlings have been occasionally observed and studied (Vander Kloet 1976). The predominant mode of reproduction is vegetative. Shoot initiation may originate from laterally growing rhizomes or originate directly from rhizomes which emerge from the soil. However, stem initiation only occurs where rhizomes are relatively close to the surface (Trevett 1962).

Burning of *Vaccinium angustifolium* stimulated shoot initiation at the region of the rhizomes below damaged stems. Numerous buds sprouted producing three to four new stems. Fire also stimulated lateral rhizome growth, which in turn produced new shoots.

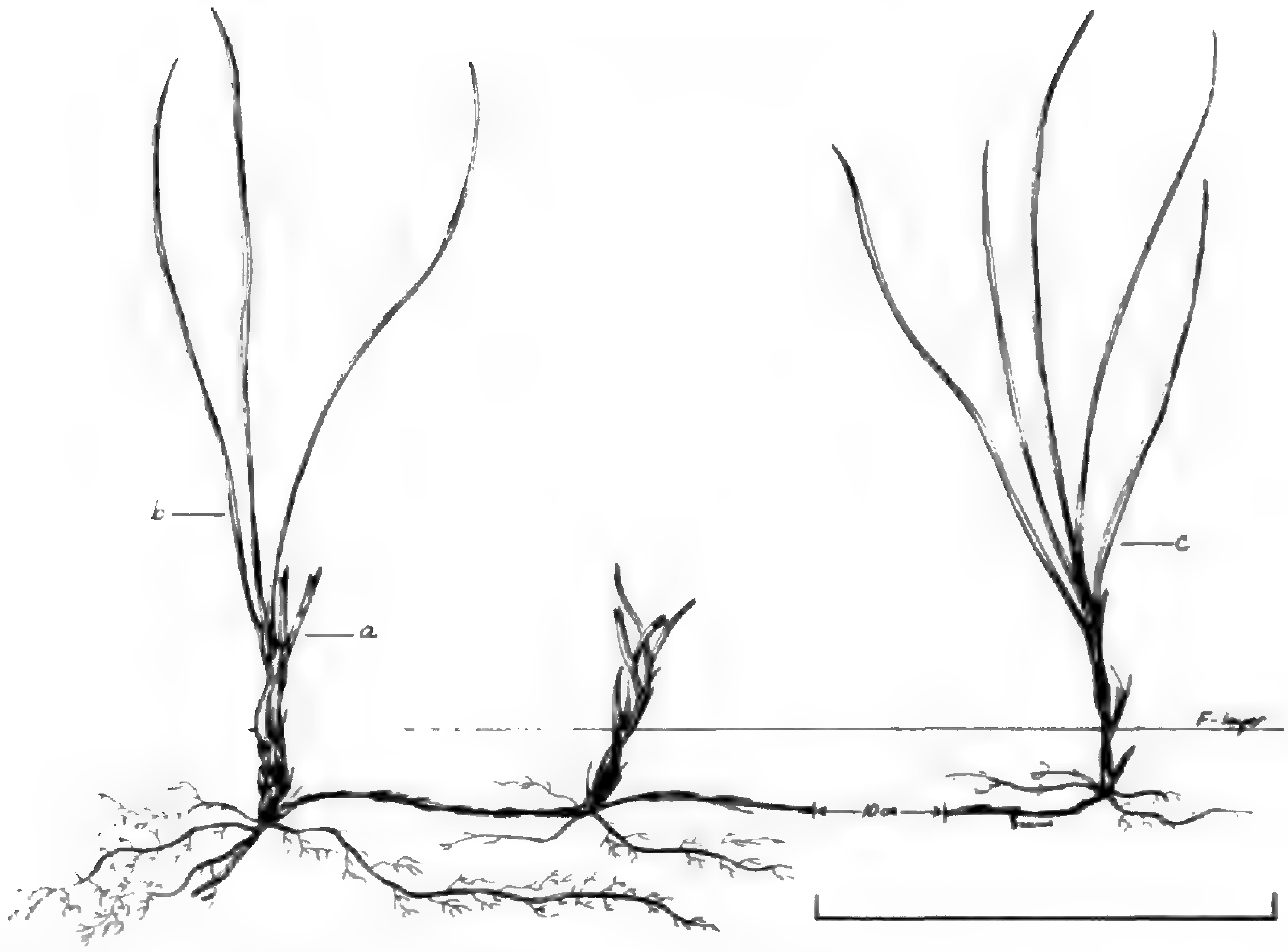


FIG. 2. *Carex pensylvanica*: **a.** burned leaf sheaths; **b.** growth from protected perennating buds; **c.** growth from new rhizome. Maximum depth of rhizomes approximately 1–3 cm below F-layer. Scale = 10 cm.

This "pruning effect" caused by burning *V. angustifolium* has been well documented by Trevett (1962) and Eaton and White (1960).

The effect of burning on flower initiation of Lowbush Blueberry is well documented (Hall 1955; Trevett 1962; Black 1963; and Eaton and White 1960). In the first growing season after fall and spring burning in the study area all Blueberry plants had sterile stems. This correlates well with the usual 3-year burn cycle applied to commercially grown Lowbush Blueberry whereby all plants are sterile the first year following burning but flower profusely the second year.

### PASSIVE CHAMAEPHYTES

**Lycopodium complanatum** L. (Ground Cedar) Lycopodiaceae

Reproduction in *L. complanatum* is typically vegetative. Reproduction by spores occurs occasionally but gametophytes seldom occur in the same places where the mature sporophytes are established (Eames 1942). Overwintering shoot primordia lie near the surface at the tips of rhizomes.

Fire seriously damaged the surface creeping stems and recovery was greatly hindered. Regeneration occurred by lateral shoot initiation from surviving stems and roots protected by litter cover and unburned pockets. Recovery of *L. complanatum* requires the entire growing season. Plants began to appear in late June with a few plants reaching vegetative maturity in the last week of August. Of all the species observed, *L. complanatum* was the least able to recover.

### ROSETTE HEMICRYPTOPHYTES

**Carex pensylvanica** Lam. (Early Sedge) Cyperaceae

Fernald (1950) described *C. pensylvanica* as being strongly stoloniferous. The horizontal stolons are cordlike and fibrillose, ascending from the litter or loosely reclining

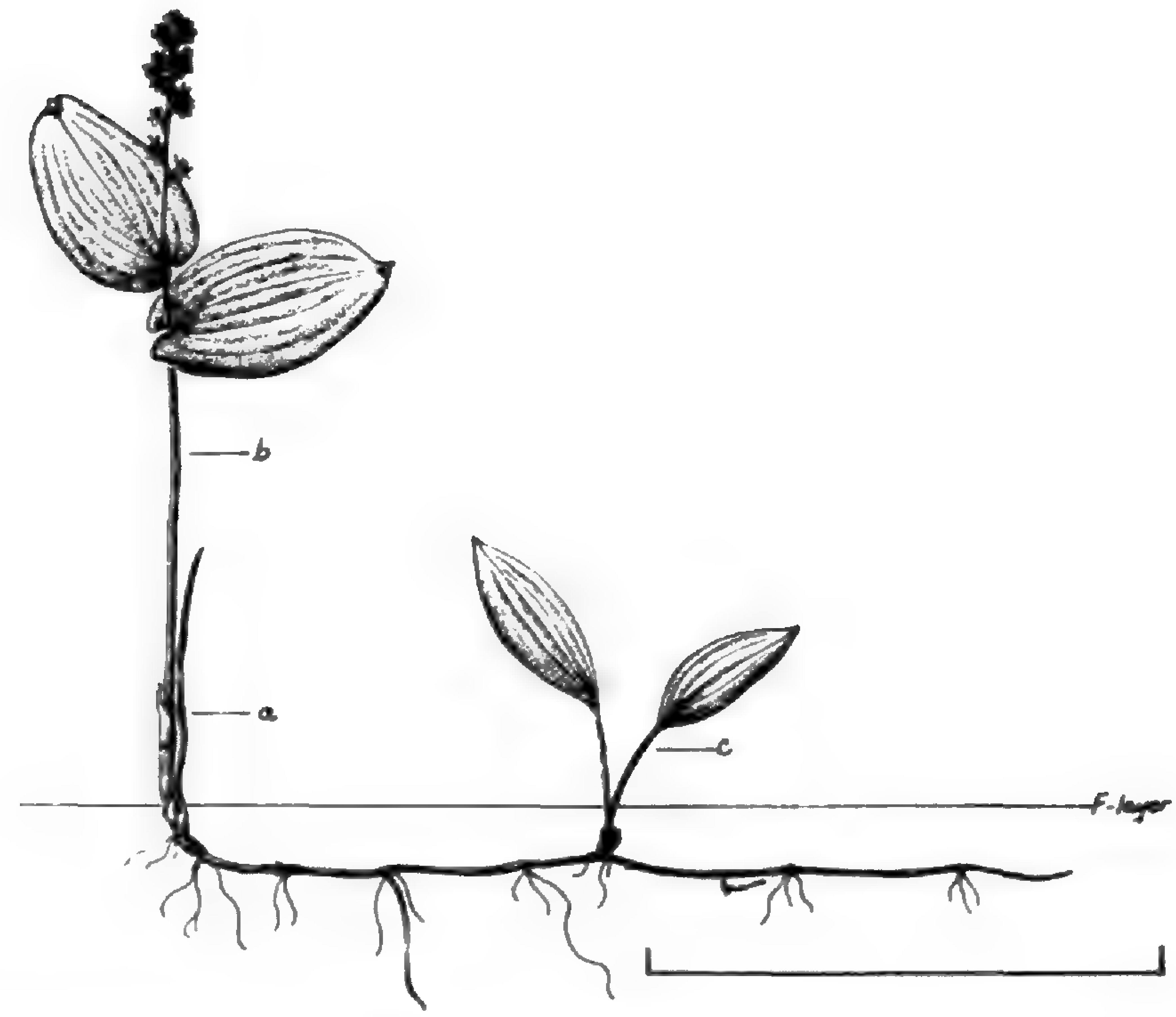


FIG. 3. *Maianthemum canadense*: **a.** burned stem and leaf sheath of original plant; **b.** new growth from protected perennating bud; **c.** vegetative growth from dormant bud along rhizome. Rhizomes approximately 1–3 cm below F-layer. Scale = 10 cm.

when in an overwintering condition. (The habit is generally hemicryptophyte but approaches the chamaephyte habit when horizontal stolons overwinter above the surface.)

Response to burning included an increase in the number of blades in each leaf tuft as a result of the initiation of buds protected by sheathing leaf bases. Some leaf tufts were damaged permanently but lateral stolons and new tufts were initiated subsequently (Fig. 2). Flowering was not stimulated by burning. Regeneration on burned plots was almost entirely vegetative.

**Viola** sp. (Stemless Violet) Violaceae

In post-burn plots regeneration was by initiation of dormant buds along the lower portion of stem axes protected by the F-layer. Violets were among the few kinds of plants to regenerate after the fire through germination of seeds. Clusters of violet seedlings were found on both fall- and spring-burned areas of the White Pine Forest site and also on the spring-burned plot of the White Pine/Mixed Hardwood Forest site. Seedlings also appeared where fire lanes were formed by raking litter aside. This latter observation suggests that seed germination was due to the mechanical effect of fire removing litter. Similarly, Ayre (1949) found violet seedlings on burned sites 2 years after the occurrence of wildfire in New Hampshire.

Seedlings did not appear until late July and were poorly developed even in late August. Flowers were not produced on burn or control plots.

SCAPOSE HEMICRYPTOPHYTES

**Rubus hispidus** L. (Dewberry) Rosaceae

The response of *Rubus hispidus* to burning was marked. Plants regenerated vegetatively from buds located near the surface but seed germination was more prevalent

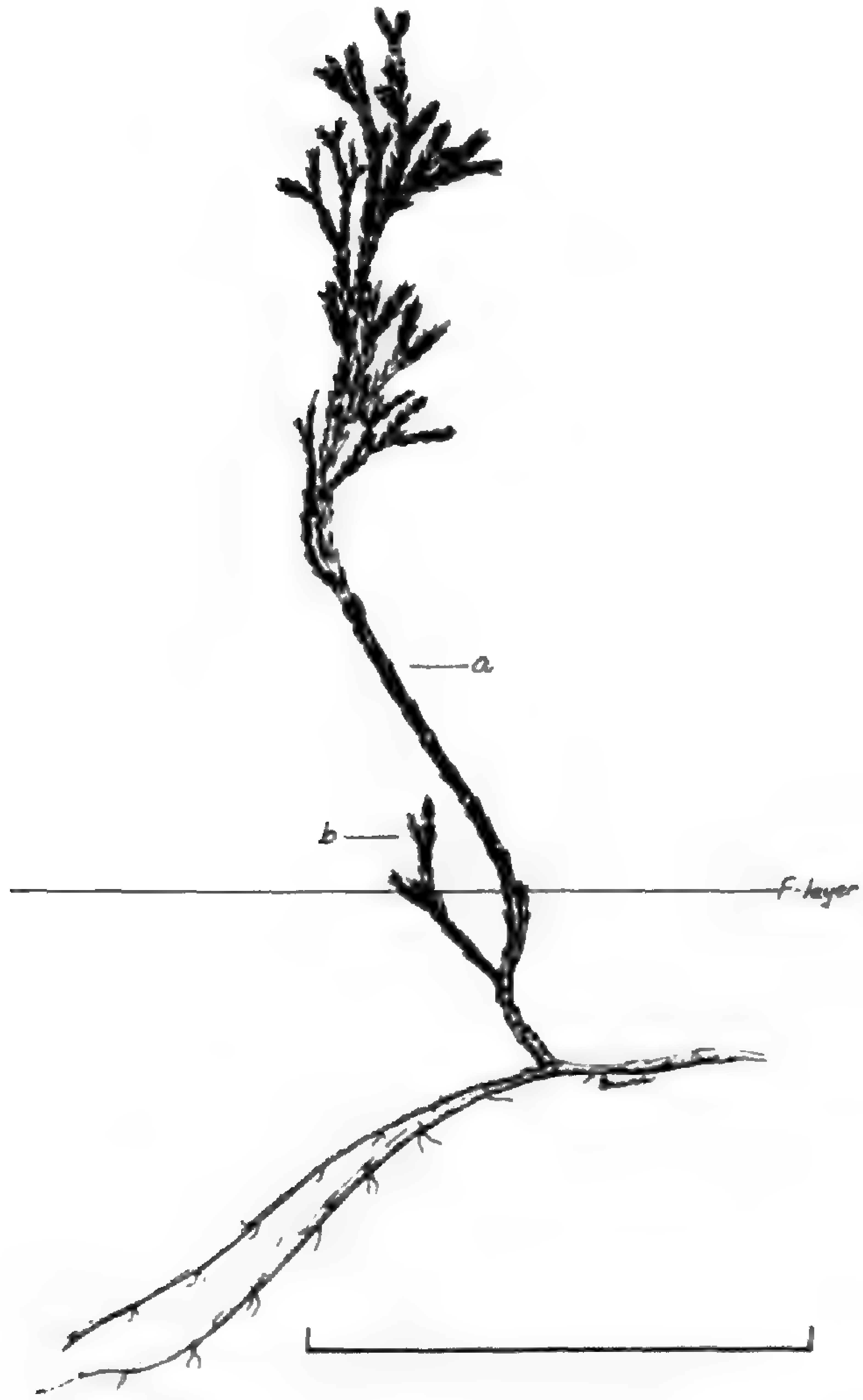


FIG. 4. *Lycopodium obscurum*: **a.** burned stem of original plant; **b.** new growth from original plant. Horizontal rhizomes lie in mineral soil. Scale = 10 cm.

and relatively abundant on all burned areas of both forest sites. Seedlings, however, were not found in control areas. Regeneration and seedling development was relatively slow. Seedlings appeared by mid-July but did not mature beyond the initiation of the first pair of mature leaves by the end of the growing season. Only a few seedlings survived the second year after burning. Flowering was rare in the study area since the event of burning eliminated the number of stems which would have normally produced floricanes the following season.

**Maianthemum canadense** Desf. (False-Lily-of-the-Valley) Lilaceae

During the growing season following burning, underground regeneration of rhizomes was extensive and seemed to be responsible for the bulk of the regeneration effort. In the second growing season, above ground vegetative reproduction was extensive due to the previous year's establishment of rhizomes. With some plants sheathing leaf bases protected perennating buds and flowering stems were produced later in the season (Fig. 3). Dormant vegetative buds along rhizomes also sprouted but consistently produced only sterile plants bearing one or two leaves. A small number of seedlings of *M. canadense* were found only on the burned areas of the two forest types. Phenologically, there was about a two week lag in emergence of plants on spring-burned areas of both forest types. Fertile plants were present by the first of June on fall-burned

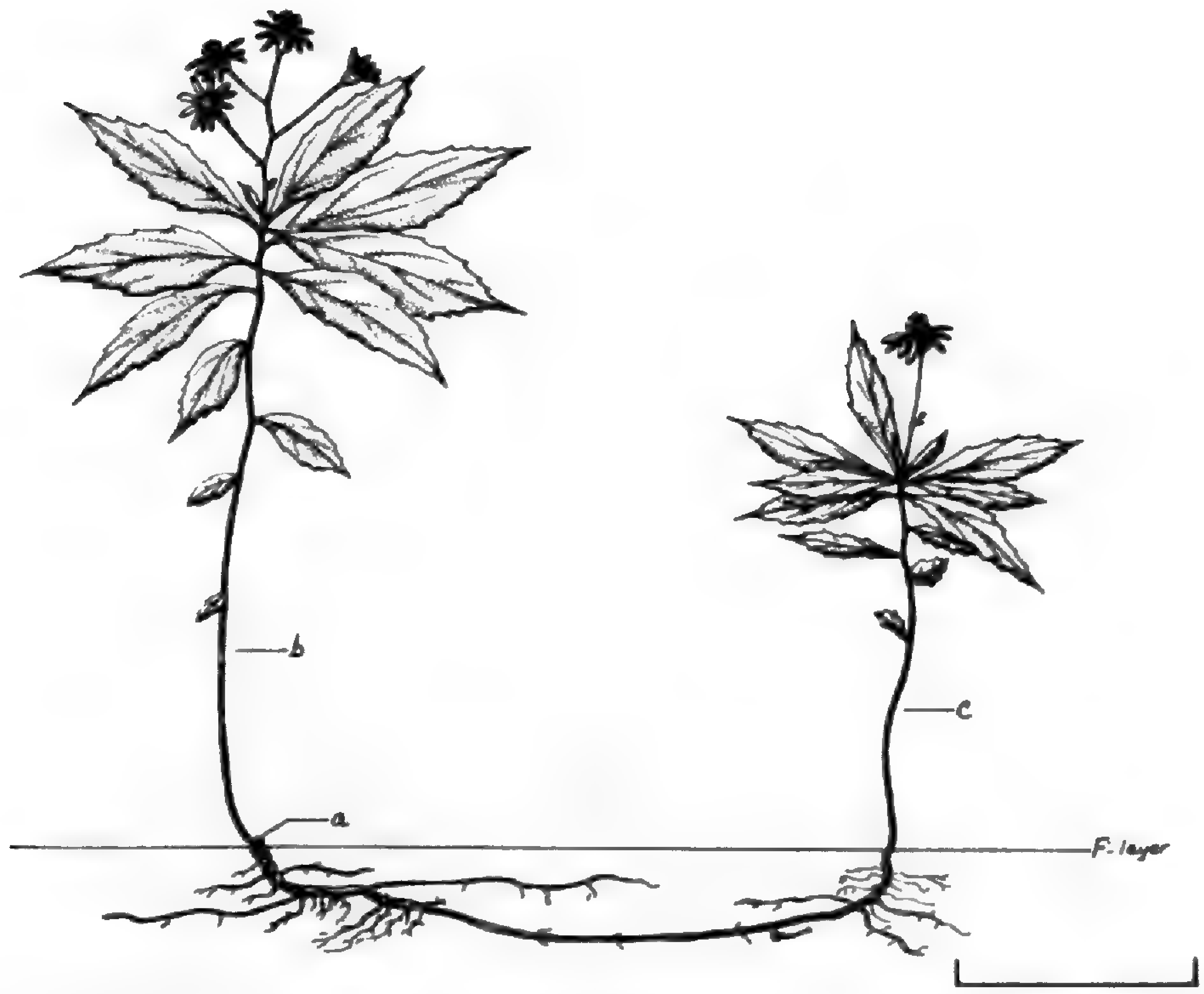


FIG. 5. *Aster acuminatus*: **a.** fire-damaged caudex; **b.** new growth from dormant bud; **c.** new plant growth. New rhizome growth originates from rhizome of fire-damaged caudex (a). Scale = 10 cm.

areas and by the third week of June on spring-burned areas. Vegetative recovery was slow relative to that of plants of this taxon growing in the control area.

**Lycopodium obscurum** L. (Ground-Pine) Lycopodiaceae

Perennating buds are terminal on ascending rhizomes. Lateral rhizomes spread from a depth of at least 6 cm below the humus layer (Flinn and Wein 1977) or approximately at the level of mineral soil. (*L. obscurum* may be placed with the chamaephytes or the hemicryptophytes depending upon the location of the apex of the rhizome to the surface.)

The fire seriously affected the population of *Lycopodium obscurum* on burned plots of the study area. Above ground stems were damaged and re-emergence of plants did not occur until mid- to late July (Fig. 4). However, plants did recover by sprouting from the undamaged portion of the stem but growth was very slow. By the second growing season, sprouted plants were fully mature, vegetatively.

Eames (1942) observed that young gametophytes occurred in soils which contained a distinct charcoal layer. He noted that the most favorable spore-bed for germination was one which had little or no humus present and that wind-carried spores arrived soon after a fire. Spore germination took place during the gradual build up of humus (2 to 3 years). Eames found that gametophytes were most abundant under trees and shrubs that ranged between 5 and 25 years old at a site which had a previous history of a forest fire after timber-cutting. Because fires in the present study site were relatively light and removed only surface litter, sufficient spore-beds may not have been formed to favor spore germination.

**Aster acuminatus** Michx. (Whorled Aster) Compositae

This species responded "favorably" to burning. Dormant buds along rhizomes were Stimulated to sprout and rhizome growth was vigorous (Fig. 5). New shoots were also

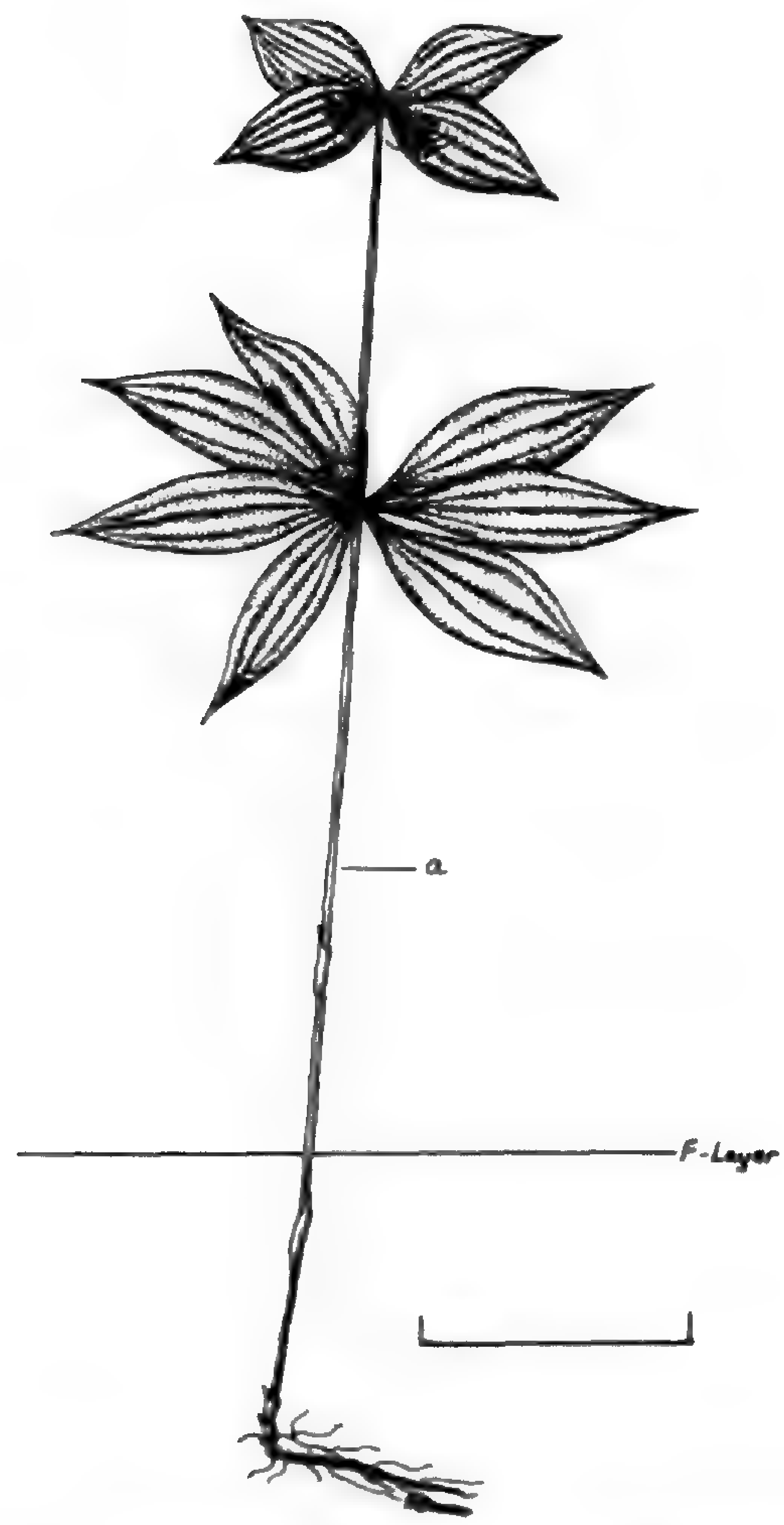


FIG. 6. *Medeola virginiana*: **a.** growth arising from underground perennating bud. Tubers occurred near mineral soil level. Scale = 10 cm.

formed when the terminal growing tips of rhizomes reached the surface. Plants flowered in the first week of September, the year after burning. Flower production as well as vegetative growth seemed to be enhanced.

### BULB AND TUBER GEOPHYTES

**Medeola virginiana** L. (Indian Cucumber) Liliaceae

Tuber depth of this species was 4 to 6 cm below the surface (Fig. 6). Flinn and Wein (1977) report a mean depth of 3 cm for perennating buds.

Plants on post-burn plots sprouted from subterranean tubers without visible effects from the fires. The fall-burned White Pine/Mixed Hardwood Forest had a small colony of *M. virginiana* that increased in number as a result of the germination of seed.

### RHIZOME GEOPHYTES

**Pteridium aquilinum** L. (Bracken Fern) Polypodiaceae

Flinn and Wein (1977) reported that the perennating buds of *P. aquilinum* occur at a mean depth of 9 cm or at the depth of mineral soil. Reproduction is vegetative through the horizontal spreading of rhizomes and new plants often appear in new locations from where plants had previously occurred.

*Pteridium aquilinum* survived fire as expected, however, the light fires did not cause the typical flourish of growth as reported by Kozlowski and Ahlgren (1974) following wildfire.

TABLE 3. Life form classification and responses of plant species to prescribed burns in southeastern New Hampshire (1976–1977).

| Life Form | Species | Response[1] |
|---|---|---|
| I. Chamaephytes | | |
| A. Suffruticose | *Aralia nudicaulis* | V |
| B. Active | *Diervilla lonicera* | V |
| | *Rhus radicans* | V |
| | *Smilax rotundifolia* | V |
| | *Vaccinium angustifolium* | V |
| C. Passive | *Epigaea repens*[2] | |
| | *Lycopodium clavatum* | v |
| | *Lycopodium complanatum* | v |
| | *Mitchella repens* | v |
| II. Hemicryptophytes | | |
| A. Rosette | | |
| 1. Partial Rosette | *Glechoma hederacea* | V |
| | *Solidago rugosa* | V |
| | *Solidago ulmifolia* | V |
| | *Aster macrophyllus* | V |
| | *Prenanthes altissima* | V |
| | *Luzula multiflora* | vs |
| 2. Rosette | | |
| a. Caespitose | *Coptis groenlandica* | V |
| | *Pyrola rotundifolia* | V |
| | *Osmunda cinnamomea* | V |
| | *Carex pensylvanica* | Vs |
| | *Clintonia borealis* | v |
| | *Cypripedium acaule* | v |
| | *Goodyera tesselata* | s |
| | *Houstonia caerulea* | s |
| | *Carex brunnescens*[2] | |
| | *Viola* sp. | vS |
| | Grass (undetermined) | vs |
| b. Scapose | *Cornus canadensis* | V |
| | *Lysimachia quadrifolia* | V |
| | *Rubus* sp. | V |
| | *Solidago caesia* | V |
| | *Solidago squarrosa* | V |
| | *Aster acuminatus* | Vs |
| | *Gaultheria procumbens* | v |
| | *Lycopodium obscurum* | v |
| | *Oryopsis asperifolia* | v |
| | *Rubus flagelleris* | v |
| | *Rubus hispidus* | vS |
| | *Maianthemum canadense* | vs |
| | *Galium triflorum* | S |
| III. Geophytes | | |
| A. Bulb and Tuber | *Iris versicolor*[2] | |
| | *Medeola virginiana* | Vs |
| | *Panax trifolium* | v |

TABLE 3. Continued.

| Life Form | Species | Response[1] |
|---|---|---|
| B. Rhizome | *Apocynum androsaemifolium* | V |
| | *Dennstaedtia punctilobula* | V |
| | *Dryopteris spinulosa* | V |
| | *Onoclea sensibilis* | V |
| | *Pteridium aquilinum* | V |
| | *Oryzopsis racemosa* | v |
| | *Trientalis borealis* | v |
| | *Uvularia sessilifolia* | v |
| | *Anemone quinquefolia* | Vs |
| | *Dryopteris noveboracensis*[2] | |
| | *Osmunda regalis*[2] | |
| | *Potentilla simplex*[2] | |
| | *Dryopteris thelypteris*[2] | |
| IV. Therophytes | *Erichtites hieracifolia* | s |

[1] S = germination of seed; V = vegetative regeneration; VS = vegetative regeneration and germination of seed. Upper case letters indicate rapid regeneration through vegetative or through means of seed germination. Lower case letters indicate slow recovery and regeneration or a less frequent method of reproduction (i.e., with seed germination).

[2] Plant species present on control plots only.

### THEROPHYTES (ANNUALS)

The only therophyte to emerge as a result from burning was *Erechtites hieracifolia* var. *intermedia* (Fireweed). A single individual appeared on the fall-burned area of the White Pine/Mixed Hardwood Forest during the month of August. The plant senesced by September. No plants appeared the second growing season after burning.

## DISCUSSION

The Life Form Spectra formed by the two forest types (Table 2) are typical of forests of the north temperate zone as described by Raunkiaer (1934). The greatest number of species of the ground cover flora of both forest types were hemicryptophytes. Raunkiaer (1934) noted that hemicryptophytes tend to be the major floral component in forests of the north temperate zone, since hemicryptophytes are best adapted to this climate, succumbing least to the unfavorable season. Geophytes are common in the north temperate zone with climates of severe winters or where there is a long dry season in which the plant remains dormant. In either case, many geophytes exist in a vegetative phase for a very short period of the life cycle.

In our study the response of the three major life forms, chamaephytes, hemicryptophytes, and geophytes, to fire corresponded to a large degree with the location of the perennating buds. Within each life form group, however, survival was variable and species-specific (see Table 3).

Chamaephytes, as a group, were seriously damaged by fire. Exposed stems of chamaephytes with perennating vegetative and flowering buds were destroyed. Regeneration depended upon dormant bud activation from protected stem portions and rhizomes. *Aralia nudicaulis* and *Vaccinium angustifolium*, suffruticose and active chamaephytes respectively demonstrated vigorous growth of rhizomes and/or a good source of underground dormant buds. The surface creeping (or passive) chamaephytes, on the contrary, responded unfavorably to fire by requiring the entire growing season for regeneration. Chamaephytes failed to reproduce sexually during the first year after fire.

Hemicryptophytes, in general, responded favorably (i.e., by vigorous sprouting, rhizome growth, and/or by seeding) to burning, but 4 species were unaffected and 2 species responded unfavorably (i.e., slow recovery, low vitality, and/or no seeding). Favorable response to burning occurred in each of the three subcategories of hemicryptophytes. Plants damaged by burning were scapose hemicryptophytes whose rhizomes grew within the litter layer.

Thus, the mode of survival often appeared to be dependent both upon the location of the perennating bud, and the location of dormant reproductive buds beneath the surface. These factors attributed to the difference in survival of hemicryptophytes such as *Aster acuminatus* and *Maianthemum canadense*. Both species are classified as scapose hemicryptophytes, but each species recovered differently from burning. Buds of *Aster acuminatus* occur within the humus layer, while those of *Maianthemum canadense* occur beneath the litter layer.

The ability to survive fire through the germination of dormant seed was most common among the hemicryptophytes. A number of species seemed to depend heavily upon seed germination as the means of survival (i.e., *Viola* sp. and *Rubus hispidus*).

Geophytes were the least affected by burning and carried through normal life cycles. The response of geophytes may be described as being "neutral." Germination of seed was not common with the exception of *Medeola virginiana*.

## Conclusion

All life form categories included species which were well or poorly adapted to survive fire. The means by which a species survived fire appear to be only partially related to the location of the perennating bud. Various modes of regeneration and recovery after fire also played an important role and were species-specific.

Raunkiaer's life form classification system may be used as a first estimate of species survival value after a prescribed fire. Better predictions, however, depend upon such factors as depth of reproductive buds, tendency to resprout, tendency for seed germination from burned seed, and other factors of a particular species' adaptive strategy to survival in response to fire.

## Acknowledgments

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## Literature Cited

Allen, B. H. 1937. A consideration of the "biological spectra" of New Zealand. Ecology 25: 116–152.

Ayre, H. 1949. Report on burned area on Durham Point. Project Report. Botany 42. University of New Hampshire, Durham, New Hampshire.

Bawa, K. S. and C. R. Keegan. 1977. Reproductive ecology of *Aralia nudicaulis* L. (Araliaceae). Bull. Ecol. Soc. Amer. 58: 24.

Beaman, J. H. and J. W. Andresen. 1966. The vegetation, floristics and phytogeography of the summit of Cerro Potosi, Mexico. Amer. Midl. Nat. 75: 1–33.

Black, W. N. 1963. The effect of frequency of rotational burning on blueberry production. Canad. J. Plant Sci. 43: 161–164.

Buell, M. F. and R. L. Wilbur. 1948. Life-form spectra of the hardwood forests of the Itasca Park region, Minnesota. Ecology 29: 352–359.

Cain, S. A. 1950. Life forms and phytoclimates. Bot. Rev. 16: 1–32.

——— and G. M. de O. Castro. 1959. Manual of Vegetative Analysis. Harper, New York. 325 pp.

——— and ———. 1971. Manual of Vegetative Analysis. Harper, New York. 325 pp.

———, ———, H. M. Pires, and M. T. da Silva. 1956. Applications of some phytosociological techniques to Brazilian rain forest. Amer. J. Bot. 43: 911–941.

Eames, J. 1942. Illustrations of some *Lycopodium* gametophytes. Amer. Fern J. 32: 1–12.

Eaton, E. L. and R. G. White. 1960. The relation between burning dates and the development of sprouts and flower buds in the lowbush blueberry. Amer. Soc. Hort. Sci. 76: 338–342.

Feoli-Chiapella, I. and E. Feoli. 1977. A numerical phytosociological study of the summits of the Majella Massive (Italy). Vegetatio 34: 21–39.

Fernald, M. L. 1950. Gray's Manual of Botany. 8th ed. American Book Co., New York. 1632 pp.

Flinn, M. A. and R. W. Wein. 1977. Depth of underground plant organs and theoretical survival during fire. Can. J. Bot. 55: 2550–2554.

Graber, R. E. and D. F. Thompson. 1978. Seeds in the organic layers and soil of four beach-birch-maple stands. U.S.D.A. Forest Serv. Res. Pap. NE-401.

Hall, I. V. 1955. Floristic changes following the cutting and burning of a woodlot for blueberry production. Canad. J. Agric. Sci. 34: 143–152.

Holland, P. G. 1978. Species turnover in deciduous forest vegetation. Vegetatio 38: 113–118.

Kozlowski, T. T. and C. E. Ahlgren. 1974. Fire and Ecosystems. Academic Press, New York. 542 pp.

Le Houerou, H. N. 1973. Fire and vegetation in the Mediterranean Basin. Proc. Tall Timbers Fire Ecology Conf. Tallahassee, Florida No. 13: 237–278.

Mueller-Dombois and H. Ellenberg. 1974. Aims and Methods of Ecology. John Wiley and Sons, New York. 547 pp.

Naveh, Z. 1973. The ecology of fire in Israel. Proc. Tall Timbers Fire Ecology Conf. Tallahassee, Florida No. 13: 131–170.

———. 1975. The evolutionary significance of fire in the Mediterranean Region. Vegetatio 29: 199–208.

Raunkiaer, C. 1934. The Life Forms of Plants and Statistical Plant Geography: being collected papers of C. Raunkiaer, translated into English by H. G. Carter, A. G. Tansley, and M. S. Fausboll. Clarendon Press, Oxford. 632 pp.

Ross, R. 1978. The Effects of Prescribed Buring on Ground Cover Vegetation of White Pine and Mixed Hardwood Forest in Southeastern New Hampshire. M.S. Thesis, University of New Hampshire, Durham. 151 pp.

Shimwell, D. 1971. The Description and Classification of Vegetation. University of Washington Press, Seattle, Washington. 322 pp.

Trevett, M. F. 1962. Nutrient and growth of the lowbush blueberry. Maine Agric. Exp. Sta. Bull. No. 605.

Trotta, J. A. 1980. The effects of prescribed fire on trees and shrubs. M.S. Thesis, University of New Hampshire, Durham. 64 pp.

Tyler, C. 1979. Classification of *Schoenus* communities in south and southeast Sweden. Vegetatio 41: 69–84.

Vander Kloet, S. P. 1976. Nomenclature, taxonomy and biosystematics of *Vaccinium* section *Cyanococcus* (the blueberries) in North America. I. Natural barriers to gene exchange between *Vaccinium angustifolium* Ait. and *Vaccinium corymbosum* L. Rhodora 78: 503–515.

Whittaker, R. H., W. A. Niering, and M. D. Crisp. 1979. Structure, pattern and diversity of a mallee community in New South Wales. Vegetatio 39: 65–76.

Bartonia No. 48: 34–41, 1981

# Robert Benson Gordon (1901–1981): A Biographical Sketch Emphasizing His Studies of Natural Vegetation Mapping

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Robert Benson Gordon (1901–1981) of West Chester, Pennsylvania, who died 11 February 1981, will be remembered for his teaching of ecological principles and biological conservation to hundreds of students at all levels of education and for his research efforts in mapping and understanding the natural vegetation of land areas in eastern United States, particularly of Indiana and Ohio. The main focus of this biographical sketch is Dr. Gordon's accomplishments in the discipline of natural vegetation mapping, through which interest I first met him on the campus of The Ohio State University in 1966. Dr. Gordon and I had occasional visits in Columbus and West Chester, where I came to learn of his life's work. He shared with me items from his library, gave me his lantern slide collection of maps and ecological sites made while teaching at The Ohio State University, and provided me with his complete vita and bibliography. In preparing this sketch, I have used those items, as well as his published papers on natural vegetation mapping.

Dr. Gordon is survived by his wife Esther L. Gordon, Honey Brook, Pennsylvania; a daughter, Virginia Hatch, Framingham, Massachusetts; a son, Robert L. Gordon, Acton, Massachusetts; seven grandchildren; and three great-grandchildren.

## PROFESSIONAL CAREER

Born in Erie, Pennsylvania, 23 July 1901, Robert Gordon completed his elementary education there, his secondary education in Mary E. Wells High School, Southbridge, Massachusetts, and his college degrees from The Ohio State University, where he received the B.S. in Applied Optics (1922), the M.S. in Botany (1928), and the Ph.D. in Botany (1931). Except for two years (1922–24) as a practicing optician and optometrist, Dr. Gordon was throughout most of his life a teacher of general botany, plant ecology, and biological conservation at the college level, although he considered adult education in the natural sciences his specialty. He taught general science and geography in Enslow Junior High School, Huntington, West Virginia (1924–26), and while in the Department of Botany at The Ohio State University he served as an assistant (1926–30), instructor (1930–37), and assistant professor (1937–38). During summers he was a field research assistant for the Ohio Agricultural Experiment Station (1927), field assistant for the United States Forest Service (1928–29), and instructor in field botany at the Allegany School of Natural History, Allegany State Park, New York (1930, 1932–40). Concurrently with the latter, he was a "temporary botanist" conducting ecological field studies for the New York State Museum, Albany.

Dr. Gordon's career as a college professor was fully developed at the Pennsylvania State Teachers College at West Chester, now West Chester State College, where he

Dr. Robert B. Gordon (photograph taken in 1955).

began as an Instructor of Science (1938), was named Head of the Department of Science (1944), and designated Professor Emeritus of Science (1964). During summers he taught at the Franz Theodore Stone Laboratory of The Ohio State University, Put-in-Bay, Ohio (1946–47, 1950); the Audubon Nature Center, Greenwich, Connecticut (1948–49); and the New Jersey School of Conservation, Stokes State Forest (1951–52). Dr. Gordon was also a member of the teaching staff of the Arboretum of the Barnes Foundation, Merion, Pennsylvania (1952–76); Professor and Head of the Biology Department of Cabrini College, Radnor, Pennsylvania (1963–64); Instructor of Horticultural Science for the Longwood Foundation, Kennett Square, Pennsylvania (1968–69, 1971); and Research Associate with the Ohio Biological Survey and The Ohio State University during summers (1964–67, 1973–74).

Dr. Gordon was active in a number of professional scientific, botanical, and conservation societies. As a member of the Wild Flower Preservation Society he served as associate editor of the Society's magazine, *Wild Flower* (1947–56). While in Columbus he was involved in the Wheaton Club, served as president of the Columbus Audubon Society (1932), was Chairman of the Wildlife and Wildflower Preservation Committee of the Ohio Association of Garden Clubs, was elected a member of The Ohio

State University Chapter of *Gamma Alpha* Graduate Scientific Fraternity and the Society of *Sigma Xi,* and joined the Wilson Ornithological Club and the Ohio Academy of Science. While in West Chester, Dr. Gordon was active in the Pennsylvania Academy of Science, serving as vice-president of the eastern division (1944–45), director of science talent search (1953–55), president-elect (1956–57), president (1957–58), and honorary life member (1974). In the Middle States Science Teachers Association he served as president (1953–54). In local organizations, Dr. Gordon was very active in the West Chester Bird Club and the Philadelphia Botanical Club. In the latter, he frequently was involved with committee work and led numerous field trips. He held memberships in the National Association of Biology Teachers, American Association for the Advancement of Science, American Institute of Biological Sciences, Ecological Society of America, the American Society of Plant Taxonomists, and the International Association for Plant Taxonomy.

## Research Career

Dr. Gordon's research interests were primarily with mapping and understanding the natural vegetation of land areas in northeastern United States and its importance to the environmental sciences of a modern civilization planning for future land use. His early interest in natural history was fostered while an undergraduate student, when he took advantage of the many field trips conducted by the central Ohio naturalists, Arthur R. Harper, Edward S. Thomas, Milton B. Trautman, Walter Tucker, and others who had joined together in the Wheaton Club. During these outings he kept field notebooks as a method of learning the native trees, shrubs, wildflowers, ferns, and birds of central and southern Ohio. While teaching in Huntington, West Virginia, Gordon wrote feature articles on the natural history of the area which were published in the local newspaper, *The Sunday Advertiser.* These articles appeared weekly, except during the summer, from February 1925 until June 1926, when he returned to Columbus to begin graduate work in botany.

As a graduate student Robert Gordon came under the tutelage of Professor Edgar N. Transeau, distinguished plant ecologist, physiologist, algologist, and chairman of the Department. Transeau and his colleague, Homer C. Sampson, were involved in reconstructing the original vegetation of the east-central states, with particular reference to Ohio. Their research consisted of describing and mapping the natural vegetation, usually at the county level, primarily by using the records of the original land surveyors combined with present-day surveys of the vegetation in the field. This methodology was first developed by Paul B. Sears in 1919 while briefly with The Ohio State University and then later pursued vigorously by Transeau and his students (Sears 1921, 1925, 1926a, b, 1970). In addition to its purely scientific value, Transeau and Sampson stressed the practical value of such maps by pointing out their usefulness to agronomists, foresters, and geographers. For example, they showed that the Mexican bean beetle and European corn borer in Ohio were destructive principally in areas once dominated by a single vegetation type in a particular kind of habitat (Neiswander, Sampson, and Kelsheimer 1928; Transeau 1927). Gordon was impressed with these correlations and the practical value of natural vegetation maps. During the 1920's and 1930's, Transeau progressed with these studies by having his graduate students compile the natural vegetation for one or two counties as their thesis requirement. In preparing his thesis for the M.S. degree, Gordon, however, took a different approach. By using the distributional data of over 250 species obtained from the plants filed in the State Herbarium, he outlined four floristic regions of Ohio (Gordon 1928b).

While a graduate student, Gordon gained much practical experience in the field. During the summer of 1927, he worked as a field assistant with Sampson studying the habitat preferences and distribution of the corn borer in northern Ohio. The next two summers he traveled and obtained data on the vegetation of Ohio, Indiana, Kentucky, and Tennessee. Gordon often accompanied Professor John H. Schaffner on field trips in Ohio to assist in the latter's studies of *Equisetum* and other pteridophytes. Field trips with Wheaton Club members also continued, but the most profitable trips may have been those with Transeau to remnant woodlots, shallow ponds, prairie openings, and swamps and bogs. One of his favorite sites was the Urbana Raised Bog, actually a fen, about which he described the vegetation and flora (Gordon 1933b). Although he did not use the word "fen," this paper is frequently cited as one of the earliest studies of fen vegetation in this country, preceding later studies of fens by a decade (Anderson 1943; Stuckey and Denny 1981). Gordon attended Transeau's classes in plant ecology and plant physiology and soon became his "right-hand man," teaching numerous classes in general botany and local flora, as well as conducting many of the field trips for Transeau's plant ecology course from 1930 to 1937. With the field reconnaissance that Gordon had completed it was possible for him to evaluate the literature and present a classification and description of the more extensive primary forest types of the east-central states, the subject of his Ph.D. dissertation (Gordon 1931a, 1932).

Gordon's field work in 1928 enabled him to produce a classification and map of the vegetation of Indiana (Gordon 1936). During summer employment with the Allegany School of Natural History and the New York State Museum he published botanical surveys and large detailed vegetation maps in color of the natural vegetation of Allegany State Park (Gordon 1937a, b, c) and of Cattaraugus County, New York (Gordon 1940a). The latter, a 102-page book with descriptive detail of forest types, associated data on soils, glaciation, bedrock, and numerous maps, including two large fold-out ones, is a model of the Transeau-Sampson method of a comprehensive natural vegetation survey at the county level. Soon after arrival in West Chester, he published an account of the natural vegetation of West Goshen Township, Chester County (Gordon 1941). His manuscript on the vegetation of Franklin County, Ohio, written about 1935, was left unpublished (original copy in office of the Ohio Biological Survey). Gordon's manuscript map of the vegetation of Indiana and those from his graduate theses were useful to Transeau (1935) in preparing his classic map of the Prairie Peninsula (Stuckey 1981). The map of the natural vegetation of Indiana was reproduced by Visher (1944) and evaluated by Potzger et al. (1958).

Transeau and Sampson never completed their study of the original vegetation of Ohio. The plant ecology program in the Department of Botany passed to Transeau's student, John N. Wolfe, and following his departure to the Atomic Energy Commission in 1955, Gareth E. Gilbert inherited the research files of the natural vegetation project. In 1964, Wolfe, Gilbert, and Charles A. Dambach, then Director of the Natural Resources Institute at the University and also Executive Secretary of the Ohio Biological Survey, decided to revive the project. Meanwhile, Gordon had developed his teaching career and had just retired from West Chester State College, when Wolfe invited him to complete the natural vegetation map of Ohio. With financial assistance from the Environmental Biology Section of the National Science Foundation and the Ohio Biological Survey, the project continued for the next two years. The studies completed by Transeau's students were reevaluated, the original survey records extant for many of the counties not studied by Transeau and his students were located, and all of the available information was interpreted and incorporated into a preliminary draft map. The final, 35″ × 38″, eight-colored comprehensive map, *Natural Vegetation of Ohio at the Time of the Earliest Land Surveys,* was published by the Ohio Biological Survey (Gordon 1966). This map, the first of its kind in scope and methodology prepared for any state in the United States, was widely acclaimed. Hal Flint, the cartographer, considered it the "most nearly perfect printing job that he had ever supervised." Smaller versions of the map were later reproduced in books describing Ohio's natural history and outdoor education areas, in environmental impact assessments, in popular magazine articles, and on post cards. Shortly thereafter, a 113-page bulletin, *The Natural Vegetation of Ohio in Pioneer Days,* also published by the Survey (Gordon 1969b), provided an informative descriptive summary of Ohio's original vegetation. Jane L. Forsyth (1970) reviewed the natural vegetation map from a geological viewpoint and noted the many close correlations of the vegetation types with the geologic substrates and urged additional detailed studies for refinement and interpretation. Paul B. Sears (1970), a native Ohioan who had pioneered in the methodology of natural vegetation mapping, acknowledged Gordon's intimate field knowledge of Ohio's vegetation, his thorough and critical review of the available data, and his "excellent map"—all representing a true "demonstration of the broad approach which is the essence of ecology."

Gordon's preparation for the two published contributions on Ohio's original vegetation was his greatest research love, and their content represents a continuous descent of the Transeau philosophy to the present-day generation. These two publications will remain Gordon's lasting achievement in science. Gordon (1931a, 1932, 1934b, 1937a, d, 1940a, 1969b) stressed the importance of understanding natural vegetation and its practical considerations. In the *Bulletin* (Gordon 1969b, p. 2) he wrote ". . . natural vegetation, if it can be correctly ascertained, provides the best possible means of judging the potentiality of the environment which has existed locally for the past thousand years. It appears basic to the environmental sciences which loom large in importance to the requirements of modern civilization and in planning for future land use." Gordon's last professional public appearance was the Sixth North American Prairie Conference held in August 1978 on the campus of The Ohio State University, where he had begun his botanical research career over 50 years previously. That conference paid tribute to Professor Transeau and his research accomplishments toward understanding the Prairie Peninsula. As a part of that tribute, Gordon (1981) presented his personal recollections of the Ohio Natural Vegetation Survey.

## Conservation Efforts; A Tribute

Dr. Gordon was a pioneer in field natural history education, where he taught in the innovative "School in the Forest" at Allegany State Park. As a result of his personal experiences in that program, he recorded the positive values of teaching in the field (Gordon 1938a). His concern for biological conservation was stressed not only in teaching, but also in his work with the Ohio Association of Garden Clubs. He pleaded for the conservation of Ohio's wildflowers in a publication of the extension service of The Ohio State University (Gordon 1931, portion reprinted 1963) and in the Garden Clubs' magazine, *The Garden Path* (Gordon 1933a, 1935). As a tribute to his educational work in biological conservation, West Chester State College in 1973 dedicated a 67-acre woodland on the campus as the "Robert B. Gordon Natural Area for Environmental Studies" (Swinehart 1973). His name is also commemorated in *Rubus gordonii*, a blackberry, described as endemic to the islands in western Lake Erie by Liberty Hyde Bailey (1948).

## List of Selected Publications of Robert Benson Gordon


1928a. Recent records of the American Egret and Little Blue Heron in Ohio. Ohio State Mus. Sci. Bull. 1(1): 47–50.

1928b. The floristic regions of Ohio. M.S. Thesis, The Ohio State Univ., Columbus. 41 pp.

1928c. The floristic regions of Ohio. Proc. Ohio Acad. Sci. 8: 168–169; Ohio J. Sci. 28: 146–147. (Abstract.)

1928d. Swallow-tailed Kite in Ohio. The Auk 45: 372–373.

1929. Suggested equations for the photosynthetic reaction. Ohio J. Sci. 29: 131–132.

1930. Notes on the vegetation of the Highland Rim. Proc. Ohio Acad. Sci. 8: 391. (Abstract.)

1931a. The primary forest types of the east-central states. Ph.D. Dissertation, The Ohio State Univ., Columbus. 65 pp.

1931b. Wild Flowers. Bull. 119. Agric. Extension Serv., The Ohio State Univ., Columbus. 28 pp. (with Victor H. Ries). (Reprinted 1934, expanded to 32 pp.)

1931c. Records of the White Ibis in southern Indiana. The Wilson Bull. 43: 309.

1932. The primary forest types of the east-central states. Abstracts of Doctors' Dissertations, The Ohio State Univ., Columbus. No. 8: 42–52.

1933a. Conserving Ohio's native flora: Drastic measures are necessary to curb the wanton destruction of native plant life in Ohio. The Garden Path 3(3): 5, 15.

1933b. A unique raised bog at Urbana, Ohio. Ohio J. Sci. 33: 453–459.

1934a. *Lemanea grandis* (Wolle) Atk. rediscovered after forty years. Bull. Torrey Bot. Club 61: 437–439.

1934b. Vegetational studies in the east-central states. The Gamma Alpha Record 24(3): 98–99.

1935. What garden clubs can do for conservation. The Garden Path 5(2): 3, 7.

1936. A preliminary vegetation map of Indiana. Amer. Midl. Nat. 17: 866–877.

1937a. The botanical survey of the Allegany State Park (with vegetation map in colors). New York State Mus. Handbook 17: 23–88.

1937b. A botanical survey of the southwestern section of the Allegany State Park. New York State Mus. Handbook 17: 199–247.

1937c. A botanical survey of the northern section of the Allegany State Park. New York State Mus. Handbook 17: 287–328.

1937d. The relation of vegetational surveys to a state park management policy. New York State Mus. Handbook 17: 329–382.

1938a. An outdoors school for the elementary science teachers. School Sci. & Math. 28: 67–71.

1938b. Plant life of the Hocking Parks. Ohio Forest News No. 38: 9–13.

1940a. The primeval forest types of southwestern New York (with vegetation map of Cattaraugus County in colors). New York State Mus. Bull. 321. 102 pp.

1940b. The botanical conference and foray at the Allegany School of Natural History. Science 92(2381): 150–151.

1940c. Additions and corrections to the flora of the Allegany State Park region, Cattaraugus County, New York (1927–38). New York State Mus. Circ. 24: 3–24 (with Homer D. House).

1941. The natural vegetation of West Goshen Township, Chester County, Pa. Proc. Pennsylvania Acad. Sci. 15: 194–199.

1943. The "Darlington Herbarium" at West Chester. Bartonia 22: 6–9.

1946. Vitamin $B_1$ activation of protoplasmic streaming. The Educational Focus 17(3): 18–22.

1947. Wild flowers of the Put-in-Bay Dolomite [Ohio]. Wild Flower 23: 25–28 + 3 pls.

1950. A revised mnemonic for chemical elements essential to plant nutrition. The Amer. Biol. Teacher 12(7): 160–161.

1952. Oldest natural history museums and institutional herbaria in America. Science 115(2982): 217–218.

1953. A summary of faunistic and floristic studies in Chester County, Pennsylvania. Proc. Pennsylvania Acad. Sci. 27: 45–51.

1955a. A Summer Key to the Genera of Native Trees and Trees Likely to be Planted in Chester County, Pennsylvania. Published by the author and the Student Activities Association of the Pennsylvania State Teachers College, West Chester. [12 pp.] (Reprinted, 1960.)

1955b. Additions and corrections to the plant and animal species count in Chester County, Pennsylvania. Proc. Pennsylvania Acad. Sci. 29: 106–108.

1957. Swallow-tailed Kite in Ohio: A retraction. The Auk 74: 262.

1960. A winter field key to willows of Pennsylvania. Proc. Pennsylvania Acad. Sci. 34: 10–14.

1961. Results from testing skins for fluorescent matter. Proc. Pennsylvania Acad. Sci. 35: 242. (Abstract.) (With D. L. Leysath.)

1963. The conservation of wild flowers. Pages 192–196 *in* I. W. Knobloch, ed. Selected Botanical Papers. Prentice-Hall Biological Science Series. Prentice-Hall, Inc., Englewood Cliffs, New Jersey. (Selection from Bull. 119, Agric. Extension Serv., The Ohio State Univ., Columbus, 1934.)

1966. Natural Vegetation of Ohio at the Time of the Earliest Land Surveys. Map (35″ × 38″) in eight colors; scale 1:500,000. Cartography by Hal Flint. Ohio Biol. Surv., Columbus. 1 p.

1967. Ohio's original vegetation. The Wonderful World of Ohio 31(5): 11–15. (Text portion reprinted 1973, Ohio Woodlands 11(2)/Conserv. in Action 12 (Feb., Mar., Apr.): 8–10.)

1969a. A note on the weathering of serpentinite found in southeastern Pennsylvania. Pennsylvania Acad. Sci. Newsletter 27(1): 1.

1969b. The natural vegetation of Ohio in pioneer days. Bull. Ohio Biol. Surv. New Ser. 3(2): xi + 113 pp. (Reprinted, 1973.)

1970a. Annotated List of Chester County Birds. West Chester Bird Club, Inc., West Chester, Pennsylvania. ca. 60 pp.

1970b. Horticulture at the IX International Botanical Congress. Newsletter of the Arboretum of the Barnes Foundation, No. 4: 1–3.

1975a. A season of bloom in the Sonoran Desert of southeastern Arizona. Newsletter of the Arboretum of the Barnes Foundation, No. 14: 10–11.

1975b. A bicentennial tree. Bull. John J. Tyler Arboretum 69: 6.

1975c. A collection of Wm. H. Harvey's Australian algae at West Chester, Pennsylvania, U.S.A. Taxon 24: 628.

1981. Personal recollections of the Ohio natural vegetation survey. Pages 49–50 *in* R. L. Stuckey and K. J. Reese, eds. The Prairie Peninsula—in the "shadow" of Transeau: Proceedings of the Sixth North American Prairie Conference, The Ohio State University, Columbus, Ohio, 12–17 August 1978. Ohio Biol. Surv., Biol. Notes No. 15. x + 278 pp.

## Deposition of Archives and Herbarium Specimens

Dr. Gordon's archives pertaining to his career at West Chester State College are deposited in the Department of Biology at the College. Materials he used pertinent to the Natural Vegetation Survey of Ohio are retained in the office of the Ohio Biological Survey, Columbus. Herbarium specimens of vascular plants of Ohio collected in the 1920's and 1930's are in the herbarium of The Ohio State University. Specimens from Cattaraugus County, New York, prepared in the 1930's while teaching at the Allegany School of Natural History, were presented to the Biology Department of St. Bonaventure University, and to the New York State Museum, Albany. Additional specimens of vascular plants are in the William Darlington Herbarium at West Chester State College and in the Department of Biology, Cabrini College, Radnor, Pennsylvania.

## References

Anderson, W. A. 1943. A fen in northwestern Iowa. Amer. Midl. Naturalist 29: 787–791.

Bailey, L. H. 1948. *Rubus gordonii*. Pages 70–73 *in* E. L. Core. The flora of the Erie Islands: An annotated list of vascular plants. The Franz Theodore Stone Laboratory Contrib. No. 9.

Forsyth, J. L. 1970. A geologist looks at the natural vegetation map of Ohio. Ohio J. Sci. 70: 180–191.

Neiswander, C. R., H. C. Sampson, and E. G. Kelsheimer. 1928. Correlation of borer population with vegetation types. Pages 169–171 *in* L. L. Huber, C. R. Neiswander, and R. M. Salter. The European corn borer and its environment. Ohio Agric. Exp. Sta. Bull. 429.

Potzger, John E., Margaret Esther Potzger, and Jack McCormick. 1958. The forest primeval of

Indiana as recorded in the original U.S. land surveys and an evaluation of previous interpretations of Indiana vegetation. Butler Univ. Bot. Stud. 13: 95–111.

SEARS, P. B. 1921. Vegetation mapping. Science 53(1371): 325–327.

———. 1925. The natural vegetation of Ohio. I. A map of the virgin forest. Ohio J. Sci. 25: 139–149.

———. 1926a. The natural vegetation of Ohio. II. The prairies. Ohio J. Sci. 26: 128–146.

———. 1926b. The natural vegetation of Ohio. III. Plant succession. Ohio J. Sci. 26: 213–231.

———. 1970. Ohio vegetation when first surveyed. Ecology 51: 556–557.

STUCKEY, R. L. 1981. Origin and development of the concept of the Prairie Peninsula, pp. 4–23; Contributors to the development of the Prairie Peninsula concept, pp. 24–39 *in* R. L. Stuckey and K. J. Reese, eds. The Prairie Peninsula—in the "shadow" of Transeau: Proceedings of the Sixth North American Prairie Conference, The Ohio State University, Columbus, Ohio, 12–17 August 1978. Ohio Biol. Surv., Biol. Notes No. 15.

——— AND G. L. DENNY. 1981. Prairie fens and bog fens in Ohio: Floristic similarities, differences, and geographical affinities. Pages 1–33 *in* R. C. Romans, ed. Geobotany II. Plenum Press, New York.

SWINEHART, MAURY. 1973. College gets ecology site. Daily Local News, West Chester, 9 Nov: 8.

TRANSEAU, E. N. 1927. Vegetation types and insect devastations: Distribution of the Mexican bean beetle and European corn borer in Ohio. Ecology 8: 285–288.

———. 1935. The Prairie Peninsula. Ecology 16: 423–437.

VISHER, S. S. 1944. Climate of Indiana. Indiana Univ. Publ. Sci. Ser. No. 13. Bloomington. 511 pp.

## REVIEW

**Rare and Endangered Vascular Plant Species in New Jersey,** prepared by The Conservation and Environmental Studies Center, Inc. in cooperation with The U.S. Fish and Wildlife Service. David B. Snyder and V. Eugene Vivian.

This publication represents the penultimate of an ambitious series devoted to the northeast's rare, threatened, and marginally existing plants, ostensibly for their greater good. Given the problems inherent in such a task all the previous lists have been remarkably thorough, with the New Jersey effort close to the top in readability and reliability. Whether the disclosure of such lists with their availability to the general public serves the final purpose of conservation is dubious. Furthermore, a common failing in works of this sort is a tendency toward some slight braggadocio of both compiler and collaborator. The small vanities of man could lead to the very destruction of the things he may wish to preserve.

A tremendous amount of detail is reflected in the New Jersey list with its attempt at county listing. Nonetheless certain minor errors of omission in range have been made and small errors of fact have crept in. Happily none of these change the overall status of the plants although the reader would have been better served were the major herbaria consulted beyond the Academy and Rutgers. The designations of rare, endangered, threatened, and other categories are personal judgments subject to the limitations of contemporary knowledge. Here the authors have been over-generous in their compiling; many of the plants, in the opinion of this reviewer, need not have been mentioned at all. Too many rare plants can surfeit the average mind and nullify the desired result. For instance, the posting in the Orchidaceae is so lengthy as to be meaningless. Certainly they are a fascinating group that is particularly interesting to the layman and certain field botanists, but as a classification it is doubtful that any of the group has changed much in status in the last half century, or full century really. Even the much publicized *Isotria medeoloides* seems to suffer more from lack of study and search over many decades rather than scarcity. There are at least a half dozen old sites in the northern counties which are not being checked at all.

The authors have not disclosed their criteria for native versus adventive species. These must be rather unusual since some plants from points south, west, and north have been entered and others ignored. *Elephantopus carolinianus, Stellaria pubera, Utricularia olivacea, Lithospermum canescens* have been listed but *Rudbeckia fulgida, Magnolia tripetala,* and *Jussiaea repens,* for instance, have not—and was there sufficient study given to the shrubby *Amelanchiers*: *sanguinea, humilis* and *intermedia*?

Five excellent tables are given in the introduction explaining the status of certain of the plants in relation to Federal Review. Table III on two species, *Dionaea* and *Phyllitis* that are currently under Federal Review for the usual reasons serves no purpose since both are acknowledged transplants and do not meet any native standard in New Jersey. Too much of this is going on in the state already.

Disregarding the doubtful value of the entire federal enterprise in protecting the rare, endangered, and threatened vascular species anywhere, this is a valuable addition to the study of New Jersey's flora and will be appreciated by professional and amateur alike. The authors deserve much praise. VINCENT ABRAITYS

## NEWS AND NOTES

SOUTH JERSEY GRAMINID BOTANIZING. Field trips to locate rare grasses and grass-like plants in southern New Jersey were organized by A. E. Schuyler in June, July, and August, 1980. Plants found were: *Carex livida, Eleocharis brittonii, E. melanocarpa, Fuirena pumila, Manisurus rugosa, Panicum hemitomon, P. hirstii, P. scabriusculum, Rhynchospora filifolia, R. fusca, R. inundata, R. knieskernii, R. oligantha, Scirpus longii,* and *Scleria reticularis.* Specimens of all except *Panicum hirstii, Rhynchospora oligantha,* and *Scirpus longii* were collected and deposited in the Academy's local herbarium. Searched for but not found were *Eleocharis equisetoides, Eriophorum tenellum, Psilocarya nitens* (found by other botanists during 1980, however), *Rhynchospora glomerata,* and *Sacciolepis striata.* ALFRED E. SCHUYLER.

THOMPSON WETLANDS PRESERVE ESTABLISHED. Thompson Wetlands, a recent acquisition of The Nature Conservancy, lies near the eastern border of Susquehanna County, six miles south of the borough of Lanesboro on Route 171. Maximum elevation is 1885 feet; minimum elevation is 1670 feet. This 232-acre preserve contains two large wetland areas, connected by a stream. The first wetland of 72 acres, known as Krall's Bog, has perhaps three acres of open water, surrounded by marshland, a stand of balsam fir, tamarack, black spruce, hemlock swamps, wet meadow, and sedge meadow. The second wetland of 160 acres contains a deep ten acre pond, known as Weir's Pond. It is surrounded by forty acres of bogland, the margin of which resembles the vegetation of Krall's Bog. A great diversity of species and a wide variety of wet and dry habitats make up Thompson Wetlands.

During the summer of 1980, Kevin Webb, a graduate of SUNY Binghamton, with some help from the Stewardship Committee of Thompson Wetlands, made an inventory of the vascular plants. He identified 368 species of plants, of which some 300 specimens have been placed in the herbarium at SUNY Binghamton. The committee plans to continue the work of flora and fauna species inventory. Presently no threatened or endangered species have been found. However, the following species should be mentioned: *Cypripedium acaule,* pink lady slipper; *Habenaria psychodes,* purple fringed orchid; *Abies balsamea,* balsam fir; *Picea mariana,* black spruce; *Larix laricina,* tamarack; *Drosera rotundifolia,* sundew; *Sarracenia purpurea,* pitcher plant; *Utricularia geminiscapa,* bladderwort.

According to Emily Blackman's *History of Susquehanna County,* 1873, Krall's Bog area was occupied by a tannery and a dam from 1830 until late in the nineteenth century. With the tannery came the demise of the hemlocks. Blackman also identifies the stream connecting Krall's Bog and the tannery dam to Weir's Pond as Spruce Swamp Creek, so undoubtedly there was a stand of black spruce at that time. Not too many boreal bogs remain in northeastern Pennsylvania, but with the balsam fir, black spruce, tamarack, and the understory of gold thread, bunchberry, bead lily, and wintergreen, it appears that this is indeed a boreal bog. Most of the preserve has been used for dairy farming for about a century and a half. It is anticipated that all these boreal bog species will reproduce more rapidly now that cattle are no longer grazing.

The Committee is grateful for the work Kevin Webb accomplished at Thompson Wetlands. PATRICIA H. CHRISTIAN AND FLORENCE L. SHELLY.

DELAWARE VALLEY BOTANIZING. The upper Delaware Valley of New Jersey produced an interesting array of plants on a spot survey done in 1980 by Philadelphia Botanical Club members Halliwell, Hanisek, Radis, Snyder, Vivian, and the writer. *Justicia americana* which is common in the Susquehanna and Schuylkill valleys has been particularly elusive on the Delaware except for a single colony near Stockton in Hunterdon County. In July scattered clumps were found in the vicinity of Dingman's bridge in Sussex County and subsequently near the Montague bridge. Its abundance at hese sites should assure further colonies downstream. Uncommon plants found with the *Justicia* were *Galeopsis tetrahit, Hypericum pyramidatum,* and *Vicia americana.*

*Silene nivea* is listed in the *Flora of Pennsylvania* as occurring along the Delaware shores of Pike and Wayne counties. It was particularly gratifying, then, to establish its presence in New Jersey in the vicinity of the above bridges growing on the sandy alluvium. Doubtless its unprepossessing appearance has mitigated against its discovery heretofore.

While *Isanthus brachiatus* has to be classed as a highly infrequent plant in this state, extensive colonies have been seen on the limestone gravels of the lower Lehigh River. In the past summer vast patches of this plant were found in the Phillipsburg railroad yards of Warren County upon the limey slag piles used as fill.

The formerly southern *Eupatorium serotinum* is common from Mercer County southward and has been noted from Warren County but it was only in 1980 that its presence was verified in Hunterdon County by single plants along the Delaware shore at Frenchtown and Stockton. Now here in the central part of the state it meets *Eupatorium altissimum* at the northeastward portion of the latter's range.

*Paspalum psammophilum* is listed as being in Bucks County on the basis of a site upon an island in the Delaware. It was discovered on the Jersey side at Bull's Island State Park on October 6, 1980, thus proving that this sand-lover is a widespread resident within the Delaware Valley. It was completely prostrate, escaping mowers, and accompanied by other low growers of open, sandy soil. VINCENT ABRAITYS.

NATURAL AREAS PROTECTED BY THE NATURE CONSERVANCY IN PENNSYLVANIA AND NEW JERSEY. The Nature Conservancy, a national conservation organization with a local office in Philadelphia, has protected more than 1,700,000 acres of natural areas nationwide, including some 16,000 in Pennsylvania and New Jersey. The Conservancy is a non-profit organization supported by more than 100,000 members (5000 in Pennsylvania and New Jersey). Its main goal is to protect unique ecosystems and habitats of endangered plant and animal species.

Following are some of the areas preserved by The Nature Conservancy in Pennsylvania and New Jersey:

*Tannersville Cranberry Bog,* a 150-acre preserve 5 miles northwest of Stroudsburg, Pennsylvania. A National Natural Landmark, Tannersville Bog is the southernmost low-altitude boreal bog along the eastern seaboard. Deep within the dense tangle of black spruce and tamarack is rich diversity of plant life: grass pinks *(Calopogon pulchellus),* white-fringed and purple-fringed orchids *(Habenaria blephariglottis* and *Habenaria psycodes),* and a variety of insectivorous plants. This quiet Pocono refuge also shelters black bears, otters, beavers, and grey foxes. The Nature Conservancy is currently attempting to acquire additional wetland areas abutting the preserve.

*Lacawac Sanctuary,* a 400-acre preserve located 25 miles east of Scranton, Pennsylvania, and designated a National Natural Landmark. The centerpiece of this exceptional preserve is Lake Lacawac, one of the southernmost unpolluted glacial lakes in North America. Offering a spectacular view of Lake Wallenpaupack, the diverse habitats at Lacawac include ponds, floating bog mats, and ledges covered with an uncommon array of ferns, lichens, and mosses.

*Thompson Wetlands Preserve* (see separate article in this issue).

*Woodbourne Forest and Wildlife Sanctuary,* a 600-acre preserve on Route 29, 5 miles south of Montrose in Susquehanna County containing one of the most remarkable stands of virgin hemlock and northern hardwoods in eastern Pennsylvania. An 11-acre swamp includes a pond surrounded by a thick growth of swamp shrubs and trees, and there are also several small sphagnum bogs on the property. There is a parking lot and self-guiding trail.

*Hutcheson Memorial Forest,* a virgin oak-hickory forest located near East Millstone, New Jersey, now owned and managed by Rutgers University.

*Little Egg Harbor,* 4400 acres of wooded upland and lowland, swamp, and large tidal marsh areas. This land has been transferred to the New Jersey Division of Fish, Game and Wildlife (525 acres) and the U.S. Fish and Wildlife Service (3900 acres) and is managed primarily for waterfowl.

There are trail maps and other information available from Brigantine National Wildlife Refuge, with headquarters just off Route 9 in Oceanville, NJ.

*Greenwood-Rancocas Tract,* an 1800-acre property in Pemberton Township, New Jersey. Typical of the New Jersey Pine Barrens, this property contains 300 acres of cedar swamp, and the remaining upland is covered with oak and pine forest. The tract contains two major streams. The Conservancy transferred title to the New Jersey Department of Environmental Protection for management as an addition to Lebanon State Forest.

Current projects of the Conservancy's Pennsylvania/New Jersey Office include Pine Barrens bogs, an *Isotria medeoloides* station, and a swamp containing an extensive population of *Trollius laxus*.

All of the Conservancy's properties in Pennsylvania and New Jersey are open to the public, although access to certain areas is limited to ensure the preservation of particularly fragile resources. Additional information is available from The Nature Conservancy, 1218 Chestnut Street, Room 801, Philadelphia, PA 19107. R. T. Cook.

PHILADELPHIA CONSERVATIONISTS ESTABLISH FORTESCUE GLADES WILDLIFE RESERVE. Land acquisition, begun in 1964, is now nearly complete for the new Fortescue Glades Wildlife Reserve in southern Cumberland County, New Jersey. This sanctuary is a pilot project of the Philadelphia Conservationists, Inc., and its associated organization, the Natural Lands Trust, Inc., the aim of which is to protect in perpetuity this area and in so doing to test a concept that allows private management of a major wild area, ensuring at the same time public interest and access. Rather than to transfer this land to a public entity such as the U.S. Fish and Wildlife Service as has usually been done with large tracts in the past, the Philadelphia Conservationists intend to maintain their own continuing ownership, management, and oversight of the area.

Located northeast of the town of Fortescue, the new sanctuary contains parts of the drainages of Oranoaken, Dividing, and Fortescue creeks. Within the 3500-acre reserve, there are four major plant communities: salt marsh, oak-pine forest, pine forest, and old-fields. Almost twenty percent of the area of the reserve is open water; approximately fifty percent is classified as open land, vegetated by wetland associations; one quarter of the area is forested and only small amounts are classified as agricultural or developed. Land use patterns have been essentially stable and unchanged over the last several decades.

The salt marsh community is dominated in some locations by *Spartina alterniflora,* in others by *S. patens,* while in some places these two species occur as codominants. Other salt marsh plants include: *Distichlis spicata, Phragmites australis, Scirpus americanus* (*olneyi*), and *Hibiscus moscheutos* with *Iva frutescens* and *Baccharis halimifolia* along the marsh borders.

Oak-pine forest dominants include the following trees in the overstory: species and hybrids of *Quercus, Pinus rigida,* and (often in the absence of the pines) *Liquidambar styraciflua, Nyssa sylvatica, Acer rubrum,* and *Magnolia virginiana.* In some localities *Ilex opaca* constitutes nearly the whole of the understory; in others occur such species as *Clethra alnifolia, Kalmia latifolia, Eubotrys racemosa* (*Leucothoë r.*), and *Myrica cerifera,* along with species and hubrids of *Vaccinium.* Where the oak-pine forest borders the ponds of the salt marsh, *Juniperus virginiana* occurs, sometimes in dense stands. At one station in this forest, *Phoradendron flavescens* grows parasitic on *Nyssa sylvatica* (Phila. Cons. photo #C1-16, Hildacy Library). This species, near the northeastern limit of its range, is considered by the compilers of the *Rare and Endangered Vascular Plant Species in New Jersey* to be vulnerable, restricted in distribution, declining, and endangered in the state. Along the northeast border of the reserve, southwest of County Highway 553, *Pinus rigida* occurs in nearly pure stands.

At the present time, botanical studies of Fortescue Glades Wildlife Reserve are being carried out by the writer, along with ornithological observations by him and others; the immediate aim of these studies is the formulation of an informed management plan for the sanctuary. In the long run, it is hoped that a major contribution will be made, with the cooperation of other members of the local botanical community, to the knowledge of the flora of the Glades and southern Cumberland County.

Plans are being formulated for visitor facilities for Fortescue Glades Wildlife Reserve; these may include a visitors' center, self-guiding nature trails, and publication of literature on the ecology of the sanctuary and its surroundings. STEVENS HECKSCHER.

LA RESIDENCIA DEL CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS, MADRID. Although this Residencia is already well-known to many investigators and researchers from many parts of the world, there are still many scientists and researchers who do not know of the existence of this very important institution. Moreover, there are many among those who come to Madrid to carry on their studies, using the Residencia as their home, who know nothing of the history of this institution.

The Residencia consists of three buildings (pabellones) which contain accommodations for 102 persons, all rooms with bath and the necessary services. In addition, there is a fine dining room where three excellent meals are served each day; meals are well-planned from the nutritional point of view, well-prepared, and well-served. There is a lobby and a salon, where residents can rest, talk to friends, partake of light refreshments; a room for watching TV, plus meeting rooms where conferences can be arranged.

This was the Residencia as I knew it ten years ago, on my first visit. This year, nothing had changed, but now picture-postcards of the Residencia were on sale. One of them was of the lovely sala (salon), in which the piano was identified as having been played by Federico Garcia Lorca, the famous poet. Another showed adelfas (oleanders) which had been planted by another poet, Juan Ramón Jiménez. When I asked questions about the relationship of these two famous men to the Residencia, I learned that the Residencia had an unusually interesting history.

First of all, it owed its existence to a movement which began in 1876. It was called La Institución Libre de Enseñanza (which I translate as the Institution for Free Teaching and Learning). The goal was to provide a system of education which would not be based on a single point of view, whether religious, philosophical, or political. In 1907, the group made connections with the Junta par Ampliación de Estudios e Investigaciones Cientificas (Council for Broadening Studies and Scientific Investigations). This group had plans for establishing Centers of Investigations, Institutes, etc., and from this came the Residencia in 1910, established in a little hotel "en la calle Fortuny," under the direction of Alberto Jiménez (who remained as director until 1936). The expenses were covered by voluntary contributions, while at the same time, arrangements were made for a system of scholarships for those who did not have the necessary funds.

The Residencia opened with 15 students and in 1915 a Residencia Femina was also established. (It is still there but women may now stay at the main Residencia.) In 1913, the Residencia moved to its present site on land which belonged to the Ministry of Public Instruction (which in those days had a beautiful view of the snow-capped Sierra de Guadarrama, 50 miles away). Later that year, the students (who might better have been considered investigators, researchers) began to publish the results of their studies. In 1926, they began publication of the *Revista,* which continued until 1936. In 1920, the Residencia was taking care of 150 "students."

Any listing of the names of Residencia students soon finds many who later became famous for their contributions to the cultural history of Spain: poets like Garcia Lorca, who lived at the Residencia for ten years, and Juan Ramón Jiménez; scientists like Juan Negrin; artists like Salvador Dali; and others like Miguel de Unamuno, and José Ortega y Gasset. La Residencia came to be well-known in centers of European culture and among the names of visitors who came to visit some of the important residents at the Residencia were H. G. Wells, Albert Einstein, Marie Curie, Ravel, Milhaud, et al.

When the Civil War broke out in 1936, the activities of the Residencia were suspended, but the Residencia remained, part of the time as a hospital. After the war, with the formation of the Consejo Superior de Investigaciones Cientificas, thoughts turned again to making the Residencia a center for intellectual activities. In 1944, the Residencia was opened once again, but mainly as just a Residencia for investigators who come to work in Madrid and use the Residencia as their home during their stay in the city, whether for a few days, several months, or a year or more. All those who have lived there carry away with them pleasant memories—a home away from home, formation of new friendships, stimulating conversations, and not to be forgotten staff, from the Director down, that does everything possible to make the visit memorable. IDA K. LANGMAN.

NEW RECORD FOR *LISTREA AUSTRALIS*. In May, 1980, Donna McBride, a staff member of the development review committee of the Pinelands Commission, discovered a new southern New Jersey station for *Listera australis* Lindl. This is the first report for the Southern Twayblade from Burlington County. The Academy herbarium contains specimens of this orchid from four other counties: Cape May, Atlantic, Ocean, and Camden. Vivian and Snyder report in *Rare and Endangered Vascular Plant Species in New Jersey* (1981) that at present there is a single extant site for each of the above counties except Camden.

On April 24, 1981, Miss McBride guided me to this Woodland Township site near Burrs Mill Brook of the Rancocas Creek basin. A diligent search of a shrub-entangled thicket overtowered by *Chamaecyparis thyoides, Nyssa sylvatica,* and *Acer rubrum trilobum* produced a dozen orchids in bud. During a return visit on June 1, 1981, nine orchids were found in the waning stage of anthesis. Finding these delicate, reddish-purple flowers in the shadow of spreading fronds of *Osmunda cinnamomea* among *Acer rubrum* seedlings, *Rubus hispidus, Gaultheria procumbens,* and *Mitchella repens* was a challenge. June obviously is not the month to hunt for the Southern Twayblade. However, more extensive searching in late April and early May, before the luxuriant growth of adjacent plants, may prove rewarding for those on the trail of *Listera australis*. TED GORDON.

UPDATE ON TWO RARE HEATHS. Naturalized from Europe, *Erica Tetralix* L. and *Calluna vulgaris* (L.) Hull are heaths infrequently encountered in the Pine Barrens of New Jersey. Our earliest Academy herbarium record for *Calluna vulgaris* is an 1878 specimen from Egg Harbor City, Atlantic County, collected by M. Parker. J. Bernard Brinton collected it there on September 8, 1889, stating that "a small patch of it now 3 × 4 feet square has existed there about 15 years." This suggests that the plant was introduced at that locality about 1874. The last collection from the site deposited at the Academy was dated 1897.

It appears that there was only one other reported 19th century station for *Calluna vulgaris*. Stowell gathered it in August, 1891, on the border of a cranberry bog near Hammonton, also in Atlantic County. It was not until December 4, 1949, that this heather was collected again. Bayard Long got it from a sandy, peaty bog about two miles south of Cookstown, Burlington County. With it he found *Erica Tetralix,* and his vouchers for the latter species are the only ones on record in the herbarium. This station most likely was near the bogs of Cranberry Hall, now, for the most part, devoured by the Fort Dix ranges. There is a slight possibility that the two heaths are still extant there.

Although Long's 1949 specimens represent the last deposited at the Academy, I am delighted to report that the pink to rose-purple flowers of these two heaths still grace the pine woods. In the summer of 1968 in Burlington County, I chanced upon a few patches of *Calluna vulgaris* in an abandoned blueberry field at Whitesbog and again on the edge of a pitch pine lowland forest about ½ mile south of Atsion. In July, 1970, in Ocean County, while studying succession in an abandoned blueberry field near Cedar Creek above Double Trouble, I was surprised to see a wide swath of *Calluna vulgaris* and lesser patches of *Erica Tetralix,* blending with the native *Pyxidanthera barbulata, Hudsonia ericoides,* and *Leiophyllum buxifolium*. TED GORDON.

## 1980 FIELD TRIPS

April 6. Tyler Arboretum, Lima, Delaware County, PA. This trip was scheduled especially for the bryophytes common to the Arboretum and Delaware County. The moss flora was represented by *Leucobryum glaucum, Platygyrium repens, Bartramia pomiformis, Aulacomnium heterostichum, Polytrichum commune, P. piliferum, Atrichum undulatum* var. *ciliare, Grimnia apocarpa, Funaria hygrometrica* var. *hygrometrica, Physcomitrium pyriforme, Dicranella heteromalla, Dicranum scoparium, D. fulvum, Ceratodon purpureus, Ditrichum pallidum, Pleuridum subulatum, Thuidium delicatulum* var. *delicatulum, Hypnum imponens, Plagiocethium denticulatum, Drepanocladus uncinatus, Hygroamblystegium tenax* var. *tenax, Hygrohypnum eugyrium, Brachythecium oxycladon, B. salebrosum, Callicladium haldianum, Climaceum americanum, Bryum argenteum, B. caespitosum, Fissidens viridulus, Rhodobryum roseum, Entodon seductrix, Anomodon attenuatus,* and *Pogonatum pensilvanicum.*

Lichen species recorded were: *Cladonia bacillaris, C. caespiticia, C. cristatella, C. coniocraea, C. chlorophaea, C. pleurota, C. strepsilis, Parmelia rudecta, Pseudoparmelia caperata, Physcia millegrana, P. aipolia, Graphis scripta, Dermatucarpun fluviatile, Biatorella clavus, Lecidea albocaerulescens, Caloplaca aurentiaca, C. citrina, Lecanora Hageni.* Leader: Jim McGrath.

May 4. Sunrise Mill Park, Limerick, Montgomery County, PA. The park is a highly productive and diverse area for which 618 species had been recorded prior to the walk. The following were among the plants observed: *Iris versicolor, Mertensia virginica, Claytonia virginica, Heteranthera reniformis, Anemone quinquefolia, Saururus cernuus, Stellaria pubera, Thalictrum dioicum, Juglans cinerea, Staphylea trifolia, Phlox subulata, Chimaphila maculata, Aquilegia canadensis, Carex sprengelii, Krigia biflora.* Leader: Ann Newbold.

May 18. Tyler Arboretum, Pink Hill, Lima, Delaware County, PA. Despite heavy rains, club members investigated the serpentine barrens and surrounding areas. The species list prepared from the walk included such plants as *Podophyllum peltatum, Arabis lyrata, Ceanothus americana, Quercus marilandica, Senecio smallii, Lobelia spicata, Phlox subulata, Cerastium arvense* var. *villosum, Rhododendron nudiflorum, Lyonia ligustrina, Sorghastrum nutans, Andropogon scoparius, A. gerardii, Dryopteris hexagonoptera, Adiantum pedatum, Dioscorea quaternata, Smilax glauca, S. herbacea, Collinsonia canadensis, Orchis spectabilis, Houstonia caerulea, Strophostyles helvola, Anthoxanthum odoratum, Dryopteris spinulosa,* and *Ranunculus abortivus.* Leader: Fred Arnold.

June 8. Woodford Property, Cedar Run Lake, Medford, Burlington County, NJ. This trip through the Pine Barrens included both upland and aquatic habitats. Recorded were such species as *Vaccinium vacillans, V. corymbosum, V. atrococcum, V. macrocarpon, Pinus echinata, P. rigida, Helonias bullata, Hudsonia ericoides, Gaylussacia baccata, G. dumosa, G. frondosa, Leiophyllum buxifolium, Arenaria caroliniana, Corema conradii, Lyonia ligustrina, Leucothoë racemosa, Hypochoeris radicata, Sarracenia purpurea, Pyxidanthera barbulata, Comandra umbellata, Calopogon pulchellus, Xerophyllum asphodeloides, Polygala lutea, Pontederia cordata, Nuphar variegatum, Nymphaea odorata,* and *Chamaecyparis thyoides.* Leader: Betty Woodford.

June 23. Mt. Mansfield and Smuggler's Notch. On Mt. Mansfield we saw an assemblage of rare alpine plants which included *Dryopteris fragrans, Lycopodium selago, Carex atratiformis, Vaccinium vitis-idaea,* and a mat form of black spruce, *Picea mariana.* Various lichens and mosses (including the luminous moss *Schistostega*) were observed. After a steep climb up Pringle Slide in Smuggler's Notch, we saw *Saxifraga aizoides, S. aizoon, S. oppositifolia, Asplenium viride, Pinguicula vulgaris, Carex scirpoidea, Scirpus cespitosus,* and *Hedysarum alpinum.* Leaders: Donovan Bowley, Mason Hale, Hubert Vogelmann, and Peter Zika.

June 24 and 25. Lake Champlain Shores. First stop: Quartzite promontories at Rock Point, Chittenden County. Here a thin layer of soil supported *Comandra richardsiana, Shepherdia canadensis, Houstonia lanceolata*—all uncommon in Vermont—as well as pine, oak, and arborvitae. Second stop: Colchester sand dunes, notable for *Hudsonia intermedia.* Third stop: Colchester Wetland Area. *Pogonia ophioglossoides, Nyssa sylvatica, Calopogon pulchellus, Carex limosa,* and *Scheuchzeria palustris* were all found in the bog area. Leaders: David Barrington and Roger Stern.

June 24 and 25. Canoe trip beginning in South Slang, down Little Otter Creek to Hawkins Bay on Lake Champlain and return. We saw extensive emergent wetland dominated by *Scirpus heterochaetus, S. fluviatilis,* and *Typha* × *glauca.* Other less common emergents included *Zizania aquatica, Butomus umbellatus, Sagittaria rigida* (also occurring as a submergent), *Sagittaria latifolia, S. cuneata, Sparganium eurycarpum, Pontederia cordata, Eleocharis palustris, E. erythropoda, Scirpus pungens, Rumex verticillatus, Lythrum salicaria,* and *Penthorum sedoides.* The diverse submergent flora included *Potamogeton crispus, P. epiphydrus, P. foliosus, P. friesii, P. nodosus, P. richardsonii, P. zosteriformis, Vallisneria americana, Elodea canadensis, Heteranthera dubia, Najas flexilis, Ranunculus longirostris, Myriophyllum spicatum, M. exalbescens, M. verticillatum,* and *Megalodonta beckii.* Numerous plants of the floating-leaved *Nuphar variegatum* and *N. rubrodiscum* were found in flower. Other floating-leaved plants present were *Nymphaea odorata* and *Potamogeton natans. Utricularia vulgaris, Lemna trisulca,* and *Spirodela polyrhiza* were floating in or on the water. At our lunch stop on Hawkins Bay, some of the terrestrial plants seen were *Adlumia fungosa, Asplenium trichomanes, Parietaria pensylvanica,* and *Valeriana officinalis. Potentilla anserina* grew abundantly along the shore. Leaders: William D. Countryman and Alfred E. Schuyler.

June 29. Stafford Forge, Eagleswood Township, Ocean County, NJ. This trip was a continuation of the September, 1979, trip which produced many interesting plants. The walk was scheduled to include areas not seen on the last walk and the midsummer aspects of the flora. The list included *Schizaea pusilla, Sarracenia purpurea, Drosera intermedia, D. rotundifolia, D. filiformis, Viola lanceolata, Utricularia fibrosa, Pogonia ophioglossoides, Isoëtes muricata, Rhynchospora gracilenta, R. alba, Lachnanthes tinctoria, Corema conradii, Orontium aquaticum, Amphicarpum purshii, Sabatia difformis, Eupatorium resinosum, Aster nemoralis, A. dumosus, Lysimachia terrestris, Vallisneria americana, Proserpinaca pectinata,* and *Sparganium americanum.* Leader: Joe Arsenault.

July 13. French Creek State Park, Warwick, Chester County, PA. This trip went to three areas: Hopewell Lake, Scott's Run Lake, and Sixpenny Creek. Plants discovered on the walk included *Andropogon glomeratus, Scirpus validus, Rosa palustris, Polygala sanguinea, Rhus vernix, Glyceria melicaria, Betula lutea, Nuphar advena, Chenopodium album, Linum medium, Cirsium arvense, Lythrum salicaria,* and *Scutellaria integrifolia*. Leader: Hans Wilkins.

August 17. Brigantine Beach, Atlantic County, NJ. On this trip 63 species characteristically associated with the foredunes, backdunes, and salt marshes were identified in an area approximately 300 m north of Brigantine Boulevard. *Solidago sempervirens, Andropogon virginicus, Cakile edentula, Spartina patens* var. *monogyna, Ammophila breviligulata, Triplasis purpurea, Euphorbia polygonifolia, Cyperus esculentus, Conyza canadensis* var. *pusilla, Eragrostis spectabilis, Strophostyles helvola, Xanthium echinatum, Gnaphalium obtusifolium,* and *Eragrostis pectinacea* were found on the beach and foredunes; *Phragmites australis, Myrica pensylvanica, Panicum virgatum, Rhus radicans, Plantago aristata, Panicum lanuginosum, Lepidium virginicum,* and *Artemisia vulgaris* were on the backdunes and disturbed areas; and *Spartina alterniflora, S. patens, Distichlis spicata, Typha latifolia, Scirpus pungens, Rosa palustris, Juncus gerardii, Kosteletzkya virginica, Epilobium coloratum, Suaeda linearis, Salicornia virginica, S. europaea, S. bigelovii, Atriplex arenaria, A. patula* var. *hastata, Sabatia stellaris, Limonium carolinianum,* and *Spergularia marina* were located in the saltmarsh and upland edge. Leader: Joe Arsenault.

September 7. Flora of coastal ponds, Monmouth and Ocean counties, NJ. At Old Sam's Pond in Point Pleasant Beach we saw *Ceratophyllum demersum, Eleocharis parvula, Elodea nuttallii, Myriophyllum spicatum, Najas gracillima, Najas guadalupensis, Nymphaea odorata, Potamogeton perfoliatus, Potamogeton pusillus, Vallisneria americana,* and *Utricularia gibba* growing in the water. Shoreline plants included *Cyperus odoratus, Echinochloa walteri, Eleocharis halophila, Eleocharis olivacea, Decodon verticillatus, Hibiscus moscheutos, Sagittaria latifolia,* and *Scirpus pungens*. Along the shore of Wreck Pond in Sea Girt we observed a few small populations of *Limosella subulata* that presumably were exposed by low tide. The presence of *Spartina alterniflora* and *Spartina patens* indicates that this pond is more saline than Old Sam's Pond. No vascular plants were found in the water at Wreck Pond. Leader: Alfred E. Schuyler.

# OBITUARIES

**Leonard Teitell (1920–1980).** Dr. Teitell, a research chemist at Picatinny Arsenal, Dover, NJ, died on December 17, 1980. He was born in Philadelphia on March 21, 1920.

Dr. Teitell received his doctorate from Temple University. He was employed at the Frankford Arsenal in Philadelphia for more than 35 years, and was internationally recognized for his work on fungicides and testing of materials.

He was a member of the American Chemical Society, the Scientific Research Society, the American Institute of Biological Sciences, the American Association for the Advancement of Science, the American Society for Testing and Materials, the Philadelphia Botanical Club, and the Botanical Society of America.

Dr. Teitell had a lifetime interest in botany.

He is survived by his wife, Ruth, two sons and two grandchildren.

**Robert Benson Gordon** (see biographical sketch in this issue).

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## Program of Meetings 1980–1981

| *1980* | *Subject* | *Speaker* |
|---|---|---|
| 25 Sep. | Members Report on Summer Activities | |
| 23 Oct. | Epiphytic Growth with Special Reference to Orchids | Howard Wood |
| 20 Nov. | Environment and the Law | Larry J. Schweiger |
| 18 Dec. | A Botanist in California | John M. Fogg, Jr. |
| *1981* | | |
| 22 Jan. | Preserving Pennsylvania's Natural Heritage | R. T. Cook |
| 26 Feb. | Muhlenberg's Contributions to Willdenow | James A. Mears |
| 26 Mar. | A Moss Study Session | Jim McGrath |
| 23 Apr. | Biology of the Mid-Appalachian Shale Barren Flora | Carl S. Keener |
| 28 May | Illustrated Report of the Local-Flora | Monitoring Committee |

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Commemorative Issue

Edgar Theodore Wherry        John Milton Fogg, Jr.

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# Edgar Theodore Wherry (1885–1982)

JOHN M. FOGG, JR.

The members of the Philadelphia Botanical Club and all who knew will mourn the death, on May 14, 1982, of Dr. Edgar T. Wherry. In his passing, at the age of 96, the world of science has lost one of its most dedicated and versatile scholars.

Edgar Wherry was born in Philadelphia on September 10, 1885 of Welsh–Quaker and German ancestry. He attended Friends Central School, the Wagner Free Institute of Science, and the University of Pennsylvania. From the last-named institution he received his B.S. in Chemistry in 1906 and his Ph.D. in geology and mineralogy in 1909.

For several years Dr. Wherry taught mineralogy at Lehigh University. He then accepted a call from Washington, to work first in the mineralogy department of the Smithsonian Institution and later as a crystallographer in the United States Department of Agriculture.

Wherry's significant contributions to the fields of chemistry, mineralogy, crystallography, and geology are far too numerous for consideration here, nor would they be particularly suitable in an account devoted primarily to his achievements in the plant sciences. Probably his most important contribution to geology was the discovery of the basaltic intrusions in the Triassic of southeastern Pennsylvania. This alone would have qualified him for a niche in geology's "Hall of Fame."

Dr. Wherry had long been a lover of wild flowers, and at their home in Chevy Chase he and his wife (nee Gertrude Smith) established a very extensive garden of native plants. He had already become an ardent conservationist, and he continued until the end of his life to campaign for the preservation of our native flora.

Wherry's affiliation with the Department of Agriculture afforded him ample opportunity for field work and the serious study of plants and their environment. These studies led to the invention of a series of indicator dyes to determine the pH of soils.

Dr. Frederick V. Coville, who was Chief Botanist in the Department, became interested in the cultivation of the high-bush blueberry (*Vaccinium corymbosum*) in southern New Jersey. Knowing of Wherry's competence in chemistry and geology, he assigned this problem to him. The results were a deeper understanding on Wherry's part of the relationship of plants to soils and greatly improved methods for the cultivation of this important crop.

Coville was also interested in the box huckleberry (*Gaylussacia brachycera*) and Wherry devoted himself to the distribution of this remarkable plant at its known stations in Pennsylvania as well as rediscovering a "lost" colony in Delaware. The colony of this plant in Perry County, Pennsylvania, covers several acres and is estimated to be about 13,000 years old, which makes it by a large margin the oldest of living plants.

In the late 20's Dr. Wherry was asked to prepare a list of the notable plants of Mount Desert Island, Maine. This led to the publication of his first book entitled, "Wild Flowers of Mount Desert Island," which became a best seller, but is long since out of print.

Although it is somewhat extraneous to this narrative, mention should certainly be made of Dr. Wherry's relation to the American Mineralogical Society of which he was the principal founder. For many years he wrote for and edited the Society's Journal. He

Edgar Theodore Wherry (1885–1982)

discovered the mineral carnotite in eastern Pennsylvania and is honored by having the mineral wherryite named for him in recognition of services to this important branch of the earth sciences.

Wherry performed a similar service in the establishment and rejuvenation of the American Fern Journal, which celebrated its 50th anniversary in 1976 by dedicating an entire issue to this man who for many years had served as editor. Later, following the publication of his "Fern Guide," he assigned the royalties from that book to the Fern Society.

In 1930 Dr. Wherry joined the faculty of the University of Pennsylvania, where he continued to teach until his retirement in 1955. During his tenure as a faculty member, he carried on a prodigious program of field work, research, and publication.

Long before he joined the faculty at Penn, Edgar Wherry had become familiar to the members of the Botanical Club. Although his home was still in Washington, his family lived in Philadelphia and he spent the Christmas holidays with them. Thus he became the regular speaker at the Club's December meeting.

I well remember many of these talks, all of them illustrated with slides hand-colored by the speaker. His topics included a wide range of subjects: ferns, orchids, carnivorous plants, ericaceous plants, and, of course, *Phlox*, a genus upon which he became a recognized authority.

In 1932 the University inherited a 180 acre tract of land in Chestnut Hill which had belonged to the Morris family. It was understood that this property should be developed as an arboretum and named after the donor. Thus it became the Morris Arboretum of the University of Pennsylvania.

Dr. Rodney H. True, who was then chairman of the Department of Botany, detached four of us from our regular duties for a year in order to establish a teaching and research program at the Arboretum. To Wherry was assigned the task of studying the ecology of the grounds. His careful survey revealed that within this relatively small area there was a marked diversity of soils. On the south slope the soil was circum-neutral, being derived from schistose rocks. The ridge which traverses the property from east to west is composed of quartzite, a metamorphosed sandstone which weathers very slowly to produce an acid soil. To the north, constituting the largest acreage within the grounds, there exists an underlying formation of Cambro-Ordovician limestone, yielding a distinctly alkaline soil. I know of no other arboretum of comparable size in this country in which there exists such a wide variety of soil types. Obviously, this survey was of immense assistance to us when it came to locating the planting sites for various groups of plants.

In 1934 the Bowman's Hill Wild Flower Preserve was established on a 100 acre piece of land near New Hope in Bucks County, PA. Since this Preserve was dedicated to the growing and preservation of plants native to the Commonwealth, it was inevitable that it should enlist Wherry's support and he became one of the first Founders. For many years Wherry continued to collect plants for the Preserve and to establish trails and locate plants according to their ecological requirements. Today the Wherry Fern Trail is one of its most popular features.

I well recall a week-long trip with him to southwestern Pennsylvania to collect rare and unusual plants for the Preserve. Our finds included *Trautvetteria carolinensis* and *Marshallia grandiflora* from Fayette County; *Cymophyllus fraseri* from Somerset County; and *Clethra acuminata* at its only known Pennsylvania locality near Elliotsville, also in Fayette County.

Dr. Wherry conducted taxonomic studies on the genus *Phlox,* which includes about 70 American species. In order to study each species in the field, Wherry visited every state in the Union. His painstaking investigations into specific and varietal characters led to the publication of 38 papers, 21 of which appeared in Bartonia. His book, "The Genus Phlox," was published in 1955 as a monograph of the Morris Arboretum.

Mention must also be made of Wherry's close association with the American Rock Garden Society, whose Bulletin he edited for many years. Until the time of his death he was designated as "Editor Emeritus."

Following his retirement from the University he continued to do active field work and to publish articles and books. Of the latter, in addition to his book on *Phlox,* there appeared two books on ferns and one on wild flowers. He also taught for several years at the Arboretum of the Barnes Foundation.

In the mid-1930's our work on the flora of Pennsylvania began in earnest. Although Dr. True was primarily a plant physiologist, he was keenly interested in field work and realized that there had been no flora of the state since 1903 (and that not a very good one).

The University had purchased a 20-passenger bus to transport students between the campus and the Arboretum, and each spring, after classes were over, we loaded the bus with presses, driers, and collecting papers, rounded up a group of our more interested graduate students, and set forth on a week's collecting trip.

Since the northern tier of counties were the least explored we headed into the northeastern corner of the state and collected everything in sight in three counties. The following year we repeated this procedure in the two or three counties to the west and so on year after year until we felt that that portion of the state had been rather well covered. Whenever possible we returned in summer or fall to gather many of the same things in flower and fruit. Wherry participated in many of these forays and his intimate knowledge of the geography and geology made him an invaluable member of our group.

The many thousands of specimens collected on these trips were mounted by a corps of thirty-some W.P.A. workers. Then came the task of identifying each specimen before it was entered in our records and dotted in on our outline maps.

I embarked upon this alone, since Wherry was still busy with *Phlox,* but he contributed his knowledge of such special groups as ferns, orchids, and ericaceous plants. Then in 1941 I became embroiled in administrative duties which took me pretty well out of the picture for a period of twelve years.

Fortunately, at this point I was able to enlist the cooperation of my colleague Dr. Herbert A. Wahl, Professor of Botany at The Pennsylvania State University. On three occasions Wahl was able to obtain year's leaves of absence and come to Philadelphia to work with Wherry on the Flora.

Here it should be noted that in addition to authenticating and recording every Pennsylvania sheet in the University herbarium we examined all material from the state in the herbarium of the Academy of Natural Sciences. In addition, we borrowed all Pennsylvania specimens from the herbaria of The Pennsylvania State University and the Carnegie Museum in Pittsburgh. We estimate that we examined close to a quarter of a million sheets of Pennsylvania plants. It may be doubted whether any other local flora was so broadly based.

The prodigious task of transferring each of these thousands of records in the form of dots to the outline maps now fell upon the shoulders of Edgar Wherry, and certainly no one could have been better qualified to perform it. He seemed to be acquainted with every town, village, and flag-stop within the stage, and every dot was placed with the utmost precision.

During the course of this operation, he noted that many common species had not been reported from nearby counties. He made a list of them and proceeded to collect these plants so that they might be included in the Atlas.

He also took occasion to compile checklists of four southeastern counties: Bucks, Montgomery, Philadelphia, and Delaware. These were published in Bartonia between 1968 and 1975.

At last, after more than 40 years of combined effort, our "Atlas of the Flora of Pennsylvania" was published by the Morris Arboretum with Edgar T. Wherry as the senior author. Publication was aided by a grant from the William Penn Foundation.

This work consists of a series of range maps showing the occurrence in Pennsylvania of some 3000 species of plants, both native and introduced. An introductory section contains a description of the geology of Pennsylvania, a list of plants of unusual habitats and an outline of synonomy.

Mention has already been made of Wherry's abiding interest in the preservation of wild flowers, a subject on which he lectured and wrote repeatedly. It was his feeling that rare or threatened species should be brought into private gardens, raised to maturity and the seed distributed among those who would propagate and thus preserve them. In an effort to protect vanishing species he established several gardens in the local area:

one is on the campus of the Friends Central School in Overbrook, one is on the grounds of the Arboretum of the Barnes Foundation in Merion, and another is on the property of Mr. and Mrs. H. H. Brenneman in Chester Heights.

Plants named for Dr. Wherry are *Tiarella wherryi* Lak., *Silene wherryi* Small, and *Dryopteris* × *neowherryi* Wagner.

Although largely incapacitated in his declining years, Dr. Wherry's mind remained alert, and he delighted in talking with those who visited him.

As a human being Edgar Wherry was gentle, modest, and unbelievably generous, on more than one occasion assigning the royalties from his books to some worthy undertaking. Nothing seemed to please him more than sharing his vast fund of knowledge with all who sought his aid, and many a student has been guided into productive careers in science through his advice.

Bartonia No. 49: 6–14, 1983

# Bibliography of Edgar T. Wherry

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This bibliography is no doubt incomplete. Dr. Wherry never kept a record of his papers, so far as I know, and his fields of interest were so diverse—chemistry, mineralogy, crystallography, geology, plant geography, ferns, and phloxes—that his publications are widely scattered. The bibliography shows his gradual transformation from a physical scientist to a biological scientist. Only in the years of his work at the University of Pennsylvania after 1930 can we say that he had become a botanist, but even then he continued for some time editing for *Chemical Abstracts* and maintained some interest in mineralogy. After he returned from Washington, D.C. to Philadelphia to teach at Penn, he became a valuable associate of the Philadelphia Botanical Club and the Academy of Natural Sciences of Philadelphia. Dr. Wherry was not a typical, traditionally trained botanist. He was regarded by some as a "loner" and a "maverick." He lacked formal education in such subjects as plant morphology, anatomy, cytology, and physiology, or what training he had did not much influence his thinking and interests. He was much more concerned with plant ecology, geography, and taxonomy. His major contributions to botany were in respect to soils and their role in determining plant occurrence. He contributed especially to the study of substrate acidity, pH. He was a great field man and found many important range extensions, especially in ferns. Taxonomically Dr. Wherry's major contributions dealt with *Phlox,* a genus he had been interested in since his college days. In his later years he became more and more a popularizer of amateur field botany and gardening native plants, and it is in these capacities that he is best remembered by many of his admirers.

1904. The causes of color in minerals. Mineral Collector 11: 87–89.

1905. Luminescent minerals. Mineral Collector 12: 115–118, 131, 133.

1905. Some misnamed local minerals. Mineral Collector 12: 155–159.

1906. Mineralogy. Nelson's Encyclopedia. 8: 172–174.

1907. A new occurrence of scapolite. Mineral Collector 14: 37–39.

1907 (with Stanley E. Law). On a rare occurrence in Delaware County, Pennsylvania. Mineral Collector 14: 33–35.

1907. Note on luminescent spodumene. Mineral Collector 14: 31–32.

1907. Radium in Pennsylvania. Mineral Collector 14: 17–20, errata 43.

1908 (with Elmer Benge). Directory of the mineral localities in and around Philadelphia. Mineral Collector 12: 49–51, 65–67, 89–91, 105–107, 119–121, 139–142, 159–160 errata (1905); 13: 7–10, 21–24, 41–43, 60–62, 65–67, 91–93, 109–111, 129–132, 151–154, 161–163, 183–184, (1906, 1907); 14: 5–7, 25–27, 42–43, (1907); 15: 6–8, 26–28, 44–46, 54–56, 69–70, 85–86, 107–109 (1908).

1908. How quartz crystals form. Mineral Collector 14: 145–151.

1908. The Newark copper deposits of southeastern Pennsylvania. Economic Geology 3: 726–738.

1908. Radium and gems. Mineral Collector 15: 29–32.

1908. Radio-active minerals found in Pennsylvania and their effect on the photographic plate. Jour. Franklin Inst. 165: 59–78.

1908. Notes on copper mining in the American colonies. Jour. Franklin Inst. 166: 309–314.

1908 (with W. H. Chapin). Determination of boric acid in vesuvianite. Am. Chem. Soc. Jour. 30: 1684–1687.

1908 (with W. H. Chapin). Determination of boric acid in insoluble silicates. Am. Chem. Soc. Jour. 30: 1687–1701.

1908. The diving rod—a scientific test. Jour. Eng. Min. 85: 1158.
1908. Amethystine glass. Science 27: 895.
1909. A new occurrence of carnotite. Science 29: 751.
1909. The early Paleozoic of the Lehigh Valley district, Pennsylvania. Science 30: 416.
1910. Contributions to the mineralogy of the Newark Group in Pennsylvania. Trans. Wagner Free Inst. Sci. 7: 5–27.
1910. The colloid nature of the complex inorganic acids. Jour. Franklin Inst. 169: 486–492.
1910 (with Carl Boyer). A comparative study of the radio-active minerals in the collection of the Wagner free institute of science. Trans. Wagner Free Inst. Sci. 7: 29–34.
1911. The copper deposits of Franklin and Adams counties, Pennsylvania. Jour. Franklin Inst. 171: 151–163.
1912. Apparent sun-crack structures and ringing-rock phenomena in the Triassic diabase of eastern Pennsylvania. Proc. Acad. Nat. Sci. Phila. 64: 169–172.
1912. Age and correlation of the "new red" or Newark group in Pennsylvania. Proc. Acad. Nat. Sci. Phila. 64: 373–379.
1912. Crystallographic tables. Science 35: 820–821.
1912. A new occurrence of carnotites. Am. Jour. Sci. 33: 574–580.
1912. Silicified wood from the Triassic of Pennsylvania. Proc. Acad. Nat. Sci. Phila. 64: 366–372.
1913. North border relations of the Triassic in Pennsylvania. Proc. Acad. Nat. Sci. Phila. 65: 114–125.
1913. Does low-protein diet produce racial inferiority? Science 37: 908–909.
1913. Nomenklatur der mineralvarietäten und kolloidmineralien. Centralblatt Mineralogie, Geologie, und Palaotologie for 1913: 518–519.
1913 (with G. S. Chiles). Chemistry of boiler scale prevention. Eng. Mag. 45: 518–23.
1914. Geology; Triassic rocks. History of Lehigh County, Pennsylvania 1: 7–8.
1914. Carnotite near Mauch Chunk, Pennsylvania. U.S. Geological Surv. Bull. 580: 147–151.
1914. Mineral nomenclature. Science 39: 575–577.
1914. Variations in the compositions of minerals. Jour. Wash. Acad. Sci. 4: 111–114.
1914. Notes on wolframite, beraunite, and axinite. Proc. U.S. Nat. Mus. 47: 501–511.
1915. The microspectroscope in minerology. Smithsonian Inst. 16 pp., 1 pl.
1915 (with Samuel Gordon). An arrangement of minerals according to their occurrence. Proc. Acad. Nat. Sci. Phila. 67: 426–457.
1916. A chemical study of the habitat of the walking fern, *Camptosorus rhizophyllus* (L.) Link. Jour. Wash. Acad. Sci. 6: 672–679.
1916. Two new fossil plants from the Triassic of Pennsylvania. Proc. U.S. Nat. Mus. 51: 327–329.
1916. Notes on allophanite, fuchsite, and triphylite. Proc. U.S. Nat. Mus. 49: 463–467.
1916. A peculiar oolite from Bethlehem, Pennsylvania. Proc. U.S. Nat. Mus. 49: 153–156, pls. 40–41.
1916. The chemical composition of bornite. Science 42: 570–571.
1916. Reference lists of chemical elements. Am. Mineral. 1: 6–8; errata 1: 36.
1916. Glauberite crystal-cavities in the Triassic rocks of eastern Pennsylvania. Am. Mineral. 1: 37–43.
1916. A peculiar intergrowth of phosphate and silicate minerals. Jour. Wash. Acad. Sci. 6: 105–108.
1916. The lozenge shaped cavities in the First Watchung Mountain zeolite deposits. Jour. Wash. Acad. Sci. 6: 181–184.
1916. Notes on the geology near Reading, Pennsylvania. Jour. Wash. Acad. Sci. 6: 23.
1916. Calcite rosettes, *in* Explorations and field-work of the Smithsonian Institution in 1915. Smithsonian Misc. Coll. 66: 19–23.
1916 (with G. V. Brown). An American occurrence of miloschite. Am. Mineral. 1: 63–67.
1917. Neodymium as the cause of the red violet color in certain minerals. Jour. Wash. Acad. Sci. 7: 143–146.
1917. The indices of refraction of analized rhodochrosite and siderite. Jour. Wash. Acad. Sci. 7: 365–368.
1917. The nomenclature and classification of the native element minerals. Jour. Wash. Acad. Sci. 7: 447–456.
1917. Clay derived from volcanic dust in the Pierre in South Dakota. Jour. Wash. Acad. Sci. 7: 576–583.
1917. Discussion of the emerald deposits of Muzo, Colombia, by Joseph E. Pogue. Trans. Am. Inst. Min. Eng. 55: 934.
1917. Precambrian sedimentary rocks in the highlands of eastern Pennsylvania. Bull. Geol. Soc. Am. 29: 375–392.
1917. Note on the nomenclature of the lead monoxide minerals. Am. Mineral. 2: 19.
1917. The probable identity of fischerite with wavellite. Am. Mineral. 2: 32.
1917. Merrilite, meteoritic calcium phosphate. Am. Mineral. 2: 119.
1917. Lamellar calcite at Keystone, South Dakota. Am. Mineral. 2: 139.

1917. The occurrence of the native elements. Am. Mineral. 2: 105–108.
1917. Terminated crystals of thaumasite. Am. Mineral. 2: 89.
1917. Observation on the habitat of certain ferns. Am. Fern Jour. 7: 110–112.
1917. A remarkable occurrence of calcite in silicified wood. Proc. U.S. Nat. Mus. 53: 227–230, pls. 29–31.
1917. Notes on alunite, psilondanite, and titanite. Proc. U.S. Nat. Mus. 51: 81–88.
1917. Two new fossil plants from the Triassic of Pennsylvania. Proc. U.S. Nat. Mus. 51: 327–329.
1917 (with E. S. Larsen, Jr.). Halloysite from Colorado. Jour. Wash. Acad. Sci. 7: 178–180.
1917 (with E. S. Larsen, Jr.). Leverrierite from Colorado. Jour. Wash. Acad. Sci. 7: 208–217.
1917 (with M. N. Glenn). Chalcedony mistaken for an iron sulfate mineral. Am. Mineral. 2: 6–7.
1918. Crystallography and optical properties of three aldopentoses. Jour. Am. Chem. Soc. 40: 1852–1858.
1918. Reactions of soils supporting the growth of certain native orchids. Jour. Wash. Acad. Sci. 8: 589–598.
1918. A tetragonal iron phosphide from the Ruff's Mountain meteorite. Am. Mineral. 2: 80–81.
1918. The assignment of crystals to symmetry classes. Jour. Wash. Acad. Sci. 8: 480–487.
1918. Note on iron as a cause of blue colors in minerals. Am. Mineral. 3: 161.
1918. Notes on mimetite, thaumasite, and wavellite. Proc. U.S. Natl. Mus. 54: 373–381.
1918. Certain relations between crystalline form, chemical constitution, and optical properties in organic compounds. Jour. Wash. Acad. Sci. 8: 277–285.
1918. Field identification of diasporite. Am. Mineral. 3: 154.
1918. Some extensions of Huay's laws of crystallography. Am. Mineral. 3: 134–136.
1918. Some minerals from Sylmar, Pa. Am. Mineral. 3: 474.
1918. Famous mineral localities; 5, the Black Hills of South Dakota. Am. Mineral. 3: 44–46.
1918. The life and work of Amos Peaslee Brown. Am. Mineral. 3: 21–23.
1918 (with E. Yanovsky). Identification of the cinchona alkaloids by optical-crystallographic measurements. Jour. Am. Chem. Soc. 40: 1063–1074.
1918 (with A. C. Hawkins). Famous mineral localities; 4, the Joplin District. Am. Mineral. 3: 36–37.
1918 (with T. L. Watson). Pyrolusite from Virginia. Jour. Wash. Acad. Sci. 8: 550–560.
1919. The statement of acidity and alkalinity with special reference to soils. Jour. Wash. Acad. Sci. 9: 305–309.
1919. Reply to Dr. Tutton's discussion of the assignment of crystals to symmetry classes. Jour. Wash. Acad. Sci. 9: 99–102.
1918. Famous mineral localities; 1, the Keokuk Geode region. Am. Mineral. 3: 3–5.
1919. Monazite from Boothwyn, Pennsylvania. Am. Mineral. 4: 123–124.
1919. Chalcopyrite crystals from the Bergen Archways. Am. Mineral. 4: 116–118.
1919. Crystallographic identification of five iso-cyamines. Science 50: 576.
1919 (with O. I. Lee). Manganotantalite from Amelia, Virginia. Am. Mineral. 4: 80–83.
1919 (with E. Q. Adams). The crystallography and optical properties of the photographic sensitizing dye pinaverdol. Jour. Wash. Acad. Sci. 9: 396–405.
1919 (with E. Q. Adams). The classification of mimetic crystals. Jour. Wash. Acad. Sci. 9: 153–157.
1919 (with E. Yanovsky). The crystallography of morphine and certain of its derivatives. Jour. Wash. Acad. Sci. 9: 505–513.
1920. Optical properties of a series of heptitols. Jour. Biol. Chem. 42: 377–82.
1920. Correlation between vegetation and soil acidity in southern New Jersey. Proc. Acad. Nat. Sci. Phila. 72: 113–119.
1920. A fruitless search for *Asplenium fontanum* in Pennsylvania. Am. Fern Jour. 10: 90–91.
1920. Observations on the soil acidity of Ericaceae and other associated plants in the Middle Atlantic States. Proc. Acad. Nat. Sci. Phila. 72: 84–111.
1920. Plant distribution around salt marshes in relation to soil acidity. Ecology 1: 42–48.
1920. The soil reactions of certain rock ferns. I. and II. Am. Fern Jour. 10: 15–22, 45–52.
1920. Nomenclature and classification of sulfide minerals. Jour. Wash. Acad. Sci. 10: 487–496.
1920. Soil acidity and field method for its measurement. Ecology 1: 160–173.
1920. Soil tests of Ericaceae and other reaction sensitive families in northern Vermont and New Hampshire. Rhodora 22: 33–49.
1920. List of triclinic minerals in Goldschmidt's Winkeltabellen. Am. Mineral. 5: 208.
1920. Lists of the monoclinic minerals included in Goldschmidt's Winkeltabellen. Am. Mineral. 5: 181–182.
1920. Lists of the orthorhombic minerals included in Goldschmidt's Winkeltabellen. Am. Mineral. 5: 164–166.
1920. Lists of the hexagonal and trigonal minerals included in Goldschmidt's Winkeltabellen. Am. Mineral. 5: 150–152.

1920. Lists of the tetragonal minerals included in Goldschmidt's Winkeltabellen. Am. Mineral. 5: 132–133.
1920. Lists of the isometric minerals included in Goldschmidt's Winkeltabellen. Am. Mineral. 5: 181–182.
1920. Note on sulfur as a mineral of the moon. Am. Mineral. 5: 167.
1920. Illustration of the isometric system; pyrite from falls of French Creek, Pa. Am. Mineral. 5: 116–117.
1920. The species rank of guadalcazarite. Am. Mineral. 5: 37.
1920. Determining soil acidity by indicators in the field. Jour. Wash. Acad. Sci. 10: 217–223.
1920. *Asplenium gravesii* in Pennsylvania. Am. Fern Jour. 10: 119–121.
1921. The soil reactions of *Spiranthes cernua* and its relatives. Rhodora. 23: 127–129.
1921. Physical chemistry-methods of stating acidity. Jour. Wash. Acad. Sci. 11: 197–199.
1921. The soil reactions of the ferns of woods and swamps. Am. Fern Jour. 11: 5–16.
1921. Ecological studies in the Stockholm cays. Ecology. 2: 223–228.
1921. The Florence Pilkington Manchester memorial collection. Am. Mineral. 6: 53.
1921. New mineral species described during 1916–1920. Am. Mineral. 6: 12–17, 176.
1921 (with W. F. Foshag). A new classification of the sulfo-salt minerals. Jour. Wash. Acad. Sci. 11: 1–8.
1922. Review of the optical-crystallographic properties of calcium oxalate monohydrate. Jour. Wash. Acad. Sci. 12: 196–200.
1922. The statement of theoretical compositions of minerals. Am. Mineral. 7: 32–33.
1922. Soil acidity preferences of some eastern conifers. Jour. Forestry 20: 488–496.
1922. Soil reaction in relation to plant growth. Am. Jour. Pharm. 94: 110–114.
1922. Crystallographic optical properties of calcium fumarate and maleate. Jour. Wash. Acad. Sci. 12: 288–296.
1922. Plagioclase feldspars as a case of atomic isomorphism. Am. Mineral. 7: 113–121.
1922. Constitution of ceruleofibrite. Am. Mineral. 7: 145.
1922. Amphisymmetry crystals. Am. Jour. Sci. 4.
1922. Soil acidity: its nature, measurement, and relation to plant distribution. Smithsonian Rept. 1920: 247–268, pls. 1, 2.
1922. Recent work on soil acidity and plant distribution. Science. 55: 568–570.
1922. Note on specific acidity. Ecology 3: 346–347.
1922 (with E. V. Shannon). Crocidolite from eastern Pennsylvania. Jour. Wash. Acad. Sci. 12: 242–244.
1922 (with G. P. Merril and M. W. Moodey. Handbook and descriptive catalogue of the collections of gems and precious stones in the United States National Museum. Bull. U.S. Natl. Mus. 118: 1–225.
1922 (with E. V. Shannon). Notes on white chlorites. Jour. Wash. Acad. Sci. 12: 239–241.
1922 (with W. F. Foshag). Notes on the composition of talc. Am. Mineral. 7: 167–171.
1923. A soil acidity map of a Long Island wild garden. Ecology 4: 395–401.
1923. Soil chemistry-relations between the active acidity and lime requirement of soils. Jour. Wash. Acad. Sci. 13: 97–102.
1923. Wall ferns in Wilmington, North Carolina. Am. Fern Jour. 13: 17–18.
1923. Volume isomorphism in the silicates. Am. Mineral. 8: 1–8.
1923. The blue rocks in Greenwhich Township. Trans. Hist. Soc. Berks County 3: 204–208.
1923. Note on the composition of thomsonite. Am. Mineral. 8: 121–125.
1923. Apatite crystal cavities. Am. Mineral. 8: 113–114.
1923. New mineral species described during 1916–1920. Am. Mineral. 8: 186.
1923. Volume isomorphism in minerals. Am. Mineral. 8: 94–95.
1923 (with G. L. Keenan). Occurrence and forms of calcium oxalate crystals in official crude drugs. Jour. Am. Pharm. Assoc. 12: 301–318.
1924. Optimum reaction ranges of crop plants. Ind. Eng. Chem. 16: 826–827.
1924. Classified list of minerals described or discredited during 1921. Am. Mineral. 9: 34.
1924. At the surface of a crystal. Am. Mineral. 9: 45–54.
1924. Further notes on atomic volume isomorphism. Am. Mineral. 9: 165–169.
1924. Classified list of minerals described or discredited during 1922. Am. Mineral. 9: 175.
1924. Ferns of eastern West Virginia, I. Am. Fern Jour. 13: 104–109.
1924. Notes on some local plants and their soil acidity. Bartonia 8: 33–34.
1924. Agricultural chemistry—the active acidity of soils. Jour. Wash. Acad. Sci. 14: 207–211.
1925. Radio detector minerals. Am. Mineral. 10: 28–31.
1925. Bentonite as a one-dimensional colloid. Am. Mineral. 10: 120–123.
1925. Tabulation of the aluminium-silicate minerals. Am. Mineral. 10: 140–145.
1925. The Appalachian Aspleniums. Amer. Fern Jour. 15: 46–54.
1925. A new acid-soil onion from West Virginia. Jour. Wash. Acad. Sci. 15: 370–372.

1925. The story of the box huckleberry. Nat. Mag. 5: 238–240.
1925. Some fern finds in Virginia. Am. Fern Jour. 15: 1–7.
1925. Psuedo-isomorphism as illustrated in thomsonite. Am. Mineral. 10: 342–347.
1925. A visit to the locality of newtonite. Am. Mineral. 10: 350–351.
1925 (with E. S. Larsen, Jr.). Beidellite, a new mineral name. Jour. Wash. Acad. Sci. 15: 465–466.
1926. Review of a recent article on the symmetry of the etch figures of alkali halides. Am. Mineral. 11: 324–325.
1926. Soil reaction preferences of three adder's tongues. Am. Fern Jour. 16: 1–3.
1926. Nitrogen as a factor in plant distribution on Mt. Desert Island, Maine. Ecology. 7: 140–142.
1926. Dimensions of oxygen atoms in a crystal. Am. Mineral. 11: 63.
1926. A new cicumnuetral soil prickly-pear from the middle atlantic states. Jour. Wash. Acad. Sci. 16: 11–14.
1926. Wood-ferns on Mt. Desert Island, Maine. Am. Fern Jour. 16: 3–7, pl. 1.
1926. Relations between soil properties and forest growth. Ecology 7: 231–232.
1926. Soil reaction in relation to horticulture. Am. Hort. Soc. 4: 1–14.
1926 (with F. W. Gray). The West Virginia locality of the southeastern relative of *Woodsia scopulina*. Am. Fern Jour. 16: 92–95, pl. 7.
1926 (with R. Buchanoan). Composition of the ash of spanish-moss. Ecology 7: 303–306.
1927. The soil reactions of some saprophytic orchids. Jour. Wash. Acad. Sci. 17: 35–38.
1927. Observations on the wooly lipfern. Am. Fern Jour. 16: 107–109.
1927. Soil reaction of *Saxifraga Aizoon* on Mt. Katahdin. Rhodora 29: 139–140.
1927. A fernless area. Am. Fern Jour. 17: 63–64.
1927. Divergent soil reactions of related plants. Ecology 8: 197–206.
1927. A new method of stating hydrogen ion concentration. Bull. Wagner Free Inst. Sci. 2: 1–6.
1927. The laws of chemical crystallography. Am. Mineral. 12: 28–31.
1927. Names for the symmetry classes based on axes. Am. Mineral. 12: 218–220.
1927. Classified list of minerals described or discredited during 1916–1922 inclusive (supplementary to previous lists). Am. Mineral. 12: 221–222.
1927. Classified list of minerals described or discredited during 1923. Am Mineral. 12: 223–224.
1927. The correct mineralogical name for cupric chloride. Am. Mineral. 12: 263.
1928. The status of keeleyite. Am. Mineral. 13: 29–30.
1928. Notes on *Asplenium Trudelli*. Am. Fern Jour. 17: 135–138, pl. 7.
1928. Selecting a national flower. Jour. N.Y. Bot. Gard. 29: 209–210.
1928. Northward range-extensions of some southern orchids in relation to soil reaction. Jour. Wash. Acad. Sci. 18: 212–216.
1928. Arrangement of the symmetry-classes. Am. Mineral. 13: 198–199.
1928. Report on the determination of the reaction value of acid soils. Jour. Assoc. Official Agr. Chem. 150–152.
1928. Kristallographisch einiger derivat die fructose. Festschr. Victor Goldschmidt 75 Geburst, 267–269.
1928. New term for the $10^{-8}$ centimeter unit. Science 68: 644.
1928. Crystallography and optical properties of b-lactose. Jour. Wash. Acad. Sci. 18: 302–304.
1928. Ferns of dripping spring, Oklahoma. Am. Fern Jour. 18: 61–63.
1928. Plant ecology and northward range-extensions of some orchids in relation to soil reaction. Jour. Wash. Acad. Sci. 18: 212–216.
1928. The history of the Franklin Tree, *Franklinia alatamaha*. Jour. Wash. Acad. Sci. 18: 172–176.
1929. Mineral determination by absorbtion spectra. Am. Mineral. 14: 299–308.
1929. Picking out the Polemoniaceae. Bartonia 11: 1–4.
1929. The eastern subulate-leaved Phloxes. Bartonia 11: 5–35, pls. 1–4.
1929. Three shale-slope plants in Maryland. Torreya 29: 104–107.
1929. Chasing Chelones. Bartonia 10: 1–11.
1929. Further occurrence of the Alleghany cliff-fern. Am. Fern Jour. 19: 101–102.
1929. Acidity relations of the Sarracenias. Jour. Wash. Acad. Sci. 19: 379–390.
1929. New data on atomic dimensions. Am. Mineral. 14: 54–58.
1930. A plea for the improvement of the names of the crystal forms. Am. Mineral. 15: 121.
1930. Suggestions as to standardizing the names of crystal forms. Am. Mineral. 15: 418–428.
1930. The *Asplenium ebenoides* locality near Havana, Alabama. Am. Fern Jour. 11: 30–33, pls. 1, 2.
1930. A long lost Phlox. Jour. Wash. Acad. Sci. 20: 25–28.
1930. Plants of the Appalachian shale-barrens. Jour. Wash. Acad. Sci. 20: 43–52.

1930 (with C. S. Ross and P. F. Kerr). Progress in the study of the clay minerals. Ann. Colloid Symp. 191–193.
1931. The eastern short-styled Phloxes. Bartonia 12: 24–53.
1931. The eastern short-stemmed leatherflowers. Jour. Wash. Acad. Sci. 21: 194–198.
1931. Save our wild flowers. Sci. Month. 33: 535–538.
1931. A new spiral-orchid from the southern states. Jour. Wash. Acad. Sci. 21: 49–51.
1931. *Asplenium bradleyi* erroneously reported on limestone again. Am. Fern Jour. 21: 111–113.
1931. One hundred wild flowers of the northern Blue Ridge. Guide to Paths in the Blue Ridge: 227–249.
1931 (with Florence Bascon et al.). Geology and mineral resources of the Quakertown-Doylestown district, Pennsylvania and New Jersey. U.S. Government Printing Office, Washington D.C. 62pp., 4 pls.
1932. The eastern long-styled Phloxes, part I. Bartonia 13: 18.
1932. The eastern long-styled Phloxes, part II. Bartonia 14: 14–26.
1932. Range-extensions and other observations, 1931–32. Am. Fern Jour. 22: 79–86, pls. 5, 6.
1932. Ecological studies of serpentine-barren plants—I. Ash composition. Proc. Pa. Acad. Sci. 6: 32–38.
1932. Acid soil gardening. New York Gardens 1–4.
1933. The eastern veiny-leaved Phloxes. Bartonia 15: 14–26.
1933. A conifer from the Triassic of Bucks County, Pa. Proc. Pa. Acad. Sci. 7: 164.
1933. The Appalachian relative of *Sarracenia flava*. Bartonia 15: 7–8.
1933. Fern field notes, 1933. Am. Fern Jour. 23: 109–112.
1933. The geographic relations of *Sarracenia purpurea*. Bartonia 15: 1–8.
1933. *Heuchera hispida* Pursh rediscovered. Rhodora 35: 118–119.
1933. Polemoniaceae—Phlox family. Manual Southeastern Flora 1099–1105.
1933. Native orchids. Our eastern orchids and their cultivation 1–4. Am. Orchid Soc. Bull.
1933. Four shale-barren plants in Pennsylvania. Proc. Pa. Acad. Sci. 7: 161–164.
1934. The box huckleberry as an illustration of the need for field work. Bull. Torrey Bot. Club. 61: 81–84.
1934. Exploring for plants in the southeastern states. Sci. Month. 38: 80–85.
1934. Further notes on three plants mentioned in Claytonia vol. I, no. 1. Claytonia 1: 7–8.
1934. *Heuchera hispida* Pursh. Claytonia 1: 25–28.
1934. *Ophioglossum Engelmanni* Prantl. Claytonia 1: 39–41.
1934. Temperature relations of the bunchberry, *Cornus canadensis* L. Ecology 15: 440–443.
1934. Fern field notes, 1934. Am. Fern Jour. 24: 97–104.
1934. The Sedums of the eastern United States. Gardeners Chronical of America 38: 264–266.
1934. The Bowmans Hill State Wild Flower Preserve. Proc. Pa. Acad. Sci. 8: 34–37.
1935. Fern field notes, 1935. Am. Fern Jour. 25: 123–126.
1935. A variety of *Phlox ovata* from the Alabama mountains. Bartonia 16: 37.
1935. Supplementary notes on the eastern Phloxes. Bartonia 16: 38.
1935. Fifteen notable shale-barren plants. Claytonia 2: 19–22.
1935. The northern limits of *Polypodium polypodioides* in the east. Claytonia 2: 32.
1935. Our native Phloxes and their horticultural derivatives. Nat. Hort. Mag. 14: 209–231.
1935. *Parnassia* in Virginia and adjoining states, another nomenclatorial mix-up. Claytonia 1: 51–53.
1935. The Polemoniaceae of Pennsylvania. Proc. Pa. Acad. Sci. 9: 150–155.
1935. The Polemoniaceae of Virginia. Claytonia 2: 3–4.
1935 (with M. V. Walcott). Illustrations of North American pitcher plants. Smithsonian Inst., 34 pp., 3 pls.
1935. An Ozark variety of *Phlox pilosa*. Am. Midl. Nat. 16: 413–416.
1935. How plants utilize the soil. Abstr. Lectures Pa. Hort. Soc.: 6–10.
1936. Fern field notes, 1936. Am. Fern Jour. 26: 127–131.
1936. Observations on *Selaginella tortipila*. Castanea 1: 65–69.
1936 (with William D. Gray). Variants of some Appalachian Aspleniums. Am. Fern Jour. 26: 77–86.
1936. *Anemone minima*. Claytonia 2: 52–53.
1936. Rock plants on bald knob, Franklin County, Virginia. Claytonia 2: 54–55.
1936. Polemoniaceae of the middle Appalachian region I., Polemoniaceae of the middle Appalachian region II. Castanea 1: 12–15, 32–35.
1936. Presidential address: Reflections on the origin of life. Proc. Pa. Acad. Sci. 10: 12–15.
1936. *Polemonium* and *Polemoniella* in the eastern states. Bartonia 17: 5–12.
1936. The ranges of our eastern Parnassias and Sedums. Bartonia 17: 17–20.
1936. Miscellaneous eastern Polemoniaceae. Bartonia 18: 52–59.
1937. Guide to eastern ferns. Science Press Printing Co., Lancaster. 220 pp.

1937. Notable Pennsylvania ferns. Proc. Pa. Acad. Sci. 11: 52–54, 79–81.
1937. *Clematis Addisonii* Britton. Claytonia 3: 42–43.
1937. The genus *Heuchera* in Virginia. Claytonia 4: 3–6.
1937. A hybrid-fern name and some new combinations. Am. Fern Jour. 27: 56–59.
1937. Synonyms and variety names for *Phlox nivalis*. Gard. Chron. Am. 41: 212–213.
1937. Two plant-geographic notes. Castanea 2: 1–2.
1937. Southern occurrences of *Dryopteris clintoniana*. Am. Fern Jour. 27: 1–5.
1937. Additional note on *Selaginella tortipila*. Castanea 2: 28.
1938. The Phloxes of Oregon. Proc. Acad. Nat. Sci. Phila. 90: 133–140.
1938. Colorado ferns. Am. Fern Jour. 28: 125–140, pl. 12.
1938. A note on the interpretation of etch figures. Am. Mineral. 23: 156–157.
1938. Midland fern notes. Am. Fern Jour. 28: 28–30.
1938 (with L. Constance). A new Phlox from the Snake River canyon Idaho—Oregon. Am. Midl. Nat. 19: 433–435.
1939. Four southwestern subspecies of Phlox. Jour. Wash. Acad. Sci. 29: 518–519.
1939. Recent fern finds in West Virginia. Castanea 4: 1–4.
1939. Plant finds in June, 1939. Castanea 4: 137–138.
1940. A novelty in the genus *Tiarella*. Not. Nat. 42: 1–4.
1940. Five recent books on ferns. Bartonia 20: 38.
1940. A northern and southern plant in York County, Pennsylvania. Bartonia 20: 27.
1940. *Phlox stolonifera*. Saxiflora (Am. Rock Gard. Soc.) 9.
1940. Geographic relations in the genus Phlox. Bartonia 20: 13–14.
1940. A provisional key to the Polemoniaceae. Bartonia 20: 14–17.
1941. Triassic life, in geology and mineral resources of Bucks County, Pennsylvania, by Benjamin L. Miller. Bull. Pa. Geol. Surv. 4th. Serv. c39: 231–236.
1941. Two Virginia fern records. Va. Jour. Sci. 2: 209.
1941. *Asplenium adiantum-nigrum* in Arizona. Am. Fern Jour. 31: 97–100.
1941. Remarks on the name *Phlox nivalis*. Rhodora. 43: 71.
1941. A new hybrid Phlox (*P. Henryae*). Nat. Hort. Mag. 20: 151.
1941. The Phloxes of Idaho. Not. Nat. 87: 1–15.
1942. The genus *Polemonium* in America. Am. Midl. Nat. 27: 741–760.
1942. *Lycopodium sabinaefolium* in Pennsylvania. Am. Fern Jour. 32: 111–113.
1942. Relationship of *Lilium Michiganense*. Rhodora 44: 453–456.
1942. The discoveries of new Pennsylvania ferns. Am. Fern Jour. 32: 148–149.
1942. The ferns and lycosphens of Pennsylvania. Bartonia 21: 11–63, 1 pl.
1942. Guide to eastern ferns. Ed. 2.
1942. The Phloxes of Nevada. Not. Nat. 113: 1–11.
1942. *Phlox* (in Arizona). Kearney and Peebles' Plants and Ferns Arizona; U.S. Dept. Agr. Misc. Publ. 423: 712.
1942. A woodfern hybrid deserves a name. Bartonia 21: 1–2, 1 pl.
1942. Observations on Florida ferns. Am. Fern Jour. 32: 139–145.
1943. The American azaleas and their varieties. Nat. Hort. Mag. 22: 158–166, 2 pls.
1943. *Phlox amoena*. Bull. Am. Rock Gard. Soc. 1: 59.
1943. *Microsteris, Phlox,* and an intermediate. Brittonia 5: 60–63.
1943. Variation in *Phlox floridana*. Bartonia 22: 1–2, 1 pl.
1944. The minor genus *Polemoniella*. Am. Midl. Nat. 31: 211–215.
1944. Ten American Polemoniums for the rock garden. Bull. Am. Rock Gard. Soc. 2: 1.
1944. The best white mossy Phlox. Horticulture 22: 358.
1944. *Cystopteris* bluff. Am. Fern Jour. 34: 92–94.
1944. Review of the genera *Collomia* and *Gymnosteris*. Am. Midl. Nat. 31: 216 231.
1944. *Osmunda cinnamomea* f. *cornucopiaefolia*. Am. Fern Jour. 34: 94–95.
1944. Note on the southeastern relatives of *Lycopodium inundatum*. Am. Fern Jour. 34: 24.
1944. New Phloxes from the Rocky Mountains and neighboring regions. Not. Nat. 146: 1–11.
1945. The indument of *Cystopteris fragilis*. Am. Fern Jour. 35: 54–55.
1945. A variant of the nodding Trillium. Bartonia 23: 49.
1945. *Phlox cluteana*. Am. Bot. 51: 2.
1945. The *Phlox carolina* complex. Bartonia 23: 1–9.
1945. Two linanthoid genera. Am. Midl. Nat. 34: 381–387.

1945. Supplementary notes on the genus *Polemonium*. Am. Midl. Nat. 34: 375–380.
1945. Our most-renamed native fern. Am. Fern Jour. 35: 128.
1945. Notes on Illinois Pteridophytes. Am. Fern Jour. 35: 92.
1946. Rock garden Phloxes. Bull. Am. Rock Gard. Soc. 4: 17.
1946. The *Gilia aggregata* group. Bull. Torrey Bot. Club. 194–202.
1946. Notes on Muhlenberg's ferns. Am. Fern Jour. 36: 54–58.
1946. A key to the cultivated Hostas. Nat. Hort. Mag. 25: 253–256.
1947. Our easternmost *Cheilanthes* species. Am. Fern Jour. 37: 77–79.
1947. A key to the eastern North American lilies. Bartonia 24: 5–8.
1947. A crispate variant of the Christmas fern. Am. Fern Jour. 37: 121.
1947. *Selaginella rupestris* in Pennsylvania. Am. Fern Jour. 37: 24–25.
1948. Remarks on the American lady ferns. Am. Fern Jour. 38: 155–158, pl. 13.
1948. Polemoniaceae (including Phlox) of Idaho. Herb. Leafl. Ida. St. Coll. 24: 1.
1948. Wild flower guide, northeastern and midland U.S. Doubleday, Garden City. 202 pp.
1949. Further observations on eastern Tiarellas. Bartonia 25: 70.
1949. A plastic spray for coating herbarium specimens. Bartonia 25: 86.
1949. Geographic notes on the bog fern. Am. Fern Jour. 39: 18–19.
1949. Progress in the genus Phlox (abstract). Am. Jour. Bot. 35: 817.
1949. Exploring for Phlox in 1948. Bull. Am. Rock Gard. Soc. 7: 5.
1949. Postscript on eastern lilies. Bartonia 25: 71–72.
1949. *Trillium pusillum* in Maryland. Bartonia 25: 71.
1950. A new interpretation of the *Dryopteris clintoniana* group. Am. Fern Jour. 40: 118–120.
1951. Isotypes and arithmotypes (with Phlox examples). Taxon 1: 32.
1951. Observations on *Phlox adsurgens*. Bull. Am. Rock Gard. Soc. 9: 80.
1951. *Phlox* (in Arizona). Kearney and Peebles' Arizona flora, 680.
1951. Observations at Bartholomew's Cobble. Am. Fern Jour. 41: 13–14.
1951. Subspecies of three eastern Phloxes. Castanea 16: 97–100.
1952. F. W. Pennell. Castanea 17: 66–67.
1952. Polemoniaceae (including Phlox). Davis' Flora of Idaho, 551.
1953. Shale-barren plants on other geological formations. Castanea 18: 64–65.
1954. Lowland Lycopodiums in the New Jersey highlands. Bull. Torrey Bot. Club. 81: 364.
1954. Nomenclature of the oak-ferns. Am. Fern Jour. 44: 85–86.
1955. The identity of *Dupratzia* Rafinesque (*Eustoma*). Castanea 20: 71.
1955. The substratum of *Trichomanes petersii*. Am. Fern Jour. 45: 93–95.
1955. The genus Phlox. Morris Arboretum Monograph 3: 174 pp.
1956. Validation of new combinations in *Phlox*. Baileya 4: 5–7.
1957. Our dwarf bindweeds. Bartonia 28: 32–33.
1957. Reminiscences of John K. Small. Castanea 22: 126–129.
1957. Which northeastern ferns are evergreen? Am. Fern Jour. 47: 93–95.
1958. Proposals (on nomenclature). Taxon 7: 152.
1959. Goose Pond saved. Bartonia 29: 2.
1959. One-hundred "lost" local plants. Bartonia 29: 5–7.
1959. Silver anniversary of the Bowman Hill State Wildflower Preserve. Bartonia 29: 8.
1959. Successive geologic maps of Buckingham Mountain. Proc. Pa. Acad. Sci. 33: 195–197.
1959. Triassic life, in geology and mineral resources of Bucks County, Pennsylvania, by Bradford Willard. Bull. Pa. Geol. Surv. 4th. Ser. c9: 114–125.
1960. How I became interested in ferns. Am. Fern Jour. 50: 225–228.
1960. Progress in the study of *Dryopteris* hybrids. Am. Fern Jour. 50: 87–92.
1961. The fern guide. Doubleday & Co., Garden City. 318 pp.
1961. A new annual *Phlox* (*P. Johnstonii*). Wrightia. 2: 198–199.
1961. Remarks on the genus *Linanthus*. Aliso 5: 9–10.
1961. Remarks on the *Ipomopsis aggregata* group. Aliso 5: 5–8.
1961. Supplementary note on *Dryopteris* hybrids. Am. Fern Jour. 51: 33–35.
1962. Native ferns in the garden. Plants & Gard. 18: 38–42.
1962. Robert P. St. John: 1869–1960. Am. Fern Jour. 52: 79–81.
1962. David Fables, naturalist and educator. Bartonia 31: 1, 1 pl.
1964. Some Pennsylvania barrens and their flora. I. Serpentine. Bartonia 33: 7–11.
1964. The southern fern guide. Doubleday & Co., Garden City. 349 pp.

1964. New combinations in Texas Polemoniaceae. Sida 1: 250–251.
1964. Some new name-combinations for southeastern ferns. Am. Fern Jour. 54: 143–146.
1965. Harry W. Trudell. Bartonia 34: 1–2.
1965. The most disjunct species in Pennsylvania. Bartonia 34: 7.
1965. Some Pennsylvania barrens and their flora. II. Bartonia 34: 8–11.
1965. Acceptance of the Mary Soper Pope Medal. Bartonia 34: 14–15.
1965. "Lady Botanist." Bartonia 34: 15.
1965. Relationships of *Phlox caespitosa, pulvinata,* and *douglasii* (Polemoniaceae). Sida 2: 154–156.
1966. The genus Phlox ten years after. Bartonia 35: 13–16.
1966. Southern records of *Ophioglossum vulgatum.* Am. Fern Jour. 56: 182–183.
1966. Polemoniaceae. In Flora of Texas 1: 284–321.
1966. The genus Phlox, ten years after. Bartonia 35: 13.
1967. Our temperature tufted Polemoniums. Aliso 6: 97.
1968. A check-list of the flora of Delaware County, Pennsylvania. Bartonia 37: 1–21.
1969. A check-list of the flora of Philadelphia County, Pennsylvania. Bartonia 38: 1–18.
1969. *Phlox* and *Polemonium* in the intermountain region. Sida 3: 441.
1970. Review of the flora of Ulster County, New York by Mary Domville and Henry F. Dunbar. Bartonia 39: 16.
1970. Notes on Phloxes in the Gulf States. Castanea 35: 198.
1971 (with Otway H. Brown). Check-list of the vascular flora of Cape May County, New Jersey. Bartonia 40: 1–18.
1972. *Rumex hastatus,* a new Delaware County taxon. Bartonia 41: 84.
1972. A check-list of the flora of Montgomery County, Pennsylvania. Bartonia 41: 71–84.
1975. *Hydrilla verticillata* (Hydrocharitaceae) new to Louisiana. Sida 5: 354.
1975. A check list of the flora of Bucks County Pennsylvania. Bartonia 43: 1–14.
1979 (with John M. Fogg, Jr. and H. A. Wahl). Atlas of the flora of Pennsylvania. Morris Arboretum, Philadelphia. xxx + 390 pp.
1982. The autobiography of Edgar T. Wherry. Fiddlehead Forum (Bull. Am. Fern Soc.) 9: 32–33.

Bartonia No. 49: 15–19, 1983

# John Milton Fogg, Jr. (1898–1982)

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John Milton Fogg, Jr. was born on November 8, 1898, in Philadelphia. He obtained a Bachelor of Science degree from the University of Pennsylvania in 1925 and his Ph.D. in botany from Harvard in 1929. He was an Instructor in botany at the University of Pennsylvania from 1925 to 1932, an Assistant Professor from 1932 to 1941, an Associate Professor from 1941 to 1944, and was promoted to full Professor in 1944. In addition to his teaching responsibilities, Dr. Fogg was Dean of the College of Arts and Sciences from 1941 to 1944 and Vice Provost of the University from 1944 to 1953. He was the Director of the Morris Arboretum from 1954 to 1965 and later the Director of the Arboretum of the Barnes Foundation from 1965 to 1979.

During his student days, Dr. Fogg worked part time at the Academy of Natural Sciences where he later held the position of Research Associate for many years. In the summer of 1923, he went to Woods Hole to assist Professor William Randolph Taylor with his course on algae. He spent five summers at Woods Hole where he became interested in the Flora of the Elizabeth Islands. This became the subject of his doctoral dissertation under the direction of Professor Merritt L. Fernald of Harvard. He travelled to the Selkirks in British Columbia with Professor Merkil Jacobs, Professor Taylor, and Paul Bowman in 1925, and to Newfoundland with Professor Fernald and Bayard Long in the summers of 1926 and 1929.

During the early 1930's Dr. Fogg's floristic interests were concentrated on southwestern New Jersey where he and Bayard Long had mutual interests. In 1932, he identified and labeled plants on what is now known as the Morris Arboretum with the help of Joe Adams. Eventually, at the suggestion of Dr. Rodney H. True, he began to prepare a flora of Pennsylvania, a project which had many interruptions because of conflicting duties.

During Dr. Fogg's 57-year career he taught botany to hundreds of students at the University of Pennsylvania. For three summers (1938–1940) he taught at the University of Virginia Biological Station at Mountain Lake. In 1940, he was one of the first instructors at the Barnes Arboretum where Mrs. Laura Barnes established the Arboretum School of Botany and Horticulture. Dr. Fogg continued to teach at Barnes until his death. Many of the plants used for teaching purposes at the Barnes Arboretum were selected by Dr. Fogg and he carefully watched over them as they grew and matured.

John Milton Fogg, Jr.

Dr. Fogg was an expert in botanical taxonomy and was frequently asked to review publications concerning plants with the purpose of assuring the writers that the plant names were those most widely accepted. Students in his classes were encouraged to be accurate in the pronunciation and spelling of botanical names. His insistence on this important phase of botany has been of great value in standardizing the proper plant names.

Dr. Fogg travelled widely during his years as an administrator to meet with groups of alumni to update them on the University's activities. Most of his travelling, however, was related to his association with the two arboretums and repeated trips were made to Europe, Asia, Africa, Australia and New Zealand, South America, Caribbean islands, and Mexico. As a botanical consultant to E. R. Squibb and Company (1954–1962), he made two trips to India, Burma, and Thailand to study *Rauwolfia* and its conditions of culture. In the United States, he conducted field work in virtually every part of the nation. He was particularly interested in the flora of the Atlantic Coastal Plain. He regularly spoke to garden clubs, the Philadelphia Botanical Club, and other organizations about the plants he was able to photograph in all parts of the world.

Dr. Fogg was a member of the Visiting Committee of the Arnold Arboretum at Harvard, a member of the Board of Managers of the New York Botanical Garden, and a member of the Executive Committee of the Pennsylvania Horticultural Society and the John Bartram Association. He also held posts in the American Philosophical Society and the Botanical Societies of Pennsylvania and America as well as the Academy of Natural Sciences and the Philadelphia Botanical Club. In the latter club he was Curator for many years and regularly gave lectures on various aspects of his many tours. He also was a member and president of the Ludwig Society of Philadelphia.

An authority on the magnolia, Dr. Fogg founded the National Magnolia Society and served as International Registration Authority for Magnolias. It was his responsibility to register new names for new varieties of magnolias. This interest has resulted in an exceptional collection of magnolias at the Barnes Arborteum.

Among the numerous honors received by Dr. Fogg were the Philadelphia Horticultural Society Distinguished Achievement Award in 1970 and the Massachusetts Horticultural Society Silver Medal in 1978. He also was awarded an honorary degree (Sc.D.) from LaSalle College. *Antennaria foggii* Fernald and *Chenopodium foggii* Wahl are plants named after Dr. Fogg.

Dr. Fogg's publications include the popular *Weeds of Lawn and Garden*, published in 1945, the *Checklist of Cultivated Magnolias* with J. C. McDaniel in 1975, and the *Atlas of the Flora of Pennsylvania* with Edgar T. Wherry and Herbert A. Wahl in 1979.

As a teacher of all phases of plant life, Dr. Fogg was beloved by his students. His broad knowledge, developed by study, research, and travel, made him a recognized authority in his field. His interesting anecdotes, interspersed in his lectures, held the rapt attention of his audience. The botanical world has lost a great champion.

Surviving Dr. Fogg are his wife Helen Biggs Fogg; daughters Sonia Davis and Felicia Gonzalez and six grandchildren.

## Bibliography of John M. Fogg, Jr.


1924. The Flora of Penikese—Spermatophyta. Rhodora 26: 219, 222–229.

1927 (with W. R. Taylor). Notes on some freshwater algae from Newfoundland. Rhodora 29: 160–164.

1928. The clandestine form of *Leersia oryzoides*. Rhodora 30: 81–85.

1929. A second station for *Panicum longifolium* in Massachusetts. Rhodora 31: 39–40.

1930. *Tipularia discolor* in Dukes County, Massachusetts. Rhodora 32: 114–117.

1930. A few noteworthy plants from Falmouth, Massachusetts. Rhodora 32: 103–110.

1930. The flora of the Elizabeth Islands. Rhodora 32: 119–132, 147–161, 167–180, 208–221, 226–258, 263–281.

1931. Notes on a few introduced species in the Philadelphia area. Bartonia 13: 48–49.

1933. *Leptoloma cognatum* in southern New Jersey. Bartonia 15: 37.

1933. Reviews of three recent floras. Bartonia 15: 46–54.

1933. *Euphorbia dentata* in the Philadelphia local flora. Bartonia 15: 35–36.

1934. *Lilaeopis chinensis* in southern New Jersey. Bartonia 16: 51–56.

1935. *Lophotocarpus spongiosis* in Salem County, New Jersey. Bartonia 17: 21–22.

1935. Review of Zenkert's Flora of the Niagara Frontier Region. Bartonia 17: 46–47.

1937. A station for *Hymenophysa pubescens* in the eastern U.S. Rhodora 39: 190–192.

1938. Spring flowers. Frontiers 2, No. 4: 120–125.

1939. A station for *Cheilanthes alabamensis* in Giles Co., Va. Rhodora 41: 137–138.

1940. Suggestions for collectors. Rhodora 42: 145–157.

1942. Eastern Asiatic plants in eastern American gardens. Morris Arb. Bull. 4: 15–20.

1945. Effects of acceleration on the faculty. Crozier Quarterly 22, No 2: 104–108.

1945. Weeds of Lawn and Garden. Univ. of Penna. Press. 215 pp.

1946. Review of: Chromosome atlas of cultivated plants by C. S. Darlington & E. K. Janaki. Science 103: 736.

1947. Some methods applied to a state flora survey. Contrib. Gray Herb. 165: 121–132.

1951. Fernald as a teacher. Rhodora 53: 39–43.

1952. The scientists look at our world. Edited and introduction. Univ. of Penna. Press.

1954. Trees in Fairmount Park. Fairmount Park Art Assoc. Ann. Rep. 82: 17–36.

1955. Boxwood at the Morris Arboretum. Morris Arb. Bull. 6: 33.

1956 (with H. L. Li). *Albizia*. Morris Arboretum Bulletin 7: 40–41.
1957. Spring Flowering Calendar. Morris Arb. Bull. 8: 9–10.
1957. *Actinidia* at the Morris arboretum. Morris Arb. Bull. 8: 23–26.
1958. An early-flowering shrub garden. Morris Arb. Bull. 9: 63–64.
1959. Review of The garden flowers of China by H. L. Li. Morris Arb. Bull. 10: 71.
1959. The Morris Arboretum. Gard. Jour. N.Y. Bot. Gard. 9, No. 1: 8–10.
1960. The nature and functions of an arborteum. Morris Arb. Bull. 11: 35–39.
1960. The deciduous hollies. Morris Arb. Bull. 11: 59–63.
1961. Cultivar versus variety. Morris Arb. Bull. 12: 7–8.
1961. International registration of plant names. Morris Arb. Bull. 12: 17–18.
1961. Our seeds go traveling. Morris Arb. Bull. 12: 35–36.
1961. The temperate American magnolias. Morris Arb. Bull. 12: 51–58.
1961. A plea for scientific names. Arb. Bull. Univ. of Washington Arboretum 119.
1962. Methods of plant identification. Lloydia 25: 285–288.
1962. The sixteenth International Horticultural Congress. Morris Arb. Bull. 13:59–62.
1962. Phytophenology. A.A.B.G.A. Quarterly Newsletter No. 51: 1–4.
1963. Review of The origin and cultivation of ornamental trees by H. L. Li. Morris Arb. Bull. 14: 55.
1963. *Tsuga* at the Morris Arboretum. Morris Arb. Bull. 14: 59–65.
1963. Summer-flowering trees. Plants and Gardens 19, (1): 26–30.
1963. A twentieth century drug garden I.C.S.U. Review of World Science 5: 70–75.
1964. The Morris Arboretum's garden of drugs. Profiles 2: 12–13.
1964. *Galega officinalis:* a weed new to the Arboretum. Morris Arb. Bull. 15:17–18.
1964. The Morris Arboretum European tour. Morris Arb. Bull. 15: 23–28.
1964. *Stewartia* in the Philadelphia area. Morris Arb. Bull. 15:43–48.
1964. Our first *Metasequoia* cone. Morris Arb. Bull. 15: 72.
1964. Why a magnolia socity? Amer. Magnolia Soc. Newsletter 1: 1–2.
1964. Magnolias provide a four-month display. The New York Times, Sunday, March 29.
1965. Landscaping an arboretum. Morris Arb. Bull. 16: 3–6.
1965. Magnolias. Horticulture February 22–25.
1965. Review of A Selected guide to the literature on the flowering plants of Mexico by Ida K. Langman Morris Arb. Bull. 16: 6.
1965. Some relatives of the *Camellia*. The Camellia Review 26: 3–6.
1965. Foreward to A garden of trees and Shrubs by Fred Lape. Cornell University Press, Ithaca.
1965. The Morris Arboretum Iberian tour. Morris Arb. Bull. 16: 19–29.
1965. A note on *Pteroceltis tatarinowii*. Morris Arb. Bull. 16: 39–41.
1965. A year later. Amer. Magnolia Soc. Newsletter 2: 1.
1966. The heath garden of the Morris Arboretum. Morris Arb. Bull. 17: 3–6.
1966. The silent travelers. Plants and Gardens 22, (3).
1966. The Morris Arboretum 1966 garden tour. Morris Arb. Bull. 17: 19–24.
1966. Coming of age. Amer. Magnolia Soc. Newsletter 3: 1–2.
1967. The Morris Arboretum 1967 tour. Morris Arb. Bull. 18: 27–39.
1967. A list of Bartram trees and shrubs. Morris Arb. Bull. 18: 75–81.
1967. A note on *Adina rubella*. Morris Arb. Bull. 18: 87.
1967. That elusive finding list. Amer. Magnolia Soc. Newsletter 4 (1): 12.
1967. Three paces forward. Amer. Magnolia Soc. Newsletter 4 (2): 1–2.
1967–1969. Bonsai & botany. Parts 1–4. Bonsai vol. 1 and vol. 2.
1968. The 1968 garden tour. Barnes Arb. Newsletter 1: 1–8.
1969. The 1969 garden tour. Barnes Arb. Newsletter 3: 1–8.
1969. The meanings of botanical names. Barnes Arb. Newsletter 2: 1–6; 3: 9–11. Reprinted in A.A.B.G.A. Bulletin 4 (3), July 1970.
1969. Ten conifers for Philadelphia. Plants and Gardens 25 (2): 36.
1969. The Mexican tour. Barnes Arb. Newsletter 2: 7–11.
1970. *Carpinus* at the Barnes Arboretum. Barnes Arb. Newsletter 4: 8–9.
1970. The 1970 tour. Barnes Arb. Newsletter 5: 1–10.
1970. Sapindaceae at the Barnes Arboretum. Barnes Arb. Newsletter 5: 10–12.
1970. Bayard Long (1885–1969). Rhodora 72: 130–136. Reprinted in Bartonia 39: 1–6.
1971. The African tour. Barnes Arb. Newsletter 6: 1–9.
1971. *Trochodendron aralioides*. Barnes Arb. Newsletter 6: 11.

1971. A visit to the Great Smokies. Barnes Arb. Newsletter 7: 1–8.
1971. The monkey-puzzle tree. Barnes Arb. Newsletter 7: 8–10.
1972. Plants of South Africa. Horticulture, April 26–29.
1972. A visit to the South Pacific. Barnes Arb. Newsletter 8: 1–8.
1972. The Mediterranean tour. Barnes Arb. Newsletter 9: 1–11.
1973. Morocco and the Canary Islands. Barnes Arb. Newsletter 10: 1–10.
1973. The Pacific northwest tour. Barnes Arb. Newsletter 11: 1–10.
1973. The Chinese tulip tree. Barnes Arb. Newsletter 11: 12. Reprinted in Amer. Magnolia Soc. Newsletter 9 (3): 10–11.
1974. The South Pacific tour. Barnes Arb. Newsletter 12: 1–11.
1974. A further note on the Chinese tulip-tree. Barnes Arb. Newsletter 12: 12.
1974. The development of horticulture in America. Morris Arb. Bull. 25: 5–9. Reprinted in the Gardeners Calendar.
1974. Review of Stone's plants of sourthern New Jersey: a reprint. Rhodora 76: 139–141.
1974. Spring tour along Lake Michigan. Barnes Arb. Newsletter 13: 1–8.
1974. Glossary of terms applied to the surface of a leaf. Barnes Arb. Newsletter 13: 12.
1974. *Rhododendron adenophorum*. Barnes Arb. Newsletter 13: 12.
1974 (with Helen B. Fogg). Those fascinating cacti and other succulent plants. U.S. Dept. Agriculture Yearbook, pp. 226–229.
1975. The South American tour. Barnes Arb. Newsletter 14: 1–9.
1975. *Rhododendron adenophorum*. Bull. Amer. Rhododendron Soc. 29: 118–119.
1975. The southwestern deserts tour. Barnes Arb. Newsletter 15: 1–9.
1975. Some interesting specific names. Barnes Arb. Newsletter 15: 11.
1975 (with J. C. McDaniel). Checklist of the cultivated magnolias. American Horticultural Society Plant Science Data Center, Mt. Vernon, VA. vii + 54 + 12 pp.
1976. A visit to the American tropics. Barnes Arb. Newsletter 16: 1–8.
1976. *Opuntia Helleri*—a correction. Barnes Arb. Newsletter 16: 10.
1976. *Magnolia* × *Watsonii* in the Philadelphia Area. Amer. Magnolia Soc. Newsletter 12 (1): 12.
1976. Edgar Wherry in Pennsylvania. Amer. Fern Jour. 66: 33–38.
1976. A tour of the Prairies and the Ozarks. Barnes Arb. Newsletter 17: 1–8.
1976. Whatever happened to *Mesembryanthemum?* Philadelphia Cactus and Succulent Bull. 1, No. 3.
1976. The genus *Senecio*. Philadelphia Cactus and Succulent Bull. 1, No. 2.
1976. The pink-flowered yellow-wood. Barnes Arb. Newsletter 17: 10–11.
1977. The 1977 Mexican tour. Barnes Arb. Newsletter 18: 1–11.
1977. *Koelreuteria bipinnata*—a correction. Barnes Arb. Newsletter 18: 16.
1977. Plant name changes. Philadelphia Cactus and Succulent Bull. 2, No. 9.
1977. Variety versus cultivar. Philadelphia Cactus and Succulent Bull. 3, No. 1.
1977. The Sonora-Chihuahua Desert tour. Barnes Arb. Newsletter 19: 1–9.
1978. Another subspecific category—the forma. Philadelphia Cactus and Succulent Bull. 3, No. 5.
1978. A visit to Egypt and Greece. Barnes Arb. Newsletter 20: 1–8.
1978. A visit to Iceland and Greenland. Barnes Arb. Newsletter 21: 1–9.
1978. The genus *Alnus* in the middle states area. Barnes Arb. Newsletter 21: 11–12.
1978. Why botanical authorities? People, Places and Plants 4, No.3.
1978. *Magnolia grandiflora* 'Praecox Fastigiata.' Amer. Magnolia Soc. Newsletter 14: 3–4.
1979. A visit to Guatemala. Barnes Arb. Newsletter 22: 1–7.
1979. Magnolias at the Barnes Arboretum. Amer. Magnolia Soc. Newsletter 15, No. 1.
1979. The Lardizabala family. The Green Scene, Sept.–Oct., 17–19.
1979 (with E. T. Wherry and H. A. Wahl). Atlas of the flora of Pennsylvania. Morris Arboretum, Philadelphia. xxx + 390 pp.
1980. A plea for registration. Amer. Magnolia Soc. Journal 16 (1): 20–22.
1980. Two early cactus pictures. Cactus and Succulent Jour. 52 (6): 267.
1981. A short history of the American Magnolia Society. Amer. Magnolia Soc. Journal 17 (1): 3–6.
1981. Foreward in the New York Botanical Garden Illustrated Encylopedia of Horticulture by T. E. Everett.
1981. Additions to a Magnolia bibliography. Amer. Magnolia Soc. Journal 17 (2): 24.
1982. Edgar T. Wherry, an obituary. Taxon 31: 803–804.
1983. Edgar Theodore Wherry (1885–1982). Bartonia 49: 1–5.
1983. Reminiscences of Liberty Hyde Bailey. Bartonia 49: 70–71.

Bartonia No. 49: 20–26, 1983

# The Salt Plants of Onondaga Lake, Onondaga County, New York

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Onondaga Lake is located south of Lake Ontario and to the west of Syracuse in the Finger Lakes area of central New York. It is a small freshwater lake surrounded for a great number of years by salt plants.

Geologists believe that about 410 million years ago Onondaga County was inundated by a shallow sea of hyper-saline water, and the salt precipitated forming a layer many feet deep. This salt layer was again inundated by sea water and buried by a very thick layer of limestone and shale.

One of the earliest descriptions we have of the area was given by Father LeMoyne, in 1654. He found Onondaga Lake surrounded by many salt springs bubbling up onto the black earth and giving the appearance of hoar frost. Onondaga Creek flowing north into the lake, often caused fluctuations in the level of the lake, flooding the surrounding swamp lands and causing a putrid odor. Swamps and upland forests were extensive.

Father LeMoyne was the first person to report to the world the knowledge of Onondaga salt. By the 1700's both Indians and white men were boiling the brine to make salt. In 1743 John Bartram made a pound of salt and collected some plants, including *Triglochin,* while visiting the area.

The earliest extant collections of salt plants from this area were made by Frederick Pursh in 1807 when he visited this region for about twenty days. Some comments made by Pursh in his journal were:

> When I came to the springs, the place was called Salt point. I found them to be situated in a low piece of a swamp, which is clear for a great part of all timber; . . .
> Near the springs themselves the *Salicornia herbacea* is the only plant which grows, . . .

He found a new creeping *Ranunculus* growing, "in thick tuffts together and covers the ground," and named it *R. cymbalaria* (this has not been seen since the early 1930's.) Pursh described the salt marshes on Salt Point as a "very disagreeable and stinking marsh."

The Onondaga Lake area was the first inland area in this country to produce large quantities of salt. From 1770 until 1888 salt workers boiled brine to produce salt. The trees surrounding Onondaga Lake were used as fuel for the boiling of the brine and for barrel making to hold the salt, until the area became denuded. It was a desolate place of black mud, marsh, swamp, and remitting "bilious fever" which was deadly to small children, killing nine out of ten cases. In 1822, the lowering of the lake was approved by the State of New York and the outlet into nearby Seneca River was straightened and cleared. The lowering of the lake improved navigation, drained the swamps (buildings could be reached without bridges), and greatly reduced flooding, thereby improving the health of the inhabitants.

By 1848, wood was in short supply, hence the salt industry began converting to coal, but solar evaporation soon proved more profitable and between 1888 and 1925 solar salt was the predominate salt made by the salt manufacturers. Many solar salt sheds were built on higher drier ground. It is interesting to note that the plants which are still present in drier salt areas (*Puccinellia distans, Spergularia media,* and *S. marina*) were not recorded until after the development of solar evaporation was in progress. These plants also grow along highways where much salt has been accumulated from salting the roads in winter. By 1870 salt was found in Michigan and Canada and the salt industry slackened and was finally given up in 1925. In 1881, Solvay Process was working in the area but getting much of the salt from salt wells about twenty miles south. At present the Solvay (Allied Corp.) waste beds, from the manufacturing of soda ash, cover the southwest side of the lake destroying all the vegetation (including the salt plants) in that area.

Mrs. Goodrich and the Syracuse Botanical Club, from 1879 to 1912, made an extensive study, report, and collection of the plants in Onondaga County including the salt plants. A large number of the Syracuse Botanical Club specimens are now housed in the herbarium at the College of Environmental Science and Forestry at Syracuse University.

From 1926 to the middle 1930's the lowlands around the southeastern part of the lake, including the land on which the present Regional Market is located, had an abundance of *Salicornia* in the parts which were flooded in the early spring, giving a gorgeous display of red in the late summer and early autumn (the natives of this area used *Salicornia* for pickles for a number of years).

In 1932–1933, Glenna Wurth studied a large area that soon was turned into McArthur Stadium and also a playground. Turning the area into a baseball stadium destroyed most of the plants. She reported that even the few *Phragmites* found in the region were disappearing! Yet, in 1942, *Phragmites* began to increase, but only in the last twenty years has the spreading of *Phragmites* become a problem, having in the early 1960's extirpated *Enteromorpha* from a small creek. On the west side of the lake, where a solid mass of *Salicornia* existed, earth was dumped by the highway construction crew to make a more solid shoulder for Route 690, thereby destroying the habitat of the *Salicornia* but leaving some of the other salt plants until *Phragmites* appeared in the late 1970's and completely covered the remaining salt plants.

At present the main area where *Salicornia* survives is between Route 57 and Onondaga Lake on the northeast side of the lake near Danforth Pool. This pool contains much *Ruppia* and some *Potamogeton*. *Salicornia* did persist in the ditches along this road but was finally extirpated by the widening of Route 57. *Spergularia media* and *Puccinellia* remain abundant in the drier areas on both sides of the highway.

The county parks are cooperating concerning the saving of the few remaining salt plants by fencing in a large area and eliminating the usual moving of this part of the parkway.

## List of Salt Plants

This report was initiated with a list of Pursh's herbarium specimens (with the exception of Pursh's report (James 1869) of *Salicornia*) as examined by Mildred E. Faust and

Nettie M. Sadler at the Academy of Natural Sciences of Philadelphia on November 4 and 5, 1950.

Additional salt species as reported by J. A. Paine (1865 and Anonymous 1865), L. L. Goodrich (1912), H. D. House (1924), G. C. Wurth (1934), M. E. Faust (1961), and R. S. Mitchell (1980) were also included. Herbarium specimens examined were: the original collection of Mrs. L. L. Goodrich and the Syracuse Botanical Club, the Faust collection, and the general herbarium collection at ESF (College of Environmental Science and Forestry at Syracuse University in Syracuse, New York).

Field identification of current salt species was done by the authors and Donald D. Cox, July 1980.

The families, genera and species follow Gleason and Cronquist (1963) with the exception of Mitchell's (1980) Polygonaceae and *Scirpus americanus* (Schuyler 1974). The *parentheses* following the genus and species enclose the names according to Faust (1961), whereas, the *parentheses* after the collector/reporters name enclose the name they used. An *asterisk* before the date indicates an herbarium specimen. Other entries are reports only.

### Typhaceae

*Typha angustifolia* L. **1865**. Paine, common around Onondaga and west of Syracuse. **1912**. Goodrich, abundant in Onondaga salt marshes. ***1980**. Faust, Cox, Roberts, salt marsh.

### Najadaceae

*Najas marina* L. **1864**. G. W. C, (*N. major* Allioni), borders of Onondaga Lake, as reported by Paine (1865). ***1878**. Lucien M. Underwood, Onondaga Lake. **1889**. Goodrich (1912), (*N. marina recurvata* Dudley) frequent Onondaga marshes, Long Branch. **1895**. Goodrich (1912), other than salt.

*Potamogeton pectinatus* L. (var. *pectinatus*). **1865**. Paine, abundant in Onondaga Lake. **1884**. Goodrich (1912), common salt marsh. ***1948**. Faust, salt pool.

*Ruppia maritima* L. [subsp. *spiralis* (L.) Agardh]. **1864**. Paine (1865), saline places at Onondaga Lake. **1895**. Goodrich (1912), brackish puddle, salt marsh near Salina, July. ***1980**. Faust, Cox, Roberts, in brackish pool.

*Zannichellia palustris* L. **1864**. G. W. Clinton, marshes adjoining Onondaga Lake, as reported by Paine (1865). ***1881**. Mary Hotchkiss, Seneca River, Baldwinsville ***1955**. Faust, S. J. Smith, Cox.

### Juncaginaceae

*Triglochin maritima* L. [var. *elata* (Nutt.) T. & G.]. **1743**. Kalm (1753) reported seeing a specimen collected by John Bartram when Bartram visited the area of the 5 nations. ***1807**. Pursh, salt marsh, July 16. **1865**. Paine, Onondaga Lake. ***1879**. Goodrich, shores of Onondaga Lake. ***1880**. Mrs. M. O. Rust, Onondaga Lake, June. ***1933**. Wurth, Onondaga salt flats.

*Triglochin pulustris* L. ***1807**. Pursh, Onondaga salt springs, July 18. **1865**. Paine, boggy borders of Onondaga Lake at Salina and northward beyond Liverpool. **1885**. Goodrich (1912), rare, near Onondaga Lake. ***1898**. Atkinson, salt springs, June 25.

### Gramineae (Poaceae)

*Agrostis stolonifera* L. var. *compacta* Hartm. [var. *palustris* (Huds,) Farw.]. ***1926**. H. Ellis, salt sheds, Onondaga Lake. ***1933**. Wurth, Onondaga salt flats. ***1980**. Faust, Roberts, salt flats.

*Distichilis spicata* (L.) Greene. **1900**. Goodrich (1912), salt marsh, Geddes. **1980**. no specimens for county at ESF.

*Echinochloa walteri* (Pursh) Nash. **1896**. Goodrich (1912), (*Panicum walteri*) local, salt marsh, Onondaga Lake, Sept. **1980**. no specimens for county at ESF.

*Hordeum jubatum* L. ***1923**. Van Eseltine, Onondaga Lake. ***1933**. Wurth, Onondaga salt flats. ***1946**. Faust, S. J. Smith, salt flats. ***1980**. Faust, Cox, Roberts, salt flats near McArthur stadium.

*Leptochloa fascicularis* (Lam.) Gray var. *martima* (Bickn.) Gl. (syn. *Diplachne acuminata*). **1864.** G. W. Clinton, abundant at Salina, and on the springy slopes southwestward along the banks of Onondaga lake, as reported by Paine (1865). **1900.** Goodrich (1912), (*Diplachne fascicularis* Beauv.) frequent, salt marsh, Salina and Camillus. **1924.** House, brackish marshes and shores . . . inland at Onondaga Lake. ***1926.** Van Eseltine, southeast shore of Onondaga Lake, Sept. 4.

*Panicum dichotomiflorum* var. *dichotomiflorum*. **1864.** G. W. Clinton, (*P. proliferum* Lam.), marshes adjoining Onondaga Lake, as reported by Paine (1865). ***1873.** B. D. Gilbert, shores of Onondaga Lake. ***1926.** Bray and Van Eseltine, southeast of Onondaga Lake growing with *Leptochloa fascicularis*. ***1980.** many specimens at ESF from a variety of habitats.

*Puccinellia distans* (L.) Parl. ***1933.** Wurth, salt flats. ***1941.** Faust and S. J. Smith, Wolf Street salt flats. ***1980.** Faust, Cox, Roberts, salt flats near Danforth Pond.

*Puccinellia fasciculata* (Torr.) Bickn. **1924.** Haberer, as reported by House, on salt marshes and in brackish meadows . . . collected at Onondaga Lake Haberer No. 3301. **1980.** no specimens for county at ESF.

*Puccinellia maritima* (Huds.) Parl. **1887.** Goodrich (1912), Rare. Salt marsh, Solvay. **1980.** no specimens at ESF.

*Spartina patens* (Ait.) Muhl. **1899.** Goodrich (1912), salt marsh near Geddes, common. ***1926.** Van Eseltine, marsh at southeast end of Onondaga Lake. ***1941.** Faust and S. J. Smith, Onondaga Lake.

*Spartina pectinata* Link. ***1807.** Pursh, (*S. cynosuroides* Willd., *S. michauxiana* Hitch., *S. schreberi* Gmel.) July 16. **1865.** Paine, Onondaga Lake, all around. **1899.** Goodrich (1912), (*S. polystachya* Michx. and *S. cynosuroides* Willd.) salt marsh near Onondaga Lake. ***1944.** Faust, salt flats growing on top of a mat of *Juncus gerardii*. ***1980.** Faust, Cox, Roberts, west shore by Onondaga Lake.

*Spartina alterniflora* Loisel. **1865.** Paine, (*S. stricta* Roth. var. *alternifolia*) banks and marshes of Onondaga Lake, chiefly on west side. **1900.** Goodrich (1912), (*S. stricta* (Ait.) Roth. var. *glabra* Muhl.) plentiful, salt marsh, Salina. **1980.** no specimens at ESF.

## CYPERACEAE

*Carex alata* Torr. & Gray. **1905.** Goodrich (1912), salt marsh near Onondaga Lake, June. ***1980.** has been found in county but not in salt.

*Carex mackenziei* Krecz. **1899.** Goodrich (1912), (*C. norvegica* Willd.) rare, salt marsh, near Onondaga Lake. **1980.** no specimens at ESF for county.

*Carex salina* Wahl. **1890, 1908.** Goodrich (1912), (*C. cuspidata* Wahl.) common, salt marsh near old salt mill. **1980.** no specimens at ESF for county.

*Cyperus filicinus* Vahl. **1865.** Paine, around Onondaga Lake. **1899.** Goodrich (1912), (*C. nuttallii* Eddy) salt marsh, Geddes and shores of Onondaga Lake. **1980.** no specimens at ESF for county.

*Eleocharis parvula* (R. & S.) Link. ***1926.** Van Eseltine, Marsh southeast of Onondaga Lake, very rare in region.

*Fimbristylis castanea* (Michx.) Vahl. **1882.** Goodrich (1912), salt land, first ward, Syracuse. **1980.** no specimens at ESF for county.

*Scirpus americanus* Pers.[1] (=*S. olneyi* Gray; not *S. americanus* as generally applied by American authors) ***1807.** Pursh, Onondaga, July 11.

*Scirpus maritimus* L. var. *paludosus* (A. Nels.) Kük. (*S. paludosus* A. Nels.). ***1807.** Pursh, apparently Onondaga salt springs. **1865.** Paine, (*S. maritimus*) Onondaga Lake. ***1891.** Goodrich, (*S. cylindricus* specimen name changed to *S. paludosus* by S. J. Smith in 1951) Salina. ***1933.** Wurth, salt flats. ***1948.** Faust and S. J. Smith, salt flats, observed it was taking over habitat of Salicornia. ***1949.** Faust and Sadler, wet salt flats. ***1982.** Faust et al., McArthur Stadium.

*Scirpus robustus* Pursh.[2] **1912.** Goodrich, abundant in all salt marshes, Salina marsh, July–Oct. ***1916.** H. P. Brown, salt sheds, Sept. 25. **1924.** Clinton, Paine, Mrs. M. O. Rust, as reported by House, Inland at the head of Onondaga Lake. ***1924.** John H. Sullivan, salt marsh, July 27.

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[1] A. E. Schuyler informs us of a more recent collection at Onondaga Lake by J. E. Kirkwood in July 1903 (specimen at the New York Botanical Garden).

[2] A. E. Schuyler informs us of a more recent collection at Onondaga Lake by Muenscher and Brown (coll. no. 21639) on 25 August 1945 (specimen at Cornell).

### Juncaceae

*Juncus bulbosus* L. **1864.** G. W. Clinton, Onondaga Lake as reported by Paine (1865). **1980.** no specimens at ESF for county.

*Juncus compressus* Jacq. ***1932.** Wurth, Onondaga salt flats. ***1949.** Faust, Sadler, salt flats.

*Juncus gerardii* Loisel. **1865.** Paine, Onondaga Lake. ***1881.** Goodrich, salt works near Salina. **1895.** Goodrich (1912), abundant in salt marsh, Onondaga Lake. ***1933.** Wurth, salt flats. ***1945.** Faust, salt flats. ***1980.** Faust, Cox, Roberts, salt flats.

*Juncus maritimus* Lam. **1912.** Goodrich, plentiful on salt marsh, shore of Onondaga Lake. The only locality reported here. **1980.** no specimens at ESF for county.

### Polygonaceae

*Polygonum ramosissimum* Michx. var. *prolificum* Small [*P. prolificum* (Small) Rob.]. **1898.** Goodrich (1912), (*P. ramosissimum*) sandy, moist soil. Occasional. Pleasant Beach Aug. ***1916.** H. P. Brown, (*P. prolificum*) salt sheds. ***1929.** E. P. Percival, (*P. prolificum*), salt flats, near fairgrounds. ***1977.** Faust, S. J. Smith, R. Mitchell, (*P. prolificum*) Liverpool. **1978.** Mitchell report.

*Polygonum ramosissimum* var. *ramosissimum*. **1978.** Mitchell report.

*Rumex hastatulus* Baldw. **1895.** Goodrich (1912), rare, saline places, salt marsh, Solvay. **1978.** Mitchell, report: literature citation on file at New York State Herbarium. **1980.** no specimens at ESF.

*Rumex triangulivalvis* (Dans.) Rech. f. (=*R. Mexicanus* Meissn.). **1895.** Goodrich (1912), (*R. salicifolius* Weinm.) not common, salt marsh, first ward. ***1955.** Faust, Smith, Cox, Hiawatha and Oswego Blvds. **1978.** Mitchell reported.

### Chenopodiaceae

*Atriplex arenaria* Nutt. **1909.** Goodrich (1912), saline places, local, Liverpool and Greenpoint. **1980.** no specimens at ESF for county.

*Atriplex patula* L. var. *hastata* (L.) Gray. **1865.** Paine, (*A. hastata* L.) common at Salina, roadside, marshes, shores of the lake. ***1891.** F. L. Stevens, Geddes. **1909.** Goodrich (1912), (*A. hastata* L.), plentiful in saline places, salt marshes, Geddes. and Salina. ***1933.** Wurth, brackish meadow, Onondaga salt flats. ***1949.** Faust, Sadler, salt flats. ***1980.** Faust, Cox, Roberts, salt flats.

*Chenopodium glaucum* L. (subsp. *glaucum*). **1865.** Paine, abundant Salina, and along the shores of Onondaga Lake, where is is native, doubtless. ***1880.** Mary Rust, shores of Onondaga Lake, near Salina. Aug. 16. ***1881.** Mary Hotchkiss, salt blocks, Salina. **1897.** Goodrich (1912), everywhere, plentiful in waste places. ***1933.** Wurth, salt flats. ***1960.** Faust, *Salicornia* swamp, Rt. 48.

*Chenopodium rubrum* L. **1864.** G. W. Clinton, (*Blitum maritimum* Nutt.) marshes at Salina southwestern shores of the lake, as reported by Paine (1865). **1897.** Goodrich (1912), among salt vats. Geddes salt marsh, Aug. ***1941.** Faust, Pleasant Beach.

*Salicornia europaea* L. **1807.** Pursh, reported in his journal, no specimens found in Philadelphia. **1865.** Paine, (*S. herbacea*) salt marshes on Onondaga Lake; common at Salina and abundant on west side of the lake opposite Liverpool. **1909.** Goodrich (1912), (*S. herbacea* & *S. biglelovii*), frequent, all salt marshes here. ***1980.** Faust, Cox, Roberts, salt flats.

*Salsola kali* L. var. *tenuifolia* G. F. W. Meyer. **1902.** Goodrich (1912), not abundant, salt marshes, near Iron Pier, Aug. ***1926.** Van Eseltine, old salt yards near fair grounds. ***1933.** Wurth, brackish meadow at Onondaga salt flats. ***1942.** Faust, Sadler, salt flats.

*Suaeda americana* (Pers.) Fern. **1912.** Goodrich, infrequent on Onondaga salt marshes, north of salt mill. **1980.** no specimens at ESF for county.

*Suaeda maritima* (L.) Dum. **1912.** Goodrich, low and inconspicuous in salt marsh, Aug., near Iron Pier. **1980.** no specimens at ESF for county.

### Amaranthaceae

*Amaranthus cannabinus* (L.) Sauer **1895.** Goodrich (1912), (*Acnida cannabina*), local salt marsh, near Iron Pier, Aug. **1980.** no specimens for county at ESF.

### Aizoaceae

*Sesuvium maritimum* (Walt.) BSP. **1890.** Goodrich (1912), rare, salt marsh near Geddes, locality destroyed by Solvay refuse. Specimens found in Aug. **1980.** no specimens at ESF for county.

### Caryophyllaceae

*Spergularia marina* (L.) Griseb. **1888.** Goodrich (1912), (*Trissa marina* & *T. rubra*) one locality only, salt marsh, near salt mill, Aug. ***1933.** Wurth, salt flats. ***1945.** Sadler, Danforth pool. ***1980.** Faust, Cox, Roberts, salt flats.

*Spergularia media* (L.) C. Presl. ***1915.** H. P. Brown, salt works. ***1926.** Van Eseltine, salt yards, Galeville. ***1933.** Wurth, brackish meadow, salt flats. ***1938.** R. L. Crockett, Syracuse. ***1949.** Faust, Sadler, salt wells. ***1980.** Faust, Cox, Roberts, salt flats.

### Cruiferae (Brassiceae)

*Cakile edentula* (Bigel.) Hook. **1900.** Goodrich (1912), only on salt marsh, Lake shore, Pleasant Beach. **1980.** no specimens at ESF for county.

### Ranunculaceae

*Ranunculus cymbalaria* Pursh. ***1807** Pursh, Onondaga salt springs July 16. **1865.** Paine, on borders of Onondaga Lake about the head of Salina and along the eastern sides. Abundant there, the only habitat given by Pursh. **1893.** Goodrich (1912), infrequent, banks of stream flowing into Onondaga Lake, Pleasant Beach July. Banks of canal, Geddes. **1932.** Seen at the AAAS meetings but not since.

### Rosaceae

*Potentilla anserina* L. ***1807.** Pursh, found at Onondaga Lake, July 20. **1865.** Paine, common around Onondaga Lake. **1909.** Goodrich (1912), shores of Onondaga Lake, plenty. ***1980.** Faust, Cox, Roberts, plentiful, very large vigorous plants, bordering Danforth Pond.

### Fabaceae

*Lathyrus palustris* var. *palustris*. ***1807.** Pursh, *Lathyrus* spp. (*L. palustris*, *L. myrtifolium*) ***1880.** H. A. S. White, Liverpool, Onondaga Lake, July. ***1885 & 1886.** M. L. Overacker, Danforth salt pool. **1890.** Goodrich (1912), frequent, marshes and shores. **1980.** other places in county.

### Euphorbiaceae

*Euphorbia polygonifolia* L. **1912.** Goodrich, plentiful on salt lands, near Onondaga Lake. **1980.** no specimens at ESF for county.

### Malvaceae

*Althaea officinalis* L. **1885.** Goodrich (1912), rare, salt marsh, first ward, locality covered with Solvay refuse. **1980.** of the specimens at ESF none are from salt areas.

*Hibiscus moscheutos* L. [subsp. palustris (L.) Clausen]. ***1807.** Pursh. Onondaga salt springs, July 16. **1865.** Paine, plentiful in the marshes around the salt lake, Onondaga N.Y., Pursh. **1895.** Goodrich (1912), scarce, brackish places around Onondaga Lake, Aug. ***1949.** Faust, Sadler, east of mud lock.

### Scrophulariaceae

*Gerardia maritima* Raf. **1908.** Goodrich (1912), Rare, salt marsh, north from salt mill, first ward, July. **1980.** no specimens for county at ESF.

### Plantaginaceae

*Plantago eriopoda* Torr. **1908.** Goodrich (1912), frequent, salt marsh, near Iron Pier. **1980.** no specimens at ESF for county.

*Plantago maritima* L. subsp. *juncoides* (Lam.) Hulten. **1883.** W. L. Beauchamp, Onondaga Lake, Aug. 27. **1890.** Goodrich (1912), (*P. decipiens*) rare, biennial, salt lands; now covered with Solvay refuse. **1980.** no specimens at ESF for county.

### Compositae (Asteraceae)

*Artemisia caudata* Michx. **1909.** Goodrich (1912), frequent in salt marsh, Court Street near bridge, Aug. **1980.** no specimens at ESF for county.

*Aster brachyactis* Blake. ***1936** Robert L. Crocket, Syracuse salt flats. ***1949** Faust, salt flats near regional market. **1977.** Faust observed in salt flats. **1980.** Faust, Roberts observed in salt flats.

*Aster novi-belgii* L. **1908.** Goodrich (1912), abundant in salt marsh, first ward, Syracuse, Sept. **1980.** no specimens at ESF for county.

*Aster subulatus* Michx. **1905.** Goodrich (1912), localized, salt marsh, first ward, Syracuse, Sept. ***1916.** H. P. Brown, salt sheds. ***1933.** Wurth, salt flats. ***1974.** Raynal, Faust, shore of Onondaga Lake in saline soil. **1980.** Faust, Roberts observed in saline soil.

*Aster tenuifolius* L. **1905.** Goodrich (1912), plentiful in salt marsh, first ward, Syracuse, Sept. **1912.** Goodrich, reported by House from salt marsh near Syracuse (Fl. Onondaga Co. 184, 1912). **1980.** no specimens at ESF for county.

*Pluchea camphorata* (L.) DC. **1910.** Goodrich (1912), occasional, salt marsh, first ward, Sept. **1924.** House, reports: reported from salt marshes of Onondaga Lake near Syracuse. **1980.** no specimens at ESF for county.

*Solidago sempervirens* L. **1882.** Haberer report. **1909.** Goodrich (1912), plentiful in one locality, salt marsh near mill, Aug. **1980.** no specimens at ESF for county.

## Literature Cited

Anonymous. 1865. Facts and observations touching the flora of the state of New York. Annual Rep. New York State Mus. 18: 197–205.

Faust, M. E. 1961. Checklist of the vascular plants of Onondaga County New York. Bull. Syracuse Univ. Mus. Nat. Sci. No. 9.

Gleason, Henry A. and Cronquist, Arthur. 1963. Manual of vascular plants of northeastern United States and adjacent Canada D. Van Nostrand Co., Princeton.

Goodrich, L. L. 1912. Flora of Onondaga County as collected by the members of the Syracuse Botanical Club.

House, Homer D. 1924. Annotated list of the ferns and flowering plants of New York State. New York State Mus. Bull. 254, Albany.

James, T. P. 1869. Journal of a botanical excursion in the northeastern parts of the states of Pennsylvania and New York during the year 1807, by Frederick Pursh. Philadelphia.

Kalm, Peter. 1753. Peter Kalm's travels in North America, English version of 1770, revised and edited by Adolph B. Benson in 1937, unabridged republication in 1966. Dover Publications, Inc., New York.

Mitchell, Richard S. 1980. Polygonaceae (Buckwheat Family) of New York State. New York State Mus. Bull. 431, Albany.

Paine, John A. Jr. 1865. Catalogue of plants found in Oneida County and vicinity. Annual Rep. New York State Mus. 18: 53–192.

Schuyler, A. E. 1974. Typification and application of the names *Scirpus americanus* Pers., *S. olneyi* Gray, and *S. pungens* Vahl. Rhodora 76: 51–52.

Van Estletine, Glenn. 1936–37. Unpublished notes on the Onondaga Flora.

Wurth, Glenna C. 1934. Studies on the vegetation of the Syracuse Salt Flats. Thesis, Botany, Syracuse University.

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# Some Additions to the Flora in Luzerne County, Pennsylvania

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The publication of the *Atlas of the Flora of Pennsylvania,* by Wherry, Fogg, and Wahl (1979), has provided a frame of reference for botanists working in the state. It is now possible to compare the flora of a specific study site with documented collections and fill in gaps in our knowledge of the state's flora. This paper presents the floristic results of a study in Luzerne County in northeastern Pennsylvania, compares the findings with the documented flora in Wherry et al. (1979), and gives an annotated list of those species not previously reported for Luzerne County.

## Description of Study Site

In 1971, Pennsylvania Power and Light Company (PP&L) began construction of a nuclear power plant, called the Susquehanna Steam Electric Station (Susquehanna SES), near the Susquehanna River, 8 kilometers northeast of Berwick, Luzerne County, Pennsylvania (Fig. 1). The PP&L lands around the construction site, approximately 760 hectares, are referred to as the Susquehanna SES site. As part of the environmental monitoring program, studies of the flora and vegetation have been conducted and are continuing. The Susquehanna SES site lies in the Ridge and Valley Province (Fenneman 1938). The underlying rocks throughout are shales of the Mahantango Formation (PP&L 1978), and the Wisconsin glacial boundary lies just to the south. The site is bisected by the Susquehanna River, with its floodplain, and contains several ridges. Elevations range from 150 meters at the river to 372 meters on Council Cup Ridge.

Vegetation of the Susquehanna SES site includes upland forest dominated by red oak (*Quercus borealis*), black oak (*Q. velutina*), white pine (*Pinus strobus*), and Virginia pine (*P. virginiana*), with relatively sparse shrub and herb layers; floodplain hardwood forest dominated by silver maple (*Acer saccharinum*), river birch (*Betula nigra*), American elm (*Ulmus americana*), and hackberry (*Celtis occidentalis*), with a rich herbaceous flora especially in spring; abandoned fields dominated by goldenrod (*Solidago* spp.), aster (*Aster* spp.), grasses and many other perennial herbs; agricultural fields, and roadsides with their associated "weeds"; and four small ponds and wetland areas with cat-tails (*Typha* spp.), grasses, sedges, and other marsh plants (Montgomery 1978, 1979). There is considerable diversity of habitats in the area of the site.

## Floristic Results

In almost 10 years of floristic study, 675 species of vascular plants have been found on the Susquehanna SES site (Montgomery 1982). This total includes 128 woody plant species and 547 herbaceous taxa; the former includes 9 conifers, the latter includes 40 pteridophytes, and the remainder of each comprises 626 species of flowering plants. Most of these are relatively common plants in Pennsylvania and all except 42 have been reported previously for Luzerne County (Wherry et al. 1979). These 42 species are discussed individually below. Five of these new records for Luzerne County represent the northern limit for the species in Pennsylvania, one represents an eastern limit in the state, and two others are regional records, i.e. they have not been reported for Luzerne or surrounding counties (Fig. 1).

Herbarium specimens, as vouchers, of all herbaceous and many woody plants have been collected and are maintained in a reference herbarium at the Susquehanna SES Biological Laboratory; duplicate specimens of the taxa discussed herein will be placed in the herbarium at the Academy of Natural Sciences of Philadelphia.

The following list contains all of the species found on the site to date that are not reported for Luzerne County in Wherry et al. (1979). Species which are introduced plants and of general distribution in the state are listed with introduced status and habitat, but not further discussed. Taxa of more restricted range, especially range extensions in the state are discussed in more detail. The list is alphabetical by families and genera within the groups Pteridophyta, Monocotyledoneae, and Dicotyledoneae.

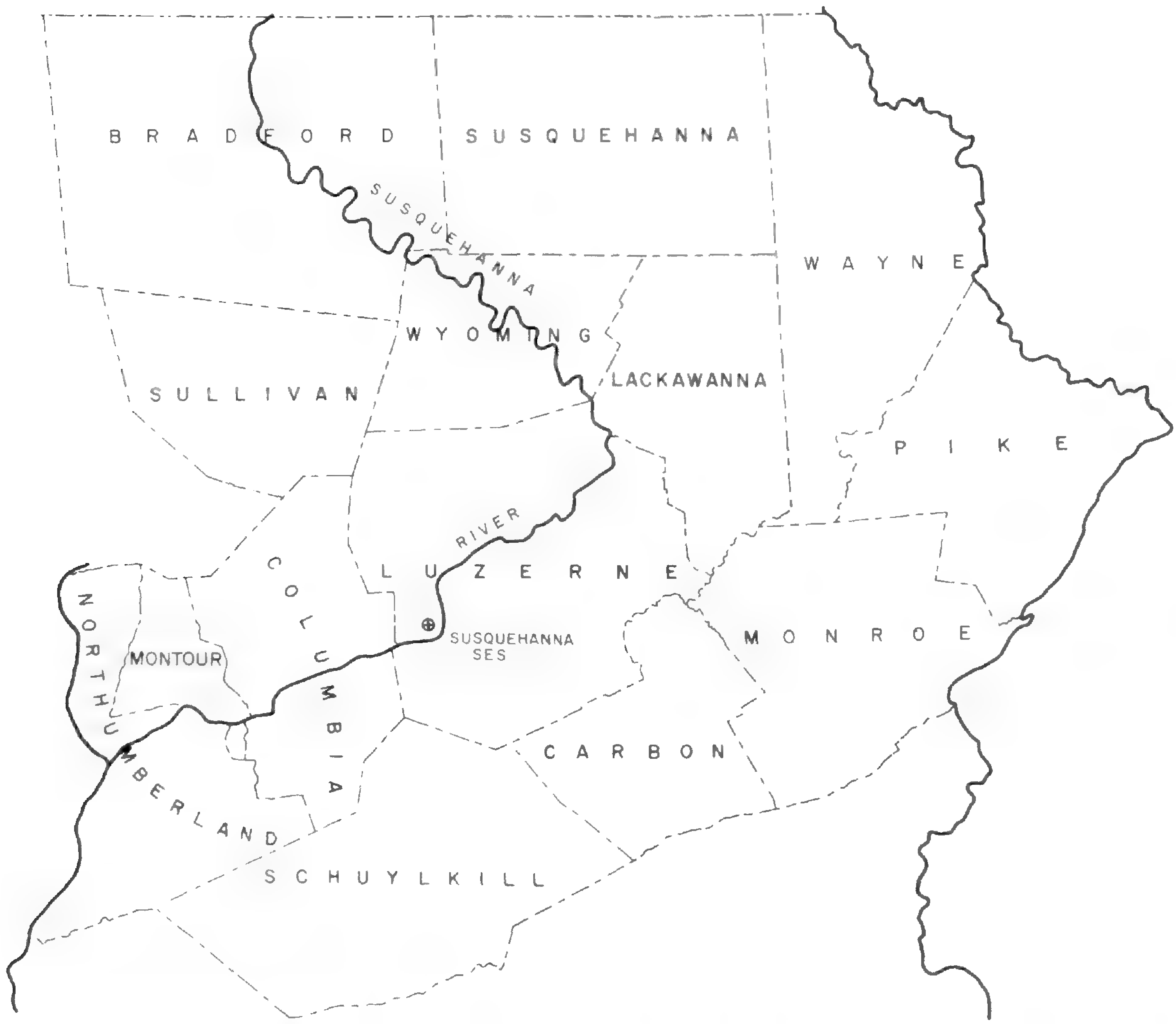


FIG. 1. Susquehanna SES site location in Luzerne County, and surrounding counties in northeastern Pennsylvania.

## Pteridophyta

Polypodiaceae: *Cystopteris protrusa* (Weath.) Blasdell, native, floodplain forest; there are no nearby locations recorded for this fern in Pennsylvania, and this is the only record in northeastern Pennsylvania; several colonies occur on the river floodplain, a habitat typical for this species (Wherry 1961). *Dryopteris* × *uliginosa* Druce, native, roadside; single clump, probably representing one original plant, on stone wall; both parents (*D. carthusiana* and *D. cristata*) are nearby; nearest localities are in Monroe, Wyoming, and Schuylkill counties.

## Monocotyledoneae

Araceae: *Arisaema dracontium* (L.) Schott, native, floodplain forest; scattered throughout floodplain forest; recorded in Columbia, Wyoming, and Lackawanna counties, all in the Susquehanna Valley.

Gramineae: *Bromus japonicus* Thunb, introduced, fields and roadsides. *Bromus mollis* L., introduced, floodplain forest; only few records in state, nearest in Sullivan County; introduced with grass mixtures in seeded areas. *Eragrostis pilosa* (L.) Beauv., introduced, river bank and abandoned field. *Eragrostis frankii* C. A. Meyer, native, river bank; there are records from Bradford and Wyoming counties upriver from the site; large colony occurs on river shore of island in Susquehanna River.

Lemnaceae: *Wolffia punctata* Griseb., native, canal; occurs on the abandoned Susquehanna Canal on the site; nearest record is in Sullivan County; distribution probably poorly known because of small plant size.

Liliaceae: *Asparagus officinalis* L., introduced, abandoned field. *Erythronium albidum* Nutt., native. floodplain forest; widely scattered, but most records from lower Susquehanna Valley; recorded from Wyoming County just north of Luzerne County line and Union County west of site; several colonies in floodplain forests. *Lilium superbum* L., native, floodplain forest; common in most of Pennsylvania and recorded from Columbia County just west of site. *Ornithogalum umbellatum* L., introduced, woodland; More common in southern Pennsylvania; also recorded from the Susquehanna Valley in Wyoming County. *Trillium cernum* L., native, floodplain forest; one small colony on the site in lowland woods; only one other record north of glacial boundary in Pennsylvania (Pike County). *Veratrum viride* Ait., native, floodplain forest; recorded from Columbia and other surrounding counties; common in the area.

Orchidaceae: *Epipactis helleborine* (L.) Crantz, introduced, floodplain forest; recorded for Columbia, Montour, and Lackawanna countries.

Typhaceae: *Typha angustifolia* L., native, open marsh; no other records for this species north of glacial boundary in eastern Pennsylvania; two stands occur, both in pond edges; *T. latifolia* also occurs on the site.

## Dicotyledoneae

Aceraceae: *Acer nigrum* Michx. f., native, floodplain forests; large trees occur in floodplain forest; recorded in northern Susquehanna Valley only from Bradford and Sullivan counties, other records are all from western Pennsylvania; this is easternmost record in state.

Asteraceae: *Aster cordifolius* L., native, floodplain and upland forests; there are records for this species in counties surrounding Luzerne, but few from the Ridge and Valley Province. *Aster dumosus* L., native, abandoned field; all other records from southeastern Pennsylvania; plants discovered by Mrs. Ann Newbold. *Erigeron* *philadelphicus* L., native, floodplain forest; known from counties both north and south of Luzerne along the Susquehanna River, including Columbia, Wyoming, and Lackawanna counties.

BORAGINACEAE: *Hackelia virginiana* (L.) Johnst., native, floodplain forest; reported for most surrounding counties.

CRUCIFERAE: *Brassica kaber* (D.C.) L. Wheeler, introduced, roadside. *Thlaspi arvense* L., introduced, roadside.

FAGACEAE: *Quercus palustris* Muenchh., native, lowland forest; scattered trees occur in both the river forest and near marshes on the site; there are records for Lackawanna, Montour, and Northumberland counties, but most are south of Luzerne County.

FUMARIACEAE: *Corydalis flavula* (Raf.) D.C., native, roadside; small colony is northernmost record for this species in Pennsylvania; nearest records are west of the site in Union County.

GENTIANACEAE: *Gentiana andrewsii* Griseb., native, abandoned field; one colony in an abandoned field on the site; there are records for Schuylkill, Wyoming, and Montour counties.

JUGLANDACEAE: *Juglans nigra* L., native, woodland; reported for Montour, Monroe, Carbon, and Schuylkill counties; common in second growth woodlands on the site.

LABIATAE: *Lamium amplexicaule* L., introduced, roadside.

LEGUMINOSAE: *Coronilla varia* L., introduced, roadside. *Lotus corniculatus* L., introduced, roadside, abandoned field. *Vicia cracca* L., introduced, roadside.

LYTHRACEAE: *Lythrum salicaria* L., introduced, wet field.

MALVACEAE: *Abutilon theophrasti* Medic., introduced, abandoned and cultivated fields.

POLEMONIACEAE: *Polemonium reptans* L., native, floodplain forest; most records are for western and southeastern Pennsylvania; nearest records are from Wyoming and Northumberland counties.

PORTULACACEAE: *Claytonia virginica* L., native, floodplain forest; common in the floodplain forest on the site; most records are from southeastern Pennsylvania, some from Wyoming and Lackawanna counties in the northern Susquehanna Valley.

ROSACEAE: *Prunus avium* L., introduced, upland forest. *Pyrus communis* L., introduced, forest edge. *Pyrus malus* L., introduced, upland forest.

RUBIACEAE: *Galium palustre* L., native, moist abandoned field; scattered in northern counties of Pennsylvania, with a few records to the south; nearest locations are in Wyoming and Sullivan counties.

SCROPHULARIACEAE: *Verbascum blattaria* L., introduced, roadside. *Veronica peregrina* L., native, canal bank; reported along the Susquehanna River in Bradford, Lackawanna, and Wyoming counties.

VALERIANACEAE: *Valerianella locusta* (L.) Betcke [*V. olitoria* (L.) Polli], introduced, canal bank; northernmost record in state, and only one north of glacial boundary.

## ACKNOWLEDGMENTS

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## Literature Cited

Fenneman, N. M. 1938. Physiography of the eastern United States. McGraw-Hill Book Co., New York

Montgomery, J. D. 1978. Flora and vegetation. Pages 279–310 *in* T. V. Jacobsen (ed.), Ecological studies of the Susquehanna River in the vicinity of the Susquehanna Steam Electric Station (Annual report for 1977). Ichthyological Associates, Inc., Berwick

———. 1979. Flora and vegetation. Pages 196–249 *in* T. V. Jacobsen (ed.), Ecological studies of the Susquehanna River in the vicinity of the Susquehanna Steam Electric Station (Annual report for 1978). Ichthyological Associates, Inc., Berwick.

———. 1982. Flora and vegetation. Pages 209–278 in T. V. Jacobsen (ed.), Ecological studies of the Susquehanna River in the vicinity of the Susquehanna Steam Electric Station (1981 Annual Report). Ichthyological Associates, Inc., Berwick.

Pennsylvania Power and Light Company. 1978. Susquehanna Steam Electric Station Environmental Report—Operating License Stage. PP&L, Allentown.

Wherry, E. T. 1961. The fern guide. Doubleday and Co., Inc., Garden City.

———, J. M. Fogg, Jr., and H. A. Wahl. 1979. Atlas of the flora of Pennsylvania. The Morris Arboretum, Philadephia.

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# The Dead Trees of Ilha da Trindade[1]

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Out in the South Atlantic some 1,500 kilometers east by north from Rio de Janeiro, a volcano top called Trindade juts above the sea (Fig. 1). Though it is scarcely a seventh the size of Manhattan, the isle does not want for wonders. It has crags, a cascade, and a columnar volcanic plug eighty stories high; a Sugarloaf to rival Rio's; a great natural tunnel through which the surf thunders; a rabble of raucous seabirds; and rustling myriads of garish red and yellow land crabs (1). But ringed with rocks and days by boat from Brazil's mainland, Trindade is not suited or situated for sightseers. A naval force of forty now shares the island with the noddies and the petrels. Before, there were prisoners for a time (2), and pirates it is said, and castaways of course. Sailing ships shunned Trindade's ironbound shore unless they lacked water for drinking or wood for the stoves. There was wood aplenty, too, for the steep slopes (Fig. 2) bore thousands of trees, by all accounts trees of one kind only. Before 1821, however, something or some event had killed them—killed them all—leaving a weird landscape of standing corpses. It was, in the words of one who saw it, "a forest of desolation, as if nature had at some particular moment ceased to vegetate."

That is what we knew or thought we knew when the question of the trees' identity brought us, a botanist and an ornithologist, together. One of us had gone to Trindade to study birds (3), had seen what is left of the forest of desolation, scattered logs and bits of wood weathering away, and had brought back a sack of samples. For some of the birds, the passing of the island's forest was no small thing. Alive or dead the trees held eggs and young away from preying crabs and, where thick-strewn, made a barrier between birds and people (Figs. 3–5). The island's birds are far fewer now than they were fifty years ago (4), and the loss of the trees must be one reason for it. When we turned our attention to the trees, works on Trindade were ascribing them to *Caesalpinia*, a genus in the legume family, but the basis for the ascription was obscure. Moreover, spare-time carvers at the naval station had said that the wood does not look and feel like bona fide *Caesalpinia* wood. Hence the botanist's role: to learn whether Trindade's logs really are remains of *Caesalpinia* trees. That question, seemingly a simple one, would bring an avalanche of others, and looking for the answers would take us down paths seldom trod by those who study plants or animals.

Smithsonian researchers usually go to experts in the Forest Service for help with puzzling woods, because identification, even of common cabinet woods, is best done by those with day-to-day practice. But exposing a wrong identification can be easy enough. One starts by cutting three carefully oriented slices from the doubtful wood: a

[1] Presented to the Philadelphia Botanical Club, April 22, 1982.

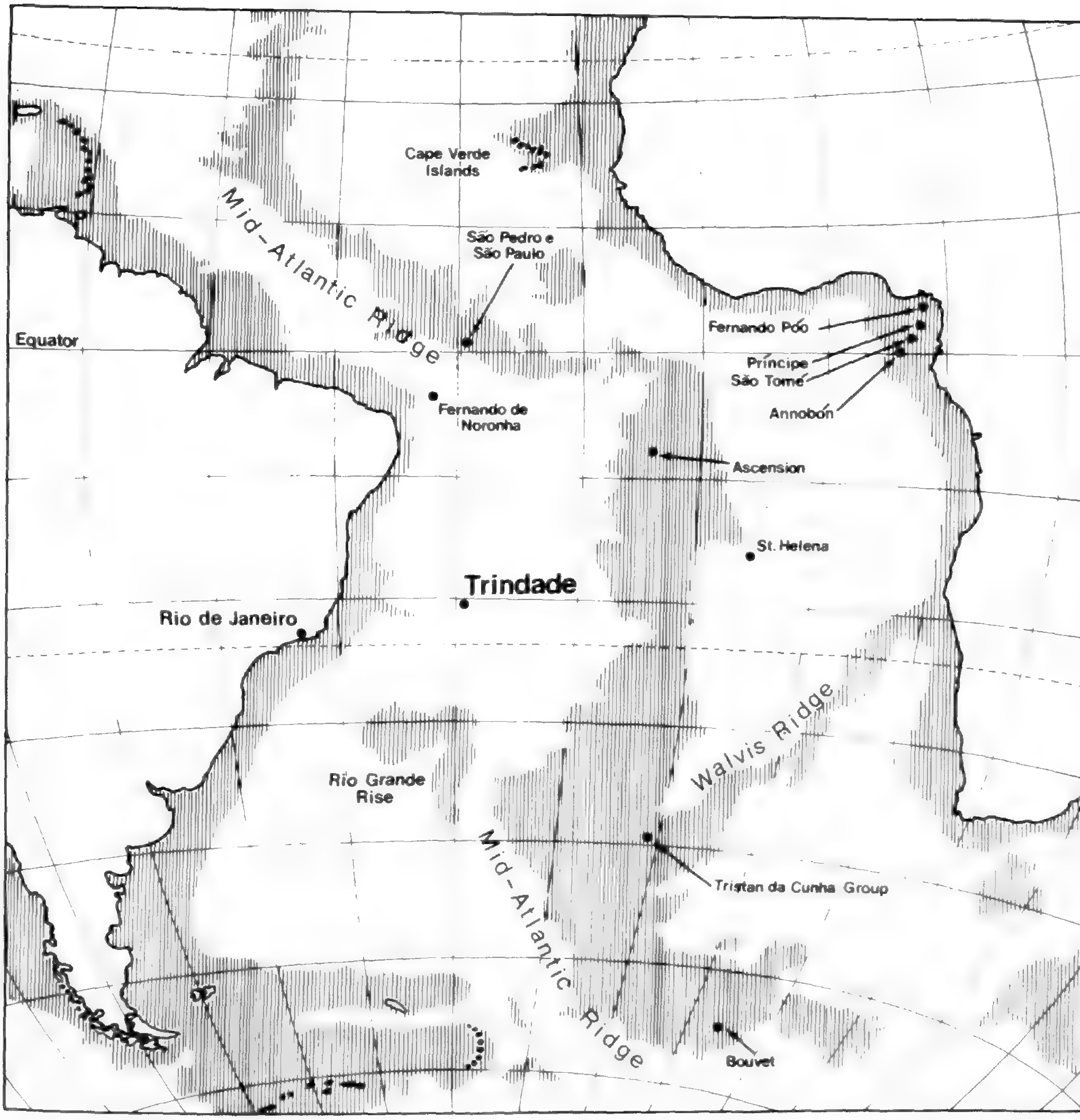



FIG. 1. Islands of the South Atlantic.

slice that is a cross section with respect to the dead tree's trunk, another that is longitudinal and radial, and a third that is longitudinal and perpendicular to the radial slice (5). The slices must be thin enough to pass light, because the goal is to match them microscopically with three similarly oriented slices from a vouchered sample—a piece of wood collected with a flowering or fruiting branch to vouch for its identity. When we put slices from a Trindade sample beside slices from vouchered *Caesalpinia* woods we found they did not match: the Trindade trees were not caesalpinias. We then took a closer look at what had been written about Trindade and discovered other ideas as to the trees' identity. Four authors had put forward, with differing levels of doubt or decision, four other genera in four plant families. In time we found that all were wrong.

We now had several questions to deal with. Of course we wanted to know what kind of trees grew on Trindade. To that end we had to ask whether any early visitor to the island had made a drawing or had pressed and preserved a leafy branch while the trees

FIG. 2. Trindade's slopes as they are today, from a Kodachrome by S. L. Olson.

still lived. And how did they come to be called *Caesalpinia?* And when did they die? And why?

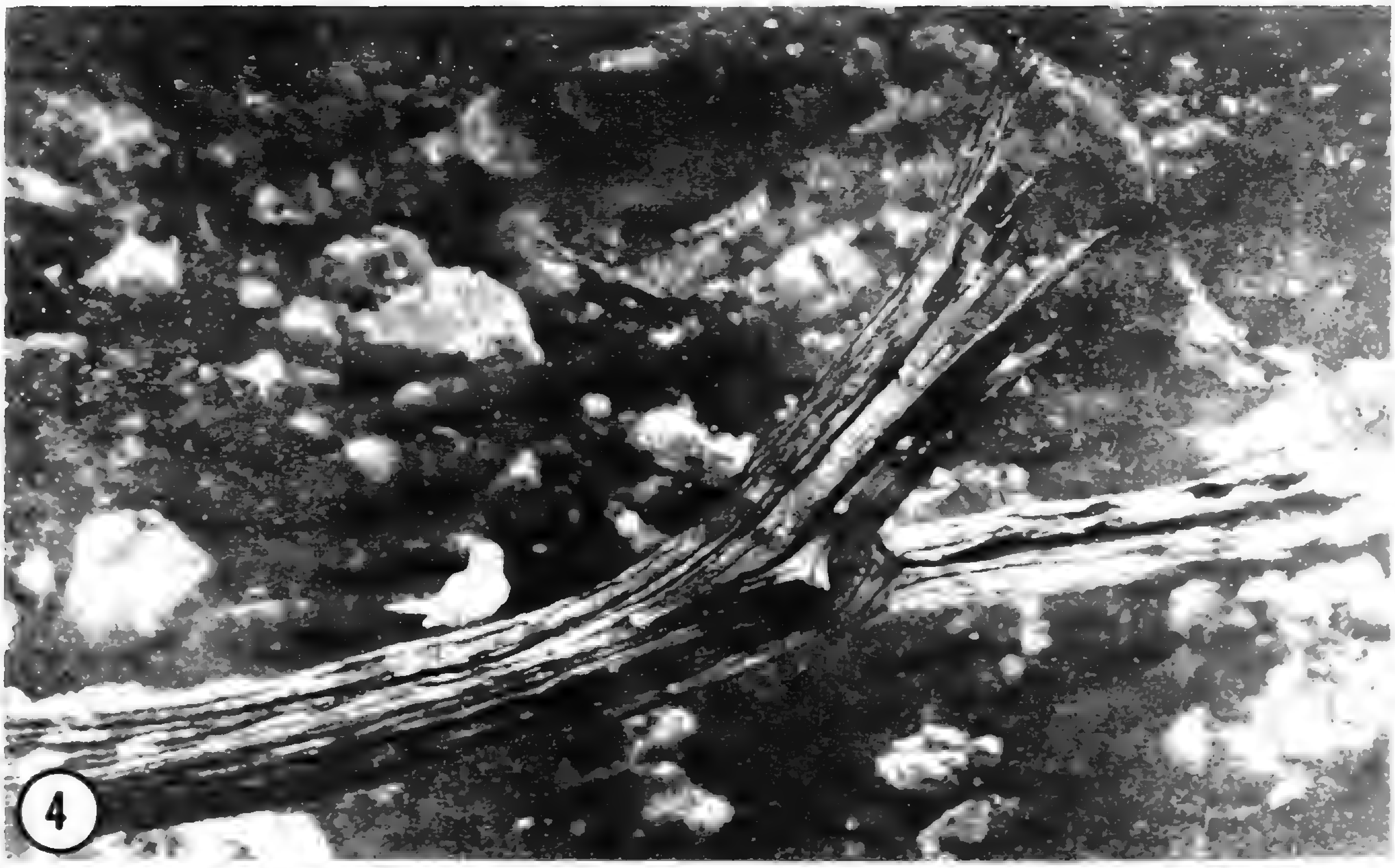
## SETTLERS BUT NO SPECIMENS

Looking for an early collection led us nowhere. It seems no visitor took a specimen or sketched one before the trees died. The first exploration on record was in April, 1700, when a British pink, the *Paramore*, Edmond Halley of comet fame commanding, landed a boat five days running. Captain Halley was a topnotch scientist, but he cared more for planets than for plants, and the *Paramore* was out to study the earth's magnetism not its vegetation. Halley's journal (6) says he drew Trindade's outline, plotted its position, and claimed it for his king, also that he "went up to the topp of the Island and found it very Steep and Laborious to ascend it." It says not a word about trees.

The Portuguese were rival claimants to Trindade, as their armadas had passed it almost two hundred years ahead of Halley. They did not really look it over, however, before 1756. In the fall of that year and again in the first months of 1757 an exploring party left the mainland to map the island, sound its waters, and see what it had to offer. Trees were not to be ignored: the governor of Rio de Janeiro had ordered that the group include a carpenter versed in New World woods and their uses. Though the explorers brought back a diary and a map, both seem to have vanished. E. M. Peixoto's massive monograph on Trindade's documents (7) does not have them, nor does it say where they are. From letters dealing with the exploration, we judge that the explorers carried home no collections and no drawings save the map. And they likely put a low value on the island, for Lisbon let it be till George Johnstone tried to take it.

The Johnstone affair was brought on by an extraordinary train of events (8). Commodore Johnstone was a bellicose schemer and sometime Member of Parliament whose

FIG. 3. Dead trees, with nest just right of center, as seen by the *Discovery* expedition, 1901. Courtesy of the Royal Society, London.



FIGS. 4 and 5. Trindade's trees as M. J. Nicoll saw them in 1905. Birds are red-footed boobies (Fig. 5) and white tern. Copied from Nicoll's *Three Voyages of a Naturalist*.

command had come as a political plum. In 1781, when Britain was at war with us, with France, with Spain, and newly with the Netherlands, the King's Secretary of State for the Southern Department sent Johnstone and his ships to the Cape of Good Hope. Johnstone's job was to grab the Cape from the Dutch before French reinforcements could get there, for both sides saw it as a vital link in the sea route to the Asian colonies. But the commodore let an enemy squadron catch him, scatter his ships, and beat him to the goal. Having thus jeopardized Britain's hold on India, he needed a gain of some kind to blunt the reproof that awaited him at home. The course he hit upon was to start a colony on tiny Trindade and tout it as a new jewel for the British crown.

He chose Captain Philip D'Auvergne, a Jerseyman, to place the first settlement, fortify it, and make it flourish. Embarking on what a biographer (9) has rightly called a fool's errand, D'Auvergne did his brave best. Trouble began when a gale broke up the young captain's vessel six days after he dropped anchor at Trindade. The ships that had escorted him could have taken him and his settlers away when they left for other tasks, but D'Auvergne turned down the offer (10). With his wrecked sloop's guns planted on the island's heights and maize planted on the flatter spots, he held to his mission. He did not know the mission would maroon him for a year. The King's court did not accept the colony quickly, as Johnstone had hoped, but called a committee to ponder it and in time said no. When the India-bound *Bristol* finally came for them, the settlers surely shed no tears of sadness, but it is hard to tell just how badly they had suffered during the delay. Reminiscing for the *Naval Chronicle* years later, D'Auvergne recalled three months of surviving on seafowl (11). Brazilians who came to Trindade on his heels, however, harvested some of his corn (12).

Johnstone's "colony" lasted not quite 15 months—from October, 1781, to the final days of 1782—but it led to a longer occupation. A fortnight after D'Auvergne's band, 29 island-weary souls all told, left Trindade with the *Bristol* and her convoy, a force arrived from Rio with instructions to put them off (13). The commodore had been in Portugal and had bragged about his new jewel, whereupon Lisbon had complained to London and had resolved to replace the thriving colony with one of its own. Needing no new quarrels, Great Britain had yielded. (This recognition of Portugal's rights took on new worth in the 1890s when Britain tried to take Trindade again, this time as a telegraph station. Brazil, a separate land by then, pressed the old Portuguese claim and got the isle for good.) The newcomers soon learned they had been hoodwinked—that Trindade's rugged surface made it unfit for farming or for anything else they could think of. What hardscrabble tilling could be done here and there would not feed a settlement, and the island's peaty soil was prone to burn. Nevertheless, the force was not soon recalled. Following royal orders, 150 men stayed to keep Trindade out of alien hands. Brazil's viceroys would groan repeatedly about the cost of halfyearly supply ships before Lisbon at last closed down the garrison, long since reduced to 88, in 1795 (14).

Trindade was aswarm with people, as desert islands go, in the 1780s and the early 1790s. Still it seems no one drew a tree or saved a branch (15). D'Auvergne, for all his mettle, lets us down here. During his distinguished later life as military governor of Jersey, he owned 72 books on botany and took the *Botanical Magazine* (16). He could draw, too. Before he joined Johnstone's squadron he had sketched crustaceans and other invertebrates for the Phipps arctic voyage (17). After landing on Trindade he had made, under orders, a map (Fig. 6) that is still a joy to look at (18). Why then did he not leave us a relic or a record of the trees? Well, the D'Auvergne of 1781 and '82 was at least a little lazy. We have this from the journal of his superior, Captain Thomas Pasley, who, acting for Johnstone, escorted D'Auvergne's vessel to Trindade and oversaw the founding of the settlement. Before giving the Jerseyman a good mark for sticking with the mission, its pages twice denounce him as a dawdler (19).

When the Portuguese posted their garrison, no botanist or zoologist had yet set foot on the island, but the time of the great collecting expedition had come. The first such to touch Trindade was French. In October, 1785, the *Boussole* and the *Astrolabe* arrived


FIG. 6. D'Auvergne's map of Trindade, courtesy of the British Library.

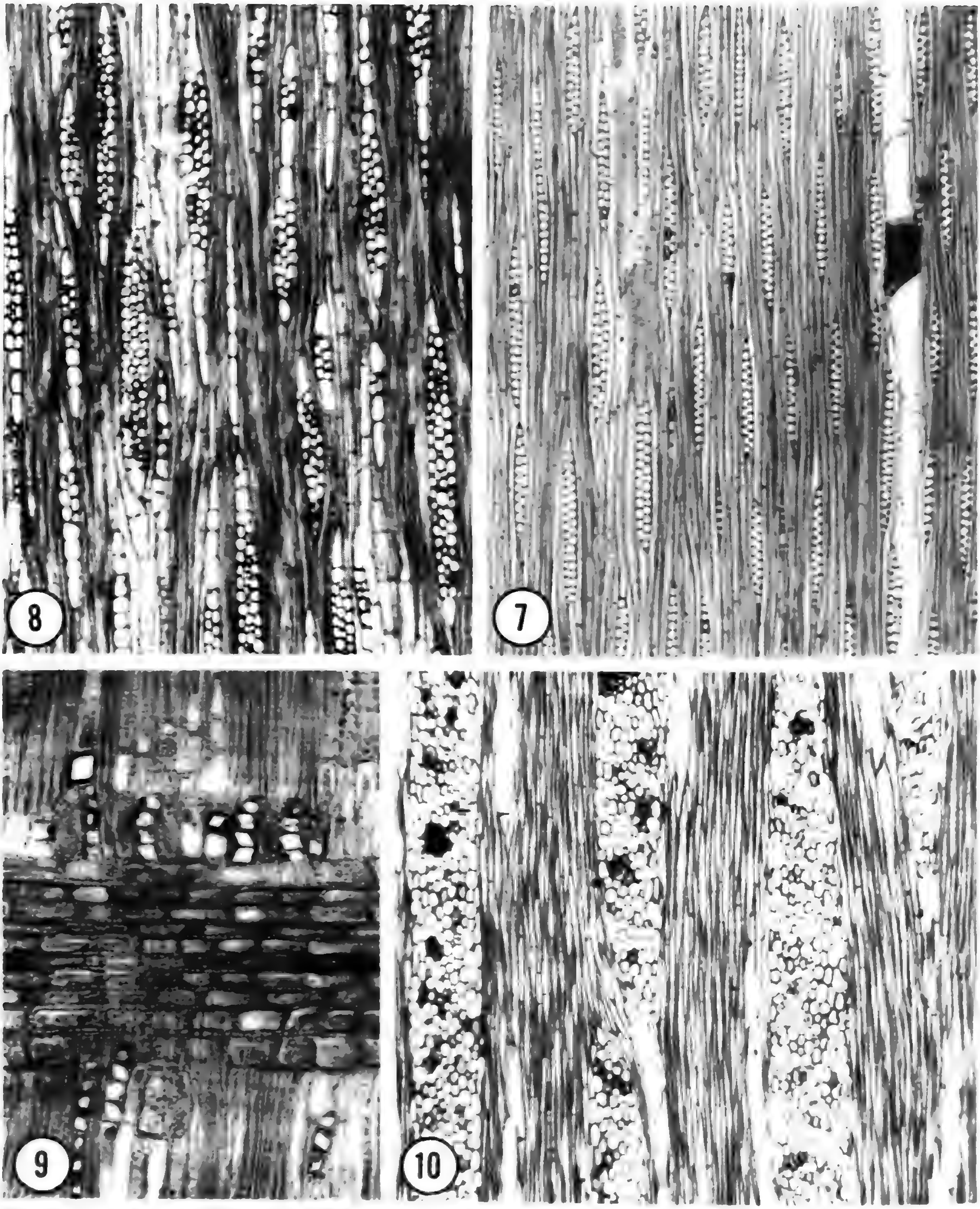
with two botanists and an artist on board and J. F. de G. de la Pérouse in charge, outward bound on a doomed "voyage round the world." Though the voyage came to grief near the Solomons some two and a half years later, collections and records returned from ports of call. Alas, collections from Trindade were not among these, because, as La Pérouse explained in his journal, the garrison's commandant had turned the landing party away just after it landed. "This officer was in such dread of our discovering the sorry state of his government," wrote La Pérouse, "that he would not even let M. de la Martinière and Father Receveur leave the shore to look for plants" (20).

French explorers came to Trindade again in 1826 when a new *Astrolabe* under Jules Dumont d'Urville set out to follow La Pérouse's path, finish his mission, and learn what had happened to him. Again, there was a plant collector on board. This time, however, there was no landing because the sea was too violent (21). As it happens, Dumont d'Urville's collector could not have gotten what we needed even if he had gone ashore, for we know from a novel that Trindade's trees were already dead. Yes, from a novel. We will explain that after we tell how we found out what trees they were.

## Telling the Tree by its Wood

Lacking a pressed specimen, we had to work toward identification with microscopic features of the wood, with post-mortem descriptions of the trees, and with whatever clues could be taken from the island's setting. We were uneasily aware, too, that the trees could have been unique to Trindade—an endemic species now forever gone. If so, it might be impossible to match their remains with a wood from somewhere else. *Caesalpinia* woods are a bad match because, among other things, the rays are not right. Rays are the ribbons of shorter, softer cells that run spoke-like through a transected trunk. Magnified *Caesalpinia* rays have a uniform look. Most are of the same thickness, and all their cells are procumbent, lying with long axes in line with the ray's length (Fig. 7). The Trindade wood, on the other hand, has rays of different thicknesses with upright cells among the procumbent cells (Fig. 8). Secondary cross walls subdivide some of the upright cells into infracellular chambers, and each chamber encloses a crystal (Fig. 9). This is the kind of rare feature a wood identifier looks for to strike off lots of possibilities at once and keep a search within bounds. For example, Trindade's dead trees can not be *Acacia*, as ornithologist M. J. Nicoll suggested in 1908 (4), or any other legume for that matter, because members of the legume family do not have crystals in chambered upright ray cells. The same goes for *Rapanea*, a genus of the myrsine family to which a 1950 article (22) assigns the dead trees; a *Rapanea*'s rays are also much too broad (Fig. 10). Clearly, later is not better in this business, for a 1964 book (23) calls the dead trees *Pisonia*, and that is the queerest attribution of the lot. Woods of the four-o'clock family, to which *Pisonia* belongs, tend to be light and flimsy owing to an oddity: regions of thin-walled phloem cells are "included" within the rigid xylem, breaking up the continuity of the wood tissue. In contrast, Trindade's wood is hard and heavy, with no included phloem. A glance at a cut surface, or just hefting a piece, is enough to rule out *Pisonia*.

It was not so easy to rule out *Eugenia*, the oldest attribution on record. The English war correspondent and travel author E. F. Knight published this one in a book about a quest for buried gold. Knight had sailed to Trindade at the end of 1889 with nine "gentlemen adventurers" to dig for pirates' treasure, had taken home a log, and had




FIGS. 7–10. Wood rays in radial (Fig. 9) and tangential section. 7. *Caesalpinia echinata*. US wood collection no. 2542. Ray cells all procumbent. ×80. 8. Trindade deadwood collected by Olson in 1976. USw 41482. Rays made up of upright and procumbent cells. ×80. 9. Trindade deadwood collected by Knight in 1890. Crystals in chambered upright cells along rays's margins and in some axial parenchyma cells. ×135. 10. *Rapanea guianensis*. USw 8942. Rays huge and without upright cells. ×40. Photos by V. Krantz.

sent a piece of the log to Kew Gardens where anatomist L. A. Boodle had looked at it (24). Working without a microtome, the present-day biologist's precise slicer, Boodle could do wonders with a razor and a hand lens. His opinion on the Trindade trees—probably the myrtle family, possibly *Eugenia*—was the best that could be had, and it was a reasonable one. The wood does have the look and feel of a *Eugenia* wood, and there are points of similarity in the more obvious cellular features. By dint of their fleshy, bird-eaten fruits, some of the eugenias are widespread on tropical islands: that is another fact that fits (25). To be sure, we could not find a *Eugenia* wood with crystals in upright ray cells. There are eugenias, however, with upright files of crystals elsewhere in the wood. We could not make a good match with respect to the distribution of the thin-walled cells called xylem parenchyma, either, but there are hundreds of species of *Eugenia*, and no one has looked at all their woods. We had to allow that there could be a *Eugenia* somewhere with a wood like the Trindade wood. Furthermore, Boodle's opinion was so worded that we could not discount it without combing the whole myrtle family for a look-alike, which was out of the question. This would have been the end of the track had we not had help.

We could have gone to our friends in the U.S. Forest Service for help, but no one knows all the world's woods, and Brazil has its own experts. An answer to our letters came first from Calvino Mainieri, who was, before his death late in 1980 (26), Brazil's pre-eminent identifier of woods. Mainieri said he did not think any Brazilian anatomist had yet looked at the remains of Trindade's trees. Could we send a sample of the so-called *Caesalpinia?* Of course we could, and almost by return mail we got a new and true identification: Trindade's trees belonged to *Colubrina*.

The quick response was startling. Maineri's way with woods was well known, but Brazil's woody species are so many and so diverse that we had not expected same-day service. Three weeks later we had the same answer, *Colubrina* in the buckthorn family, from a second anatomist, Armando de Mattos Filho, who sent along a piece of Trindade deadwood from the collections of the Jardim Botânico in Rio (27). The Jardim's wood was just like our samples. Then the Kew anatomists sent a bit of the log that yachtsman Knight took home in 1890. It, too, was just like ours. At least one thing we had read at the outset was correct. The dead trees were of one kind.

## Confirmation from the Herbarium

With a little cutting and comparing we saw for ourselves that the trees were some kind of *Colubrina*. Now we needed to know something about the species of *Colubrina*. Not that we hoped to carry the identification down to the species level; wood anatomy can not often do that. We did hope to learn the ranges of the species and to find out whether any one of them occurs on the Brazilian coast nearest to Trindade. To do that we would have to look into a recent taxonomic treatment of *Colubrina*. We were in luck: there was one. Marshall Johnston of the University of Texas had put *Colubrina* in order in 1971 (28), and the Smithsonian's botany library had his work.

Taxonomists are the ofttimes undervalued heroes of biology who sort out the species, tell us their traits, map their ranges, and untangle their nomenclatural snarls. A scientist of another stripe can know the worth of all that only when he or she has run into a roadblock, then gone to a good taxonomic treatment and found what is needed to carry on. Professor Johnston's work gave us what we wanted and more. There are 31 species of *Colubrina* in the world and Brazil's southeastern coast has two of them. One of these is made up of thorny little trees that do not fit the descriptions of Trindade's dead trees.

The other, *Colubrina glandulosa,* fits nicely. To be exact, southeastern Brazil's populations of *Colubrina glandulosa* belong to an infraspecific variant, *C. glandulosa* variety *reitzii* (Fig. 11). Johnston's work told us that collectors have taken specimens of this variety in the state of Rio de Janeiro, in five other states on Brazil's mainland, and on Ilha da Trindade.

On Trindade? The herbarium case where colubrinas are kept is 27 strides from our botany library. The fat folder marked *Colubrina glandulosa* holds three dozen specimens, and, sure enough, two were taken on Trindade. Their labels show that they came to the Smithsonian from research centers in Paris and Rio through routine sharing of duplicates. One was taken in 1959, the other in 1961 (29); both are from Trindade's peaks. The herbarium sheets also carry Marshall Johnston's labels endorsing their identity. So Trindade's trees did not all die. A few persisted, or came back from seeds, on the island's upper reaches. And there were pressed specimens close at hand all the while we looked for one.

Suddenly our mystery trees seemed almost commonplace. Colubrinas are found in most warm parts of the world. Some species, with seeds that float for weeks in salt water and still germinate, are able colonizers of seaside sites (30). There are shrubby colubrinas in our southwestern states and tree colubrinas in tropical Florida. Hawaiians have one that is something of a vine. Puerto Ricans call one of theirs mabí and make a tasty beverage from its bark. Brazil's foresters plant *C. glandulosa* var. *reitzii,* which they know as *saguaraji* or *sobraji,* for its fast growth and cut it for its rot-resistant wood. (The old logs lying on Trindade's slopes demonstrate its durability.) Variable in size and shape, trees of this kind can reach anywhere from three meters to 20 meters or more, and they grow straight in planted forests. On Trindade they were 10 meters tall; some or all had twisted trunks.

How was it that no one thought to link the colubrinas on the peaks with the lifeless forest on the slopes? Even the more casual visitors had seen clumps of small trees or shrubs at the island's top. Some of the old reports were based on sightings at a distance that did not let the visitor tell true trees from tree ferns. (Trindade still has tree ferns and once teemed with them.) Others, however, made it plain that the visitor had climbed a peak for a closer look at what was growing there. And E. F. Knight, who stayed three months and explored the island thoroughly, searched the summit for live trees of a size and shape to match the dead ones before concluding that there were none. When collectors came at last, they recognized *Rapanea* and *Pisonia* among the highland plants, and authors eager for identification then put these names to the dead trees without proof. There was no reason, really, to think of *Colubrina* if one had the dead trees tagged already as rapaneas, as pisonias, or—to recall the common error—as caesalpinias.

## How the Trees Were Wrongly Named

The mischief-makers in the *Caesalpinia* matter were George R. M. Murray and Robert Cushman Murphy. Keeper of the Department of Botany in the British Museum (Natural History) from 1895 to 1905, Murray was also a scientific director of the National Antarctic Expedition, which took him to Trindade in 1901. A year later the *Geographical Journal* carried his account of collecting there and with it these words. "I scraped some freshwater algae from stones in the bed of the stream. . . . Two lichens were fairly abundant on the stones and on the trunks of the numerous dead trees described by Mr. Knight from this and other valleys. These trunks (*Caesalpinia* sp.)


FIG. 11. *Colubrina glandulosa* var. *reitzii*, drawn by A. Tangerini from a specimen (*J. Becker 28*) taken on Trindade. Stamens and hood-like petals are in the same radii, a family trait. Smallness of flowers and fruits, lack of bright color doubtless made it easy for early visitors to give Trindade's trees scant heed.

have plainly been dead for many years, and are bleached white, and for a great part covered with lichens. The wood is a hard red wood, and, from the abundance of the trunks, they must represent a considerable forest, now vanished from the island" (31). It puzzled us when we found this, the first ascription to *Caesalpinia*, because Murray was an authority on marine algae, and algologists do not ordinarily count the identification of tropical woods among their skills. We guessed Murray had shown a specimen to an anatomist, but an exchange of letters with his department drew a blank. The current keeper told us there is no such specimen among the museum's collections; he said further that Murray's words suggest to him a casual observation unaccompanied by a collection (32). Why, then, did Murray ignore the earlier view that the trees were of the myrtle family? Surely he knew about it, for his article referred more than once to Knight's book, where that opinion had appeared. Could it be that he thought poorly of Boodle, whose opinion it was? Not likely, because he had named an alga *Boodlea* "in honour of my friend Mr. Leonard Boodle" (33). The key to the puzzle may lie in the worsening mental condition (poor concentration was a symptom) that led Murray to leave science at age 46 (34). In any case, the American ornithologist Murphy took up the error in 1915 without saying where he got it: "But the most striking element in the vegetation of Trinidad is its great groves of dead trees of the genus *Caesalpinia*" (35).

The red heartwood of Trindade's trees helped to keep the *Caesalpinia* story going. As all Brazilian children learn in school, Brazil was named for the dyewood trees that brought its first settlers. We now know those trees as a kind of *Caesalpinia*, but "brazil" and "brazilwood," *pau-brasil* in Portuguese, are centuries older than Linnean nomenclature. Before America's discovery European traders had called red dyewoods from the Orient brazil—that could mean the dye, the wood, or the tree—and the name crossed the Atlantic when explorers found red dyewoods in the New World. Portuguese settlements of the 1520s were little more than camps for the cutting and the caching of these woods. At first brazil could be any of a half dozen dyewoods, but the better dyewood tree from Pernambuco became in time "the true brazil" (36). This one *pau-brasil, Caesalpinia echinata*, has been Brazil's national tree by law since December 7, 1978 (37). Over the years, however, usage had become so loose in some parts that *pau-brasil* could mean any tree with reddish wood, whether or not it would yield a dye. A visitor to Trindade who had known that usage would have called the dead trees *pau-brasil*, and a botanically naive writer might then have looked that up and made it *Caesalpinia*. Naive or not, Murphy did use *Caesalpinia* and brazilwood interchangeably when he wrote about Trindade again in 1936 (38), and the added air of authenticity made the error that much harder to dislodge.

The same loose usage troubled Brazil's timber trade till 1960, when the Institute for Technological Research in São Paulo put out a work with photomicrographs to set things straight (39). Its author: Calvino Mainieri. It gave microscopic features for separating *Caesalpinia* woods from other red woods called *pau-brasil*, and *Colubrina glandulosa* var. *reitzii* was one of them. Coming on that publication only after we had learned from Mainieri what our "*Caesalpinia*" was, we recalled the swift unriddling with a smile. His work of 1960 held the answer for the taking, though he had not known when he wrote it of Trindade's long-dead trees.

## Time of Death

Long dead, certainly, but dead how long? We can be sure the trees died before 1821 because they were dead when Captain Frederick Marryat saw them. Marryat wrote the desolate forest's description (a bit of which is in our opening paragraph) into *The Naval Officer*. Published in 1829, this was the first of Marryat's twenty-odd novels, and it lightly fictionalized his own ample adventures (40). Many events are real and places are truly portrayed. One of the successful British writers of his time, Marryat grew famous enough to draw a parody from Bret Harte, important enough in retrospect to draw homage from Joseph Conrad and an essay from Virginia Woolf (41). It means more to us that he was a keen observer with a bent for scientific inquiry. Examples: Marryat gave formal taxonomic standing to two mollusks that experts still treat as good taxa (42), and his *Life and Letters* (43) contains "Anecdotes of Wounded Men" that a medical man might have written. Those who went to Trindade after him vouched for his depiction of the island. He did, however, tamper with the time. *The Naval Officer* took its hero to Trindade—with a Yankee prisoner—while our War of 1812 was on. The real Marryat had stopped there on his way to St. Helena, where he was to help guard Napoleon through the erstwhile emperor's last days. Marryat's private log, now in Britain's National Maritime Museum, says he went ashore "to procure water and to examine the Island" on January 9, 1821.

If Marryat was not the first to see the dead trees, he was, it seems, the first to write about them. In 1817 survivors of the *Jeune Sophie* took refuge on Trindade when their ship caught fire at sea. A Brazilian newspaper ran the story of their rescue, but apparently the news account (44) had nothing for the naturalist. 1817 also brought edition two of Horsburgh's *India Directory*, the East India Company's sailing guide. The *Directory*'s claim that "there are trees about 12 or 18 inches diameter" on Trindade was at best an overestimate, perhaps an outright error, and Horsburgh did not tell where (or when) he got it. On the chance that a logbook would give better information, we wrote to British sailing archives to ask about the vessels Horsburgh said had watered at Trindade. The obliging archivists who rummaged through the records for us turned up nothing on the trees (45).

The trees were not dead in 1781: that we know from Captain Pasley's journal. Sailing round Trindade on June 5, Pasley saw "a pleasant appearance of Verdure near the Shore, and the little Valleys and sides of the mountains cloathed with Wood," adding, "it makes a most picturesque appearance." Landing later with D'Auvergne to put the infant colony in place, he "found the island covered with Wood, the Soil uncommonly Rich, and several Excellent springs of Water in the Woods which were all absorbed by the sponginess of the Soil ere they reached the Sea." It is clear enough that Pasley saw a greenwood rather than a scene of desolation.

It is clear, too, that the trees had not died when D'Auvergne departed, because a map made by the Portuguese who took his place shows tree-clad terrain (46). But the leader of the garrison soon deemed these woodlands worthless. He wrote back to Rio that the forest was inconsequential, the trees slender, low, and crooked. He could not find one fit, he said, to function as a flagpole (47). This report, dated a month after the takeover, already has the sour tone that would run through all the garrison's papers: time and again they stress the island's *total inutilidade* while saying nothing further on the trees. From this we take it that the trees lived through the 12-year occupation: Brazil's viceroys were not loath to list the island's shortcomings, and a dead forest would have been grist to their mill. For much the same reason we think the trees stayed green through 1803, when the New England sealer Amasa Delano toured Trindade. Delano filled his *Narrative of Voyages and Travels* (48) with lively glimpses of other places but offered bland details about Trindade. On Trindade's trees he said only that "Wood may be cut on the mountain just above the first landing place." He likely would have told his readers of it had he seen the melancholy sight that Marryat saw.

Marryat's description holds a hint that the forest died not too many years before he looked at it in 1821. The picture that emerges from the passage in *The Naval Officer* is one of trees still standing where they grew. Most had fallen when Robert McCormick, a medical officer with the Ross Antarctic Expedition, saw them in 1839. They were then "scattered around in wild confusion, here and there one fixed in the soil in an erect position" (49). With this we have said all we can about the time of death: the trees likely lived beyond 1803, and the upright trunks of Marryat's account suggest a death-year more toward 1821. It could have been 1816. That will be of interest when we guess what killed the trees.

## Death's Cause: Guesses Galore

We might have sought a clue to cause of death from another island with a *Colubrina* forest—if there were such. Though colubrinas of the Trindade kind tend to grow in clusters on the mainland, they never covered any island but Trindade. The closest match may have been one of Florida's keys, where a hundred years ago a different *Colubrina* formed a dense forest. At any rate, that is what Charles Sprague Sargent's 1884 *Report on the Forests of North America* says. Sargent got the story from plant collector A. H. Curtiss, and with it came specimens of *C. elliptica* from "Umbrella Key" (the Smithsonian's herbarium has one of them). Floridians have used that name for more than one island, but the state has history-minded librarians who could help us get the right one: Curtiss took the specimen from the high key now called Windley Key (50). We have talked with skeptics who know Windley well and doubt it ever had enough colubrinas to make a forest. Whatever their numbers were, Windley's colubrinas are no more. Development did them in and hurricanes helped. But Trindade's desolation can not be blamed on bulldozers—or on high winds either if the trees still stood when Marryat saw them—so we must look to other causes.

Guesses at the cause of death began with Marryat, who looked for signs of soil erosion around the roots, and, finding none, decided that the trees had died for one of two reasons. The likelier one, he thought, was a "sudden and continued eruption of sulphuric effluvia from the volcano." If not that, "by some unusually heavy gale of wind or hurricane, the trees had been drenched with salt water to their roots." The second guess tells us that he saw the trees still standing as they grew. Had they been down, he would have skipped the salt water and let the gale of wind uproot them. The water story will not work, for, as E. F. Knight pointed out, there were dead trees on the mountains way beyond the reach of any waves. Knight favored a volcanic cause, but that will not work either, because Trindade the volcano has been quiet for millenia (51). And fire was not the cause of death. To be sure, the Trindade of an earlier time did have a tindery substrate. Portuguese settlers learned this in 1783 when the soil burst into flame for no known reason and kept on burning till they stopped it with a dammed-up stream (52). Those who left the isle in 1795 would have let such a fire burn: Brazil's outgoing viceroy had written his successor in 1789 that he would rather raze Trindade to make it more useless than spend more money to defend it (53). Nevertheless, we can be sure soil fires did not spread widely enough to kill all the trees, for Marryat found afterward "no want of rich earth for nourishment of the roots." We can count crown fires out, too. Some of the logs do have fire-blackened parts, but charring must have taken place after death. Had Marryat seen a fire-charred forest he would not have guessed that gases or a gale had killed the trees.

Trindade has had free-roaming hogs and goats—infamous for what they do to vegetation—off and on since Edmond Halley set some loose in 1700. Those brought in by settlers of the 1780s must have stripped the isle of many smaller plants, and the settlers' doings doubtless added to the devastation. There were still wild hogs and goats on Trindade in 1821, when Marryat noted the lack of undergrowth within the dead forest. Clearly, hungry goats kept the colubrinas from replacing themselves, and in that sense their coming brought the forest to an end. But goats could hardly have killed the older trees, nor could hogs have done so without baring roots to Marryat's scrutiny.

More than one of Trindade's visitors said the forest looked as if a plague had struck it, and perhaps one had. A fungus disease or insect infestation, started by a chance British or Portuguese introduction, could have passed through all the island's valleys in short order. This happened on Bermuda, a much larger area than Trindade, when scale insects brought in by accident in 1943 or thereabouts killed nine-tenths of the native cedars in ten years (54). The likelihood of an exotic pest's coming to Trindade was highest when Johnstone sent D'Auvergne to make a jewel of it. Captain Pasley's *Jupiter* went along from St. Helena as "a perfect Noah's Ark," bearing barnyard beasts and "all kinds of Trees to Plant and Grasses of every kind—Seeds both Cape and European without number and without name—Water Cresses, Sorrel, Water Dock, Purcelean, Will'd Mint, Time—and the Lord knows what" (55). Though the Portuguese did not have Johnstone's Noah-impulse, their chance to loose a plague lasted longer. If a plague is to blame—that is, if *Colubrina glandulosa* var. *reitzii* succumbs easily to a pest of some kind—the weakness may show up where these trees serve for reforesting. As far as we know, mainland plantations have not yet had a pest problem.

### A New Notion

So far no one has proposed that Trindade's trees died of old age, but that is less absurd than it may seem. With goats eating all the undergrowth, the forest was bound to become geriatric. Marryat saw "thousands and thousands of trees . . . each of them about thirty feet high," and all seemed to have died simultaneously. His observations bring to mind the widespread death of ohia-lehua (*Metrosideros collina*) on the island of Hawaii. Foresters who first surveyed ohia dieback from the air thought it was the work of a newly brought in fungus, and they feared the native forest would be gone in 20 years. A thorough search, however, turned up no fungus or insect that could be the primary cause. Among those who have studied this puzzle most deeply are University of Hawaii botanist Dieter Mueller-Dombois and his students. Observing that dieback hits only the mature trees, Mueller-Dombois puts the blame on age and on normal ups and downs in growth conditions (56). In a poorly drained area, a root-flooding wet spell that is tolerable to young ohias can kill the old ones quickly, and a drier spell can kill the oldsters where the runoff is rapid: Mueller-Dombois's study areas include dieback sites of both kinds. After a dieback, young ohias grow with greater vigor. "The dieback thus has become a successful mechanism," Mueller-Dombois says, "to maintain an essentially shade-intolerant pioneer species as the structure-forming dominant in the course of primary succession." That sounds a lot like *Colubrina*.

If Hawaii's dieback is the right model for Trindade's desolation (57), a dry spell must have been the cause of death. Rainfall runs readily enough from the island's mountainsides, and the annual average may have been near the trees' lower limit to begin with. On the mainland, colubrinas grow where sun is bright and rain abundant (58). The *Flora Ilustrada* of Santa Catarina, a Brazilian coastal state, has a map of *Colubrina* sites, which we compared with a map of Santa Catarina's rainfall distribution (59), and we found all the sites get at least 1,300 millimeters a year. Trindade's weather station, set near sea level, now receives 800 millimeters or so (60). With green slopes to aid cloud formation, the valleys would have got more rain than that, but we doubt their wetness ever matched the wetness of the mainland's *Colubrina* stands.

To fit the ohia model, Trindade's colubrinas need not have had a drastic drop in rainfall: one of the drier stretches in an ordinary set of fluctuations would have been enough. As it happens, though, we have cause to conjecture that something extraordinary brought an extra dry spell. We said the death-year could have been 1816. That was "the year without a summer" in New England, with June snows and August frost in that region and bouts of record-breaking bad weather in parts of Europe, too (61). This nasty weather came a year after the eruption of Indonesia's Mount Tambora, the biggest blast of any kind in written history. Tambora discharged 100 cubic kilometers of debris (62), some of which stayed aloft, where, months later, it could still turn a part of the sun's heat away from the earth's surface. Murray Mitchell, a climatologist with the National Oceanic and Atmospheric Administration, explained in answer to our queries what this might have done to Trindade. As Tambora lies below the meteorological equator, its dust and droplets could have changed the weather in parts of the world's southern half as readily as in the north. Cooler surface waters near Trindade would have made for smaller shower clouds above the island and for reduced rainfall when the clouds dropped their moisture on the slopes.

The Tambora tale requires some heavy hedging. There are no long-range records to show that weather really cooled anywhere in lower latitudes—north or south—in 1816. Furthermore, there are those who doubt Tambora caused the year without a summer, and they give good reasons for their doubts (63). One counterargument: Volcanic dust-and-droplet veils do not have to keep solar radiation from the earth; much of it can scatter forward from the motes and reach the earth's surface indirectly. And temperatures reached record lows at some European and American weather stations, but not others. Why, the doubters ask, would a world-wide veil make bad weather only here and there? And if volcanic matter did make the bad weather, it may have come from more than one volcano, for there were other big blowups within a few years of Tambora's. To make things even more uncertain, temperatures seem to have been lower than usual in many places from 1810 to 1820, a decade that also had a low sunspot count. Thus, Tambora could have been just a help to a cooling trend starting from the sun. For all that, we like the thought that a pyrotechnic drama on the earth's other side could have finished off Trindade's forest. If it is not true, it is too good a lie to go untold.

To return to firmer ground: A dry spell for any reason suits our notion of the forest's death. Then, as now, Trindade's sometimes cloud-cloaked peaks were wetter than the valleys; consequently, colubrinas on the mountaintops could carry on when others perished. But keeping wet was not enough. Survivors had to keep away from goats as well; that is, their offspring had to do so. Maybe the beasts passed up a seedling now and then because, on the peaks, the colubrinas grew with woody plants of other kinds, some not tasty to a goat. Or perhaps the scant rewards a goat could get from browsing near the summit made roaming to the top a rare event. Anyhow it happened, we are grateful that the browsers missed a few and let us put away the *Caesalpinia* story with precision. That story started with a botanist and a bird man. It is fitting we should join to set it right (64).

## Notes and References


1. G. F. Simmons's "Sindbads of science," *National Geographic* 52:1–75 (1927), and R. H. Rockwell's "Southward through the doldrums," *Natural History* 32:424–436 (1932), have pictures taken on Trindade. See also Edward Wilson's lovely painting of Trindade before sunrise in his *Diary of the Discovery Expedition to the Antarctic Regions, 1901–1904*, Ann Savours, Ed. (Humanities Press, New York, 1967).
2. Rockwell (1), p. 434.
3. Aided by a grant from the National Geographic Society, Olson was on Trindade from December 18, 1975 to February 10, 1976. See his "Natural history of vertebrates on the Brazilian islands of the mid South Atlantic," *National Geographic Society Research Reports* 13:481–492 (1981).
4. For comments on the numbers and the tameness of Trindade's birds, see Rockwell (1) and M. J. Nicoll, *Three Voyages of a Naturalist* (Witherby, London, 1908). Both show photographs of birds on dead trees; see also the photo in (31), p. 431.
5. For more on wood and the way it is identified, see F. W. Jane, *The Structure of Wood*, ed. 2 revised by K. Wilson and D. J. B. White (Adam & Charles Black, London, 1970).
6. N. J. W. Thrower, Ed., *The Three Voyages of Edmond Halley in the Paramore, 1698–1701* (Hakluyt Society, ser. 2, vol. 156 and 157, London, 1981).
7. E. M. Peixoto, *Ilha da Trindade: Memoria Historica* (*Publicações do Arquivo Nacional* vol. 28, xv + 667 p., Rio de Janeiro, 1932).
8. G. Rutherford, "Sidelights on Commodore Johnstone's expedition to the Cape," *Mariner's Mirror* 28:189–212, 290–308 (1942). V. T. Harlow, *The Founding of the Second British Empire, 1763–1793*, vol. 1, *Discovery and Revolution* (Longmans, Green & Co., London, 1952). See p. 107–125, "The sea-route to India."
9. G. R. Balleine's *The Tragedy of Phillippe d'Auvergne, Vice-Admiral in the Royal Navy and Last Duke of Bouillon* (Phillimore, Chichester, 1973), tells of D'Auvergne's mission to Trindade and of his adventures before and after that. Britain's main link with French royalist guerillas during the Napoleonic wars, D'Auvergne was also heir by adoption to a rich duchy, but his attempts to claim it brought him to a destitute end.
10. T. Pasley, *Private Sea Journals, 1778–1782*, R. M. S. Pasley, Ed. (Dent, London & Toronto, 1931). D'Auvergne's decision is in the entry covering October 23–31, 1781.
11. Anonymous, "Biographical memoir of Philip d'Auvergne, Duke of Bouillon, Commodore in His Majesty's Service, &c. &c.," *Naval Chronicle* 13:169–191 (1805). Published to answer a detractor, this sketch seems to have got most of its information from its subject.
12. Peixoto (7), p. 418.
13. Balleine (9) wrongly has the *Bristol* come by accident. Her captain's report to the Admiralty makes it clear that she went to Trindade for the settlers (James Burney's in-letter of April 17, 1783, Public Record Office, London, file ADM 1/1504). Furthermore, the force from Rio carried orders right from London telling D'Auvergne and his group to leave without a struggle; see Peixoto (7), p. 37.
14. Peixoto (7), p. 470.
15. The leader of the troops from Rio was told early on to get "tudo o que pertence à Historia Natural": Peixoto (7), p. 403; Lobo (27), p. 118. But this was one order among many. If he did take specimens, nothing is known of them: P. de Assis Ribeiro, "Expedição à Ilha da Trindade," *Revista Brasileira de Geografia* 13:293–314 (1951), p. 304.
16. Balleine (9), p. 105.
17. C. J. Phipps (2nd Baron Mulgrave), *A Voyage towards the North Pole Undertaken by His Majesty's Command, 1773* (J. Nourse, London, 1774). The biographical sketch of 1805 (11) says D'Auvergne did the first drawings for all of Phipps's plates.
18. First published in 1787 and again with Pasley's *Journals* (10).
19. Pasley's (10) entries for September 27 and October 11, 1781.
20. "Cet officier était dans une telle crainte qu'on ne s'aperçût du misérable état de son gouvernement, qu'il ne voulut jamais permettre à M. de la Martinière et au père Receveur de s'éloigner du rivage pour herboriser." *Voyage de La Pérouse autour du Monde*, L. A. Milet-Mureau, Ed. (Imprimerie de la République, Paris, 1797), vol. 2, entry for October 18, 1785. Lola Higueras of Madrid's Museo Naval told us after we had done our text that a Spanish voyage round the world stopped at Trindade, too: the

*Descubierta* and the *Atrevida,* under Alessandro Malaspina, paused to plot the isle's position on September 5 and 6, 1789, but no one went ashore.

21. J. Dumont d'Urville, *Voyage de la Corvette l'Astrolabe, Exécuté par Ordre du Roi, pendant les Années 1826–1827–1828–1829. Histoire du Voyage,* vol. 1 (Tastu, Paris, 1830). See p. 68–71 for Trindade.
22. J. R. Andrade Ramos, "Expedição à Ilha da Trindade," *Revista da Escola de Minas* 15(6):5–14 (1950).
23. L. de Castro Soares, "As ilhas oceânicas," p. 341–378 in *Brasil, a Terra e o Homem,* vol. 1, A. de Azevedo, Ed. (Companhia Editora Nacional, São Paulo, 1964). For Trindade's trees, p. 361.
24. We used a 1934 printing of Knight's *Cruise of the "Alerte" in Search of Treasure* (Wm. Farquahar Payson, New York) and a 1914 printing of his *Cruise of the "Falcon"* (Longmans, London), wherein Knight told of an earlier, briefer visit to Trindade and showed an artist's rendering of the dead forest. From entries in *The National Union Catalog* we judge these works first came out in 1890 and 1884, respectively. For more on Knight, see his *Reminiscences* (Hutchinson, London, 1923). Knight did not say who at Kew had identified his wood; we learned that from C. R. Metcalfe of Kew's Jodrell Laboratory.
25. Accordingly, H. N. Ridley repeated the assignment of Trindade's trees to *Eugenia* on p. 683 of his *Dispersal of Plants throughout the World* (Reeve, Ashford, 1930).
26. International Association of Wood Anatomists, *IAWA Bulletin* 2:51 (1981).
27. The Jardim sent a collector to Trindade as early as World War I, when Brazilian forces occupied the isle. See B. Lobo, "Conferencia sobre a Ilha da Trindade," *Archivos do Museu Nacional do Rio de Janeiro* 22:107–158 (1919).
28. M. C. Johnston, "Revision of *Colubrina* (Rhamnaceae)," *Brittonia* 23:2–53 (1971).
29. *J. Becker 28* from Museum National d'Histoire Naturelle, *H. P. Veloso 387* from Instituto Oswaldo Cruz.
30. S. Carlquist, "The biota of long-distance dispersal. III. Loss of dispersability in the Hawaiian flora," *Brittonia* 18:310–335 (1966).
31. G. Murray, "The voyage southward of the *Discovery.* II. From Madeira to the Cape," *Geographical Journal* 19:423–435 (1902). Murray's first thought was that the trees might be ebony: Wilson's *Diary* (1), p. 52.
32. We thank Keeper J. F. M. Cannon and his colleage J. Lewis for the prompt and thoughtful answer.
33. G. Murray, "On *Boodlea,* a new genus of Siphonocladaceae," *Journal of the Linnean Society, Botany* 25:243–245; pl. 49 (1889).
34. J. Britten, "George Robert Milne Murray (1858–1911)," *Journal of Botany, British and Foreign* 50:73–75 (1912).
35. R. C. Murphy, "The bird life of Trinidad Islet," *Auk* 32:332–348 (1915).
36. J. H. Holland, "Brazil-wood," *Royal Botanic Gardens, Kew. Bulletin of Miscellaneous Information* 9:209–225 (1916). See also (39).
37. Law no. 6.607: J. H. Kirkbride, Universidade de Brasília, kindly sent a copy.
38. R. C. Murphy, *Oceanic Birds of South America* (American Museum, New York, 1936), vol. 1, p. 173.
39. C. Mainieri, *Estudo Macro e Microscópico de Madeiras Conhecidas por Pau Brasil* (Instituto de Pesquisas Tecnológicas Publicação no. 612, São Paulo, 1960).
40. We read an edition titled *Frank Mildmay* (Macmillan, New York, 1897). The name of the novel's hero rose from subtitle to title in versions printed after 1834 or thereabouts. For more on Marryat, start with M.-P. Gautier's *Captain Frederick Marryat, l'Homme et l'Oeuvre* (Didier, Paris, 1973). There are three biographies in English, but the French one, being newest, has the fullest reading list.
41. B. Harte, "Mr. Midshipman Breezy, a naval officer," in Harte's *Condensed Novels* (Literature House/Gregg Press, Upper Saddle River, 1969). J. Conrad, *Notes on Life & Letters* (Dent, London & Toronto, 1921). "Tales of the sea," p. 73–78, is Conrad's homage to Marryat and to James Fenimore Cooper. V. Woolf, *The Captain's Death Bed and Other Essays* (Hogarth, London, 1950).
42. F. Marryat, "Descriptions of two new shells," *Transactions of the Linnean Society of London* 12:338–339; tab. 10 (1818). Smithsonian malacologist J. Rosewater told us how the taxa fared.
43. Florence Marryat, *Life and Letters of Captain Marryat,* 2 vol. (Bentley, London, 1872).
44. Summarized by P. T. X. de Brito in "Memoria historica e geographica da Ilha da Trindade," *Revista Trimensal do Instituto Historico, Geographico e Ethnographico do Brasil* 40(2):249–275; 5 pl. (1877).
45. We thank M. R. Edwards, Public Record Office; R. W. Jones, Post Office Archives; R. J. B. Knight, National Maritime Museum; M. Meaden, India Office Records.
46. Peixoto (7), following p. 4. Four views of Trindade drawn when the map was made also seem to show forested slopes. See Brito's (44) final plate.
47. Peixoto (7), p. 414.

48. Printed by E. G. House for the author, Boston, 1817; reprinted by Praeger, 1970. See p. 424–425.
49. R. McCormick, *Voyages of Discovery in Arctic and Antarctic Seas* (Sampson Low, Marston, Searle & Rivington, London, 1884), vol. 1, p. 24.
50. The Coast and Geodetic Survey map of 1856 and the 1870 census of Monroe County and the Keys use "Umbrella Key" for what is now Windley. Finding that out was not easy. For help with the "digging," we thank Karen Achor, G. N. Avery, C. M. Brookfield, Bill Ford, Wright Langley, Nixon Smiley, W. L. Stern, Alexander Sprunt, Dan Ward, H. S. Zim, and especially librarians Betty Bruce, Key West, and Becky Smith, Miami.
51. F. F. M. de Almeida, *Geologia e Petrologia da Ilha da Trindade*, Departamento Nacional da Produção Mineral, Divisão de Geologia e Mineralogia, Monografia 18 (1961).
52. Peixoto (7), p. 422.
53. Peixoto (7), p. 428.
54. D. Challinor and D. B. Wingate, "The struggle for survival of the Bermuda cedar," *Biological Conservation* 3:220–222 (1972). C. Nolan, "Loss of a treescape—a report from Bermuda," *Quarterly Journal of Forestry* 74:165–176 (1980).
55. Pasley (10), entry for September 27, 1781.
56. D. Mueller-Dombois, "The 'ōhi'a dieback phenomenon in the Hawaiian rain forest," p. 153–161 in *The Recovery Process in Damaged Ecosystems*, J. Cairns, Jr., Ed. (Ann Arbor Science, Ann Arbor, 1980).
57. A. Cronquist pointed out to us that the model works better if Trindade's trees were short-lived, that is, if trees big enough to escape goats were bound to go overage within the thirty years or so between the 1780s and the 1810s. We have seen no figures on trees on the Trindade kind. As a rule among trees of the tropics, though, fast-growing pioneers do have short lives: P. W. Richards, *The Tropical Rain Forest* (Cambridge University Press, 1952).
58. R. M. Klein's ecological remarks in M. C. Johnston and M. A. de Freitas Soares, *Flora Ilustrada Catarinense: Ramnáceas* (Itajaí, 1972).
59. Departamento Estadual de Geografia e Cartografia, *Atlas Geográfico de Santa Catarina* (I. B. G. E., Conselho Nacional de Geografia, Directório Regional de Santa Catarina, 1958).
60. S. Serebrenick, unpublished: see Castro Soares (23), p. 362.
61. H. Stommel and E. Stommel, "The year without a summer," *Scientific American* 240(6):176–186 (1979).
62. T. Simkin, L. Siebert, L. McClelland, D. Bridge, C. Newhall, and J. H. Latter, *Volcanoes of the World* (Hutchinson Ross, Stroudsburg, 1981). See also W. A. Petroeschevsky, "A contribution to the knowledge of the Gunung Tambora (Sumbawa)," *Tijdschrift van het Koninklijk Nederlandsch Aardrijkskundig Genootschap* 66:688–703 (1949).
63. H. E. Landsberg and J. M. Albert, "The summer of 1816 and volcanism," *Weatherwise* 27:63–66 (1974). S. Self and M. R. Rampino, letter, *Scientific American* 241(4): 10 (1979).
64. Earlier writings on Trindade have drawn on British or Brazilian sources, not both. We could use both because we had help: Ann Shirley, National Maritime Museum, put us onto Balleine's book (9), and Max Justo Guedes, Serviço de Documentação Geral da Marinha, gave us Peixoto (7). Some others who helped are named in the text and in the foregoing notes. We also thank Manoel Cardozo, David Cutler, M. C. Johnston, Philip Lundeberg, Regis Miller, Carmen A. Pérez, M. R. Rampino, T. Simkin, Lyman Smith, Norman Thrower, Wilcomb Washburn, S. Yankowski.

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# Distributional Notes on Northwestern Montana Aquatic Vascular Plants—1982

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During the summer of 1982 I was able to visit many aquatic habitats in northwestern Montana with students and colleagues while teaching a course on aquatic vascular plants at the University of Montana Biological Station on Flathead Lake at Yellow Bay. Our field work was mostly conducted in Flathead and Lake counties where there are diverse riverine, lacustrine, and palustrine habitats that have high environmental quality. It is also an area that still needs botanical exploration as demonstrated by the recent range extensions reported here and elsewhere (McCune 1982; Schuyler 1980).

I am grateful to the students—Fred Bassett, Henry Corddry, Laura Holub, Leslie Kline, Meg Mayers, DeDe Montgomery, Nancy Roush, Bob Waldron, and Steve Williams—and to Michael Gallagher, Sherman Preece, Patricia Schuyler, Ellen Seeley, Jack Stanford, and Bob Steele for help in various ways. In the following discussion, the distributions given in Hitchcock and Cronquist (1973) and Scoggan (1978–1979) as well as collections at the University of Montana are heavily relied on. Unless stated otherwise, the discoveries reported here were made during the summer of 1982 and voucher specimens are in the herbaria of the University of Montana at Missoula and/or Yellow Bay. The names follow Hitchcock and Cronquist (1973) except for *Phragmites australis* (Cav.) Trin. ex Steud.

**Bidens beckii.** This is primarily a species of southeastern Canada and the northeastern United States that has a disjunct western North American range in British Columbia, Washington, and Oregon (Hitchcock and Cronquist 1973). Here the western range is extended to Montana where the first known collection was made in 1967 by Marie Mooar at Seeley Lake in Missoula County. In Flathead County, we found *B. beckii* in the Swan River 3.4 kilometers east of Bigfork and in Smith Lake 1.8 kilometers southeast of Kila. At both of these localities it was growing in water about 1 meter deep with *Myriophyllum exalbescens*.

**Brasenia schreberi.** This widely distributed species has disjunct eastern and western North American ranges. Its western range extends from southeastern Alaska to California eastward to Idaho and Montana. We found it in Flathead County at Mud Lake 8.1 kilometers northeast of Bigfork and at Blanchard Lake 3 kilometers southwest of Whitefish. It had previously been collected at the latter locality by Marie Mooar in 1969. At Mud Lake we only found floating rhizome fragments with young shoots but at Blanchard Lake attached floating-leaved plants were abundant and many had flowers. This species is also known from Seeley Lake in Missoula County where the most recent collection was made in 1967 by Marie Mooar.

**Eleocharis pauciflora.** This circumboreal species extends southward to California, Arizona, and New Mexico in western North America but is rarely found in Montana. In Flathead County, we found small populations at Blanchard Lake 3 kilometers southwest of Whitefish where the plants grew on recently exposed soft peaty substrates with *Utricularia minor*.

**Lythrum salicaria**. This Eurasian introduction is a weed problem in many eastern North American wetlands and has the potential to become one in western North America (Stuckey 1980). The only Montana locality known to me for *L. salicaria* is in Lake County along the bank of Spring Creek near the east side of route 93 in Ronan where we found one clump. If this species spreads in the manner in has elsewhere and gets into the nearby potholes and wetlands adjacent to Ninepipe Reservoir, it will have an adverse impact on the extensive aquatic flora there.

**Najas guadalupensis**. This widely distributed transcontinental species is rare in Montana where it is near the northern limit of its range. Haynes's (1979) map shows one Montana locality in Cascade County and one locality in southern Alberta. In Lake County, Montana, we found it in water about 0.5 meter deep in the northwest end of Ninepipe Reservoir 3.1 kilometers northeast of Charlo where it was locally abundant.

**Nymphaea tetragona**. The range of this widely distributed but often localized circumboreal species extends southward to northern Washington, northern Idaho, and northwestern Montana in western North America. In Flathead County, Montana, it has been collected in McWenneger Slough 8 kilometers east northeast of Kalispell at various times since 1948. We relocated a small population there and also found scattered plants in the northwest end of Blanchard Lake 3 kilometers southwest of Whitefish. At both localities, only a few plants had flowers or flower buds. This species is also known from Salmon Lake in Missoula County where Dennis Woodland collected it in 1966.

**Phragmites australis (communis)**. This nearly cosmopolitan grass is rare in northwestern Montana. We found it on the northwest side of Ashley Creek 1.5 kilometers south of Kila in Flathead County where LeRoy Harvey collected it in 1952. It is a small stand (estimated to be 20 square meters at the most) adjacent to fill for the approach to the bridge over Ashley Creek. This locality is in an extensive emergent wetland adjacent to Smith Lake where there is much *Scirpus acutus, Typha latifolia*, and *Phalaris arundinacea*. *Phragmites australis* often spreads into and dominates wetland habitats altered by man, a situation that might develop here if such alterations occur.

**Scirpus subterminalis**. This widespread but often localized species has disjunct eastern and western North American ranges. Its western range is from southeastern Alaska to California east to Montana, Wyoming, and Utah. The only previously reported (Maguire 1939) Montana locality for it is in Lake McDonald, Glacier National Park, where no one has reported seeing it since 1934. We found it growing abundantly in water about 0.5–1.0 meters deep in the northeast end of Blanchard Lake 3 kilometers southwest of Whitefish in Flathead County.The plants were mostly vegetative; only a few had culms bearing spikelets.

**Utricularia intermedia**. The southern limit of the range of this circumboreal species extends through Washington and Oregon to California in western North America and from Iowa to Delaware in eastern North America. Here the range is extended to Flathead County, Montana, where we found it in Glacier National Park. The plants were abundant in pools in the bog mat along the west side of Fish Lake 2.3 kilometers southeast of Lake McDonald Lodge.

**Wolffia columbiana and Wolffia punctata**. Both of these species are rare in the Pacific Northwest, where they are at the northern limit of their ranges. Both are reported from Oregon and *W. punctata* also is reported from Washington (Hitchcock and Cronquist 1973). In Montana, where they apparently have been overlooked, we found abundant plants of both species in a pothole near Ninepipe Reservoir 3.8 kilometers northeast of Charlo in Lake County. We also found abundant plants of *W. columbiana* in McWenneger Slough 8.5 kilometers east northeast of Kalispell in Flathead County.

## Literature Cited

Haynes, R. R. 1979. Revision of North and Central American *Najas* (Najadaceae). Sida 34–56.

Hitchcock, C. L. and A. Cronquist. 1973. Flora of the Pacific Northwest. University of Washington Press, Seattle. xix + 730 pp.

Maguire, B. 1939. Distribution notes concerning plants of Glacier National Park—II. Rhodora 41: 504–508.

McCune, B. 1982. *Howellia aquatilis* Gray (Campanulaceae). Madroño 29: 123–124.

Schuyler, A. E. 1980. *Carex chordorrhiza* in Glacier National Park, Montana. Rhodora 82: 519.

Scoggan, H. J. 1978–1979. The flora of Canada. National Museum of Natural Sciences, Publications in Botany, No. 7, parts 1–4. xiii + 1711 pp.

Stuckey, R. L. 1980. Distributional history of *Lythrum salicaria* (purple loosestrife) in North America. Bartonia No. 47: 3–20.

Bartonia No. 49: 55–58, 1983

# Viewing Plants through the Seasons in Upper Perkiomen Valley Park (Montgomery County, Pennsylvania)

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It has been suggested to me by Ann Newbold that the members of the Philadelphia Botanical Club who enjoy checking out nearby flora in the field might be interested to know what a variety of species can be found in the Upper Perkiomen Valley Park, the Montgomery County park at Green Lane, and in areas contiguous to it: areas belonging at this writing to the Philadelphia Suburban Water Company and to the University of Pennsylvania, the latter piece of land leased to Community Diversified Services, Inc., and known as "Deep Creek Camp." In my frequent walks over these areas, I have identified well over five hundred of the species listed in Dr. Edgar T. Wherry's 1972 *Check-list of the Flora of Montgomery County* and in the additions to that list made by Mrs. Newbold (*Bartonia* numbers 45, 46, 47).

Taking things from the viewpoint of one walking about looking for flowers and proceeding through the calendar, let's start with spring. There are all the usual spring flowers: Hepaticas, Bloodroot, Spring Beauties, Rue Anemones, Trout Lilies, Bluets, Early Saxifrage, and Dutchmen's Breeches. Along the Perkiomen creek there are quantities of Virginia Bluebells interspersed with Cut-leaved Toothworts. There and in Deep Creek Camp are large patches of Wild Ginger (*Asarum canadense*). Others less well known by every passer-by perhaps are the large-flowered, early buttercup, *Ranunculus hispidus,* the starlike chickweed, *Stellaria pubera,* and, in the woods, the secretive *Obolaria virginica.* Raising one's eyes from the ground, there is the yellow of Spicebush, the white of Blackhaw (*Viburnum prunifolium*), and the pink of Wild Honeysuckle, or Wild Azalea (*Rhododendron nudiflorum*). Behind the county park campsites is an area where, I am told Frank Huber, Warren Schanley, and the Reverend Mr. William Kistler, planted two kinds of trilliums, *T. erectum* and *T. grandiflora,* some time in the 1950s. About thirty years later they are flourishing and spreading. Nearby is one plant of *Clintonia umbellulata,* perhaps planted by the same gentlemen?

Beginning in May one can find *Hydrophyllum virginianum, Anemone quinquefolia, Viola conspersa,* all in quantity, along with *Pedicularis canadensis, Thalictrum dioicum,* and two kinds of Solomon's Seal, *Polygonatum pubescens* and *P. biflorum.* The first is the earliest and the more common here. The very large Great Solomon's Seal (*P. canaliculatum*), which can grow up to my shoulder, emerges and blooms later along Deep Creek on the Deep Creek Camp land. If you search in just the right spot in the woods, you should find Showy Orchis (*Orchis spectabilis*). The wooded hillside above the Perkiomen and below the county campsites will be full of White Baneberry (*Actaea pachypoda*). Mixed with it will be that plant with such confusingly similar foliage, Bugbane (*Cimicifuga racemosa*). The wooded hill on the opposite side of the park, along Hill Road, is full of the *Cimicifuga,* which blooms a month later. Near the Perkiomen one may find One-flowered Cancer-root (*Orobanche uniflora*).

Soon the hillside above Green Lane Road will be full of Blue-eyed Grass (*Sisyrinchium angustifolium*), *Salvia lyrata,* and Golden Ragwort (*Senecio aureus*)—the *S.*

*pauperculus* and *S. obovatus* will be a bit later and in other places. Now on the hill and along Deep Creek will be the pink of *Phlox pilosa.* In the woods will be Canada Mayflower (*Maianthemum canadense*), and in far-scattered spots, that tall relation of the Forget-Me-Not, *Cynoglossum virginianum.* In low, damp places will be two species of *Valerianella* and Golden Alexanders (*Zizia aurea*). In a few places is *Thaspium trifoliatum,* too.

Ferns will be developing. There is a fairly good representation of the ferns and their allies *Lycopodium lucidulum* and *L. flabelliforme.* At the right seasons, lots of *Botrichium virginianum* and a few *B. dissectum* forma *obliquum.* And of the Polypodiaceae: *Cystopteris fragilis, Onoclea sensibilis, Phegopteris hexagonoptera, Thelypteris novoboracensis, Dryopteris marginalis, Polystichum acrostichoides, Dennstaedtia punctilobula, Pteridium aquilinum, Adiantum pedatum,* and *Polypodium virginianum,* for sure.

June will bring *Asclepias quadrifolia,* and a bit later, if you are lucky, you will find *A. exaltata.* There will be *Hieracium venosum* certainly. Probably, in the right places, there will be *Oxalis violacea, Castilleja coccinea,* and *Chamaelirium luteum.* There will be cherries: *Prunus avium,* then *P. serotina,* then *P. virginianum;* shrubs: Ninebark (*Physocarpus opulifolius*) and two more Viburnums, *V. acerifolium* and *V. dentatum.* There will be two Beardtongues, *Penstemon hirsutus* and *P. digitalis,* and a lovely Bedstraw, *Galium boreale,* one of the six or seven of the genus *Galium* here. The first of the Lysimachias, *L. quadrifolia* and *L. nummularia,* bloom now. Later there will be *L. ciliata,* and among the Cattails and Sweet Flag in a wet place by Knight Lake, Swamp Candles (*L. terrestris*). The June list would include Indian Pipes (*Monotropa uniflora*), *Lilium canadense, Baptisia tinctoria, Panax quinquefolia* (which is easily overlooked until its berries turn red in the fall), *Chimaphila maculata, Pyrola elliptica,* quantities of *Cimicifuga racemosa* in the latter part of June into July, *Asclepias purpurascens, Ceanothus americanus, Oenothera tetragona, Aureolaria virginica*—the *A. pedicularia* doesn't bloom until late August or September. Most of the *Apocynum* will be *A. cannabinum,* but there are a few plants of *A. androsaemifolium* with its tiny, but lovely, pink bells. There will be Skullcaps: *Scutellaria elliptica, S. integrifolia, S. lateriflora,* and if you are lucky you will find the orchid, *Habenaria lacera.*

In July and August look for *Cephalanthus occidentalis, Heteranthera reniformis, Mimulus ringens, Veronicastrum virginicum,* and once in a long time, you will find Pinesap (*Monotropa hypopithys*). Certainly there will be *Agalinis tenuifolia, Silene stellata, Lobelia siphilitica, L. spicata, Phryma leptostachya, Cirsium altissimum* (to pick a less common thistle), *Cunila origanoides, Prenanthes alba, Boehmeria cylindrica, Trichostema dichotomum, Laportea canadensis, Gaura biennis, Diodia teres, Chelone glabra,* and a half dozen or more of the genus *Polygonum,* including *P. sagittatum* and *P. arifolium.* There will be *Rudbeckia:* first *R. hirta,* then *R. laciniata, R. fulgida,* and *R. triloba.* One may spot *Aristolochia serpentaria,* but I have yet to see it in bloom. In the right years there will be *Goodyera pubescens* and *Sabatia angularis.* For a couple of years I could count on finding Tall Bellflower (*Campanula americana*) by the Perkiomen, but it has been missing from that spot in recent years—crowded out by Garlic Mustard (*Alliaria officinalis*)?

Within the park Deep Creek will be bordered by Arrowhead (*Sagittaria latifolia*) in bloom. Nearby in boggy spots will be Water Plantain (*Alisma subcordatum*). There will always be some Ladies' tresses (*Spiranthes cernua*) here and there. One time a couple of years ago when the grass on the moist meadow by Deep Creek near the Swamp Oaks had not been mowed for a week or two an area of about twenty feet was full of them. Along the right bank of the stream in Deep Creek Camp are a lot of Beechdrops (*Epifagus virginiana*), oddly enough under *Quercus*, not *Fagus*, but that is "keeping it in the family" (Fagaceae).

By late summer or early fall there will be *Seriocarpus asteroides* close to where *Aureolaria virginica* bloomed and now has ripened capsules and *Solidago bicolor* will soon be full of flowers. *Aureolaria pedicularia* will now be blooming nearby.

One could collect *Desmodium*, or just enjoy the flowers of the beggar-ticks, or tick-trefoils, which are really very pretty. First blooms *D. glutinosum*, then *D. canescens*, *D. dillenii*, *D. paniculatum*, *D. nudiflorum*, *D. rotundifolium*. Or study the Asters; there are at least *A. schreberi*, *A. sagittifolius*, *A. laevis*, *A. cordifolius*, *A. prenanthoides*, *A. novae-angliae*, *A. patens*, *A. lateriflorus*, *A. divaricatus*, *A. macrophyllus*. *A. simplex*, and *A. pilosus var. demotus*. Or the *Eupatorium* group: *E. fistulosum*, *E. sessilifolium*, *E. perfoliatum*, *E. purpurem*, *E. rugosum*. Or the Goldenrods: *Solidago juncea*, *S. bicolor*, *S. gigantea*, *S. nemoralis*, *S. canadensis*, *S. altissima*, *S. rugosa*, *S. graminifolia*, *S. ulmifolia*, *S. rigida*, *S. speciosa*, *S. flexicaulis*, *S. caesia*. Come October be sure to look for the Gentians, *Gentiana andrewsii* and *G. crinita*. And finally, after all the other flowers, on the bare branches, the yellow of Witchhazel (*Hamamelis virginiana*).

For those interested in grasses, I know the park and environs has many species I am unable to identify. I do know the hillside above Park Road is fragrant with Sweet Vernal Grass (*Anthoxanthum odoratum*) when the Bluegrass (*Poa*) is in bloom. My eye has been caught by a different-looking *Paspalum* (*P. circulare?*) in midsummer, but the time when the grasses are really noticeable, of course, is in late summer and fall. If they don't mow the park grass constantly, which they have in 1980 and in 1981, the hillside will sport rosy mounds of Purple Lovegrass (*Eragrostis spectabilis*). Everywhere are the tall, gracefully drooping, purple heads of Purpletop whose common names seem to fit better than its scientific one, *Triodia flava*. At the woods edges are *Bromus purgans*, *Elymus riparius*, and Bottle-Brush Grass (*Hystrix patula*). In open waste-type places, every year I am confused by *Panicum clandestinum* whose leaves are so broad they do not say "grass" to me. On the dry, hard, open ground of the gas line right-of-way is *Sporobolus vaginiflorus*, and, so Ann tells me, *Arthraxon hispidus*. What is impossible to miss is all the Little Bluestem (*Andropogon scoparius*) with its feathery "beards" glinting in the slanting rays of the fall afternoon sun, and the Indian Grass (*Sorgastrum nutans*) that grows taller than I.

There are sedges, of course! For examples: *Cyperus strigosus*, *Bulbostylis capillaris*, *Scirpus cyperinus*, and *S. atrovirens*, *Carex lurida*, and all those other of the genus *Carex* for the Caricologist. Rushes there are, too. Path Rush (*Juncus tenuis*) of course; *J. effusus*, *J. biflorus*, and others no doubt.

To this point I have listed herbaceous plants and a few shrubs. Perhaps I should give some indication of the variety of trees, plus some other shrubs, in the park. The hillside above Park Road is edged in spring with the white of Dogwood (*Cornus florida*) and the pink of Judas Tree (*Cercis canadensis*). Through the park are quite a variety of species: *Populus grandidentata*, *Juglans nigra*, a variety hickories: *Carya ovata*, *C. tomentosa*, *C. cordiformis*, *C. glabra*. Occasionally in the woods one finds *Corylus americana*. At various places there are both *Ostrya virginiana* and *Carpinus caroliniana* for those wanting to compare the confusing "Ironwoods" or "Hornbeams." There is a great deal of *Betula lenta* and three examples of *B. lutea*, a species not listed for Montgomery

County until the No. 47 *Bartonia*. There is *Fagus americana,* and quite a variety of oaks: *Quercus alba, Q. bicolor, Q. prinus, Q. velutina, Q. rubra* (and gradations between), and *Q. coccinea*. There are both American Elm (*Ulmus americana*) and Slippery Elm (*U. rubra*), quantities of *Liriodendron tulipifera,* considerable *Sassafras albidum,* a large Sycamore (*Platanus occidentalis*) plus many smaller ones, some *Amelanchier arborea,* and some *Xanthoxylum americanum*. Sumacs (*Rhus typhina, R. glabra, R. copallina*) are there as well as copious amounts of *Toxicodendron radicans*. And while mentioning vines, there are grapes (*Vitis aestivalis* and *V. vulpina*), Moonseed (*Menispermum canadense*), and Wild Yam (*Dioscorea villosa*). There are quantities of Bladdernut (*Staphylea trifolia*) which, incidentally, has lovely racemes of white bells in May. There is a little *Ilex verticillata* and a selection of maples: *Acer rubrum, A. saccharum, A. platanoides,* and *A. negundo*. There is a lot of *Tilia americana* and some *Nyssa sylvatica*. The woods are full of *Cornus florida,* and by streams and in open places there are the shrubby dogwoods: *C. ammomum* and *C. racemosa*. There is a small grove of Persimmons (*Diospyros virginiana*). White Ash (*Fraxinus americana*) is everywhere.

Happy hunting to the Club members throughout the seasons.

Bartonia No. 49: 59–68, 1983

# Field Report on the Delmarva Flora, I

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The list that follows was initiated to put on record some recently found locations of noteworthy plants of the Delmarva Peninsula that mainly update R. R. Tatnall's 1946 flora of the area. Some are range extensions of rare species he listed and seven are not reported in his book and are apparently new additions to the peninsula's flora. Some are modern locations of plants not seen for many years and twelve are probably additions to Maryland's Flora.

The status of each plant is considered in the light of Tatnall's reference and some modern papers and articles. No extensive search of the literature or herbaria has been undertaken. Some readers may wish to further amend this report by additional research. Any up-dates, locations, corrections, or comments would be greatfully appreciated by the writer. Most names are according to Gray's Manual, 8th Edition, by M. L. Fernald.

### 1. Azolla caroliniana

MARYLAND: Worcester Co.: Big Mill Pond, 31 Aug 1978, Frank Hirst & Gilbert Cavileer. Pocomoke City, artificial pond SE of town, 14 Aug 1982, Frank Hirst.

In both cases thousands of plants were present covering the surface with a reddish mat. Not seen in Big Mill Pond since and completely absent three weeks later at Pocomoke. Harvill et al. (1977) have ten records from southeastern Virginia but there is no mention of the plant in Tatnall (1947). Reed (1953) lists the habitat as "limestone streams" in Frederick County, well off the peninsula. These are his only Maryland records.

### 2. Lygodium palmatum

MARYLAND: Wicomico Co.: N of Colbourne, 21 Mar 1981, Frank Hirst & Joe Fehrer, Jr.

A nice surprise to find this unique and graceful fern growing along a *Taxodium/Chamaecyparis* swamp far down into the coastal plain. The situation was reminiscent of the stations seen on the western edge of the New Jersey Pine Barrens. Tatnall records it as rare (two locations) on the Piedmont in Delaware. In 1982 a second station was located a short distance away by Jim Stasz while he was working for The Nature Conservancy doing a plant inventory. No reports of other lower coastal plain sightings are known.

### 3. Dryopteris celsa

MARYLAND: Worcester Co.: SW of Stockton, 11 Mar 1980, Frank Hirst & Joe Fehrer, Jr.

About 18 plants in an *Acer/Nyssa* swamp along Little Mill Run. A rich wooded area Southwest of Ocean City, Maryland, on South Point, was the only other peninsula record. This station has been known for over 40 years (Tatnall 1946) and was still extant in 1980. The Stockton colony is new.

### 4. Lycopodium clavatum

MARYLAND: Worcester Co.: N of Snow Hill, 14 Jul 1979, Frank Hirst & Gilbert Cavileer.

Small patch growing in a *Pinus/Acer* swamp along Nassawango Creek a mile below the old iron furnace. There are three records in Tatnall (1947): 1842, 1866, and a collection in 1941 by Bayard Long, all in Northern Delaware. Dr. Mary Humphreys located the plant near Libertytown, Worcester County, Maryland, on March 25, 1981, in another coastal plain situation.

### 5. Isoetes saccharata

MARYLAND: Worcester Co.: N of Stockton, Rowley Creek, 11 Mar 1973 & 5 Jul 1973, Frank Hirst. Scarboro Creek, 7 Jul 1979, Frank Hirst.

This plant occurs in deeper pockets of small intermittent woodland streams just up from the salt marsh but beyond the limits of the highest tide. Seems to be the only record for the east side of the peninsula in Maryland. Although this plant keys in Gray's 8th (1950) to *I. saccharata,* most modern students consider it to be a form or variety of *I. riparia*. The unusual habitat causes the amateur field botanist to wonder.

### 6. Isoetes riparia

MARYLAND: Dorchester Co.: Galestown, 4 Aug 1982, Frank Hirst & Dan Boone.

A small patch growing on mud in a fresh tidal marsh along Gales Creek. The specimen keys to this species. There was a small patch of about 40 plants and they were covered at high tide. Tatnall (1946) only has records for the 1800's. Reed's (1953) map 55 shows about the same range. Needs study by experts.

### 7. Leersia hexandra

MARYLAND: Worcester Co.: N of Pocomoke, 6 & 18 Sep 1982, Frank Hirst.

A noteworthy range extension from southeastern Virginia and an addition to the Flora of Maryland and the peninsula. In Virginia, Harvill et al. (1977) and Porter (1979) only list one county (collection?). Not listed in Norton & Brown (1946). A small well established colony in a dry woodland pond.

### 8. Muhlenbergia torreyana

MARYLAND: Caroline Co.: Goldsboro, 25 Sep 1982, Frank Hirst & Dan Boone.

A small population of mostly sterile plants with only a few flowering culms. In wet, often flooded, open woods. Seemingly rare everywhere. This makes a new Maryland plant and only the third station on the peninsula. Tatnall (1946) only lists Felton in 1873 and Ellendale in 1895 & 1940. Norton and Brown (1946), Tucker et al. (1979), or Broome et al. (1979) have no additional locations. This may be the second rarest grass on the eastern Coastal Plain with only a very few stations known in New Jersey (Snyder & Vivian 1981). No modern extant stations south of Maryland seem to be recorded (Dan Boone, pers. comm., 1982).

### 9. Panicum hemitomon

MARYLAND: Caroline Co.: E of Goldsboro, 26 Aug 1974, Frank Hirst.

*Panicum hemitomon* has proven to occur much more frequently than records indicate. Since the above specimen was collected, it has been observed in a large percentage of the small intermittent ponds located in northern Caroline County and also close by in its neighbors Queen Annes County, Maryland, and Kent County, Delaware. The four places it occurs in New Jersey are also open ponds, an identical habitat, where it is almost an aquatic grass. The writer has never seen this species flower in very wet years when its base is in deep water. At Bennetts Bog in Cape May County, New Jersey, it is mostly always without flowering culms. This characteristic may account for its inclusion in Maryland and Delaware "Rare and Endangered" lists. Tatnall (1946) lists it as "ditches and borders of ponds not often collected" with three records: two in Delaware and one in Maryland. Seen in about 20 spots in 1982 in the above mentioned counties (Hirst & Boone).

**10. Panicum wrightianum**

DELAWARE: Sussex Co.: Milton, 6 Nov 1982, Frank Hirst & Dan Boone. E of Midway, 14 Nov 1982, Frank Hirst & Dan Boone.

A delicate attractive panicum that seems to appear late in the growing season. This may somewhat explain the lack of records. It prefers dried pond bottoms and as a result is not seen for long periods of successive wet years. This trait is common to a large group of coastal plain wetland plants, especially the ones too short to be emergent in a few inches of water.

In 1966, a dry year in New Jersey, the writer and Gilbert Cavileer made five collections of *Panicum wrightianum* from five pond depressions in Atlantic County. The specimens dated from June 30 to August 25 and are in the Philadelphia Academy. The ponds dried up early that year showing the relationship of plant appearance dates to precipitation levels.

**11. Eleocharis equisetoides**

DELAWARE: Sussex Co.: Ellis Pond, 9 Aug 1961, Frank Hirst. MARYLAND: Wicomico Co.: Wango, 13 Aug 1982, Frank Hirst & Jim Stasz.

Listed as rare in Tatnall (1946) where one Delaware and two Maryland collections are reported. These are the only apparent modern records of this impressive spike rush north of Virginia where Harvill et al. (1977) show an Accomack County record on the peninsula. The New Jersey stations failed to show in recent years (Snyder & Vivian 1981).

**12. Eleocharis melanocarpa**

MARYLAND: Queen Ann Co.: Suddlersville, 19 Aug 1982, Frank Hirst, Dan Boone, & George Fenwick.

There are also two adjacent Caroline County spots in woodland pond/bogs with scarce to rare populations. Tatnall (1946) reports "rare" with two locations in Delaware and notes that it grows in wet sand. In these Maryland stations and three stations known to the writer in New Jersey, this species grows in wet clay or peaty mud, not in sand. This is an addition to Maryland's flora as far as any reports examined show. Not listed by Norton & Brown (1946).

**13. Eleocharis robbinsii**

DELAWARE: Sussex Co.: E of Midway, 9 Aug 1961, Frank Hirst, 14 Nov 1982, Frank Hirst & Dan Boone. N of Milton, 6 Nov 1982, Frank Hirst & Dan Boone. MARYLAND: Wicomico Co.: San Domingo, 26 June 1982, Frank Hirst, Dan Boone, & Barbara Dowell. Dorchester Co.: Galestown Mill Pond, 15 Jul 1982, Frank Hirst.

The Wicomico County collection is probably the first Maryland record and an addition to the state's flora. Not listed in Norton & Brown (1946). There are three Delaware sites in Tatnall (1946). The most modern is 1906 collected by Long and Van Pelt.

**14. Eleocharis smallii**

MARYLAND: Worcester Co.: N of Stockton, 6 Aug 1982, Frank Hirst.

Occurs in a small pond surrounded by *Pinus taeda,* associated with *Eleocharis quadrangulata, Cladium mariscoides, Utricularia gibba,* and other expected coastal plain pond plants. Not seen elsewhere on Delmarva. Listed as rare in Tatnall (1947) & Tucker et al. (1979). Norton & Brown (1946) record it from Maryland but their list doesn't have locations.

**15. Psilocarya nitens**

MARYLAND: Wicomico Co.: San Domingo, 20 Jul 1982, Frank Hirst & Dan Boone. DELAWARE: Sussex Co.: Milton, 6 Nov 1982, Frank Hirst & Dan Boone.

The status of this rare sedge as a Maryland plant is indecisive as far as the meager records show. A. V. Smith (1938) has the plant recorded in his Mill Pond dissertation but Robert Tatnall has no record for Maryland in his 1946 flora, although he does cite two Delaware collections. Since Smith's report is 8 years older than Tatnall's, one wonders if it was an oversight or if the Smith report was based on a misidentification. Smith made no mention of voucher specimens or their locations. If the report was in error, then the Wicomico County record would be the first for this species in Maryland. No mention was made in Broome et al. (1979) as an endangered or rare plant in Maryland.

**16. Fimbristylis perpusilla**

MARYLAND: Caroline Co.: Goldsboro, 26 Aug 1974, Frank Hirst. Henderson, 25 Sep 1982, Frank Hirst & Dan Boone.

This tiny sedge was discovered on the peninsula by the writer during a woodland bog/pond search in 1974. Although at first not identified but considered as possibly one of two other taxa even though the descriptions and text plates didn't match. First suspected to be *F. perpusilla* by Dan Boone of the Maryland Natural Heritage Program, after researching the southern manuals and comparing herbarium specimens. Plants were sent to the Academy and Dr. A. E. Schuyler verified that they were *Fimbristylis perpusilla.*

The species was thought to be a Georgia endemic for many years and was known from only two counties. It was also recently found in 1980 by Steven Leonard (1981) growing around a moist depression in a roadside canal in Horry County, northeastern South Carolina. Leonard's record is approximately 600 km northeast of the Georgia stations and this Delmarva record skips another 600 km to Caroline County, Maryland. The plants were growing in bare wet mud surrounded by *Carex walteriana* swales.

**17. Scirpus etuberculatus**

DELAWARE: Sussex Co.: Ellis Pond, 9 Aug 1961, Frank Hirst.

This plant along with *Eleocharis equisetoides, Eleocharis quadrangulata,* and *Xyris congdoni* were all growing in a small boggy spot at the head of this small mill pond east of Laurel, Delaware. Subsequent to this discovery in Delaware, Neil Hotchkiss (pers. comm.) checked the area ponds and located some additional populations. Tatnall (1946) listed "streams, Salisbury," Maryland before 1894 but stated Sussex County, Delaware as its northern range. He did not list a Delaware record, but had two Maryland collections for Salisbury. In 1982 a small colony was relocated in Maryland by Jim Stasz in Wicomico County along Nassawango Creek on Nature Conservancy land.

**18. Cladium jamaicense**

VIRGINIA: Accomack Co.: W of Greenbackville, 28 Nov 1982, Frank Hirst & Joe Fehrer, Jr.

A small clump growing next to the woods on the edge of a brackish marsh. An interesting range extension from the south. Apparently not known north of southeastern Virginia. Harvill et al. (1977) has one county (Virginia Beach) dotted on the map in the Atlas. Further searching along seaside tidal streams between here and the Cape should reveal more locations, certainly the habitat is not rare. The specimen was collected less than 2000 feet from the Maryland/Virginia line.

**19. Scleria pauciflora**

MARYLAND: Worcester Co.: Longridge, 3 Sep 1982, Frank Hirst, Dan Boone, & Jim Stasz.

Even though Tatnall (1946) lists this *Scleria* as "infrequent", this is apparently the only population found on the Delmarva recently. There are records from serpentine only in the Maryland Natural Heritage file according to Dan Boone (pers. comm.). The plants were growing under a power line in cleared sandy semi-wet soil very near the Worcester–Wicomico county line. Could have been in either county. Not listed in Broome et al. (1979) or Tucker et al. (1979).

**20. Scleria reticularis**

MARYLAND: Worcester Co.: N of Pocomoke, 6 Sep 1982, Frank Hirst.

Pond depression in Pine woods. Tatnall (1946) mentions that the plant is infrequent and not collected recently. Harvill et al. (1977) have a record for Northampton County, Virginia, on their map. It appeared at quite a few open depressions in the central peninsula this dry fall.

**21. Scleria minor**

MARYLAND: Worcester Co.: Longridge, 3 Sep 1982, Frank Hirst, Dan Boone, & Jim Stasz.

Tatnall's record of August 3, 1940 at "One and a half miles northwest of Colbourne, Worcester County" is probably the same area or very close to it. The plant was growing in wettish sand under a powerline in the same situation as *Scleria pauciflora* and associated almost directly with it. Since this is apparently the only area on the peninsula for *S. minor*, one wonders in what habitat the taxa were found in 1940 before the powerline existed. No other Delaware or Maryland records were found for Delmarva.

**22. Rhynchospora filifolia**

MARYLAND: Worcester Co.: N of Pocomoke, 18 Sep 1982 & 2 Oct 1982, Frank Hirst.

Dry pond bottom in pine woods. An addition to Maryland's flora. A small but dense population that had fruited much earlier than the collection date but still easy to identify although achenes were scarce. The only other collection on the peninsula was in 1899 east of Ellendale, Sussex County, Delaware (Tatnall 1946). Harvill et al. (1977) have only recorded it from one county in southeastern Virginia.

**23. Carex joorii**

MARYLAND: Worcester Co.: E of Stockton, 1 Aug 1981, & 1 Nov 1981, Frank Hirst.

A small colony of scattered "tufts" occurring in an *Acer/Nyssa* swamp on state owned land. Not observed elsewhere. A "rare" classification by Tatnall (1946) seems a good designation. He has four records for the peninsula, all in Maryland: two in Dorchester and two in Worcester Counties.

**24. Carex hyalinolepis**

MARYLAND: Somerset Co.: Rehobeth, 27 Jun 1982, Frank Hirst.

First noticed by me in the winter of 1978. This large persistant sedge occurs along both sides of the Pocomoke River and is most abundant up the smaller tidal marsh creeks in Worcester County, across the river. Although the plant is fairly obvious and abundant in patches, the scarcity of fertile culms probably accounts for it not being detected before this. Labeled "infrequent" by Tatnall (1946) with a very old record for 1875 "above Wilmington." There is another Maryland report in Calvert County, off the peninsula (Dan Boone, pers. comm., Maryland Heritage File, December 1982).

**25. Lemna perpusilla**

MARYLAND: Worcester Co.: Big Mill Pond, 31 Jul 1971, Frank Hirst & Gilbert Cavileer.

Occurring with *Lemna minor* and *Wolffia papulifera* in dense pockets along the edges and at the dam. Tatnall (1946) has only a northern location: Wilmington, Delaware, 1899. There is a listing in Norton & Brown (1946) for Maryland in their checklist.

**26. Wolffia papulifera**

MARYLAND: Worcester Co.: Big Mill Pond, 31 Jul 1971, Frank Hirst & Gilbert Cavileer.

Although this *Wolffia* is not listed for the peninsula or Maryland, it occurs in many locations. In recent years the nitrogen run off from agriculture and sewage disposal has caused *Wolffia* and *Lemna* to increase in huge quantities. Often these plant explosions smother out all the other aquatics. *Wolffia papulifera* showed up in seven lower peninsula mill ponds in 1981 and 1982 but in 1946 Tatnall had not recorded it.

**27. Trillium pusillum var. virginianium**

MARYLAND: Worcester Co.: Near Stockton, Powell Creek, *Acer/Nyssa* Swamp, 4 Apr 1972 & 22 Apr 1973, Frank Hirst. Little Mill Run, *Acer* Swamp, 10 Apr 1977, Frank Hirst & Donna Snow. Hancock's Creek, *Acer/Pinus* Swamp, 12 Apr 1980, Frank Hirst & Gilbert Cavileer. Pike's Creek, *Acer/Taxodium* Swamp, 12 Apr 1980, Frank Hirst & Gilbert Cavileer.

Although the "dwarf trillium" was not known from the Delmarva until after Tatnall's book (1946), its discovery by Beaven and Oosting (as *T. sessile*) and subsequent rediscovery by Tatnall, Proctor, and Wherry are well covered in the literature (Beaven & Oosting 1939; Wherry 1949).

C. F. Reed (1956; 1980) reported the plant from one new location in southeastern Worcester County, Maryland, and seven in northeastern Accomack County, Virginia. The dates range from the middle 1950's to the early 1960's. His 1980 article treats it as a distinct species. His No. 36292 Worcester County, "Rt. 582 two miles southeast of Stockton," could be the same as Hancock's Creek cited above but I couldn't find rt. 582 on any map.

In addition to the four recent sightings listed above, the dwarf trillium is now also known at Milbourne Landing in Pocomoke State Forest (Broome et al. 1979) and Riley Creek east of Stockton (fide Mary Humphreys & Joe Fehrer, Sr. 1981).

Reveal & Broome (1982) report another large population at Milbourne Landing and the "discovery" of hundreds of plants at Powell Creek. This is the same as my Powell Creek location from 1972 and verified by Dr. E. T. Wherry from a voucher specimen placed in the Philadelphia Academy in 1974.

In 1982 some likely habitats north of Pike's Creek on the eastern edge of the Worcester County mainland were field checked but no additional locations were found.

### 28. Iris verna

MARYLAND: Worcester Co.: Longridge, 4 May 1973, Frank Hirst.

A "car window discovery" was made by me in 1972 of a nice group of plants growing almost on the road shoulder in a grassy swale. Roadside mowing may be instrumental in the survival or even the origin of this colony. This fall the surrounding woodland was destroyed and the future of the plant for the peninsula looks bleak. A new plant for the peninsula not listed in Tatnall (1946). A few non-flowering plants seen under a powerline nearby this summer could be this species. This location and the one in Phillips (1978) are the same.

### 29. Orchis spectabilis

MARYLAND: Worcester Co.: Public Landing, 12 May 1982, Frank Hirst, Lynda Fehrer, & Jason Fehrer.

This attractive *Orchis* is surprisingly growing in a "pocket" of rich woods in eastern Worcester County, Maryland. A very unusual situation for the eastern edge of the Delmarva Coastal Plain. About six of these spots or pockets have been noticed, five in eastern Worcester County and one in northeastern Accomack County, Virginia. The plant communities are very interesting and different from the adjacent typical woodlands. A partial list includes *Obolaria virginica, Ophioglossum vulgatum, Sanguinaria canadensis, Dentaria laciniata, Liparis lilifolia, Carex laxiflora, Oxalis violacea, Viola triloba, Claytonia virginica, Polymnia uvedalia, Aristolochia serpentaris* and even one tree of what may be a non-fruiting *Quercus muehlenbergii. Orchis spectabilis* has only been located in one of these areas. C. F. Reed (1964) cites a Caroline County record and a Talbot County record (from Tatnall 1946) well up the peninsula.

### 30. Cleistes divaricata

MARYLAND: Wicomico Co.: Sharptown, 26 Jun 1982, Frank Hirst, Dan Boone, & Barbara Dowell.

The spreading Pogonia was first discovered in Maryland by Dr. Mary Humphreys who found and photographed the plant near Berlin in Worcester County on June 27, 1975. Only one plant was found by Dr. Humphreys and it wasn't seen again until one sterile individual was seen in 1981 by Humphreys & Hirst and again one non-flowering plant in 1982 by Humphreys & Boone.

The Sharptown station, a low thicket, had four plants with one flowering and it later developed a nice capsule (July 20, 1982). There are apparently no other known locations in Maryland. Tatnall (1946) lists three Delaware locations in Sussex County, the last collection in 1938.

### 31. Listera australis

MARYLAND: Worcester Co.: NE of Girdletree, 9 May 1976, Frank Hirst & Joe Fehrer, Jr.

Not mentioned in Tatnall (1946). A large colony still thriving in 1980. There is a Dorchester County, Maryland, record in the Blackwater Wildlife Refuge according to the late Dr. Claude Phillips (pers. comm.) and recorded with a photograph in his *Wildflowers of Delaware & the Eastern Shore*. Dan Boone located a colony in southern Worcester County near Pocomoke in 1981 and in 1982 Jim Stasz located a few plants along Nassawango Creek north of Snow Hill on Nature Conservancy land. These, plus a report from Selbyville, Delaware, unconfirmed, leads one to the belief that the absence of any reference to this orchid in older lists is a result of too little field work in its habitat, or searching at the wrong time. Most all literature has its blooming date much too late. It was seen blooming in Atlantic County, New Jersey, as early as April 20th by the writer.

**32. Berchemia scandens**

VIRGINIA: Accomack Co.: Parramore Island, 30 May 1978, Frank Hirst & Joe Fehrer, Jr.

The supple Jack grows abundantly in most of the wettish dune areas on this large barrier island. Tatnall (1946) has only one record and that from Chincoteague Island. Since the habitat doesn't seem unique, with more field work it should be (or has been) found on all the Virginia wooded Barrier Islands. Harvill et al. (1981) have a Northampton County record in their atlas.

**33. Myriophyllum heterophyllum**

MARYLAND: Worcester Co.: Big Mill Pond, 31 Jul 1971, Frank Hirst & Gilbert Cavileer.

Listed as "rare" in Tatnall with Sussex County, Delaware, records from 1908 and 1935. In this pond the plant has disappeared for the last four years. This seems to be a typical occurrence of a present–absent–present, etc., cycle of many of the rarer aquatic plants.

**34. Cardamine longii**

MARYLAND: Worcester Co.: Snow Hill, 7 Jul 1982, Frank Hirst & Jim Stasz.

This very rare *Cardamine* occurs in good numbers in tidal mud near the limits of high tide along Nassawango Creek. It grows in Maple/Gum/Cypress swamps near the creek where its base is inundated at normal high tides. At present it is only known to occur on the peninsula at this spot. A category two on the Federal Endangered List, and one of the northeast's rarest plants. The Cecil County, Maryland, location where Long collected the type specimen has not been relocated (Broome et al. 1979; Reveal & Broome 1982).

**35. Utricularia purpurea**

MARYLAND: Caroline Co.: NW of Bridgetown, 22 Jul 1982, Frank Hirst & Dan Boone.

A new Maryland species, this is another plant that seems to have escaped detection until recently although its preferred habitats of shallow water in ponds, back waters, streams, and ditches seem abundant. For Delaware it is listed as "infrequent" in Tatnall (1946) but Phillips (1978) put it in his appendix B as "not seen." Tucker et al. (1979) cite Tatnall's designation and have four locations listed under counties last seen. The dates, 1874 and 1938, suggest that they are the same as Tatnall's. In New Jersey, in the same kind of habitats, Snyder and Vivian (1981) consider it as declining with eight counties listed and include the comment "seen 1980." (Dan Boone and I saw the plant blooming on July 5, 1982, in Atlantic County, New Jersey.)

Another small population was located by Jim Stasz in Wicomico County, Maryland, on July 25, 1982, during an inventory of Nature Conservancy property near Nassawango Creek.

**36. Lobelia elongata**

MARYLAND: Worcester Co.: W of Pocomoke City, 27 Aug 1981, Frank Hirst & Joe Fehrer, Jr.

This beautiful blue lobelia is more typically a plant of the southern river systems and seldom seen on the peninsula. Extremely rare in the early years but recent field work has uncovered several stations on the west side of the Delmarva. The above location was in fresh to brackish marshes of the Pocomoke River across from the town of Rehobeth. Here it was associated with *Sagittaria falcata, Eryngium aquaticum, Lobelia cardinalis, Scirpus pungens, Ptilimnium capillaceum,* and other typical marsh plants. Tatnall (1946) had *L. elongata* from Sussex County, Delaware, and Somerset and Wicomico counties in Maryland. Broome et al. (1979) added Worcester County citing a record from Redmond (1932) that Tatnall didn't include although he listed this flora in the bibliography. William Sipple (1978) reports two recent discoveries from Farm Creek and the Chicamacomio River in Dorchester County, Maryland. Claude Phillips (1978) lists Sussex, Wicomico, and Somerset counties with no locations or dates. Possibly recent sightings because he omitted the taxa from his appendix B which is titled "not seen."

**37. Lobelia canbyi**

MARYLAND: Worcester Co.: S of Whiteburg, 6 Sep 1982 & 12 Nov 1982, Frank Hirst.

Canby's lobelia is probably a new Maryland plant, previously only known on the peninsula from the Ellendale area in Sussex County, Delaware. A second colony was located about one quarter mile away growing on the edge of an open, normally wet depression in the woods, a similar habitat. Not listed in Norton and Brown (1946), The Maryland Natural Heritage File (Dan Boone, 1982, pers. comm.) or recorded anywhere in Virginia, Harvill et al. (1981).

## Acknowledgments

The list of people who deserve special thanks for help is quite long and impossible to include. It dates back even to my early days in the New Jersey Pine Barrens. The writer will never forget the enthusiasm, understanding, and patience given him by all but especially by Louis Hand, Dave Fables, Lee Edwards, and Bayard Long. The love of native plants and their ranges shown by these men has been inspirational for over 30 years. More recently, the enthusiasm and companionship of my son-in-law, Joe Fehrer, Jr., and Gil Cavileer were greatly appreciated and their love of botanizing was a great impetus to go afield. Dan Boone of the Maryland Natural Heritage program deserves a very special thanks. He is responsible for being the catalyst that removed the writer from "archeological moth balls" and has proven to be an indefatigable, zealous, alert companion in the field. His encouragement, research, and prodding played a large part in this article's final undertaking. Finally to my wife, Jean, go the greatest thanks. She unsnarled my spelling, grammar, and phrases and typed all of this into something readable and hopefully worthwhile.

There are few words that express the personal loss that field botany and I suffered from the loss of my brother, Robert R. Hirst, who died from cancer at age 38 in 1964. No person ever delighted more in searching for a rare, unusual, or attractive plant than he. No amateur worked harder to struggle through the technical keys of Gray's 8th and no botanist surpassed his desire to check "one more spot" before it was too dark to see. It was never too hot, buggy, wet, cold, or late to go swampin', boggin', or pondin' for him. For the hours we spent together, the botanical partnership we shared, and motivation he gave, I will be forever indebted and grateful.

## Voucher Specimens

Voucher specimens of *Eleocharis equisetoides, Fimbristylis perpusilla, Scirpus etuberculatus* and *Trillium pusillum* var. *virginianum* (location # 1) are in the herbarium of the Academy of Natural Sciences of Philadelphia. Specimens were not collected or retained for the 8 taxa numbered 1, 2, 4, 25, 26, 30, 32, 33 and 36. Some (*Lygodium palmatum, Cleistes, Lycopodium clavatum,* and *Lobelia elongata*) were too scarce to risk collecting. Others were mostly fragments or poor specimens and discarded with the well meaning intention of recollecting better material later. All the others are presently in the collection of the writer and will be deposited in The Claude E. Phillips Herbarium at The University of Delaware in the near future.

## Literature Cited


Beaven, G. F. and H. J. Oosting. 1939. Pocomoke Swamp: A Study of a Cypress Swamp on the Eastern Shore of Maryland. Bull. Torrey Bot. Club 66: 367–389.

Broome, C. R., J. L. Reveal, O. A. Tucker, and N. H. Dill. 1979. Rare and Endangered Vascular Plants of Maryland. U.S. Fish and Wildlife Service. Newton Corner, MA 02158.

Harvill, Jr., A. M., C. E. Stevens, and D. M. E. Ware. 1977. Atlas of the Virginia Flora. Part 1. Pteridophytes through Monocotyledons. Virginia Botanical Associates. Farmville, VA 23901.

Harvill, Jr., A. M., T. R. Bradley, and C. E. Stevens. 1981. Atlas of the Virginia Flora. Part II. Dicotyledons. Virginia Botanical Associates. Farmville, VA 23901.

Leonard, S. W. 1981. *Fimbristylis perpusilla* Harper in South Carolina. Castanea 46: 341–342.

Norton, J. B. S. and R. G. Brown. 1946. A Catalog of the Vascular Plants of Maryland. Castanea 2: 1–50.

Phillips, C. E. 1978. Wildflowers of Delaware and The Eastern Shore. Delaware Nature Education Society. Delaware State College, Dover, DE 19901.

Porter, D. M. 1979. Rare and Endangered Vascular Plant Species in Virginia. U.S. Fish and Wildlife Service, Washington, DC.

Reed, C. F. 1953. The Ferns and Fern Allies of Maryland and Delaware including District of Columbia. Published by the author, Reed Herbarium, Baltimore, MD.

———. 1956. Contribution to the Flora of Maryland 2. The Genus *Trillium*. Castanea 21: 145–151.

———. 1964. Orchidaceae of Maryland, Delaware, and District of Columbia. Castanea 29: 77–109.

———. 1982. *Trillium virginianum* (Fern.) Reed, comb. nov., in Maryland, Virginia, West Virginia, and North Carolina. Phytologia 50: No. 4.

Redman, P. J. 1932. A Flora of Worcester County, Maryland. Catholic Univ. Amer., Biol. Ser. 2: 1–40.

Reveal, J. L. and C. R. Broome. 1982. Comments in Maryland's Proposed Endangered and Threatened Vascular Plants. Castanea 47: 191–200.

Sipple, W. S. 1978. An Atlas of Vascular Plant Species Distribution Map for Tidewater Maryland. Wetland publication No. 1. Department of Natural Resources. Water Resources Administration, Annapolis, MD.

Smith, A. V. 1938. The Ecological Relations and Plant Successions in Four Drained Mill Ponds of the Eastern Shore of Maryland. A dissertation. The Catholic University of America, Washington, DC.

Snyder, D. B. and V. E. Vivian. 1981. Rare and Endangered Vascular Plant Species in New Jersey. U.S. Fish and Wildlife Service, Washington, DC.

Tatnall, R. R. 1946. Flora of Delaware and the Eastern Shore: An Annotated List of the Ferns and Flowering Plants of the Peninsula of Delaware, Maryland and Virginia. The Society of Natural History of Delaware, Lancaster, PA.

Tucker, A. O., N. H. Dill, C. R. Broome, C. E. Phillips, and M. J. Maciarello. Rare and Endangered Vascular Plant Species in Delaware. U.S. Fish and Wildlife Service, Washington, DC.

Wherry, E. T. 1949. *Trillium pusillum* in Maryland. Bartonia 25: 71.

## REVIEW

**Southern Gardens, Southern Gardening** by William Lanier Hunt, foreward by Elizabeth Lawrence. xv & 180 pp. Duke University Press, Durham N.C. 1982. $16.50

How pleasant it is for avid gardeners that American publishers have begun to realize that there is an audience interested in more than another "how-to" book about gardening. There has been a healthy trickle of books that reflect deeper interest: in garden history, in the "personality" of both plants and gardeners, in floral combinations in a garden . . . even the "why" and "wherefore" of gardening. William Hunt has written such a book, and while it is pointed toward the southern gardener, as its title indicates, it is a very "readable" book, with appeal for gardeners everywhere.

The book is arranged, with deceptive simplicity, by months. Within each month is a generous amount of practical advice. Throughout the book, however, Hunt discusses plants in their full context. In July one finds, as one might expect, a heading of "Daylilies," so depended upon for bloom in the summer months. Within this context, however, Hunt gives the reader some background about the development of daylilies by Dr. Stout and Bertrand Farr; the gardens where they bloom the earliest; books about plant exploration in China where daylilies originated; garden design focusing on effective uses of daylilies. He does this in a conversational way, so that we do not feel we are learning more about daylilies than we care to know.

"Daylilies" is only one of over 150 topics, which range from "Arboreta and botanical gardens" to "Astilbes and the like," from "Mulches" to "Mediterranean flowers." If one is determined to use the book as an encyclopedia, there is an excellent index where one can check on all the references for "Daffodil" and "Narcissus," for example . . . in the course of which one can find out the cultivars which have lasted best in southern gardens, where many *Narcissi* resent the lack of a good period of dormancy.

Throughout, Hunt deals specifically with species and cultivars which do well in the upper south or deep south, and mentions gardens, both well-known and unfamiliar, where particularly good examples may be seen. In recommending plants, Hunt gives special emphasis to the effective use of American ones, from less known species of holly—particularly useful in the deep south—to asters and goldenrods. He is very aware of climate and microclimate in discussing regional differences.

The way to enjoy *Southern Gardens, Southern Gardening,* however, is just to read it slowly, for that is like walking in a fine garden with a knowledgeable and conversational friend (who may be forgiven for patting himself on the back occasionally). Hunt puts us in touch with the "Brothers of the Spade," as Peter Collinson the 18th century English friend to all gardeners described it. Through books recommended and lively anecdotes, Hunt exposes us to not only his own experience, but to the wisdom of three centuries of other gardeners. ELIZABETH P. MCLEAN.

## NEWS AND NOTES

REMINISCENCES OF LIBERTY HYDE BAILEY. I first met Dr. Bailey in 1925 when, as a graduate student, I visited the Gray Herbarium at Harvard. Dr. Bailey happened to be there at the time and Professor Fernald introduced me to him. He said to me, "Mr. Fogg" (not just Fogg mind you, but *Mister* Fogg), "What are you working on?" When I told him that I was engaged in a floristic study of the Elizabeth Islands in Massachusetts he said, "Good for you; we need more studies of that kind."

In 1926 the Fourth International Botanical Congress was held at Cornell University. That year Dr. Bailey was President Of the American Association for the Advancement of Science, President of the American Botanical Society, and President of the Congress. The opening session was held in the Bailey Auditorium with a distinguished gathering of American and foreign botanists. When Dr. Bailey stepped upon the stage to welcome the delegates the entire audience rose as one man to pay tribute to this great man. In his welcoming address Dr. Bailey said that although America was a relatively new country he wanted us to know that we were not unaware of our cultural heritage, as witnessed by the fact that in addition to Ithaca, the state of New York contained cities named Athens, Rome, Troy, Syracuse, and Utica.

The following day Dr. Bailey was on the program of the Systematic Section to present an account of his studies of the blackberries of North America. He opened his remarks by saying, "Ladies and Gentlemen, the genus *Rubus* in North America is in a state of taxonomic chaos. I know, I put it there."

In 1937 I gave a paper on the plants of the Pine Barrens of New Jersey at the Atlantic City meetings of the A.A.A.S. Dr. Bailey very graciously wrote to me saying that he had greatly enjoyed my talk, and asking whether it was true that the Pine Barrens were in danger of being turned into a vast recreational area with widespread destruction of its unique native flora. Fortunately, I was able to put him in touch with the Director of Forest and Waters to whom he wrote to express his hope that this precious ecosystem would never be altered. The threat is still a viable one. I mention this merely to show the man's deep and abiding interest in the preservation of natural areas.

In 1941 the Philadelphia Botanical Club celebrated its fiftieth Anniversary, and we were so fortunate to have Dr. Bailey as guest speaker at our banquet. He began by telling us how transported he had been as a young man to meet Asa Gray. He said, "I walked home on the housetops." I had felt the same way upon having met him in 1925 and have always regretted that I did not tell him so. He also said that he realized that he had been bitterly criticized in his Encyclopedia, Manual, and other publications by citing only one authority (that of the original describer). He said, "That's the way I have always done it and that's the way I shall continue to do it."

Several years later Dr. Bailey wrote to me saying that in all his studies of blackberries he had never seen and collected *Rubus cuneifolius* in the field. He was going to be in Philadelphia for a couple of hours between trains on a certain date and could I possibly pick him up and take him to a place where he could see and collect this species. I readily assented and the rendezvous was met. We crossed over into New Jersey and I took him to a locality where I knew this species occurred. He put several species in his field press and then as we were ready to leave on the return trip to Philadelphia I discovered to my consternation that my car was out of gas! Fortunately, a good Samaritan came along, gave us a couple of gallons, and I was able to get the great man back in Philadelphia in time to catch his train.

In 1952 we embarked on the first of our annual visits to Mexico. It was our good fortune to find as guide and chauffeur a man who over the years drove us to almost all sections of the country. When he discovered that I was a botanist he asked whether I had ever heard of a man named Bailey. When I replied in the affirmative he told us that several years ago he had been employed by such a person to drive him to places where he could collect palms. He added, "Although he had pure white hair and was obviously much older than I, it was difficult for me to walk fast enough to keep up with him."

My good friend and colleague, the late Dr. J. R. Schramm, (whose name will be remembered by many Cornellians) told me that on one occasion Macmillan had approached Dr. Bailey with the request that he revise and update his *Encyclopedia of Horticulture.* He is supposed to have said, "Oh no, I cannot do that, but I'll tell you what I will do. I'll write a completely new one." Jack Schramm could not vouch for the story, nor of course can I, but it certainly sounds like our man.

The last time I saw Dr. Bailey was at the New York Meetings of the A.A.A.S. when he was well into his nineties. He had just returned from Cuba and when I introduced my wife to him she asked what he had been doing there. He replied that he had been collecting palms. She innocently inquired how many he had gotten, and he answered, "Why, I got them all!"

Soon after that he had a bad fall and in 1954 he died at the age of 96. No one who had the privilege of knowing this great man can ever forget his enormous capacity for friendship, his all-embracing concern with preservation of the environment, and his monumental contribution to botany and horticulture. He was indeed for many decades the Dean of American Horticulture. We shall not look upon his like again. JOHN M. FOGG, JR.

RARE NEW JERSEY GRASSES AND SEDGES. The following information should be of considerable interest to all those who seek New Jersey's rarer grasses and sedges. These records are largely the result of field work conducted by Club members Vincent Abraitys and Thomas Halliwell during the 1980–1982 field seasons. Voucher specimens have been collected for all species except *Sacciolepis striata* and *Psilocarya nitens.*

In the past few seasons, seven unsuccessful searches of the known stations for *Sacciolepis striata* in Cape May County have been made. Its absence from one pond, which had been a fairly reliable source for the species, was particularly discouraging. The rediscovery of *Sacciolepis* at this pond in the fall of 1981 came as a relief to those who had begun to feel that the species may have been no longer extant in the state. Within a few yards of the *Sacciolepis* were found scattered clumps of *Cyperus brevifolioides,* a new record for Cape May County.

Although of more general distribution in southern New Jersey, *Psilocarya nitens* can be equally elusive in certain years. Recent sightings include stations in Atlantic and Cape May counties. *Eriophorum tenellum,* which of late has become increasingly more difficult to locate, was observed growing in respectable numbers in a bog bordering the Batsto River in the general vicinity of Quaker Bridge. After some very disquieting lean years, *Panicum hirstii* is, it appears, on the increase with nearly two dozen fruiting culms counted in July 1982. While hardly thriving, the world's known population of *Panicum hirstii,* is at least, holding its own.

Northern New Jersey also has had its fair share of graminid discoveries. An extensive colony of *Alopecurus aequalis* was found growing in a wet wooded glade in the limestone region of Sussex county. The species was also found growing in abundance in wet, muddy ground along an abandoned railroad near Monmouth Junction, Middlesex county.

*Eleocharis pauciflora* var. *fernaldii,* which in New Jersey has been found exclusively on limestone, was observed growing on the shore of a pond in the Johnsonburg area of Warren county. The adjacent swamp and surrounding sedge mat of this same pond also produced *Carex aquatilis* var. *altior, C. diandra,* and *C. prairea.*

*Scirpus torreyi* is of spotty and sporadic occurrence in New Jersey, its appearance—or non-appearance—in the state being apparently linked to the seasonal fluctuations of the water table. It is of no small interest then, to report that the species has substantially returned to a limestone sinkhole in Sussex county from which it has been absent from in the last several years.

*Bouteloua curtipendula,* continuing its eastward advance, has established itself on an open, rather dry, rocky hillside on the first Watchung Mountain near Bound Brook, Somerset County. Nearby, in a more wooded area, *Carex willdenowii* is locally frequent. A far rarer *Carex* is *Carex hitchockiana,* which was discovered on the shaded talus slope at the base of Mt. Tammany at the Delaware Water Gap.

*Eleocharis compressa,* whose existence in the state has been doubted by some, was observed covering substantial areas of the Delaware River shore at two locations in Sussex County. Here, too, was found a small patch of *Carex crawei.* These few culms account for the known occurence of the species in New Jersey, as well as making the southeasternmost point of its geographical distribution in the U.S.

Encouraging as these finds have been, still some additional field work is needed if New Jersey's grass and sedge list is to be brought up to date. Although all have been observed in the state within the last 30 years or so, the following species, for whatever reasons, are now listed among the missing: *Oryzopsis pungens, Carex paupercula, Eleocharis equisetoides, Eriophorum spissum, Hemicarpha micrantha,* and *Rhynchospora rariflora.* DAVID B. SNYDER.

IDENTIFICATION DAY AT THE ACADEMY. The Academy of Natural Sciences sponsored an identification day on Saturday, June 19, 1982. All clubs which are associated with the Academy, or use the Academy facilities for meetings, etc., were asked to participate. The purpose of this event was to give the amateur collector an opportunity to have their natural objects identified by experienced naturalists. Kasia Fogarasi and Grace M. Tees represented the Philadelphia Botanical Club in this year's Identification Day. The Academy of Natural Sciences plans to make this an annual event and is already looking forward to Identification Day 1983. Any Philadelphia Botanical Club members who would like to participate in next year's event are most welcome. KASIA FOGARASI.

HONORARY MEMBERS OF THE PHILADELPHIA BOTANICAL CLUB. Members in good standing who have made worthy contributions to the Club may be nominated by the general membership and elected by a majority vote to honorary membership. They are entitled to all privileges of the Club except voting, without payment of dues. Currently, Philadelphia Botanical Club Honorary Members are: Mrs. Nellie Erisman (elected January 1982), Mrs. John M. Fogg, Jr. (elected January 1981), and Mr. Hans Wilkens (elected January 1981). Dr. Edgar T. Wherry was an Honorary Member of the Club for many years, and Dr. John M. Fogg, Jr. was one since January 1981. KASIA FOGARASI.

LAWRENCE MEMORIAL AWARD. The Award Committee of the Lawrence Memorial Fund is pleased to announce that Ms. Janet R. Sullivan of the University of Oklahoma was selected to receive the 1982 Lawrence Memorial Award. A student of Dr. James R. Estes, Ms. Sullivan is investigating the taxonomy, ecology and evolution of the genus *Physalis* (Solanaceae). She will use the proceeds of the Award in travel to the southeastern United States and the Gulf Coast for field studies.

The Lawrence Memorial Fund has been established at the Hunt Institute for Botanical Documentation, Carnegie-Mellon University to commemorate the life and achievements of its founding director, Dr. George H. M. Lawrence. Proceeds from the Fund are used to make annual awards of $1,000 to outstanding doctoral candidates for travel in support of dissertation research in systematic botany or horticulture, or the history of the plant sciences. Constituted initially by contributions from the Lawrence family and The Hunt Foundation, the Fund has been augmented by donations from many of Dr. Lawrence's friends and colleagues. Additional contributions are welcomed.

Nominations for the 1983 Award are now being entertained. Major professors are urged to submit letters in behalf of outstanding doctoral students who have achieved official candidacy for their degrees, will be conducting dissertation research in relevant fields, and whose work would benefit significantly from the travel enabled by the Award. The Committee will consider nominations only—no direct applications will be entertained. Letters of nomination and supporting materials should be addressed to Dr. R. W. Kiger, Hunt Institute, Carnegie-Mellon University, Pittsburgh 15213; the deadline for their receipt is 1 May 1983. T. D. JACOBSEN.

## 1981 FIELD TRIPS

May 3: Spring Flowers of the Brandywine Area of Chester County, PA. The Brandywine area has always had a rich spring flora and representatives of most common species were observed by the group. A noticeable decline in stands of *Mertensia virginica* was discussed. The leader believes this situation was probably due to heavy spring floods and "washouts" in the alluvial soil areas where this species is normally found in maximum abundance. On route home a final stop was made at the Unionville serpentine barrens to see displays of *Phlox subulata* and other early blooming species. Leader: Dr. R. Sargent.

May 23: Fortescue Glades Wildlife Refuge, Cumberland County, NJ. The refuge visited includes both saltmarsh and adjacent uplands, mainly oak and oak-pine forest. Members boarded two boats belonging to the Philadelphia Conservationists and Natural Lands Trust, owners of the reserve, to explore saltmarsh in the morning. In the afternoon a wooded area, typical of the Glades uplands, was studied. The species list for the trip included the following: *Distichlis spicata, Spartina alterniflora, S. patens, Eleocharis fallax, E. tenuis, E. parvula, Scirpus pungens, Carex hormathodes, Juncus bufonius, J. gerardi, Smilax glauca, Dioscorea villosa, Cypripedium acaule, Phoradendron flavescens, Viola lanceolata, Aralia nudicaulis, Rhododendron viscosum, Gaylussacia baccata, G. frondosa, Vaccinium caesariense, V. corymbosum, Iva frutescens, Solidago sempervirens, Baccharis halimifolia.* Leader: Stevens Heckscher.

June 14: Near Sumneytown, Salford Township, Montgomery County, PA. In a lichen-covered field of diabase, we were treated to "probably the only station in the county for *Stereocaulon paschale,* the Easter lichen" and, among others, *Rhizocarpon petraeum,* the toad-skin lichen. *Corydalis sempervirens* added color. A small green meadow had *Chamaelirium luteum, Castilleja coccinea, Lobelia spicata, Lilium canadense, Krigia biflora, Phlox maculata,* red-ripe *Fragaria virginiana, Oenothera tetragona, Cirsium muticum,* fringed about with *Xanthoxylum americanum, Physocarpus opulifolius, Cephalanthus occidentalis,* and *Ceanothus americanus. Ostrya virginiana* and *Carpinus caroliniana* were fruiting on the border. *Waldsteinia fragarioides* was spotted for the first time in this locale. *Oryzopsis racemosa* was another good find. Ferns and their allies were abundant and varied—thirteen were found on the walk down to Unami Creek. *Camptosorus rhizophyllus* was on a huge boulder, followed by a mass of *Lycopodium lucidulum,* and a giant patch of *Adiantum pedatum* on the flood plain below. The moss *Rhodobryum roseum* and the lichen *Cladonia furcata* were interesting finds also. We crossed the Unami and were rewarded by the county's only recorded stand of *Dirca palustris.* Leader: Ann Newbold.

July 11: Silver Lake Nature Center, Bristol, Bucks County, PA. The rapid encroachment and expansion of industry on the "green space" make the preservation of specialized botanical habitats vital for future botanists. Field trip participants were able to observe and examine a good cross section of typical Coastal Plain species of this excellent nature center. We recorded the Coastal Plain indicator trees *Liquidambar styraciflua, Magnolia virginiana* and *Nyssa sylvatica.* Other plant species listed were *Dulichium arundinaceum, Saururus cernuus, Decodon verticillatus* and *Polygala viridescens.* A rather spectacular display of many plants of *Rhexia mariana* "highlighted" the trip. Leader: Robert Mercer.

July 25: Tyler Arboretum, Lima, Delaware County, PA. A variety of habitats in the Arboretum were surveyed and the following species noted: Old Arboretum: *Asimina triloba, Polygonum perfoliatum, Petasites hybridus, Myosotis scorpioides;* Pinetum Field: *Cynanchum nigrum, Mentha arvensis, Aesculus parviflora, Lobelia inflata, Idesia polycarpa, Lespedeza cuneata, Solidago juncea, Achillea millefolium, Satureja vulgaris, Malus* sp., *Habenaria lacera;* Dismal Run Woods: *Cimicifuga racemosa, Vernonia* sp., *Vitis aestivalis, Carya tomentosa, Rubus phoenicolasius, Microstegium vimineum, Agastache nepetoides, Smilax herbacea* var. *pulverulenta, Dioscorea villosa, Morus rubra;* Pink Hill (Open): *Rumex, Agrimonia* sp., *Lobelia inflata, Pycnanthemum tenuifolium, Cerastium arvense* var. *villosissimum, Senecio smallii, Viola sagittata, V. fimbriatula, Asclepias verticillata, Lilium philadelphicum, Agropyron repens, Aster depauperatus, Agrostis* sp.; Pink Hill Woods: *Dennstaedtia punctilobula, Viola rotundifolia, Medeola virginiana, Collinsonia canadensis, Viburnum acerifolium, Aster schreberi, Aralia racemosa, Carya ovata, Osmunda regalis, O. cinnamomea,* fern moss, *Cryptotaenia canadensis, Cinna* sp., *Solidago flexicaulis, Amphicarpa bracteata, Arisaema triphyllum, Aster divaricatus, Solidago patula;* Farm Area: *Cicuta maculata, Agrimonia parviflora, Rosa multiflora, Sicyos angulatus, Gymnocladus dioica, Urtica dioica, Polygonum cespitosum, Geum canadense, Agropyron* sp., *Linaria vulgaris, Dianthus armeria, Acer negundo;* Shade Tree Farm Field: *Solanum carolinense, Agastache nepetoides, Nepeta cataria, Vitis labrusca, Quercus robur;* Pinetum: *Sequoia giganteum, Metasequoia glyptostroboides.* Leader: Fred Arnold.

August 9: Mannington Marsh, Salem County, NJ. The purpose for this trip was to see *Nelumbo* which was reported from Mannington Creek. It was found in large stands in between Rt. 45 and Painters-Sharptown Roads. There was some doubt about the specific designation, whether it was *N. pentapetala,* or the white phase of *N. nucifera.* After consulting the local manuals, it was tentatively identified as *N. pentapetala,* with a few reservations from some of the participants. In addition, the following species were representative of the total species list prepared: *Wolffia columbiana,* new for Salem county, *Pontederia cordata, Nuphar advena, Peltandra virginica, Sagittaria latifolia, Acorus calamus, Potamogeton crispus, Hibiscus moscheutos, Ceratophyllum demersum, Echinochloa walteri, E. muricata, Rumex altissimus, Paspalum circulare, Asclepias incarnata* v. *pulchra, Hypericum mutilum, Polygonum arifolium, P. sagittatum, P. pensylvanicum, P. scandens, Spartina alterniflora, Scirpus pungens, Scirpus validus,* and *Ptilimnium capillaceum.* Leader: Joe Arsenault.

September 6: Coastal Ponds, Monmouth and Ocean counties, NJ. Our first stop was Sylvan Lake in Avon-by-the Sea where we saw *Elodea nuttallii, Eleocharis parvula, Nymphaea odorata, Potamogeton pectinatus, Potamogeton perfoliatus,* and *Vallisneria americana* in the water. Male flowers of *Vallisneria* were floating on the water surface. Seeking greater species diversity, we went to Old Sam's Pond in Point Pleasant Beach. Here we found many of the plants observed in 1980 (Bartonia No. 48:51) as well as the following aquatic and shoreline plants: *Cyperus diandrus, Cyperus filicinus, Cyperus rivularis, Leersia oryzoides, Lindernia anagallidea, Myriophyllum tenellum, Najas flexilis, Phragmites australis, Polygonum punctatum, Polygonum sagittatum, Potamogeton pectinatus,* and *Sium suave.* Leader: Alfred E. Schuyler.

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## Program of Meetings 1981–1982

| *1981* | *Subject* | *Speaker* |
|---|---|---|
| 24 Sep. | Members Report on Summer Activities | |
| 22 Oct. | Algae in the Environment | Larry Lyons |
| 19 Nov. | The Flora of the Unicorn Tapestries | Lawrence Crockett |
| 17 Dec. | A Botanist in China | John M. Fogg, Jr. |
| *1982* | | |
| 28 Jan. | The 1981 International Botanical Congress | E. Marie Boyle and Elizabeth Woodford |
| 25 Feb. | Botanical Highlights of a Visit to Hungary | Kasia Fogarasi |
| 25 Mar. | Endangered Plants of Pennsylvania | Paul Wiegman |
| 22 Apr. | The Dead Trees of Ilha da Trindade | Richard H. Eyde |
| 27 May | Illustrated Report of the Local Flora | Monitoring Committee |

# BARTONIA

## JOURNAL OF THE PHILADELPHIA BOTANICAL CLUB

**No. 50**

**75th Anniversary Issue**

## CONTENTS



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# 75th Anniversary Issue of Bartonia

The Philadelphia Botanical Club was founded in 1891 and published the first issue of Bartonia in February 1909 with the following "Introductory":

At the close of its seventeenth year the Philadelphia Botanical Club has decided to begin the issue of a series of annual publications containing an abstract of its proceedings, and short articles dealing with the plants of the region about Philadelphia covered by its Herbarium.

As a title we have chosen BARTONIA in honor of Prof. Wm. P. C. Barton, Professor of Botany in the University of Pennsylvania, 1815, and author of the first local flora relating to this vicinity, the COMPENDIUM FLORÆ PHILADELPHICÆ, published in 1818.

Our frontispiece represents our first President, and the leading spirit in the foundation of the Club, the late Dr. J. Bernard Brinton, to whose enthusiasm and untiring zeal much of the success of the Club is due.

The plate is from a sketch by our late member, Mr. Albrecht Jahn.

STEWARDSON BROWN, *Editor,*
JOSEPH CRAWFORD,
WITMER STONE,
*Publication Committee.*

The membership roster in Bartonia No. 1 lists 56 active members, 15 corresponding members, and 15 deceased members.

Today the interests of the club membership are botanically diverse and articles in Bartonia go much beyond "the plants of the region about Philadelphia." Although the name of our club and our commitment to local flora imply a provincial perspective, this definitely is not the case. Many of our members and contributors to Bartonia reside far beyond the counties within a 50 mile radius of Philadelphia. Thanks to the efforts of our officers and membership, the club is much stronger today, as its centennial anniversary approaches, than in years past.

ALFRED E. SCHUYLER, *Editor*

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# Visits to Bartram's Garden: 1829

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Botanical Excursions:
Jan. Feb. March.

Botany neglected for parties. Writing letters constantly. January & February & March—cannot recollect distinctly any botanical discoveries, although went out to Carr's occasionally & two or three times with Will, over the Schuylkill, by Mantua Church & along the creek to the road; thence down the river—our old acqce the bluetts, anemonies, claytonias & violets greeted us. Once to Germantown & down the Wissahoccon [sic]. Many flowers & the yellow violet (rare).

Appointed collector 16th March. New duties commence—but find time for rambles.

Thus begins a small diary now in the ms collection at the Academy of Natural Sciences. Its author, Major James Barker (1784–1858), a former alderman and mayor of Philadelphia, was at the time of writing newly appointed by President Jackson as collector of the port of Philadelphia.[1] (In 1838, Barker was to become controller of the US Treasury, which post he held until his death.) The diary, in detail only from July 4th through December 1829, records regular weekly excursions to many places of local botanical and horticultural interest, listing the plants seen by a mix of Latin and English names. Although the diary is written in abbreviated form for personal recollection, it reveals a command of the English language not surprising for the author of two dramas and other works.[2] It is the diary of an enthusiastic amateur naturalist whose favorite place was Bartram's Garden.

Barker botanized along the banks of the Schuylkill, Kaighn's Point, and Wissahickon, collecting garnets along the latter as well . . . describing one rock as "studded like a plum pudding with garnets." He regularly visited the main Philadelphia nurseries and gardens: Smith's Labyrinth, Kokinberger's, Landreth's, Hibbert's, D'Arras's, and M'Arran's, often bringing plants back to his garden at 214 Walnut Street. Most often, however, he visited Bartram's garden and talked with Robert Carr. One assumes, since Barker uses Latin names much more frequently in describing his visits to Bartram's Garden, that he got his information directly from Carr.

Bartram's Garden, one of the earliest botanic gardens in North America, was founded along the banks of the Skuylkill by the Quaker farmer and self-taught botanist, John Bartram. After Bartram's death in 1776, the garden was continued by his son, John Jr., until the latter's death in 1812, when the garden and nursery were left to his daughter and son-in-law, Ann and Robert Carr.

A broadside (circa 1783) and a catalogue (1807) were issued under John Bartram Jr.; the latter catalogue was reissued in 1814 by Robert Carr, with no changes in the plants listed. Carr issued a greatly expanded catalogue in 1828, an *Addition* of four pages in

[1] The diary is not signed, but internal evidence (including reference to his new duties as collector) shows it to be Barker's diary.

[2] The plays included "Marmion" and "Superstition," which were evidently successful. (Simpson 1859, pp. 26–28.)

1830, a *Catalogue of American Trees, Shrubs, Plants & Seeds* in 1831, and the last known catalogue in 1836. There is little written about the activities of Bartram's Garden under the Carrs, so Barker's diary is interesting, not only for the observations of an amateur botanist in 1829, but also for a picture of what was actually being grown at Bartram's Garden. Some plants, such as *Theobroma cacao,* do not appear in any of the Bartram/Carr catalogues; other, more "common" plants, such as the *Calendula officinalis,* appear in 1807, but not later. One assumes that Barker was not recording all he saw, but what was of interest to him; he particularly noted what was in bloom at the time of his visits.

The list of plants seen at Bartram's follows; it represents 10 visits between July 4 and November 29th. Perhaps the entry for Christmas day best represents the priorities of a Philadelphia gentleman-botanist in 1829:

Christmas (Mary presented me with her portrait by Sully) Coldish and not very pleasant. After dinner walk with Edmd [his son] to Schuykill, by D'Arras's . . . only chickweed.

### List of Plants Seen at Bartram's Garden by James Barker in 1829

Plants are listed by: (1) names used by Barker and description, if any, in quotes; (2) publication date of Bartram/Carr catalogue(s) which list Barker plant, with scientific name used in catalogue if different or missing from Barker; (3) an asterisk is used when a plant listed by Barker appears in no Carr/Bartram catalogue; (4) comments by me are in brackets.

All known editions of Bartram/Carr catalogues were examined, with the exception of the announced catalogue of 1825, listed in the *Master Book List for Bibliographia Huntia,* and not found, after a reasonable search of libraries by the author. Since no source included all catalogues, and none listed the catalogue of 1830, a complete list is included in the bibliography.

"Aranda [?] tree, from Rocky Mountains, with its red berries." *
"Acacia from Mexico (shiny yellow.)" 1828 [14 different acacias listed]; 1836 [idem].
"*Ailanthus*. Japanese Tree of Heaven. The same as before Dr. Coxe's door." 1828: *Ailanthus glandulosa*.
"Amaranths." 1807 [5 different amaranths]; 1831: *Amaranthus hypondriacus, spinosus* &c.
"*Amaryllis lutea*—fine yellow lily in pot." 1828: *Amaryllis lutea* (*Sternbergia lutea*).
"*Antirrhinum majus* (English rich purple snapdragon)." 1807; 1836.
"*Aristolochia labiosa* from Rio Janiero." 1830.
"*Asclepias cons*/ from s. America. Hot House. Like Tuberosa. Grows on the Coast of Carolina." 1828: *Asclepias arborea, curassavica, parviflora;* 1836: *Asclepias curassavica* [only *Asclepias* listed in Hot House].
"Asters. 22 species collected within half a mile of the garden. Specimens of all in blossom viz."
"*Aster cyaneus*. Deep purple—thickly clustered—rich and beautiful—large lower leaves." 1831.
"*Aster foliosus*. White smaller leaf, linear lanceolate."*
"*Aster grandiflora*. Purple. Large & handsome. Next to china aster in beauty." 1828.
"*Aster graveolens* (Nuttall) who brought it from Arkansas. Pale purple, thickly clustered, very handsome." 1828.
"*Aster linariifolius*, purple." 1807; 1828.
"*Aster novae angliae*, purple, large." 1807.
"*Aster serotinus*, pale purple."*
"*Aster suaviolens*, yellowish white."*
"*Aster tenuifolius*, white, very thickly clustered." 1807; 1831.
"*Aster undulatus*, fine rich purple, small ovate leaf."*
"*Aster versicolor*, white with reddish centre." 1831.
"Aster (unknown), small white, from a bush with at least 10,000 flowers."*

"Aster, unknown, small yellow."*
"Aster, unknown, very pale purple."*
"Aster, unknown, white, ovate leaf, large."*
"Barbadoes nickel [?] tree, not in flower."*
"Batchelor's button." 1831: *Centaurea americana.*
"*Begonia argyrostigma,* spotted." 1828; 1836.
"*Begonia discolor*—in flower." 1828; 1836: *Begonia evansiana* (discolor.)
"*Begonia* (leaves white, spotted.)"*
"Box, variegated." 1828: *Buxus arborescens v. aur. varieg;* 1836: *Buxus sempervirens v. aurea, Buxus sempervirens v. argentea.*
"*Cactus* (in hot house.)" 1806 [6 species listed]; 1828 [13 species]; 1831: *Cactus bransiliensis, Cactus truncatus, Cactus cylindricus* (and 30 other species lately received from Mexico); 1836 [21 species listed] with many other species from Mexico.
"*Calendula officinalis* (pot marigold.) Yellow flower, like the Everlasting." 1807.
"*Calendula*—very small mary gold—with leaf, rubbed smelling & tasting like annissed [sic] leaf evergreen."*
"*Campanula pyramidalis.*" 1828; 1836.
"Cane, small carolina." 1807: *Arundo tecta* Walt., *Arundo palustrus* Auth.[3]
"Cape jasmine—large leaf. Chinese make a yellow dye of it. Also use it for hedges. It is originally thorny, but cultivation takes away its thorns." 1807: *Gardenia florida;* 1828 [4 species listed]; 1836 [6 species and varieties listed].
"Carnations (flowers)." 1807: *Dianthus caryophyllus;* 1828: *Dianthus caryophyllus* many varieties, shades & colors; 1838 [idem].
"*Celastrus scandens,* the staff tree, whose orange berries look like the berries of the euonymous, differently tinted." 1807; 1828; 1831; 1836.
"*Ceratonia,* St. John's Bread. Supposed to be locust of the scripture (Carob tree.) The boys may be seen bringing into town its large horn like pods, which they call locusts. They are sweet inside." 1836: *Ceratonia siliqua,* St. John's Bread or Carob Tree.
"Cerisia fetida—small white—very handsome (in pot) (root only—bad smell.)" 1807: *Seriscia foetida;* 1828: *Serissa foetida fl. pleno* (*Lycium japonicum*); 1836 [idem].
"Chaste tree (*Cistus Agnus*); 1828; 1836: *Vitex agnus-castus.*
"China aster." (*Callistephus*)*
"Chinese wax tree (in hot house.)" 1828: *Stillingia sebifera,* Chinese tallow tree.
"*Chrysanthemum indicum.*" 1807; 1828.
"Chrysanthemums—beautiful—Carr say they are just beginning [October 4]. They are now pure white. They change their color with age." 1807: *C. leucanthemum.*
"*Cocoa*—not in flower."*
"*Commelina virginica*—fine blue. Like the *Tradescantia*—tho the flower in one hour dissolved into black mass in my box. (Day flower.)" 1807; 1831; 1836.
"*Convolvulus pyramidalis*—beautiful, large purple, growing against the house."* 1807 [5 species listed, perhaps *Convolvulus purpureus*].
"*Corchorus japonica.*" 1831: *Kerria japonica* (*Corchorus japonicus.*)
"*Coreopsis tinctoria.*" 1828 [idem]; 1831: *Coreopsis tinctoria* sp. nov.
"Cornelian cherry." 1807; 1828; 1836: *Cornus mas.*
"*Correa alba* of Mexico." 1828; 1836.
"Crab apple, Siberian. Red & small like a plumb [sic]." 1828.
"*Cyclamen* in beautiful flower." 1807: *Cyclamen europeum;* 1828: *Cyclamen europeum* and *Cyclamen hederaefolium;* 1836 [idem].
"*Cytisus* or *Genista* (dyer's broom.) Yellow, papil-s leaves, locust like." 1828.
"Dahlias—the original single—and 4 or 5 varieties, double & variously colored, yellow etc." 1828: *D. superflua,* (many varieties, single & double); 1838 [four pages of *Dahlia*].
"*Darlingtonia* (De Candolle) formerly *Mimosa illinoensis.*" 1828: *Mimosa illinoensis vel Darlingtonia brachyloca.*
"*Dianthus barbata.*" 1807; 1836: *Dianthus barbatus.*
"*Dichorizandra thersiflora*—a purple flower, from Rio Jo., just flowering for the first time." 1828; 1836: *D. thysiflora.*

[3] "Auth." refers to the "author of this catalogue" in 1807.

"*Dionaea*. Caught a daddy long legs which we found kicking his long legs & freed." 1807; 1828; 1836: *D. muscipula*.

"Eggplants, fruit 30 inches around." 1807: *Solanum melongena*.

"*Erodium* (small red flower.)" 1828: *E. incarnatum*.

"*Eupatorium* in full flower in garden [October 4]. Brought home a bush & planted it." 1807 [14 species]; 1828 [Idem]; 1838 [4 species].

"Fern." 1807 [20 varieties]; 1831 [46 varieties of "fern" including *Lycopodium*].

"*Franklinia*—flower fine & fragrant." 1807; 1831; 1838: *Gordonia pubescens* or *Franklinia*.

"*Geranium piedmontum*." 1828 [4 species listed, perhaps *Geranium pyrenaicum?*].

"*Gnaphalium*, purple." 1831: *Gnaphalium purpureum*.

"Grapes, native." 1807: [10 varieties of *Vitis* listed, and] The varieties are infinite; 1828 [two pages of grapes]; 1831 [8 native grapes including 2 sp. nov.].

"Grapes, Alexander. Are no better than my white grapes." 1807: *Vitis alexandria* Auth.; 1828: *Vitis alexandria* or Schuylkill Muscadel.

"Grapes, Bland." 1807: *Vitis blandia* Auth.; 1828: Bland's Virginia.

"Grapes, Formiant. Small black grape, from Tokay . . . from which is made an essence of Tokay, used in small quantities." 1828: Formiant from Tokay.

"Grapes, Isabella." 1828; 1831.

"Ground ivy (*Hederacea*) with its blue blossoms; will greet the early spring." 1831; 1836: *Glecoma hederacea*.

"*Gymnocladus canadensis* (Kentucky Coffee Tree.) This tree at Bartram's is 70 feet high & straight. (See also Michaux,) yet London described it as thorny, leaf & branch—and twining!" 1806; 1828; 1831; 1836.

"*Helenium autumnale*." 1807; 1828; 1831.

"*Helianthus* (new species, not named, large yellow.)" 1828 [5 species]; 1828 [13 varieties]; 1836 [4 varieties].

"*Heliopsis*." 1831: *Helipsis laevis*.

"Holly, with red berry." 1807 [4 species]; 1831 [4 species]; 1836: *Ilex opaca, Ilex aquifolium*.

"Honeysuckles, blossom and berry Sept. 13." 1807 [Honeysuckles include: *Azalea, Diervilla*, and *Lonicera*]; 1831 [most of *Lonicera* changed to *Caprifolium*]; 1836 [Honeysuckles include: 15 species of *Azalea, Caprifolium, Diervilla*, and *Lonicera*].

"Ice plant." 1828: *Mesembryanthemum crystallinum* . . . and many other species; 1836: *Mesembryanthemum crystallinum, Mesembryanthemum glaucum*.

"*Ipomaeca coccinea* . . . scarlet bindweed . . . scarlet *Ipomaea*. Very like each other (*I. quamoclit*). Leaf differing the 1st cypress like—the 2nd cordata." 1807; 1831: *Ipomaea coccinea*.

"*I. quamoclit*, cypress vine." 1807; 1831.

"*Jasminum* (hot house?). 1828 [10 varieties]; 1836 [9 varieties].

"Lady slippers." 1807 [5 species of *Cypripidium*]; 1828: *Cypridipium pubescens, Cypripidium spectabile, Cypridium humile;* 1831 [5 species listed].

"*Lagerstroemia* (grape tree)." 1807: *Lagerstroemia indica;* 1828: *Lagerstroemia indica, Lagerstroemia indica v. purpurea, Lagerstroemia indica v. coccinea;* 1836: *Lagerstroemia indica, Lagerstroemia indica v. purpurea*.

"*Lantana americana* from Mexico. Handsome—like *Asclepias tuberosa*." 1836.

"Larkspur, fine blue tint." 1807; 1828; 1831; 1836 [ten different varieties].

"*Lathyrus latifolius*." 1807; 1828; 1836.

"*Laurus cinnamonum* from which the Cinnamon." 1836: *Cinnamomum verum*.

"*Ligustrum vulgare*, privet (black berry.)" 1807; 1828; 1836.

"*Lonicera perfoliatum*."* 1807 [9 varieties]; 1828 [15 varieties]; 1836 [2 *Lonicera*].

"*Lonicera sempervirens*, might be called 'semperflorens,' now in flower & fruit." 1807; 1828; 1836.

"*Malva*—English mallow." 1807: *Malva alcaea*.

"*Maranta*—arrowroot." 1830; 1836: *Maranta arundinacea*.

"Marygolds double like huge balls." 1807: *Tagetes erecta, Tagetes patula;* 1828: *Tagetes lucida;* 1836: [idem].

"Medlar apples—ugly things not fit to eat till rotten & then not eatable." 1836 [listed in index, as on p. 63, but no copy found which included pages past 53].

"*Mimosa* leaves & limbs sensitive." 1828: *Mimoma sensitiva*, shrubby sensitive Mimosa; 1836: *Mimosa pudica*, Sensitive plant.

"*Nicotiana* (fragrant.)" 1807: *Nicotiana rustica, Nicotiana paniculata;* 1831: *Nicotiana rustica* sp. nov.; 1836: *Nicotiana fruticosa*.

"*Nicotiana* (same genus as tobacco, quadrivalvis?) funnel form white flower shaped like 4 o'clock." [See above]

"*Nigella damascena*." 1807.
"Oak . . . the water oak is nearly evergreen." 1807; 1828; 1831; 1836: *Quercus aquatica*.
"*Oenothera grandiflora* (tree primrose.)" 1807; 1831; 1836.
"*Parthenium integrifolium*—white umbelliferous—blossom something like *Eupatorium*—a native." 1831.
"*Passiflora coerula?*" 1828; 1836.
"*Passiflora incarnata*, both beautiful." 1807; 1829; 1831; 1836.
"*Passiflora maculata*, a curious leaf." 1831, 1836.
"*Passiflora palmata* (Carr)." 1836.
"Pear, sickle." 1828.
"Pear, buerre gris." 1828.
"*Pelargonium acerifolium* maple leaved & lemon scented."* [In the 1828 catalogue "*Pelargonium citriodora* (lemon scented)" is a possibility, and in the 1836 catalogue *Pelargonium limonium* and *Pelargonium citridorum* are possibilities].
"*Pelargonium*, Waterloo. A hybrid from Zonal and Insigiana (horseshoe & scarlet.)" 1828; 1836.
"*Phlox*." 1807 [7 varieties]; 1828 [6 varieties]; 1831 [17 varieties]; 1836 [13 *Phlox*].
"Primrose, Chinese." 1828: *Primula sinensis;* 1836: *Primula sinensis alba*.
"Primrose, original white cowslip etc." 1807; 1828; 1836: *Primula veris*.
"*Rhus?* The leaves turning streaked beautiful red & green??" [in hot house]. 1828: *Rhus lucida, Rhus triloba, Rhus sp?* from Brazil; 1831 [10 native *Rhus*].
"Rose apple of West Indiea—in fruit [Oct. 4]. The fruit grows as large as an egg and tastes like rosewater. (*Sysigium jambos*.)" 1828; 1836: *Eugenia jambos*.
"Roses." 1807: 18 species; 1828: 50 species & varieties; 1830 [30 varieties "lately received from Paris"]; 1831 [10 species]; 1836 [10 pages of roses].
"*Rudbeckia*—one or two." 1807: *Rudbeckia triloba, Rudbeckia fulgida, Rudbeckia purpurea;* 1831: 7 species; 1836: 6 species.
"Sago—the inhabitants of Cochin China live for 4 months of the year upon the farina, made into bread." 1828; 1836: *Cycas revoluta* (Sago palm.)
"*Salvia splendens* in flower [Oct. 4]." 1828; 1836.
"*Scabiosa* (sps.)" 1807: *Scabiosa atropurpurea*.
"*Solidago*." 1807 [13 species, including *Solidago caesia* and *Solidago suaveolens* Auth]; 1831 [14 species].
"*Spartium* (Scotch broom.)" 1807; 1828; 1836: *Spartium scoparium*.
"*Symphoria glomerata* (red berry—will remain till spring.)" 1831; 1836.
"*Symphoria racemosa*—snowberry bush—soiled and injured by the snow." 1831; 1836.
"Tea plant, in flower like the camelia in flower, except that in the former the corolla is erect, the latter reversed." 1807; 1828; 1836: *Thea veris*.
"Trumpet flower with humming birds." 1807: *Bignonia radicans;* 1828 [Idem and 6 other species]; 1831: [Idem and 5 species and varieties]; 1836 [Idem and 8 species and varieties].
"*Viola tricolor*." 1807.
"Violet, double, which is very sweet scented, grows as well in the open air as any native plant; it is not now in flower." 1828: *Viola odorata, Viola purpurea;* 1836: *Viola alba plena, Viola odorata coeruleo plena*.
"*Xeranthemum annuum*—everlasting flowers."* 1828; 1831: *Xeranthemum fulgidum*.
"Youpon tea—Cassine—sold in the markets of Charleston . . . U. States Indians, at a certain time of the year, assemble round the fire, make the tea, vomit—drink—vomit etc. several times, until sufficiently cleansed & then march off—each with a branch. 1807; 1828; 1831: *Ilex vomitoria;* 1836: *Ilex cassine*.
"Zebra, mammoth, with large leaves, striped like the zebra." 1828: *Maranta zebrina*, sp. nov.
"*Zinnia elegans* no English name."*
"*Zinnia multiflora*." 1807; 1831.

## Literature Cited

The final abbreviation in the Bartram/Carr catalogue descriptions indicates where a copy can be seen. ANSP refers to the Academy of Natural Sciences of Philadelphia; HSP is the Historical Society of Pennsylvania; LCP is the Library Company of Philadelphia.

BARTRAM, JOHN. c. 1783. Catalogue of American tree, shrubs and herbacious plants, most of which are now growing, and produce ripe seed in John Bartram's Garden, near Philadelphia. The seed and growing plants of which are disposed of on the most reasonable terms. Broadside. HSP.

———. 1807. A catalogue of trees, shrubs, and herbaceous plants, indigenous to the United States of America; cultivated and disposed of by John Bartram & Son, At their Botanical Garden, Kingsess, near Philadelphia. To which is added a catalogues of foreign plants, collected from various parts of the globe. Bartram and Reynolds, Philadelphia. 33 pp. LCP.

CARR, ROBERT. 1814. A catalogue of tree, shrubs and herbaceous plants, indigenous to the United States of America, cultivated and for sale at Bartram's Botanical Garden. Robert & William Carr, Philadelphia. 53 pp. Library of the USDA, Beltsville, Md.

———. 1828. Periodical catalogue of fruit and ornamental trees and shrubs, green house plants, & cultivated and for sale at Bartram's Botanic Garden, Kingsessing, near Gray's Ferry—four miles from Philadelphia. Robert Carr, Proprietor. Russell and Martien, printers. 48 pp. ANSP, LCP.

———. March, 1830. Additions. 4 pp. LCP.

———. 1831. Periodical Catalogue of American Trees, Shrubs, Plants and Seeds, Cultivated and for Sale at the Bartram Botanic Garden, near Philadelphia. Robert Carr, Proprietor. Russell & Martien, Philadelphia. Pp. 63–84. LCP.

———. 1836. Periodical catalogue of fruit and ornamental trees and shrubs, green-house plants & c. cultivated and for sale at Bartram's Botanic Garden, Kingsessing, near Gray's ferry, three miles from Philadelphia. Robert Carr, proprietor. William S. Martien, Philadelphia. lv + 56 pp. Index lists through page 69, the second part consisting of fruit trees and shrubs, grapes, vegetable seed and American trees, shrubs and plants. No catalogue has been found which includes these pages. ANSP. LCP.

HUNT INSTITUTE FOR BOTANICAL DOCUMENTATION. 1972. Master Book List for Bibliographia Huntiana. Carnegie-Mellon University; Pittsburgh, PA.

SIMPSON, HENRY. 1859. The Lives of Eminent Philadelphians. Philadelphia.

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# Classification of Life Forms and Growth Forms of Aquatic Macrophytes

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Aquatic macrophytes can be grouped into life form categories defined by their relationships to water level and substrate, and into growth form categories defined by their gross structural characteristics. Organizing these categories into a hierarchy enables us to characterize the aquatic flora in a way that conveys information about its general appearance without considering species composition. Botanists use life forms and growth forms as headings in taxonomic keys (Voss 1967) and as artificial groupings in identification guides (Hotchkiss 1972). In addition, the kinds of life forms and growth forms present in a given aquatic habitat convey information about ecological conditions. For example, rosulate submergents are more characteristic of oligotrophic conditions and caulescent submergents are more characteristic of eutrophic conditions (Hutchinson 1975).

The life form and growth form classification scheme presented here (Table 1) was developed in connection with my courses on aquatic plants at the University of Montana Biological Station and Rutgers University (Camden). I am grateful to the students for their willingness to work with various stages of it. I also thank W. D. Countryman, G. E. Hutchinson, D. H. Les, R. L. Stuckey, and E. G. Voss for comments and/or suggestions.

It is hoped that this classification scheme is straightforward enough to be used by people with diverse interests in water plants and their ecology. It is a provisional scheme that undoubtedly can be improved. It probably does not completely encompass the remarkable diversity of growth forms of aquatic plants on a worldwide scale. Also there may be better descriptive words to replace some of those used here. Most users, particularly those lacking detailed knowledge of systematic botany, hopefully will find the groups easy to recognize even though the plants in them may not be closely related and may have fundamentally different structure. In some instances, judgment has to be used when a species has more than one life form or growth form or is structurally intermediate between two growth form categories. In general, however, these situations should not cause serious problems.

The first two levels of the hierarchy in Table 1 are life form categories and the third level is growth form categories. This scheme was developed from that of Hutchinson (1975) with one major modification: broader growth form categories designated by botanical descriptive terms (e.g., caulescent, rosulate, thalloid) are used in the third level of the hierarchy. Hutchinson used categories like these for submergents (Table 2) but not for other groups. Instead, he and other authors (Hartog and Segal 1964; Hogeweg and Brenkert 1969; Segal 1971) have named growth forms after plant groups that exemplify them with the use of an "id" ending. Sometimes there is a problem with this, however, when the plant group is not as homogeneous relative to growth forms as desired. Thus the treatment of caulescent mesopleustophytes as utriculariids

TABLE 1. Life forms and growth forms of aquatic macrophytes

I. Pleustophytes. Floating free from substrate (pleustonic)
   A. Mesopleustophytes. Vegetative plant body underwater
      1. Caulescent. Leaves or leaf-like structures on elongate stems (e.g., *Ceratophyllum* and *Utricularia* when not benthic)
      2. Rosulate. Leaves radiating from short stems (e.g., *Stratiotes* when floating underwater)
      3. Thalloid. Not differentiated into stems and leaves (e.g., *Riccia fluitans* and *Lemna trisulca* when not benthic)
   B. Acropleustophytes. Vegetative plant body on water surface
      1. Caulescent. Leaves scattered or closely spaced along stems, not radiating (*Azolla, Salvinia*)
      2. Rosulate. Clusters of leaves radiating from short stems (*Pistia stratiotes, Hydrocharis morsus-ranae, Eichhornia crassipes*)
      3. Thalloid. Not differentiated into stems and leaves (*Lemna minor, Spirodela polyrhiza, Wolffia punctata*)

II. Benthophytes. Basal portion of plant in or on substrate (benthic)
   A. Submergents. Vegetative plant body underwater
      1. Caulescent. Leaves on elongate stems protruding above substrate (e.g., *Potamogeton pectinatus, Myriophyllum spicatum*); also including plants not differentiated into true stems and leaves (e.g., *Chara* and aquatic mosses) or where this differentiation is obscure (e.g., *Utricularia*)
      2. Rosulate. Clusters of leaves radiating from short stems in or slightly protruding above substrate (e.g., *Vallisneria*); also including plants with unbranched stems in rosettes (e.g., *Eleocharis acicularis*)
      3. Scopiform. Stems or leaves protruding above substrate as simple solitary units (e.g., stems of *Myriophyllum tenellum* and underwater leaves of *Juncus militaris* when scattered along horizontal rhizomes)
      4. Thalloid. Not differentiated into stems and leaves (e.g., thallus of *Podostemum* and the lichen *Hydrothyria venosa*)
   B. Planmergents. Conspicuous portion of vegetative plant body on water surface
      1. Caulescent. Floating leaves on elongate stems protruding above substrate (e.g., *Potamogeton natans, Brasenia schreberi, Sparganium angustifolium*)
      2. Rosulate. Clusters of floating leaves radiating from short portions of elongate stems that protrude above substrate (e.g., *Trapa natans*)
      3. Foliose. Floating leaves protruding from stems in or slightly protruding above substrate (e.g., *Nymphaea odorata, Nuphar lutea*)
   C. Emergents. Vegetative plant body protruding above water surface
      1. Caulescent. Leafy stems protruding above water (e.g., *Typha, Polygonum punctatum*); also including plants with green leafless stems protruding above water (e.g., *Eleocharis palustris, Scirpus acutus*)
      2. Foliose. Only leaves protruding above water (*Sagittaria, Peltandra*)

and ceratophyllids (Table 2) does not seem desirable because, possibly more often than generally recognized, the basal portions of *Utricularia* and *Ceratophyllum* are in the substrate. If desired, however, these categories may be used in the fourth level of the hierarchy presented here. Eventually it may be desirable to use morphological terms instead of modified plant names for such growth form categories so that there is more consistency in their application.

Hutchinson (1975) used the terms rhizophytes for plants rooted in sediment and pleustophytes for free-floating plants. Since many plants with basal portions in or on the substrate lack roots, I prefer not to use rhizophyte as an antonym of pleustophyte. Instead, the term benthophyte seems more suitable. The latter category is broadly defined here to include Luther's (1949) rhizophytes (penetrating or covered by substrate), haptophytes (attached to surface of substrate), and benthopleustophytes (living

TABLE 2. Comparison between scheme used here and Hutchinson's (1975) scheme.

| | Hutchinson's Scheme |
|---|---|
| I. Pleustophytes | Pleustophytes |
| A. Mesopleustophytes | Mesopleustophytes |
| 1. Caulescent | ----- |
| ----- | Utriculariids, Ceratophyllids |
| 2. Rosulate | ----- |
| 3. Thalloid | ----- |
| ----- | Wolffiellids |
| B. Acropleustophytes | Acropleustophytes |
| 1. Caulescent | ----- |
| ----- | Salviniids[a] |
| 2. Rosulate | ----- |
| ----- | Salviniids,[a] Hydrocharids, Eichhorniids, Stratiotids |
| 3. Thalloid | ----- |
| ----- | Lemnids |
| II. Benthophytes | Rhizophytes |
| A. Submergents | Hyphydates |
| 1. Caulescent | Vittate |
| ----- | Magnopotamids, Parvopotamids, Myriophyllids |
| 2. Rosulate | Rosulate |
| ----- | Vallisneriids, Otteliids, Isoetids |
| 3. Scopiform | ----- |
| 4. Thalloid | ----- |
| B. Planmergents | Ephydates |
| 1. Caulescent | ----- |
| ----- | Nymphaeids,[b] Natopotamids, Batrachiids |
| 2. Rosulate | ----- |
| ----- | Trapids |
| 3. Foliose | ----- |
| ----- | Nymphaeids,[b] Marsileids |
| C. Emergents | Hyperhydates |
| 1. Caulescent | ----- |
| ----- | Graminids, Herbids, Ipomeids, Decodontids, Aeschynomenids |
| 2. Foliose | ----- |
| ----- | Sagittariids, Nelumbids |

[a] Hutchinson included caulescent and rosulate acropleustophytes in this category.
[b] Hutchinson included caulescent and foliose planmergents in this category.

on the substrate). Thunmark's hyphydates, ephydates, and hyperhydates apparently were originally applied (Björk 1967) to both pleustophytes and benthophytes. Hutchinson (1975) restricted them so they are essentially equivalent to submergents, planmergents, and emergents as defined here (Table 2).

## LITERATURE CITED

BJÖRK, S. 1967. Ecologic investigation of *Phragmites communis*. Studies in theoretic and applied limnology. Folia Limnol. Scand. 14, 248 pp.

HARTOG, C. DEN AND S. SEGAL. 1964. A new classification of the water plant communities. Acta. Bot. Neerl. 13: 367–393.

HOGEWEG, P. AND A. L. BRENKERT. 1969. Structure of vegetation: a comparison of aquatic vegetation in India, the Netherlands, and Czechoslovakia. Trop. Ecol. 10: 139–162.

HOTCHKISS, N. 1972. Common marsh, underwater, and floating-leaved plants of the United States and Canada. Dover Publications, Inc., New York. v, 99, vii, + 124 pp.

HUTCHINSON, G. E. 1975. A treatise on limnology, vol. III, limnological botany. John Wiley + sons, New York. xi + 660 pp.

LUTHER, H. 1949. Vorschlag zu einer ökologischen Grundeinteilung der Hydrophyten. Acta Bot. Fenn. 44, 15 pp.

SEGAL, S. 1971. Principles on structure, zonation, and succession of aquatic macrophytes. Hidrobiologia (Bucharest) 12: 89–95.

VOSS, E. G. 1967. A vegetative key to the genera of submersed and floating aquatic vascular plants of Michigan. Michigan Bot. 6: 35–50.

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# First-Year Loss of Mass and Nutrients from Leaf Litter in the New Jersey Pine Barrens

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Ecological studies of fire-prone ecosystems generally focus on the effects of fire on ecosystem processes, such as nutrient cycling (review by Boerner 1982), soil dynamics (review by Raison 1979), or colonization and regrowth of vegetation (e.g. Keeley and Keeley 1981; Boerner 1981) during the immediate post-fire recovery period. Since much breakdown of organic matter, release of nutrients, and most opening of safe-sites for colonization occur as a direct result of fires, the immediate post-fire recovery periods may represent peak periods for biological and biogeochemical activity, though increasing fire return intervals may increase the importance of nutrients cycled during periods between fires in determining productivity and influencing competitive interactions. This may be the case in upland forests of the New Jersey Pine Barrens where the pre-1940 fire return interval of 20–25 years has increased to 70+ years today (Forman and Boerner 1981).

The object of this study was to examine some biogeochemical aspects of Pine Barrens upland, pine-oak forests during the period between fires by: (1) quantifying the rates of mass loss and nutrient mineralization from leaf litter, (2) comparing inputs of nutrients to the forest floor/soil from litterfall and decay to those from bulk precipitation, and (3) evaluating the relative magnitude of nutrient mobilization from leaf litter to that mobilized by periodic prescribed burning.

## THE STUDY AREA

The Pine Barrens of New Jersey cover approximately 550,000 ha in southern New Jersey. The upland soils of the region are nutrient-poor, excessively-drained spodosols with sand content generally >85%, cation exchange capacity <5 mEq/100 g, and low base saturation (Tedrow 1952; Markley 1979). Fire changes the nutrient availability of these nutrient-poor soils only slightly (Burns 1952).

The climate of the region is humid, continental temperate; summer temperatures average 23°C and winters 1°C (Robichaud and Buell 1973). Precipitation averages 114 cm/yr and is distributed uniformly throughout the year (Robichaud and Buell 1973).

Upland forests of the region are dominated by pitch pine (*Pinus rigida* Mill.) and several species of oak, including *Quercus alba* L., *Q. velutina* Lam., *Q. coccinea* Muenchh., and *Q. prinus* L. Shrub cover is dense and dominated by heaths (*Gaylussacia* spp. and *Vaccinium* spp.) and, in some areas, by shrub oaks (*Q. ilicifolia* Wang., *Q. marilandica* Muenchh., and *Q. prinoides* Willd.). All dominant species sprout from trunk or roots following fire; actual fire-induced mortality is low and biomass redevelopment is rapid (Boerner 1981).

The study site was located in Lebanon State Forest, Burlington County. It had been burned by wildfire in 1963 and burned by prescription in the 1970's. The relative density of canopy trees (>10 cm dbh) was 71% pitch pine, 20% white oak (*Q. alba*), and 9% shortleaf pine (*P. echinata* Mill.). The understory was primarily *Q. ilicifolia*. The forest floor had a relatively uniform 1–4 cm deep litter (01 horizon) layer over a well defined humus (02) layer; Lakewood series soils underlay the site.

## Methods

Freshly fallen leaf litter was collected during October and November 1981 in plastic laundry baskets placed on the forest floor. Litter was air-dried for two weeks, then approximately 20–25 g of air-dried litter were packed into each 20 cm × 20 cm, 3 mm mesh polyethylene litterbag (Gosz et al. 1973; Lousier and Parkinson 1978). Equal amounts of pine and oak litter were included in each bag since this closely approximated their relative contributions to autumn litterfall. A subsample of air-dried litter was dried at 80°C for 48 hrs, then weighed to determine fresh/dry ratio. The litter was 9.7% moisture (standard error = 0.9%) when packed into the litterbags.

Litterbags were returned to the sample site on 1 January 1982 and secured to the forest floor. Groups of three bags were recovered at 1, 3, 5, 8, and 10 months; five bags were recovered at 12 months.

Recovered bags were weighed fresh, then dried at 80°C for 48 hours before reweighing. The difference between the fresh and dry weight of the bag contents was used as an estimate of litter moisture. No attempt was made to separate fungal hyphae from litter. Samples of 01 (= L + F sensu Lutz and Chandler 1946) and 02 (= H) horizons were taken in August 1980; standing mass of 01 and 02 horizons are from Boerner (1980, 1983).

Dried litter samples were ground in a Wiley Mill with a 20 mesh screen and frozen pending analysis. Ground samples (0.500 g) were ashed at 475–500°C for 4 hours and the resultant ash dissolved in 10 ml of 6N HCL and diluted to 100 ml (Likens and Bormann 1970). Phosphorus concentrations in the digestate were determined by the stannous chloride method (American Public Health Association 1976), and following addition of $La_2O_3$ in 6N HCL to a concentration of 0.5% La (Likens and Bormann 1970), cation concentrations were determined by atomic absorption spectrophotometry. Standard reference material (National Bureau of Standards, standard 1575, red pine needles) was analyzed with each set of samples to ensure accuracy. Nitrogen and lignin determinations were performed at the Ohio Agricultural Research and Development Center, Wooster, Ohio, utilizing semimicro-Kjeldahl (Bremner 1965) and Van Soest (1963) methods, respectively.

Bulk precipitation data were from the Washington's Crossing, New Jersey, National Atmospheric Deposition Program station, 40 km northwest of the study site and were supplied by the New Jersey Department of Environmental Protection.

## Results and Discussion

MASS LOSS. The rate of mass loss from decaying leaf litter was low, averaging 12.6% (standard error = 3.2%) over the first year. Most of the mass loss occurred during February and March (Fig. 1); this was the only period when litter moisture was >50% (Fig. 1). Litter moisture averaged <20% throughout most of the year. While some fragmentation of both oak leaves and pine needles occurred during summer and autumn, most of the leaves and needles were essentially intact at the end of one year.

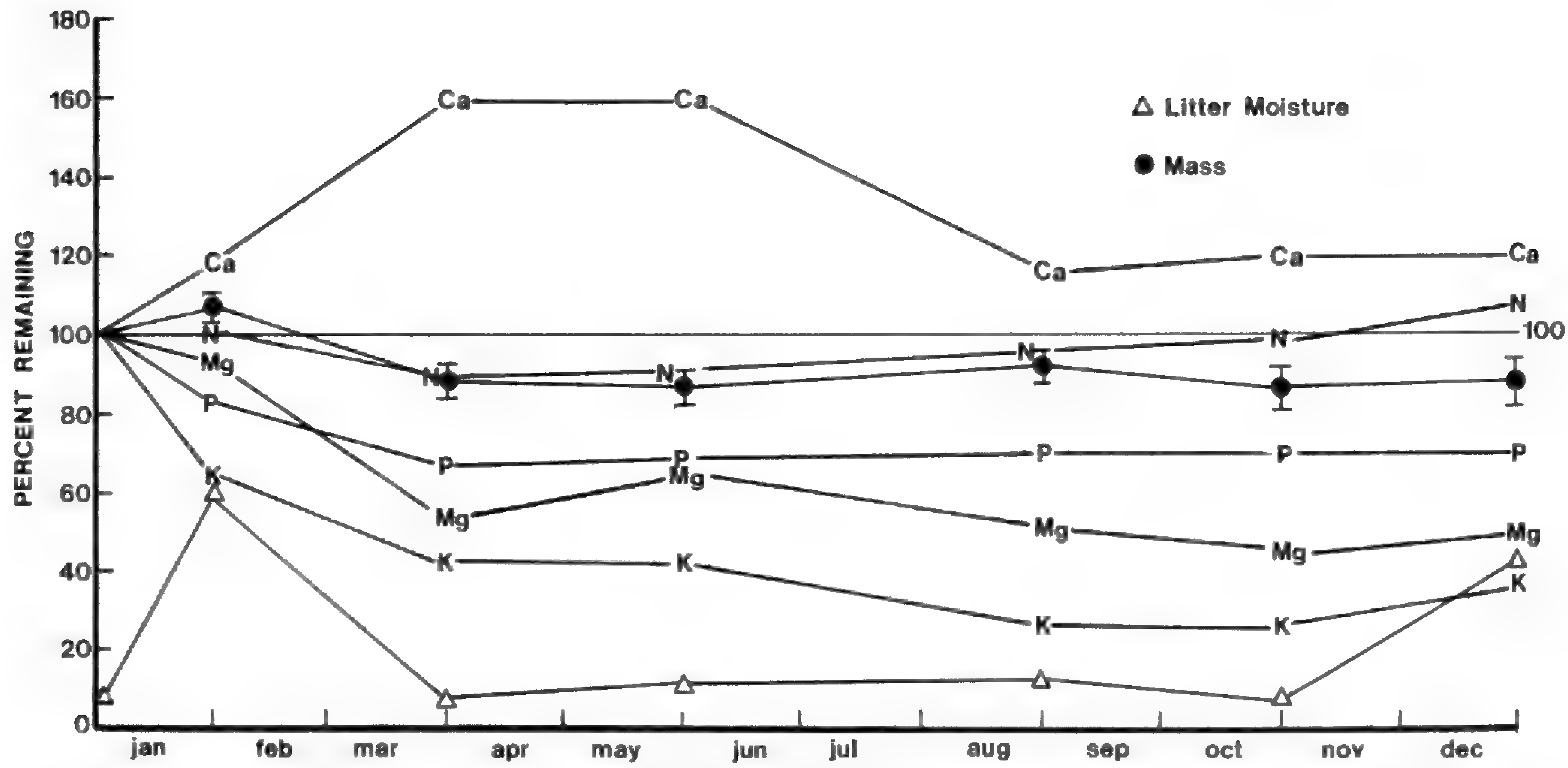


FIG. 1. Changes in percent original mass and nutrient bulk remaining in leaf litter during one year incubation in litterbags. Each nutrient element is represented by its chemical symbol whereas mass is represented by closed circles. Standard error ranges are given for mass means; error ranges for nutrient means fell within the symbols. Mean values for percent litter moisture on each sampling data are given as open triangles.

In order to estimate the relative decay rate (k sensu Jenny et al. 1949), the pattern of mass loss was fit to linear, exponential and double exponential functions (Wieder and Lang 1982). A linear function is expected to fit well when the labile fraction of the litter is relatively small. First year mass loss in this Pine Barrens site fit a linear function with a relative decomposition rate of $-.145$ ($r = -.654$, $r^2 = .428$, $p < .002$). The fit to an exponential function was, however, equally good ($r = -.653$, $r^2 = .427$, $p < .002$) and yielded an estimate of relative decay rate of $-.157$. If the intractable, lignin fraction of the litter was large, a double exponential function based on the separation of litter into labile and recalcitrant fractions, each with a distinct relative decomposition rate, should fit the mass loss pattern best (Wieder and Lang 1982). The lignin fraction (22.2%) and total mass loss were relatively small, and the fit to a double exponential function poor.

Both the proportion of mass loss during the first year (10–15%), and the estimates of relative decay rate ($-.145$, $-.157$) were lower than those reported for other coniferous and mixed forests (Jenny et al. 1949; Maclean and Wein 1978; Fahey 1983). Two factors contribute to this low rate of mass loss. Litter moisture was low throughout most of the year. Mass loss rates of 30% (*Pinus banksiana,* MacLean and Wein 1978) to 44% (*Pinus taeda,* Thomas 1968) have been reported from areas where precipitation, microclimate, and soils interact to produce higher soil moisture levels; rates of mass loss similar to ours (18–23%) were reported for *P. contorta* in a dry environment in Wyoming (Fahey 1983).

A second factor influencing decay rate is initial litter chemistry. Mass loss rates are generally proportional to initial nitrogen and phosphorus concentrations (Berg and Ekbohm 1983; Boerner, in review) and inversely proportional to lignin concentration (Meentemeyer 1978; Aber and Melillo 1982). Initial nitrogen and phosphorus concentrations in Pine Barrens pine-oak litterfall (Table 1) were significantly lower than those reported for white pine (*P. strobus*) and oak litter in Tennessee (Cromack and Monk

TABLE 1. Nutrient concentrations (mg/g dry weight, except nitrogen, %) in freshly fallen leaf litter, 01, and 02 horizons in a New Jersey Pine Barrens upland pine-oak forest. Standard errors of the means are given in parentheses. Values followed by the same lower case letters were not different following analysis of variance and plotting of $LSD_{.05}$.

| Component | Nitrogen | Phosphorus | Calcium | Magnesium | Potassium |
|---|---|---|---|---|---|
| Litterfall | 0.75 (.007)a | 0.728 (.015)a | 6.255 (.030)a | 1.747 (.017)a | 2.363 (.027)a |
| 01 layer | 0.79 (.009)a | 0.577 (.061)b | 3.267 (.412)b | 0.241 (.046)b | 0.358 (.063)b |
| 02 horizon | 0.83 (.065)a | 0.535 (.047)b | 1.910 (.190)c | 0.281 (.038)b | 0.411 (.065)b |

1975), jack pine (*P. banksiana*)/hardwood litter in New Brunswick, Canada (MacLean and Wein 1978), and similar to those in lodgepole pine (*P. contorta*) in Wyoming (Fahey 1983). Lignin concentration was similar to that of oaks and white pine in Tennessee (Cromack and Monk 1975). While low, the mass loss rate observed in our site was consistent with that predicted on the basis of initial nitrogen and lignin concentrations by Aber and Melillo (1982). Thus, relatively low initial nutrient concentrations combined with a moderate lignin level and low litter moisture to generate conditions unfavorable for rapid mass loss.

NUTRIENT MINERALIZATION/IMMOBILIZATION. Initial litter concentrations of all nutrients, except nitrogen, were significantly higher than in 01 or 02 forest floor layers (Table 1). Forest floor C:N ratios were 73:1 (01) and 70:1 (02), considerably higher than the 20–30:1 commonly considered necessary to produce rapid microbial mineralization of nitrogen from litter (Gosz et al. 1973). N:P ratios were 14–16:1, levels similar to those needed to synthesize microbial biomass (Gosz et al. 1973), though forest floor C:P ratios (1005:1, 01; 1084:1, 02) were higher than those reported in forest floor of other podzolized soils (e.g. Gosz et al. 1973; Yount 1975). Thus, like fresh litterfall and soils, the forest floor layers of these Pine Barrens sites were relatively low in nutrients.

Nitrogen concentration in the litterbags remained constant until mid-summer (Fig. 2). Nitrogen concentration rose through autumn and was 21% above initial by the end of December (Fig. 2). The mass of nitrogen in the litterbags decreased through February and March as mass was lost (Fig. 1); by April 1st, approximately 10–12% of the original nitrogen had been lost. Much of this mass and nitrogen loss may have been the result of leaching. In response to increasing nitrogen concentration after July 1st (Fig. 2), the mass of nitrogen in litterbags increased to 15% above initial by the end of the year (Fig. 1).

Similar patterns and magnitudes of nitrogen immobilization have been observed in decaying *P. contorta* (Fahey 1983) and *P. banksiana* (MacLean and Wein 1978) litter. Immobilized nitrogen may come from precipitation, throughfall, nitrogen-fixation, or transfers from the forest floor or soil (Fahey 1983). The C:N ratio decreased from 73:1 to 60:1 during the year. Since mass loss from older pine needle litter is generally slow (e.g. Fahey 1983), considerable further nitrogen immobilization is necessary before the C:N ratio approaches a level where mineralization can begin.

Phosphorus concentration decreased by approximately 25% during the first month, then remained relatively stable (Fig. 2). Since both mass and phosphorus changed most during this period, the majority of phosphorus mineralization occurred during late winter/early spring (Fig. 1); 30+% of the original phosphorus content had been mineralized by April 1.

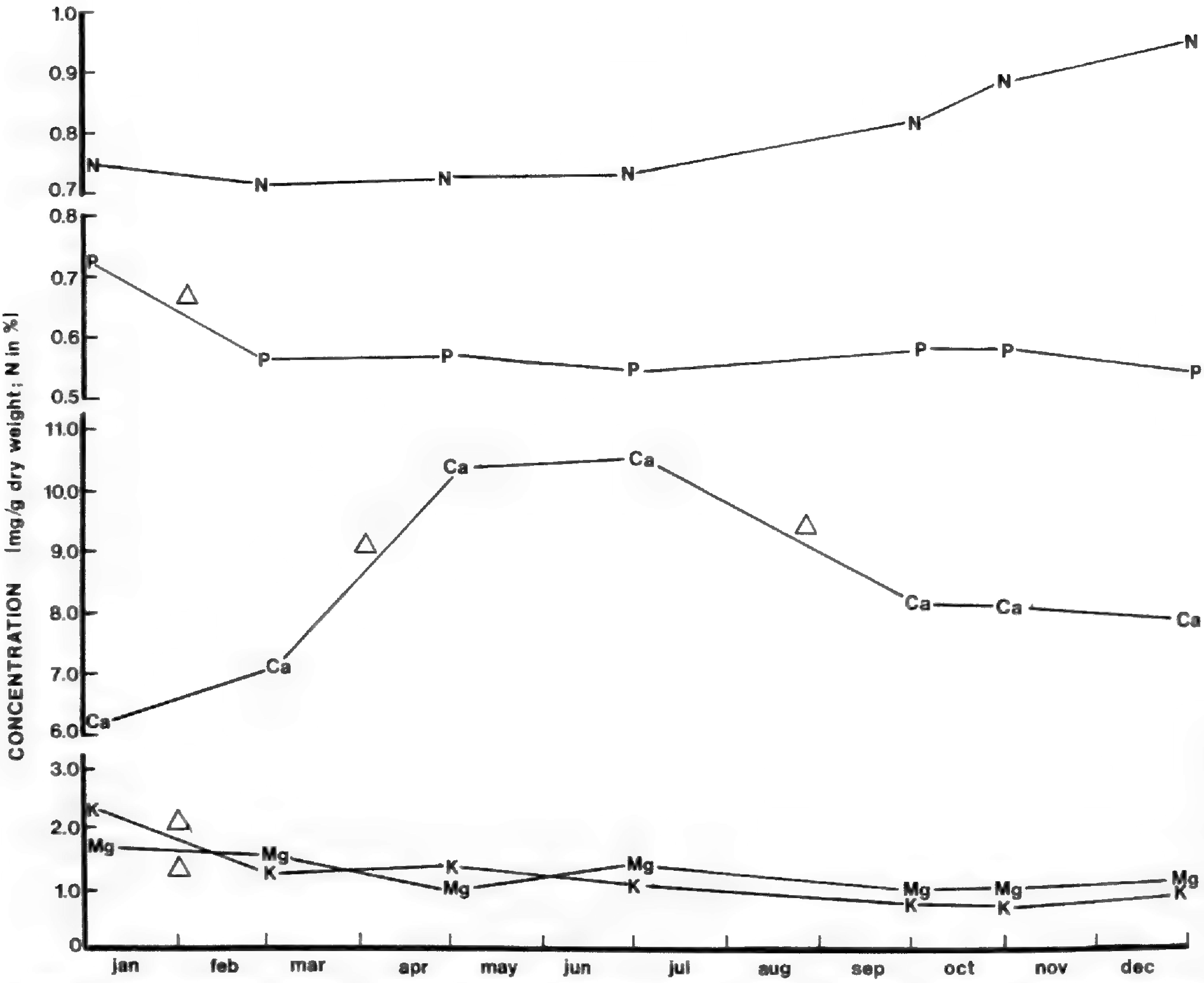


FIG. 2. Concentration of five nutrient elements in leaf litter during one year incubation in litterbags. Each nutrient element is represented by its chemical symbol. Time intervals during which significant changes in concentration occurred are indicated by deltas.

While early leaching of soluble phosphorus compounds had been observed in hardwood litter (Gosz et al. 1973; Boerner, in review), in general, phosphorus tends to be immobilized in phosphorus-poor pine litters (e.g. MacLean and Wein 1978; Fahey 1983), at least over the first year of decay. Mycorrhizal fungi, noted for translocating phosphorus to tree and shrub hosts, may outcompete free-living fungi for available nutrients, thereby decreasing the rate of phosphorus immobilization and mass loss (Gadgil and Gadgil 1971). The trees and shrubs common in this area are dependent on mycorrhizae; over 70% of active mycorrhizal hyphae are found in the upper 7.0 cm of upland Pine Barrens soils (Buchholz and Motto 1981). Whether mycorrhizal fungi are responsible for the relative lack of phosphorus immobilization in Pine Barrens litter, however, cannot be evaluated without more direct experimental evidence, since, presumably, mycorrhizae are also common in pine-dominated forests where net phosphorus immobilization has been observed.

Calcium concentration increased to 165% of original by April 1st, remained stable through June, then decreased to 120% of initial by years end (Fig. 2). The same pattern was observed for calcium bulk with net calcium immobilization being equivalent to 20% of original calcium mass. These levels of calcium immobilization were consistent with those observed in *P. contorta* litter (Fahey 1983). Whether calcium is mineralized or immobilized in leaf litter depends on the initial C:Ca ratio, with calcium rich litters undergoing rapid mineralization while calcium is immobilized in calcium-poor litter (MacLean and Wein 1978; Boerner, in review). Forest floor calcium taken up by fungi may be transferred to the litter, though higher concentrations in attached hyphae than in litter (Lawrey 1977; Fahey 1983) suggest preferential accumulation of calcium in hyphae for use in carbohydrate metabolism (Cromak and Monk 1975).

Magnesium and potassium concentrations decreased steadily throughout most of the year (Fig. 2), as did the mass of these two elements in litterbags (Fig. 1). Losses of these two elements fit exponential models well (Mg: $k = -.692$, $r^2 = .721$, $p < .02$; K: $k = -1.024$, $r^2 = .693$, $p < .02$). By the end of the year, approximately 50% of the magnesium and 60% of potassium had been lost.

By the end of the first year of decay, then, nitrogen concentration had increased, and phosphorus decreased, to levels similar to those in the 02 horizon (Table 2). Magnesium and potassium concentrations were lower than fresh litter but higher than the 02 horizon. Leaching of these two elements may have been limited by precipitation volume or insufficient balancing anion fluxes (Fahey 1983). Since calcium was strongly immobilized, litter calcium did not approach forest floor levels.

NUTRIENT FLUXES FROM LEAF LITTER. Estimates of net fluxes through litter decomposition were calculated from the proportion of original mass of each element remaining at the end of one year, initial litter nutrient concentrations, and estimates of litterfall mass for two Lebanon State Forest pine-oak forests given by Boerner (1980). Molar-equivalent fluxes of phosphorus were calculated as phosphate-P; nitrogen was calculated as 1:1 $NH_4$-N:$NO_3$-N, as these two nitrogen forms are equally abundant in Pine Barrens surface waters (Patrick et al. 1979). When ordered by molar-equivalents mineralized, magnesium flux was the greatest, followed by potassium then phosphorus (Table 2). Relatively more nitrogen was immobilized than calcium though the differences were small.

To determine the significance of these fluxes to the Pine Barrens ecosystem, they can be compared to inputs in bulk precipitation and nutrient masses mobilized by

TABLE 2. First-year fluxes of nutrients from leaf litter decomposition. The mass of nutrients in litterfall is estimated as the product of initial litter concentrations and estimates of litterfall mass for two upland pine-oak stands near the study site (Boerner 1980). Standard errors of the means are given in parentheses. Precipitation data are for 1 September 1981 through 31 August 1982 at Washington's Crossing, NJ, 40 km northwest of the study site (courtesy of the New Jersey Department of Environmental Protection).

| Parameter | Nitrogen | Phosphorus | Calcium | Magnesium | Potassium |
|---|---|---|---|---|---|
| percent original remaining | 115.1 (6.2) | 68.9 (2.4) | 120.1 (9.2) | 52.3 (3.9) | 39.8 (5.1) |
| mass in litterfall ($mg/m^2/yr$) | 2554 (70) | 249 (7) | 2138 (59) | 597 (16) | 808 (22) |
| annual mineralization (immobilization) | | | | | |
| $mg/m^2/yr$ | (386) | 77 | (430) | 285 | 486 |
| $mEq/m^2/yr$ | (27.6)* | 2.5* | (21.5) | 23.4 | 12.4 |
| bulk precipitation $mEq/m^2/yr$ | 35.1 | 0.1 | 9.3 | 4.7 | 0.7 |

* calculated as 1:1 $NH_4$-N:$NO_3$-N and $PO_4$-P

periodic prescribed burning. Even though precipitation inputs represent externally derived nutrients while decomposition and prescribed burning recycle nutrients already in the ecosystem, we feel this comparison is valid, since all three pathways bring nutrients to the forest floor and surface soil in a form available for plant uptake.

The amount of nitrogen immobilized during the first year of litter decay was similar to input from bulk precipitation, whereas the amount of calcium immobilized in litter was 2.3 times the atmospheric input (Table 2). Thus while the amount of nitrogen immobilization observed over the first year of decay could have occurred without reducing soluble soil/humus nitrogen levels, most of the calcium immobilized must have come from the soil/humus complex, where concentrations were already low.

Fluxes of other minerals from litter greatly exceeded atmospheric inputs. When compared to bulk precipitation, 5 × as much magnesium, 18 × as much potassium, and 25 × as much phosphorus were supplied by first-year litter decay (Table 2). Thus, first-year decay was a major pathway for addition of magnesium, potassium, and phosphorus to the forest floor and soil.

Prescribed burning at intervals of 3–5 years has become an important management practice for decreasing wildfire probability and increasing site fertility (Little and Somes 1961). Boerner (1980, 1983) found that early spring prescribed burning of a nearby site similar in vegetation and fire history to our study site reduced litter standing mass (01) by 42%, or approximately 340 g/m$^2$ dry mass, while leaving the 02 horizon essentially intact. Using the exponential model for litter mass loss ($k = -.157$), 13.8% loss of litterfall mass is predicted for the first year of decay, followed by 12.5%, 10.7%, 9.2%, and 7.8% in succeeding years. Summing the decomposition of each annual litter increment over 3, 4, and 5 years gives decomposition estimates of 264 g/m$^2$ over three years, 432 g/m$^2$ over four years, and 616 g/m$^2$ over five years (Table 3). Thus the oxidation of leaf litter through decomposition over 3–4 years was equivalent to that of a single prescribed burn.

Calculations of mineral fluxes from decomposition and prescribed burning assumed all minerals contained in combusted litter were rendered soluble. No attempt was made to estimate the amount of nitrogen made available by prescribed burning since the completeness of fuel combustion will vary from fire to fire as a function of litter moisture, weather, and fire intensity. These factors control the degree of combustion, which, in turn, determines the proportion of nitrogen volatilized vs deposited in ash (Boerner 1982). Likewise, since calcium and nitrogen were immobilized in litterbags, no estimate of their loss rates from litter were possible.

Multiplying the standing mass of minerals in the 01 layer by the proportion of mass

TABLE 3. Comparison of organic matter and mineral mineralization over 3–5 years of litter decay to that induced by a single prescribed burn. Totals for three years of decay, for instance, represent the sums of three years of decay of one litterfall increment, two years of decay for a second increment, and one year of decay for a third. Magnesium and potassium fluxes from litter are based on exponential decay models while phosphorus losses are considered as leaching losses alone. See text for further details. Mass values are in g/m$^2$, elements in mg/m$^2$. ND = no data available.

| Source | Dry Mass | Phosphorus | Calcium | Magnesium | Potassium |
|---|---|---|---|---|---|
| Prescribed Burn | 340 | 195 | 1102 | 81 | 121 |
| Litter Decay, 3 yr | 264 | 224 | ND | 1333 | 1346 |
| Litter Decay, 4 yr | 432 | 300 | ND | 1864 | 2083 |
| Litter Decay, 5 yr | 616 | 373 | ND | 2396 | 2820 |

lost by combustion gives an estimate of nutrient supply due to prescribed burning (Table 3). The rank order of elements released by prescribed burning was Ca > P > K > Mg. Calculations of potassium and magnesium fluxes assumed no further losses after predicted litterbag concentrations reached 02 layer concentrations. Since significant phosphorus loss after the initial 30% leaching loss is not likely to occur until a lower litter C:N or C:P ratio is attained, only this initial loss was used in calculating annual fluxes. Since net phosphorus mineralization will likely occur during the 3–5 year projected period, the estimates based solely on annual leaching losses will underestimate actual phosphorus supply rate.

Predicted losses of potassium and magnesium due to leaching from litter over 3–5 years greatly exceeded levels made available by prescribed burning. Since these elements are rapidly leached from litter by rainfall, have high mobility in soil solution, and are also cycled in throughfall (Boerner 1980), long-term accumulation in litter is unlikely to create shortages of these elements. Estimated phosphorus flux from prescribed burning was no greater than three years phosphorus loss from litter decay, even if no phosphorus, other than initial leaching losses, was mineralized during decay.

CONCLUSIONS. Nutrient fluxes from decomposing leaf litter represented important pathways for nutrient recycling in these nutrient-poor forests. The amount of nitrogen immobilized during the first year of decay was similar to precipitation input; thus, no decrease in levels of available nitrogen in the soil was likely to occur. Calcium immobilization exceeded atmospheric input by 2.3 fold, so leaf litter was a significant sink for available calcium. Phosphorus, magnesium, and potassium were mineralized at rates equivalent to, or greater than, those supported by bulk precipitation or periodic prescribed burning. Longer-term studies of decomposition are necessary to evaluate prescribed burning as a strategy for mobilizing calcium and nitrogen since neither litter decay fluxes or prescribed burning releases could be adequately predicted by this study. While many questions are left open by this study, our results do emphasize the importance of nutrient transfers from leaf litter even in forests where mass loss rates are low. Such fluxes will become more important as man's activities increase the time interval between wildfires.

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## LITERATURE CITED

ABER, J. D. AND J. M. MELILLO. 1982. Nitrogen immobilization in decaying hardwood leaf litter as a function of initial nitrogen and lignin content. Canad. J. Bot. 60: 2263–2269.

AMERICAN PUBLIC HEALTH ASSOCIATION. 1976. Standard Methods for the Examination of Water and Wastewater. 14th ed. Washington. 1193 pp.

BERG, B. AND G. EKBOHM. 1983. Nitrogen immobilization in decomposing needle litter at variable carbon:nitrogen ratios. Ecology 64: 63–67.

BOERNER, R. E. J. 1980. Post-fire mineral cycling and ecosystem stability in the New Jersey Pine Barrens. Ph.D. Thesis, Rutgers University, New Brunswick, NJ. 262 pp.

———. 1981. Forest structure dynamics following wildfire and prescribed burning in the New Jersey Pine Barrens. Amer. Midl. Natur. 105: 321–33.

———. 1982. Fire and nutrient cycling in temperate ecosystems. BioScience 32: 187–192.

———. 1983. Nutrient dynamics of vegetation and detritus following two intensities of fire in the New Jersey Pine Barrens. Oecologia: 59: 129–134.

———. In review. Nutrient fluxes in litterfall and decomposition in four forests along a gradient of soil nutrient availability within a southern Ohio watershed. Canad. J. For. Res.

——— AND R. T. T. FORMAN. 1982. Hydrologic and mineral budgets of New Jersey Pine Barrens upland forests following two intensities of fire. Canad. J. For. Res. 12: 503–510.

BREMNER, J. M. 1965. Inorganic forms of nitrogen. Pages 1179–1237 *in* Methods of Soil Analysis, Part 2. American Society of Agronomy. Madison, WI.

BUCHHOLZ, K., AND H. MOTTO. 1981. Abundance and vertical distribution of mycorrhizae in Plains and Barrens forest soils from the New Jersey Pine Barrens. Bull. Torrey Bot. Club 108: 268–271.

BURNS, P. Y. 1952. Effect of fire on forest soils in the Pine Barren region of New Jersey. Yale Univ. For. Bull. #50. New Haven, CT.

CROMACK, K., JR., AND C. D. MONK. 1975. Litter production, decomposition, and nutrient cycling in a mixed hardwood watershed and a white pine watershed. Pages 609–624 *in* Howell, F. G., J. B. Gentry, and M. H. Smith, eds. Mineral Cycling in Southeastern Ecosystems. National Technical Information Service, Washington.

FAHEY, T. J. 1983. Nutrient dynamics of aboveground detritus in lodgepole pine (*Pinus contorta* subsp. *latifolia*) ecosystems in southeastern Wyoming. Ecol. Monogr. 53: 51–72.

FORMAN, R. T. T. AND R. E. BOERNER. 1981. Fire frequency and the New Jersey Pine Barrens. Bull. Torrey Bot. Club 108: 34–50.

GADGILL, R. L. AND P. D. GADGILL. 1971. Mycorrhiza and litter decomposition. Nature 233: 133.

GOSZ, J. R., G. E. LIKENS, AND F. H. BORMANN. 1973. Nutrient release from decomposing leaf and branch litter in the Hubbard Brook Experimental Forest, N.H. Ecol. Monogr. 43: 173–191.

JENNY, H., S. P. GESSEL, AND F. T. BINGHAM. 1949. Comparative study of decomposition rates of organic matter in temperate and tropical regions. Soil Sci. 63: 419–432.

KEELEY, J. E. AND S. C. KEELEY. 1981. Post-fire regeneration of southern California chaparral. Amer. J. Bot. 68: 524–530.

LAWREY, J. D. 1977. Elemental partitioning in *Pinus resinosa* leaf litter and associated fungi. Mycologia 69: 1121–1128.

LIKENS, G. E. AND F. H. BORMANN. 1970. Chemical analysis of plant tissues from the Hubbard Brook Ecosystem in New Hampshire. Yale Univ. For. Bull. #79. New Haven, CT.

LITTLE, S. A., AND H. A. SOMES. 1961. Prescribed burning in the pine regions of southern New Jersey and eastern shore Maryland. U.S.D.A. Forest Service, N.E. Forest Experiment Sta. Paper #151. Upper Darby, PA. 12 pp.

LOUSIER, J. D. AND D. PARKINSON. 1978. Chemical element dynamics in decomposing leaf litter. Canad. J. Bot 56: 2795–2812.

LUTZ, H. J. AND R. F. CHANDLER, JR. 1946. Forest Soils. J. Wiley and Sons, Inc., New York. 514 pp.

MACLEAN, D. A. AND R. W. WEIN. 1978. Weight loss and nutrient changes in decomposing litter and forest floor material in New Brunswick forest stands. Canad. J. Bot. 56: 2730–2749.

MARKLEY, M. L. 1979. Soil series of the Pine Barrens. Pages 81–93 *in* R. T. T. Forman, ed. Pine Barrens: Ecosystem and Landscape. Academic Press, New York.

MEENTEMEYER, V. 1978. Macroclimate and lignin control of decomposition rates. Ecology 59: 465–472.

PATRICK, R., B. MATSON, AND L. ANDERSON. 1979. Streams and lakes in the Pine Barrens. Pages 169–194 *in* R. T. T. Forman, ed. Pine Barrens: Ecosystem and Landscape. Academic Press, New York.

RAISON, R. J. 1979. Modification of the soil environment by vegetation fires, with particular reference to nitrogen transformations. Plant Soil 51: 73–108.

ROBICHAUD, B. AND M. F. BUELL. 1973. Vegetation of New Jersey. Rutgers Univ. Press, New Brunswick, NJ. 340 pp.

TEDROW, J. C. F. 1952. Soil conditions in the Pine Barrens of New Jersey. Bartonia 26: 28–35.

THOMAS, W. A. 1968. Decomposition of loblolly pine needles with and without the addition of dogwood leaves. Ecology 49: 568–571.

VAN SOEST, P. J. 1963. Use of detergents in the analysis of fibrous feeds: II. A rapid method for the determination of fiber and lignin. J. Assoc. Off. Anal. Chem. 49: 546–551.

WIEDER, R. K. AND G. E. LANG. 1982. A critique of the analytical methods used in examining decomposition data obtained from litter bags. Ecology 63: 1636–1642.

YOUNT, J. D. 1975. Forest floor nutrient dynamics in southern appalachian hardwood and white pine plantation ecosystems. Pages 598–608 *in* F. G. Howell, J. B. Gentry, and M. H. Smith, eds. Mineral Cycling in Southeastern Ecosystems. National Technical Information Service, Washington.

Bartonia No. 50: 21–22, 1984

# The Rediscovery of *Oxypolis canbyi* on the Delmarva Peninsula

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In August of 1867, William Canby discovered a new species of *Oxypolis* which was subsequently described and named *O. canbyi* (Coulter and Rose) Fern. in his honor (Fernald 1939). Kral (1981) and Tucker et al. (1983) have recently reaffirmed the distinctness of the species. The only known locality for Canby's collections were "meadows and bogs at Ellendale, Sussex County, Delaware" (Tatnall 1946). Over the next 27 years, 5 collections were made from this site. The last collection was by Canby in August, 1894. Since that time, no other Delaware populations have been reported, and, in fact, it was presumed "extinct" on the Delmarva (Fernald 1950). The Ellendale area was subsequently ditched and drained, destroying most of the unusual wetlands there.

On August 19, 1982, nearly a century later, we located a small population of this endangered umbellifer in a sphagnous intermittent wetland on the Eastern Shore of Maryland, the first record for the state. We were conducting a rare plant inventory of the seasonally flooded wetlands (termed "ponds" or "bays") that pock the countryside in the Maryland/Delaware area.

We counted 36 individual plants (33 in flower) in this wetland, which is dominated by *Carex walteriana,*[1] *Cladium mariscoides* and *Panicum hemitomon*. Other associate herbaceous plants found here include *Sagittaria engelmanniana, Panicum verrucosum, P. longifolium, Erianthus giganteus, Eleocharis microcarpa, E. melanocarpa, Juncus canadensis, Hypericum adpressum, H. virginicum, Ludwigia sphaerocarpa, Proserpinaca pectinata*, and *Utricularia geminiscapa*. The dominant shrub in this wetland is Buttonbush (*Cephalanthus occidentalis*), though growing only in a few small patches. An occasional Red Maple (*Acer rubrum*), Sweetgum (*Liquidambar styraciflua*), and Persimmon (*Diospyros virginiana*) add to the savanna-like appearance of this habitat. A specimen voucher of *Oxypolis canbyi* will be deposited in the Norton-Brown Herbarium in College Park, Maryland.

R. M. Harper discovered a Georgia station for *Oxypolis canbyi* in 1901, the first population found outside of Delaware. Since then, it has been collected in 4 counties in Georgia and 5 counties in South Carolina (Robinson 1982). However, most records are historic and do not represent extant populations. There are only two extant pop-

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[1] All scientific names are according to Fernald (1950).

ulations known for South Carolina (Doug Rayner, pers. comm. 1982) and only 3–4 different localities seen recently in Georgia.

Undoubtedly, a major reason for the scarcity of *Oxypolis canbyi* is the loss of its habitat. Kral (1981) explains:

> This plant is seriously endangered in that much of its original habitat has been, or is being, destroyed. The shallow flatwoods ponds and low pineland savanna which are its best habitat are being ditch-drained, then bulldozed and converted to lowland pasture, to row crops (usually soy beans) or to pine plantations . . . .

Godfrey and Wooten (1979) express similar sentiments about the plight of the intermittent wetlands of the southeastern United States (south of Virginia). Fernald (1937) lamented the destruction of bogs and other inland wetlands found on the Coastal Plain of Virginia. He writes about the "ruinous ditching":

> It is certainly a pity that Man so selfishly or shortsightedly is bent on spoiling the treasures which future generations must do without; but in eastern Virginia he is doing just what he does everywhere else, looking upon his temporary profits as outweighing all else.

We have witnessed the same patterns of destruction to these unusual wetlands in Maryland, Delaware, and New Jersey, where at least four additional candidate endangered species and many nationally-rare plant species are known to occur.

The U.S. Fish and Wildlife Service lists *Oxypolis canbyi* as a Category 1 candidate Endangered Species (Arnett 1983). Unfortunately this designation affords no legal protection for the plant. The current status of *Oxypolis canbyi*, as well as the high degree of threat to its habitat, indicates that this species is in danger of extinction if steps are not taken to protect it.

## Literature Cited

Fernald, M. L. 1937. Local plants of the inner coastal plain of southeastern Virginia. Rhodora 39: 321–366.

———. 1939. *Oxypolis canbyi* (Coult, & Rose), comb. nov. Rhodora 41: 139.

———. 1950. Gray's Manual of Botany. 8th ed. American Book Co., New York.

Godfrey, R. K., and J. W. Wooten. 1979. Aquatic and Wetland Plants of Southeastern United States: Monocotyledons. University of Georgia Press, Athens.

Kral, R. 1981. Notes on some "quill"-leaved umbellifers. Sida 9: 124–134.

Arnett, G. R. 1983. Endangered and threatened wildlife and plants; supplement to review of plant taxa for listing as endangered or threatened species. Federal Register 48: 53640–53670.

Robinson, A. F. 1982. Endangered and Threatened Species of the Southeastern United States including Puerto Rico and the Virgin Islands. U.S. Forest Service, Atlanta.

Tatnall, R. R. 1946. Flora of Delaware and the Eastern Shore: An annotated list of the ferns and flowering plants of the peninsula of Delaware, Maryland, and Virginia. The Society of Natural History of Delaware.

Tucker, A. O., N. H. Dill, T. D. Pizzolato, and R. D. Kral. 1983. Nomenclature, Distribution, Chromosome Numbers, and Fruit Morphology of *Oxypolis canbyi* and *O. filiformis* (Apiaceae). Systematic Botany 8: 299–304.

Authors' note. Because this present population is small, the authors do not wish to divulge its location. Also, the landowners voluntarily agreed to protect this site on the condition that there be no visitors.

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# *Scirpus triqueter* Established Along Tidal Portions of the Columbia River System

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*Scirpus triqueter* L., a widely distributed Eurasion aquatic bulrush (DeFilipps 1980; Koyama 1958) was found growing in freshwater portions of the intertidal zone of the Columbia River by Brian Lightcap in August 1981 while investigating dredged disposal islands. At Columbia River mile 50.9, it was discovered in abundance on Eureka Bar, a sixty-acre dredge material disposal island created on an intermittently exposed sand shoal. Here it is interspersed and hybridizing with *Scirpus tabernaemontanii* Gmel. (*Scirpus validus* Vahl). Extensive robust stands of *S. triqueter* were also found at Columbia River mile 46 (the upstream tip of Puget Island) and mile 48 (the downstream tip of Wallace Island). Along the Clatskanie River, which joins the Columbia River behind Wallace Island at river mile 50, *S. triqueter* occurred along marshy shoreline zones and adjacent sloughs for a distance of about four miles near its mouth. These plants were circa 1-2 decimeters shorter than those found on Wallace Island and were reproductively immature when observed on 9 September 1982.

It is possible that *Scirpus triqueter* was introduced by the Corps of Engineers via hopper dredges used in the Pacific during World War II, the Korean War, and the Vietnam War. A substantial amount of dredged material was discharged at Eureka Bar in 1950, 1952, and 1953. It is equally plausible that achenes were introduced many years ago along with ship ballast water, since there are numerous international cargo and grain ports on the Columbia from Kelso, Washington, to Portland.

The mechanisms of spread of *S. triqueter* and its impact on Columbia River flora (e.g., whether or not it has significantly displaced native flora) are not known. However our overall knowledge of this flora is increasing and a brief description of present plant associations, succession, and water regimes in this part of the river is part of an environmental analysis and field report of dredging impacts on wetlands in the Columbia River (Lightcap, unpublished). A comprehensive Corps study of riparian habitats also provides data on plant species endemic to the Columbia River (Tabor and Meslow 1976).

Hybridization with *S. tabernaemontanii* presumably occurred after *S. triqueter* was introduced into the Columbia River system, although we can't be sure of this because of the worldwide distribution of *S. tabernaemontanii*. Similar hybrids are reported from Europe (Ascherson und Graebner 1898; Bakker 1968; Druce 1924; Junge 1905) where they were most recently treated as *Scirpus* × *scheuchzeri* Bruegg. (Bakker 1968). In the Netherlands, hybrids have been found in several localities in tidal freshwater areas where apparently they are fertile and forming hybrid swarms (Bakker 1968). The well-developed achenes of the Columbia River hybrids indicate these plants are fertile too. As is the case of *S. triqueter,* we do not know how these hybrids are spreading or what their impact is on native flora. Whether or not the hybrids are reproducing sexually and backcrossing with the parents are questions that remain to be answered.

## Literature Cited

Ascherson, P. und P. Graebner. 1898–1899. Flora des Nordostdeutschen Flachlandes (ausser Ostpreussen). Gebrüder Borntraeger, Berlin. xii + 875 pp.

Bakker, D. 1968. *Scirpus lacustris* L. ssp. *glaucus* (Sm.) Hartm. × *Scirpus triqueter* L. (*S.* × *scheuchzeri* Bruegg.) in Nederland. Gorteria 4: 76–79.

DeFilipps, R. A. 1980. 1. Scirpus L. Pages 277–280 *in* T. G. Tutin et al., eds. Flora Europaea, vol. 5, Alismataceae to Orchidaceae (Monocotyledones). Cambridge University Press, Cambridge. xxxvi + 452 pp.

Druce, G. C. 1924. Plant notes, etc. for 1923. 2535. *Scirpus Tabernaemontani* × *triqueter* = *S. arunensis* mihi. Bot. Soc. Exch. Club Brit. Isles 7: 68.

Junge, P. 1905. Beiträge zur Kenntnis der Gefässpflanzen Schleswig-Holsteins. Mitt. Bot Staatsinst. Hamburg 47–108.

Koyama, T. 1958. Taxonomic study of the genus *Scirpus* Linné. J. Fac. Sci. Univ. Tokyo, Sect. 3, Bot. 7: 271–366.

Lightcap, B. W. Unpublished. An Environmental analysis on the historical impacts of dredged material disposal on wetlands in the Columbia River. U.S. Army Corps of Engineers, Portland District (January 1984).

Tabor, J. E. and E. C. Meslow. 1976. Inventory of riparian habitats and associated wildlife and the Columbia River, vol. 2A. U.S. Army Corps of Engineers, North Pacific Division.

Bartonia No. 50: 25–26, 1984

# *Cleome ornithopodioides* (Capparaceae): Adventive and Spreading in North America

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On 28 June 1982 in the railroad yard at Silver Grove, Campbell County, Kentucky, we collected specimens of a member of the Capparaceae that was quite unknown to us. The plants were taken from a colony of about 25 individuals and were growing intermingled with another Capparacea, *Polanisia graveolens*, the odor and "cool," clammy feel of which they mimicked. After some struggle with literature and study of exsiccata, we determined our plant to be *Cleome ornithopodioides* L., a Eurasian species first reported for North America by Reed (1965). His specimens came from a vanadium slag pile at Canton, Baltimore, Maryland. Eleven years later, Browne and Athey (1976) included the species in a paper on new or rare plants in western Kentucky. Their specimens, representing a taxon new to the state, were collected on chrome ore piles, Calvert City, Marshall County, about 250 miles southwest of our Campbell County site.

In addition to the Maryland and Kentucky records, we here note a Pennsylvania collection: Mercer County, 2 miles west of Harrisville, *L. K. Henry s.n.*, 14 Sep 1957 (WIS). The species is not accounted for in Wherry, Fogg, and Wahl's (1979) Pennsylvania atlas.

In spite of the 1965 and 1976 reports of the species, *C. ornithopodioides* is not mentioned in the Kartesz and Kartesz (1980) checklist of the flora of the United States, Canada, and Greenland. However, it is listed (as *C. "ornithopoides"*) in the USDA Soil Conservation Service (1982) *National List of Scientific Plant Names*.

The Old World range of the birdfoot cleome is, according to *Flora Europaea* (Chater 1964), "S.E. Europe, from Athos to the Lower Don." The *Flora of Turkey* (Coode and Cullen 1965) gives the range as "Balkans, Caucasia, Iran, Cyprus; Lebanon?." The *Flora of the U.S.S.R.* (Bobrov 1970) adds "east Afghanistan." The species, the lectotype species of its genus, was originally described from the environs of Istanbul.

The gynophore of our Kentucky plants is ca. 1–1.5 mm long, which makes them neither var. *stipitata* Boiss. (gynophore 2–10 mm long) nor var. *sessilis* Boiss. (fruits sessile) (Bobrov 1970). Cullen and Coode (1965) discussed variation in *C. ornithopodioides*, concluding that the species is highly variable and that the recognition of infraspecific taxa is not supported by their data.

From the 17 species of *Cleome* previously known in the conterminous United States, *C. ornithopodioides* may be distinguished by its combination of the following features: annual; leaves trifoliolate; inflorescence a raceme with simple bracts; petals white and small (3–4 mm long); stamens 6; gynophore short (1–1.5 mm long); and pedicels and fruits outwardly and downwardly arching.

The species was still present in the Campbell County railroad yard in June 1983, when we located two populations, each of about 20 individuals. To aid other collectors in the recognition of this distinctive taxon, which certainly can be expected to spread further, we include the following description, based primarily on our Kentucky specimens but slightly supplemented with pertinent data from the literature.

Glandular pubescent, erect annual, simple or branched, to 60 cm tall. Leaves trifoliolate (or the very uppermost rarely simple), gradually reduced upward and passing insensibly into bracts; leaflets linear to narrowly oblong- or elliptic-lanceolate, 0.6–3.5 cm long, 0.5–6 mm wide; petioles 0.6–2 cm long. Inflorescene a bracteate raceme, the internodes elongating as the fruits mature, with up to 60 flowers; pedicels 10 mm long in flower, to 18 mm long in fruit; bracts reduced upwards, simple (the lowermost very rarely trifoliolate), the lowermost to 14 mm long and nearly as long as the pedicels, the uppermost as short as 2 mm and 1/5 as long as the pedicels. Sepals 4, equal, 1.5 mm long, 1 mm wide, elliptic; petals 4, subequal, white, usually denticulate, 3–4 mm long (including the claw), 1.8–2 mm wide, the blade broadly elliptic, the claw 1 mm long; stamens 6, subequal, the filaments 4–5 mm long, the anthers 0.8–0.9 mm long. Fruits outwardly and downwardly arching, torulose, to 3.8 cm long and 1.8 mm wide, the gynophore 1–1.5 mm long; seeds 4–18, colliculate, mottled black and khaki, 1.5–1.8 mm long.

Our Kentucky voucher for *C. ornithopodioides* (*Thieret & Thompson 53500*) is deposited at KNK; duplicates have been sent to NCU, NY, PH, and WIS.

## Literature Cited


Bobrov, E. G. 1970. Capparidaceae. Pages 3–13 *in* V. L. Komarov, chief ed. Flora of the U.S.S.R. Vol. 8. English translation of a work first published in 1939. Israel Program for Scientific Translation, Jerusalem.

Browne, E. T., Jr. and R. Athey. 1976. Herbarium and field studies of Kentucky plants. III. New or rare flowering plants in western Kentucky. Jour. Elisha Mitchell Sci. Soc. 92: 104–109.

Chater, A. O. 1964. *Cleome* L. Page 259 *in* T. G. Tutin et al., eds. Flora Europaea. Vol. 1. University Press, Cambridge.

Coode, M. J. E. and J. Cullen. 1965. *Cleome* L. Page 498 *in* P. H. Davis, ed. Flora of Turkey and the East Aegean Islands. Vol. 1. University Press, Edinburgh.

Cullen, J. and M. J. E. Coode. 1965. Capparaceae. Pages 197–198 *in* P. H. Davis et al. Materials for a flora of Turkey: X. Notes Roy. Bot. Gard. Edinburgh 26: 165–201.

Kartesz, J. T. and R. Kartesz. 1980. A synonymized checklist of the vascular flora of the United States, Canada, and Greenland. University of North Carolina Press, Chapel Hill. 498 pp.

Reed, C. F. 1965. *Cleome ornithopodioides* L. on vanadium-slag at Canton, Baltimore, Maryland with notes on the biochemistry of vanadium. Phytologia 11: 423–431.

USDA Soil Conservation Service. 1982. National list of scientific plant names. Vol. 1. 416 pp.

Wherry, E. T., J. M. Fogg, and H. A. Wahl. 1979. Atlas of the flora of Pennsylvania. The Morris Arboretum, Philadelphia. 390 pp.

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# The Flora of Bull Island, Charleston County, South Carolina

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Bull Island is a Holocene beach ridge island which is the largest of four islands that comprise the Cape Romain National Wildlife Refuge. It is located in Charleston County, South Carolina, 21 miles northeast of Charleston. Like many of the islands in the Sea Island Region of South Carolina, Bull Island is vegetated by maritime forests that are flanked by dunes on their ocean-facing side and extensive salt marshes on their sheltered landward side. The island, encompassing 5200 acres, has a variety of habitats which support three major plant communities: the salt marsh community, the live oak-laurel oak forest community, and sand dune community. Two minor communities, the freshwater marsh and shrub community, are also present.

THE SALT MARSH COMMUNITY. The salt marsh vegetation on Bull Island resembles that of other South Carolina barrier islands and the southeastern United States (Duncan 1974). *Iva frutescens* occupies an area infrequently flooded at high tide. *Spartina patens* grows above and below *Iva frutescens*. This species is restricted to a narrow infrequently flooded salt marsh fringe or is an occasional occupant of coastal dunes at Bull Island. Below the *Iva* zone, *Borrichia frutescens* forms a belt of gold and green. Next, a mosaic of *Salicornia, Limonium, Spartina alterniflora, Distichlis spicata,* and *Atriplex areneria* occupy only a slight elevation gradient, usually a foot or less (Kurz and Wagner 1957; Stalter 1968). *Batis maritima* also grows with these species and reaches its northern limit at Bull Island. Below this mosaic of species occurs a stand of pure dwarf *Spartina alterniflora*, and then a pure stand of tall *S. alterniflora*. Inundation at the lowest fringe of this zone may be as long as 14 hours per day (Stalter 1968).

THE LIVE OAK-LAUREL OAK FOREST. The most important components of the live oak-laurel oak forest are *Quercus virginiana* and *Quercus laurifolia* (Table 1). *Polystichum acrostichoides* can usually be found on *Q. virginiana, Q. laurifolia,* and *Magnolia grandiflora*. In areas ravaged by hurricanes (1893, 1954), *Pinus taeda* is dominant. The shrub stratum consists of *Myrica cerifera, Ilex vomitoria, Xanthoxylum clava-herculis, Rhus copallina,* and *Callicarpa americana*. The herbaceous stratum includes *Uniola laxa, Elephantopus, Galium hispidulum, Rubus trivialis, Hypericum stans, Paspalum, Panicum,* and *Oplismenus*.

THE SAND DUNE COMMUNITY. *Uniola paniculata* is the dominant plant of the dune community. Other important dune associates include *Salsola kali, Heterotheca subaxillaris, Spartina patens, Panicum amarum,* and *Iva imbricata*. These species thrive on the front and top of the first ocean-facing dune. Beach erosion, especially at the east northeast end of the island, is severe. Sun bleached skeletons of live oak washed daily by the tides are evidence of this. On the east southeast portion of the island, a live oak forest of *Quercus virginiana* grows up to the crest of the first line of dunes. In most portions of the island, the dunes are gradually encroaching upon the live oak forest.

TABLE 1. Frequency (F), relative frequency (RF), density (D), relative density (RD), basal area (BA), relative dominance (RD), and importance value (IV) for arborescent species greater than 3″ DBH (7.6 cm DBH) at Bull Island, South Carolina.

| Species | F | RF | D | RD | BA | RD | IV |
|---|---|---|---|---|---|---|---|
| *Quercus virginiana* | 60 | 16 | .80 | 16 | 18,852 | 35 | 67 |
| *Pinus taeda* | 35 | 9 | .55 | 11 | 16,634 | 31 | 51 |
| *Quercus laurifolia* | 55 | 15 | .80 | 16 | 7,170 | 13 | 44 |
| *Ilex opaca* | 65 | 18 | 1.00 | 19 | 1,687 | 3 | 40 |
| *Sabal palmetto* | 45 | 12 | .55 | 11 | 3,061 | 6 | 29 |
| *Liquidambar styraciflua* | 35 | 9 | .60 | 12 | 2,492 | 5 | 26 |
| *Magnolia grandiflora* | 35 | 9 | .40 | 8 | 2,238 | 4 | 21 |
| *Persea borbonia* | 30 | 8 | .35 | 7 | 363 | 1 | 16 |
| *Nyssa biflora* | 10 | 3 | .10 | 2 | 1,080 | 2 | 7 |

FRESHWATER MARSH. The freshwater marshes and impoundments contain a variety of species peculiar to each area. Some of the marsh areas are slightly saline. The most common genera include *Nymphaea, Cladium, Scirpus, Lippia, Azolla, Spirodela, Utricularia, Typha, Kosteletskya,* and *Rumex.*

SHRUB COMMUNITY. The shrub community exists above the fringe of the salt marsh and occasionally borders the dune community and freshwater ponds. In the open level areas above the fringe of the salt marsh, several species of *Baccharis, Myrica cerifera, Ilex vomitoria* and *Rhus copallina* exist. These shrubs and associated lianas often form a nearly impenetrable mass of vegetation. The most common vines associated with the shrubs include *Ampelopsis arborea, Vitis rotundifolia, Toxicodendron radicans, Berchemia scandens, Lonicera japonica, Smilax spp., Parthenocissus quinquefolia,* and *Passiflora lutea.*

## LIST OF SPECIES

Two plants of each species were collected from August 1973 to October 1975. The plants are on deposit at the herbarium at The Citadel in Charleston, South Carolina, and at St. John's University, Jamaica, New York. The species list includes 85 families, 268 species, and 10 new records for Charleston County. Nomenclature and arrangement of species in this paper follow Radford et al. (1968) in most cases.

### PTERIDOPHYTES

ASPIDIACEAE: *Dryopteris ludoviciana, Onoclea sensibilis.* ASPLENIACEAE: *Asplenium platyneuron.* AZOLLACEAE: *Azolla caroliniana.* OSMUNDACEAE: *Osmunda regalis* var. *spectabilis.* POLYPODIACEAE: *Polypodium polypodioides.* PTERIDACEAE: *Pteridium aquilinum.*

### GYMNOSPERMS

CUPRESSACEAE: *Juniperus silicicola.* PINACEAE: *Pinus taeda.*

### ANGIOSPERMS

AMARANTHACEAE: *Amaranthus pumilus, Amaranthus viridis.* AMARYLLIDACEAE: *Crinum bulbispermum, Hymenocallis crassifolia.* ANACARDIACEAE: *Rhus copallina,* *Toxicodendron radicans, Toxicodendron toxicarium.* APIACEAE: *Centella asiatica, Hydrocotyle bonariensis, Hydrocotyle umbellata, Hydrocotyle verticillata, Sanicula canadensis.* AQUIFOLIACEAE: *Ilex opaca, Ilex vomitoria.* ARALIACEAE: *Aralia spinosa, Hedera helix.* ARECACEAE: *Sabal palmetto.* ASCLEPIADACEAE: *Cynanchum palustre.* ASTERACEAE: *Ambrosia artemisiifolia, Aster carolinianus, Aster subulatus, Aster tenuifolius, Baccharis angustifolia, Baccharis glomeruliflora, Baccharis halimifolia, Bidens bipinnata, Borrichia frutescens, Carduus spinosissimus, Chaptalia tomentosa, Elephantopus carolinianus, Elephantopus tomentosus, Erechtites hieracifolia, Erigeron canadensis, Erigeron quercifolius, Eupatorium capillifolium, Eupatorium hyssopifolium, Eupatorium leucolepis, Gnaphalium obtusifolium, Gnaphalium purpureum* var. *americanum, Haplopappus divaricatus, Helenium amarum, Heterotheca subaxillaris, Hieracium gronovii, Iva frutescens, Iva imbricata, Lactuca graminifolia, Mikania scandens, Pluchea foetida, Pyrrhopappus carolinianus, Solidago sempervirens, Solidago tenuifolia.* BATACEAE: *Batis maritima.* BIGNONIACEAE: *Anisostichus capreolata, Campsis radicans, Catalpa* sp. BORAGINACEAE: *Heliotropium curassavicum.* BRASSICACEAE: *Cakile harperi, Lepidium virginicum.* BROMELIACEAE: *Tillandsia usneoides.* CACTACEAE: *Opuntia compressa, Opuntia drummondii.* CAPRIFOLIACEAE: *Lonicera japonica.* CHENOPODIACEAE: *Atriplex patula, Chenopodium album, Salicornia bigelovii, Salicornia virginica, Salsola kali, Suaeda linearis.* CISTACEAE: *Lechea villosa.* CONVOLVULACEAE: *Ipomoea sagittata.* CYPERACEAE: *Carex dasycarpa, Carex gigantea, Cladium jamaicense, Cyperus psuedovegetus, Dichromena latifolia, Eleocharis* spp., *Fimbristylis spadicea, Rhynchospora cephalantha, Scirpus pungens, Scirpus robustus, Scirpus validus, Scleria triglomerata.* DIOSCOREACEAE: *Dioscorea villosa.* EUPHORBIACEAE: *Acalypha gracilens, Croton glandulosus* var. *septentrionalis, Croton punctatus, Euphorbia maculata, Euphorbia polygonifolia, Sapium sebiferum.* FABACEAE: *Apios americana, Cassia fasciculata, Centrosema virginianum, Desmodium spp., Erythrina herbacea, Galactia volubilis, Glottidium vesicarium, Lespedeza* sp., *Strophostyles helvola, Wisteria frutescens.* FAGACEAE: *Quercus laurifolia, Quercus nigra, Quercus pumila, Quercus virginiana.* HALORAGACEAE: *Myriophyllum* sp. HAMAMELIDACEAE: *Liquidambar styraciflua.* HYPERICACEAE: *Hypericum stans.* JUGLANDACEAE: *Carya aquatica, Carya illinoensis.* JUNCACEAE: *Juncus acuminatus, Juncus roemerianus.* LAMIACEAE: *Monarda punctata, Salvia lyrata, Teucrium canadense.* LAURACEAE: *Persea borbonia.* LEMNACEAE: *Spirodela polyrhiza.* LENTIBULARIACEAE: *Utricularia* sp. LILIACEAE: *Allium bivalve, Smilax auriculata, Smilax bona-nox, Smilax laurifolia, Smilax rotundifolia, Yucca filamentosa.* LOGANIACEAE: *Polypremum procumbens.* MAGNOLIACEAE: *Magnolia grandiflora.* MALVACEAE: *Kosteletskya virginica, Sida rhombifolia.* MELIACEAE: *Melia azedarach.* MORACEAE: *Morus rubra.* MYRICACEAE: *Myrica cerifera.* NYMPHAEACEAE: *Nymphaea* sp. NYSSACEAE: *Nyssa sylvatica* var. *biflora.* OLEACEAE: *Ligustrum japonicum, Osmanthus americana.* ONAGRACEAE: *Gaura* sp., *Gaura filipes, Ludwigia alternifolia, Oenothera biennis, Oenothera humifusa, Oenothera laciniata.* OXALIDACEAE: *Oxalis dillenii.* PASSIFLORACEAE: *Passiflora lutea.* PHYTOLACCACEAE: *Phytolacca americana.* PLUMBAGINACEAE: *Limonium carolinianum, Limonium nashii.* POACEAE: *Andropogen ternarius, Andropogon virginicus, Arundinaria gigantea, Arundo donax, Cenchrus longispinus, Cenchrus tribuloides, Cynodon dactylon, Digitaria sanguinalis, Distichlis spicata, Eleusine indica, Elymus virginicus, Erianthus* sp., *Muhlenbergia capillaris, Oplismenus setarius, Panicum amarum, Panicum anceps* var. *rhizomatum, Panicum dichotomum, Panicum virgatum, Paspalum boscianum, Paspalum dilatatum, Pas-*

*palum setaceum, Setaria geniculata, Setaria magna, Sorghum halepense, Spartina alterniflora, Spartina patens, Sporobolus poiretii, Sporobolus virginicus, Stenotaphrum secundatum, Tripsacum dactyloides, Uniola laxa, Uniola paniculata.* POLYGONACEAE: *Polygonum aviculare, Polygonum hydropiperoides, Polygonum setaceum, Rumex verticillatus.* RHAMNACEAE: *Berchemia scandens.* ROSACEAE: *Prunus angustifolia, Prunus caroliniana, Prunus serotina, Rubus trivialis.* RUBIACEAE: *Diodia teres, Diodia virginiana, Galium tinctorium, Houstonia procumbens, Mitchella repens.* RUTACEAE: *Xanthoxylum clava-herculis.* SALICACEAE: *Salix nigra.* SCROPHULARIACEAE: *Bacopa monnieri, Linaria canadensis.* TAMARICACEAE: *Tamarix gallica.* TYPHACEAE: *Typha angustifolia, Typha domingensis.* ULMACEAE: *Ulmus americana.* URTICACEAE: *Boehmeria cylindrica.* VERBENACEAE: *Callicarpa americana, Lippia lanceolata, Lippia nodiflora* VITACEAE: *Ampelopsis arborea, Parthenocissus quinquefolia, Vitis aestivalis, Vitis rotundifolia.*

## Acknowledgments

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## Literature Cited

DUNCAN, W. H. 1974. Vascular halophytes of the Atlantic and Gulf coasts of North America north of Mexico. Pages 23–50 *in* R. J. Reimold and W. H. Queen, eds., Ecology of halophytes. Academic Press, New York.

KURZ, H. AND K. WAGNER. 1957. Tidal marshes of the Gulf and Atlantic coasts of northern Florida and Charleston, South Carolina. Florida State Univ. Stud. No. 24, 168 pp.

RADFORD, A. E., H. E. AHLES, AND C. R. BELL. 1968. Manual of the vascular flora of the Carolinas. University of North Carolina Press, Chapel Hill.

STALTER, R. 1968. An ecological study of a South Carolina salt marsh. Unpublished Ph.D dissertation. 63 pp.

Bartonia No. 50: 31–35, 1984

# Rare Sedges Discovered and Rediscovered in Delaware[1]

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Throughout the history of Delaware field botany, lack of study and undercollection have characterized members of the sedge family (Cyperaceae). An example of the neglected study and current lack of knowledge of Delaware Cyperaceae is the fact that Tucker et al. (1979) list the status of all but 2 of the 67 considered sedge taxa as "undertermined." To help remedy this neglect, notes on 20 rare sedge species found in 1983 are given below. Included are 3 new state records and 5 new county records. Unless mentioned otherwise, all localities are new stations for each species. Voucher specimens of all species except numbers 19, 20, and the second locality listed under number 5 are deposited in the Claude E. Phillips Herbarium at Delaware State College. Duplicate vouchers of numbers 4, 9, 11, 13, 15, 16, and 17 are deposited at the Academy of Natural Sciences of Philadelphia. The nomenclature follows Fernald (1950) for the most part; if a different name is used, the one from Fernald follows in parentheses.

**1. Carex amphibola**

New Castle Co.: N of Rockland, rocky woods above Brandywine Creek, 7 Jun 1983, *Naczi 215*.

Only a few plants were seen of this sedge which Tatnall (1946) lists as "rare" with the last collection in 1927.

**2. Carex collinsii**

Sussex Co.: N of Milton, sphagnous *Chamaecyparis* swamp, 29 Jun 1983, *Naczi 263*.

Last collected in 1937, this species was quite abundant at this site and grew with two other Delaware rare plants, *Sarracenia purpurea* and *Drosera rotundifolia*. One factor contributing to the rarity of the sedge is the fact that its preferred habitat, Atlantic White Cedar swamps, is uncommon in Delaware.

**3. Cyperus amuricus (microiria)**

Sussex Co.: E of Georgetown, wet sandy soil, 25 Aug 1983, *Naczi 342*.

A small population of this plant was growing at the base of a sand mound in a sand and gravel storage yard. Tatnall (1946) does not list this species which is adventive from Asia and Fernald (1950) records it no farther south than eastern Pennsylvania. Thus this specimen is apparently a new Delaware record extending the species' known United States range south to Delaware.

**4. Cyperus brevifolioides (brevifolius)**

New Castle Co.: S of Claymont along the Delaware River, gravelly mud in intertidal zone near high tide limit, 4 Sep 1983, *Naczi 343*.

In the Philadelphia area, *C. brevifolioides* Thier. & Delahous. is nearly restricted to intertidal zones (Ferren and Schuyler 1980). In the Delaware River intertidal zone just south of Claymont, I found it growing abundantly with *Panicum virgatum* within a

[1] Contribution No. 3 from the Claude E. Phillips Herbarium.

small area. This site is probably at or near the southern limit of the species in the Delaware's immediate tidal marshes because the river becomes more saline downstream.

Although Gleason (1952) includes Delaware in the range of this sedge (under the name *C. brevifolius*), efforts to locate a Delaware specimen which Gleason may have seen in the New York Botanical Garden's herbarium were unsuccessful. Tatnall does not list this plant nor do Delahoussaye and Thieret (1967) cite any Delaware specimens among the New World specimens they examined. Ferren and Schuyler (1980) record this species no farther south in the Delaware River system than South Philadelphia. Thus this record apparently extends the known range of *C. brevifolioides* south in the Delaware River system to Delaware. This sedge is probably an introduction from eastern Asia (Ferren and Schuyler 1980) and may be spreading.

**5. Cyperus retrofractus**

Kent Co.: N of Houston, dry woods, 10 Aug 1983, *Naczi and Seyfried;* Choptank Mills, sandy clearing in pine woods, 5 Sep 1983.

North of Houston, Nancy E. Seyfried and I collected this species from a small population of scattered plants in barren woods. At Choptank Mills one plant was observed. Tatnall records this species as rare, with the last Delaware collection in 1945 at Choptank Mills, his only Delaware station.

**6. Eleocharis brittonii**

Sussex Co.: Ellendale, moist sandy soil at edge of shallow ditch, 8 Oct 1983, *Naczi 370A*.

A single plant of this spike rush was first detected growing with *Eleocharis microcarpa* and *E. tuberculosa* on 25 August. On 8 October, Drs. Dill, Schuyler, Tucker, and I scoured the habitat for more plants of *E. brittonii*, but to no avail.

Tatnall does not record *E. brittonii*. This species apparently reaches the northern limit of its range in southeastern North Carolina except for one disjunct population in southern Cape May County, New Jersey (Snyder and Vivian 1981). The Delaware locality is just south of the New Jersey one. There is an earlier collection of this species from Ellendale (dried-up ditches, 27 Sep 1895, *Commons*) in the herbarium of the Academy of Natural Sciences.

**7. Eleocharis engelmannii**

Sussex Co.: Ellendale, mud of moist shallow ditch, 1 Aug 1983, *Naczi 291A*.

Most plants in the Ellendale population of this sedge were the typical form, but a few plants of f. *detonsa* were among them. Tatnall does not record forms. He regards *E. engelmannii* as "infrequent" and f. *detonsa* is certainly more so.

**8. Eleocharis equisetoides**

Kent Co.: S of Frederica, shallow water of pond, 13 Jul 1983, *Naczi 265*.

This tall spike rush grew abundantly with *E. palustris, E. quadrangulata,* and *Utricularia gibba*. This collection is the first Kent County record and only the third Delaware collection. Tatnall cites an 1874 collection from southern Sussex and Hirst (1983) cites a 1961 collection from the same region.

**9. Eleocharis melanocarpa**

Sussex Co.: Ellendale, moist sandy peaty acid soil at edge of meadow, 13 Jul 1983, *Naczi 275*.

Associated with a large population of this species are *Rhynchospora* spp. and *Lobelia canbyi*. The second of two collections of *E. melanocarpa* in Delaware was in 1908 from Ellendale (Tatnall 1946).

**10. Eleocharis palustris (smallii)**

Kent Co.: S of Frederica, shallow water of pond, 13 Jul 1983, *Naczi 267*.

Plant associates of this spike rush are *E. equisetoides* and *E. quadrangulata*. In this southern Kent County pond, *E. palustris* is the least common of the three spike rushes whereas *E. quadrangulata* is the most common. This specimen constitutes the first Kent County record and the third Delaware collection (Tatnall 1946).

**11. Eleocharis robbinsii**

Sussex Co.: NE of Millsboro, shallow water of pond, 1 Aug 1983, *Naczi 302;* N of Ellendale, shallow water at pond edge, 8 Oct 1983, *Naczi 368*.

At each pond, only small populations of this species were observed, but the plant may be more abundant because neither site was thoroughly explored. This plant, by no means common in Delaware, is at least more common than Tatnall's "rare" label indicates. Including the above-cited specimens, *E. robbinsii* has been collected from at least 7 localities in Delaware (Williamson 1909; Tatnall 1946; Hirst 1983).

**12. Fuirena pumila**

Kent Co.: S of Frederica, wet sandy soil of roadside ditch, 8 Oct 1983, *Naczi 361*.

Growing with *Cyperus flavescens* and *Fimbristylis autumnalis* were a few plants of this sedge which Tatnall lists as infrequent from Sussex County. This collection is apparently the first from Kent County.

**13. Psilocarya nitens**

Sussex Co.: E of Ellendale, moist sandy soil, 25 Aug 1983, *Naczi 330*.

Many depauperate plants (the tallest were only 5 cm high) of this species grew at this site. Although this is the fourth Delaware station (Tatnall 1946; Hirst 1983), collections from two of them were made over 60 years ago.

**14. Psilocarya scirpoides**

Sussex Co.: N of Ellendale, moist sandy clearing, 25 Aug 1983, *Naczi 316*.

Several plants of this bald rush were growing with *Panicum verrucosum, Eleocharis tuberculosa, Rhynchospora* spp., and *Xyris difformis* (*caroliniana*) at the same station where Tatnall had collected it in 1938. Tatnall's collection is the second of two cited Delaware collections.

**15. Rhynchospora cephalantha**

Sussex Co.: Ellendale, acid soil meadow, 1 Aug 1983, *Naczi 294*.

Several plants of this species grew with other beak rushes in a locality from which it has been collected several times, though not recently. Every plant examined was f. *antrorsa*. Apparently this is the more common form since 3 of the 4 Delaware specimens Gale (1944) cites are this form.

**16. Rhynchospora chalarocephala**

Kent Co.: S of Frederica, wet sunny hummocks in a pond, 25 Aug 1983, *Naczi 314;* Sussex Co.: E of Ellendale, moist sandy clearing, 1 Aug 1983, *Naczi 301;* N of Ellendale, moist sandy clearing, 25 Aug 1983, *Naczi 318;* Ellendale, moist sandy soil, 25 Aug 1983, *Naczi 327.*

In each of the above localities, *R. chalarocephala* was growing in moist to wet, acid soil, often with other *Rhynchospora* spp. Tatnall cites one Delaware collection, while Gale (1944) adds another. The Kent County specimen is the first from the county. This beak rush is probably more common in Delaware than previously reported—it may be overlooked because of its superficial resemblance to *R. capitellata,* a much more common species.

**17. Rhynchospora fusca**

Sussex Co.: Ellendale, moist sandy soil, 13 Jul 1983, *Naczi 279.*

A small population of this primarily northern beak rush was growing with *Lycopodium alopecuroides* and other beak rushes. Tatnall cites 3 collections, with the last at Ellendale in 1890. Since Delaware is the southern limit of this species (Fernald 1950) and it has not been collected farther south than Ellendale in over 100 years (Tatnall 1946), this apparently is the southernmost extant population of *R. fusca* in the United States.

**18. Rhynchospora glomerata**

Sussex Co.: SE of Laurel, moist soil of pond margin, 1 Aug 1983, *Naczi 307.*

Associated with *Paspalum floridanum* and *Cyperus pseudovegetus* was a small colony of this tall beak rush. Previously, it has been collected three times in Delaware (last in 1897), which is near its northern limit.

**19. Scirpus subterminalis**

Kent Co.: S of Frederica, shallow water of pond, 25 Aug 1983; Sussex Co.: E. of Ellendale, shallow water of pond, 13 Jul 1983; NE of Millsboro, shallow water of pond, 1 Aug 1983.

Many plants of this aquatic bulrush grew in these ponds of acidic water. Tatnall does not list this plant from Kent County and he states that it has not been collected recently.

**20. Scleria reticularis**

Sussex Co.: Ellendale, moist sandy soil, 1 Aug 1983.

Many plants of this nut rush grew scattered throughout one of the Ellendale meadows. It has been collected at Ellendale, though probably not since 1899 (Tatnall 1946).

## Concluding Remarks

As a result of the 1983 field work in Delaware, two conclusions become evident. First, more field work is necessary to update the knowledge of the distributions and abundance of Delaware's sedge flora. Second, Delaware possesses a diverse sedge flora, of which many species are rare.

The habitats of rare sedges are vulnerable to man's activity, and conservation is vital if the plants are to continue to exist in Delaware. For example, the Ellendale meadows are currently being altered by agriculture and the shoreline of the pond north of Ellendale is being turned into a housing development. If these and other habitats like them vanish, so will many rare plant species, even species having a sole Delmarva Peninsula occurrence.

## Acknowledgments

Drs. Norman H. Dill and Arthur O. Tucker provided advice, encouragement, and help in connection with field and herbarium work. Dr. A. E. Schuyler verified many of my specimens and provided help with field work and herbarium searches, and Dr. Patricia K. Holmgren provided information on *Cyperus brevifolioides* at the New York Botanical Garden. Nancy E. Seyfried botanized with me on two very hot days last summer and gave me information about the habitat of *Cyperus amuricus*. Finally, Frank Hirst gave me the impetus to botanize by pointing out in Bartonia No. 49 that the Delmarva Coastal Plain harbors many rare plants.

## Literature Cited

Delahoussaye, A. J. and J. W. Thieret. 1967. *Cyperus* subgenus *Kyllinga* (Cyperaceae) in the continental United States. Sida 3: 128–136.

Fernald, M. L. 1950. Gray's Manual of Botany. 8th ed. American Book Co., New York. lxiv + 1632 pp.

Ferren, W. R. and A. E. Schuyler. 1980. Intertidal vascular plants of river systems near Philadelphia. Proc. Acad. Nat. Sci. Philadelphia 132: 86–120.

Gale, S. 1944. *Rhynchospora*, section *Eurhynchospora*, in Canada, the United States and the West Indies. Rhodora 46: 89–134.

Gleason, H. A. 1952. The New Britton and Brown Illustrated Flora of the Northeastern United States and Adjacent Canada. The New York Botanical Garden, New York. v. 1 of 3 v.

Hirst, F. 1983. Field report on the Delmarva Flora, I. Bartonia 49: 59–68.

Snyder, D. B. and V. E. Vivian. 1981. Rare and Endangered Vascular Plant Species in New Jersey. U.S. Fish and Wildlife Service, Washington, D.C. 98 pp.

Tatnall, R. R. 1946. Flora of Delaware and the Eastern Shore. The Society of Natural History of Delaware, Wilmington. xxvi + 313 pp.

Tucker, A. O., N. H. Dill, C. R. Broome, C. E. Phillips, and M. J. Maciarello. 1979. Rare and Endangered Vascular Plant Species in Delaware. U.S. Fish and Wildlife Service, Washington, D.C. 89 pp.

Williamson, C. S. 1909. Notes on the flora of central and southern Delaware. Torreya 9: 160–166.

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# A Preliminary Report on the 18th Century Herbarium of Robert James, Eighth Baron Petre

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The Academy of Natural Sciences has received an unusal loan from the California States Libraries, on behalf of the Sutro Library in San Francisco: an eighteenth century English herbarium. The Sutro Library, originally the largest private library in the United States,[1] was formed in the late nineteenth century by Adolph Sutro, mining engineer and former mayor of San Francisco. The herbarium, sixteen bound volumes, had been the property of Robert James (1713–1741), the eighth baron Petre; it was purchased in 1886, but its whereabouts were not well known.[2] The first printed notice of this herbarium was made in 1970 by Professor Joseph Ewan, in *Essays in Biohistory*.[3]

The initial volumes on loan (Vols. XI, XII, XIII, and XV) containing two volumes of vascular plants collected by Philadelphia's John Bartram, one volume of "mosses" collected by Bartram, and one of English mosses collected by "Sir" John Hill, have been studied for a year. During this time the albums containing annotated Bartram specimens were put on display, in connection with an Academy exhibit of "The Flowers of Three Centuries" from the Fitzwilliam Museum, Cambridge, England. I studied Petre, Bartram, and Hill material in the British Library, The British Museum (Natural History), the Linnean Society, and the Essex Record Office, as well as the Dillenian herbarium at Oxford. Dr. William R. Buck, the byrologist from the New York Botanical Garden, has examined the mosses. Local specialists are examining the Bartram plant material. A preliminary report follows.

Robert James, eighth baron Petre, was an active precocious collector even by the intense collecting standards of the eighteenth century. His large library was particularly extensive in the field of natural science. His hothouse, one of the greatest in Europe, was filled with "exotics." On his Essex estate, "Thorndon," Petre planted over 40,000 trees (including 10,000 American) before he died . . . at the age of 29.[4]

Even before Petre, a posthumous only child, reached his maturity, he was underwriting collecting expeditions. In 1731–1733, he was the largest subscriber (£50) to underwrite the Caribbean collection of William Houstoun, ships surgeon, who was also collecting useful plants for Oglethorpe's new colony in Georgia.[5] Eleven of the twelve volumes still at Sutro are full of Caribbean plants collected by Houstoun; Professor Ewan's 1970 paper deals with many of these.[6] It was a time when Tournefort had only recently defined "genus," and newly discovered plants were being named after patrons and fellow botanists. Volume IX is full of such plants collected by Houstoun with generic names such as Martynia, Turneria, Sherardia, and, of course, Petrea.

Since Houstoun also sent specimens back to Philip Miller, of Chelsea Physica Garden, who grew them there, and named new genera in various editions of his *Dictionary*, future study may determine that some of these specimens are isotypes. Miller was also a friend of Petre's and made a ms. catalogue of the plants grown at "Thorndon."[7]

Two of the volumes are of English plants and mosses collected and annotated by "Sir" John Hill. Hill, an apothecary, and later a doctor, was a controversial person whose considerable talents were outrun by his own opinion of them.[8] In the early 1740's he collected and sold horti sicci; these volumes are obviously his. Not only does he annotate specimens collected "near Goodwood" (the home of the Duke of Richmond), but the style and handwriting match the frontispiece of another set (now separated) at the British Museum of Natural History. Hill also worked on the herbaria of both Petre and the Duke of Richmond;[9] annotations on many of the Petre volumes are in his hand. In most cases Hill cites the classic pre-Linnean authors, particularly Morison and Dillenius. In other cases Hill names "new" plants.

The most interesting volumes, for Americans, are those which contain specimens collected by John Bartram, Philadelphia Quaker and self-taught botanist. Bartram became North America's foremost plant collector in the eighteenth century, shipping boxes of 100 species of trees and shrubs, at 5 guineas a box, to over 100 patrons and clients, procured for him by Peter Collinson, London Quaker, draper, and passionate gardener.[10] It was Lord Petre, however, who was Bartram's first and strongest patron, buying two boxes a year, but also helping to underwrite his first trip South.

Bartram was not only sending seeds of trees and shrubs for great English landowners to place on their estates, but he was sending sets of dried plant specimens to Peter Collinson, under the latter's careful tutelage. Collinson even sent the mounting paper. Bartram was to prepare two of everything, and send one to Collinson, who then sent his set to either Gronovius, the great Dutch botanist who edited Clayton's *Flora Virginica,* or Dillenius, the German botanist then working at Oxford. Collinson would send back a numbered list of the identified plants; Bartram would thus be able to know what he had, as identified or newly named by top botanists. Some of Collinson's sets evidently went to Lord Petre for the latter's herbarium.

A numbered list of plants, which Collinson identified for Bartram in 1741, includes many of the plants in Volume XII, and in the same general order as in the volume.[11] Both Collinson's list and the volume of "Hortus siccus Stirpum Americanarum aliarumque Extra Britanniam tom 12" begin with "sweet fern," (*Comptonia peregrina* (L.) Coult.), which a ticket in Bartram's hand describes as "this we call sweet fern from its similitude to that plant ye root is A wonderful astringent for stoping of blood." The Collinson list also includes "Holly I am pleased to see have often heard of it." This appears on Bartram's ticket as "this is our jersy holy (*Ilex opaca*) grows mostly in swamps 15 foot high & 5 inches diameter." There are few contemporary annotations in volume XII, except for 1965 notations by Professor Ewan identifying the tickets as the hand of John Bartram. Volume XI is plants most probably collected by Bartram, since Petre had no other North American collector, and has virtually no annotations at all.

Probably the most unusual album in the whole collection is Volume XIII, consisting of "mosses" (which include lichens and *Lycopodia*) collected by John Bartram and sent in 1741.[12] Not that many people were interested in "mosses" in the first half of the eighteenth century. In fact, Bartram commented that "Before (Doctor Dillenius' request) I took no particular notice of mosses, but looked upon them as a Cow looks at a pair of new barn doors."[13] In 1741 Bartram sent duplicate sets of mosses to Collinson, one for Dillenius, who was then finishing his *Historia Muscorum,* and the other for Lord Petre.[14] Some of Bartram's specimens sent to Dillenius are in his herbarium, cited as types. Dr. Buck has commented:

The bryophyte collection has both historical and scientific value. Historically, these specimens represent some of the oldest, if not the oldest, collections of bryophytes from the United States. Although there are no rare species, one would not expect these to be among the gatherings of a general collector.

Scientifically the specimens are of interest primarily because of the duplicate set which went to Dillenius. Dillenius described a number of species based on the Bartram collections. Although Dillenius is pre-Hedwigian, i.e., pre-starting point for moss nomenclature, Hedwig cited numerous Dillenian polynomials and gave them binomials. Therefore, the Dillenian specimens are the holotypes for the Hedwigian names. The Sutro specimens would be isotypes.[15]

In addition to several probable types of mosses, there are two probable *Lycopodium* types which have been identified by Dr. Buck. One of these, *Lycopodium obscurum* L., is enclosed in its original sheet, with Bartram's comment "These I take to be beauties of their kind I gathered them 250 mile of home in my Journey to the northward I never saw any so perfect before pray let Lord Petre have one & Dillenius have another." Linnaeus often cited Dillenius in naming species, as in this case.

Dr. Buck and I are currently working on the "moss" specimens in Volume XIII and Dr. Buck plans to study the mosses collected and annotated by "Sir" John Hill. Specimens of other plant groups are being correlated with Bartram's correspondence, as the moss specimens have been. The next step is to identify the Caribbean specimens and check them for types, particularly those collected by Houstoun.

The decades immediately preceding Linnaeus' *Species Plantarum* were seminal ones in botanical history. A thorough study of the specimens in the Petre Herbarium, correlated with botanical literature and correspondence of the period, will increase our understanding of the emergence of modern botany, and those who forged it. In particular, we get a better understanding of the collecting activities of a famous eighteenth century American botanist, John Bartram.

## Notes and References


1. *The Anatomy of a Library* (California State Printing Office: n.d.)
2. Item 281 in *Puttick & Simpson, April 19, 20, 21, 1886*. Sales Catalogues Collection, British Library, London. Not seen. Sir George Clutton was working on a biography of the eighth baron Petre, but died in 1970 before its completion. His ms. notes indicate that the herbarium was bought by Mr. Mayer for £1/12/0; Clutton thought Mr. Mayer was probably a buyer for Sutro. "The Library at Old Thorndon Hall, Essex," in papers relating to Robert James, 8th Lord Petre, compiled by Sir George Clutton, Essex Record Office, Chelmsford, T/P 249/4/1.
3. Joseph Ewan, "Plant Collectors in America: Backgrounds for Linnaeus," *Essays in Biohistory*, Regnum Vegetable, (Utrecht: International Association for Plant Taxonomy, 1970), p. 32.
4. Collinson to Bartram, 1 Sept. 1741, Bartram Papers, II: 60. Historical Society of Pennsylvania, Philadelphia. *Transactions of the Linnaean Society*, 10 (1811): 274.

   An edited collection of Bartram/Collinson correspondence appears in William Darlington, *Memorial of John Bartram and Humphry Marshall* (1849; reprint ed., New York: Hafner Publishing Co., 1967).
5. Harman Verelst to Sir Hans Sloane, 13 Feb. 1733, Sloane MSS 4053 f. 167, British Library, London.
6. Ewan, "Plant Collectors," pp. 44–47.
7. Hilda Grieve, *A Transatlantic Gardening Friendship, 1694–1777* (Chelsmford: Historical Association, Essex Branch, 1981), p. 18.
8. G. S. Rousseau, "John Hill, Universal Genius Manque," *The Renaissance Man in the Eighteenth Century* (Los Angeles: University of California, Williams Andrews Clark Memorial Library, 1978), pp. 49–129. Professor Rousseau is working on a biography of John Hill.
9. Blanche Henrey, *British Botanical and Horticultural Literature before 1800* (London: Oxford University Press, 1975) Vol. 2, p. 90.

10. Edmund Berkeley and Dorothy S. Berkeley, *The Life and Travels of John Bartram* (Tallahassee: University Presses of Florida, 1982). The best biography of Bartram; plant exploration and exportation are well presented.
11. Peter Collinson to John Bartram, 1741, Bartram papers, II, 63.
12. "from J. Bartram's of Sepr: 25: 1740," Peter Collinson's Large Commonplace Book, the Linnaean Society, London, p. 177. Microfilm N. 629, p. 177, from the Linnaean Society, at the American Philosophical Society, Philadelphia.
13. John Bartram to Mark Catesby, 1740? Bartram Papers, I, 42–43.
14. Peter Collinson's Large Commonplace Book, p. 177.
15. William R. Buck, ms. note, Botany Department, Academy of Natural Sciences, Philadelphia.

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# Environmental Status of the Stinking Cedar, *Torreya taxifolia*

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*Torreya taxifolia* Arn. is one of the rarest of Florida's trees. Its common name, stinking cedar, is derived from the disagreeable odor given off when the tree, its bark, branches, or leaves are bruised. *Torreya* was discovered by H. B. Croom near the Aspalaga Crossing on the Apalachicola River in 1833. *Torreya* occurs naturally in three counties in Florida: Gadsden, Liberty, and Jackson, and at one station in southern Decatur County, Georgia, just north of the city of Chattahoochee, Florida. The natural habitat of *Torreya* is limestone bluffs on the eastern banks of the Apalachicola River and its tributaries from Chatahoochee, south to Torreya State Park. One population of *Torreya* exists approximately twelve kilometers west of the Apalachicola River in the vicinity of Dog Pond, a small pond, near a much larger pond, Ocheesee Pond.

The objectives of the present study are: (1) locating populations or individuals of extant Torreyas in their natural range; (2) outlining methods which if followed may preserve *Torreya* in ravines and on limestone bluffs of the Apalachicola River and its tributaries, at Maclay State Gardens, and at Torreya State Park.

Three trips were made to the Apalachicola River in May 1980, January 1981, and July 1981 to locate populations of *Torreya*. Sites in extreme southern Georgia and bluffs along the Apalachicola River and its tributaries in northwestern Florida were examined to locate *Torreya*. These sites were: (1) Chattahoochee Nature Park, Chattahoochee, Jackson County. One *Torreya* approximately 0.3 meters tall was observed here. (2) Woods at the terminus of Satsuma Road West, Chattahoochee, Jackson County. *Torreya* was observed growing on moderate slopes of the woods associated with *Pinus glabra, Fagus grandifolia,* and *Acer floridana*. Several dead Torreyas, 4–8 meters tall, were mute evidence of the blight's effect. These and a dozen living Torreyas were within 200 meters of the road. (3) Florida 269 at Flat Creek, Gadsden Co., Florida. Four Torreyas were located within 10 to 50 meters of Flat Creek, 200 to 500 meters north of Florida 269; one plant, 1 meter tall, was located on the south side of the creek within 150 meters of the road. (4) Torreya State Park, Liberty County. Torreyas used to grow naturally in this park which was established as a *Torreya* preserve. Several planted specimens are located on the lawn in front of the Gregory House. Additional cultivated specimens are planted in the nearby woods. The planted Torreyas are approximately 2.5 meters tall and are badly infected with a fungal infection. Noel Wamer and I observed 20 smaller Torreyas south of the Gregory House on river bluffs overlooking the Apalachicola River. These Torreyas are on the sides of steep ravines. *Taxus floridana*, a plant that somewhat resembles *Torreya*, thrives here. (5) Aspalaga Landing, Gadsden County. We searched and found approximately 20 Torreyas on the limestone banks of a small tributary creek of the Apalachicola River near Aspalaga Landing. Several dead Torreyas, that may have been 7 to 10 meters tall while living, were observed in varying stages of decay. Here and in the other sites where *Torreya* grows, they were observed to be associated with *Pinus glabra, Acer floridana, Fagus grandifolia, Ulmus* sp., *Magnolia grandiflora,* and other species. (6) Ocheesee Pond, Jackson County. The tallest (2.3 meters) native Torreyas occur at Ocheesee Pond, located 11 kilometers west of the Apalachicola River. All of the largest trees were badly infected with blight. The population numbered one dozen individuals. (7) Maclay Gardens, Tallahassee, Leon County. Several dozen Torreyas are growing here and all are badly infected by blight. The largest *Torreya* is 10 meters tall and has a DBH of 0.25 meters. One of the Torreyas here produces seed. The work of a concerned horticulturist, Bob Bowden, resulted in the germination of 28 of 35 seeds collected in 1980. (8) Decatur County, Georgia. One small population of 24 Torreyas exists on the banks of a steep ravine just south of Lake Seminole. These trees were observed in the second ravine south of the Resource Manager's Office, approximately 0.8 kilometers north of Chattahoochee, Florida, perhaps 100 meters from the Georgia-Florida border. Several additional Torreyas were observed just south of the Georgia-Florida border. These ranged in size from 0.3 to 1.2 meters tall.

*Torreya taxifolia* has been planted in at least three locations in Georgia. Two mature Torreyas are located on Front Avenue in Columbus, Georgia's historic district. A dozen planted Torreyas are growing at Callaway Gardens, Georgia. These are males, fungus free, and range from 0.2 meters to 3.2 meters tall. Mr. Burl Turnage, Albany, Georgia, propagates Torreyas from cuttings, and distributes them throughout the United States (Butler 1981). Fourteen healthy trees ranging from 6 to 10 meters in height are thriving at the Biltmore Gardens, Asheville, North Carolina. These Torreyas produce seed and several seedlings have been observed near the parent trees (Timothy Dunford, pers. comm.). A male and female tree are thriving at the Brooklyn Botanical Gardens, New York. Two other Torreyas are growing at Planting Fields Aboretum, near Oyster Bay, New York. Additional trees may be growing on the estates of wealthy individuals along the eastern United States.

In March 1962, Drs. Godfrey and Kurz noticed that population of *Torreya* on the east side of the Apalachicola River at Aspalaga Landing and Rock Bluff were decimated by a fungal infection. Alfieri et al. (1967) identified the fungi responsible for the stem and needle blight of *Torreya* to be *Physalospora* and *Macrophora*. However, these investigators did not determine how the fungal agents act to cause the blight.

At the present time there may be only 100 native Torreyas (1.5 to 2.0 meters tall) left in the wild. These trees, like their extinct predecessors, will most surely succumb to the blight. Some living Torreyas may send up root sprouts, as *Castanea* does. Unless measures to control the blight are undertaken to preserve *Torreya* in its natural range, the taxon is doomed for extinction. The authors suggest several measures to preserve the species: (1) First, disease-free Torreyas along the Apalachicola River should be identified. (2) The conditions necessary for the fungal agent(s) to cause the infection should be determined.

Alfieri et al. (1967) found that Maneb fungicide at the concentration of 1.5 lb/100 gal applied at weekly intervals resulted in "very good control" of the fungal agents, *Physalospora* and *Macrophora*, after 9 weeks of treatment. *Torreya* trees at Maclay treated in this manner "showed marked improvement and recovery" and produced new growth "showing little or no infection." Trees at Maclay State Gardens and "accessible" trees in the wild should be treated in the aforementioned manner to control the fungal infection. Additional work must be completed to determine: (1) what fungal agents are involved in causing the blight; (2) what special environmental conditions (e.g. severe cold, drought, wetness, etc.) enhance or stimulate the growth of fungi on *Torreya*.

To accomplish the above objectives, the following steps should be used to determine the causative agent of the blight: (1) The constant association of a given fungal species or genus (genera) with each case of the blight should be identified. Infected plant material should be gathered and examined from the populations described in this paper. (2) Isolate the blight related organism(s) and grow these fungi in pure culture. (3) From the pure culture(s), inoculate *Torreya* and observe the subsequent development of the disease. Cuttings from disease-free plants from North Carolina should be transported to Florida, rooted, and grown in green houses, inoculated, and observed for the subsequent development of the disease. (4) Finally, the disease causing organism(s) should be reisolated from the inoculated Torreyas. If the organism(s) is (are) identified and if certain environmental factors appear to enhance the development of the fungi, then the environment might be modified to mitigate the deleterious affect of the blight-causing agent(s) on *Torreya*. Spraying the Torreyas with Maneb as described above is a simple and effective way of dealing with the blight. (5) Disease-free populations of *Torreya* should be established outside of its natural range. Fourteen healthy, disease-free mature trees are thriving at the Biltmore Gardens, Asheville, North Carolina. Seeds or cuttings from these trees might be used to propagate the species in commercial or private gardens in the northeastern United States. Populations of *Torreya* might be established as far north as Long Island, New York, since minimum temperatures on Long Island and Asheville, North Carolina are similar, even though the mean January temperature for Asheville is five degrees warmer (U.S.D.A. 1941).

No populations of *Torreya* should be established within 250 miles of Chattahoochee, Florida, since the disease might be carried from population to population until all populations of *Torreya* are infected, until the disease has been eliminated within the natural range of *Torreya*. If the fungal agents were to infect the disease-free populations, treatment with Maneb might prevent the fungus from killing the trees.

None of the investigators observed any trees more than 2.3 meters tall in the wild, and certainly no trees in sexual reproduction phase. Robert Godfrey (pers. comm.) doubts if any seed-producing trees have been present in the wild for the past 25 years. Yet *Torreya* has been able to persist in the wild by producing stem sprouts. If nothing is done to mitigate the effects of the fungal agents, the status of *Torreya taxifolia* as an extant species in its natural range is very grave, and it may be extinct by the turn of the century. However, the procedures listed above, if followed, may enable *Torreya* to survive.

## Literature Cited

Alfieri, S. A., A. P. Martinez, and C. Wehlbure. 1967. Stem and needle blight of Florida *Torreya*, *Torreya taxifolia* Arn. Proc. Florida State Hort. Soc. 80: 428–431.

Butler, W. 1981. Status of the Florida *Torreya* in Georgia. Unpublished report prepared for the Dept. Nat. Res. Game and Fish Div., 270 Washington St., Atlanta. 8 pp.

U.S.D.A. 1941. Climate and man. Yearbook of Agriculture, U.S. Gov't. Printing Office, Washington. 1248 pp.

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# Check-List of the Native Vascular Flora of Middlesex County, New Jersey

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Middlesex County is located in north-central New Jersey. The Fall Line, which runs diagonally from approximately Little Rocky Hill in the southwestern corner of the County to Perth Amboy in the northeast, divides the County more or less equally into Peidmont and Coastal Plain. Topography is mostly gentle, with elevations being generally below 150 feet, but a maximum height of nearly 300 feet is reached at Little Rocky Hill. Only a small portion of the County, the northeast corner, has been glaciated and the Terminal Moraine (Wisconsin stage) tracks southward through South Plainfield to Metuchen, then eastward towards Perth Amboy.

There is a surprising diversity of habitats found in Middlesex County. Sea beach, salt marsh, and tidal estuaries occur along the Raritan bayshore in the northeast, while in the southwestern section of the County there are the rocky wooded slopes of Little Rocky Hill. In the northern part of the County along the floodplain of the Raritan River are rich alluvial woods, and southward can be found acid bogs and pine barren woodlands.

With a diversity of habitat comes a diversity of plant species, and Middlesex County's rich flora has attracted the visits of many prominent field botanists. Of the more prolific botanical collectors should be mentioned Nathaniel L. Britton (1859–1934), Waldron de Witt Miller (1864–1929), Witmer Stone (1866–1939), Mintin A. Chrysler (1871–1963), Kenneth K. Mackenzie (1877–1934), Homer D. House (1878–1949), and Bayard Long (1885–1969).

The rich floral diversity of Middlesex County is now seriously threatened as its woodlands give way to shopping malls, and its pine barrens to pavement. Much of the County's wetlands and waterways have been either filled, drained, or polluted. As a result many plant species are disappearing. Indeed, species such as *Carex louisianica, Chamaelirium luteum, Platanthera peramoena, Populus heterophylla, Leiophyllum buxifolium* and *Rhododendron canadense* are perhaps already lost forever to the County. Despite the destruction and degradation of habitats, many of the rarer members of the County's flora still persist. *Juncus greenei, Xerophyllum asphodeloides, Platanthera ciliaris, Arenaria caroliniana, Pyxidanthera barbulata, Utricularia purpurea,* and *Aster radula* are yet found in pine barren remnants near Browntown, Helmetta, and Spotswood. In a white cedar swamp near Milltown, a small colony of *Helonias bullata* still grows. The tidal marshes and estuaries of the Raritan and South Rivers, still support healthy populations of *Sagittaria calycina* and *Bidens bidentoides*. But these species too, shall surely soon vanish unless adequate steps are taken to plan for their protection.

This check-list of the native flora of Middlesex County is an attempt to document the quickly diminishing vascular flora of the County. Voucher specimens for the majority of taxa listed have been examined, the bulk of which is contained in the Chrysler Herbarium of Rutgers University. Other specimens examined are contained in the herbaria of the Academy of Natural Sciences of Philadelphia, the New York Botanical

Garden, and the author's private collection. Records taken from the literature, largely Britton's Catalog (1889), Stone's Flora (1911), and Taylor's Flora (1915), which no voucher specimens were seen, are followed by the abbreviation "lit." in parentheses. A few sight records by reliable observers have been admitted and are identified as such.

Nomenclature generally follows Fernald (1950), but names in Gleason and Cronquist (1963) and the National List of Scientific Plant Names (1982) have also been used.

Comments have been provided for some of the rare or unusual species found in the County. Additions, corrections, or comments to this check-list are encouraged.

## Pteridiophytes

LYCOPODIACEAE: *Lycopodium alopecuroides, appressum, dendroideum, digatatum, inundatum, lucidulum, obscurum.*

SELAGINELLACEAE: *Selaginella apoda.*

ISOETACEAE: *Isoetes echinospora, engelmannii.*

EQUISETACEAE: *Equisetum arvense, hyemale* var. *affine.*

OPHIOGLOSSACEAE: *Botrychium dissectum, dissectum* var. *obliquum, lanceolatum, virginianum; Ophioglossum vulgatum* var. *pseudopodium.*

OSMUNDACEAE: *Osmunda cinnamomea, claytonia, regalis* var. *spectabilis.*

SCHIZAEACEAE: *Lygodium palmatum,* rare, no recent sightings.

ADIANTACEAE: *Adiantum pedatum.*

POLYPODIACEAE: *Polypodium virginianum.*

DENNSTAEDTIACEAE: *Dennstaedtia punctilobula; Pteridium aquilinum* var. *latiusculum.*

THELYPTERIDACEAE: *Thelypteris noveboracensis, palustris, simulata.*

ASPLENIACEAE: *Asplenium platyneuron, rhizophyllum, trichomanes; Athyrum filix-femina* var. *angustum; Cystopteris fragilis* var. *mackayii; Dryopteris carthusiana, clintonia, cristata, intermedia, marginalis; Onoclea sensibilis; Polystichum acrostichoides; Woodsia obtusa.*

BLECHNACEAE: *Woodwardia areolata, virginica.*

## Gymnosperms

PINACEAE: *Pinus echinata* (lit.), *strobus, rigida, virginiana; Tsuga canadensis.*

CUPRESSACEAE: *Chamaecyparis thyoides; Juniperus virginiana.*

## Monocots

TYPHACEAE: *Typha angustifolia, latifolia.*

SPARGANIACEAE: *Sparganium americanum, androcladum, eurycarpum.*

ZOSTERACEAE: *Potamogeton epihydrus, foliosus, nodosus, oakesianus* (lit.), *perfoliatus* var. *bupleuroides, pulcher, robbinsii, vaseyi,* rare, one locality.

NAJADACEAE: *Najas gracillima* (lit.).

ALISMATACEAE: *Alisma subcordatum; Sagittaria australis, calycina,* tidal portions of Raritan River, extensive extant population, *graminea, latifolia, rigida, subulata.*

HYDROCHARITACEAE: *Elodea nuttallii; Vallisneria americana.*

GRAMINEAE: *Agrostis hyemalis, perennans; Andropogon gerardii, scoparius, virginicus, virginicus* var. *abbreviatus; Aristida dichotoma, purpuracens, tuberculosa; Bromus ciliatus* var. *intonsus; Calamagrostis canadensis, cinnoides; Calamovilfa brevipilis,* rare, one locality; *Cinna aruninaceae; Danthonia spicata; Deschampsia flex-*

*uosa; Digitaria filiformis; Distichlis spicata; Eragrostis hypnoides, pectinacea, spectabilis; Glyceria canadensis, obtusa, pallida, septentrionalis, striata; Hierchloe odorata; Hystrix patula; Leersia oryzoides; Muhlenbergia frondosa, schreberi, tenuiflora; Panicum anceps, capillare, clandestinum, columbianum, commonsianum, depauperatum, dichotomiflorum, gattingeri* (lit.), *latifolium, longifolium, lucidum, microcarpon, philadelphicum, polyanthes, sphaerocarpon, stipitatum, verrucosum, virgatum; Paspalum laeve* var. *circulare* (lit.), *setaceum; Phalaris arundinacea; Phragmites communis* var. *berlandieri; Spartina alterniflora, cynosuroides, patens, pectinata; Sporobolus asper; Stipa avenacea; Triodia flava; Tripsacum dactyloides* (lit.); *Uniola laxa; Zizania aquatica.*

CYPERACEAE: *Bulbostylis capillaris; Carex abscondita, albolutescens* sight record, V. Abraitys, *annectens, artitecta, atlantica, barrattii,* rare, no recent sightings, *bullata, canescens, caroliniana, cephalantha, collinsii, crinita, davisii, debilis,* sight record V. Abraitys, *emmonsii, exilis, folliculata, glaucodea, gracillima, grayii, intumescens, laxiculmis, laxiflora, louisianica,* single verified station for species in NJ, *lupiliformis, lupilina, lurida, pensylvanica, pensylvanica* var. *distans, polymorpha,* rare one locality, no recent sightings known, *rosea, rostrata* var. *utriculata, scoparia, seorsa, squarrosa, stipata, straminea, straminea* var. *invisa, stricta, stricta* var. *strictior, swanii,* sight record V. Abraitys, *tribuloides, umbellata, vesicaria, vestita, vulpinoidea, willdenowii;*[1] *Cladium mariscoides; Cyperus dentatus, diandrus, filicinus, grayii, retrorsus, rivularis, strigosus; Dulichium arundinaceum, Eleocharis engelmannii, intermedia, obtusa* var. *obtusa* and var. *peasei, olivaea, robbinsii, rostellata, tenuis, tuberculosa; Eriophorum virginicum; Rhynchospora alba, capitellata, glomerata; Scirpus americanus (olneyi), cylindricus,* rare, *cyperinus, maritimus,* very rare, station now gone, *pungens, robustus, smithii.*

ARACEAE: *Acorus calamus; Arisaema dracontium* (lit.), *triphyllum, triphyllum* ssp. *pusillum; Calla palustris* (lit.); *Orontium aquaticum; Peltandra virginica; Symplocarpus foetida.*

LEMNACEAE: *Lemna minor; Spirodela polyrhiza; Wolffia columbiana.*

XYRIDACEAE: *Xyris caroliniana, torta.*

PONTEDERIACEAE: *Heteranthera dubia, reniformis; Ponterderia cordata.*

JUNCACEAE: *Juncus acuminatus, bufonius, canadensis, dichotomus, effusus, gerardii, greenei,* rare, scattered extant stations known, *marginatus, pelocarpus, scirpoides, subcaudatus,* sight record V. Abraitys, *tenuis; Luzula echinata.*

LILIACEAE: *Aletris farinosa; Allium canadensis, tricoccum; Chamaelirium luteum,* single locality, now destroyed; *Erythronium americanum; Helonias bullata,* rare, small extant colony known; *Lilium canadense, superbum; Medeola virginiana; Maianthemum canadense; Polygonatum biflorum, canaliculatum, pubescens; Smilacina racemosa, glauca, pseudo-china, rotundifolia; Trillium cernuum* (lit.); *Uvularia perfoliata, U. sessifolia; Veratrum viride; Xerophyllum asphodeloides,* rare, single extant colony; *Zygadenus leimanthoides.*

DIOSCOREACEAE: *Dioscorea villosa.*

AMARYLLIDACEAE: *Hypoxis hirsuta.*

IRIDACEAE: *Iris prismatica, versicolor; Sisyrinchium arenicola,* rare, *atlanticum, graminoides, mucronatum*

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[1] A specimen of *Carex limosa* at CHRYS labeled "Edison" was collected in Sussex County, not Middlesex County.

ORCHIDACEAE: *Arethusa bulbosa*, rare; *Corallorhiza maculata, odontorhiza; Cypripedium acaule; calceolus* var. *parviflorum; Goodyera pubescens; Isotria verticillata; Liparis lilifolia,* sight record E. Green; *Listera australis* (lit.); *Malaxis unifolia* (lit.); *Platanthera blephariglottis, ciliaris, cristata, flava (lit.), lacera, peramoena,* single station, now destroyed;[2] *Pogonia ophioglossoides; Spiranthes cernua, gracilis, ochroleuca, praecox, tuberosa.*

## DICOTS

SAURURACEAE: *Saururus cernuus.*

SALICACEAE: *Salix bebbiana* (lit.), *discolor, humilis* var. *microphylla, nigra; Populus grandidentata, heterophylla,* rare one locality, *tremuloides.*

MYRICACEAE: *Myrica asplenifolia, cerifera, pensylvanica.*

JUGLANDACEAE: *Carya cordiformis, glabra, ovalis, ovata, tomentosa; Juglans cinerea, nigra.*

BETULACEAE: *Alnus serrulata; Betula lenta, nigra, populifolia; Carpinus caroliniana* var. *virginiana; Corylus americana; Ostrya virginiana.*

FAGACEAE: *Castanea dentata; Fagus grandifolia; Quercus alba, bicolor, coccinea, × heterophylla, ilicifolia, marilandica, palustris, phellos, prinoides, prinus, rubra, stellata, velutina.*

ULMACEAE: *Celtis occidentalis; Ulmus americana, rubra.*

MORACEAE: *Morus rubra.*

URTICACEAE: *Boehmeria cylindrica; Laportea canadensis; Pilea pumila.*

SANTALACEAE: *Comandra umbellata.*

LORANTHACEAE: *Phoradendron flavescens,* rare, a single locality.

ARISTOLOCHIACEAE: *Asarum canadense.*

POLYGONACEAE: *Polygonella articulata; Polygonum arifolium* var. *pubescens, aviculare* var. *littorale, careyi, coccineum, erectum, exertum* (lit.), *glaucum, hydropiperoides, pensylvanicum, punctatum, ramosissimum, sagittatum, scandens, tenue; Tovara virginiana.*

CHENOPODIACEAE: *Atriplex patula* var. *hastata, patula* var. *littoralis; Chenopodium boscianum; Salicornia bigelovii, europaea; Salsola kali.*

AMARANTHACEAE: *Acinida cannabina.*

PHYTOLACCACEAE: *Phytolacca americana.*

PORTULACACEAE: *Claytonia virginica.*

CARYOPHYLLACEAE: *Arenaria caroliniana, lateriflora; Cerastium arvense; Paronychia fastigiata; Silene antirrhina, caroliniana* var. *pensylvanica, stellata; Spergularia marina; Stellaria alsine, longifolia.*

CERATOPHYLLACEAE: *Ceratophyllum demersum.*

NYMPHAEACEAE: *Brasenia schreberi; Nuphar advena, variegatum; Nymphaea odorata.*

RANUNCULACEAE: *Actaea pachypoda; Anemone quinquefolia, virginiana;*[3] *Anemonella thalictroides; Aquilegia canadensis; Caltha palustris; Cimicifuga racemosa*

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[2] Reports of *Platanthera integra* from Cheesequake State Park in Middlesex County are based on a misidentified specimen of *P. ciliaris* at CHRYS.

[3] *Anemone canadensis* reported from Woodbridge (Middlesex County) in Taylor's Flora is a typographical error for Wood Ridge (Bergen County) of Britton's Catalog.

(lit.); *Clematis virginiana; Hepatica americana; Ranunculus abortivus, ambigens, flabellaris* (lit.), *hispidus, pensylvanicus* (lit.), *pusillus,* rare, extant population known, *recurvatus, scleratus; Thalictrum dioicum, polygamum, revolutum,* rare.

BERBERIDACEAE: *Podophyllum peltatum.*

MENISPERMACEAE: *Menispermum canadense.*

LAURACEAE: *Lindera benzoin; Sassafras albidum.*

PAPAVERACEAE: *Dicentra cucullaria; Sanguinaria canadensis.*

CRUCIFERAE: *Arabis laevigata, lyrata; Cakile edentula; Cardamine bulbosa, parviflora* var. *arenicola, pensylvanica; Dentaria laciniata; Draba reptans* (lit.); *Lepedium virginicum; Rorippa islandica.*

SARRACENIACEAE: *Sarracenia purpurea.*

DROSERACEAE: *Drosera intermedia, rotundifolia.*

CRASSULACEAE: *Sedum ternatum.*

SAXIFRAGACEAE: *Chysosplenium americanum; Heuchera americana; Itea virginica,* sight record V. Abraitys; *Penthorum sedoides; Ribes americana,* rare, *hirtellum,* rare, one locality; *Saxifraga virginiensis.*

HAMAMELIDACEAE: *Hamamelis virginiana; Liquidambar stryaciflua.*

PLATANACEAE: *Platanus occidentalis.*

ROSACEAE: *Aronia arbutifolia, melanocarpa, prunifolia; Agrimonia gryposepala, parviflora, striata; Amelanchier canadensis, obovalis; Crataegus crus-galli, pruinosa, punctata, uniflora; Fragaria vesca* var. *americana, virginiana; Geum canadense, laciniatum; Physocarpus opulifolius,* rare, bluffs along Raritan River; *Potentilla canadensis, norvegica, simplex; Prunus maritima, serotina, virginiana; Rosa carolina, palustris, virginiana; Rubus canadensis, cunefolius, flagellaris, hispida, occidentalis; Sanguisorba canadensis; Spiraea latifolia, tomentosa.*

LEGUMINOSAE: *Amphicarpa bracteata* var. *comosa; Apios americana; Baptisia tinctoria; Cassia fasciculata, hebecarpa, nictitans; Crotalaria sagittalis; Desmodium canadense, canescens, ciliare, dilleni, nudiflorum, paniculatum, rotundifolium; Galactia regularis* (lit.); *Lathyrus ochroleucus,* single pre-1900 collection, only NJ station; *Lespedeza angustifolia, capitata, hirta, intermedia,* × *nuttallii* (lit.), *procumbens, stuevei* (lit.), *virginica; Lupinus perennis; Strophostyles helvola, umbellata; Stylosanthes biflora; Tephrosia virginiana; Vicia americana,* bluffs along Raritan River, no recent sightings.

LINACEAE: *Linum medium, striatum, virginianum.*

OXALIDACEAE: *Oxalis filipes, stricta, violacea.*

GERANIACEAE: *Geranium carolinianum, maculatum, robertianum.*

POLYGALACEAE: *Polygala cruciata, lutea, nuttallii, paucifolia, polygama,* rare, extant population known, *sanguinea, verticillata.*

EUPHORBIACEAE: *Acalypha rhomboidea, virginica; Euphorbia corollata, dentata, ipecacuanhae, maculata, polygonifolia, supina.*

CALLITRICHACEAE: *Callitriche deflexa* var. *austini* (lit.), *heterophylla.*

ANACARDIACEAE: *Rhus copallina, glabra, typhina; Toxicodendron radicans, vernix.*

AQUIFOLIACEAE: *Ilex glabra, laevigata, opaca, verticillata, verticillata* var. *tenuifolia; Nemopanthus mucronata,* rare.

CELASTRACEAE: *Celastrus scandens; Euonymus americanus, atropurpureus,* rare.

STAPHYLEACEAE: *Staphylea trifolia.*

ACERACEAE: *Acer negundo, rubrum, rubrum* var. *trilobum, saccharinum, saccharum.*

BALSAMINACEAE: *Impatiens capensis.*

VITACEAE: *Parthenocissus quinquefolius; Vitis labrusca, vulpina.*

TILIACEAE: *Tilia americana, heterophylla* (lit.).

MALVACEAE: *Hibiscus palustris; Kosteletzkya virginica* var. *aquilonia* (lit.).

HYPERICACEAE: *Ascyrum hypericoides* var. *multicaule; Hypericum boreale, canadense, densiflorum,* × *dissimulatum, gentianoides, muticum, punctatum; Triadenum virginicum.*

ELATINACEAE: *Elatine americana.*

CISTACEAE: *Helianthemum bicknellii, canadense, propinquum; Hudsonia ericoides, tomentosa; Lechea intermedia* (lit.), *leggettii, villosa.*

VIOLACEAE: *Viola affinis, blanda, brittoniana, brittoniana* var. *pectinata, conspersa, cucullata,* × *emarginata, fimbriatula, incognita,* rare, one locality, *lanceolata,* × *notabilis, palmata, papilionacea, pedata* var. *lineariloba, pensylvanica, primulifolia,* × *porteriana, pubescens, rafinesquii, rostrata, rotundifolia, sagittata, sororia,* × *stoneana, triloba.*

CACTACEAE: *Opuntia humifusa.*

LYTHRACEAE: *Cuphea petiolata; Decodon verticillatus; Lythrum alatum, lineare* (lit.).

NYSSACEAE: *Nyssa sylvatica.*

MELASTOMATACEAE: *Rhexia virginica.*

ONAGRACEAE: *Circaea quadrisulcata; Epilobium angustifolium, coloratum, glandulosum* var. *adenocaulon; Gaura biennis; Ludwigia alternifolia, palustris* var. *americana, sphaerocarpa; Oenothera biennis, fruticosa, laciniata, perennis, tetragona.*

HALORAGACEAE: *Myriophyllum exalbescens, heterophyllum, humile.*

ARALIACEAE: *Aralia hispida, nudicaulis, racemosa, spinosa,* perhaps not native; *Panax trifolium.*

UMBELLIFERAE: *Cicuta bulbifera* (lit.), *maculata; Chaerophyllum procumbens; Cryptotaenia canadensis; Eryngium aquaticum* (lit.); *Heracleum maximum; Osmorhiza claytonii, longistylis; Oxypolis rigidior; Ptilimnium capillaceum; Sanicula canadensis, gregaria, marilandica; Sium suave; Taenidia integgerrima; Thaspium trifoliatum; Zizia aptera.*

CORNACEAE: *Cornus alternifolia, amomum, florida, racemosa, rugosa, stolonifera.*

CLETHRACEAE: *Clethra alnifolia.*

PYROLACEAE: *Chimaphila maculata; Pyrola elliptica, rotundifolia.*

MONOTROPACEAE: *Monotropa hypopithys, uniflora.*

ERICAEAE: *Arctostaphylos uva-ursi* var. *coactilis; Chamaedaphne calyculata* var. *angustifolia; Epigaea repens; Gaultheria procumbens; Gaylussacia baccata, frondosa; Kalmia angustifolia, latifolia; Leiophyllum buxifolium,* rare, no recent sightings; *Leucothoe racemosa; Lyonia ligustrina, mariana; Rhododendron canadense,* a single plant, locality now destroyed, *periclymenoides, viscosum; Vaccinium angustifolium, atrococcum, caesariense, corymbosum, corymbosum* var. *glabrum, lamarckii, macrocarpon, stamineum, vacillans.*

DIAPENSIACEAE: *Pyxidanthera barbulata.*

PRIMULACEAE: *Hottonia inflata,* rare, single locality; *Lysimachia ciliata, hybrida,* × *producta, quadrifolia, terrestris; Samolus parviflorus; Trientalis borealis.*

PLUMBAGINACEAE: *Limonium carolinianum, nashii.*

EBENACEAE: *Diospyrus virginiana.*

OLEACEAE: *Fraxinus americana, pennsylvanica.*

GENTIANACEAE: *Bartonia paniculata, virginica; Gentiana clausa, saponaria; Sabatia angularis, dodecandra,* rare, *stellaris.*

ASCLEPIADACEAE: *Apocynum androsaemifolium, cannabinum, cannabinum* var. *pubescens, × medium; Asclepias amplexicaulis, incarnata* var. *pulchra, purpurescens, quadrifolia, rubra,* rare, *syriaca, tuberosa, variegata* (lit.), *verticillata, viridiflora.*

CONVOLVULACEAE: *Convolvulus sepium, spithamaeus; Cuscuta compacta, gronovii, pentagona; Ipomoea pandurata.*

POLEMONIACEAE: *Phlox maculata, pilosa* (lit.), *subulata.*

HYDROPHYLLACEAE: *Hydrophyllum virginianum.*

BORAGINACEAE: *Hackelia virginiana; Mertensia virginiana,* locally frequent along the Raritan River; *Myosotis laxa, verna; Onosmodium virginianum,* rare, no recent localities known.

VERBENACEAE: *Verbena hastata, simplex, urticifolia.*

LABIATAE: *Agastache nepetoides; Collinsonia canadensis; Hedeoma pulegiodes; Lycopus americanus, uniflorus, virginicus; Mentha arvensis; Monarda fistulosa, fistulosa* var. *mollis, punctata; Physostegia virginiana,* perhaps not native; *Prunella vulgaris* var. *lanceolata; Pycnanthemum incanum, muticum, tenuifolium, verticillatum, virginianum; Salvia lyrata; Scutellaria elliptica, galericulata, integrifolia, lateriflora, leonardi,* rare, single locality, *nervosa,* rare; *Stachys hyssopifolia, tenuifolia, tenuifolia* var. *hispida; Teucrium canadense; Trichostema dichotomum.*

SOLANACEAE: *Physalis pruinosa, subglabrata; Solanum carolinense.*

SCROPHULARIACEAE: *Chelone glabra; Gerardia maritima, paupercula, purpurea, tenuifolia; Gratiola neglecta; Linaria canadensis; Lindernia anagallidea, dubia; Melampyrum lineare; Micranthemum micranthemoides,* very rare, a single station on tidal flats of the Raritan River; *Mimulus ringens; Pedicularis canadensis, lanceolata,* rare; *Penstemon hirsutus, laevigatus; Scrophularia marilandica; Tomanthera auriculata,* introduced ?; *Veronica officinalis, peregrina, scutellata; Veronicastrum virginicum.*

OROBANCHACEAE: *Conopholis americana; Epifagus virginiana; Orobanche uniflora.*

LENTIBULARIACEAE: *Utricularia geminiscapa, inflata, purpurea, vulgaris.*

ACANTHACEAE: *Ruellia strepens,* a single collection, the only one known for NJ; perhaps merely adventive.

PLANTAGINACEAE: *Plantago major* var. *scopulorum, rugelii.*

RUBIACEAE: *Cephalanthus occidentalis; Diodia teres; Galium aparine, asprellum, circaezans, tinctorium, triflorum; Mitchella repens.*

CAPRIFOLIACEAE: *Diervilla lonicera,* rare, bluffs along the Raritan River; *Lonicera dioica, sempervirens; Sambucus canadensis; Triosteum aurantiacum; Viburnum acerifolium, cassinoides, dentatum, nudum, prunifolium.*

CUCURBITACEAE: *Echinocystis lobata; Sicyos angulatus.*

CAMPANULACEAE: *Campanula aparinoides; Lobelia cardinalis, inflata, nuttallii, puberula* (lit.), *siphilitica, spicata, Specularia perfoliata.*

COMPOSITAE: *Ambrosia artemisiifolia, trifida; Anaphalis margaritacea* var. *intercedens; Antennaria neglecta, neglecta* var. *attenuata, plantaginifolia; Artemisia caudata,* rare, no recent sightings; *Aster concolor* (lit.), *cordifolius, divaricatus, dumosus, lateriflorus, linariifolius, lowrieanus, novae-angliae, patens* var. *phlogifolius, paternus, pilosus, pilosus* var. *demotus, pilosus* var. *platyphyllus, novi-belgii, novi-belgii* var. *atlanticus, novi-belgii* var. *elodes, puniceus, radula,* very rare, *simplex, solidagineus, spectabilis, subulatus, tenuifolius, umbellatus, vimineus, vimineus* var. *subdumosus; Baccharis halimifolia, Bidens bidentoides,* rare, tidal shores and marshes of the Raritan and South Rivers, *bipinnata, cernua, connata, coronata, discoidea* (lit.), *frondosa, laevis, vulgata;*[4] *Chrysopsis mariana; Cirsium altissimum,* a single locality, only vouchered record for NJ and not recently reported, *discolor; Conyza canadensis; Eclipta alba; Erechtites hieracifolia; Erigeron annuus, pulchellus, strigosus; Eupatorium album, album* var. *saundersi, aromaticum,* rare, *dubium, fistulosum, hyssopifolium, perfoliatum, purpureum, rotundifolium, rugosum, serotinum; Gnaphalium obtusifolium; Helenium autumnale; Helianthus decapetalus, giganteus, tuberosus; Heliopsis helianthoides* var. *scabra; Hieracium gronovii, paniculatum* (lit.), *venosum; Iva frutescens; Krigia biflora, virginica; Kuhnia eupatorioides,* rare, no recent reports; *Lactuca biennis, canadensis; Liatris borealis,* rare, no recent reports, *Liatris spicata; Mikania scandens; Pluchea odorata; Prenanthes altissima, trifoliata; Rudbeckia hirta; Senecio aureus; Solidago altissima, arguta, bicolor, caesia, canadensis, elliottii* var. *ascendens,* rare, *gigantea, gigantea* var. *serotina, graminifolia, juncea, nemoralis, odorata, patula, puberula, rigida,* rare, a single locality, not recently reported, *rugosa, rugosa* ssp. *aspera, rugosa* var. *celtidifolia, sempervirens, speciosa* (lit.), *squarrosa,* bluffs along the Raritan River, *squarrosa* f. *ramosa,* occasional with the last, *uliginosa, ulmifolia; Vernonia noveborascens; Xanthium echinatum.*

## Summary

This check-list includes 948 taxa believed to be indigenous to Middlesex County. Of these, 43 are Pteridiophytes (36 species, 7 varieties), 7 are Gymnosperms, 250 are Monocots (238 species, 1 subspecies, 11 varieties), and 648 are Dicots (595 species, 1 subspecies, 9 hybrids, 42 varieties, 1 form).

Some of the largest families occurring in the County are: Compositae (108), Cyperaceae (77), Graminae (64), Rosaceae (34), Labiatae (30), Leguminosae (30), Violaceae (26), Ericaceae (23), Liliaceae (23), Orchidaceae (22), Scrophulariaceae (22), and Ranunculaceae (20).

## Acknowledgments

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## Literature cited

Britton, N. L. 1889. Catalogue of Plants Found in New Jersey. Geol. Surv. N.J., Final Rep. State Geol.

Fernald, M. L. 1950. Gray's Manual of Botany, 8th ed. American Book Co., New York.

Gleason, H. A. and A. Cronquist. 1963. Manual of Vascular Plants of the Northeastern United States and Adjacent Canada. D. Van Nostrand Co., New York.

Stone, W. 1911. The Plants of Southern New Jersey, with Especial Reference to the Flora of the Pine Barrens. Ann. Rep. N.J. State Museum for 1910, Trenton, New Jersey.

Taylor, N. 1915. Flora in the Vicinity of New York. Mem. N.Y. Bot. Gard., Vol. V.

United States Department of Agriculture, Soil Conservation Service. 1982. National List of Scientific Plant Names. U.S. Government Printing Office, Washington, D.C.

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[4] No specimens were seen to substantiate reports of either *Bidens eatonii* or *Bidens heterodoxa* in Middlesex County.

Bartonia No. 50: 51–53, 1984

# Vincent Abraitys (1915–1983)

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Vince Abraitys possessed intimate knowledge of New Jersey's flora, from *Potentilla tridentata* beneath the High Point tower to *Habenaria nivea* in a Cape May bog. His passing leaves a void not unlike the loss of a lone station for a rare and noble plant.

After several years of failing health, he died Nov. 3, 1983, at his home in the Sergeantsville section of Delaware Township, N.J. He was 68.

Abraitys, a holder of public office in Hunterdon County for most of three decades, was many things to many people, but to those of us interested in the wild places of the world he will remain above all an amateur naturalist of extraordinary stature. Few would dispute his position as New Jersey's foremost field botanist. He located stations for more than 2,400 native and introduced plant species in the state during decades of ardent pursuit, and recent publications on the state's flora relied heavily on his field studies.

His discoveries added the following species to the state list: *Amelanchier humilis, Bromus rigidus, Cyperus brevifolioides, Eleocharis verrucosa, Equisetum variegatum, Eupatorium altissimum, Hydrocotyle ranunculoides, H. sibthorpioides, Juncus filiformis, Milium effusum, Prunus alleghaniensis, Ribes missouriense, Rumex conglomeratus, Scirpus microcarpus,* and *Streptopus amplexifolius.*

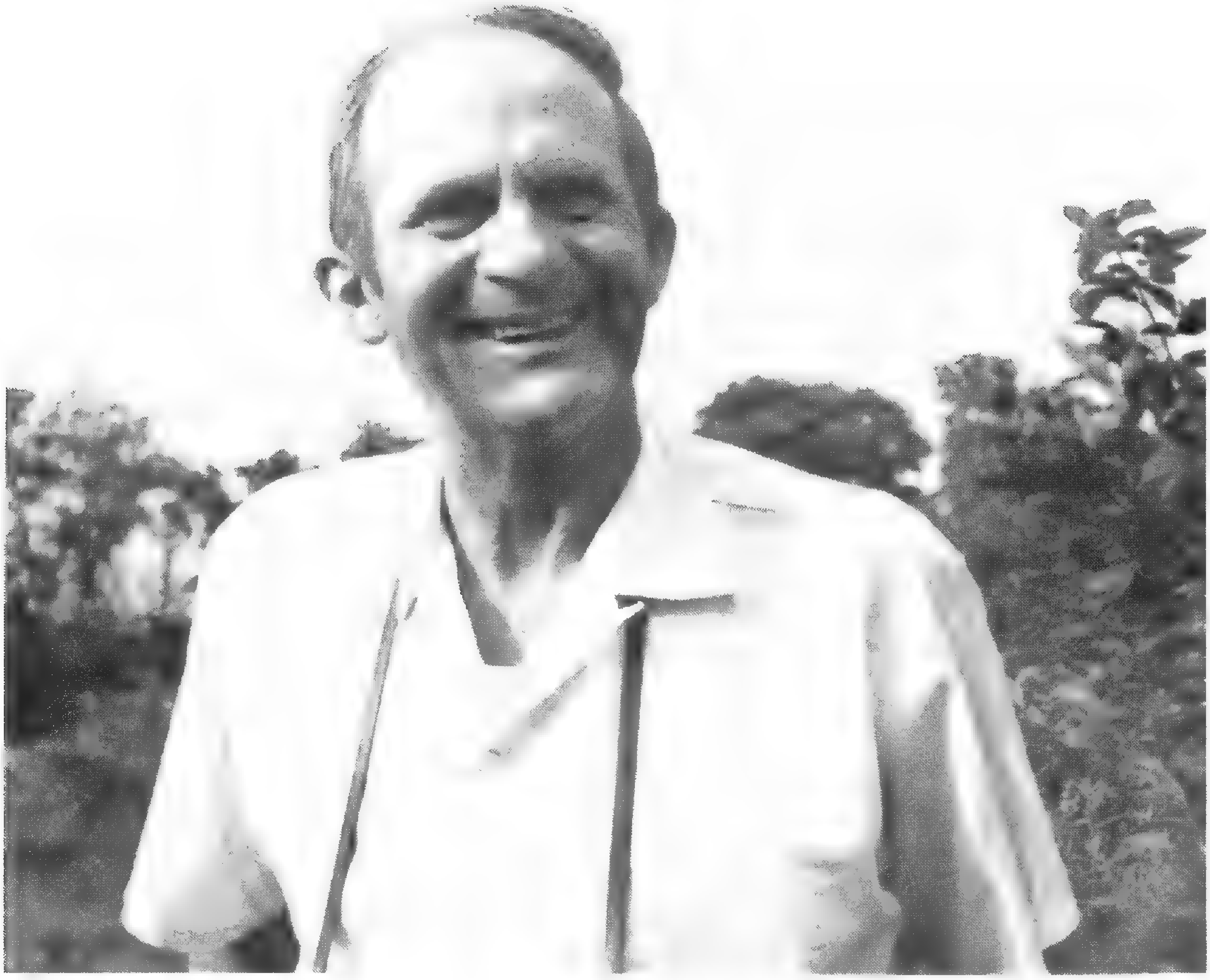
One of his remarkable qualities was a memory capable of storing and retrieving information on virtually all of those ca. 2,400 plants, even when he was well into his 60s. This knowledge wasn't limited to his New Jersey specialties, and every trip afield with him revealed powers of recall waiting to be tapped.

It wasn't unusual to be driving through some distant region, perhaps the lowlands of southeast Virginia or the Catskill high country, and have him deliver instructions to slow down for a dirt lane or old railroad bed that should be coming up after the next swale. He'd then recall how he'd found a certain plant there five or ten years earlier and proceed to track down its location from a stream crossing to a noteworthy grove of trees and on to an old foundation hole.

Although his knowledge of plant locales seemed staggering, it hardly filled his memory bank. Like many of the best and brightest born early in this century, he lacked a college education, but he was nonetheless a learned man. His appetite for books was voracious and his reading interests diverse.

Few topics arose on which he couldn't add an interesting fact or opinion, and when talk turned to natural history, as it usually did, there seemed no limit to the fields he'd explored. He was an expert birder. No plant description passed without a notation on the pertinent geological formation involved. He would surprise you now and then with a mushroom binomial or the growth habits of a lichen, and then delight you with a discourse on Indian artifacts. While you digested that, a sound in the underbrush would trigger discussion on the ranges of various chorus frogs.

Despite this impressive store of specialized knowledge, he was a man without pretension. He lived in the old house on the family chicken farm in Sergeantsville, a farm he worked until the 1950's, when he entered politics, and he paid little mind to the trends and fashions that clutter so many of our lives. His wry sense of humor rose to



the surface when he talked about poultry farming, and he always credited bad times in the chicken business as the spark that led to a career in public life. He would occasionally say, with a twinkle in his eye, that he still awoke now and then from a bad dream about raising brood hens.

Born in Yonkers, N.Y., on March 7, 1915, he came to the Sergeantsville farm with his family in 1921.

A successful Democratic office holder in a county dominated by Republicans, he won 20 consecutive elections after losing a sheriff contest in 1959. He served 11 years on the Hunterdon County Board of Chosen Freeholders, retiring in 1975. He also retired in 1975 after 20 years as a member of the Hunterdon Central Board of Education, and he retired in 1978 after 30 years as Delaware Township's tax collector–treasurer and custodian of school monies.

He was honored by 325 persons at a testimonial dinner in 1975. The large turnout attests to both his impact on people who knew him and to a long and varied list of affiliations.

He was a past director of the New Jersey Audubon Society, a past president of the Hunterdon County Nature Club and the Urner Ornithological Club, and a charter member, trustee, and past treasurer of the South Branch Watershed Association. Other memberships included the Philadelphia Botanical Club, the Torrey Botanical Club, the American Ornithologists Union and the Delaware Valley Ornithological Society.

He was a past president and charter member of the Sergeantsville Fire Co.; a life member and former captain and president of the Flemington–Raritan Rescue Squad; past president of the Hunterdon County Board of Taxation, and a past chairman of the Hunterdon County Heart Fund campaign.

He had been a member of the Hunterdon County Board of Agriculture; New Jersey Farm Bureau; the Flemington Auction Market; the Hunterdon County Poultry Association; the Locktown Grange; the Hunterdon County Historical Society; the Delaware Valley Protective Association; and Hunterdon County Red Cross.

He managed to balance the duties that came with each office, while finding time for tramping the woods and fields, slogging through bogs and reading late into the night in his book-lined sanctum sanctorum.

His appetite for books eventually led him to authorship. For many years he wrote a nature column for Hunterdon County Democrat, and a collection of the columns has been published as a book, "The Backyard Wilderness." A second book, "Wayside Simples and Grateful Herbs," pays homage to many of the plants he pursued and admired. His knowledge, style and keen eye for detail come through in both.

In *Bartonia,* he published: "A Check-List of the Flora of Hunterdon County, New Jersey" (47:23–30); "Status of Some North Jersey Wet Habitats" (47:37); "Loblolly Pine in Salem County, New Jersey" (47:41); and "Additions to the Flora of Hunterdon County, New Jersey" (48:11). His obituary of fellow New Jersey field botanist James Leland Edwards was published in *Torreya.*

To the residents of Hunterdon County, he leaves a fine system of parks and nature preserves. The land acquisition began during his tenure as freeholder, and he was instrumental in preserving these wild places for the future. An herbarium bearing his name is located at the county park headquarters, and it is no accident that one of Hunterdon's preserves holds New Jersey's only known station for *Viola canadensis.*

I recall one instance that sums up well the nature of this unique man, the country scholar who sought knowledge for its own sake and found no need to parade it before those he sensed would be uninterested.

It was late in Vince's life, when his health was failing and he was forced to curtail the outdoor exploring that meant so much to him. Three of his young proteges accompanied him to the Wawayanda Plateau, where years earlier he'd visited a station for *Lycopodium annotinum.* He wanted to know if it persisted but could no longer make the hike, so he sent us off with a typical set of directions geared to spring runs, slopes of land and growths of trees.

When we returned, we found the old Hunterdon County chicken farmer in the front seat of the car, occupying himself with a bit of light reading—a history of the Byzantine Empire.

It's our own sense of loss that surfaces when we realize moments such as that have come to an end.

## Postscript

In January 1984, the Hunterdon County freeholders designated a portion of the county arboretum as the Vincent Abraitys Wetland Study Area.

Bartonia No. 50: 54–56, 1984

# Botanical Discoveries of Vincent Abraitys

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Vincent Abraitys was a simple man. Unpretentious and direct. A man of quiet wit and unending enthusiasm. His seemingly infinite knowledge of all things natural was a continuous source of amazement and inspiration to all those who walked the waysides with him.

Although a writer of much talent and acclaim, Vince preferred a hand lens and his well-worn copy of Gray's "Eighth" to paper and pen. His bibliography, therefore, is not one to be compiled from the pages of our botanical journals. Rather, it is to be sought in the remote ravines, lost bogs, and roadside meadows of New Jersey's dwindling wilderness. For his botanical achievements are a living legacy to all of us who would follow in his footsteps.

His systematic exploration and documentation of New Jersey's flora began fairly late in his life, when he was entering his forties. Despite his late start, Vince was responsible for an impressive number of State records, relocations, and reinstatements of plants either new or rare to New Jersey.

The following is a listing of most of Vince's noteworthy botanical discoveries. The list is arranged chronologically and has been compiled from his field notes. In keeping with Vince's "keep it under your hat" policy, locations are approximate, so as to protect species from possible vandalism.

1957, Oct 5: *Prunus depressa:* Raven Rock, Hunterdon Co.; new station; previously known from 1 or 2 old Warren Co. collections.

1958, May: *Hybanthus concolor:* Frenchtown, Hunterdon Co.; new station, in 1965 relocated extensive pre-1900 station at Lambertville, Hunterdon Co.; known from 3 stations in NJ.

1958, Aug 25: *Rudbeckia fulgida:* Stockton, Hunterdon Co.; new station. 1 of 4 known for NJ.

1959, Apr 16: *Dicentra canadensis:* Lambertville, Hunterdon Co.; relocation of Mackenzie's 1922 station; 1 of 2 stations known for NJ. May 24: *Viola canadensis:* Bloomsbury; new station; first 20th century sighting of the species; only extant station known in NJ. Jun 3: *Rhododendron canadense:* Culvers Gap, Sussex Co.; new station, 1 of 5 or 6 reported for NJ. Aug 13: *Agastache scrophulariefolia:* near Raven Rock; new station; only extant station known.

1960, Jan 2: *Asplenium bradleyi:* Blairstown, Warren Co.; relocation of Wherry's 1935 station—years after it was reported destroyed. May 21: *Stellaria pubera:* Bull's Island, Hunterdon Co.; one of two 20th century stations known for the State. Jul 18: *Zygadenus leimanthoides:* Edinburg, Mercer Co.; new station, 1 of 2 extant NJ stations.

1962, Apr 21: *Ribes cynosbati:* Mt. Moe, Passaic Co.; new station; previously known from a few questionable old reports and collections. Aug 1: *Sagittaria cuneata:* Greendell, Sussex Co.; also 1978 station at Newton, Sussex Co.; only extant stations currently known. Sep 15: *Justicia americana:* Stockton, Hunterdon Co.; first sighting since early part of this century.

1963, Jun 12: *Cardamine longii:* Barnegat, Ocean Co.; new state record; also a 1971 station on the Delaware River in Burlington Co. Jun 15: *Eleocharis compressa:* Wallpack Bend, Sussex Co.; first sighting since Mackenzie discovered the species in NJ in the early 1920's. Jun 15: *Streptopus amplexifolius* var. *americanus:* Delaware Water Gap, Warren Co.; new state record; also a second site in Sussex Co. discovered in 1965. Jun 19: *Anemone canadensis:* Wallpack Bend, Sussex Co.; 1 of about 6 stations recorded for NJ. Jun 19: *Dicentra exima:* Delaware Water Gap, Warren Co.; relocation of Edward's 1933 station, which is the only unquestionably native site known in NJ. Jul 23: *Juncus greenei:* Prospertown, Monmouth Co.; one of several stations discovered by Abraitys for this rare rush. Sep 1: *Kuhnia eupatorioides:* Johnsonburg, Warren Co.; 1 of 3 stations for this species discovered in the state since the early part of this century.

Sep 11: *Hemicarpha micrantha:* Pompton Plains, Morris Co.; new station and is the only extant station currently known in NJ.

1964, Mar 24: *Picea rubens:* Bearfort Mountain, Passaic Co.; first of 5 new stations discovered by Abraitys. Mar 28: *Ribes glandulosum:* Kittatinny Mountain, Sussex Co.; relocation of Davis' station, the only verified site for the species in NJ. May 29: *Lathyrus venosus:* Holland Township, Hunterdon Co.; relocation of Porter's station, 1 of 2 stations ever reported for the species, and remains the only extant population. May 30: *Vicia caroliniana:* Phillipsburg, Warren Co.; first sighting of the species in NJ since the early part of this century. Jun 27: *Jeffersonia diphylla:* Johnsonburg, Warren Co.; new station, 1 of 3 known for NJ. Jul 28: *Hypericum spathulatum:* Colesville, Sussex Co.; new state record; 1 of 2 prolific colonies discovered, the second found in Warren Co. in 1965. Jul 28: *Prunus alleghaniensis:* Sand Brook, Hunterdon Co.; new station, 1 of 2 known in NJ and only extant station. Aug 10: *Aster junciformis:* Greendell, Sussex Co.; new station; first sighting of the species in the state since Mackenzie collected it in 1921. Aug 10: *Trollius laxus:* Greendell, Sussex Co.; new station and 1 of several additional ones discovered through the years by Abraitys.

1965, Apr 21: *Dentaria diphylla:* Buttermilk Falls, Sussex Co.; one of many stations found by Abraitys which demonstrated that this species was not an extreme rarity in NJ. Jul 7: *Thermopsis mollis:* Culver's Gap, Sussex Co.; new state record for this rare adventive. Aug 13: *Asimina triloba:* Frenchtown, Hunterdon Co.; relocation of Best's late 1800's station; also a 1976 station at Bordentown, Burlington Co. Aug 27: *Megalodonta beckii* (*Bidens beckii*): Byram Township, Sussex Co.; new station and only extant site known for the species in NJ. Sep 8: *Liatris borealis:* Keyport, Monmouth Co.; only modern record known. Sep 11: *Populus heterophylla:* Hancocks Bridge, Salem Co.; one of several stations discovered by Abraitys in Salem and Cumberland cos. Oct. 23: *Cyperus brevifolioides:* Beverly, Burlington Co.; new state record for this adventive; also a 1981 station in southern Cape May Co.

1966, May 18: *Aesculus octandra:* Bordentown, Burlington Co.; new state record; stations also in Gloucester and Somerset Co.; in 1976 Abraitys revisted the Bordentown colony and questioned whether it might not be *A. parvia*. Both species are probably escaped or adventive in NJ. May 18: *Magnolia tripetala:* Bordentown, Burlington Co.; first record since Long's 1938 collection in the same general area; probably adventive in NJ. Jul 31: *Milium effusum:* Netcong, Morris and Sussex Co.; new state record; a single colony on Morris and Sussex Co. line. Aug 24: *Xyris flexuosa:* Hampton Furnace, Burlington Co.; relocation of Stone's 1911 station; a new station discovered nearby in 1968 is the third record known for the species in NJ.

1967, Jul 17: *Vitis novae-angliae:* Colesville, Sussex Co.; perhaps only the second location in NJ. Sep 8: *Eupatorium altissimum:* New Village, Warren Co.; new state record; several additional stations discovered in Hunterdon and Somerset cos. in later years. Oct 20: *Hydrocotyle ranunculoides:* Mannington Meadow, Salem Co.; new state record. Nov 29: Ilex montana: Stokes State Forest, Sussex Co.; also a Passaic Co. site found in 1973; first modern records for NJ.

1968, Jan 28: *Pinus pungens:* Sergeantsville, Hunterdon Co.; revisitation of the single stand known for the species in NJ, which Abraitys had relocated previously. Apr 28: *Oryzopsis pungens:* High Point, Sussex Co.; relocation of Mackenzie's 1910 station, which is the only one known in the state. May 10: *Ranunculus fasicularis:* Wallpack Center, Sussex Co.; one of the few, if not the only correctly identified collections for this species in NJ. Aug 19: *Rhynchospora knieskernii:* Speedwell, Burlington Co.; three additional stations for this NJ/DE endemic were discovered in subsequent years. Sep 6: *Echinodorus tenellus:* Delanco, Burlington Co.; relocation of Stone's 1907 station, only station known for the species in NJ. Sep 25: *Pinus taeda:* Canton, Salem Co.; new station. See Bartonia 47:41 (the date of discovery is incorrectly given as "1967"). Oct 8: *Hydrocotyle sibthorpioides:* Trenton, Mercer Co.; state record for this rare adventive.

1969, Jun 4: *Juncus filiformis:* Bearfort Mountain, Passaic Co.; also a second station in Sussex Co.; only other known record is a pre-1900 collection from ballast at a Camden Co. shipyard. Jul 2: *Triglochin maritima:* Newton, Sussex Co.; relocation of Mackenzie's 1914 station, one of about 5 stations recorded for NJ. Jul 5: *Scirpus longii:* Parkdale, Camden Co.; an extensive stand.

1970, Oct 3: *Aster prenanthoides:* Near Layton, Sussex Co.; first modern record for species.

1971, Aug 11: *Rhynchospora rariflora:* Cape May Court House, Cape May Co.; a new station, only the second recorded for the species in NJ. Oct 4: *Sparganium angustifolium:* Green Pond, Morris Co.; first sighting of the species in NJ since 1884, only known station in NJ.

1972, Apr 7: *Arabis drummondi:* Cape May Point, Cape May Co.; relocation of NJ's only known station. Aug 9: *Platanthera peramoena:* Red Valley, Monmouth Co.; new station consisting of a single plant, last known sighting in NJ.

1973, Aug 17: *Anemone cylindrica:* Ogdensburg, Sussex Co.; relocation of NJ's only known extant population.

1974, Apr 24: *Ribes missouriense:* Devil's Tea Table, Hunterdon Co.; new state record.

1975: *Eleocharis verrucosa:* Sourland Mountain, Somerset Co.; new state record. Aug 30: *Agrimonia microcarpa:* Milford, Hunterdon Co. Only modern record known for the species.

1977, Jun 15: *Equisetum variegatum:* Marksboro, Warren Co.; new state record; southeasternmost station currently reported for the species in the U.S.; previous published accounts of the species occurrence in NJ have proven erroneous. Jun 22: *Carex crawei:* Near Layton, Sussex Co.; first known collection since early part of this century. Oct 18: *Potamogeton praelongus:* Swartswood Lake, Sussex Co.; relocation of Mackenzie's station of 1921.

1979, Sep 12: *Spiranthes ochroleuca:* Millbrook, Warren Co.; one of the few extant stations for the species currently known.

1981, May 6: *Amelanchier humilis* (*sanguinea*): Harmony, Warren Co.; first state record. May 7: *Amelanchier* × *intermedia:* Newton, Sussex Co.; perhaps the first record for this hybrid in NJ. Jun 23: *Carex polymorpha:* Chester, Morris Co.; first modern collection of this rare U.S. *Carex* in NJ.

1982; Jun 12: *Scirpus microcarpus* (*rubrotinctus*): Rosenkrans Ferry, Sussex Co.; the last species added to the list of NJ flora by Vincent Abraitys.

**Luigi Castiglioni's Viaggio: Travels in the United States of North America, 1785–1787,** translated and edited by Antonio Pace, with Natural History Commentary and Luigi Castiglioni's Botanical Observations translated by Antonio Pace and edited by Joseph and Nesta Ewan. 487 pp. Syracuse University Press, Syracuse, NY. 1983. $39.00

In an unsigned article in the *North American review* (July 13, 1821), ostensibly devoted to a review of Bigelow's *American medical botany,* Caleb Cushing takes the opportunity to expatiate on "the printed sources, from which a knowledge of our botany may be derived," in the course of which he remarks (p. 108):

> Before leaving the botanical works printed in the eighteenth century, we ought to mention some remarks on the most useful vegetables of the United States, forming a very considerable part of the Travels of Luigi Castiglioni, a gentleman of Milan, who passed nearly three years in this country between 1785 and 1787, and published a reputable account of his observations upon his return to Italy.

This is one of the few extant references in English to Castiglioni's visit to North America and the book he wrote about it. Though his work is mentioned in the bibliographies of Sabin and Pritzel and Meisel and, more recently, of Stafleu, he himself has remained until now a shadowy figure and his interesting work neglected. This is partly because of the language barrier. Cushing was a polyglott and could read Italian with ease. Nevertheless, other foreign-language accounts of travel in North America have been long available in English. The French account of Charlevoix was translated in 1761, that of Bossu in 1771. Pehr Kalm's Swedish (surely a more exotic language than Italian) was also translated in that year. Why has Castiglioni had to wait so long for a complete translation? Unlike those others he was an early traveller in post-revolutionary America and, for that reason alone, a translation might have been expected sooner. He was, of course, no Tocqueville, whether from timidity or conservatism or fear of censorship, but his narrative is interesting in other ways. It is now published here in a plain and pleasing English translation by Antonio Pace, eschewing what the translator calls "the lamentable idiosyncracies of the original."

It is a simple, sober, factual account of his visit to the New England states and into Canada, to the Carolinas and south as far as Georgia, to Virginia, Maryland, Delaware and Pennsylvania. Its popular appeal in Europe (always hungry for first-hand reports of journeys through America) was eclipsed by a native work that appeared in the following year, 1791, William Bartram's *Travels through North and South Carolina, Georgia, East and West Florida.* It has none of Bartram's romanticism and excitement, none of his high-flown passages or accounts of fights with alligators, which so appealed to the European public. What Castiglioni does share with William Bartram however, apart from an observant eye and an appetite for facts, is an admiration for Indians, and he even reproduces some of their langauges.

In his encounters with the great men of the time he is curiously reticent. He met Jefferson, Franklin, and Washington, but tells us nothing about them that we do not already know. He visited Bartram's garden, where he saw *Franklinia* growing, but he does not say anything of meeting William Bartram himself, who was then retired there.

What he does give us, in Pace's translation at least, is an account more to the modern taste than Bartram's (as if from the travel section of the *New York Times*) of an intelligent observer of the topography, climate, inhabitants, agriculture, industry, and natural history of the various states he passed through. It is highly readable and brings to our consciousness in a quiet way those early days of the new nation.

The Appendix, Castiglioni's *Observations on the most useful plants in the United States,* which occupies about a quarter of the present work, will be of the most interest to readers of *Bartonia.* This part, also translated by Pace, has been edited with customary thoroughness by Joseph and Nesta Ewan, who have also provided a list of Castiglioni's references as well as their own. It consists of a list of ninety-eight genera, mostly of trees and shrubs, with their species, followed by Latin diagnoses of each, references to the literature, common American names, and descriptive notes in the vernacular, sometimes quite extensive, embodying such details as may be of interest such as habitat, leaves, blossoms, fruits and medical and economic uses.

The editors remark "His influence on the progress of North American botany was negligible because of his language, place of publication, and his ultraconservative species concept." They also note that the few species that Castiglioni believed to be new and undescribed have all been reduced to synonyms by later botanists. His own American plant collections, which would have been of value, were lost in fording rivers. Nevertheless he has his own small part in the history of botany. He was the first to provide an illustration of *Franklinia* (reproduced here), preempting Bartram's plate in his *Travels*. "One can hope" he says "with good reason that this shrub can hold up in our Lombardy climate, since it flourishes in that of Pennsylvania." Can it? It would be an interesting thing to know. Ruiz and Pavon named a genus in the Euphorbiaceae for him, *Castiglionia,* but that has since been declared illegitimate.

The preparation and publication of this work were made possible by grants from the National Endowment from the Humanities, a very worthwhile use for federal funds.

This splendid book brings Luigi Castiglioni out of the undeserved obscurity in which he has languished as a chronicler of the young republic (why does Pace call him "an observer of colonial America"?) and a cataloguer of its more useful plants. The translator and the editors are to be commended. IAN MACPHAIL

**New Jersey Wild Plants,** by Mary Y. Hough. vii + 414 pp. Harmony Press, Harmony, NJ. 1983. $14.95

Needless to say, as a serious working field botanist who is preparing an illustrated flora of the New Jersey Pine Barrens, I was pleased to receive a copy of Mary Y. Hough's book on New Jersey Wild Plants. Both lower vascular plants, quillworts, club mosses, ferns and spike-mosses, and the more advanced conifers and flowering plants are included, for a total of over 2600 plants. This book is just the right size for a field guide, and occurs in paperback, and so I turned its pages eagerly. All the plants have been arranged alphabetically by their latin name, and the binomials used are largely those used in Gleason and Cronquist's Manual of the Vascular Plants of the United States and Adjacent Canada, with mention of those names which differ in Gray's Manual 8th edition, in which case the synonymy is mentioned. In cases where *both* names are now considered to be in error, she says, "the current name is provided". This is a puzzling statement, for if the names in Gleason and Cronquist, or Gray's Manual are not in error, then they, too, should be considered current. If just *one* of the manuals is in error, what was the basis for deciding? Perhaps with just a little more work (I realize the great amount of work that the project involved) Ms. Hough could have used the names from the most current checklist, The National List of Scientific

Plant names (USDA, Soil Conservation Survey bulletin TP-159), which gives us the names accepted by a large number of working botanists. Then, too, I feel that each bionomial should be accompanied by its author or authors. The older synonyms should be listed.

The book offers no keys, and no illustrations. It is intended as a supplement to field guides such as Newcomb's, Audubon, Peterson, Gray's, Britton and Brown, etc., and actually gives page numbers where the plant is described and/or illustrated. In addition the species are each accompanied by a dot map giving statewide locations of the plants, by counties. These dots are based on field reports, or data taken from herbarium sheets, and in many cases Ms. Hough indicates the year of the last field siting. She also gives several of the common names for each plant, and approximate blooming times, based on old data, often from herbarium sheets. Frequently, she makes comments on the plant, as to edibility or other use, or whether there is a nomenclatorial problem.

What, then are the problems that this book presents to the potential users? First, the book will not help a layman identify a plant. The lay-botanist must key out the plant correctly to begin with, then he or she can check Ms. Hough's book to see if it is reported for New Jersey. I would estimate that 80% or more of the plants are not readily accessible to the amateur botanist, unless he or she has spent many years with Gray's Manual or with Britton and Brown, or Gleason and Cronquist. Therefore the book must be geared towards the more professional type botanist or talented amateur. The latter would want the complete names and synonomies I have a feeling, and also would like to made aware of the vast degree of simplification which has occurred within the genus *Panicum,* due to the work of Gould and Clark.

My remaining comments have to do with printing and editing. Many of the page sequences are out of order in the center of my copy of the book, for example page 239 skips to 245, page 235 skips to 229, etc. There are misspellings: for example "*Albizia, Anthoxathum, Antirrhium, Arisaema draconitum, Glecoma, Hypochaeris, Trioda.*" So many that I cannot list them here. Next, the introductory material nearly needs a microscope to read, so great is the reduction from the original typewritten copy. The body of the book is also in small type, but the spacing makes it easier to read. There are a few species which I have seen which could be added (*Carex aestivalis*), and some instances of where a species listed as rare, are rather common (*Fimbristylis castanea*), although possibly common only locally.

In spite of its shortcomings Ms. Hough's book will be useful, it contains a lot of information, and it does not pretend to be anything more than a working supplement. Ms. Hough invites information that will help her update and correct the information contained. In the future, I think the book deserves larger type, and a thorough editing, the latest acceptable names (with synonyms from the past). There are far too few people around who appreciate the kind of work that Ms. Hough does, and she should have received more support and help. ALBERT LIST, JR.

ACADEMY NAMES NEW BOTANY CHAIRMAN. The Academy of Natural Sciences of Philadelphia has announced the appointment of a new Senior Curator and Chairman of its Botany Department. He is Dr. Benjamin Stone, currently at the University of Malaya, who will assume his post in the spring.

Dr. Stone has been at the University of Malaya since 1965 and is an internationally-recognized expert on plants of tropical Asia and the Pacific. In addition, he is knowledgeable in Asian economic botany and has been involved in a wide range of environmental policy issues. During recent years, he has served as a special consultant to Malaysia's Ministry of Science and Technology and worked with the World Wildlife Fund. Before going to Malaya, Dr. Stone was department chairman and a professor at the College of Guam. He received his B.A. from Pomona College in California and his Ph.D. from the University of Hawaii.

The Academys President, Dr. Peter Bennett says: "Dr. Stone's research interests and activities will immediately establish the Academy at the forefront of studies on Asian flora. In systematic botany, the Academy will be propelled into a leadership position in the study of a world-important class of plants." MIKE QUINN.

ANNUAL JOINT FIELD MEETING. The Northeastern Section of the Botanical Society of America, the Torrey Botanical Club, and the Philadelphia Botanical Club will hold their field meeting on June 17 to 20, 1984, in Salisbury, MD. Accommodations will be at Salisbury State College. There will be guided field trips to dunes, forests, swamps, and marshes at various sites on the Delmarva Peninsula in Maryland, Virginia, and Delaware. Space is limited and prior registration is required. Full details will be available after February 1, 1984, by writing to the Chairman, Dr. Larry H. Klotz, Dept. of Biology, Shippensburg University, Shippensburg, PA 17257 (717-532-1401). JAMES K. MCGRATH.

TWO NEW NATURE PRESERVES IN PINE BARRENS. The establishment of two unusual preserves in the southern region of New Jersey's Pine Barrens was announced on 21 March 1983 by two nonprofit conservation organizations. The sanctuaries were created in a cooperative project by the New Jersey Conservation Foundation, headquartered in Morristown, New Jersey, and The Nature Conservancy, a national organization with a local office in Philadelphia.

The land was set aside to protect important habitats for several of New Jersey's rarest and most endangered plants and animals. In Cape May County, near the town of Eldora, a 177-acre tract harboring 17 species of rare or endangered moths was donated to the New Jersey Conservation Foundation by Dr. C. Brooke Worth, a lepidopterist and naturalist. The Foundation subsequently transferred the property to The Nature Conservancy, which will manage the site as a natural area with special attention to the rare moths.

According to David J. Ennis, Land Fund Director of the New Jersey Conservation Foundation, years ago Dr. Worth recognized the importance of the site to moths and protected the property from gypsy moth spraying, one of the greatest threats to the site. The site has been studied by moth experts for many years and The Nature Conservancy plans to encourage future scientific research.

A similar joint venture of The Nature Conservancy and the New Jersey Conservation

Foundation has led to the creation of a nature preserve along the Manumuskin River in Cumberland County.

A 6.65-acre tract containing one of the Middle Atlantic region's most threatened habitat types, the freshwater tidal marsh, was donated by Jean Curnow, a Cumberland County resident.

Ms. Curnow donated the property in memory of her brother Paul Curnow to the New Jersey Conservation Foundation, which in turn transferred it to The Nature Conservancy to be managed as a natural area. According to Bud Cook, Director of The Nature Conservancy's Pennsylvania/New Jersey Office in Philadelphia, in addition to being an excellent example of a freshwater tidal marsh on one of New Jersey's most pristine rivers, the site supports the largest known population of the sensitive joint vetch (*Aeschynomene virginica*). Only three or four populations of the sensitive joint vetch, a member of the pea family, remain in the world. Cook said that habitat destruction is the major reason for the plant's rarity. Formerly found from North Carolina to New Jersey, today the plant is found only in Maryland and New Jersey, and Cook added that the Manumuskin River site contains the largest and healthiest population of this species.

Information about visits to both sanctuaries is available from The Nature Conservancy's Pennsylvania/New Jersey Office at 1218 Chestnut Street, Room 1002, Philadelphia, Pennsylvania 19107. BUD COOK AND PAT BAXTER.

BRYOLOGICAL/LICHENOLOGICAL COMMITTEE. This committee has been formed to pursue the following goals with the guidance and direction of Academy personnel: (1) Collect and identify fresh specimens in the Local Flora Area. (2) Set up procedures for accurate identification of each specimen before deposition into the herbarium including maintenance of a specimen log and specimen numbering system. (3) Initiate identification service for specimens submitted by interested bryologists and lichenologists and complete processing of identified specimens in the herbarium. (4) Establish authoritative sources for specimen numbers and current nomenclature. (5) Set up storage space for local collections on separate shelves from the general collections to minimize use of general herbarium specimens. (6) Hold hourly meetings of Committee as per regular Philadelphia Botanical Club meeting schedules (same night but one hour earlier—7 P.M.). (7) Set up coordinators for each plant group.

The committee is composed of nine volunteers who are serious amateur bryologists and lichenologists. The acquisition of Mr. Hans Wilkens' excellent collection of local bryophytes and lichens was a significant "highlight" of 1983. This important donation represents some fifty years of field collecting experience and contains many species rare or local in our area; a valuable source of reference material for both professionals and amateur bryologists. JAMES K. MCGRATH.

RARE PENNSYLVANIA PLANTS. The Morris Arboretum of the University of Pennsylvania has concluded the second year of the eastern Pennsylvania rare plant survey. Directed by Ann F. Rhoads, the Survey Team included Ann Newbold and Roger Latham and ranged over the eastern 37 counties of the state. Under a contract with the Pennsylvania Department of Environmental Resources (DER) the project is charged with determining the current status of species on the Pennsylvania Plants Special Concern List. Results of the survey along with data being gathered by the Western Pennsylvania Conservancy, have been used to evaluate species proposed for inclusion on the state rare plant list now being compiled. In addition information on all rare plant sites is being entered in the Pennsylvania Natural Diversity Inventory data base in Harrisburg.

During the 1982 and 1983 seasons all areas of Delaware River intertidal marsh from Morrisville south were visited, including Little Tinicum Island which was recently acquired by DER and designated as a State Forest Natural Area. Healthy populations were found of a number of species limited to this endangered habitat: *Amaranthus cannabinus, Bidens bidentoides, Echinochloa walteri, Eleocharis obtusa* var. *peasei, Isoetes riparia, Sagittaria calycina* var. *spongiosa, Sagittaria subulata, Scirpus fluviatilis, Scirpus smithii,* and *Zizania aquatica.* Other species such as *Aeschynomene virginica, Elatine americana, Eriocaulon parkeri, Eryngium aquaticum, Limosella subulata, Micranthemum micranthemoides,* and *Tillaea aquatica* could not be found and are presumed extirpated from the state. Habitat degradation has been a severe problem along the lower Delaware. Fortunately several of the remaining areas are state or municipally owned. The Nature Conservancy is currently pursuing means of protecting additional sites.

Another focus of the rare plant survey has been serpentine barrens species. In the past two years the survey team has visited all existing serpentine barrens in the state. These sites range in area from less than two acres to several hundred acres and stretch across Delaware, Chester, and southern Lancaster counties. Species of interest are *Aster depauperatus* and *Talinum teretifolium* which are represented by healthy populations on fifteen and twelve barrens, respectively. *Fimbristylis annua,* another barrens species, was observed at a number of locations. Less frequent were *Carex bicknellii* (one site) and *Sporobolis heterolepis* (three sites). *Cerastium arvense* var. *villosissimum* is known only from the type locality along Octararo Creek in Chester County.

Searching islands and shores of the lower Susquehanna with the help of Dr. James Parks, the team was successful in locating populations of *Asplenium bradleyi, Sida hermaphrodita, Rotala ramosior, Cyperus refractus, Solidago spathulata* ssp. *randii* var. *racemosa,* and *Dichanthelium commutatum.* Not found, but formerly reported from that area, were *Boltonia asteroides, Vitis rupestris, Phoradendron serotinum,* and *Phyllanthus caroliniensis.*

Upstream on the west branch of the Susquehanna River and its tributary, Pine Creek, the team located a healthy population of *Cryptogramma stelleri* and several large stands of *Isoetes riparia.* A second *Cryptogramma* site reported in Lycoming County could not be found.

On the east bank of the Susquehanna River in Northumberland County is an extensive sand dune deposit dating from the glacial period. The area contains a number of species more common in the southeastern counties, including *Carex bullata, Scirpus fluviatilis, Woodwardia virginica,* and *Bartonia virginica.* Only the first two were of direct interest to the rare plant survey.

In northeastern Pennsylvania a number of lakes were visited to record populations of *Myriophyllum tenellum, Eleocharis robbinsii, Lobelia dortmanna, Sparganium fluctuans,* and *S. emersum* (*angustifolium*). Microscopic examination of the macrospores of *Isoetes* collected at these sites showed them to be other than *I. riparia* contrary to earlier reports. Several northern bog species including *Scheuchzeria palustris, Eriophorum tenellum,* and *Amelanchier bartramiana* were not found despite repeated searching.

Three mountain top sites in the northeast were found to support thriving populations of *Potentilla tridentata*. However, *Oryzopsis pungens* from similar habitats could not be located.

A search of waterfalls in Pike, Monroe, and Carbon counties confirmed the presence of three small colonies of *Lycopodium porophilum*. Two had to be viewed with binoculars as they grow high on vertical rock cliffs in the mist zone of the falls. A report of *Lycopodium selago* at the Delaware Water Gap could not be confirmed despite extensive searches on several different days.

The survey team canoed 20 miles of the middle Delaware with the cooperation of staff of the Delaware Water Gap National Recreation Area and found several vigorous populations of *Prunus pumila* on islands in the river. Other interesting finds were *Aster ericoides* and *Isoetes riparia*.

Franklin Buser of Stroudsburg accompanied the team on numerous trips in Northampton, Monroe, and Pike county areas. Exploration of some of the few remaining fen areas turned up two new sites for *Trollius laxus*, a species under consideration for federal listing. Other fen species previously recorded by the team were *Rhynchospora capillacea, Scleria verticillata, Lobelia kalmii,* and *Potentilla fruticosa*. Not found were *Salix serissima, Cyripedium candidum, Cyripedium parviflorum,* and *Carex tetanica*. Sand and gravel mining has drastically reduced the once extensive limestone wetlands in Northampton County.

While good progress has been made in updating information on populations of rare plant species, more remains to be done. Establishment of the Wild Resources Conservation Fund and inclusion of the Pennsylvania Natural Diversity Inventory in the Bureau of Forestry in Harrisburg augers well for continued emphasis on identification and preservation of our natural heritage. ANN F. RHOADS.

NEW PENNSYLVANIA LOCALITY FOR *CRYPTOGRAMMA STELLERI*. *Cryptogramma stelleri* is a boreal fern species reported from only three localities in Pennsylvania: two in Sullivan County and one in Lycoming County (Wherry, Fogg, and Wahl, *Atlas of the Flora of Pennsylvania*, 1979). I have recently located a population of some eight plants near the Blair-Cambria County line in an area called Bells Gap. They are located in a remote ravine growing on a southeastern exposure of calcareous sandstone, probably the Loyalhanna member of the Mauch Chunk formation. The exposure is shaded by mature hemlock (*Tsuga*), tulip poplar (*Liriodendron*), and yellow birch (*Betula lutea*). Associated fern species include maidenhair spleenwort and walking fern (*Asplenium trichomanes* and *A. rhizophyllum*). This new locality is over 100 miles southwest of the closest known Pennsylvania station and over 150 miles from the closest station in West Virginia (Strausbaugh and Core, *Flora of West Virginia*, 1980). Botanists are encouraged to search ravines along the Allegheny front for additional populations of this fern which is on the Pennsylvania endangered species list (Wiegman, *Rare and Endangered Vascular Plant Species in Pennsylvania*, 1979). Voucher specimens are on deposit at the Millersville University herbarium, MVSC. J. C. PARKS.

*POTAMOGETON CONFERVOIDES* IN CUMBERLAND COUNTY, NEW JERSEY. On 12 June 1982, while leading a Philadelphia Botanical Club field trip to Bear Swamp West, in Cumberland County, New Jersey, I found an extensive stand of *Potamogeton confervoides* in a shallow pond immediately adjacent to a much larger pond formed by glass-sand mining activities carried out until recently. On 23 July 1983, the site was revisited by A. E. Schuyler, Dan O'Connor, and me; the plant was growing profusely in the above-mentioned shallow pond, and in the large pond as well. The larger portion of the stand, in the shallow pond, is about 25 m in length.

In New Jersey, *Potamogeton confervoides* is considered to be rare. Snyder and Vivian, in *Rare and Endangered Vascular Plant Species in New Jersey,* 1981, list it as of undetermined status, declining, and at the southern limit of its range. They go on to say, "The only recent report is from Ocean Co. (Abraitys 1973). Reported from a pond on the Kittatiny Mountain Range in Warren Co. by J. L. Edwards. Possibly overlooked."

It is of interest that *Potamogeton confervoides* was recently collected in South Carolina for the first time, by Cecil C. Frost, in May 1979 (Castanea 45: 146–147, 1980). The new site, in a beaver pond in Sand Hill State Forest, Chesterfield County, is contiguous with previously known sites for the species in Scotland, Richmond, and Moore counties, North Carolina; these sites represent a disjunction of 700 km from southern New Jersey (Frost, loc. cit.).

On the 1983 visit to the Bear Swamp site, Schuyler noticed spatulate leaves on one or two individuals of the species. This is interesting, because the plant is traditionally described in manuals as having linear leaves only, these being entirely submersed. The spatulate leaves were small and also submersed, a few centimeters below the surface.

Other aquatic plants occurring at the site included *Sagittaria engelmanniana, Eleocharis microcarpa, Scirpus cyperinus, S. subterminalis, Triadenum virginicum, Myriophyllum humile, Juncus effusus, J. pelocarpus, J. subcaudatus, Utricularia geminiscapa, U. vulgaris,* and *Decodon verticillatus.*

A voucher specimen is on deposit at the Academy (Heckscher 502, 4.1 km E of Newport) and photographs taken in situ and in the laboratory of living material are on file at the Natural Lands Trust field office, Hildacy Farm, 1031 Palmers Mill Road, Media, PA 19063 (Natural Lands Trust photos C6-17, C6-22, C6-23, C8-18).

I thank Club member James McGrath for assistance with the identification. STEVENS HECKSCHER.

FIELD UPDATE ON *SCIRPUS LONGII.* During 1983 I searched for *Scirpus longii* in the New Jersey Pine Barrens to get better knowledge of its distribution and abundance there. With the help of David Snyder, Ted Gordon, and Patricia Schuyler, I found plants at six localities—about 25% of the recorded localities for this species in New Jersey. If further searching had been conducted, I am sure it could have been found at many more localities. Finding plants of *Scirpus longii* is difficult because it rarely produces culms and often grows with similar appearing sedges lacking culms. Vegetative plants, even when locally abundant, usually go unrecognized because structural features associated with culms are not available to aid in identification. At two of the six localities visited in 1983, plants were found with culms developing during August—two months later than usual for culm formation in this species. A wet spring and a hot dry summer may be responsible for this unusual situation.

Habitats for *Scirpus longii* are peaty depressions dominated by sedges although they may also be comparatively open with *Sphagnum* and dried algal mats. The most extensive stand (4.4 km NE of Atsion) had vegetative plants of *S. longii* mixed with *Cladium mariscoides, Carex bullata,* and *Juncus canadensis* for a distance of about 120 meters. A pure stand covering 75 square meters (2 km SW of Atsion) had numerous plants with culms that grew lower in the depression than adjacent plants of *Carex* *walteriana* and *Woodwardia virginica*. In another stand about the same size (2.3 km E of Atsion), which lacked culms, *S. longii* was mixed with fewer plants of *Carex walteriana* in a depression also having a stand of *Muhlenbergia torreyana*. Near the headwaters of the Gun Branch of the Mullica River (4 km NE of Elm) about 50 scattered plants of *S. longii* that lacked culms occurred with scattered plants of *Carex walteriana*. The two remaining localities visited had only a few plants of *S. longii:* one where plants lacked culms (2 km NE of Atsion) and one where plants had culms (6.1 km W of Forked River). ALFRED E. SCHUYLER.

*NELUMBO LUTEA* IN CECIL COUNTY, MARYLAND. On 20 July 1982, while searching the shoreline of Back Creek, a tributary of Maryland's Sassafras River, I discovered an extensive stand of the American lotus, *Nelumbo lutea* (= *pentapetala*). The stand is on property of the Mt. Harmon Plantation, near Cecilton. Mt. Harmon belongs to the National Trust for Historic Preservation and the natural lands on the plantation property are managed by the Natural Lands Trust.

On 3 August 1983, while I was accompanied by Virginia Parks, D. Daniel Boone, and Wayne Klockner, stands of the lotus were observed within a circle of radius of about one kilometer. By far the largest was on the shore of the Sassafras River and was estimated to be about 2 hectares. Boone and Klockner also discovered a small stand of *Limosella subulata* which was abundant in association with *Scirpus pungens* in the narrow intertidal zone of Back Creek about one meter wide.

According to Boone (pers. comm.), there is no other known extant station for *Nelumbo lutea* on the Delmarva Peninsula. In addition to the present station, the only other known extant Maryland station is in Charles County (Broome et al., *Rare and Endangered Vascular Plant Species in Maryland,* 1979). Probably the nearest station to this one in Cecil County is the one in Salem County, New Jersey (Schuyler, Bartonia 47: 41, 1980).

Earlier records show that the lotus was formerly more widespread in the region than it is at present. A collection (specimen at the Academy) was made from the St. Jones River in Kent County, Delaware, where the plant was probably last recorded in 1945 (Tucker et al., *Rare and Endangered Vascular Plant Species in Delaware,* 1979). The lotus is also reported as having been "rare in New Castle County," Delaware, in 1930, but now probably extirpated from that state (Tucker et al., op. cit.). *Nelumbo lutea* is generally considered to be uncommon even in the heart of its range, the southern U.S. coastal plain, but it is often extremely abundant where it is found, as in the present instance.

A voucher specimen for the lotus at the new station is at the Academy. Photographs of *Nelumbo* (C5-19 through C5-31, and C5-42) and *Limosella* (C5-38) are deposited at the field office of the Natural Lands Trust, Hildacy Farm, 1031 Palmers Mill Road, Media, PA 19063. STEVENS HECKSCHER.

RUTH PATRICK HONORED. On November 11, 1983, Dr. Ruth Patrick was honored for her 50 years at the Academy. Dr. Patrick was recognized for her service to the Academy, her research and administrative accomplishments, her many awards and honors, and for her contributions to environmental sciences. In tribute to her distinguished career, the Academy's Division of Environmental Research in Philadelphia was designated the Patrick Center for Environmental Research. ALFRED E. SCHUYLER.

## FIELD TRIP REPORTS

April 10, 1982: Tyler Arboretum, Lima, Delaware County, PA. The early spring flora was somewhat late this year. A few individual blooming plants of the usual species were observed while *Viola rotundifolia,* the main attraction of this trip, was not in bloom on this date. Leader: John Ballas.

April 18, 1982: Stiles Estate, Mt. Bethel, Northampton County, PA. Approximately 16 people attended this trip to Getz Swamp, a limestone fen in Upper Bethel Township, and were rewarded with an abundant show of *Trollius laxus* in full bloom. Because of the very early date, little else was in flower. Club members were warned of the poison sumac which was also fairly abundant. Leader: Tom Dolan.

May 9, 1982: Berks County, PA. It was perfect weather for a field trip for the 21 people who attended. In the sloping, rocky, non-climax woods of the Fronheiser Estate off Weinsteiger Road, Washington Township, Bechtelsville, we saw several acres of *Hydrastis canadensis,* some still in bloom but most just past their prime. The woods were full of other spring blooms: *Viola rostrata, hirsutula,* and *sororia, Anemonella thalictroides, Saxifraga virginiensis, Podophyllum peltatum, Cimicifuga racemosa, Polygonatum pubescens,* and *Smilacina racemosa.* At Crow Hill Road in Dale, another wooded, but steeper hillside produced much *Cypripedium pubescens* with three plants of *Panax quinquefolia* mixed in. *Orchis spectabilis* also was noted in the same woods. About a mile to the north, *Poa alsodes* was on a small dirt road leading into the woods. The forest floor seemed covered with *Maianthemum canadense, Panax trifoliata,* six species of *Viola,* and *Polygala paucifolia.* In wetter ground, *Saxifraga pensylvanica* grew with *Veratrum viride.* A fitting end to the day occurred when *Hydrastis* was found on a wooded hill back at the Newbold property. Leader: Ann Newbold.

May 16, 1982: Nolde Forest State Park, Reading, PA. There were about a dozen participants, half of them from the Muhlenberg Botanical Society of Lancaster. A few of the early spring flowers were still in bloom. *Floerkea proserpinacoides* was on the bank of the lower parking lot. We went a short distance down the valley of Angelica Creek, then up the slope to the west. Here we saw a small *Asimina triloba* in fine flower. After lunch we went a short distance up Punches Run, then up the steep slope to the Conference Center. We were able to visit only a small part of the park. Leader: Hans Wilkens.

May 23, 1982: Vineland, Cumberland County, NJ. Three unusual plants for the state were found: (1) the largest specimen recorded of *Carya pallida* with a height of 94 ft, a crown diameter of 86 ft, a trunk diameter of $11^1/_2$ ft, and an estimated age of 300 years; (2) *Chionanthus virginicus,* a rare species in the state; and (3) *Isatis tinctoria,* an European weed and source of blue dye. Leaders: Theresa Filippi and Steve Field.

June 6, 1982: Lower Bear and Upper Bear Islands, Susquehanna River, Lancaster County, PA. The 13 botanists were rewarded with sunshine, spectacular scenery, and diverse plant communities. On Lower Bear we traversed the powerline clearing and found *Arisaema dracontium, Ascyrum hypericoides, Cacalia atriplicifolia, Euphorbia corollata, Oxalis violacea, Phacelia dubia, Rhododendron viscosum, Spartina pec-*

*tinata, Stipa avenacea,* and *Tripsacum dactyloides.* At the northern end of Lower Bear *Asplenium montanum* grew in abundance on the sheer cliffs. Upper Bear Island, the largest and least disturbed of the Conowingo Islands, supports marshes, ponds, windswept rocky outcrops, alluvial bottomland, and virgin hemlock-beech forest. Noteworthy species identified included *Asimina triloba, Chionanthus virginicus, Euonymus americanus, Hibiscus laevis, Hybanthus concolor, Ilex opaca, Lilium superbum, Lorinseria areolata, Saururus cernuus,* and *Scutellaria serrata.* Leader: Nancy Kuntzleman.

June 12, 1982: Bear Swamp West, Cumberland County, NJ. Two distinct plant communities in little-known Bear Swamp West were visited. The first consists of three clear, acidic ponds which have filled abandoned pits made by glass-sand mining activities earlier in the century. These ponds have developed an interesting aquatic and hydric flora, including the following species found by the group: *Carex crinita, C. intumescens, Decodon verticillatus, Drosera intermedia, Juncus effusus* var. *compactus, Lycopodium appressum, Myriophyllum humile, Pogonia ophioglossoides, Potamogeton confervoides, Scirpus pungens, Sparganium americanum, Utricularia fibrosa, U. subulata, Viola lanceolata.* The second plant community visited by the group is a mature swamp forest which is quite possibly a remnant of primary forest. Where the group penetrated this forest, the canopy is dominated by huge specimens of *Nyssa sylvatica,* with large *Acer rubrum* and *Magnolia virginiana* in the subcanopy and understory, and *Ilex opaca* with *Clethra alnifolia* as smaller trees or shrubs. *Osmunda cinnamomea* is dominant at the herbaceous level, and *Phoradendron flavescens* is parasitic on *Nyssa* at one station. *Itea virginica* was in flower at a wet, open spot at the edge of the forest. *Aletris farinosa* was flowering in a vehicle track through sand in an outlying area of oak-pine forest. Leader: Stevens Heckscher.

July 18, 1982: Clark's Pond, Fairton, Cumberland County, NJ. Eight members met at the railroad tracks on Rt. 553 and botanized the road edge, railroad bed, old fields, and pond edge. A list of 175 species and one oak hybrid of uncertain parentage was compiled. The interesting species seen included: *Chondrilla juncea, Scirpus subterminalis, Utricularia purpurea, Saururus cernuus, Panicum sphaerocarpon, Panicum dichotomum, Panicum lanuginosum* var. *fasciculatum,* and *Carex muhlenbergii.* Leader: Joe Arsenault.

August 7, 1982: Ridley Creek State Park, Delaware County, PA. Nine members explored Ridley Creek from Barren and Sycamore Mills Road north and just upstream from Baltimore Pike where we found the following: *Helianthus decapetalus, Tovara virginiana, Cryptotaenia canadensis, Panicum dichotomum, Panicum clandestinum, Solidago flexicaulis, Osmorhiza longistylis, Aster cordifolius, Staphylea trifoliata, Carex glaucodea, Aster lateriflorus, Festuca ovina, Microstegium vimineum, Commelina communis, Arctium minus, Eupatorium rugosum, Carya cordiformis Amphicarpa bracteata, Alliaria officinalis, Tilia americana, Humulus japonica, Pilea pumila, Elymus villosus, Elymus riparius, Verbena urticifolia, Polygonum cuspidatum, Eupatorium fistulosum, Polygonum scandens, Sicyos angulatus, Geum canadensis, Urtica gracilis, Impatiens pallida, I. capensis, Fraxinus pennsylvanica, Galium triflorum, Polygonatum canaliculatum, Smilacina racemosa, Zizia aurea, Prunus serotina, Celastrus scandens, Laportea canandensis, Plantago rugellii, Agropyron repens, Juglans* *nigra, J. cinerea, Parthenocissus* sp., *Athyrium filix-femina, Athyrium thelypteroides, Polystichum acrostichoides, Circaea quadrisulcata, Dennstaedtia punctilobula, Chelidonium majus, Vitis aestivalis, Gymnocladus dioica, Carya ovata, Castanea dentata, Acer negundo Hamamelis virginiana, Mitchella repens, Rhododendron nudiflorum, Prenanthes altissima, Hieracium paniculatum, Eupatorium perfoliatum, Malus* sp., *Prunella vulgaris, Elodea canadensis, Lindernia dubia, Cuscuta* sp., *Heracleum lanatum, Polygonum perfoliatum, Cicuta maculata, Galium asprellum, Podostemum ceratophyllum, Carpinus caroliniana, Rubus phoenicolasius, Agastache nepetoides.* A side trip was made to Gleave L. Baker Park, Baltimore Pike, Media, which yielded the following: *Marsilea quadrifolia, Hydrocotyle ranunculoides, Heteranthera reniformis, Myosotis scorpiodes, Juncus tenuis, Typha latifolia, Arthraxon hispidus, Nuphar lutea, Cornus amomum, Penthorum sedoides, Nasturtium officinale, Lythrum salicaria, Mimulus alatus, M. ringens, Juncus effusus, Rudbeckia laciniata, Ludwigia palustris, Ceratophyllum demersum, Vitis labrusca, Agrimonia parviflora, Verbena hastata, Desmodium canadense, Eupatorium dubium, Achillea millefolium, Phragmites australis, Helenium nudiflorum, Peltandra virginica, Hypericum mutilum, Vernonia noveboraceneis, Ludwigia alternifolia, Phytolacca americana, Teucrium canadense, Polygonum punctatum, Polygonum pensylvanicum, Lycopus americanus, Boehmeria cylindrica, Carex frankii, Lindera benzoin, Sparganium americanum, Sagittaria australis, Cinna arundinacea, Arisaema triphyllum, Epilobium coloratum, Alisma triviale, Hypericum punctatum, Callitriche stagnalis, Alnus serrulata, Scirpus georgianus, Echinochloa crusgalli, Lobelia inflata, Eleocharis obtusa.* Leader: Fred Arnold.

August 29, 1982: St. Peter's Village, Chester County, PA. Ten club members went along and studied the flora in abandoned fields and old ponds adjacent to the railroad bed leading north from Trythall Rd. to just west of St. Peter's Village. There was an unusual show of *Lobelia cardinalis* as well as *L. siphilitica, Sparganium americanum, Sagittaria rigida,* and a few plants of *Sabatia angularis*. There also was a good showing of *Pedicularis lanceolata*. There were not many woody plants of special interest except perhaps *Ilex verticillata* and *Cephalanthus occidentalis*. Leader: Carl Williams.

September 11, 1982: Willisbrook Meadow Wild Life Reserve, Willisbrook Township, Chester County, PA. That portion of the Sugartown Barrens now included in the Willisbrook Meadow Wildlife Preserve of the Natural Lands Trust, as well as parts of the Barrens not currently under protection, were visited by about 20 Club members and guests. The Sugartown Barrens is a serpentine outcropping which supports a flora rich in the specialties expected to occur over this soil type. Among these were noted: *Fimbristylis annua, Spiranthes gracilis, Polygonum tenue, Aster depauperatus, A. lateriflorus, A. dumosus, Asclepias verticillata, Sorghastrum nutans, Pycnanthemum tenuifolium, Pinus virginiana, Agalinus purpurea, Scleria pauciflora, Senecio smallii, Agrostis alba, Panicum oligosanthes, Deschampsia caespitosa, Linum medium, Polygala verticillata, Ceanothus americanus, Eragrostis spectabilis, Solidago juncea, S. graminifolia, Sporobolus vaginiflorus, Aristida dichotoma, Andropogon scoparius, Cyperus aristatus, Echinochloa crusgalli, Talinum teretifolium, Panicum spaerocarpon, Danthonia spicata, Cerastium arvense* var. *villosum.* Leader: Stevens Heckscher.

September 12, 1982: Aquatic Plants of Swartswood Lake, NJ. With some of us in boats and others on shore, we explored the southeast side of Swartswood Lake between Dove Island and the northeast end. In shallow water near the shore we saw *Peltandra virginica* and *Saururus cernuus*. In water up to about one meter deep, *Najas flexilis* was the most abundant submergent. Also in water about this depth were numerous plants of *Potamogeton perfoliatus, P. robbinsii,* and *Elodea nuttallii* along with fewer plants of *Potamogeton gramineus*. In water about two meters deep, *Myriophyllum spicatum* and *Potamogeton praelongus* were abundant. Some of the former were flowering but there was no sign of flowering in the latter here at its only New Jersey locality. *Bidens beckii,* previously known from this lake, was not found. In the cove south of Dove Island, *Nuphar lutea* and *Nymphaea odorata* were abundant. Emergent peltate leaves of *Nelumbo pentapetala* were visible from the highway along the northwest side of the lake at the north end. Some of us also made a stop at nearby Frog Pond to see *Boltonia asteroides*. Leader: Alfred E. Schuyler.

September 18, 1982: Bulls Island, Hunterdon County, NJ. Over 70 species of plants were noted on this visit to an island in the Delaware River, and to nearby areas. Pteridophytes included: *Woodsia obtusa, Pellaea glabella,* and *Cystopteris fragilis,* growing in masonry walls, as well as *Equisetum hyemale, E. arvense,* and *Matteuccia struthiopteris*. Grasses of interest included *Bromus latiglumis, Cinna arundinacea, Elymus riparius, Andropogon gerardii,* and *Sorghastrum nutans*. Other plants included *Celtis occidentalis, Laportea canadensis, Mirabilis nyctaginea, Humulus japonica, Menispermum canadense, Lindera benzoin, Physocarpus opulifolius, Amorpha fruticosa, Strophostyles helvola, Geranium nepalense, Ptelea trifoliata, Euphorbia corollata, Impatiens pallida, I. capensis, Gaura biennis, Anthriscus sylvestris, Perilla frutescens, Collinsonia canadensis, Helianthus tuberosus, Heliopsis helianthoides, Verbesina alternifolia,* and *Picris hieracioides*. Leader: Karl Anderson.

September 19, 1982: Clark's Landing, Mullica River, Atlantic County, NJ. We botanized the pine-oak island, brackish marsh, and adjacent upland habitats and recorded a list of taxa which represents the local flora. The surrounding brackish marshes were dominated by four species of *Spartina* (*patens, alterniflora, cynosuroides, pectinata*), *Scirpus americanus* × *pungens, S. pungens, S. validus,* and *Typha angustifolia*. The pine-oak island was dominated by *Juniperus virginiana, Pinus rigida, Quercus falcata, Q. marilandica, Q. stellata, Q. alba,* and *Q. velutina*. The surrounding uplands were dominated by similar species and graded down to a *Chamaecyparis-Acer-Nyssa* swamp which abutted the marsh. Leader: Joe Arsenault.

November 21, 1982: Tinicum National Environmental Center, Philadelphia, PA. An informative foray was made of Tinicum's interesting galls, their makers, and relationship to various plant species. Leader: John D. Sacksteder.

April 2, 1983: Tyler Arboretum, Lima, PA. This is our second spring field trip to see *Viola rotundifolia* in bloom, without success! The species is abundant at this locality but its actual blooming dates are much later than anticipated. The usual spring flora was present but not at its peak on this date. Leader: John Ballas.

April 17, 1983: Lebanon State Forest, NJ. A group of enthusiastic bryologists and lichenologists in the Ongs Hot and McDonald's Branch areas recorded the following interesting species: Mosses: *Thelia hirtella, T. asperella, Aulacomnium palustre, Ulota crispa, Dicranum scoparium, Rhynchostegium serratum, Polytrichum commune, P. jun-*

*iperinum, P. ohioense, Ceratodon purpureus,* and *Entondon seductrix.* Lichens: *Cladonia submitis, C. uncialis, C. atlantica, C. chlorophaea, C. strepsilis, C. coniocrea, C. calycantha, C. cristatella, C. squamosa,* and *C. bacillaris, Parmelia caperata, P. rudecta, P. saxatilis, P. perforata, Parmeliopsis aleurites, Phaeophyscia adiastola, P. rubropulchra, Physcia millegrana, Candelaria concolor,* and *Biatora uliginosa.* At McDonald's Branch, noteworthy mosses were: *Sphagnum magellanicum, S. flavicomans,* and *Taxiphyllum deplanatum.* An interesting *Cladonia* species on hammocks in the White Cedar bogs proved to be *Cladonia santensis.* Leader: Paul Driver.

May 1, 1983: Tyler Arboretum and Paoli, PA. The effects of chemical and thermal pollution upon lichen species near Philadelphia make it difficult to find good field trip localities. We made two worthwhile visits to the above areas which yielded an attractive diversity of species. At Tyler Arboretum: *Dermatacarpum fluviatile, Graphis scripta, Physconia pulverulenta, Caloplaca cerina, C. aurantiaca, Lecanora hagenii, Lecide albocaerulescens* were noted. The Paoli locality is in a rapidly expanding industrial complex and has a remarkable variety of *Cladonia* species. Lichenologists were able to collect fine specimens of *Cladonia cristatella, C. pleurota, C. chlorophaea, C. verticillata, C. rei, C. macilenta, C. squamosa, C. apodocarpa, C. coniocrea, C. mitrula,* and *C. strepsilis.* Leader: Jim McGrath.

June 4, 1983: Goat Hill Serpentine Barrens, West Nottingham Township, Chester County, PA. We visited one of the largest serpentine barrens in the eastern U.S. Serpentine soils throughout the world harbor a peculiar flora. Goat Hill is no exception! We traversed the area beneath the transmission line west of Red Pump Road. Noteworthy species encountered included: *Acerates viridflora, Adiantum pedatum, Amianthium muscaetoxicum, Arenaria stricta, Baptisia tinctoria, Ceanothus americanus, Cerastium arvense* var. *villosum, Chamaelirium luteum, Liparis loeselii, Oenothera fruticosa, Pinus rigida, Quercus marilandica, Q. prinoides, Q. stellata, Salix tristis, Sisyrinchium mucronatum, Talinum teretifolium, Vaccinium stamineum,* and *Viola sagittata.* Leader: Nancy Kuntzleman.

June 11, 1983: Bear Swamp East, Cumberland County, NJ. This trip censused an area of Bear Swamp East which is threatened by mining interests, and which has not heretofore been documented botanically. Of greatest interest was the discovery of a stand of *Pinus serotina* containing about seven trees of low to medium height. *Pinus rigida, Fagus grandifolia, Quercus* spp., and *Acer rubrum* were found in association with it. Also of interest was the large number of dead individuals of *Quercus alba* and *Q. michauxii* seen on the trip. Cause of death is presumably infestation by the gypsy moth, which has peaked in Bear Swamp East in recent summers. Although *Quercus michauxii* is locally abundant and extremely large specimens have been recorded in Bear Swamp East, the future of this rare New Jersey species at this locality is now in doubt. Further monitoring is needed. Leader: Stevens Heckscher.

July 31, 1983: Jenny Jump State Park and Johnsonburg, NJ. Eleven members and friends attended this trip to a limestone area. Over 100 species of plants were seen, among them 21 fern species, and four orchids. Ferns of particular interest included: *Asplenium ruta-muraria, A. trichomanes, Camptosorus rhizophyllus, Cystopteris fragilis, C. bulbifera, Woodsia obtusa, Pellaea atropurpurea,* and *Thelypteris hexagon-*

*optera*. Orchids found in bloom included *Corallorhiza maculata, Goodyera pubescens* and *Epipactis helleborine;* in addition, a *Liparis,* almost certainly *L. loeselii,* was found in fruit. Other noteworthy plants included *Aralia racemosa, Verbascum lychnites, Sambucus pubens, Potentilla fruitcosa, Phryma leptostachya,* and *Campanula rotundifolia. Rubus phoenicolasius,* in abundant fruit along with several other *Rubus* species, also proved of general interest. Leader: Karl Anderson.

August 13, 1983: Mullica River, Burlington and Atlantic counties, NJ. Departing Batsto with nine members, our first stop was a freshwater tidal marsh at Crowley's Landing where we saw *Zizania aquatica, Scirpus subterminalis, S. pungens, Eleocharis olivacea* var. *reductiseta, Carex stricta, Pontederia cordata, Orontium aquaticum, Peltandra virginica, Lobelia cardinalis, Sagittaria latifolia, Bidens connata, Xyris difformis, Eriocaulon parkeri, Juncus pelocarpus, Viola primulifolia,* and *Gratiola aurea*. Our second stop was across from Green Bank where we saw *Spartina pectinata, Zizania aquatica, Echinochloa walteri, Panicum virgatum, Rhynchospora macrostachya, Eriocaulon parkeri, Smilax walteri, Toxicodendron radicans, T. vernix, Eryngium aquaticum, Mikania scandens, Bidens coronata, Scirpus subterminalis,* and *Cicuta maculata*. At our next stop in Lower Bank, we found *Spartina cynosuroides, Echinochloa walteri, Typha angustifolia, Cyperus filicinus, C. strigosus,* and *C. rivularis*. At Turtle Creek Road, in the Swan Bay Wildlife Management Area, we found *Juncus biflorus, Polygala cruciata, Lobelia nuttallii, Solidago stricta, S. fistulosa,* and *Helianthus angustifolius*. At our final stop in Port Republic we looked for submerged plants in Nacote Creek although a high tide well above predicted heights made this difficult. Here we saw *Potamogeton pusillus, P. perfoliatus, Ruppia maritima, Scirpus americanus* (*olneyi*), *Scirpus americanus × pungens, S. validus, Sabatia dodecandra, Lilaeopsis chinensis,* and *Lythrum lineare*. Leader: Joe Arsenault.

August 27, 1983: Whitehouse, Somerset County, NJ. On a blazing hot day the vegetation in the area of Whitehouse Station was parched because of heat and drought. Forty-one species of grasses were identified in the field, all of them common in the Northeast. Among a few members of the sedge family found were *Cyperus strigosus, Eleocharis obtusa, Bulbostylis capillaris, Scirpus pungens, S. cyperinus,* and *S. atrovirens*. Two interesting mid-west plants, *Euphorbia dentata* and *Salvia reflexa* were found. The former was along the railroad and the latter, probably introduced by seed from a bird feeder, was in the leader's yard. The following plants were found growing in abundance along the railroad tracks: *Diodea teres, Aristida dichotoma, A. oligantha, Panicum virgatum, P. dichotomiflorum, Sorghastrum nutans, Andropogon gerardii, A. scoparius, Froëlichia gracilis, Leptoloma cognatum, Eragrostis spectabilis, Trichostoma dichotomum, Euphorbia preslii, Digitaria sanguinalis,* and *D. ischaemum*. Leader: Robert C. Meyer.

September 11, 1983: Iona Island Marsh, Rockland County, NY. We visited this extensive Hudson River marsh at high tide but still managed to find a diverse assemblage of species. The emergent wetland is dominated by *Typha angustifolia* and *Phragmites australis* but also includes *Zizania aquatica, Lythrum salicaria, Bidens eatonii, Scirpus cylindricus, Echinochloa walteri, Amaranthus cannabinus, Sium suave, Typha latifolia, Pontederia cordata, Peltandra virginica, Aster subulatus, Pluchea odorata, Sagittaria calycina, Sagittaria latifolia, Leersia oryzoides,* and *Hibiscus moscheutos*. Fragments of submerged flora washed along the edge of the marsh included *Ceratophyllum demersum, Myriophyllum spicatum, Najas flexilis, Potamogeton crispus,* and *Vallisneria americana.* We found a few plants of *Trapa natans* which apparently is reaching its downstream limit in the Hudson River. *Lemna minor* and *Spirodela polyrhiza* were floating on the water surface. A return trip at low tide should reveal additional species that grow lower in the intertidal zone. Leaders: Alfred E. Schuyler and Naomi Dicker.

September 18, 1983: Great Bay Wildlife Management area and Lake Pohatcong, Tuckerton, NJ. We traveled from a freshwater pond through a salt marsh to sand dunes along a bay shore, noting the flora along the way. About sixty plant species were seen. Among them, the fresh-water pond produced *Myriophyllum humile* and *Juncus pelocarpus.* The edge of the salt marsh featured *Sabatia stellaris, Plantago juncoides, Scirpus robustus, Typha angustifolia, Eleocharis rostellata, Samolus parviflorus, Polygonum prolificum, Spartina cynosuroides, Aster tenuifolius,* and *Aster subulatus.* The salt marsh itself produced *Salicornia europaea, Salicornia bigelovii, Salicornia virginica,* and *Ruppia maritima,* as well as the ever-present *Spartina patens, Spartina alterniflora,* and *Distichlis spicata.* Plants of the beach and dune, included *Salsola kali, Bassia hirsuta, Suaeda maritima, Suaeda linearis, Atriplex arenaria, Euphorbia polygonifolia, Echinochloa walteri, Cenchrus tribuloides* and *Honkenya peploides.* The rapidly spreading South African grass, *Eragrostis curvula,* was noted on a roadside. Leader: Karl Anderson.

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## Program of Meetings 1982–1983

| *1982* | *Subject* | *Speaker* |
|---|---|---|
| 23 Sep. | Members Report on Summer Activities | |
| 28 Oct. | Ecological Studies, Ovule Abortion, and Seed Dispersal in *Cryptantha* (Boraginaceae) | Brenda Casper |
| 17 Nov. | The Golden Era of Botanical Illustration | Janet E. Klein |
| 16 Dec. | The Gardens of China | William M. Klein, Jr. |
| *1983* | | |
| 27 Jan. | Rare and Endangered Species | Ann Newbold and Ann Rhoads |
| 24 Feb. | A Year in the Life of a Bog | Alfred E. Schuyler and William McLean |
| 24 Mar. | Morris Arboretum, Past and Present | William M. Klein, Jr. |
| 28 Apr. | TL II—The Literature of Taxonomic Botany | Richard S. Cowan |
| 26 May | Illustrated Report of the Local Flora | Monitoring Committee |

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# 200th Anniversary of *Arbustum Americanum*

This year marks the bicentennial of *Arbustum Americanum*, the first American botanical book about our native trees and shrubs. The celebration is likely to be as quiet as the winter sales greeting it in 1785, however, a reflective reading will help us appreciate the gardener-botanists' role in the evolution of American botanical literature.

The author, Humphry Marshall (1722–1801), like his cousin John Bartram, founded one of America's earliest botanical gardens. Muhlenberg, Pursh, Rafinesque, Hamilton, Darlington and Baldwin were among the early Philadelphia botanists to visit there. Marshall was a successful farmer, stonemason, miller, public servant, astronomer, and a plantsman with substantial Old World trade.

*Arbustum* is remarkable because, unlike most botanical works of the period, it used "plain and familiar" descriptions written in English. This, combined with an introduction to systematics, offered Marshall's countrymen "an useful *Vademecum Botanicum*, or *Botanical Companion*" promoting applied botany as a means to understand and utilize the young Republic's vast resources. It was welcomed as a school book by "young scholars exceedingly glad to see a book in (botany) from their native country." No American botany text would appear until Benjamin Smith Barton's *Elements of Botany* in 1803.

Joseph Crukshank printed 1000 copies of *Arbustum* in his Market Street, Philadelphia shop at the cost of 70 pounds, 2 shillings, and 6 pence, stitching extra. This small duodecimo volume was xx + 174 pages. Half of the copies went unsold. When subscriptions lagged, Samuel Vaughan purchased 150 copies, and the American Philosophical Society purchased forty. Marshall's European audience was more receptive. French and German translations (1788) brought increased orders for seeds and plants sent from his Chester County garden.

ROBERT R. GUTOWSKI
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Bartonia No. 51: 2–16, 1985

# Distributional History of *Najas marina* (spiny naiad) in North America

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*Najas marina* L., spiny naiad (Najadaceae), is an annual, submersed, rooted aquatic vascular plant whose distribution in North America (Haynes 1979 and some recent information) is unlike that of most other rooted submergents. In the northern part of the continent, it occurs in the Great Lakes region in New York, Ohio, Michigan, Illinois, Indiana, Wisconsin, and farther westward in Minnesota and the Dakotas; in the southwest in New Mexico, Arizona, Utah, Nevada, California, Baja California, and Mexico; and in the Gulf coastal area in Texas, Florida, the West Indies, and southward into Mexico and Central America. This unusual distribution pattern, of which the Great Lakes portion has become known within the past 50 years, defies a simple explanation and suggests that the species may be increasing its range in certain portions of North America (Davenport 1980; Reveal 1977; Swink 1969, 1974; Swink and Wilhelm 1979; Stuckey and Roberts 1982; Wentz and Stuckey 1971). This invasion and spread into certain areas has been suggested as occurring through the migration of waterfowl (Chase 1947; Gillis, Howard, and Proctor 1973; Merilainen 1968; Swink 1969, 1974; Tans and Read 1975). To explain the North American distribution of *N. marina*, evidence is needed to determine how it became dispersed and established. This paper brings together available data from botanical and zoological literature, macrofossil records in paleoecological studies, bird migration corridors, and herbarium specimens in order to summarize the known distributional history of *N. marina* in North America and to suggest problems deserving further investigation.

## DESCRIPTION, ABUNDANCE, HABITAT, AND ASSOCIATED PLANTS

*Najas marina* is the most morphologically distinctive (Fig. 1) North American naiad. The plants are dioecious, bright green or pale green to reddish or reddish brown, and extremely brittle. The stout stems are dichotomously branched, spreading to ascending, and often repent towards the base with prickly internodes and extensive roots on the lower nodes. The leaves have margins with sharp broad-based prickles and sheaths that are generally entire or 1–2 toothed. The one-seeded fruits, largest among the North American species, are plump, often reddish, and usually 2.2–4.5 mm. long, 1.2–2.2 mm. wide, with a finely reticulate and scurfy surface. The species has been divided into numerous varieties based on minor differences in the size of the leaves and the number of prickles on the internodes that do not warrant taxonomic recognition (Haynes 1977, 1979).

Little information is available on the abundance of *N. marina*. It has been noted as locally abundant, common, or frequent in certain localities, such as Onondaga Lake, Irondequoit Bay, Cayuga Lake, and Big Mendon Pond in New York, at Well Pond in the Resthaven Wildlife Area near Castalia in Ohio, at Brooks Lake, Peach Lake, and Whitmore Lake in Michigan, at brackish ponds and hot springs in Utah and Nevada, and at Oso Flaca Lake in California (Gray 1866; Beckwith and Macauley 1894; Muenscher 1928; Clausen 1940; Wentz and Stuckey 1971; Voss 1979; Hermann 1935;

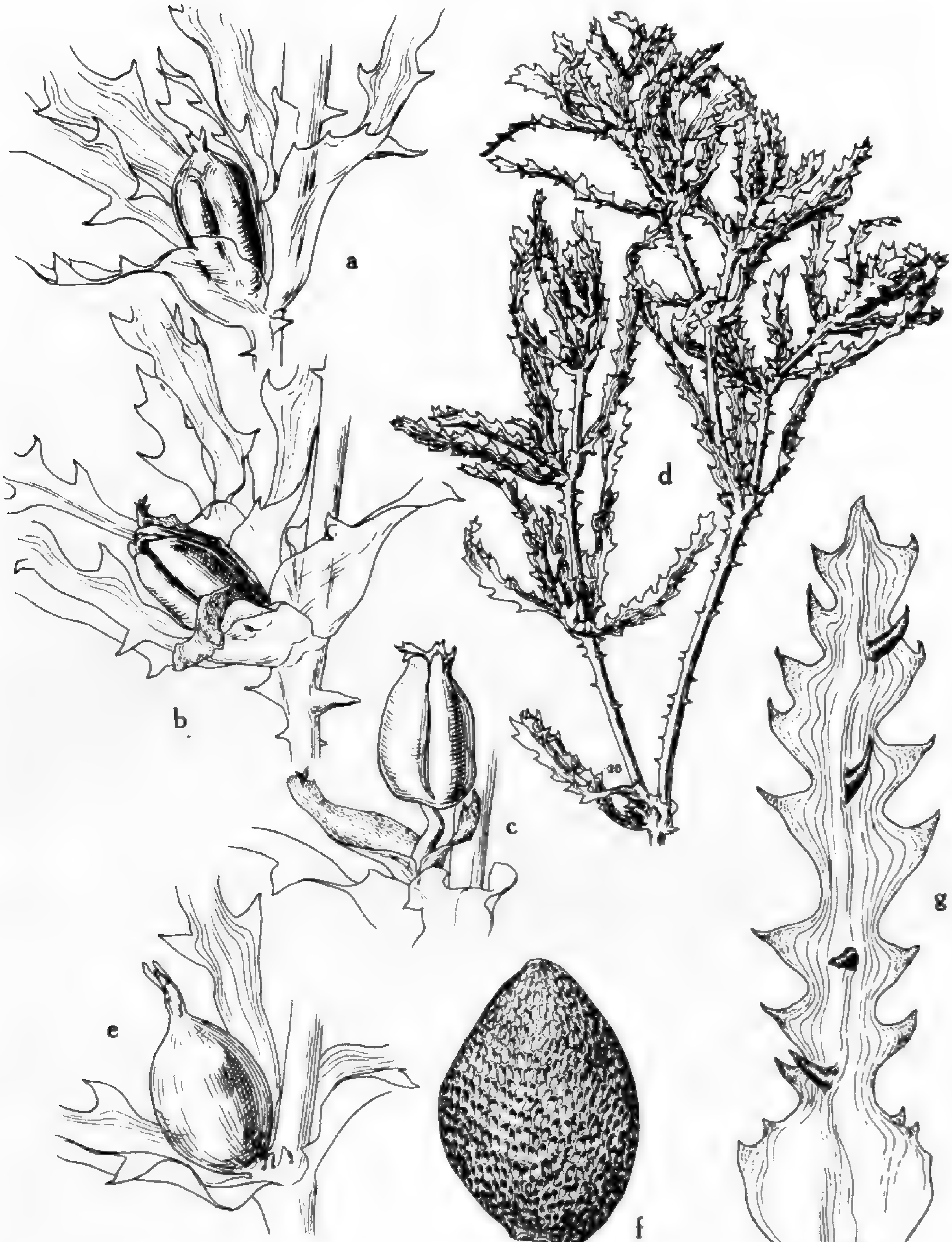


FIG. 1. Illustration of *Najas marina* showing: *a–c*, development of anther, *a*, anther enclosed in sessile spathe in leaf axil, ×8; *b*, anther beginning to elongate and rupture spathe, ×8; *c*, mature anther, showing short filament, ×8; *d*, habit, showing the stems beset with prickles, and the spiny-toothed leaves, ×1[1]/[5]; *e*, mature pistillate flower, showing the three stigmas and the intravaginal scales at base, ×8; *f*, mature seed, ×10; *g*, leaf blade, showing the coarse, spiny-toothed margins, the spines on the outer side along the midrib, and the rounded shoulders of the leaf sheaths, ×6. Reproduced from Mason, 1957, p. 82, fig. 33, by permission of the University of California Press, Berkeley.

Holmgren 1942; Hoover 1970). However, in Texas, Arizona, New Mexico, Utah, Nevada, and southern California, the species has been reported as rare or occasional (Correll and Correll 1972; Martin and Hutchins 1980; Reveal 1977; Mason 1957; Munz 1974).

*Najas marina* inhabits brackish, saline, alkaline, or fresh waters of tropical and temperate regions of the world. It occurs in ponds, lakes, reservoirs, slow moving streams, and canals to recorded depths of five meters. In central New York, *N. marina* occurs in brackish or saline lakes and marshes with numerous well-known maritime and halophytic species (Catling and McKay 1981; Drummond 1864, 1867; Faust and Roberts 1983; Paine 1865; Svenson 1927). Chase (1947) reported *N. marina* in waters with a pH of 8.4 to 8.6 and an alkalinity of 110 to 130 parts per million in New York. In northern Ohio, Michigan, and Illinois, the ponds and lakes with *N. marina* are decidedly alkaline with the pH ranging from 8.4 to 9.0 in many of them (author's observations; Winterringer 1966). In Minnesota, *N. marina* inhabits lakes that are relatively high in dissolved carbonates and sulphates, but not to the extent of being brackish (Rosendahl 1939). Moyle (1945b) gave the following ranges for the chemical parameters measured in waters where *N. marina* occurred: total alkalinity, 146.8–376.0 parts per million; sulfate-ion concentration, 50.0–1296.6 parts per million; pH, 8.2–9.0. In Utah and Nevada, *N. marina* has been reported growing in hard-water springs with temperatures of 80° to 90°F. (Maguire and Jensen 1942; Hermann 1935, 1940). In California, *N. marina* is usually reported from fresh-water ponds and in Florida the water is usually described as brackish. In localities near Miami, plants have been noted in waters with a pH of 8.1 to 8.5 (Ronald Mossman, pers. comm. 1979). The species usually associated with *N. marina* (Table 1) are characteristic of alkaline waters.

From Well Pond near Castalia, Ohio, whose waters have a pH as high as 9.0, Gatewood (1980) obtained plants of *N. marina* and cultured them in alkaline water at a pH of 8.1. The plants were grown in aquaria given 16 hours of light at room temperature for 12 days prior to subjecting them to different levels of pH by adding varying amounts of sulfuric acid. Following treatment, plants in waters below a pH of 4.7 down to a pH of 2.2 became chlorotic after three days and all were dead within 11 days. Plants in waters over 6.2 continued to live, and those under the controlled conditions in a pH of 8.1 displayed the most extensive growth. It was concluded that somewhere within the pH range of 6.2 and 4.7, the species encounters an "environmental stress that it cannot physiologically accommodate." The critical pH level for continued survival was not determined.

## Distribution

*Najas marina* is wide ranging (Hultén 1962) in the world and occurs in Europe, northern and central Africa, Asia Minor, India, Manchuria, China, Japan, and Australia. In the Western Hemisphere, the species is in North America, Central America, and northern South America, on the Hawaiian and Galapagos Islands, and in the West Indies. In the United States, the distribution of *N. marina* was early documented by Morong (1893), later mapped by Clausen (1936) and Haynes (1979), and now mapped in detail here (Fig. 2). The earliest known records of the species in the northern portion of its Western Hemisphere range appear to be those by Braun (1864) who noted that it had been reported from Florida by Cabanis, and by Grisebach (1864) who cited it from Antigua based on a specimen collected by Heinrich Wullschlägel. The latter

TABLE 1. Submersed species associated with *Najas marina*, based on field observations and literature.

| Species | Cayuga Lake, NY (Muenscher 1928; Miller 1978) | Irondequoit Bay, NY (Clausen 1940) | Big Mendon Pond, NY (Clausen 1940) | Well Pond, OH (Foos 1971; observations of R. L. Stuckey) | Middle Harbor, OH (Anderson 1950) | Whitmore Lake, MI[a] (Observations of E. G. Voss) | Wind Lake, WI (Swink 1969, 1974) |
|---|---|---|---|---|---|---|---|
| *Najas flexilis* | x | x | x | x | x | x | x |
| *Potamogeton pectinatus* | x | x | x | x | x | x | x |
| *Myriophyllum exalbescens* | | x | x | | x | x | x |
| *Vallisneria americana* | x | x | x | | x | x | |
| *Ceratophyllum demersum* | x | x | x | | | x | |
| *Heteranthera dubia* | x | x | x | | | x | |
| *Zannichellia palustris* | | x | | | x | x | |
| *Elodea canadensis* | x | | x | | | x | |
| *Potamogeton nodosus* | | x | x | | | x | |
| *Utricularia vulgaris* | | | | x | | x | |
| *Myriophyllum spicatum* | x | | | x | | x | |
| *Potamogeton freisii* | | x | | | | | x |
| *Proserpinaca palustris* | | | | x | | | |

[a] Species known from the lake, not necessarily growing in close proximity with *N. marina*, since it is still not known where *N. marina* grows in Whitmore Lake.

obtained plants in Antigua from 1844 to 1847 (Stern 1965). The earliest specimens seen from Florida are from Sand Point, Indian River in 1874 (*Palmer 533*, MO, US) and Palm Creek near Camp Romano in 1880 (*Curtis 2705*, CU, MIN, MO, PH; cited by Morong 1885). Morong (1893) noted it from Cuba, as well as from Florida, and Rendle (1899) also cited some of the same records from Florida and the West Indies.

In the southwestern United States and adjacent Mexico, the earliest specimens came from Arizona along the Santa Cruz River in 1867 (*Palmer 249*, MO) and in 1881 (*Pringle s.n.*, F, PENN, US), from Utah at Lake Utah in 1875 (*Parry 32*, GH, MO, NY), from Nevada at Huntington Valley (Rothrock 1878) and at Ash Meadows in Death Valley in 1891 (*Coville & Funston 371*, NY, US), from California at Clear Lake in 1863 (*Bolander 2658*, GH, US), and from Baja California at Tijuana in 1884 (*Orcutt 1184*, GH). The increase in the past 30 years in the number of known sites for spiny naiad in the southwestern United States, especially in canals and at newly constructed reservoirs, suggests that the species is expanding locally and is now of more frequent occurrence. This conclusion is derived from information in Otto and Bartley (1965), notes on herbarium specimens (MO, NY, OS, UC), and reports by a number of investigators in Arizona (Kearney and Peebles 1942, 1951; McCleary 1957), Utah and Nevada (Reveal 1977), and California (Hoover 1970; Munz 1935, 1974; Twisselmann 1967).

The earliest known specimen of *N. marina* from Texas is from Brownsville, Cameron County (19 Aug 1923, *Weed & Camp s.n.*, MICH) and specimens collected from 1929 to 1946 have been seen from four other sites in Cameron County (OKLA, SMU, TEX, US). Other Texas collections are from Lake Austin, Travis County in 1944 (MSC),

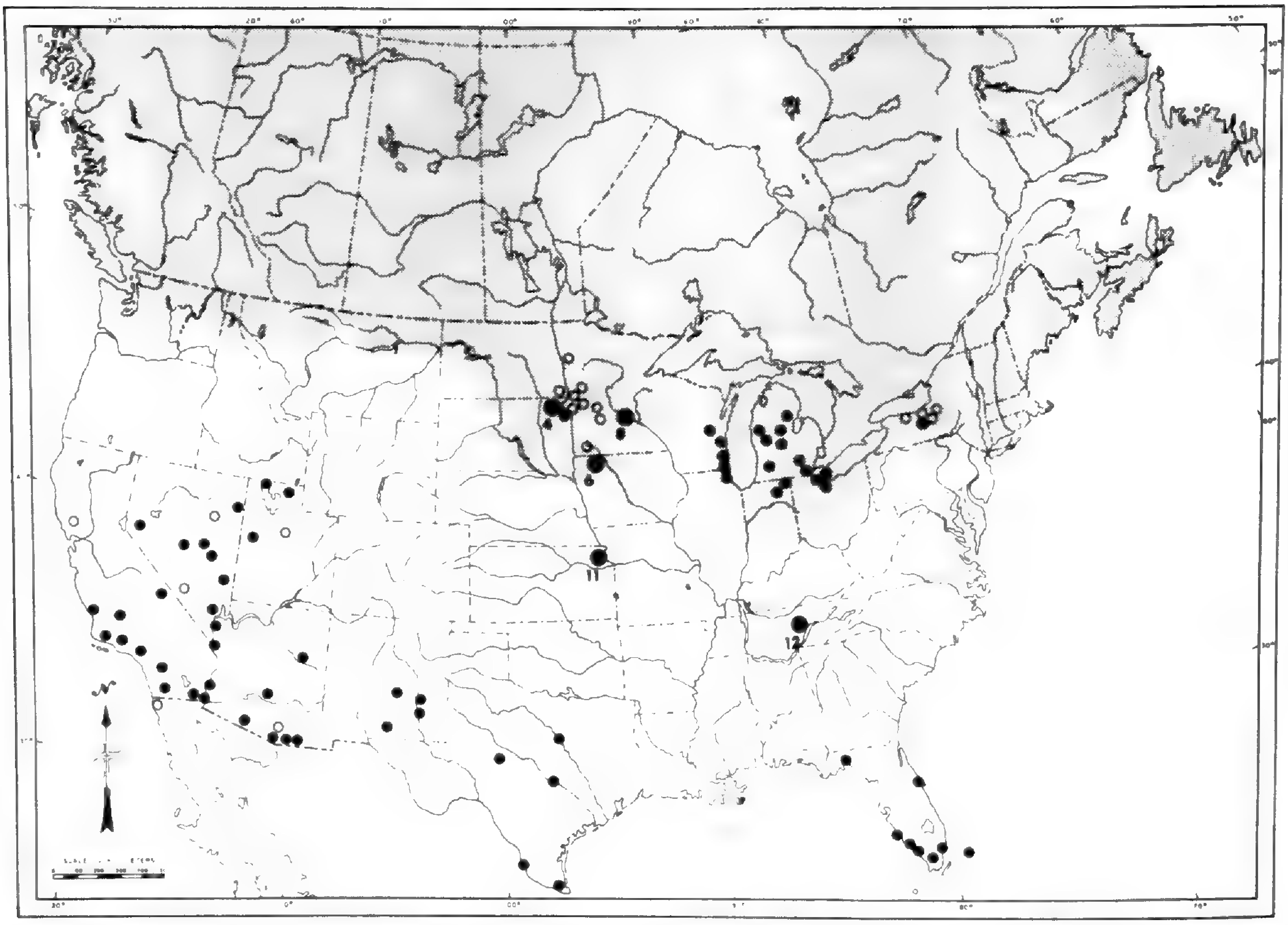

FIG. 2. Map of the known distribution of *Najas marina* in the United States based on herbarium specimens and reliable literature sources. Large dots represent localities of dated fossil fruits, with the number beside these dots being the approximate age in thousands of years B.P. Circles represent specimen records before 1940 in New York, Minnesota, and North Dakota and before 1900 in southwestern United States at localities where no known specimens have been obtained since. Dots represent specimen records since these years in these respective regions of the United States and all records in the western Great Lakes region (dated since 1937), Texas (dated since 1923), and Florida (dated since 1874). The shaded area on the map is that part of the continent once covered by ice during Wisconsinan glaciation.

Falcon Lake, Zapata County in 1962 (NYS), Lake Nasworthy, Tom Green County in 1970 (TEX), and Granbury Lake, Somervell County in 1975 (SMU). All localities mapped for New Mexico are from Martin and Hutchins (1980), the dates of whose records are probably recent, as the species was not reported in an earlier *Flora of New Mexico* (Wooton and Standley 1915).

The distributional history of *N. marina* in New York was first summarized by Fernald (1923). Asa Gray (1865) was the first to note its occurrence at Onondaga Lake, Onondaga County, New York. The plant was first detected in 1864 by G. W. Clinton on the northern border of the lake between Salina and Liverpool, and soon after by John A. Paine, Jr., on the western side of the lake where it grew luxuriantly and abundantly in the brackish waters near the vicinity of the salt works along with other salt-tolerant species. Paine (1865) wrote that the plant was in the streams entering the lake and abounded in the lake in water 10 to 20 feet deep some distance from the shore where the much-branched plants could be seen rooted on the bottom in the clear still water. The following year, Gray (1866) reported the species from Irondequoit Bay on Lake Ontario, Monroe County, which was later confirmed by Beckwith and Macauley (1894) and Beckwith, Macauley, and Baxter (1917). Other early localities in the Finger Lakes region of New York were from the Seneca River near Savannah, Wayne County (Peck 1874); Black Lake and the foot (north end) of Cayuga Lake, Cayuga County (Peck 1883); Cayuga Bridge at Cayuga Lake and the Canoga Marshes, Seneca County (Dudley 1886); Tulley Lake and marshes near Long Branch, Onondaga County (Goodrich 1912); and Duck Lake and Crusoe Lake, Cayuga County (Wiegand and Eames 1926). The presence of the species at the Canoga Marshes was later confirmed by specimens (at CU) obtained in field surveys by W. C. Muenscher and P. B. Burkholder in 1927, as reported by Muenscher (1928), and by specimens cited by Chase (1947). In Monroe County, it was discovered in 1939 at Big Mendon Pond (Shanks and Goodwin 1943).

As pointed out by Chase (1947), however, *N. marina* became unknown in New York in several localities where it previously grew in abundance. He related that spiny naiad had disappeared from Irondequoit Bay and Big Mendon Pond in Monroe County. Clausen (1940) and Shanks and Goodwin (1943) also noted that *N. marina* was last known from Irondequoit Bay in 1915. This disappearance was attributed to increased turbidity and pollution of the water from industrial wastes. Specimens of *N. marina* have been seen from all of the above-mentioned localities in the Finger Lakes region, but no herbarium specimens dated since 1939 have been located or seen.

Recent data on the occurrence of *N. marina* in New York appears to be scarce. One record appears for the early 1960's from the Black Lakes in the Montezuma National Wildlife Refuge, Seneca County (Cowardin 1965). During 1974, in a field survey of eight major lakes in the Finger Lakes region, the presence of *N. marina* was not recorded (Baston, Ross, and Miller 1975); however, during 1977 in a survey of nine of the largest lakes in Cayuga County, spiny naiad was reported to be present at the north end of Cayuga Lake and in Duck Lake (Miller 1978). In 1981, plants were locally abundant in the Canoga Marshes at the north end of Cayuga Lake (Thomas Rawiniski, pers. comm. 1983). These statements lead to the conclusion that the current abundance and distribution are not well known for *N. marina* in New York. The species evidently is not considered endangered or threatened, as it is not listed in three recent publications on rare plants of New York (Mitchell 1979; Mitchell and Sheviak 1981; Mitchell, Sheviak, and Dean 1980).

*Najas marina* was detected in southwestern Minnesota as early as 1891 in lake Minnewaska, Pope County (*Taylor s.n.*, GH, MIN, US). Subsequent records from Minnesota and North Dakota are known from 10 other lakes and date from 1917 to 1938 (Clausen 1936; Metcalf 1931; Rosendahl 1939; Rosendahl and Butters 1935; herbarium specimens, GH, MIN, US). In the early 1940's, Smith (1946) noted the abundance of spiny naiad in Lake Christina near Ashby, Grant County, in connection with studies of the Canvasback duck. In northeastern South Dakota, spiny naiad occurs in a "man-made pond at Blue Cloud Abbey, 12 mi. west of Milbank, . . . Grant County, 26 July 1976," as confirmed by Wentz (1980), who also stated that "*N. marina* appears to be widely distributed in this area but uncommon due to drought conditions and lack of suitable habitat." The species is not included in the recent flora of South Dakota (VanBruggen 1976), and it appears that specimen records are wanting from North Dakota since 1917 and from Minnesota since 1938, leading to the suggestion that either recent field exploration and specimen documentation are lacking, or this species is also disappearing from this region of the country.

In Michigan, the earliest known specimens are from Brooks Lake, Newaygo County in 1937 (*Bazuin 442*, HAM) and 1940 (Bazuin 1948), Peach Lake, Ogemaw County in 1938, and Crystal and Mud Lakes, Montcalm County in 1941. Specimens are known from 11 cited localities in Michigan (Near and Belcher 1974; Wentz and Stuckey 1971). The most recent additional records known are those from Peach Lake (28 Jul 1975, *Haynes 5233*, MICH, OS), Asylum Lake in Kalamazoo County (19 Jul 1976, *McCann s.n.*, MICH) and Whitmore Lake in Washtenaw County (11 Sep 1974, *Voss 14516*, MICH, OS; Oct 1978, *Les s.n.*, OS). In Brooks Lake, Bazuin noted on labels of herbarium specimens obtained in 1940 that "It is slowly replacing other plants in this lake" (MICH) and "Becoming the dominant plant of this lake" (GH). Voss (1972) stated that *N. marina* "appears to be somewhat aggressive," and the recent additional localities for its occurrence continue to confirm that spiny naiad is spreading in Michigan.

In Ohio, *N. marina* has been seen in four different man-made shallow ponds (Big Dike Pond, Marl Pond, Pike Haven Pond, and Well Pond) at the Resthaven Wildlife Area about a mile west of Castalia and from one location in the west limestone quarry on Kelleys Island, Erie County, and from Middle Harbor at East Harbor State Park, Ottawa County. The earliest known record (*Core* and *Anderson 10*, CU), dated 1949, is from the latter locality where it has not been seen or collected since (I have visited this locality yearly since 1968). At Well Pond, where is was first collected in 1959 and is usually very abundant, it has been seen every year since 1968.

The earliest known specimen of *N. marina* for Wisconsin is from Random Lake, Sheboygan County in 1941 (Ross and Calhoun 1951). Its distributional history in Wisconsin has been summarized by Tans and Read (1975), who cite specimens of the late 1960's and early 1970's from five different lakes, indicating an apparent recent spread of the species in that state. In Illinois, the first known specimen is from Druce Lake, Lake County in 1964 (Winterringer 1966). Recent collections have been made at five small lakes near the southwestern shore of Lake Michigan (Merilainen 1968; Mohlenbrock 1970; Swink 1969, 1974; Swink and Wilhelm 1979). The first specimens for Indiana were obtained in 1979 from Green Lake, Steuben County, and Cree Lake, Nobel County, in the northeastern corner of the state (Davenport 1980). The report of *N. marina* from Kentucky (Cranfill and Thieret 1981) was erroneously based on a particularly robust specimen of *N. minor* (Thieret, pers. comm. 1983).

## Dispersal by Birds

Birds have long been suspected as agents of dispersal for aquatic plants, yet most of the information is based on assumption and speculation, rather than on original observation or experimental research, of which data for the latter is difficult to obtain. The dissemination of plants by birds has been discussed and summarized by many authors, among them Cruden (1966), deVlaming and Proctor (1968), McAtee (1947), and Ridley (1930); yet none of these authors mention *N. marina*. Examination of the north-south waterfowl migration corridors east of the Rocky Mountains, particularly for diving ducks, as mapped by Bellrose (1968, 1976), are certainly suggestive as avenues of transport of *N. marina* between Florida and Texas to the Great Lakes region, Minnesota, and the Dakotas. Among the diving ducks, the maps showing the migration corridors of the Canvasback (*Aythya valisineria*) and the Redhead (*Aythya americana*) are of the most interest in this respect (Bellrose 1976). Large numbers of Canvasbacks migrate between Florida and New York and across the western Great Lakes region into Minnesota, while large numbers of Redheads travel between Florida and Ohio and between Texas and Minnnesota with strong cross migrations between Ohio and Minnesota. Overwintering concentrations of these birds are found in Florida and southern Texas where *N. marina* is present, and also in the Chesapeake Bay where spiny naiad is not known to occur. Negating these migrational suggestions is the fact that *N. marina*, because it is a rare species, is not a common dietary component of these and other diving ducks. According to McAtee (1939) fruits of *Najas* have been found in the stomachs of 20 species of American wild ducks, occasionally as many as 4000 to a single stomach. *Najas flexilis*, however, is much more commonly encountered than *N. marina*. As summarized from Cottam (1939), *Najas* usually composes less than 2% of the diet of the predominately plant feeding diving ducks, as compared to from 10 to 28% of their diet being pondweeds (*Potamogeton* spp.). He had examined three Redhead ducks that held between 1200 and 2000 fruits of *N. flexilis*, *N. guadalupensis*, and *N. marina* in their stomachs. *Najas marina* is listed as a minor food source of the Redhead by Kubichek (1933) and of the Blue-winged Teal by Mabbott (1920). However, Martin and Uhler (1939) considered *N. marina* to be "too scarce and too localized to have appreciable value as duck foods." Although acknowledged as a food for waterfowl, Hewitt (1944) found no fruits of *N. marina* in the stomachs of ducks examined at Cayuga Lake, where *N. marina* also occurs. These statements lead to the suggestion that the north-south distributional pattern of *N. marina* in North America probably has not developed through long distance dispersal by aquatic birds. Dispersal by waterfowl probably should not be discounted and may be plausible within localized areas as suggested by Chase (1947) in New York, Swink (1969, 1974) in the Chicago region, Tans and Read (1975) in Wisconsin, and Gillis, Howard, and Proctor (1973) in the Bahamas.

## Fossil Record

In lake sediments, the large plump fossil fruits of *N. marina* are readily distinguished from the slender fruits of the other species in the genus. Fossil fruits of *N. marina* are well-known from sediments in the British Isles and in Scandinavia along the Baltic coast to the Arctic Circle (Backman 1941; Forsberg and Forsberg 1961; Godwin 1975; Tralau 1959). As shown by the fossil record, the distribution of *N. marina* in northwestern Europe extended much farther north before glaciation than at present. Since glaciation its distribution has become extremely restricted in the British Isles and limited to extreme southern portions of Norway, Sweden, and Finland. The fossil record further indicates that the species lived in both fresh and brackish water environments, but now it is nearly confined to brackish waters, with a few exceptions in Scandinavia as noted by Forsberg and Forsberg (1961).

In North America, a fossil record of *N. marina* was not known until the report by Watts and Bright (1968), who noted its occurrence in Pickerel Lake, Day County, northeastern South Dakota. The fossil fruits were recovered from sediments deposited between 9400 and 3000 years B.P., with the best general estimate being 4000 years B.P., in a lake interpreted as having fresh, shallow, highly carbonated water, high sulphate concentration, and a pH greater than 7. Associated submersed aquatic plants were *Ceratophyllum demersum*, *Najas flexilis*, *N. guadalupensis*, *Potamogeton pectinatus*, *P. richardsonii*, *P. foliosus*, and *Zannichellia palustria*, while the adjacent marsh around the edge was dominated by *Typha*, *Sparganium*, and *Scirpus*. The surrounding upland vegetation was interpreted to consist of prairie grasses and forbs with perhaps a few groves of deciduous trees.

Additional fossil fruits have been recovered from lake sediments at three other localities in the upper midwestern states: (1) from a marsh near Muscotah, Atchinson County, northeastern Kansas, with an estimated age of 11,000 years B.P. (Grüger 1973); (2) from West Lake Okoboji, Dickinson County, northwestern Iowa, with an estimated age of 6200 years B.P. (Van Zant 1979); and (3) from Golden Valley in eastern Minnesota, of Holocene age (Watts 1980). (If the deposit was mid-Holocene, it would represent an age of about 8000 years B.P.) In all three of the published reports, the fossil fruits of *N. marina* were deposited in shallow water lakes at a time when dry prairie vegetation flourished in the surrounding countryside. This species evidently was very prevalent under these conditions, which at each respective site existed at the height of the Xerothermic Period. Unlike some other species of aquatic plants which apparently disappeared from shallow or dried out lakes of the Prairie Peninsula (Stuckey 1983), *N. marina* has persisted to the present time in a few of these remaining shallow alkaline-sulphate prairie lakes. These warm water lakes with a high concentration of solutes would have been even more prevalent and more widely distributed during the Xerothermic Period.

An isolated fossil fruit of *N. marina* has also been reported from Anderson Pond, White County, middle Tennessee, with an estimated age of 12,750 to 12,500 years B.P. (Delcourt 1979). From the associated fossil plants, the surrounding vegetation at this period in middle Tennessee has been interpreted as a mixed mesophytic forest.

## Interpretation of the Distribution

The present, historical, and fossil occurrences of *N. marina* lead to the interpretation that this species is boreal circumpolar as mapped by Hultén (1962), and represents a remnant of the Arcto-Tertiary flora in North America, a distribution pattern first described by Asa Gray (1859). According to this theory, the flora of the northern hemisphere on both continents prior to continental glaciation consisted of many widely distributed northern or boreal circumpolar species that had developed and spread since the late Tertiary when climatic conditions were much warmer. With the onset of a cooler environment and extensive glaciation, these more or less continuous distribution patterns of the species of this Arcto-Tertiary flora were interrupted and became extensively modified by one or more periods of continental glaciation. This modification occurred to the degree that only those species whose ranges either already extended far to the south in North America or whose plants were able to migrate southward as environmental conditions changed with the onset of glaciation were able to survive along the glacial ice margin or in somewhat isolated areas, such as lakes or ponds, away from the glacier. In these isolated areas or *survivia*, also called *refugia* by some authors, the surviving plants were able to live at the southern extremes of their ranges.

In the United States, *N. marina* would have survived continental glaciation at many localities south of the maximum glacial border. The species certainly would have survived in the numerous alkaline lakes in southwestern United States, where the plants were present in the 1860's. *N. marina* may also have survived as far south as Texas and Florida, but certainly it must have been in Tennessee, as confirmed by the one fossil record from there. However, the evidence is stronger that *N. marina* must also have survived in shallow alkaline lakes and ponds near the glacial border in the Great Plains. Following the retreat of the ice, the plants invaded glacially formed lakes in

Kansas, Iowa, South Dakota, and Minnesota, as the fossil record confirms. Here, after flourishing for a period of time, especially in shallow lakes during the Xerothermic Period, the species disappeared from some lakes, but survived in other lakes in Minnesota and the Dakotas into historic time.

During Wisconsinan glaciation, *N. marina* may have also survived near the glacial boundary in eastern United States where alkaline waters were present. Upon retreat of the glacier, the species then invaded glacially formed lakes and persisted in a few of these localities in central New York and possibly even in central Michigan. The historic records in New York are early ones that date from the 1860's, whereas in Michigan the plants were not discovered until the late 1930's. In New York, the possibility must be allowed for an historic introduction, perhaps from Europe, in association with salt mining operations. Introduced salt tolerant species such as *Juncus gerardii* and *J. compressus* were first recorded there in the 1860's and 1890's, respectively (Stuckey 1980, 1981). The possibility of a foreign introduction of most of these halophytes into central New York is strongly suggested by Catling and McKay (1981).

In the western Great Lakes region, *N. marina* possibly spread from some isolated native population or populations. In a region which was well explored botanically prior to the first third of this century, it would be expected that if the species were native to that region, it would have already been documented. Therefore, I conclude that *N. marina* is a recent re-invading species into the western Great Lakes region in Indiana, Illinois, Michigan, Ohio, and Wisconsin, where the species has been noted as somewhat aggressive. This viewpoint is in agreement with my earlier statements (Wentz and Stuckey 1971; Stuckey and Roberts 1982), and also with those who have attempted to explain its recent occurrence and/or spread in Indiana (Davenport 1980), Illinois (Swink 1969, 1974; Swink and Wilhelm 1979), and Wisconsin (Tans and Read 1975).

The native status of *N. marina* in Florida and the West Indies may be questioned. The species was not reported in two floras of the West Indies prior to 1862 and the earliest specimen seen from Florida is dated 1874. Certainly spiny naiad has spread locally in recent years in Florida as shown by its more frequent occurrence in manmade ditches and artificial ponds. In the Bahama Islands, where a specimen was first obtained in the Duck Pond near the airport on South Bimini, the plants were believed to have been brought from Florida and are now being spread to other islands in the chain by birds (Gillis, Howard, and Proctor 1973; Gillis, 1978).

The explanation of the recent occurrences of *N. marina* in southern Texas also is a problem. Aside from a possible survival as part of Arcto-Tertiary flora, the species had not been discovered there until the early part of the twentieth century. However, perhaps the southern Texas plants are a recent invasion from populations farther northward in New Mexico, where plants could have migrated or been brought down the Brazos, Colorado, and Rio Grande rivers and then became established.

As in Europe, *N. marina* undoubtedly must have had a much wider native range in North America than at present. It appears that *N. marina* may be disappearing in New York, Minnesota, and the Dakotas, where at least in the latter region the species is certainly native. It is expanding its range in the Great Lakes region in a manner similar to aggressive non-indigenous species. The question of why *N. marina* has been extirpated in certain areas and is expanding in other areas presents unanswered questions. These questions, particularly the one of extirpation, have been given some consideration by investigators in England. Birks (1980) suggested that different biotypes of *N. marina* have evolved and existed in different parts of the species' range. As climatic conditions changed throughout the Quaternary, the biotypes differed in their responses to modifications in habitat and competition with associated species. Watts (1978) suggested a shorter period with the high average temperature necessary for growth and fruiting has caused the plants to disappear. He also allowed for genetic variation in geographically different populations, or the dependence of the plants on a specific nutrient that may fall below a critical threshold of availability because of progressive leaching. In a letter to me, Watts (1980) wrote that the reason for the extirpation of *N. marina* "might be related to lowered average annual temperatures and in some cases to development of peatland around lake basins with introduction of Humus to lake waters." The latter idea seems more plausible, because under such conditions, the waters would become more acidic and *N. marina* could not survive, as has been demonstrated by Gatewood (1980) in the laboratory cultured plants that died in waters with a pH lower than 4.7. Furthermore, recent losses have been attributed to pollution and other locally associated man-induced changes that are occurring in lakes and ponds.

These conjectures on the distributional history of *N. marina* in various regions of North America leave many unanswered questions based on the present available evidence. It appears that this species would be a good candidate for study by recent methods involving chemosystematic studies and enzyme electrophoresis analyses in an effort to determine the geographical affinities of any varying genotypes that might exist throughout the world.

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## References

Anderson, John. 1950. Some aquatic vegetational changes following fish removal. J. Wildlife Mgmt. 14: 206–209.

Backman, A. L. 1941. *Najas marina* in Finland während der postglazialzeit. Acta Bot. Fenn. 30: 1–39.

Baston, Les, Jr., Bonnie Ross, and Gary L. Miller. 1975. The distribution of aquatic weeds in the Finger Lakes of New York State and recommendations for their control. Tech. Rep. SS-506 New York Assembly Public Service Legislative Studies Program. New York State Assembly Scientific Staff, Albany, New York. v + 113 pp.

BAZUIN, CLAYTON W. 1948. Interesting species of vascular plants collected in western Michigan. Pap. Michigan Acad. Sci. (1946) 32: 3–13.

BECKWITH, FLORENCE AND MARY E. MACAULEY. 1894. Plants of Monroe County, New York, and adjacent territory. Proc. Rochester Acad. Sci. 3: 1–150.

———, ———, AND MILTON S. BAXTER. 1917. Plants of Monroe County, New York, and adjacent territory. Second Supplementary List. Proc. Rochester Acad. Sci. 5: 59–121.

BELLROSE, FRANK C. 1968. Waterfowl migration corridors east of the Rocky Mountains in the United States. Illinois Nat. Hist. Surv. Biol. Notes No. 61. 24 pp.

———. 1976. Ducks, Geese, & Swans of North America. 2nd ed. Stackpole Books, Harrisburg, Pennsylvania. 540 pp. (Reprinted, 1978.)

BIRKS, HILARY H. 1980. Plant macrofossils in Quaternary Lake sediments. Ergebnisse der Limnologie, No. 15. 60 pp.

BRAUN, ALEXANDER. 1864. Revision of the genus *Najas* of Linnaeus. J. Bot. London 2: 274–279.

CATLING, P. M. AND S. M. MCKAY. 1981. A review of the occurrence of halophytes in the eastern Great Lakes region. Michigan Bot. 20: 167–179.

CHASE, S. S. 1947. Preliminary studies in the genus *Najas* in the United States. Ph. D. Dissertation, Cornell Univ., Ithaca. 164 pp., 6 maps, 12 pls.

CLAUSEN, R. T. 1936. Studies in the genus *Najas* in the northern United States. Rhodora 38: 333–345.

———. 1940. Aquatic vegetation of the Lake Ontario watershed, pp. 167–187, annotated list, pp. 180–187. *In* A Biological Survey of the Lake Ontario Watershed Supplemental to Twenty-ninth Annual Report, 1939. Consv. Dept., State of New York, Biol. Surv. No. 16 (1939), Albany. 261 pp. + maps.

CORRELL, DONOVAN S. AND HELEN B. CORRELL. 1972. Aquatic and Wetland Plants of Southwestern United States. Water Pollution Control Research Series. U.S. Government Printing Office, Washington, D.C. 1777 pp. (Reprinted Stanford Univ. Press, Stanford, Calif. 2 vols, 1975.)

COTTAM, CLARENCE. 1939. Food habits of North American diving ducks. U.S. Dept. Agric. Tech. Bull. 643. 140 pp.

COWARDIN, LEWIS M. 1965. Annotated list of the vascular plants of the Montezuma National Wildlife Refuge, Seneca Falls, N.Y. Final Report No. 3. Cornell Univ. in cooperation with New York Consv. Dept., U.S. Fish & Wildlife Serv., and Wildlife Mgmt. Inst. 60 pp.

CRANFILL, RAY AND JOHN W. THIERET. 1981. Thirty additions to the vascular flora of Kentucky. Sida 9: 955–958.

CRUDEN, ROBERT WILLIAM. 1966. Birds as agents of long-distance dispersal for disjunct plant groups of the temperate Western Hemisphere. Evolution 20: 517–532.

DAVENPORT, L. J. 1980. *Najas marina*: new to the Indiana flora. Sida 8: 353–354.

DELCOURT, HAZEL. 1979. Late Quaternary vegetation history of the eastern Highland Rim and adjacent Cumberland Plateau of Tennessee. Ecol. Monogr. 49: 255–280.

DEVLAMING, VICTOR AND VERNON W. PROCTOR. 1968. Dispersal of aquatic organisms: Viability of seeds recovered from the droppings of captive killdeer and mallard ducks. Amer. J. Bot. 55: 20–26.

DRUMMOND, A. T. 1864. Observations on Canadian geographical botany. Canad. Naturalist Geol. new ser. 1: 406–419.

———. 1867. The distribution of plants in Canada in some of its relations to physical and past geological conditions. Canad. Naturalist Geol. new ser. 3: 161–177.

DUDLEY, WILLIAM R. 1886. The Cayuga Flora. Part I: A Catalogue of the Phaenogamia Growing Without Cultivation in the Cayuga Lake Basin. Andrus & Church, Ithaca. xxx, 133 pp. + index i-v.

FAUST, MILDRED E. AND NANCY R. ROBERTS. 1983. The salt plants of Onondaga Lake, Onondaga County, New York. Bartonia 49: 20–26.

FERNALD, M. L. 1923. Notes on the distribution of *Najas* in north-eastern America. Rhodora 25: 105–109.

FOOS, KAREN ADAMS. 1971. A Floristic and phytogeographical anlaysis of the fen element at the Resthaven Wildlife Area (Castalia Prairie), Erie County, Ohio. M. S. thesis, The Ohio State Univ., Columbus. 81 pp.

FORSBERG, B. AND C. FORSBERG. 1961. Fresh water environment for *Najas marina*. Svensk. Bot. Tidskrift 55: 604–612.

GATEWOOD, ROBERT. 1980. pH tolerance of *Najas marina*. Report for special problem in botany submitted to Ronald L. Stuckey. 18 pp.

GILLIS, WILLIAM T. 1978. Letter to Ronald L. Stuckey, 6 December, from East Lansing, Michigan.

———, RICHARD A. HOWARD, AND GEORGE R. PROCTOR. 1973. Additions to the Bahama flora since Britton and Millspaugh—I. Rhodora 75: 411–425.

GOODRICH, MRS. L. LEONORA HUTCHINSON. 1912. Flora of Onondaga County as collected by the members of the Syracuse Botanical Club. Printed by the McDonnell Co., Syracuse, New York. 210 pp.

GODWIN, HARRY. 1975. The History of the British Flora: A Factual Basis for Phytogeography. 2nd ed. Cambridge Univ. Press, Cambridge. 541 pp.

GRAY, ASA. 1859. . . . [Observations upon the relations of the Japanese flora to that of North America, and of other parts of the northern temperate zone.] Mem. Amer. Acad. Arts & Sci. New Ser. 6: 437–449. (Reprinted under the title, The Flora of Japan, pp. 125–141. *In* Charles Sprague Sargent. Scientific Papers of Asa Gray. Vol. II. Essays; Biographical Sketches 1841–1886. Houghton, Mifflin & Co., Boston. 1889; Ronald L. Stuckey. Essays on North American Plant Geography from the Nineteenth Century. Arno Press, New York. Pages not numbered + introduction, 4 pp. 1978.)

G[RAY], A[SA]. 1865. *Najas major, Ruppia maritima*, &c discovered at Salina, N.Y. Amer. J. Sci. 89: 106–107.

———. 1866. Catalogue of plants found in Oneida County [New York] and vicinity; by John A. Paine, Jr. . . . Amer. J. Sci. 91: 130–132.

GRISEBACH, A. 1862. Plantae Wrightianae e Cuba Orientali, Pars. II. Monopetalae et Monocotyledons. Mem. Acad. Amer. Arts. Sci. n. ser. 8: 503–536. 1863. (Preprinted, 1862.)

GRISEBACH, A. H. R. 1864. Flora of the British West Indian Islands. Lovell Reeve & Co., London. 789 pp. [Published in 7 parts from 1859–1864, with pp. 507–789 published in 1864; *Najas marina* appears on p. 507]

GRÜGER, JOHANNA. 1973. Studies on the late Quaternary vegetation history of northeastern Kansas. Geol. Soc. Amer. Bull. 84: 239–250.

HAYNES, ROBERT R. 1977. The Najadaceae in the southeastern United States. J. Arnold Arbor. 58: 161–170.

———. 1979. Revision of North and Central American *Najas* (Najadaceae). Sida 8: 34–56.

HERMANN, F. J. 1935. *Naias marina* in hot springs. Leafl. W. Bot. 1: 182.

———. 1940. Naiadaceae of Nevada. Contributions Toward a Flora of Nevada. No. 15. Div. of Plant Exploration and Introduction, Bureau Plant Industry, U.S. Dept. Agric., Washington, D.C. 2 pp.

HEWITT, OLIVER HAROLD. 1944. Waterfowl Food Plants and the Duck Population at the Head of Cayuga Lake. Ph.D. Dissertation. Cornell Univ., Ithaca. 196 pp.

HOLMGREN, ARTHUR H. 1942. A Handbook of the Vascular Plants of Northeastern Nevada. Grazing Service, U.S. Dept. Int. and Utah State Agric. Coll. Exp. Sta. 214 pp.

HOOVER, ROBERT F. 1970. The Vascular Plants of San Luis Obispo County, California. University Calif. Press, Berkeley. 350 pp.

HULTÉN, ERIC. 1962. The Circumpolar Plants. I. Vascular cryptogams, conifers, monocotyledons. Kungl. Svenska Vetenskapsakademiens Handlingar Fjärde Serien. Band 8. Nr. 5. 275 pp. (Reprinted with additions and corrections, 1964.)

KEARNEY, THOMAS H. AND ROBERT H. PEEBLES. 1942. Flowering plants and ferns of Arizona. U.S. Dept. Agric. Misc. Publ. No. 423. 1069 pp.

———, ———, AND COLLABORATORS. 1951. Arizona Flora. Univ. Calif. Press, Berkeley and Los Angeles. 1032 pp. Suppl. by John Thomas Howell and Elizabeth McClintock and collaborators. 1960. Pages 1033–1085. (Reprinted, 1964.)

KUBICHEK, W. F. 1933. Report on the food of five of our most important game ducks. Iowa State Coll. J. Sci. 8: 107–126.

MABBOTT, DOUGLAS C. 1920. Food habits of seven species of American Shoal Water Ducks. U.S. Dept. Agric. Bull. 862. 67 pp.

MAGUIRE, BASSETT AND G. HORTIN JENSEN. 1942. Great Basin plants V.—Aquatics. Rhodora 44: 4–9.

MARTIN, A. C. AND F. M. UHLER. 1939. Food of game ducks in the United States and Canada. U.S. Dept. Agric. Tech. Bull. No. 634. 157 pp.

MARTIN, WILLIAM C. AND CHARLES R. HUTCHINS. 1980. A Flora of New Mexico. Vol. I. J. Cramer, Vaduz. xiii + 1276 pp.

MASON, HERBERT L. 1957. A Flora of the Marshes of California. Univ. California Press, Berkeley and Los Angeles. 878 pp.

MCATEE, W. L. 1939. Wildfowl Food Plants: Their value, propagation, and management. Collegiate Press Inc., Ames, Iowa. 141 pp.

———. 1947. Distribution of seeds by birds. Amer. Midl. Naturalist 38: 214–223.

MCCLEARY, JAMES A. 1957. Notes on Arizona plants. Southw. Naturalist 2: 152–154.

METCALF, FRANKLIN P. 1931. Annotated list of plants collected about lakes and sloughs, pp. 47–64. *In* Wild-duck foods of North Dakota lakes. U.S. Dept. Agric., Tech. Bull. No. 221. 72 pp.

MERILÄINEN, JOUKO. 1968. *Najas minor* All. in North America. Rhodora 70: 161–175.

MILLER, GARY L. 1978. An ecological inventory of aquatic vegetation in the major lakes of Cayuga County, New York, and recommendations for their management. Prepared for the Cayuga County Environ. Mgmt. Council. [Cayuga County Planning Board, Auburn, New York] ix + 172 pp.

MITCHELL, RICHARD S. 1979. Preliminary lists of rare, endangered and threatened plant species in New York state. New York State Mus. Leafl. No. 21. 15 pp.

——— AND CHARLES J. SHEVIAK. 1981. Rare plants of New York state. New York State Mus. Bull. No. 445. viii + 96 pp.

———, ———, AND J. KENNETH DEAN. 1980. Rare and endangered vascular plant species in New York state. New York State Mus., Albany, and U.S. Fish and Wildlife Serv. 38 pp.

MOHLENBROCK, ROBERT H. 1970. The Illustrated Flora of Illinois, Flowering Plants, *flowering rush to rushes*. Southern Illinois Univ. Press, Carbondale and Edwardsville. 272 pp.

MOORE, DAVID L. 1976. Changes in the marsh and aquatic vascular flora of East Harbor State Park. Ottawa County, Ohio, since 1895. Ohio J. Sci. 76: 78–86.

MORONG, THOMAS. 1885. Notes on Naiadaceae. Bot. Gaz. 10: 254–256.

———. 1893. The Naiadaceae of North America. Mem. Torrey Bot. Club 3(2): 1–65 + pls. XX-LXXXIV.

MOYLE, JOHN B. 1945a. Classification of lake waters upon the basis of hardness. Proc. Minnesota Acad. Sci. 13: 8–12.

———. 1945b. Some chemical factors influencing the distribution of aquatic plants in Minnesota. Amer. Midl. Naturalist 34: 402–420.

——— AND NEIL HOTCHKISS. 1945. The aquatic and marsh vegetation of Minnesota and its value to waterfowl. Minnesota Dept. Consv., Tech. Bull. No. 3. 122 pp.

MUENSCHER, W. C. 1928. Vegetation of Cayuga and Seneca Lakes, pp. 243–248, list, pp. 246–248. *In* A Biological Survey of the Oswego River System Supplemental to Seventeenth Annual Report, 1927. Consv. Dept., State of New York. Biol. Surv. No. 2 (1927). Albany. 248 pp. + maps.

MUNZ, PHILIP A. 1935. A Manual of Southern California Botany. Claremont Colleges. Claremont. 642 pp.

———. 1974. A Flora of Southern California. Univ. California Press, Berkeley. 1086 pp.

NEAR, KAREN A. AND ROBERT O. BELCHER. 1974. New localities for *Najas minor* and *N. marina* in southeastern Michigan. Michigan Bot. 13: 181–185.

OTTO, N. E. AND T. R. BARTLEY. 1965. Aquatic pests on irrigation systems: Identification guide, a water resources technical publication. U.S. Dept. Interior, U.S. Government Printing Office, Washington, D.C. 72 pp.

PAINE, JOHN A., JR. 1865. Catalogue of Plants Found in Oneida County and Vicinity. Rep. Regents Univ. New-York. 140 pp.

PECK, CHARLES H. 1874. New stations of rare plants, remarks and observations, pp. 87–91. *In* Report of the botanist (for 1872). 26th Ann. Rep. New York State Mus. pp. 35–91.

———. 1883. New stations, remarks and observations, pp. 35–40. *In* Report of the botanist (for 1882). 36th Ann. Rep. New York State Mus. pp. 27–49.

RENDLE, ALFRED BARTON. 1899. A systematic revision of the genus *Najas*. Trans. Linnean Soc. London 2nd ser. 5: 379–436 + pls. 39–42.

REVEAL, JAMES L. 1977. Najadaceae, pp. 22–23. *In* Arthur Cronquist, Arthur H. Holmgren, Noel H. Holmgren, James L. Reveal, and Patricia K. Holmgren. Intermountain Flora: Vascular Plants of the Intermountain West, U.S.A. Vol. Six, The Monocotyledons. Columbia Univ. Press, New York. 584 pp.

RIDLEY, HENRY N. 1930. The Dispersal of Plants throughout the World. L. Reeve & Co., Asford, England. 744 pp.

ROSENDAHL, C. O. 1939. Additional notes on *Najas* in Minnesota. Rhodora 41: 187–189.

——— AND F. K. BUTTERS. 1935. The genus *Najas* in Minnesota. Rhodora 37: 345–348.

ROSS, JAMES G. AND BARBARA M. CALHOUN. 1951. Preliminary reports on the flora of Wisconsin. XXXIII. Najadaceae. Trans. Wisconsin Acad. Sci. 40: 93–110.

ROTHROCK, J. T. 1878. Catalogue of Plants Collected in Nevada, Utah, Colorado, New Mexico, and Arizona, . . . pp. 53–351. *In* Vol. VI. Botany. Report Upon United States Geographical Surveys West of the One Hundreth Meridian, in Charge of First Lieut. Geo. M. Wheeler, . . . Government Printing Office, Washington, D.C. xx, 404 pp. + XXX pls.

SHANKS, ROYAL E. AND RICHARD H. GOODWIN. 1943. Notes on the flora of Monroe County, New York. Proc. Rochester Acad. Sci. 8: 299–343.

SMITH, J. DONALD. 1946. The canvas-back in Minnesota. The Auk 63: 73–81.

STERN, WILLIAM T. 1965. Grisebach's flora of the British West Indian islands: A biographical and bibliographical introduction. J. Arnold Arbor. 46: 243–285.

STUCKEY, RONALD L. 1980. The migration and establishment of *Juncus gerardii* (Juncaceae) in the interior of North America. Sida 8: 334–347.

———. 1981. Distributional history of *Juncus compressus* (Juncaceae) in North America. Canad. Field-Naturalist 95: 167–171.

———. 1983. Absence of certain aquatic vascular plants from the Prairie Peninsula, pp. 97–104. *In* Richard Brewer, ed. Proc. 8th North Amer. Prairie Conf., Western Michigan Univ., Kalamazoo. viii + 176 pp.

——— AND MARVIN L. ROBERTS. 1977. Rare and endangered aquatic vascular plants of Ohio: An annotated list of the imperiled species. Sida 7: 24–41.

——— AND ———. 1982. Monocotyledons, pp. 27–47. *In* Tom S. Cooperrider, ed. Endangered and Threatened Plants of Ohio. Ohio Biol. Surv. Biol. Notes No. 16. 92 pp.

SVENSON, H. K. 1927. Effects of post-pleistocene marine submergence in eastern North America. Rhodora 29: 41–48, 57–72, 87–93, 105–114.

SWARTZ, OLAVO. 1791. Observations Botanicae Quibus Plantae Indiae Occidentalis Alliaeque Systematis Vegetabilium. Ed. XIV. Sumtu J. Jacobi Palmii, Erlangae. 424 pp.

SWINK, FLOYD. 1969. Plants of the Chicago region. The Morton Arbor., Lisle, Illinois. 445 pp.

———. 1974. Plants of the Chicago region. 2nd. ed. The Morton Arbor., Lisle, Illinois. 474 pp.

——— AND GEROULD WILHELM. 1979. Plants of the Chicago Region: A Checklist of the Vascular Flora of the Chicago Region, with Keys; Notes on Local Distribution, Ecology, and Taxonomy; and A System for Evaluation of Plant Communities. Revised and Expanded Edition with Keys. The Morton Arbor., Lisle, Illinois. lxxii + 922 pp.

TANS, WILLIAM E. AND ROBERT H. READ. 1975. Recent Wisconsin records for some interesting aquatic vascular plants in the western Great Lakes region. Michigan Bot. 14: 131–143.

TRALAU, H. 1959. Extinct aquatic plants of Europe. Bot. Not. 112: 385–406.

TWISSELMANN, ERNEST C. 1967. A flora of Kern County, California. Wasmann J. Biol. 25(1/2): 1–395.

VANBRUGGEN, THEODORE. 1976. The Vascular Plants of South Dakota. Iowa State Univ. Press, Ames. 538 pp.

VAN ZANT, KENT. 1979. Late glacial and postglacial pollen and plant macrofossils from Lake West Okoboji, northwestern Iowa. Quaternary Res. 12: 358–380.

VOSS, EDWARD G. 1972. Michigan Flora: A Guide to the Identification and Occurrence of the Native and Naturalized Seed-plants of the State Part I Gymnosperms and Monocots. Cranbrook Inst. Sci., Bloomfield Hills, Bull. 55, and Univ. Michigan Herb., Ann Arbor. xviii + 488 pp.

———. 1979. Letter to Ronald L. Stuckey. 19 January, from Ann Arbor, Michigan.

WATTS, W. A. 1978. Plant macrofossils and Quaternary Paleoecology, pp. 53–67. *In* D. Walker and J. C. Guppy, eds. Biology and Quaternary Environments, based on the Symposium on Biological Problems in the Reconstruction of Quaternary Terrestrial Environments, held in Canberra, February 1978. Australian Acad. Sci.

———. 1980. Letter to Ronald L. Stuckey, 28 January, from Dublin, Ireland.

——— AND R. C. BRIGHT. 1968. Pollen, seed, and mollusk analysis of a sediment core from Pickerel Lake, northeastern South Dakota. Geol. Soc. Amer. Bull. 79: 855–876.

WENTZ, W. ALAN. 1980. Letter to Ronald L. Stuckey, 11 June, from Brookings, South Dakota.

——— AND RONALD L. STUCKEY. 1971. The changing distribution of the genus *Najas* (Najadaceae) in Ohio. Ohio J. Sci. 71: 292–302.

WIEGAND, KARL M., AND ARTHUR J. EAMES. 1926. The flora of the Cayuga Lake basin, New York. Cornell Univ. Agric. Exp. Sta. Mem. 92. 491 pp.

WINTERRINGER, GLEN S. 1966. Aquatic vascular plants new for Illinois. Rhodora 68: 221–222.

WOOTON, E. O., AND PAUL C. STANDLEY. 1915. Flora of New Mexico. Contr. U.S. Natl. Herb. 19: 1–794.

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# "Mosses" in Lord Petre's Herbarium Collected by John Bartram

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"Mosses" in the 18th century included not only Musci and Hepaticae, but also lichens, algae and lycopods: "every low-growing plant which was not clearly a flowering plant, a fern or a fungus" (Margadant 1968). The publication of Dillenius's *Historia Muscorum* in 1742 was significant because it represented the first work devoted solely to "mosses." Although Dillenius's understanding of the Musci was imperfect (he thought spores were pollen, for example), the very act of working on the publication aroused the interest of others in the subject. The American botanist-farmer, John Bartram, confessed that before Dillenius stimulated his interest, he "took no particular notice of mosses, but looked upon them as a Cow looks at a pair of new Barn doors" (Bartram Papers 1: 42). The study of contemporary herbaria, descriptions, and correspondence, along with Dillenius's published works can give us a better understanding of the formative years of bryology, as well as lichenology.

The early 18th century was a lively time, botanically speaking: a time of active interchange between amateurs (in the original sense of the word), professionals, self-taught plant explorers, physicians and patrons—all working toward a more accurate understanding of the rapidly enlarging known botanical kingdom. Sir Hans Sloane, whose collection was the foundation of the British Museum of Natural History, is well known as a patron of botany. Less well-known, partially because of his early death at 29, is a fervent patron of the same period, Robert James (1713–1742), 8th Baron Petre (Henrey 1975; McLean 1984).

Petre's botanical enthusiasm was on a large scale, even by the standards of the period. Among Sir Hans Sloane and a small number of others, this Roman Catholic peer was the largest subscriber for the Caribbean plant collections of William Houstoun; he was also the Philadelphia Quaker, John Bartram's greatest patron. Petre planted trees by the tens of thousands (with emphasis on American species) on his estate, Thorndon, in Essex (Grieve 1981; O'Neill 1984).

Petre's large library reflected the interests one might expect of a Fellow of the Royal Society, and contained dozens of books on natural science, from 17th century classics such as Tournefort's *Elemens de botanique* to Dillenius's *Historia Muscorum* (in sheets); it also included a bound 16 volume herbarium (McLean 1984). Maintained in the Petre family until the 19th century, the herbarium was purchased by Adolph Sutro in 1886. The Sutro Library is now part of the California state library system and is housed at San Francisco State University, in the city of which Sutro was once mayor. The volume of American "mosses" collected by John Bartram in Petre's herbarium is the concern of this paper. "Sir" John Hill, described by another employer, the Duke of Richmond as a "Bottanist, apothecary, poet or stage player" (Rousseau 1982), was also employed by Petre to annotate most of the herbarium, including the Bartram "mosses" (McLean 1984).

John Bartram's link to the British botanical world was Peter Collinson, Quaker draper, enthusiastic gardener, plant collector, and friend to the botanical community. It was through Collinson that Bartram was introduced, first to Lord Petre and then to a number of patrons and clients which was to eventually include George III, to whom Bartram became the "King's botanist." It was Collinson who instructed Bartram how to collect and press specimens, even sending him paper for pressing. Bartram was to document his seeds by enclosing two specimens of the original plant. Collinson then sent Bartram's specimens to Gronovius, the great Dutch botanist (who had edited John Clayton's *Flora virginica*) or to Dillenius, the German botanist who was working at Oxford. These botanists would identify Bartram's specimens, with particular interest in "new" plants, and Collinson would relay the information to Bartram (Bartram Papers 2: 9). Although Bartram soon corresponded with Dillenius "directly," these letters were sent, as were the specimens, through Collinson.

The Bartram-Collinson correspondence, lasting over 30 years, makes lively reading (Darlington 1849). The first known mention of mosses was in January, 1739, when Collinson asked Bartram to "pray get some Mosses for him [Dillenius] He is now Engraveing his Collection of Mosses in order to publish them" (Bartram Papers 2: 43). Dillenius evidently sent specimens of mosses to Bartram, as part of his education on the subject, but they took a year to reach him (Bartram Papers 1: 19). In November, 1739, Bartram wrote Collinson that he had sent "a letter to doctor dillenius & thee two little cedar boxes one of mosses for ye doctor" (Bartram Papers 1: 19). It was not until July 22, 1740 that Collinson replied: "The Boxes of Mosses come safe . . . and was very acceptable to Docr Delenius for thee has outdone all his other Correspondents . . ." (Bartram Papers 2: 53). There evidently was another shipment, for in October, 1740, Dr. Dillenius wrote Bartram directly that the "last parcell of Mosses & Letter from April 20 is safe come to hands by ye care of P. Collinson" (Bartram Papers 3: 99).

For a novice at collecting mosses, Bartram became very busy. In September, 1740, Bartram wrote Collinson "in my Journey to Menesinks on the Eastern Branch of Delaware att the foot of the paqualian Mountains . . . I have colected for thee & Lord Petre about 60 sorts of mosses . . . thine is of the same sorts with his pray if thee canst Conveniently let Doctor Dillenius see them it may be there may be some new sorts" (Collinson ms.). Other mosses were sent in July of 1741, crossing with a sad letter from Collinson telling of the death of Lord Petre from smallpox (Bartram Papers 2: 21, 68). Finally, Dillenius sent the "p[re]sent of his History of Mosses" (Bartram Papers 2: 67) in May of 1742, which Bartram thought was "ye Compleatest of that kind that ever was wrote . . ." (Bartram Papers 1: 28).

The most pertinent letter is that from Bartram, indicating that he had sent duplicate specimens to Collinson for Lord Petre and Dillenius. Since the Dillenian herbarium at Oxford contains specimens of certain "mosses" that typify names validly published by Hedwig and Linnaeus, it was probable that the Petre collection would contain some isotypes. Accordingly, the *Historia Muscorum* was searched for references to specimens from John Bartram, as was post-Hedwigian literature for citations to pertinent Dillenian material. The Dillenian herbarium at Oxford was examined (by E. P. McL.), with the assistance of H. N. Clokie, and the original Dillenian drawings for the *Historia* were examined at the British Museum (Natural History).

The Bartram material, especially the Bartram-Petre material, evidently arrived at the last minute, given the dates of the letters and the actual publication of the *Historia* (see Henrey 1975 for publication details). Some of the specimens were obviously important enough to be included. Dillenius seemed to have etched several illustrations, based on Bartram's specimens, directly on the plates, because there are no detailed drawings for these specimens. The drawing for *Lycopodioides radiatum dichotomum*, for example, is only a rough sketch. A high proportion of the Bartram specimens which are types for Dillenian names are in the Appendix of the *Historia* and in the same section of the Dillenian herbarium. Bartram was correct in his belief that the collection from the Menesinks contained some "new sorts."

The Dillenian herbarium was evolving, not static, as is usually indicated. Clokie (1964) stated that the specimens are pasted on the herbarium sheets "in the order in which he engraved them," and Druce and Vines (1907) indicated the same. What has escaped notice is the fact that changes were made by Dillenius to support the projected abridged edition of the *Historia*. (The first edition sold only 250 copies.) The manuscript for this unpublished edition is at the Bodleian Library; it is a combination of pasted names, illustrations, and brief descriptions cut from the 1741 *Historia*, to which are added brief notes in Dillenius's hand. For example, the plant originally described in the *Historia* as *Lycopodioides radiatum dichotomum* "E Pensylvania a Jo. Bartram accepi" was changed to *Lycopodium radiatum dichotomum* (by a penned line and the addition of "um") and moved from the *Lycopodioides* section to the *Lycopodium* section in both the herbarium and the manuscript of the abridged edition.

Another Bartram specimen in the Dillenian herbarium is *Polytrichum acaulon capillaceum, capsulis cylindraceis* which was cited by Hedwig (1801) as the basis for *Polytrichum pensilvanicum*, now known as *Pogonatum pensilvanicum* (Hedw.) P.-Beauv. There is no drawing for his late-arriving specimen, which Dillenius (1741) wrote was "Gathered on Jersey Side at the Menesinks, at the Upper Inhabitants on Delaware." There is also a specimen in the Petre herbarium (34, see below), labeled *Polytrichum aureum minus capsula oblongorotunda calyptra ad oras lacerata* which is *Pogonatum pensilvanicum*. The polynomial was given by "Sir" John Hill, evidently written while Dillenius was writing his *Historia*.

All the annotations on the Bartram "moss" specimens in the Petre herbarium are in the hand of John Hill. The citations used are: Caspar Bauhin, *Πιναξ*, 1623; Johannes Dillenius, *Catalogus plantarum circa Gissam sponte nascentium*, 1718; John Ray, *Synopsis methodica stirpium britannicarum*, 3rd edition (edited by Dillenius), 1724. According to Lord Petre's personal catalogue of his library (now in the library of the Essex Record Office), Ray's *Synopsis* was in Petre's extensive library, but not Dillenius's *Catalogus*. By far the greatest number of specimens (35 out of 52) have no bibliographic citation, only Hill's own polynomial.

Hill's work on the Bartram mosses seems uneven, with the hindsight of almost 250 years. In many cases Hill identified species as "common in England," such as the above mentioned *Pogonatum pensilvanicum*, but which Crum and Anderson (1981) indicate are endemic to North America. In other examples, such as *Hypnum repens triangularibus . . . pensylvanicum et virginianum* (= *Rhytidiadelphus triquetrus*), Hill incorrectly identified species as "peculiar to America," which also occur in England. Hill, though, is closer than Dillenius in modern thought in his commentary on the lichen *Byssus pulverulenta incana farinae instar strata* (= *Pertusaria paratuberculifera*): "D$^{r}$. Dillenius calls it a Moss—but I am apt to believe it rather a small Fungus or Congeries of Fungi. . . ." None of Hill's "new" names from the Petre herbarium was ever published, despite his voluminous later publications on, and continued interest in, "mosses" (e.g., Hill 1751).

The Bartram "mosses" give us a chance to examine some of the oldest, if not the oldest, collection of bryophytes from the United States and an opportunity to date some of the "mosses" in the Dillenian herbarium. Bartram may not have collected any bryophytes which are now considered rare, but he did develop an eye for species new to Dillenius, and himself. Also, a number of these collections were later used as the bases for Hedwigian and Linnaean binomials. The Petre herbarium, in conjunction with its annotations, the contemporary publications and correspondence, helps fill in the picture of an emerging understanding of "mosses" in the early 18th century.

## Catalogue of Specimens

The following catalogue is arranged according to the order in which the specimens are filed in volume XIII of the Sutro Library (and more or less in the order they are presented in *Historia Muscorum*). The arabic number indicates the sheet and is followed by the polynomial which Hill applied to the specimen. If Hill used a name from a previous author, the bibliographic citation is listed. If the polynomial is Hill's, only his name follows. None of Hill's names was ever published. After the polynomial is Hill's common name for the taxon followed by a modern determination. If no determinator follows the name it was determined by the senior author. The subsequent paragraph in quotation marks was written by Hill. The final paragraph(s) are annotations by the current authors on the taxon and/or specimen in question, or on Hill's commentary.

3. *Byssus pulverulenta incana farinae instar strata* R[ay,] S[ynopsis methodica stirpium britannicarum] Ed[itio] ter[tia] pag. 56 [1724]. Grey dusty moss. = *Pertusaria paratuberculifera* Dibben, det. R. C. Harris. Thin layer chromatography: lichexanthone, 2-0-methylperlatolic acid. Fig. 1.

"This was found on the Roots of Trees in Pensylvania. It is also common in England in shady Places, strewd over the bark of Trees or other rotten Mosses as in this Specimen. D^r^. Dillenius calls it a Moss—but I am apt to believe it rather a small Fungus or Congeries of Fungi, like what we call Mouldiness on many putrifyd Bodies."

Although Hill reported this as "common in England," he obviously had a broad concept of the taxon because *P. paratuberculifera* is an eastern North American endemic (Dibben 1980). This is the first report of the species for Pennsylvania.

It is of interest that Hill realized that this lichen was not a moss, but rather a fungus. It was Morison (1680–1699) who first associated lichens with fungi in his section "Musco-Fungi." However, this knowledge was overlooked by Morison's contemporaries and by Dillenius (1741). Hill seems to have only made this observation about the sole crustose lichen in the collection and did not expand his concept to include the foliose and fruticose lichens.

4. *Lichenoides arboreum villosum* [Hill], *Usnea off*[*icinarum*]–C. B[auhin], Pin[ax] 361 [1623]. Hairy tree moss. = *Usnea trichodea* Ach., det. R. C. Harris. Thin layer chromatography: usnic acid, diffractaic acid, constictic acid.

"This was gatherd on Trees in the Woods, in Pensylvania. It is also found in England tho not common. In Charlton Forest in Sussex there are many Trees coverd with it."

Although Hill reported this as occurring in England, Motyka (1936) only cited eastern Canada, eastern United States, and a single Mexican locality for the species. Hale's (1979) distribution map shows the species restricted to eastern United States from New England to eastern Texas.

5. *Lichenoides arboreum caule rigidiore et crassior* [Hill]. Strong hard branched tree moss. = *Usnea rubicunda* Stirton, det. R. C. Harris. Thin layer chromatography: usnic acid, stictic acid agg.

"This was gatherd on a Tree in Virginia. It is also found in England as in Charlton Forest in Sussex."

Motyka (1936) reported this species as occurring in the Azores, Spain, Portugal, France, Switzerland, Germany, Italy, Austria, Czechoslovakia, Yugoslavia, Romania, Albania, Ireland, England; India, China, Taiwan, Korea, Japan, Java, Hawaii; eastern United States; Jamaica, Cuba, Puerto Rico, El Salvador, Costa Rica, Colombia, Ecuador, Bolivia, Peru, Brazil, and Argentina. Hale (1979) shows *U. rubicunda* occurring from southern Maine across New England and the midwest to Missouri and Oklahoma, south to eastern Texas and Florida.

6. *Lichenoides tubulosum, ramosissimum, fruticuli specie, candicans, humilius, et crassius, Pensylvanicum* [Hill]. Low, branched coralline moss. = *Cladina subtenuis* (Abb.) Hale & Culb., det. R. C. Harris. Thin layer chromatography: usnic acid, fumarprotocetraric acid.

"This is common in Pensylvania, and very much resembles our common Coralline Moss; but a close examination shews it evidently another Species."

Hill was correct in his observations that this species is distinct from the common European species, probably *Cladina portentosa* (Duf.) Follm., because *C. subtenuis* is an American endemic. Thomson (1967) records its distribution (sub *Cladonia*) as Maine to Florida and west to Illinois, Alabama, Oklahoma, and Texas; Haiti, Jamaica, and Guyana.

Although Hill followed Dillenius (1718) in his use of the generic name *Lichenoides*, he (Hill 1751) used the name *Cladonia* later. Hill's (1751) usage of the name *Cladonia* appears to be the earliest use of the name in the modern sense, and more importantly, he provided a description of the genus which later served as the basis of the genus (Laundon 1984). Although this is also true of *Usnea*, Hill obviously picked up the name from Bauhin (see above, 4).

7. *Lichenoides saxatile, cinereum, foliis divisis, subtus nigricantibus, segmentis frequentioribus, et rotundioribus, pumilum* [Hill]. Little, round-segmented, bastard-liverwort. = *Heterodermia speciosa* (Wulf.) Trev., det. R. C. Harris. Thin layer chromatography: atranorin, zeorin.

"This was gatherd on the Rocks in Pensylvania. Its tubercles appear in November."

*Heterodermia speciosa* occurs in continental Europe, but not the British Isles (Kurokawa 1962, sub *Anaptychia*), Japan, China, India, Hawaii, United States, Mexico, Costa Rica, Brazil (Kurokawa 1962 sub *Anaptychia pseudospeciosa* var. *tremulans* = *H. speciosa* fide Swinscow and Krog 1976), and eastern Africa (Swinscow and Krog 1976). In the United States Hale (1979) shows the species known from Maine to Minnesota, south to Louisiana and Georgia and also in Arizona and New Mexico.

The fact that Hill referred to this lichen, and some other foliose lichens, as a liverwort is interesting because it not only shows the confusion caused by common names, but also the confusion between different plants which have converged on the thalloid habit.

8. *Lichenoides arboreum crustaceum cinereum apophysibus foliosis numerosissimis onustum* [Hill]. Grey crustaceous leafy tree moss. = *Punctelia rudecta* (Ach.) Krog, det. R. C. Harris.

"This grew on the bark of a Tree in Virginia. Its Heads appear in September."

It is not surprising that Hill did not recognize this lichen, which although common in eastern North America, is absent from Europe (Hale 1965). It also occurs in Asia and Australia (Krog 1982), Mexico, Chile, and Argentina (Culberson 1962). In the United States *P. rudecta* occurs from Maine to North Dakota south to Texas and Florida and also in Arizona, New Mexico, and Colorado (Hale 1979).

9. *Lichenoides saxatile fusco purpurascens majus et rugosum Jerseianum* [Hill]. Great brown roughleav'd bastard liverwort. = *Umbilicaria muhlenbergii* (Ach.) Tuck., det. R. C. Harris.

"This was gatherd on a Rock near the Top of The Parqualiana [Paqualian] Mountains in the Jerseys and has never I believe been found any where else."

Far from a New Jersey endemic, *U. muhlenbergii* ranges from the Appalachian Mountains north to New England and to Ungava, Canada, west through the Great Lakes region to Minnesota, and sporadically in the northern West (Llano 1950). It is also known from North Temperate Asia.

Although Bartram was the first to collect this lichen, Acharius (1810) described it on the basis of material collected by Muhlenberg from Bartram's home state of Pennsylvania.

10. *Lichenoides saxatile, coriaceum, majus, et planum, inferne nigricans, Jerseianum* [Hill]. Great smooth paleleav'd bastard liverwort. = *Umbilicaria mammulata* (Ach.) Tuck., det. R. C. Harris.

"This was also gatherd on the same Rock with The former and is I believe like that peculiar To the Place."

*Umbilicaria mammulata* has a range similar to that of *U. muhlenbergii* (q.v., 9), but somewhat more abbreviated and not occurring in Asia. It, also like *U. muhlenbergii*, was described by Acharius (1814) from material sent to him from Pennsylvania by Muhlenberg.

11. *Lichenoides peltatum terrestre cinereum majus, foliis divisis* [Dill.,] Cat[alogus] Giss[am] 208 [1718]. Ash colourd ground liverwort. = *Peltigera canina* (L.) Willd., det. R. C. Harris.

"This is found in dry Places in Pensylvania and is well known To be common in England being The very species with which the fam'd Powder against the Bite of a mad Dog is made. Its tubercles appear in November."

Hill's comment, although not followed by modern medicine, did refer to the correct lichen (Crombie 1880). The specific epithet refers to this supposed property as well as the tomentose upper surface of the thallus. Dillenius (1741) later referred to this lichen as *Lichenoides digitatum cinereum, Lactucae foliis sinuosis*.

12. *Lichenoides peltatum arboreum maximum* [*platyphyllum*] [Dill.,] Cat[alogus] Giss[am] pag. 208 [1718]. Tree lungwort. = *Lobaria pulmonaria* (L.) Hoffm., det. R. C. Harris. Thin layer chromatography: norstictic acid, stictic acid agg.

"This is found on moist ground, on the Hills in Pensylvania. It is also found In England on the Bark of Old Trees in Shady Woods: as in Charlton Forest in Sussex—and on Rooks Hill near the same Place I have gatherd it in its american situation a moist Place on the ground. Its tubercles appear in January."

Hill's determination of this lichen, later known by Dillenius (1741) as *Lichenoides pulmoneum reticulatum vulgare, marginibus peltiferis*, was correct (Crombie 1880). Although Hill records this lichen as found on moist ground, it almost surely fell from a tree trunk, as Hill records its habitat in England. *Lobaria pulmonaria* occurs in eastern and western North America (Hale 1979) as well as all of Europe, eastern and southerrn Africa, north-central and eastern Asia (Yoshimura 1971).

13. *Lichenoides arboreum ramosum rigidius et altius divisum colore e cinereo-viridi, albicante* [Hill]. Hard, flatleav'd, branch'd tree moss. = *Ramalina americana* Hale s.l., det. R. C. Harris. Thin layer chromatography: no lichen acids.

"This is found on Trees In Pensylvania. Its tubercles appear in November."

*Ramalina americana* is an eastern North American endemic, similar to the European *R. fastigiata* (Pers.) Ach., with which it was originally confused (Hale 1978).

14. *Lichenoides tubulosum pyxidatum, cinereum* [Dill.,] Cat[alogus] Giss[am] 204 [1718]. Common grey cup moss. = *Cladonia grayii* Merr. ex Sandst., det. R. C. Harris. Thin layer chromatography: grayanic acid.

"This is found in the uplands parts of Virginia—tis also common on Heaths In England. It appears from September to February."

Although *C. grayii* does occur in England (Hawksworth et al. 1980), Hill had confused this lichen with another cup-forming *Cladonia, C. fimbriata* (L.) Fr. (Crombie 1880), which Dillenius (1741) later called *Coralloides scyphiforme, tuberculis fuscis*. *Cladonia grayii* is a member of the *C. chlorophaea* complex and ranges sporadically throughout northern Europe, Japan, Uruguay, and New Zealand; in North America from Newfoundland to Manitoba south to Nebraska, Texas, and Florida; and in Alaska and Greenland (Ahti 1966).

15. *Lichenoides tubulosum, pyxidatum proliferum marginibus serratis, crustaceum, et foliosum* [Hill]. Serrated leafy childing cup moss. = *Cladonia squamosa* (Scop.) Hoffm., det. R. C. Harris. Thin layer chromatography: squamatic acid.

"This was gatherd in the upland Parts of Pensylvania and Virginia. It appears from August Till January."

It is difficult to understand Hill's comment that this lichen appears from August through January. It, like all Cladoniae, are perennial and long-lived. *Cladonia squamosa* is arctic to temperate and circumpolar; in North America it occurs from Greenland to Alaska south to California and Florida (Thomson 1967).

16. *Lichenoides tubulosum pyxidatum exiguum, fusco-virens* [Dill.,] Cat[alogus] Giss[am] 204 [1718]. Little crustaceous cup moss. = *Cladonia* sp. (sterile), det. R. C. Harris. Thin layer chromatography: fumarprotocetraric acid.

"This was gatherd in dry barren places in Pensylvania but is also common to England and found on many Heaths. It appears from September Till January or February."

Although Hill has provided this specimen with a Dillenian polynomial equivalent to *Cladonia fimbriata* (L.) Fr. fo. *tubaeformis* Hoffm. (Crombie 1880, = *C. coniocrea* auct., Fink 1935), it is sterile and consists solely of squamules. The chemistry is consistent with numerous Cladoniae, but without podetia an identification is impossible. Incidentally, *C. coniocrea* has just fumarprotocetraric acid, but the squamule morphology is different from this specimen.

17. *Hypnum repens triangularibus majoribus et pallidioribus foliis, pumilum pensylvanicum et virginianum* [Hill]. Dwarf paleleav'd upright wood moss. = *Rhytidiadelphus triquetrus* (Hedw.) Warnst.

"This was gatherd in woods in Virginia and Pensylvania and is I believe Peculiar to America it seems a perfect dwarf Representation of our great upright wood moss. Its Heads appear in November."

*Rhytidiadelphus triquetrus* is not an American endemic, but is reportedly common and even locally abundant in Great Britain (Smith 1978). It is also known from throughout central Europe, northern and central Asia, and Japan. In North America it is distributed from Alaska and the Yukon south to California and Montana, eastward to Newfoundland, and south to North Carolina, Tennessee, and Arkansas (Crum and Anderson 1981).

No reference has been found to Hill's citation of the "great upright wood moss." Dillenius (1741) makes no reference to this name among his Hypna. This incident points to the problems associated with common names.

18. *Hypnum arboreum, majus, cauliculis teretibus, erectis, foliis brevioribus, et angustis, luteovirentibus* [Hill]. Large round branch'd upright tree moss. = *Entodon seductrix* (Hedw.) C. Müll.

"This was found on the Bark of a Tree In some part of Virginia. Its Heads appear in December."

*Entodon seductrix* is an American endemic, occurring from Vermont to Ontario, Minnesota, Nebraska, and Kansas south to Florida and Texas (Crum and Anderson 1981). The type specimen is from Lancaster, Pennsylvania (Hedwig 1801), presumably collected by Muhlenberg. Hedwig (1801) never made reference to Dillenius's (1741) *Hypnum julaceum sericeum repens, capsulis cylindraceis*, which according to Lindberg (1883) is also *E. seductrix*.

Although Hill records this species as growing on the bark of a tree, it was almost surely on the base of a tree as the species rarely if ever grows up the trunks of trees.

19. *Hypnum arboreum minus, cauliculis teretibus erectis, foliis brevioribus et angustis luteovirentibus* [Hill]. Little round branch'd yellowish tree moss. = *Anomodon rostratus* (Hedw.) Schimp.

"This was found on the Bark of a Tree in Virginia. Its Heads appear in December."

Although *Anomodon rostratus* does not occur in England, it does grow in central Europe and is common in eastern North America (Crum and Anderson 1981). Hedwig's (1801) type came from Lancaster, Pennsylvania.

20. *Hypnum sylvaticum repens minus foliis luteovirentibus ramosum* [Hill]. Pale leav'd little wood trailing moss. = *Entodon seductrix* (Hedw.) C. Müll.

"This was gatherd in woods in Virginia. It is also common in England. Its Heads appear in January."

It is interesting that Hill did not recognize this specimen as the same species as one above (18, q.v.). It seems that habitat alone influenced his decision since his Latin polynomials reflect this before morphological characteristics.

Since *Entodon seductrix* is an American endemic, one wonders what Hill thought was the same in England, especially when the only species of *Entodon* in Britain, *E. concinnus* (De Not.) Par., is very different.

21. *Hypnum arboreum repens foliis congestis parvis obscurevirentibus* [Hill]. Little creeping darkgreen tree moss. = *Leucodon julaceus* (Hedw.) Sull.

"This was gatherd on the Bark of a Tree in Pensylvania. Its Heads appear in January."

Hedwig (1801) described this species as *Pterigynandrum julaceum*, and based it upon Dillenius's (1741) *Hypnum julaceum, perichaetio setas paene aequante*. Dillenius based his species on three collections from Pennsylvania and Virginia made by John Mitchell, John Bartram, and John Clayton. Since Mitchell and Clayton sent Dillenius material from Virginia and Bartram was Dillenius's only Pennsylvanian correspondent (Dillenius 1741), the Bartram collection is an isosyntype of Dillenius' polynomial, which then is the foundation of Hedwig's name.

*Leucodon julaceus* is a North American endemic, occurring from New York and southern Ontario to Michigan, Iowa, and Kansas south to Florida, Texas, and northern Mexico (Crum and Anderson 1981).

22. *Hypnum terrestre, luteovirens, ramulis brevioribus, foliis latioribus* [Hill]. Short branch'd shining trailing moss. = *Bryoandersonia illecebra* (Hedw.) Robins.

"This was gatherd on dry clay ground in Pensylvania: but is also common to England, and found by way sides in many Places. The Heads appear in January."

*Bryoandersonia illecebra* is a North American endemic even though Hedwig (1801) gave both Europe and North America as its range. However, a specimen from Lancaster, Pennsylvania is the only one cited. Dillenius (1741) may have aided in this confusion. His *Hypnum cupressiforme rotundius, vel Illecebrae aemulum*, according to Lindberg (1883), is a mixture of three species, *Hypnum purum* (= *Pseudoscleropodium*), *H. boscii* (= *Bryoandersonia illecebra*) and *H. illecebrum* L. ex Brid. (= *Scleropodium touretii*). The *Bryoandersonia* (Dillenius 1741, fig. 46B) collection is presumably the one cited from "Lancastrienses" [Pennsylvania]. We have no direct evidence that Bartram was associated with this collection. The species has traditionally been plagued by nomenclatural problems but these were discussed and resolved by Robinson (1962).

23. *Hypnum filicinum repens virginianum minus foliis tenuissime divisis* [Hill]. Small, fine divided virginian fern moss. = *Thuidium delicatulum* (Hedw.) B.S.G.

"This was gatherd in the woods in Pensylvania growing on the Bark of a Tree near the Ground. Its Heads appear in December."

*Thuidium delicatulum* is our most common *Thuidium*. It also occurs in western and northern Britain and Ireland, Europe, northern and central Asia, China, Japan, North America, West Indies, and Andean South America (Smith 1978). It is curious that Hill did not recognize this moss from England and even more curious that he used "virginian" in the common name when his specimen came from Pennsylvania.

Despite its wide range, Hedwig (1801) described it as occurring only in North America. Although Hedwig only cited Pennsylvania as a locality, he referred to Dillenius (1741) and his *Hypnum filicinum, tamarisci foliis minimis non splendentibus, setis capsulis brevioribus*. Dillenius cited Virginia, Pennsylvania, and Maryland but without collectors. However, since Bartram was Dillenius's only Pennsylvanian contact, it is conceivable that Dillenius, was referring, in part, to a portion of the gathering from which this specimen came.

24. *Hypnum palustre, erectum, arbusculam referens, ramulis subrotundis* [Dill.,] Cat[alogus] Giss[am] pag. 220 [1718]. Upright round branch'd tree moss. = *Climacium dendroides* (Hedw.) Web. & Mohr.

"This was gatherd in a moist Place in Pensylvania but is also found in England In damp Places in woods: as in Charlton Forest. Its seeds appear in January."

*Climacium dendroides* is a widespread and distinctive species. It is therefore no surprise that Hill recognized it. As reported by Lindberg (1883), the Dillenian polynomial of 1741, *Hypnum dendroides sericeum, setis et capsulis longioribus erectis*, is equivalent to *Climacium dendroides*. However, Lindberg (1883, p. 21) reported "Specimina in collectione sunt sterilia, excepto eodem, e Pensylvania", quod *Cl. americanum*." Our specimen, though, is not *C. americanum* Brid., which is sympatric in Pennsylvania with *C. dendroides* (Horton and Vitt 1976). Either the Pennsylvanian specimen in the Dillenian herbarium referred to by Lindberg is not a portion of this collection, or Lindberg was swayed by geography and misnamed the specimen.

25. *Hypnum palustre arbusculam referens minus, ramulis brevioribus angustioribus et magis erectis* [Hill]. Upright tree moss with shorter branches. = *Climacium americanum* Brid.

"This was gatherd in a moist shady Place in Virginia. Its Heads appear in December."

*Climacium americanum* is an American endemic ranging from Nova Scotia to Minnesota south to Texas and Florida (Horton and Vitt 1976). It is interesting that Hill recognized that *Climacium americanum* was distinct from *C. dendroides* (24, q.v.) in the 1740's, many years before Bridel described the American segregate.

26. *Hypnum terrestre sericeum luteovirens ramulis teretibus foliis creberrimis brevioribus obsitis* [Hill]. Yellowish silky ground moss. = *Pleurozium schreberi* (Brid.) Mitt.

"This grows in the Ground in dry Places in Pensylvania. Its Heads appear in January."

*Pleurozium schreberi* is common in Britain and also occurs in central Europe, Asia, and America (Smith 1978). It was known to Dillenius (1741), as *Hypnum cupressiforme tenuius et compressius*, as well as to earlier authors. Hedwig (1801) apparently did not refer to this species, probably due to the fact that Linnaeus (1753) used the name *Hypnum parietinum* for this moss as well as two others! Hedwig picked up the two non-*Pleurozium* usages of *H. parietinum* but seemingly missed this one.

27. *Hypnum palustre repens pumilum et ramosum lutescens, foliis angustioribus longioribus et aduncis, unam praecipue partem spectantibus* [Hill]. Yellow small curl'd leav'd ground moss. = *Philonotis fontana* (Hedw.) Brid. var. *caespitosa* (Jur.) Schimp.

"This was gatherd in moist Places in Virginia. Its Heads appear in January."

This variety occurs from Nova Scotia to Minnesota south to Arkansas and Tennessee, also in central and northern Europe, Asia Minor, and northern and central Asia (Crum and Anderson 1981). It is of interest that Hill referred this to *Hypnum*, a genus of pleurocarpous mosses. Even Dillenius (1741) placed the acrocarpous *Philonotis fontana* under the genus *Bryum* as *Bryum palustre, scapis teretibus stellatis, capsulis magnis subrotundis*. Dillenius (1718), however, did refer the species to *Hypnum* in his *Catalogus Gissam*.

28. *Hypnum aquaticum, erectum, cauliculis compressis, et ramosis, foliis brevioribus, et angustis, rarius sitis, virentibus* [Hill]. Green, small leav'd, upright, water moss. = *Hypnum pratense* Koch ex Spruce.

"This is found in very wet Places and by the Sides of Waters in Jersey. Its Heads appear in January."

Although not an aquatic species, *H. pratense* does grow in marshy areas. It occurs from Newfoundland to British Columbia and south to the Great Lakes region and in the east to North Carolina; northern and central Europe, northern Asia, and Japan (Crum and Anderson 1981).

29. *Hypnum terrestre, parvum, luteovirens, ramosum, ramulis compressis, foliis angustioribus, et oblongis, creberrimis, extremetatibus reflexis obsitis* [Hill]. Little shining ground moss with reflex leaves. = *Hypnum curvifolium* Hedw.

"This grows on Hills in the upland Parts of Virginia. Its Heads appear in January."

*Hypnum curvifolium* is a North American endemic. Hedwig (1801) described it from a Mühlenberg specimen from Lancaster, Pennsylvania.

30. *Hypnum terrestre erectum, pumilum, cauliculis brevioribus, minus ramosis, foliis latioribus, et brevioribus, splendide virentibus* [Hill]. Little upright green earth moss. = *Eurhynchium pulchellum* (Hedw.) Jenn.

"This is found in moist Places In Virginia. Its Heads appear in January."

This moss is very common in eastern North America but the type is from Sweden, collected by O. Swartz (Hedwig 1801). Dillenius (1718, 1741) never referred to it.

31. *Hypnum terrestre, repens, sericeum, lutescens, ramosum, foliis crebrioribus, et latioribus, caulem amplexantibus* [Hill]. Yellow creeping broadleav'd ground moss. = *Brachythecium salebrosum* (Web. & Mohr) B.S.G.

"This is found in hilly places In Virginia and also in England. Its Heads appear in November."

*Brachythecium salebrosum* does occur in England although it is not common there (Smith 1978). The species also occurs throughout much of North America, northern and central Europe, northern and central Asia, Japan, Australia, and Kerguelen (Crum and Anderson 1981).

32. *Polytrichum vulgare et majus, capsula quadrangulari* [Dill.,] Cat[alogus] Giss[am] 221 [1718]. Great golden maidenhair. = *Polytrichum commune* Hedw.

"This is found in woods in Pensylvania and is also common in England. Its Heads are ripe in August."

Hill's use of Dillenius's 1718 name is correct. It is a synonym of Dillenius's 1741 *Polytrichum quadrangulare vulgare, Juccae foliis serratis,* which, according to Lindberg (1883), is equivalent to *Polytrichum commune.*

Hill's common name is interesting for what we call the common hair cap moss. Dillenius (1741) referred to it as the "great Goldilocks." Dillenius gave no reference to any American material.

33. *Polytrichum montanum et minus, capsula quadrangulari* [Dill.,] Cat[alogus] Giss[am] pag. 221 [1718]. The lesser golden maidenhair. = *Polytrichum juniperinum* Hedw.

"This was gatherd in woods in Virginia. It is also found in many woods in England. The Heads are ripe in August."

In 1714 Dillenius referred to this moss as *Polytrichum quadrangulare, Juniperi foliis brevioribus et rigidioribus*. According to Lindberg (1883) the polynomial indeed belongs to *Polytrichum juniperinum.* However, of Dillenius's 10 figures, two of them (F and H) are based on *P. attenuatum* Menz. ex Brid. var. *brachycarpum* Lindb. (= *P. formosum* Hedw.). Dillenius provided no indication of having seen American material.

34. *Polytrichum aureum minus capsula oblongorotunda calyptra ad oras lacerata* [Hill]. Little round headed golden maidenhair. = *Pogonatum pensilvanicum* (Hedw.) P.-Beauv.

"This is found in dry sandy Places in Virginia—and is also common to England. Its Heads appear in September."

Hedwig (1801), when describing *Polytrichum pensilvanicum,* cited "Pensilvania circa Lancaster solo simili, quo Polytrichum *nanum* crescere solet, lectum misit Rev. D. Mühlenberg. Primum ibi a Jo. Bartram, neque hactenus alibi inventum, *Pensilvanicum* cognominavi." In the *Historia Muscorum* Dillenius (1741) called this species *Polytrichum acaulon capillaceum, capsulis cylindraceis.* He cited "Misit vero eam ex Pensylvania Jo. Bartram et locum vernaculo idiomate sequentem in modum descripsit: *Gathered on Jersey Side at the Menesinks, at the Upper Inhabitants on Delaware.*" Therefore, although some of Bartram's material was used in the understanding and description of this species, it was not this collection which was considered.

Since *Pogonatum pensilvanicum* is restricted to the New World (Crum and Anderson 1981), it was probably *Pogonatum nanum* (Hedw.) P.-Beauv. with which Hill was confused.

35. *Polytrichum capsulis subrotundis, pediculis brevissimis insidentibus, calyptra striata, arboreum et terrestre minus, ramosum, et breve* [Dill.,] Cat[alogus] Giss[am] 222 [1718]. Little round headed golden maidenhair with darkgreen leaves. = *Grimmia pilifera* P.-Beauv., det. S. P. Churchill.

"This was gatherd on the Bark of a Tree in Virginia—it is also found on Trees and walls In England. Its Heads appear in January."

Dillenius's (1718) *Catalogus Gissam* name is equivalent to his 1741 *Polytrichum Bryi ruralis facie, capsulis sessilibus, minus,* which, according to Lindberg (1883) is *Orthotrichum stramineum* Hornsch. However, this specimen is a member of the Grimmiaceae, not the Orthotrichaceae. Therefore, one wonders if Hill might not have altered the habitat data to fit his concept of the species since this specimen was surely collected from rock.

36. *Bryum erectis capitulis angustifolium, caule reclinato* [Dill.,] Cat[alogus] Giss[am] pag. 222 [1718]. Fine, narrow-leav'd, green wood moss. = *Dicranum scoparium* Hedw. Fig. 2.

"This was gatherd in the woods In Pensylvania. It is also found In England in most shady Places. Its heads appear in November."

In his *Historia Muscorum* Dillenius (1741) called this species *Bryum reclinatum, foliis falcatis, scoparum effigie*, with collections, but without collectors, cited from, among others, Virginia and Pennsylvania. When Hedwig (1801) described the species he cited Dillenius's *Historia Muscorum* polynomial and listed, along with several others, Virginia and Pennsylvania as localities. Without collectors one cannot be positive, however, since Bartram was Dillenius's only contributor of Pennsylvania material, it is probable that some of the American collections were made by Bartram and that this is a duplicate of one such collection.

37. *Bryum palustre, cauliculis nigricantibus, erectis, foliis brevioribus, et angustioribus, in pilum canescentem desinentibus* [Hill]. Black stald'd, hairy leav'd, marsh, upright moss. = *Hedwigia ciliata* (Hedw.) P.-Beauv.

"This was gatherd in a marshy Place in Jersey. Its Heads appear in February."

Although this may have been collected in a marshy place, the plants were surely growing well above the wetness on a rock. Dillenius (1741) called this moss *Sphagnum nodosum, hirsutum et incanum* and wrote that he had seen Pennsylvanian material. Presumably Dillenius's citation refers to a previous shipment received from Bartram and not this one.

38. *Bryum arboreum minus fusco virens foliis longioribus angustioribus confertis* [Hill]. Cluster leav'd darkgreen upright moss. = *Drummondia prorepens* (Hedw.) Britt. ( + scrap *Ulota crispa* (Hedw.) Brid.).

"This was gatherd on the bark of a Tree in Pensylvania. Its Heads appear in January."

Although the type of this species was collected in Pennsylvania, it was made by Muhlenberg near Lancaster (Hedwig 1801). The species is endemic to the eastern and central portion of North America from Nova Scotia to Michigan and Nebraska south to Georgia and Oklahoma (Vitt 1972).

39. *Bryum trichoides, erectis capitulis, albidum, fragile* [Dill.,] Cat[alogus]. Giss[am] 225 [1718]. Whitish, brittle upright moss. = *Leucobryum albidum* (Brid.) Lindb.

"This was gatherd in a moist Place in Virginia. It is also found in such Places, in many Parts of England; as on Hampsted Heath, but what is very observable is, that, here, it very seldom produces any Heads; indeed I never coud see any, tho I have watchd it for many years: but it shoud seem by The Quantity on this Specimen that they are common enough there. The Heads appear in July."

The Dillenian name and its 1741 equivalent, *Bryum albidum et glaucum fragile majus, foliis erectis, setis brevibus*, both are referrable to *Leucobryum glaucum* (Hedw.) Ångstr. ex Fries. Presumably Dillenius's reference to Virginia and Pennsylvania specimens either are in error or are based on other specimens, and not this one. Although *L. glaucum* is common to both Europe and North America, *L. albidum* is restricted to the Americas. Hill's comments on the frequency of sporophytes is interesting for even though both *L. glaucum* and *L. albidum* are dioicous, Crum and Anderson (1981) wrote "It is our impression that *L. albidum* fruits commonly, certainly more often than *L. glaucum*."

40. *Bryum palustre cauliculis longissimis erectis, foliis longioribus et angustioribus luteovirentibus cinctis* [Hill]. Long-branch'd, marsh, upright moss. = *Lycopodium* cf. *alopecuroides* L.

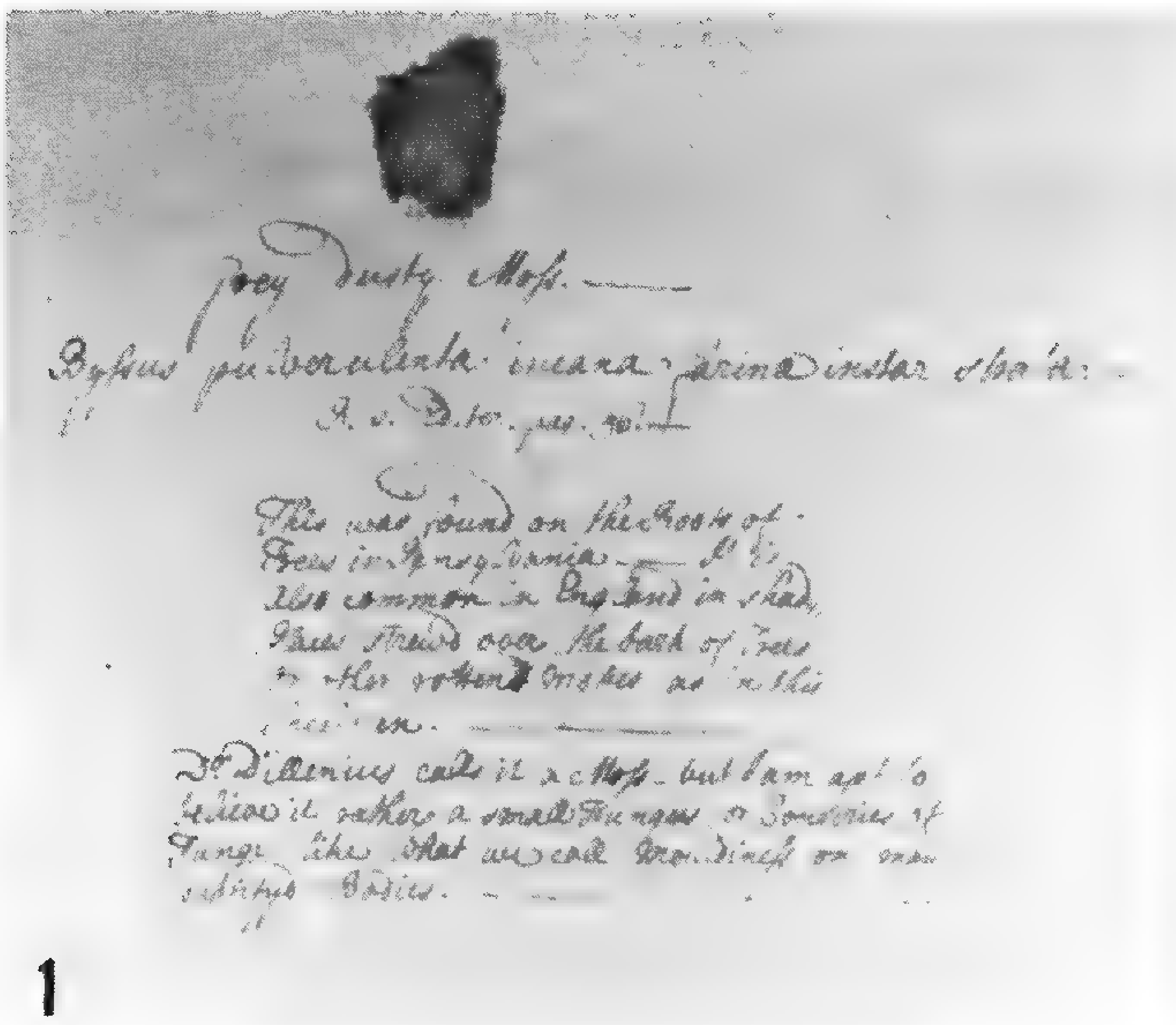
"This was gatherd in a moist Place In the Desart in Jersey. It is also found on many bogs in England. Its Heads appear in January."

Without strobili a positive identification is difficult. However, the size indicates that *L. alopecuroides* is probably the correct name. The species does not occur in England and Hill probably had it confused with the not very similar *L. inundatum* L., the only member of subgenus *Lycopodiella* in Britain. In the United States the species occurs from the Gulf states north in the Atlantic coastal plain to Connecticut (Wherry 1961). Hill's citation of this specimen having been collected in the "Desart in Jersey" perhaps refers to the New Jersey pine barrens.

Linnaeus (1753) based his *Lycopodium alopecuroides*, at least in part, on Dillenius's *Lycopodium alopecuroides, flagellorum extremitatibus radicosis*. Without reference to collectors, Dillenius noted collections from Virginia, Pennsylvania, and Carolina. Therefore, although this specimen from New Jersey is not mentioned, presumably an earlier Bartram collection is, in part, a basis for the Linnean binomial.

41. *Bryum* [*erectis*] *capitulis oblongis rubentibus, foliis oblongis, augustis, pellucidis rugosis* [Dill.,] Cat[alogus] Giss[am] pag. 222 [1718]. Long headed, upright moss, with narrow, crumpled leaves. = *Atrichum oerstedianum* (C. Müll.) Mitt.

"This was gatherd in woods in Virginia. It is also found in England in many Places. Its Heads appear in September."



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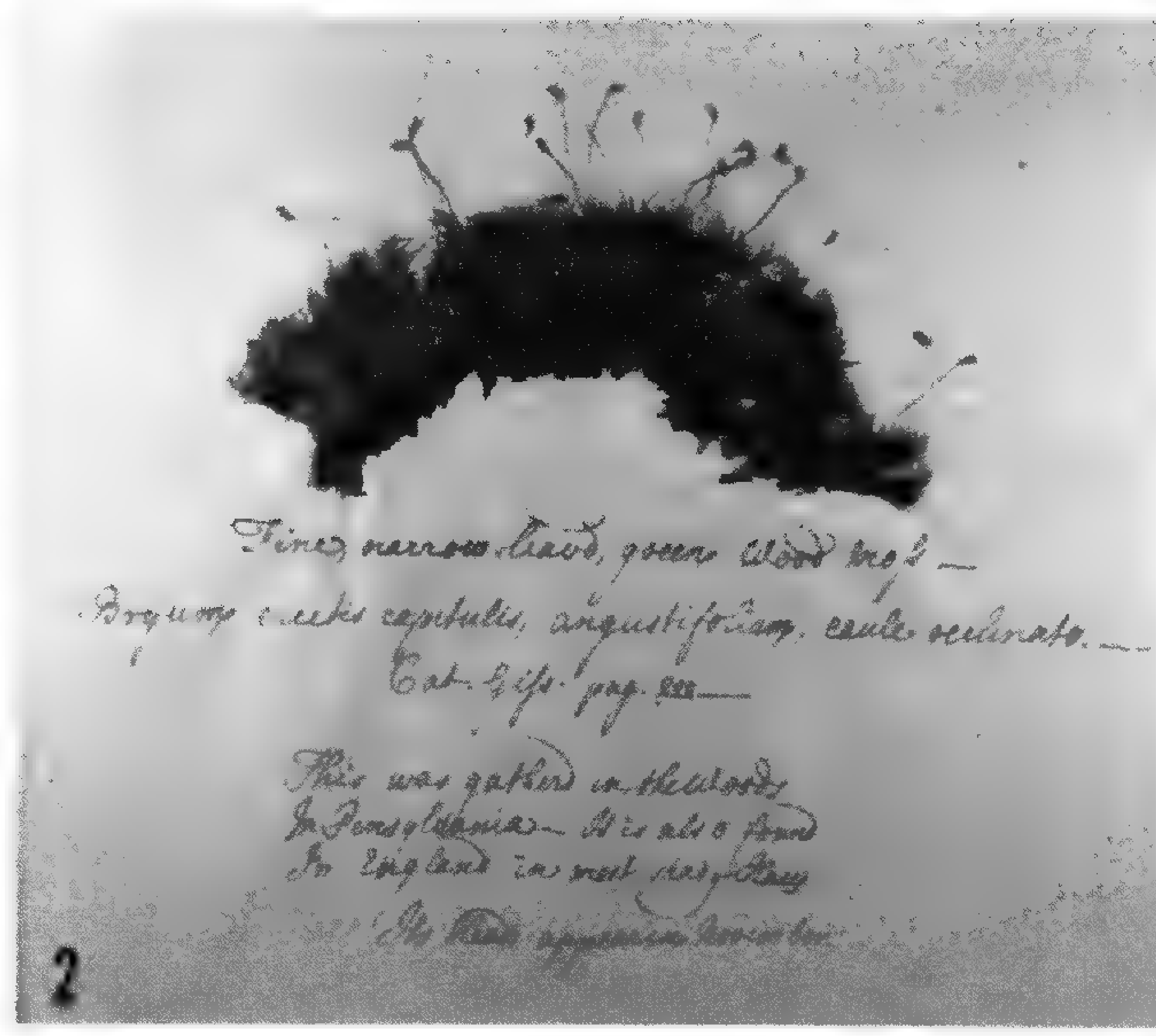


2

FIGS. 1 and 2. **1.** *Pertusaria paratuberculifera* Dibben; **2.** *Dicranum scoparium* Hedw.

Dillenius referred to his *Catalogus Gissam* name as a synonym of his 1741 *Bryum Phyllitidis folio rugoso acuto, capsulis incurvis,* which Lindberg (1883) placed in the synonymy of *Atrichum undulatum* (Hedw.) P.-Beauv. Actually some authors, e.g. Crum (1971), consider *A. oerstedianum* only a variety of the widespread and variable *A. undulatum*. However, Ireland (1969) has argued for its recognition as a species on the basis of sexuality, stature, tomentum, capsule morphology, and habitat. Crum and Anderson (1981) refer to this taxon as "the most common and widespread expression of *A. undulatum* in eastern North America."

42. *Bryum roseum, majus, foliis oblongis, pellucidis, splendide virentibus* [Hill]. Little dark green rose headed upright moss. = *Rhodobryum ontariense* (Kindb.) Kindb.

"This was gatherd in a moist Place In Pensylvania. It is also found On Hearths in England. Its Heads have not yet been ever seen, that I have heard."

Hill, like numerous authors since then, confused *Rhodobryum roseum* and *R. ontariense*. Admittedly the species are subtly differentiated and some modern authors (e.g. Crum and Anderson 1981) still do not choose to segregate the two taxa. However, Iwatsuki and Koponen (1972) have argued convincingly for the recognition of two species. In England only *R. roseum* is present whereas only *R. ontariense* grows in eastern North America.

43. *Bryum palustre, pumilum, ramulis habitioribus, foliis oblongis, angustis, laete-virentibus acutis, extremitatibus reflexis, cinetis* [Hill]. Little, thick-branched, marsh, upright moss. = *Aulacomnium palustre* (Hedw.) Schwaegr.

"This is found in marshy Places In the back of Virginia. Its Heads appear in January."

This species is almost cosmopolitan. In the tropics it is mostly known from high elevations. Dillenius apparently did not refer to it in the *Catalogus Plantarum circa Gissam sponte nascentium* (1718), but numerous specimens were cited in 1741 sub *Mnium majus, ramis longioribus bifurcatis*.

44. *Bryum terrestre, erectum, foliis longioribus, angustis, acuminatus, laete virentibus, summitatibus aduncis* [Hill]. Narrow-leav'd bright-green upright moss. = *Dicranum fulvum* Hook.

"This was gatherd on a Rock in Virginia: but Is also found in many Places in England on moist ground—as on the side of Rooks Hill. Its Heads appear in February."

Hill was obviously confused about this species. Not only does it not occur in England, but it is restricted to granitic or siliceous rocks. It ranges from Nova Scotia (from where it was described) to Wisconsin, south to Georgia and Arkansa, and in Europe from Sweden to northern Italy (Crum and Anderson 1981).

45. *Bryum nitidum serpilli rotundis et latioribus foliis pellucidis* R[ay,] S[ynopsis methodica stirpium britannicarum] pag. 108. Ed[itio] tert[ia] [1724]. Thyme-leav'd pellucid upright moss. = *Plagiomnium ellipticum* (Brid.) Kop.

"This was gatherd in moist Places In Pensylvania but is also found In England. Its Heads appear in April."

Ray's polynomial of 1724 is cited in synonymy by Dillenius (1741) under *Bryum pendulum, serpilli folio rotundiore pellucido, capsulis ovatis* Dill. According to Lindberg (1883), this is equivalent to *Astrophyllum punctatum* (Hedw.) Lindb. (= *Rhizomnium punctatum* (Hedw.) Kop.).

Some authors (e.g. Crum and Anderson 1981) prefer to recognize *Mnium* in the broad, traditional sense. However, Koponen (1968) had divided the genus into numerous segregate genera and has generally been followed. *Plagiomnium ellipticum* ranges throughout Britain and Scandinavia south to northern Italy, Iceland, Asia Minor, northern and central Asia, Japan; Chile, Argentina; in North America from Greenland to Alaska south to Pennsylvania and Ohio in the east and Arizona and New Mexico in the west (Koponen 1971).

46. *Bryum nitidum, serpyllifolium, repens, foliis brevioribus, mucronatis, sparsim nascentibus, pellucidis* [Hill]. Little creeping thyme-leav'd pellucid moss. = *Plagiomnium cuspidatum* (Hedw.) Kop.

"This is found in moist shady Places in Virginia. Its Heads appear in September."

It is surprising that Hill did not recognize this moss because not only is it one of the most common mosses in North America, but is also frequent throughout England, Europe, Asia, and Asia Minor (Smith 1978).

47. *Sphagnum cauliferum et ramosum, palustre, molle candicans, reflexis ramulis, foliis latioribus* [Dill.,] Cat[alogus] Giss[am] pag. 229 [1718]. Great branched white water moss. = *Sphagnum subsecundum* Nees ex Sturm var. *subsecundum*.

"This is found in wet Places in Jersey—and is common also on Bogs in England. It seldom Produces any Heads but when it does tis in July."

Dillenius's 1718 name is equivalent to his 1741 *Sphagnum palustre molle deflexum, squamis cymbiformibus*. Lindberg (1883) cited this latter name under the synonymy of *Sphagnum palustre* L. Even though *Sphagnum* is a notoriously troublesome genus with numerous species interpretations, Hill should have done better in his identification because *S. palustre* is in a different section of the genus than *S. subsecundum*.

The one-layered stem cortex and stem leaves the same size or smaller than the branch leaves clearly place this specimen in the var. *subsecundum*. This variety ranges from Greenland to Alaska and south to California and North Carolina, and in the Old World throughout northern and central Europe and Asia, Japan, Southeast Asia, and India (Crum 1984).

48. *Sphagnum cauliferum, et ramosum, palustre, molle, candicans, reflexis ramulis, foliis angustioribus* [Dill.,] Cat[alogus] Giss[am] 229 [1718]. Little branch'd white water moss. = *Sphagnum tenerum* Sull. & Lesq. ex Sull., det. H. Crum.

"This is found in Marshy Places with the former in England as well as America. It produces its Heads in July."

Dillenius (1741) lists his *Catalogus* polynomial under the synonymy of *Sphagnum palustre molle deflexum, squamis capillaceis*, which Lindberg (1883) considered a synonym of *S. nemoreum* Scop. (= *S. capillifolium* (Ehrh.) Hedw.). *Sphagnum tenerum* is sometimes considered a variety of the variable *S. capillifolium*, but the stem leaves in this specimen have an abundance of commissural pores. Thus, Hill's determination was surprisingly accurate. *Sphagnum tenerum* ranges from Newfoundland to Manitoba south to Kansas and Florida, and in British Columbia and Alberta; Norway, Sweden, Germany, Czechoslovakia, and the Caucasus; Japan (Crum 1984).

49. *Selago repens, et ramosae, virginiana, ramulis quadratis, foliis cinereis, in pilum canescentem desinentibus* [Hill]. Square branch'd, grey, virginian, seeding moss. = *Selaginella rupestris* (L.) Spring.

"This was gatherd on a Rock in the back of Virginia And is I think Peculiar to the Place. Its seeds are ripe in January."

Although not restricted to Virginia, *Selaginella rupestris* is an eastern North American endemic, ranging from Nova Scotia to Manitoba south to Georgia and Oklahoma (Reed 1953).

Linnaeus's (1753) description of *Lycopodium rupestre* is based in part on Dillenius's (1741) *Lycopodium rupestre pilosum et incanum, spicis acute quadrangularis*. Although Dillenius does not cite any specific collector, his material is from Virginia and Pennsylvania and therefore Bartram's gatherings are probably partially a basis for the protologue.

50. *Lycopodium pensylvanicum repens et ramosum, foliis compressis, dentatis, luteovirentibus, clavis, in singulis pediculis, plurimis* [Hill]. Branched many club'd, pensylvanian woolfs-claw-moss. = *Lycopodium digitatum* A. Braun. Fig. 3.

"This was gatherd in a sandy barren Place in Pensylvania. The seeds are ripe in August."

Dillenius (1741) called this taxon *Lycopodium digitatum foliis Arboris Vitae, spicis bigemellis teretibus*, and based the name on a specimen collected by John Bartram in Pennsylvania. However, the name lay in synonymy for many years and the species was most commonly known as *Lycopodium flabelliforme* (Fern.) Blanchard (Wilce 1965). However, Braun (*in* Kunze 1848) was the first to recognize this taxon at the species level and based his name on Dillenius's (1741) description and illustration. Recently Hickey and Beitel (1979) resurrected Braun's name and lectotypified it with plate LIX from *Historia Muscorum*.

In 1957 Stearn suggested the use of the term *typotype* for the specimen from which an illustration, which is a type, is drawn. Therefore, the Bartram specimen from Pennsylvania is a typotype and this specimen is considered an isotypotype.

51. *Lichenastrum imbricatum majus* [Dill.,] Cat[alogus] Giss[am] Suppl[ement] 172 [1719]. Broad leav'd flat branch'd scaly moss. = *Porella platyphylloidea* (Schwein.) Lindb., det. B. M. Thiers.

"This was gatherd in moist Places In Virginia and is found also In many such Places in England. It flowers in April."

In 1741 Dillenius called his earlier trinomial *Lichenastrum imbricatum majus, squamis compressis et planis* which, according to Lindberg (1883), is currently known as *Radula complanta* (L.) Dum. Therefore, Hill grossly misidentified the specimen. However, what Dillenius called this specimen is of more interest. Dillenius (1741) described *Lichenastrum Arboris Vitae facie, foliis minus rotundis* on the basis of material from England, Virginia, and Pennsylvania. Although Bartram is not specifically cited as the collector, since Bartram was the only one to send Dillenius material from Pennsylvania, at least some of Bartram's material was involved. The Dillenian polynomial then became the basis for *Jungermannia platyphylla* L. (= *Porella platyphylla* (L.) Lindb.). Dillenius illustrated four plants of *Porella* and Eustace W. Jones (pers. comm.) has indicated that, due to the different aspects of the plants and their admixtures, these are probably separate collections. However, Dr. Jones was unable to determine whether any or all of the collections are *Porella platyphylloidea*. Despite the identity of the plants, only one collection needs to be chosen for the typotype. Isoviita (1970) outlined many of the problems concerning Dillenian typification. Thus, until there is a critical examination of the material in Dillenius's herbarium, a question will remain as to its identity.

52. *Lichenastrum imbricatum, purpurascens, foliis angustioribus, et pro magnitudinis ratione longioribus, minus* [Hill]. Long leav'd narrow purplish scaly moss. = *Frullania eboracensis* Gottsche, det. B. M. Thiers.

"This is found in moist Places on the side of Hills in Pensylvania. It is also found in England as very plentyfully on Rooks Hill. It flowers in April."

*Frullania eboracensis* is a North American endemic (Breil 1970) so Hill obviously had this species confused with a British one. However, there are five species of *Frullania* in Britain (Jones 1958) and he presumably had one of these in mind.

53. *Hypnum aquaticum, ramulis angustioribus, foliis longissimis et angustissimis acutis laete virentibus* [Hill]. Narrow-leav'd, green, water, trailing moss. = *Dichelyma capillaceum* (With.) Myr.

"This was gatherd in a Pond of Water in Pensylvania. It is also found in many Rivers and Ditches in England."

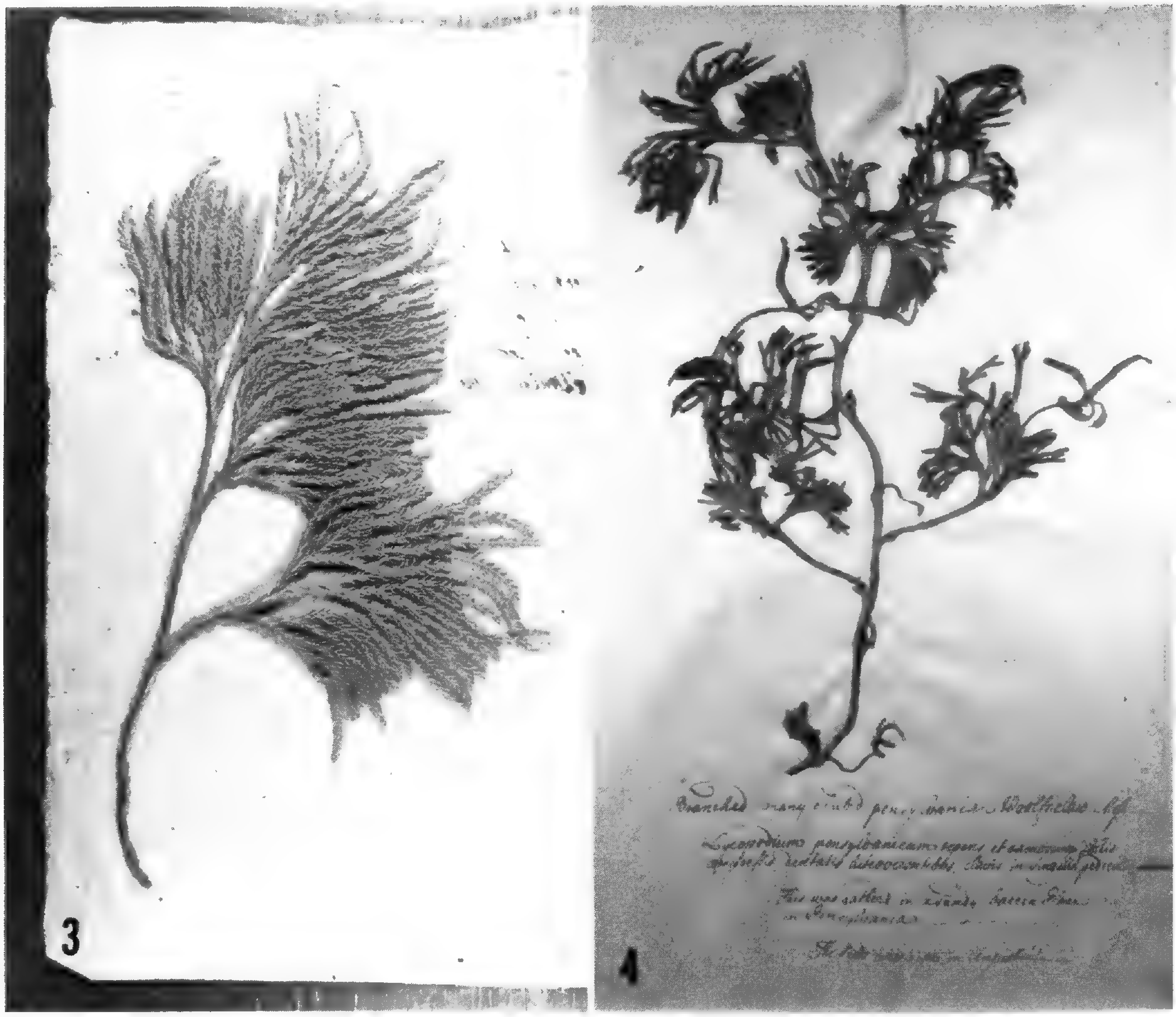
Withering (1801), when describing this species, referred to Dickson's *Plantarum Cryptogamicarum Britanniae* and Dillenius's *Historia Muscorum*. Dickson (1790), also referred to Dillenius's (1741) *Fontinalis capillacea, calycibus stili instar cuspidatis*. Dillenius based his polynomial on material collected by John Bartram from a lake in Pennsylvania. Therefore, this collection is best considered an isotypotype of *Fontinalis capillacea* With. Hill himself (1751) later described this very specimen as *Fontinalis foliis capillaceis* and wrote that "Dillenius is the only author who has described it: he received specimens of it from Pensylvania, gathered there by John Barham [sic], at the same time that mine and those of all the other botanical people who have it were sent over." This definitely verifies that this collection is the only one Bartram sent to Europe and is therefore unquestionably authentic and the basis for the modern usage. Welch (1960) provides a concise, yet complete, account of the nomenclatural problems.

Although Withering (1801) cited a specimen of *Fontinalis capillacea* as occurring in "mountain rivulets in Scotland," he was obviously mistaken as the genus *Dichelyma* does not even occur in Britain (Smith 1978). However, Welch (1960) discusses the specimen upon which this report is based. She provided the range for the species to be Scandinavia, France, Germany, and in North America from Newfoundland to Wisconsin, south to Florida and Louisiana.

54. *Hypnum terrestre, obscurevirens, ramulis gracilioribus, foliis brevioribus* [Hill]. Short leav'd darkgreen slender branch'd trailing moss. = *Drummondia prorepens* (Hedw.) Britt.

"This was gatherd on a Rock near a Spring of Water in the back of Virginia—but is also found in England, as in Charlton Forest in Sussex. The Heads appear in September."

It is odd that Hill did not realize that this specimen is the same as one above (38, q.v.). Also, the species does not occur in England. Hill was probably confusing it with a species of *Orthotrichum*. This specimen almost surely grew on a tree trunk as the species is corticolous and not known from saxicolous habitats.



FIGS. 3 and 4. 3. *Lycopodium digitatum* A. Braun (isotypotype); 4. *Lycopodium obscurum* L. (isotypotype).

[55.] Unnumbered specimen. = *Lycopodium obscurum* L. Fig. 4.

Hill seemingly did not see this specimen for it is not annotated by him. It, unlike any other specimen in the volume, is not mounted on a sheet, but is rather in the original wrappers which Bartram sent it in. In Bartram's hand on the outside of the folder paper is written (Fig. 5): "these I take to be beauties of

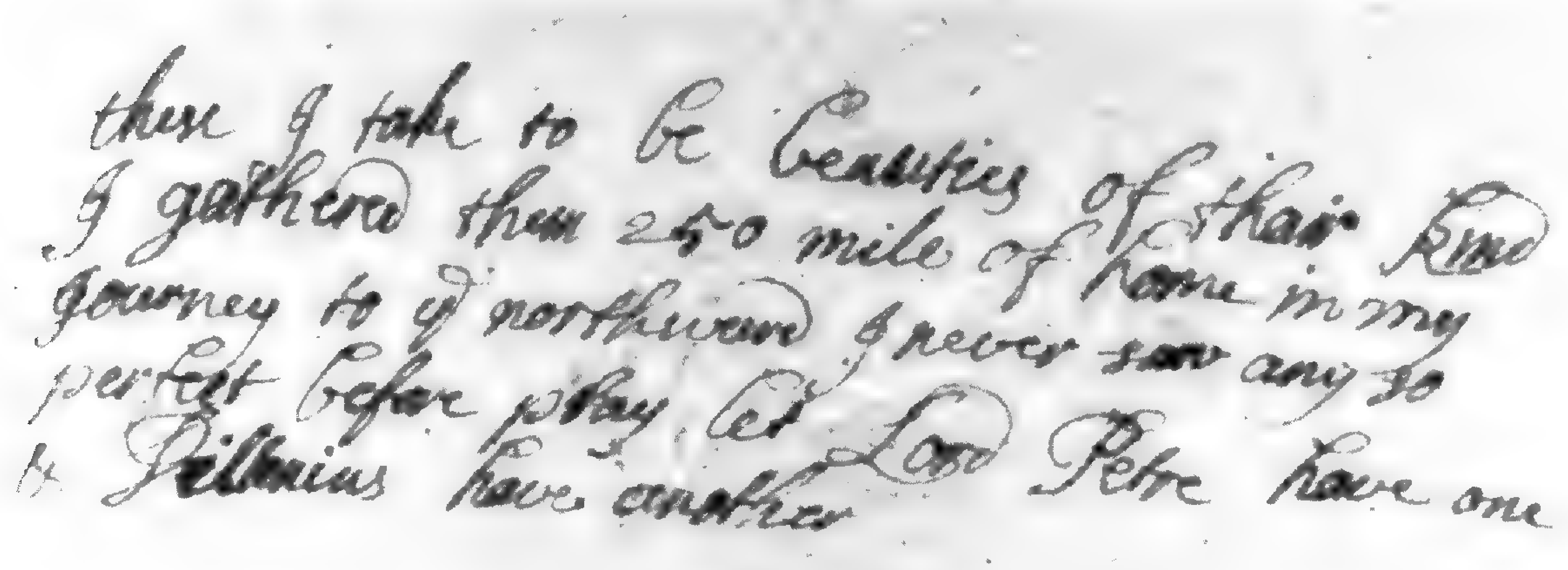



FIG. 5. John Bartram's annotation of *Lycopodium obscurum* L.

their kind. I gathered them 250 mile of home in my journey to ye northward. I never saw any so perfect before pray let Lord Petre have one & Dillenius have another."

Dillenius (1741), citing Bartram as the collector, described this plant as *Lycopodioides radiatum dichotomum*. Linnaeus (1753) cited only Dillenius's trinomial when establishing *Lycopodium obscurum*. Recently Hickey (1977) in a revision of the *L. obscurum* complex in North America lectotypified the species. He chose Dillenius's (1741) plate LXVII as the lectotype. Therefore, following Stearn's (1957) terminology, this specimen should be considered an isotypotype. In these days when *Lycopodium* taxonomy is in a "splitting" phase, a specimen, rather than a plate, is the only way a name can be absolutely based. In fact it is difficult to know how Hickey (1977) was able to decide upon the variety of *L. obscurum* which Dillenius's plate represents.

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## Literature Cited

Acharius, E. 1810. Lichenographica universalis. J. F. Danckwerts, Göttingen. viii + 696 pp.

———. 1814. Synopsis methodica lichenum. Svanborg et Soc., Lund. xiii + 392 pp.

Ahti, T. 1966. Correlation of the chemical and morphological characters in *Cladonia chlorophaea* and allied lichens. Ann. Bot. Fenn. 3: 380–390.

Bartram, J. 1735–1768. Bartram Papers. 3 vol. Historical Society of Pennsylvania, Philadelphia.

Bauhin, C. 1623. Πιναξ theatri botanici. Ludovici Regis. xxiv + 522 + 22 pp.

Breil, D. A. 1970. Liverworts of the mid-Gulf coastal plain. Bryologist 73: 409–491.

Clokie, H. N. 1964. An account of the herbaria of the Department of Botany in the University of Oxford. Oxford University Press, London. viii + 280 pp.

Collinson, P. Undated. Large Commonplace Book. The Linnaean Society, London. [A manuscript of Collinson's copies of his own letters.]

Crombie, J. M. 1880. On the lichens of Dillenius's 'Historia Muscorum,' as illustrated by his herbarium. J. Linn. Soc., Bot. 17: 553–581.

Crum, H. 1971. Nomenclatural changes in the Musci. Bryologist 74: 165–174.

———. 1984. Sphagnopsida. Sphagnaceae. N. Amer. Fl. II, 11: i–iv, 1–180.

——— and L. E. Anderson. 1981. Mosses of eastern North America. 2 vol. Columbia University Press, New York. 1328 pp.

Culberson, W. L. 1962. Some pseudocyphellate Parmeliae. Nova Hedwigia 4: 563–577.

Darlington, W. 1849. Memorial of John Bartram and Humphry Marshall with notes of their botanical contemporaries. Lindsay & Blakiston, Philadelphia. 585 pp. Reprinted in 1967 by Hafner, New York, with an introduction by J. Ewan.

Dibben, M. J. 1980. The chemosystematics of the lichen genus *Pertusaria* in North America north of Mexico. Milwaukee Public Mus. Publ. Biol. Geol. 5: i–iv, 1–162.

Dickson, J. 1790. Plantarum cryptogamicarum britanniae. Fasciculus secundus. G. Nicol, London. 31 pp.

Dillenius, J. J. 1718. Catalogus plantarum circa Gissam sponte nascentium. Joh. Maximilianum à Sande, Frankfort am Main. [xvi +] 240 [+17] pp.

———. 1741 [1742]. Historia Muscorum; in qua circiter sexcentae species veteres et novae ad sua genera relatae describuntur: et iconibus genuinis illustrantur: cum appendice et indice synonymorum. Theatro Sheldoniano, Oxford. xvi + 576 + 8 pp.

Druce, G. C. and S. H. Vines. 1907. The Dillenian herbarium. An account of the Dillenian collections in the herbarium of the University of Oxford together with a biographical sketch of Dillenius, selections from his correspondence, notes, &c. Clarendon Press, Oxford. cxii + 258 pp.

Fink, B. 1935. The lichen flora of the United States. University of Michigan Press, Ann Arbor. 426 pp.

Grieve, H. 1981. A transatlantic gardening friendship, 1694–1777. [Chelmsford] Historical Association, Essex. 27 pp.

Hale, M. E. 1965. Studies on the *Parmelia borreri* group. Svensk Bot. Tidskr. 59: 37–48.

———. 1978. A new species of *Ramalina* from North America (Lichenes: Ramalinaceae). Bryologist 81: 599–602.

———. 1979. How to know the lichens. 2nd ed. Wm. C. Brown Co., Dubuque, Iowa. viii + 246 pp.

Hawksworth, D. L., P. W. James and B. J. Coppins. 1980. British lichen-forming, lichenicolous and allied fungi. Lichenologist 12: 1–115.

Hedwig, J. 1801. Species muscorum frondosorum descriptae et tabulis aeneis LXXVII coloratis illustratae. Lipsiae. vi + 353 pp.

Henrey, B. 1975. British botanical and horticultural literature before 1800. Volume 2 (of 3). Oxford University Press, London. xvi + 748 pp.

Hickey, R. J. 1977. The *Lycopodium obscurum* complex in North America. Amer. Fern J. 67: 45–48.

——— and J. M. Beitel. 1979. A name change for *Lycopodium flabelliforme*. Rhodora 81: 137–140.

Hill, J. 1751. A general natural history: or, new and accurate descriptions of the animals, vegetables, and minerals of the different parts of the world. Volume 2. A history of plants. Thomas Osborne, London. xxvi + 624 [+17] pp.

Horton, D. G. and D. H. Vitt. 1976. Morphological characters, relative to distribution, and taxonomic considerations of the genus *Climacium* in North America. Canad. J. Bot. 54: 1872–1883.

Ireland, R. R. 1969. Taxonomic studies on the genus *Atrichum* in North America. Canad. J. Bot. 47: 353–368.

Isoviita, P. 1970. Dillenius's 'Historia Muscorum' as the basis of hepatic nomenclature, and S. O. Lindberg's collection of Dillenian bryophytes. Acta Bot. Fenn. 89: 1–28.

Iwatsuki, Z. and T. Koponen. 1972. On the taxonomy and distribution of *Rhodobryum roseum* and its related species (Bryophyta). Acta Bot. Fenn. 96: 1–22.

Jones, E. W. 1958. An annotated list of British hepatics. Trans. Brit. Bryol. Soc. 3: 353–374.

Koponen, T. 1968. Generic revision of Mniaceae Mitt. (Bryophyta). Ann. Bot. Fenn. 5: 117–151.

———. 1971. A monograph of *Plagiomnium* sect. *Rosulata* (Mniaceae). Ann. Bot. Fenn. 8: 305–367.

Krog, H. 1982. *Punctelia*, a new lichen genus in the Parmeliaceae. Nordic J. Bot. 2: 287–292.

Kunze, G. 1848. Notes on some ferns of the United States. Amer. J. Sci. Arts II, 6: 80–89.

Kurokawa, S. 1962. A monograph of the genus *Anaptychia*. Beih. Nova Hedwigia 6: 1–115.

Laundon, J. R. 1984. Proposal to emend *Cladonia* Hill ex Browne, 1756, *nom. cons.*, and delete *Cladona* Adanson, 1763, *nom. rej.* (Ascomycetes: Lecanorales). Taxon 33: 109–112.

Lindberg, S. O. 1883. Kritisk granskning af mossorna uti Dillenii Historia Muscorum. J. C. Frenckell & Son, Helsinki. 59 pp.

Linnaeus, C. 1753. Species plantarum. 2 vol. Impensis Laurentii Salvii, Stockholm. 1: i–xii, 1–560; 2: 561–1200.

Llano, G. A. 1950. A monograph of the lichen family Umbilicariaceae in the Western Hemisphere. Office of Naval Research, Washington, DC. vi + 281 pp.

McLean, E. P. 1984. A preliminary report on the 18th century herbarium of Robert James, eighth baron Petre. Bartonia 50: 36–39.

Margadant, W. D. 1968. Early bryological literature. Hunt Botanical Library, Pittsburgh, Pennsylvania. xi + VIII + 278 pp.

Morison, R. 1680–1699. Plantarum historiae universalis oxoniensis pars secunda [tertia] seu herbarum distributio nova. Theathro Sheldoniano, Oxford. 2: i–iv, 1–619. 1680; 3: i–xxiv, 1–657. 1699. [Volume one was never published.]

Motyka, J. 1936. Lichenum generis *Usnea* studium monographicum. Pars systematica. Volumen primum. Leopoli. iv + 304 pp.

O'Neill, J. 1984. Peter Collinson and the American garden. Garden 8(4): 20–23, 31.

Ray, J. 1724. Synopsis methodica stirpium britannicarum. Ed. 3. Guilielmi & Joannis Innys, London. xvi + 512 pp.

Reed, C. F. 1953. The ferns and fern-allies of Maryland and Delaware including District of Columbia. Reed Herbarium, Baltimore, Maryland. xviii + 286 pp.

ROBINSON, H. 1962. Generic revisions of North American Brachytheciaceae. Bryologist 65: 73–146.

SMITH, A. J. E. 1978. The moss flora of Britain and Ireland. Cambridge University Press, Cambridge. viii + 706 pp.

STEARN, W. T. 1957. An introduction to the *Species Plantarum* and cognate botanical works of Carl Linnaeus. *In* C. Linnaeus. Species plantarum. A facsimile of the first edition 1753. Volume one. Ray Society, London. xiv + 176 pp.

SWINSCOW, T. D. V. AND H. KROG. 1976. The genera *Anaptychia* and *Heterodermia* in East Africa. Lichenologist 8: 103–138.

THOMSON, J. W. 1967. The lichen genus *Cladonia* in North America. University of Toronto Press, Toronto. xi + 172 pp.

VITT, D. H. 1972. A monograph of the genus *Drummondia*. Canad. J. Bot. 50: 1191–1208.

WELCH, W. H. 1960. A monograph of the Fontinalaceae. Martinus Nijhoff, The Hague. 357 pp.

WHERRY, E. T. 1961. The fern guide. Northeastern and midland United States and adjacent Canada. Doubleday & Co., Inc., New York. 318 pp.

WILCE, J. H. 1965. Section *Complanata* of the genus *Lycopodium*. Beih. Nova Hedwigia 19: i–ix, 1–233.

WITHERING, W. 1801. A systematic arrangement of British plants; with an easy introduction to the study of botany. The fourth edition, in four volumes. Volume 3. T. Cadell et al., London. Pages 445–900.

YOSHIMURA, I. 1971. The genus *Lobaria* of eastern Asia. J. Hattori Bot. Lab. 34: 231–364.

Bartonia No. 51: 34–36, 1985

# A Limestone Glade in West Virginia

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Limestone glades are sparsely wooded communities of shallow soils and bare rock associated with limestones (Baskin et al. 1968). They achieve their greatest abundance in the Interior Low Plateau, especially in the Central Basin of Middle Tennessee. In this region, these "cedar glades" are marked by a rich endemic flora (Baskin et al. 1968). Limestone glades are also known from southwestern Virginia where they have been referred to as red cedar woodlands (Harvill et al. 1977). In this paper, I describe a limestone glade found in 1983 in West Virginia where limestone glades were previously unknown. Nomenclature follows Strausbaugh and Core 1977.

The West Virginia limestone glade occurs on 6 ha of Knobly Mountain, Grant County, at an elevation of 500 m in the Ridge-and-valley province of Fenneman (1938). The glade is on a gently sloping, southwest facing flat of the mountain. It is underlain by limestones of the Tonoloway, Wills Creek, and Williamsport complex of the Silurian Period. The west edge of the glade is marked by a cliff, the east edge grades into a xeric woodland. Part of the glade was pastured until 1924 (R. Smith pers. comm.), but no exotic species have been noted on the glade. There has been no subsequent disturbance to most of the glade.

Woody plants are scattered over the glade, but are sparse (less than 30% cover) and often absent from areas of thinnest soil and bare rock. *Cercis canadensis* and *Juniperus virginiana* are the dominant woody species, although *Quercus muehlenbergii, Robinia pseudo-acacia,* and *Rosa carolina* also occur. Herbaceous dominants are *Bouteloua curtipendula* and *Helianthus microcephalus*, with *Paronychia virginica* var. *virginica* becoming important in areas of thinnest soil.

Twenty-five herbaceous vascular plants have been noted on the glade (Table 1); the glade has not been explored in spring and early summer. None of these plants are endemics of the Interior Low Plateau cedar glades (see Baskin et al. 1968), but six of the West Virginia limestone glade plants are considered to be endemics of the mid-Appalachian shale barrens (see Table 1). The presence of these shale barren endemics on the limestone glade supports the belief that at least some of the shale barren endemics may have arose in a wide range of xeric habitats and were subsequently restricted to the shale barrens with the recent displacement of once more widespread open xeric habitats by forest (see Keener 1983).

Several of the West Virginia limestone glade plants have a predominantly midwestern range (Table 1). Of these, *Paronychia virginica* var. *virginica* is a local endemic variety of a midwestern species. These species may be relicts of extensive early Holocene migrations that apparently allowed a number of midwestern species to invade the central Ridge-and-valley (see Harvill et al. 1977 and Keener 1983).

The limestone glade is not only a unique ecosystem in West Virginia, but of its twenty-five known herbaceous plants, ten species are considered rare in West Virginia (Table 1). Of these rare species, *Paronychia virginica* var. *virginica* and *Pseudotaenidia montana* are under review for the federal endangered and threatened species list. 2000

TABLE 1. The known herbaceous vascular flora of the West Virginia limestone glade.

| Rare in WV (Clarkson et al. 1981) | Predominantly midwestern ranges | Shale barren endemics (based on Keener 1983) | Name of Plant |
|---|---|---|---|
| | | | *Andropogon gerardii* |
| | | X | *Antennaria virginica* |
| | | | *Arenaria stricta* |
| | | | *Asclepias tuberosa* |
| | X | | *Asclepias verticillata* |
| | | | *Asplenium platyneuron* |
| | X | | *Aster oblongiifolius* |
| | | | *Blephila ciliata* |
| X | X | | *Bouteloua curtipendula* |
| X | | | *Carex eburnea* |
| X | | X | *Convolvulus purshianus* |
| | | | *Helianthus divaricatus* |
| X | | X | *Helianthus laevigatus* |
| | | | *Helianthus microcephalus* |
| | | | *Hystrix patula* |
| | | | *Kuhnia eupatorioides* |
| X | | | *Lespedeza nuttallii* |
| X | X | | *Linum sulcatum* |
| X | | X | *Oenothera argillicola* |
| X | X | | *Paronychia virginica var. virginica* |
| | | | *Phlox subulata* |
| | | | *Pycnanthemum incanum* |
| X | | X | *Solidago harissii* |
| X | | X | *Taenidia montana (Pseudotaenidia montana)* |
| | | | *Triosteum perfoliatum* |

to 2500 plants of *Paronychia virginica* occur at the glade and may be the variety's largest extant population. Future work at the site is expected to reveal additional rare species.

A small portion of the limestone glade has been destroyed by a limestone quarry. The current landowner has entered into a short-term voluntary protection agreement with The Nature Conservancy. In view of its rare species richness and being a unique habitat-type in West Virginia, it is hoped that long-term protection can be achieved for the site.

## LITERATURE CITED

BASKIN, J. M., E. QUARTERMAN, AND C. CAUDLE. 1968. Preliminary checklist of the herbaceous vascular plants of cedar glades. J. Tennessee Acad. Sci. 43: 65–71.

CLARKSON, R. B., D. K. EVANS, R. FORTNEY, W. GRAFTON, AND L. RADER. 1981. Rare and endangered vascular plant species in West Virginia. U.S. Government Printing Office, Washington, DC.

FENNEMAN, N. M. 1938. Physiography of Eastern United States. McGraw-Hill, New York.

HARVILL, A. M., JR., C. E. STEVENS, AND D. M. WARE. 1977. Atlas of the Virginia Fora. Part 1. Pteridophytes through Monocotyledons. Virginia Botanical Associates, Farmville.

KEENER, C. S. 1983. Distribution of biohistory of the endemic flora of the mid-Appalachian shale barrens. The Botanical Review 49: 65–115.

STRAUSBAUGH, P. D. AND E. L. CORE. 1977. Flora of West Virginia. 2nd ed. Seneca Books, Grantsville.

U.S. FISH AND WILDLIFE SERVICE. 1983. Endangered and threatened wildlife and plants; supplement to review of plant taxa for listing; proposed rule. Federal Register 48: 53640–53670.

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# The Natural History of John Abbot: Influences and Some Questions

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John Abbot and James Edward Smith lived in a period of intense interest in the world of nature. Between 1775 and 1825 the South Pacific had been explored scientifically, with collections to document the first navigation, the plants and animals of the Pacific Coast from Monterey to Alaska. Firsts included the California Condor (originally ranging from the Columbia River to Baja California) and the coast redwood (*Sequoia sempervirens*). The bellowing of the alligator was reported by William Bartram, the cry of the limpkin, the carnivory of the Venus-fly trap, and the glory of the Appalachian rhododendrons—all came within Abbott's lifetime as he lived out his years in Georgia.

Born in London in 1751 the son of a well-to-do attorney, John Abbot was captivated as a youth by the insect cabinets of Dru Drury and Henry Smeathman and the parley of entomologists. He saw the plates of Catesby's *Natural History* and was encouraged to make his own sketches. At twenty-two he emigrated to America, arriving first in Virginia and then settling in rural Georgia where he lived for the next half century. He died in a plantation cottage in Bulloch County unnoticed by the scientific world.

Did John Abbot influence the growth of natural history? Very little, as the world judges. Yet for our knowledge of insects, their illustration and description, of spiders, birds, and plants, for all of these their portraiture and description Abbot left in sum an impressive even though little noticed treasure of natural history. The totals of Abbot's *survived* relics are truly impressive and seldom matched in the history of natural history: over 2000 watercolor drawings of insects and arachnids, over 5000 insect specimens, 500 drawings of birds and bird eggs, an undetermined number of bird skins, and some dried plant specimens. Why, then, is there no John Abbot in the *Dictionary of American Biography* or other usual sources? Why is he not mentioned in the histories of biology? *Why* did Abbot fail directly to influence the natural sciences? Was it his retiring personality that he did not publish his discoveries, or was it his rural residence? Abbot was not fond of strangers. He was the hermit naturalist, "the world forgetting, by the world forgot." Abbot's reticence was evident when, on sending his drawings and notes to Francillon he left instructions for the possible future editor, "prune and trim"! And to make "what you please of the following crude notes."[1] We think of William Bartram who, when his *Travels* which appeared in 1791 were being published, did not press to see the proofs. Yet Bartram did publish his discoveries although he was a hermit naturalist who declined a professorship in the University of Pennsylvania, appointment to government expeditions, and who did not attend meetings of scientific societies although they were held in nearby Philadelphia across the Schuylkill from his farm. Notice Abbot's geographic location. Most of his life he lived on the border of a woodsy creek in the great Savannah River flood plain, so isolated that the most widely travelled naturalist in our history, the intrepid Thomas Nuttall, did not venture to Abbot's home from Savannah where he visited Oemler. All the while Abbot lived near Savannah there was no scientific society meeting there, nor did he initiate one, to catalyze potential fraternal scientific growth. Unlike Charleston, Savannah, though a port city, had not spawned a natural history organization.[2] Charleston, a Crown colony, enjoyed an organic connection with its economy and scientific activities. The Charleston Museum dates from 1773. Consider James Hamilton Couper (1794–1866) of Darien, Georgia. Couper as an isolated scientist, interested in fossils, shells, and geology, was a part of a Philadelphia-London circle rather than of a non-existent Savannah society. Charles Lyell visited Couper in 1845.[3] The Bartrams, Benjamin Smith Barton, Thomas Say, William Maclure, Richard Harlan, Thomas Nuttall, George Ord, Alexander Wilson—all related to the bustling port city of Philadelphia.

Abbot, the rural naturalist, did not propose any innovative concepts of classification. His suggestion that spiders may be classified by the construction of their webs might have become classic, but he did not pursue the idea.

The magnetic power of the exotic! Drury told Abbot, while he was still in London, that Surinam was the best field in which to find natural history novelties.[4] James Petiver, apothecary and a real antiquarian, had initiated Surinam ornithology at the beginning of the 18th century when he described three birds, not from skins, but from Dutch paintings.[5] Records are sketchy of actual collections taken during the 18th century but we know that Peter Gerret, a successful coffee planter, and Lt. Col. Dahlberg, of the military, made collections that reached Europe. Daniel Rolander, a Dane, collected insects in Surinam in 1755 for Linnaeus.[6] When Linnaeus wrote his *Systema naturae,* tenth edition, he was impressed particularly by the cockroaches in his cabinet trays. I like Linnaeus' description for *Blatta gigantea* as *Diametro ovi gallinacei,* that is, with the diameter of a hen's egg![7] Abbot would have been impressed! He came to know a somewhat smaller version in Georgia kitchens.

But it would have been the Bird-eating spider that really caught his eye. Marcgraf pictured it in 1648 from Brazil, but Maria Sibylle Merian and her daughter returned from Surinam in 1701 with drawings of plants, reptiles, and insects.[8] On plate 18 of her classic folio on Surinam creatures she pictured a huge spider capturing a hummingbird at its nest. There are twice as many eggs in its nest as there rightfully should be, and the text relates that hummingbirds are the only food of the priests in Surinam! Surinam continued to fascinate any museum visitor although Abbot had determined to go to Georgia. William Bullock, who quotes Abbot's observations on the nesting anhinga,[9] exhibited in his museum at Piccadilly a "bird-catching or Great Surinam Spider." In his *Companion* written for the museum visitor he explains that the spider measures 8 to 10 inches in extent, its legs "covered with rough hairs."[10]

Clearly John Abbot was influenced by the natural history classics he saw. What Audubon's elephant folio may be to the susceptible young naturalist today, Catesby's *Natural History* was the provocation in John Abbot's youth. No matter that some of Catesby's figures were inexact now and then. His swallow-tail (plate 86 in vol. 2) was, in entomologist Strecker's words, "either a monstrosity or a palpable exaggeration"! But Catesby's Cecropia moth, Polyphemus moth, or Horned caterpillar were eye-catching. Do you suppose Abbot discovered that Catesby had also resided in Turnham Green where Abbot later swung his insect net? Catesby slept here. It was George Edward's style of drawing that influenced Abbot, not in the personal way in which

William Bartram had been schooled in the magpie and stump style,[11] but by his quiet inspection of Edward's drawings. Catesby had instructed Edwards in etching his plates for Edwards' *Natural History of Uncommon Birds* (London, [1750]). On Catesby's death in 1749 Edwards assisted his widow in the publication of the second edition of the Carolina *Natural History* (1771). Edwards had been fortunate in meeting Hans Sloane early in his career and it was Sloane who effected his appointment as librarian at the Royal College of Physicians. The surviving letters and archives of Edwards, which you would anticipate as being at the College, were destroyed, a loss for historians.[12] The Bartram letters, for example, would have feathered out the skeletal Collinson record. Abbot was 23 when Edwards died.

As George Edwards made known the Bartram discoveries in America, so John Latham published Abbot's Georgia birds. Three Georgia birds were first announced by Latham from Abbot's description, the Yellow-billed cuckoo, the Prothonatory warbler, and the darter or anhinga. Abbot told Wilson about the anhinga, and his observations were quoted in Wilson's *American Ornithology,* and in turn by Audubon in his *Birds of America.*[13]

When Henry Smeathman first met Abbot, who was then about nineteen, Smeathman introduced himself as "a brother Flycatcher." Very nearly the same age, the two were in London for two years comparing their modest insect collections before Smeathman left for West Africa and Abbot for Georgia. Smeathman's life was to embrace three continents and reach from termite condominiums to celestial aeronautics. In 1771 he went to Sierra Leone aided by the philanthropy of the Quaker, Dr. John Fothergill, with whom were joined Dru Drury, Joseph Banks, and Marmaduke Tunstall in supporting the explorer.[14] In Sierra Leone Smeathman lost his travelling companion from "bilious fever," but he gained firsthand knowledge of termites, collected insects and plants, both herbarium specimens and living tree ferns.[15] He was on the West Indian island of Tobago for two or three years.[16] In 1781 he published in the *Philosophical Transactions of the Royal Society,* and in separate bookform, his *Some Account of the Termites which are found in Africa* (London, 1781). This rarity was issued with copper plates in color; a copy is still in Benjamin Smith Barton's library in Philadelphia. Smeathman was in Paris in 1783 attending all the hot air balloon experiments of the Montgolfier brothers. The Frenchmen made the first public ascent of an unmanned balloon on June 4th, 1783, and on September 19th, a rooster, a sheep, and a duck were airborne at Versailles. In October the first man, Pilátre de Rozier, left the earth![17] But all the while the termite man was not idle. Smeathman had plans of a horizontally positioned balloon, with wings, which could be steered and alight equally well on land or water. It would have been used for the delivery of dispatches. He declined all French offers to implement the plan until he had some response from Britain. He wrote to Joseph Banks hoping for his support representing the government as Banks did in matters of science. Incidentally, Franklin approved of Smeathman's aeronautical experiment.[18] On a completely different level Smeathman launched a new scheme in 1786: the opening of a new settlement for poor blacks in Sierra Leone.[19] In this endeavor another Quaker physician John Coakley Lettsom gave support. Smeathman, however, died that same year before the colonization party could set out. We do not know whether Abbot, then in Georgia, ever learned about brother Smeathman's later "Flycatcher" sweeps.

The history of biology is marked by its facilitators. Hans Sloane and William Sherard were among the patrons of Catesby; Linnaeus facilitated Artedi in publishing his classic on fishes. Lambert, Vice President of the Linnean Society, was the facilitator of Pursh in the publication of his *Flora;* James Edward Smith, of Abbot for *Rarer Lepidopterous Insects of Georgia.*

Plant and animal names are the hitching posts in the race that science runs. Abbot drew wondrously but named negligibly. Swainson's warbler was known to him 25 years before Audubon named it for William Swainson. Abbot knew the Solitary vireo, and the Golden-Crowned kinglet, before they were named by ornithologists. Abbot illustrated the Gopher apple or cocoa-plum in 1797 *before* Andre Michaux named the plant. The irony here was that James Edward Smith failed to recognize the affinities of the plant, which Abbot had drawn, as new to science and so left the plant innominate! Michaux named it *Chrysobalanus oblongifolius* in 1803.[20]

Science progresses step by step, for example: first Maria Sibylle Merian illustrates an insect selecting one of its stages of metamorphosis but with no sequential significance of the stage indicated; nearly a century later Abbot illustrates a lepidopterous insect selecting the last stage of the life cycle before the imago or adult; William Henry Edwards followed with the indication of the complete insect metamorphosis beginning with the egg, which Abbot neglected to illustrate in his account.[21] Whereas Merian often depicted the insect with simply another plant characteristic of the country, not necessarily associated with it in an obligate association, Abbot carefully related the insect with its food plant.

Another sociobiological record of Abbot's is the fascinating habit of the wasp, called the Mud dauber, finding, stunning, and then hauling off a benumbed spider to its burrow as providential food for its larva months later upon hatching. This caught the interest of Charles Darwin. When the second extensively revised edition of Darwin's *Journal of Researches . . . of countries visited during the voyage of H.M.S. Beagle* appeared in 1845 a footnote was added which referred to Abbot's observation of the wasp-spider predation as preserved in the manuscripts at the British Museum (Natural History).[22] Darwin documents the Abbot record by way of Adam White of the Zoology Department of the Museum who had published a short paper in 1841 on new or little known spiders.[23] Presumably it was Darwin's decision to add this reference to the "enthusiastic naturalist" John Abbot in the second edition on the suggestion of Adam White. Darwin's Abbot reference was reproduced as a footnote in all reissues of his *Journal of Researches* as recently as the Heritage Press edition of 1957.

Abbot's contribution to the plant world was scarcely planned. Stephen Elliott of Charleston evidently appreciated Abbot's interest in his work and just may have wished for more! Abbot presumably sent Elliott a few dried plant specimens for identifications perhaps to add the names to his drawings. One of these was an undescribed "marsh pink," a species of *Sabatia* which Elliott duly announced in his classic *Sketch of the Botany of South Carolina and Georgia.*[24] The *Rarer Lepidopterous Insects* of 1797 is often overlooked by botanists for the real merit of the plant drawings. One of Abbot's notable botanical events: he illustrated the beautiful Coral bean, *Erythrina herbacea* L., as Plate XV, the third time it had been pictured. Catesby first gave us a nice plate, and then Dillenius in his great *Hortus Elthamensis* in 1774.[25] And there were other especially noteworthy plants in Abbot's album. Botanists with an interest in the advent of our weedy immigrants will appreciate, for example, the milkweed *Asclepias curassavica* L., beloved of the Monarch butterfly, the subject of Abbot's Plate VI. This tells us that it was probably well known in the 1790's about southern seaports such as Savannah. It was surely native to the West Indies and a Northbound fellow traveller with the Jimson weed, *Datura stramonium* L., as a vagabond. William Baldwin noted it at St. Mary's in 1812.[26] The wavy-leaved milkweed, described by James Edward Smith in *Rarer lepidopterous Insects* as *Asclepias amplexicaulis* rests scientifically both on Abbot's effective drawing, Plate VII, and on an unspecified collection which Smith said represented the species. Today three specimens have been located from that period, that Smith would have seen, all in the Banks Herbarium: two sad collections, one by John Bartram and one by John Fraser,[27] and a satisfactory specimen sent over by William Young, Bartram's competitor and neighbor on the Schuylkill, his plant taken presumably near Charleston.[28] This William Young specimen may well serve the botanist as the type.

Abbot's watercolor (Plate XXIII) of the Wisteria is the first illustration of our native vine. Although Catesby did not illustrate Wisteria, he is said to have introduced it into England. Another first was Abbot's "nodding grass" (Plate XIII) whose true identity was not established until 1897! Elliott had described the grass though he failed to note its distinction from a widespread relative. Today it is known as *Sorghastrum elliottii* (Mohr) Nash.[29] Among Abbot's unpublished drawings we take note of the Spider flower, *Cleome gynandra* L., that tells another story: of West African origin and the high probability that it came over as a stowaway with the arriving slave ships.[30] Or could it have been a choice favorite in some Ethiopian's garden plot and wilfully treasured as a packet of seed? There are linguistic associations supportive of its Old World Origin. During the last two centuries Spider flower has emigrated as a weedy waif to Jamaica, Grenada, Bahamas, Florida, and Louisiana, especially about seaports. The herbalist John Parkinson grew Spider flower in his garden near London in 1620.

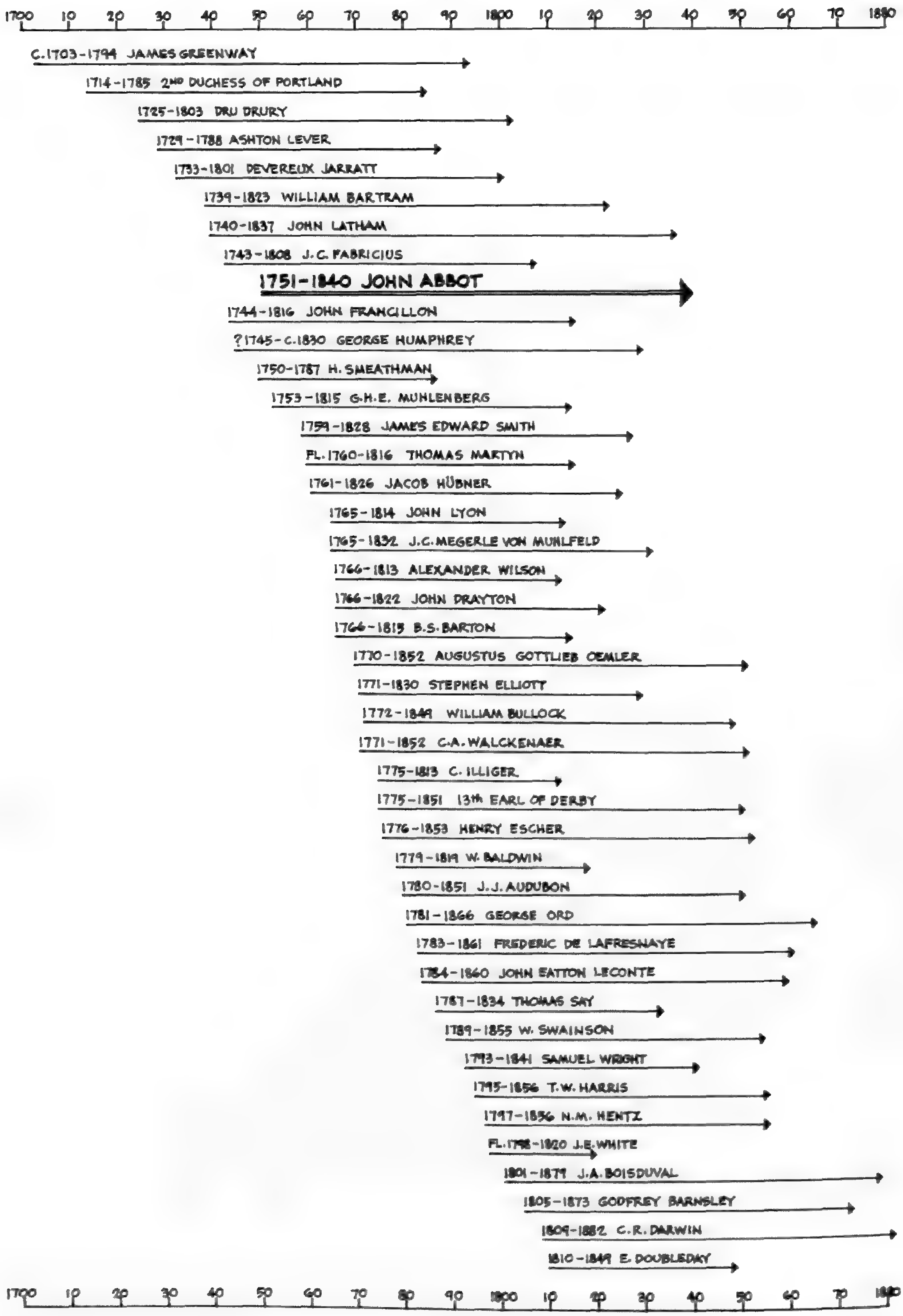
We have some questions: (1) What became of the books Abbot owned? We know Dr. William Pepper noticed in 1910 in a Philadelphia bookshop the unique copy of John Ellis' *Directions* (1771) which included as an appendix instructions on collecting insects. He passed the book along to his lepiodopterist friend Henry Skinner (1861–1926) who failed to identify the marginalia as Abbot's handwriting. It is now in the Academy of Natural Sciences Library in Philadelphia. Whose hands held that book for seventy years we do not know.

(2) Thomas Say's biographers do not mention Abbot.[31] It is difficult to think that the gentle Quaker did not solicit opinions from Abbot. Say was in Savannah around New Year's Day, 1818, with Titian Ramsey Peale, William Maclure and George Ord. Say had been in correspondence with Oemler and had received a box of insects from him (surely of Abbot's collecting). The lepidopterist William Henry Edwards reminisces that Peale told him he had met Abbot on that winter's visit to Savannah. Peale related that negro boys in Savannah brought caterpillars to Abbot for his cages.[32]

(3) The absence of Abbot letters in our archives is one reason why he has not been noticed by historians. Even the Linnean Society of which James Edward Smith was the founder, holds Abbot letters only in the Swainson correspondence. There is a single letter in Philadelphia: a three-page letter to George Ord, March 7, 1814, which had been saved for its autograph interest![33] Among the 7000 letters in the calendared Joseph Banks correspondence, there is not one Abbot letter.

(4) Dr. James Greenway of Dinwiddie County, Virginia, was alerted to Abbot's imminent arrival on the James River by Dru Drury, and Abbot spent his two years in Virginia with the Goodall family with whom he had close ties, and did not take time to contact Greenway.[34] No letters from Greenway to Abbot are known, but Greenway

# A TIME CHART OF JOHN ABBOT'S ASSOCIATIONS



letters to Benjamin Smith Barton written in a clear strong hand after Greenway reached ninety have surfaced in the last few years.

(5) Carl Peter Thunberg (1743–1828) assembled a cabinet of 7,500 American insects. Although these specimens often lack precise locality data, the handwriting on the labels may authenticate them, and there is the extensive Thunberg correspondence preserve at Uppsala which may give clues. Thunberg never visited the New World. There is a good possibility that among those 7,500 exotic specimens there may be John Abbot captures. Thunberg was the last and most successful of Linnaeus' pupils. He succeeded to his master's chair at the University of Uppsala after nine years travel in South Africa, Japan, Java, and Ceylon. He was the author of 139 publications, including a pioneer synopsis of the flora of Japan. The Abbot query relates to his American collections overlooked by American entomologists.[35]

(6) Another naturalist who may have learned about Abbot when he visited Savannah in 1796 was the Frenchman Palisot de Beauvois, who came to the United States as an escapee from Santa Domingo where he had collected insects, as he had before that in West Africa.[36] He was known to Thomas Jefferson, Caspar Wistar, Charles Willson Peale,—he collaborated in the writing of a visitors' guide to the Peale Museum—and Benjamin Smith Barton, among others. Beauvois survived one misfortunate after another climaxed with the loss of his natural history collections at sea off Halifax before he reached France in 1798.

(7) Abbot mentions meeting a Frenchman and his son, presumably in London, who had travelled in Louisiana before 1773. Could that Frenchman have been Antoine Simon Le Page Du Pratz? The French edition of his residence in Louisiana of sixteen years had appeared in 1758. He may have been in London arranging for the English edition which was to appear in 1774. That Le Page Du Pratz had a natural history interest commends this suggestion.[37]

(8) The Georgia spiders that Abbot collected, described and pictured have been admirably documented by Ralph Chamberlain and Wilton Ivie in 1944,[38] emphasizing that what Smith did for Abbot's unpublished drawings of Lepidoptera, Walckenaer carried out for Abbot's unpublished "Spiders of Georgia." The British arachnologist Theodore Savory wrote the first history of the subject in 1961.[39] There is a need today for bringing together in a web of information the lives of American arachnologists, where precisely they collected, and their associations, in the manner of Professor Geiser's essays on naturalists of the Southwest.

Thomas Ashe wrote in 1806 "Whatever capacity you allow to a naturalist, still, in the wastes of science he can only advance step by step. Aided by genius, a Titian or an Angelo, can at one flight reach the summit of his art," but Ashe concludes, the naturalist "in his way has absurdities to engage and prejudices to conquer, which require faculties not always at command, and at a time perhaps otherwise to be employed."[40] Walter Pater commented on the necessities of success in life: "to burn always with this hard gem-like flame, to maintain this ecstasy."[41] John Abbot must have had that flame, that ecstasy.

## Postscript

Since this essay was written in the summer of 1983 two Abbot studies, both fully documented, have been published: Vivian Rogers-Price, *John Abbot in Georgia: the vision of a naturalist artist, 1751-ca. 1840*. Madison-Morgan Cultural Center, Madison, Ga. "1983" [March, 1984] 149 pp. illus. (see review in this issue of *Bartonia*) and Marcus B. Simpson, Jr., Artist-Naturalist John Abbot (1751-ca. 1840): contributions to the ornithology of the Southeastern United States. *North Carolina Historical Review* 61 (July 1984): 347–390. illus.[42]

## NOTES

1. Note by Abbot accompanying drawings, British Museum (Natural History).
2. J. Ewan, Growth of learned and scientific societies in the Southeastern United States to 1860, in *Pursuit of Knowledge in the Early American Republic*, edited by Alexandra Oleson and S. C. Brown (Johns Hopkins Press, Baltimore, 1976) 208–218. Museum development was discouraged in Savannah by a disastrous fire in 1796. C. W. Peale responded by contributing one day's receipts at his Museum ($144) to the city (C. C. Sellers, *Mr. Peale's Museum* (N.Y., 1980) 100).
3. Ewan, *op. cit.* 213. Correction: Couper was not a physician but a planter. Charles Lyell, *Second Visit to the U.S.* (N.Y., 1850) Chap. XVIII.
4. Mentioned in Drury letter to Keuchan [sic], Jan. 21, 1775. *Sci. Mo.* 14 (1922) 81.
5. Thomas E. Penard, Historical Sketch of the Ornithology of Surinam. *De west-Indische Gids* (1924–25) 146–168.
6. Daniel Rolander (1726–1793) collected plants and insects in Surinam during 1755–56. See N. Papavero, *Essays on the history of neotropical Dipterology* (Sao Paulo, 1971) 1: 8–9.
7. Linneaus, *Systema naturae* ed. 10, (1758) 424.
8. Merian, *Surinamensis* pl. 18.
9. William Bullock, *Companion* ed. 12 (1812) 65.
10. *Ibid.* opposite p. 119.
11. J. Ewan, William Bartram. *Botanical and Zoological Drawings, 1756–1788.* Mem. Amer. Philos. Soc. 74 (1968) 5.
12. Cf. Elsa G. Allen, *Trans. Amer. Philos. Soc.* 41 (1951) 480–486.
13. Audubon quoted Abbot as transmitted by Wilson for the Black-billed cuckoo and the anhinga.
14. R. H. Fox, *Dr. John Fothergill and his Friends* (London, 1919) 213–214.
15. F. N. Hepper and F. Neate, *Plant Collectors in West Africa.* Regnum vegetabile no. 74 (Utrecht, 1971) 75.
16. J. C. Lettsom, *Works of John Fothergill, M.D.* (London, 1784) 3: 183–196. see especially p. 193. "Mr. Lee of Hammersmith" mentioned by Smeathman was James Lee (1715–1795), horticulturist who supported plant collectors in America and the Cape. T. Jefferson visited his nursery in 1786. According to J. C. Fabricius Lee was "a keen entomologist and has an extensive collection partly from native and partly from foreign sources." Carl Thunberg visited Lee in 1778 and saw his daughter's "fine collection of insects." E. J. Willson, *James Lee and the Vineyard Nursery, Hammersmith* (London, 1961) 32–35.
17. Courtlandt Canby, *New Illustrated Library of Science and Invention. A History of Flight* (Hawthorn Books, N.Y., 1963) 3: 114.
18. Warren R. Dawson, *Banks Letters* (London, 1958) 758.
19. O. F. Cook, Aublet the Botanist, a pioneer against slavery, with a memorial genus of palms. *Jour. Wash. Acad. Sci.* 30 (1940) 294–299. see especially 296–297.
20. André Michaux, *Flora boreali-americana* (Paris, 1803) 1: 283.
21. Cyril F. dos Passos, *Jour. N.Y. Entom. Soc.* 59 (1951) 149.
22. Chapter II. Footnote reads "In a manuscript in the British Museum by Mr. Abbot, who made his observations in Georgia."
23. Adam White, Descriptions of new or little known Arachnids. *Annals Natural Hist.* 7 (1841) 471–477. see especially 472.
24. *Sabatia gentianoides* Elliott, *Sketch* (Charleston, March 1817) 1: 286, based on Abbot collection in "Bullock [sic] Co., Ga." in Herb. of Charleston Museum. Cf. R. L. Wilbur, *Rhodora* 57 (1955) 100.
25. Both Catesby, plate 49, and Dillenius, *Hortus Elthamensis*, plate 90, were cited by Linnaeus, *Species plantarum*, (1753) 706. The source of the specimens is given as "Habitat in Carolina, Missipi." What may be the history of the unusual Mississippi record prior to 1753 is not determined. The eye-catching scarlet seeds perhaps were taken back to Europe as souvenirs and planted as curiosities. The Linnaean type according to Spencer Savage is designated "H[orto] U[psaliensi]," the Uppsala University collections.
26. Quoted by William Darlington, *Reliquiae Baldwinianae* (Phila., 1843) 68. William Bartram did not collect the plant on his travels in the southeastern U.S. during 1774–76.

27. The John Bartram collection from "Carolina" consists of two detached leaves and fragments of inflorescence; the Fraser collection, only somewhat more ample, was presumably taken in vicinity of Charleston about 1787.
28. William Young collection, no. 195. My thanks to Arthur O. Chater of the British Museum (Natural History) for locating these specimens. Young's drawings of plants date from 1767 after his return to Philadelphia from England August 21, 1766 (cf. Ewan, *Bartram Drawings*, (1968) 36). These specimens may have been gathered from plants grown in his garden near Philadelphia. Cf. also James Britten, *Jour. Bot.* 32 (1894) 332–337.
29. Elliott, *Sketch* (Dec. 1816) 1: 144, called the grass *Andropogon nutans* L., another species. C. T. Mohr distinguished it as *Chrysopogan elliottii* in the *Bull. Torrey Bot. Club* 24 (1897) 21. The grass is now known as *Sorghastrum elliottii* (Mohr) Nash, published in *North Amer. Flora* (N.Y. Bot. Garden, 1912) 17: 130.
30. Slave traffic as an avenue of penetration of plants and animals from country to country will be a dramatic story, but not yet told. Scattered references include: E. D. Merrill, *Botany of Cook's Voyages* (Chron. Bot. vol. 14, Waltham, Mass., 1954) Chapter V, esp. 229. Pierre Dansereau, "Man's impact on the landscape" *Biogeography* (N. Y., 1957) 258–293, esp. 264–265. C. R. Boxer, *Golden Age of Brazil* (Univ. Calif. Press, 1969), see "slaves and slavery" in index. Alfred W. Crosby Jr., *Columbian Exchange* (Greenwood Publ., Westport, Conn., 1972) esp. 106–107, and 213; excellent bibliography. J. Ewan, What's history to him or he to history/That the systematist should bother, *History in the Service of Systematics* (London, 1981) 157–164, esp. 158.
31. For a full list of references see M. M. Carpenter, *Amer. Midland Naturalist* 33 (1945) 90–91. E. O. Essig, *History of Entomology* (N.Y., 1931) 750–756 and L. O. Howard in *Dict. Amer. Biog.* (1935) are most useful. Harry B. Weiss and Grace M. Ziegler, *Thomas Say* (Springfield, Ill., 1931) does not mention Abbot but Elizabeth N. Shor, on Say in *Dist. Sci. Biog.* (1975) acknowledges Abbot's role.
32. C. F. dos Passos, *Jour. N.Y. Entom. Soc.* 59 (1951) 149. Jessie Poesch, *Titian Ramsey Peale* (Mem. Amer. Philos. Soc. 52. 1961) relates the Savannah visit but dates are lacking.
33. Published by W. Stone, *Auk* 23 (1906) 365–368. See also published letter: Abbot, Aug. 30, 1835, to T. W. Harris (*Jour. N.Y. Entom. Soc.* 22 (1914) 71–72).
34. Sci. Mo. 14 (1922) 77, and *Lepidopterists News* 2 (1948) 29.
35. L. Hedstrom, The Entomologist Carl Peter Thunberg, *Acta Universitatis Upsaliensis. Symbolae botanicae Upsalienses* 22. no. 4. (1979) 21–23.
36. A. M. F. J. Palisot de Beauvois, *Insectes recueilles en Afrique et en Amerique* (Paris, 1805). See E. D. Merrill, *Proc. Amer. Philos. Soc.* 76 (1936) 899–909, reprinted in *Chron. Bot.* 10 (1946) 280–286.
37. Antoine Simon Le Page Du Pratz (c. 1695–1775), Dutch by birth, French by adoption, he arrived in New Orleans in 1718 and departed in 1734. See J. Ewan, Bibliography of Louisiana Botany, *Southwestern Louisiana Jour.* 7 ("1967" [1968]) 8–9.
38. Ralph V. Chamberlin and Wilton Ivie, Spiders of the Georgia region of North America. *Univ. Utah Bull.* (Biol. ser. vol. 8, no. 5) 35. no. 9 (1944) 1–267. Discussion of Abbot's "Spiders of Georgia" 7–29.
39. Thomas H. Savory, *Spiders, Men, and Scorpions* (Univ. London Press, 1961).
40. Thomas Ashe, *Memoirs of Mammoth* (Liverpool, 1806) 32.
41. Walter Pater, *The Renaissance* (N.Y., 1961), "Conclusion."
42. Another recent recognition of Abbot is "John Abbot's London Years," *Entomologists' Record* 15 (1984): 110–123, 165–176, 222–229, and 273–285, documented with full notes, by Ronald S. Wilkinson.

Bartonia No. 51: 46–51, 1985

# Pteridophytes of Monmouth County, New Jersey

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This study provides an updated record of Monmouth County pteridophytes. No previous article dealing exclusively with these species has been published (see Fairbrothers 1964, 1966). Stone (1911) lists 32 taxa for the county and Chrysler and Edwards (1947) list 51 taxa. Extensive 'development' has occurred since Chrysler and Edwards published; in 1950 the population was 225,327, in 1980, 503,173 (Bureau of Government Research 1984). Species succession has occurred as well. Herbaria provide many more current records than does the literature, but these records are often spotty—dependent on the schedules of collectors who can devote only a limited amount of time to any one county.

Existing collections date back to those of H. Johnson in the 1870s, N. L. Britton in the 1880s, and W. M. Van Sickle in the 1890s. Prior to World War I, M. Carhart and J. H. Grove were active. After the war, Bayard Long collected intermittently in the county for over thirty years. K. K. Mackenzie and W. H. Witte in the 1920s and J. M. Fogg in the 1930s were among Long's contemporaries. V. L. Frazee and T. A. Zanoni collected in the county after World War II. J. D. Montgomery is the most active recent collector (1980–1984).

I conducted fieldwork in Monmouth County from 1977 to 1984. Herbarium collections were also studied at the Chrysler Herbarium, Rutgers University (CHRB), Academy of Natural Sciences of Philadelphia (PH), New York Botanical Garden (NY), American Fern Society (AFS), and Brooklyn Botanic Garden (BKL).

Thirty-eight taxa have been found in Monmouth County during eight years of field study. Nineteen additional taxa have been collected by previous workers or reported in the literature but not seen in the field by me. None of these latter species has been collected since 1960. Of the 32 taxa recorded by Stone (1911), *Adiantum pedatum*, *Cystopteris fragilis*, and *Ophioglossum vulgatum* have not been seen by me or collected in the last 33 years. Owing largely to the efforts of Long, 19 new taxa were collected during the 36 years between Stone (1911) and Chrysler and Edwards (1947). These were: *Lycopodium alopecuroides*, *L. clavatum*, *L. lucidulum*, *Athyrium filix-femina* var. *asplenioides*, *A. thelypteriodes*, *Azolla caroliniana*, *Botrychium dissectum*, *B. lanceolatum*, *B. matricaeriaefolium*, *B. multifidum*, *B. oneidense*, *Dryopteris carthusiana*, *D. clintoniana* (but see listing below), *D. × bootii*, *D. × pittsfordensis* (but see listing below), *D. × slossonae*, *D. × uliginosa*, *Polypodium virginianum*, and *Woodsia obtusa*. In the 37 years since Chrysler and Edwards, 14 taxa have not been rediscovered. These are the aforementioned *A. pedatum*, *C. fragilis*, and *O. vulgatum*, and also *Equisetum hyemale*, *Azolla caroliniana*, *Botrychium lanceolatum*, *B. multifidum*, *B. oneidense*, *Dryopteris clintoniana*, *D. × pittsfordensis*, *D. × slossonae*, *D. × uliginosa*, *Pteridium aquilinum* var. *pseudocaudatum*, and *Woodsia obtusa*. Since 1960, *Lycopodium tristachyum*, *Equisetum fluviatile*, *E. hyemale*, *Athyrium filix-femina* var. *asplenioides* have not been rediscovered. During this period two new taxa were collected: *Lycopodium × copelandii* and *Dryopteris × triploidea*.

## ANNOTATED LIST OF SPECIES

LYCOPODIOPHYTA: *Lycopodium alopecuroides* L., one stand seen in a damp field, Shark River; collected in Eatontown by Fogg (1937, PH), in Shark River by Witte (1920, CHRB) and Mackenzie (1920, PH), and in Asbury Park by Van Sickle (1894, BKL). *Lycopodium appressum* (Chapm.) Lloyd and Underw., one stand seen in a sphagnum swamp, Shark River; Stone (1911) lists collections from Wall, Farmingdale, Belmar, Shark River; collected in Shark River by Montgomery and Drew (1980, CHRB). *Lycopodium clavatum* L., two stands seen in damp woods, one in Colts Neck, one in Howell; collected in Prospertown (Upper Freehold) by Long (1950, PH) and in Howell by Montgomery, Morrisey, and Domidion (1981, CHRB). *Lycopodium digitatum* A. Br., found occasionally, but often in large stands, in woods near streams; seen in Rumson, Howell, Marlboro, Upper Freehold; collected in Upper Freehold by Montgomery, Morrisey, and Domidion (1981, CHRB). *Lycopodium lucidulum* Michx., found occasionally in damp woods, usually near stream banks but never in the floodplain; seen in Marlboro, Walnford (Upper Freehold), and Howell; collected in Walnford by Montgomery, Morrisey, and Domidion, (1981, CHRB). *Lycopodium obscurum* v. *dendroideum* L., fairly common in rich woods; seen in Howell, Colts Neck, and Holmdel; collected in Upper Freehold by Wikoff (1941, CHRB) and in Shark River by Montgomery and Drew (1980, CHRB). *Lycopodium obscurum* v. *obscurum* L., seen in Howell, Upper Freehold, Marlboro, Hazlet; collected in Farmingdale by Frazee (1952, PH), in Shark River and Hazlet by Montgomery and Drew (1980, CHRB), in Howell by Long (1952, CHRB) and by Montgomery, Morrisey, and Domidion (1981, CHRB), and in Upper Freehold by Montgomery, Morrisey, and Domidion (1981, 1982, CHRB). *Lycopodium tristachyum* Pursh, Stone (1911) lists collection from Shark River by Brown and Taylor, 1910, of plants "growing along a railroad bank and perhaps not native"; collected in Shark River by Frazee (1952, PH). *Lycopodium* × *copelandii* (*alopecuroides* × *appressum*) Eiger., seen with *L. appressum* in Shark River; collected in Shark River by Montgomery and Drew (1980, CHRB). *Selaginella apoda* L., collected in Farmingdale by Long and Brown (1910, PH) and in Allenwood (Wall) by Frazee (1952, PH); Monmouth County horticulturist and conservationist Dr. Betty B. Knorr reports stands in Tinton Falls and Wall (pers. comm. 1982).

EQUISETOPHYTA: *Equisetum arvense* L., common throughout the county in woods and along roadsides; seen in Middletown, Rumson, Wall, Colts Neck, Holmdel, Upper Freehold; collected in Upper Freehold by Hertzog (1939, CHRB) and Wikoff (1945, CHRB), and in Middletown by Montgomery, Morrisey, and Domidion (1983, CHRB). *Equisetum fluviatile* L., collected in Hornerstown (Upper Freehold) by Long (1950, CHRB), which is the only record for the county. *Equisetum hyemale* v. *affine* L., collected "near Keyport" by Britton (1881, CHRB), in Hornerstown (Upper Freehold) by Long (1949, PH), and north of New Egypt by Frazee (1960, PH); exploration of sites north of New Egypt revealed many plants on the Ocean County side of Route 547 but none on the Monmouth County side.

POLYPODIOPHYTA: *Adiantum pedatum* L., collected north of New Egypt by Grove (1905, PH), in Farmingdale by Long and Brown (1910, PH), and in Keyport by Long (1919, PH). *Asplenium platyneuron* L., found in small stands throughout the county on shaded slopes, rock walls, in fields, old orchards, and along roadsides; seen in Middletown, Colts Neck, Shark River, Upper Freehold; collected by Montgomery, Morrisey, and Domidion in Upper Freehold (1981, CHRB) and in Colts Neck (1981, CHRB).

*Athyrium filix-femina* v. *angustum* Willd., common throughout the county in swamps and damp woods; seen in Middletown, Rumson, Wall, Howell, Colts Neck, Holmdel, Marlboro, Upper Freehold; collected in Wall by Zanoni (1970, CHRB), in Upper Freehold and Marlboro by Montgomery, Morrisey, and Domidion (1981, CHRB) and in Middletown and Colts Neck by Montgomery, Morrisey, and Domidion (1983, CHRB); v. *asplenioides* Michx. collected in Farmingdale by Long (1937, PH) and in Wickatunk (Marlboro) by Frazee (1956, CHRB). *Athyrium thelypterioides* (Michx.) Desv., found in rich, deciduous woods along stream banks, sometimes in flood plains; seen in Colts Neck, Holmdel, Marlboro; collected in Holmdel by Long (1941, PH) and in Colts Neck by Montgomery, Morrisey, and Domidion (1983, CHRB); Long's site still exists. *Azolla caroliniana* Willd. collected in Prospertown (Upper Freedhold) by Grove (1914, PH), only record for the County; predominantly a southern species, it may have been introduced. *Botrychium dissectum* Spreng. v. *dissectum*, found with the more common v. *obliquum* in widely scattered stands; seen in Middletown, Colts Neck, Upper Freehold; stand in Middletown includes several plants of the most 'skeletonized' form; collected in Colts Neck by Montgomery, Morrisey, and Domidion (1981, CHRB); v. *obliquum* (Muhl.) Clute, found in open woods, old orchards, and along roadsides, mostly in the northern part of the county; seen in Middletown, Rumson, Colts Neck, Holmdel, Upper Freehold; collected in East Keansburg (Middletown) by Montgomery and Drew (1980, CHRB), in Colts Neck and Upper Freehold by Montgomery, Morrisey, and Domidion (1981, CHRB). *Botrychium lanceolatum* (Gmel.) Angs., collected in Cream Ridge (Upper Freehold) by Long (1941, PH), which is the only record for the county. *Botrychium matricariaefolium* (Doll) A. Braun., seen in Upper Freehold near the top of a shady bank above a stream and collected by Montgomery, Morrisey, and Domidion (1982, CHRB); collected in Tennent (Freehold Township) by Benner (1932, PH), in Cream Ridge (Upper Freehold) by Long (1941, PH), and in Hornerstown (Upper Freehold) by Long (1949, PH). *Botrychium multifidum* (Gmel.) Rupr., collected in Keyport by M. Carhart (1915, NY); this is the only record in the county and is also the southernmost collection in New Jersey, the only one south of the glacial boundary (Chrysler and Edwards 1947); listed as rare and vulnerable in New Jersey by Snyder and Vivian (1981). *Botrychium oneidense* (Gilbert) House, collected in Cream Ridge (Upper Freehold) by Long (1941, PH), which is the only record for the county; listed as rare in New Jersey by Snyder and Vivian (1981). *Botrychium virginianum* (L.) Sw., not as common as *B. dissectum* v. *obliquum*, but found occasionally in damp woods; seen in Middletown, Colts Neck, Holmdel; collected in Keyport by Long (1919, CHRB), in Upper Freehold by Long (1949, CHRB), in Colts Neck by Montgomery, Morrisey, and Domidion (1981, CHRB), and in Upper Freehold by D. Snyder (1983, CHRB). *Cystopteris fragilis* (L) Bernh. v. *mackayi* Lawson, Stone (1911) lists a collection in Freehold by Willis, 1903; collected in Red Bank by A. T. Beals and G. W. Bassett (1923, PH) and in Holmdel by Long (1941, PH); the Red Bank area has now been extensively 'developed'; the general area of the Holmdel site remains undeveloped, but searches have been unsuccessful; this stand may have fallen victim to succession. *Dennstaedtia punctilobula* (Michx.) Moore, common throughout the county, usually in slightly dry circumstances, sun or shade; most vigorous in full sun; seen in Middletown, Rumson, Wall, Colts Neck, Holmdel; collected in Hazlet and Shark River by Montgomery and Drew (1980, CHRB), in Freehold by Montgomery and D. Young (1981, CHRB), and in Upper Freehold by Montgomery, Morrisey, and Domidion (1981, CHRB), and in Colts Neck by the same collectors (1983, CHRB). *Dryopteris carthusiana* (Vill.) H. P. Fuchs, common throughout the county in swamps and damp woods; seen in Wall, Howell, Colts Neck, Marlboro, Upper Freehold; collected in Marlboro by Montgomery, Morrisey, and Domidion (1981, CHRB) and in Manalapan by Montgomery and Young (1981, CHRB). *Dryopteris clintoniana* (D. C. Eaton) Dowell, collected in Morganville (Marlboro) by Carhart (1915, AFS), which is the only record from the county and it was probably a cultivated specimen (Montgomery 1975). *Dryopteris cristata* (L.) A. Gray, found very occasionally in swampy, usually wooded, areas near streams; seen in Colts Neck, Marlboro, Upper Freedhold; collected in Marlboro and Howell by Montgomery, Morrisey, and Domidion (1981, CHRB). *Dryopteris intermedia* (Muhl. ex. Willd.) A. Gray, common in damp woods and along shaded stream banks; seen in Wall, Howell, Colts Neck, Marlboro; Collected in Marlboro by Montgomery and Young (1981, CHRB), in Howell (1981, CHRB), and in Colts Neck (1983, CHRB) by Montgomery, Morrisey, and Domidion. *Dryopteris marginalis* (L.) A. Gray, uncommon in the county; seen along shaded stream banks in Middletown, Howell, Colts Neck; collected in Colts Neck by Montgomery, Morrisey, and Domidion (1981, CHRB). *Drypoteris × boottii* (*D. cristata × intermedia*) (Tuckerm.) Underw., three plants seen in the county, two in Colts Neck and one in Marlboro; collected in Keyport by Carhart (1908, NY), in Marlboro (1981, CHRB) and in Colts Neck (1983, CHRB), by Montgomery, Morrisey, and Domidion. *Dryopteris × pittsfordensis* (*D. carthusiana × marginalis*) Slosson, collected in Keyport by Carhart (1908, NY), "possibly from cultivated plants" (Montgomery 1976). *Dryopteris × solossonae* (*D. cristata × marginalis*) Wherry, collected in Morganville (Marlboro) by Carhart (1913, NY). *Dryopteris × triploidea* (*D. carthusiana × intermedia*) Wherry, this is the most common Dryopteris hybrid in New Jersey (Montgomery 1976) and in the county; first collected in Marlboro by Montgomery, Morrisey, and Domidion (1981, CHRB); seen in Colts Neck and Wall. *Dryopteris × uliginosa* (*D. carthusiana × cristata*) (A. Braun) Druce, collected in Keyport by Carhart (1915, NY). *Lygodium palmatum* (Bernh.) Sw., one stand seen in a Shark River sphagnum swamp; plants appear to be vigorous, covering an area of some 400 square feet; collected by Montgomery and Drew (1980, CHRB); Stone (1911) records undated collections from Keyport, Matawan, Shark River; listed as "State endangered," vulnerable, declining, and local by Snyder and Vivian (1981). *Matteuccia struthiopteris* (L.) Todaro, Stone (1911) lists an undated collection from Upper Freehold by Sturtevant; collected in Walnford (Upper Freehold) by Long (1949, CHRB) and in Upper Freehold by Snyder (1982, CHRB); single specimen growing along Rolling Mill Creek in Colts Neck is known to have been introduced. *Onoclea sensibilis* L., abundant throughout the county in swamps, ditches, wet fields; seen in Middletown, Rumson, Wall, Howell, Colts Neck, Marlboro, Holmdel, Upper Freehold; collected in Shark River by Montgomery and Drew (1980, CHRB) and in Manalapan by Montgomery and Young (1981, CHRB). *Ophioglossum vulgatum* v. *pseudopodum* (Blake) Farw., Stone (1911) lists an undated collection from "Monmouth County" (no township given); collected in Cream Ridge (Upper Freehold) by Long (1941, PH). *Osmunda cinnamomea* L., perhaps the most widespread species in the county, it can be seen in every township where suitable habitat exists; collected in Hazlet by Montgomery and Drew (1980, CHRB) and in Upper Freehold by Montgomery, Morrisey, and Domidion (1981, CHRB). *Osmunda claytoniana* L., noticeably less common than *O. cinnamomea*, this species usually occurs in slightly drier circumstances; seen in Middletown, Wall, Colts Neck, Marlboro, Upper Freehold; collected in Middletown, Colts Neck, Upper Freehold by Montgomery, Morrisey, and Domidion (1983, CHRB). *Osmunda regalis* L., somewhat less common than *O. claytoniana,* this species occurs in swamps and damp woods; seen in Little Silver, Shark River, Wall, Colts Neck, Upper Freehold; collected in Shark River by Montgomery and Drew (1980, CHRB), in Manalapan by Montgomery and Young (1981, CHRB), and in Upper Freehold by Montgomery, Morrisey, and Domidion (1981, CHRB). *Polypodium virginianum* L., the two known stands in the county are both on steep, dry banks; seen in Tinton Falls and Colts Neck; collected in Colts Neck by Long (1938, PH) and by Montgomery, Morrisey, and Domidion (1981, CHRB); the Colts Neck population is located in a protected area and so might be the same as Long's. *Polystichum acrostichoides* (Michx.) Schott, common throughout the county in woods and along shaded stream banks; seen in Middletown, Rumson, Holmdel, Colts Neck, Marlboro, Howell, Upper Freehold; collected in Holmdel by Montgomery and Drew (1980, CHRB), in Upper Freehold (1981, CHRB) and in Colts Neck (1983, CHRB) by Montgomery, Morrisey, and Domidion. *Pteridium aquilinum* v. *latiusculum* (Desv.) Underw. ex Heller, common in dry areas, especially in pine woods; seen in Middletown, Wall, Colts Neck, Freehold Township; v. *pseudocaudatum* (Clute) Heller, collected in Ocean Grove by Fisher (1895, CHRB, PH), which is the only record for the county, and the site is almost surely 'developed'; a form intermediate between v. *latiusculum* and v. *pseudocaudatum* was collected in Ocean Grove by Johnson (1874, CHRB). *Schizaea pusilla* Pursh, no herbarium record of this taxon exists for the county; William F. Sandford reports that specimens existed "many years" ago in a section of Burnt Fly Bog, Marlboro, before a housing project destroyed the site (Sandford 1980); evidently, no firm record was ever made; site also reportedly featured a stand of *Chimaecyparis thyoides,* with which *S. pusilla* associates in its known New Jersey stands; listed as under federal review for being threatened or endangered, and is listed as local, restricted, disjunct, and vulnerable by Snyder and Vivian (1981). *Thelypteris hexagonoptera* (Michx.) Weath., found occasionally in rich woods in the north-central section of the County; seen in Colts Neck, Holmdel, Marlboro, Middletown; Stone (1911) lists an undated collection from Long Branch; collected in Holmdel by Montgomery and Drew (1980, CHRB), in Upper Freehold by Snyder (1983, CHRB), and in Middletown by Montgomery, Morrisey, and Domidion (1983, CHRB). *Thelypteris noveboracensis* (L.) Nieuwl., abundant throughout the county in damp woods; this is by far the most common species of the genus and one of the commonest pteridophytes overall; only *Osmunda cinnamomea* and, perhaps, *Onoclea sensibilis* are more widespread; seen in Rumson, Tinton Falls, Wall, Howell, Colts Neck, Holmdel, Marlboro, Upper Freehold; collected in Wall by Zanoni (1970, CHRB), in Holmdel by Montgomery and Drew (1980, CHRB), in Upper Freehold (1981, CHRB) Colts Neck and Middletown (1983, CHRB) by Montgomery, Morrisey, and Domidion. *Thelypteris palustris* Schott, fairly common in swamps, although no more so than the following species; seen in Sandy Hook, Wall, Colts Neck, Holmdel; collected at Sandy Hook by Britton (1883, CHRB), at Sandy Hook by Mekenian (1962, CHRB), and in Manalapan by Montgomery and Young (1981, CHRB). *Thelypteris simulata* (Davenp.) Nieuwl., found in swamps, but generally in more acidic sites than the preceding species; often associated with sphagnum moss; seen in Wall, Howell, Colts Neck, Holmdel; collected in Hazlet by Montgomery and Drew (1980, CHRB) and in Freehold Township by Montgomery and Young (1981, CHRB). *Woodsia obtusa* (Spreng.) Torr., collected in Crawfords Corner (Holmdel) by Long (1940, PH), which is the only record for the county. *Woodwardia areolata* (L) Moore, found in acidic swamps, often in association with the less frequent

*Thelypteris simulata,* this species is common except in the extreme western end of the county; seen in Middletown, Rumson, Wall, Howell, Colts Neck, Holmdel; collected in Shark River by Montgomery and Drew (1980, CHRB) and in Freehold Township by Montgomery and Young (1981, CHRB). *Woodwardia virginica* (L.) J. E. Smith, noticeably less frequent than *W. areolata,* this species has been seen in acidic swamps in Wall, Neptune, Howell, Colts Neck; the largest stands in the county, extending for hundreds of feet, occur in Turkey Swamp Park, Freehold Township; collected in Asbury Park by Brown (1902, PH), in Keyport by Carhart (1915, NY), in Farmingdale by Long (1919, PH), and in Fort Plains (Howell) by Frazee (1955, PH).

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## LITERATURE CITED

BUREAU OF GOVERNMENT RESEARCH. 1984. 1984 New Jersey Legislative District Data Book. Rutgers University, New Brunswick.

CHRYSLER, M. A. AND J. L. EDWARDS. 1947. The Ferns of New Jersey. Rutgers University Press. New Brunswick.

FAIRBROTHERS, D. E. 1964. An annotated bibliography of the floristic publications of New Jersey from 1753–1961. Bull. Torrey Club 91: 45–56.

———. 1966. An annotated bibliography of the floristic publications of New Jersey from 1962–1965. Bull. Torrey Club 93: 352–356.

MONTGOMERY, J. D. 1975. *Dryopteris celsa* and *D. clintoniana* in New Jersey. Am. Fern J. 65:3, 65–69.

———. 1976. The distribution and abundance of *Dryopteris* in New Jersey. Am. Fern J. 66:2, 53–59.

SANDFORD, W. F. 1980. Just what is Burnt Fly Bog? The Sunday Register, September 14, 1980, Shrewsbury, N.J.

SNYDER, D. B. AND V. E. VIVIAN. 1981. Rare and endangered vascular plant species in New Jersey. U.S. Fish and Wildlife Service.

STONE, W. 1911. The Plants of Southern New Jersey, with Especial Reference to the Flora of the Pine Barrens and the Geographical Distribution of Species. Ann. Rep. New Jersey State Mus., 1910, part II: 21–828.

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# Geographical Distribution of New Jersey's Pteridophytes

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The 1947 publication of the *Ferns of New Jersey* by M. A. Chrysler (1871–1963) and J. L. Edwards (1895–1972) was the first and only treatment dealing exclusively with the taxonomy and geography of pteridophytes growing wild in New Jersey. The extensive collections and knowledge of northern New Jersey flora possessed by Edwards, and of southern New Jersey flora by B. Long and E. T. Wherry were reflected in the contents of this book. Since its appearance 37 years ago, diverse published research has included incidental information about New Jersey ferns. Such data and/or herbarium specimens were frequently collected as portions of floristic and ecological research conducted at Rutgers University.

Information about ferns growing in New Jersey has appeared in publications for many years. Thomas Nuttall (1818) specifically refers to New Jersey locations for his genera: *Dicksonia, Isoetes, Lygodium, Schizaea,* and *Woodwardia*. P. D. Knieskern (1857) in his small booklet listed 19 pteridophytes for Monmouth and Ocean Counties. O. R. Willis (1874) in his list of New Jersey plants recorded 42 pteridophytes for the state. N. L. Britton (1889) in his catalogue listed 1995 vascular plants of which 65 were pteridophytes. W. Stone (1911) listed 50 pteridophytes for southern New Jersey. M. A. Chrysler and J. L. Edwards (1947) recognized 81 pteridophytes included in 8 families and 29 genera. The two authors of this survey recognize 115 pteridophytes included in 15 families and 39 genera. M. Y. Hough (1983) in her book about New Jersey vascular plants obtained fern information from discussions and published and unpublished data provided by Montgomery and/or Fairbrothers; therefore, her treatment of pteridophytes closely corresponds to the data in our present publication.

Interest in endangered and threatened plant species stimulated investigations which include ecological and geographical distribution data for vascular plants in the state, and pteridophytes were included within these projects (Fairbrothers and Hough 1973, 1975; Snyder and Vivian 1981). The distribution of species and hybrids of *Dryopteris* in the state was discussed by Montgomery (1975, 1976). There are recently published annotated checklists of the flora of Hunterdon County (Abraitys 1980) and Middlesex County (Snyder 1984). These studies indicated that geographical distribution of ferns and fern-allies was poorly known for certain parts (counties) of the state and stimulated additional field work. The result is this county distribution list for New Jersey pteridophytes.

METHODS. Preliminary distributions of the pteridophytes of New Jersey were obtained from records at the following herbaria: CHRB, BKL, EONJ, NY, PENN, PH, US, and Staten Island Museum. Distributions for all taxa were recorded by locality and date of collection; these records were then arranged by county and date.

Apparent gaps in distribution records were made the subject of field studies in 1980–1983, especially in those counties where records were old or lacking, and in collaboration with helpful local field workers.[1] Voucher specimens were collected and deposited in the Chrysler Herbarium (CHRB) at Rutgers University and county records for each taxon were continuously updated.

RESULTS AND DISCUSSION. We recognize 115 taxa of pteridophytes (classified in 15 families and 39 genera) with verified voucher specimens from New Jersey. This total includes 80 species, 7 additional varieties (species with more than one variety in the state), and 28 designated and named hybrids.

Distribution for each taxon within counties is presented in Table 1. Records are plotted for three time periods: before 1900, 1900–1949, and 1950–date. Although these dates are somewhat arbitrary, they correspond reasonably well to periods of collecting activity in the state's botanical history. Early records were, for the most part, between 1860 and 1890, and there is a gap between about 1890 and 1910. The period of collecting that culminated in the Chrysler and Edwards book (1947) ended approximately 1950, and there was little intensive interest in ferns until relatively recently.

Thirteen taxa have been recorded from all 21 of New Jersey's counties. Three species, *Osmunda cinnamomea, O. regalis,* and *Onoclea sensibilis* have been recorded since 1950 for all counties. *Lycopodium digitatum, Pteridium aquilinum,* var. *latiusculum,* and *Polystichum acrostichoides* have been recorded for all counties except Hudson; *Adiantum pedatum* from all except Cumberland County; *Dryopteris intermedia* from all except Middlesex County; and *D. marginalis* from all except Cape May County.

Thirteen taxa have been recorded from only a single county, *Dryopteris celsa* and five hybrids involving *D. celsa* are recorded only from Bergen County; *D. goldiana* × *intermedia* and *Cryptogramma stelleri* are also recorded only from Bergen County. *Isoetes macrospora, Equisetum* × *trachydon* and *Botrychium simplex* var. *simplex* are known only from Sussex County. *Isoetes melanopoda* is recorded only from Cape May County, and *Asplenium* × *trudellii* only from Warren County.

There are no records (supported by herbarium specimens) since 1950 for ten taxa. *Cryptogramma stelleri* has not been recorded since approximately 1950 (Snyder and Vivian 1981), and *Dryopteris celsa* has not been collected since 1915 (Montgomery 1975). These species are probably extirpated in New Jersey. *Marsilea quadrifolia,* introduced from Europe probably via New England, has not been collected since 1946. The remaining taxa for which there are no records are designated and named hybrids, including two of *Asplenium* and five of *Dryopteris*. Except for those hybrids in which *Dryopteris celsa* is involved, they could be located again in the state.

Two taxa have recently been added to the pteridophyte flora of the state: *Equisetum variegatum* was found by the late V. Abraitys in 1977 (Montgomery 1981), and *Botrychium simplex* var. *simplex* by D. B. Snyder in 1980. *Equisetum variegatum* is now known from three localities, two in Morris County and one in Warren County; apparently it is spreading in the northern part of the state.

Sussex County, located in the northwest corner of the state, has the largest number of pteridophytes: 94 taxa. This represents an unusually rich fern flora for a single county in the U.S. Wagner (1966) records 75 taxa from Giles County in Virginia, another area considered rich in pteridophytes. Morris (80 taxa), Warren (76), and

[1] The authors wish to thank the following for help in the respective counties: R. Cahayla-Wynne (Bergen, Hudson), C. W. Haefele, III (Passaic), J. S. Meyer (Hunterdon, Middlesex, Somerset), W. Morrisey (Monmouth), and D. B. Snyder (several areas).

TABLE 1. Distribution of New Jersey pteridophytes.

● = Records 1950-1983, • = records 1900-1949, · = records before 1900.

| Taxon | Bergen | Essex | Hudson | Union | Passaic | Morris | Sussex | Warren | Hunterdon | Somerset | Middlesex | Mercer | Monmouth | Ocean | Burlington | Camden | Gloucester | Salem | Cumberland | Atlantic | Cape May | State |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lycopodiaceae | | | | | | | | | | | | | | | | | | | | | | |
| Lycopodium | | | | | | | | | | | | | | | | | | | | | | |
| L. alopecuroides | | | | • | | | ● | | | | ● | · | • | ● | ● | • | • | ● | • | ● | ● | ● |
| L. annotinum | | | | | | • | ● | | | | | | | | | | | | | | | ● |
| L. appressum | • | | | • | · | ● | ● | | | | ● | • | ● | ● | ● | • | ● | • | ● | ● | ● | ● |
| L. carolinianum | | | | | | | | | | | | | | ● | ● | ● | • | | • | ● | • | ● |
| L. clavatum | ● | | | • | ● | • | ● | ● | • | | | | ● | | ● | • | ● | ● | | | | ● |
| L. digitatum | ● | ● | | • | ● | ● | ● | ● | ● | • | ● | ● | ● | • | ● | • | ● | ● | ● | • | • | ● |
| L. inundatum | • | | | | | ● | ● | · | | | • | | | · | | • | • | | | | | ● |
| L. lucidulum | • | • | | | ● | ● | ● | ● | ● | • | | · | ● | ● | • | ● | • | ● | ● | | • | ● |
| L. obscurum var. obscurum | ● | ● | | | ● | ● | ● | ● | • | | ● | ● | ● | ● | ● | • | ● | • | ● | ● | ● | ● |
| L. obscurum var. dendroideum | ● | • | | | • | ● | • | | • | · | • | • | ● | | • | • | • | • | • | • | | ● |
| L. tristachyum | ● | • | | | ● | ● | ● | · | | | | | • | • | • | | | ● | • | ● | | ● |
| L. X copelandii | • | | | • | · | ● | ● | | | | • | • | ● | ● | ● | • | • | • | • | ● | ● | ● |
| L. X habereri | • | | | | | ● | ● | | | | | | | | | | | | | | | ● |
| L. alopecuroides X inundatum | | | | | | ● | ● | | | | | | | | | | | | | | | ● |
| L. appressum X inundatum | | | | | | ● | ● | | | | | | | | | | | | | | | ● |
| Selaginellaceae | | | | | | | | | | | | | | | | | | | | | | |
| Selaginella | | | | | | | | | | | | | | | | | | | | | | |
| S. apoda | • | | | • | · | ● | ● | ● | • | ● | · | · | ● | ● | • | • | • | • | • | • | ● | ● |
| S. rupestris | · | • | · | | • | • | ● | • | ● | ● | | | | | | | | | | | | ● |
| Isoetaceae | | | | | | | | | | | | | | | | | | | | | | |
| Isoetes | | | | | | | | | | | | | | | | | | | | | | |
| I. eatoni | | | | | • | ● | ● | | | | | | | | | | | | | | | ● |
| I. echinospora | • | | | | • | ● | ● | • | | | ● | | | • | ● | • | | • | ● | ● | | ● |
| I. engelmannii | ● | | | • | • | ● | ● | ● | | • | ● | • | | · | ● | • | | ● | | ● | | ● |
| I. macrospora | | | | | | | ● | | | | | | | | | | | | | | | ● |
| I. melanopoda | | | | | | | | | | | | | | | | | | | | | ● | ● |
| I. riparia | | | | | • | ● | ● | • | | | | • | | | ● | • | • | • | ● | | ● | ● |
| Equisetaceae | | | | | | | | | | | | | | | | | | | | | | |
| Equisetum | | | | | | | | | | | | | | | | | | | | | | |
| E. arvense | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | • | ● | ● | ● |
| E. fluviatile | • | | | | | ● | ● | ● | • | ● | | • | ● | | • | • | | | | | | ● |
| E. hyemale var. affine | • | | | ● | ● | ● | ● | ● | ● | ● | • | ● | ● | ● | • | • | • | • | | ● | • | ● |
| E. pratense | · | | | | • | ● | • | | | | | | | | | | | | | | | ● |
| E. sylvaticum | • | • | | | ● | ● | ● | ● | ● | • | | | | | | | | | | | | ● |
| E. variegatum | | | | | | ● | | ● | | | | | | | | | | | | | | ● |
| E. X ferrissii | | | | | | | ● | ● | | | | | | | | | • | • | | | | ● |
| E. X litorale | | | | | | | ● | ● | | | | | | | | | | | | | | ● |
| E. X trachyodon | | | | | | | ● | | | | | | | | | | | | | | | ● |
| Ophioglossaceae | | | | | | | | | | | | | | | | | | | | | | |
| Botrychium | | | | | | | | | | | | | | | | | | | | | | |
| B. dissectum var. dissectum | ● | ● | · | • | ● | ● | ● | ● | ● | ● | ● | • | ● | • | ● | • | • | ● | ● | ● | ● | ● |
| B. dissectum var. obliquum | • | ● | · | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | • | ● | ● | ● | ● | ● | ● |
| B. lanceolatum | · | • | | | • | • | ● | ● | | | • | | • | | | | • | | | | | ● |
| B. matricariaefolium | • | • | | • | ● | ● | • | ● | • | | | | ● | | ● | • | ● | • | | | | ● |
| B. multifidum | · | | | | | • | • | ● | | | | | • | | | | | | | | | ● |
| B. oneidense | ● | | | | | • | ● | | | ● | | | • | | | • | • | | | | | ● |
| B. simplex var. simplex | | | | | | | | ● | | | | | | | | | | | | | | ● |
| B. simplex var. laxifolium | | | | | • | • | ● | • | | | | | | | | | | | | | | ● |
| B. simplex var. tenebrosum | | | | | • | ● | ● | | • | | | | | | | | | | | | | ● |
| B. virginianum | • | • | · | | • | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | • | • | • | | • | ● |
| Ophioglossum | | | | | | | | | | | | | | | | | | | | | | |
| O. vulgatum var. pseudopodum | • | • | | • | • | ● | ● | ● | | • | • | | • | • | ● | • | ● | · | • | ● | · | ● |
| O. vulgatum var. pycnostichum | | | | | | | | | | | | | | | | | | • | ● | | | ● |
| Osmundaceae | | | | | | | | | | | | | | | | | | | | | | |
| Osmunda | | | | | | | | | | | | | | | | | | | | | | |
| O. cinnamomea | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| O. claytoniana | ● | ● | · | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | • | ● | • | • | • | | | ● |
| O. regalis | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |

TABLE 1. (continued).

● = records 1950–1983, • = records 1900–1949, · = records before 1900.

| Taxon | Bergen | Essex | Hudson | Union | Passaic | Morris | Sussex | Warren | Hunterdon | Somerset | Middlesex | Mercer | Monmouth | Ocean | Burlington | Camden | Gloucester | Salem | Cumberland | Atlantic | Cape May | State |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Schizaeaceae | | | | | | | | | | | | | | | | | | | | | | |
| Lygodium | | | | | | | | | | | | | | | | | | | | | | |
| L. palmatum | | | | | | | | | | | • | · | ● | | ● | • | • | | | • | | ● |
| Schizaea | | | | | | | | | | | | | | | | | | | | | | |
| S. pusilla | | | | | | | | | | | | | | ● | ● | • | • | | • | ● | | ● |
| Adiantaceae | | | | | | | | | | | | | | | | | | | | | | |
| Adiantum | | | | | | | | | | | | | | | | | | | | | | |
| A. pedatum | ● | • | · | • | ● | ● | ● | ● | ● | ● | • | ● | • | • | • | • | ● | • | | • | | ● |
| Cheilanthes | | | | | | | | | | | | | | | | | | | | | | |
| C. lanosa | · | • | · | • | · | • | ● | • | ● | | | | | | | | | | | | | ● |
| Cryptogramma | | | | | | | | | | | | | | | | | | | | | | |
| C. stelleri | • | | | | | | | | | | | | | | | | | | | | | • |
| Pellaea | | | | | | | | | | | | | | | | | | | | | | |
| P. atropurpurea | | | | | | • | ● | ● | ● | ● | | | | | | | | | | | | ● |
| P. glabella | | | | | | | ● | ● | ● | | | | | | | | | | | | | ● |
| Polypodiaceae | | | | | | | | | | | | | | | | | | | | | | |
| Polypodium | | | | | | | | | | | | | | | | | | | | | | |
| P. virginianum | ● | • | · | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | • | ● | • | • | ● | • | ● | • | ● |
| Dennstaedtiaceae | | | | | | | | | | | | | | | | | | | | | | |
| Dennstaedtia | | | | | | | | | | | | | | | | | | | | | | |
| D. punctilobula | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | • | ● | ● | • | • | ● |
| Pteridium | | | | | | | | | | | | | | | | | | | | | | |
| P. aquilinum var. latiusculum | ● | ● | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | • | ● | ● | ● | ● | ● | ● |
| P. aquilinum var. pseudocaudatum | | | | | | | | | | | | | | ● | ● | • | · | | • | ● | ● | ● |
| Thelypteridaceae | | | | | | | | | | | | | | | | | | | | | | |
| Thelypteris | | | | | | | | | | | | | | | | | | | | | | |
| T. hexagonoptera | ● | • | · | ● | ● | ● | ● | ● | ● | ● | | ● | ● | ● | • | • | ● | • | • | | | ● |
| T. noveboracensis | ● | ● | • | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | • | ● |
| T. palustris | • | ● | · | ● | ● | ● | ● | ● | • | ● | ● | ● | ● | ● | ● | ● | • | ● | ● | ● | ● | ● |
| T. phegopteris | | | | | • | • | ● | ● | ● | | | • | | | | | | | | | | ● |
| T. simulata | • | | | | | ● | ● | | | | ● | ● | ● | ● | ● | ● | ● | • | ● | ● | • | ● |
| Aspleniaceae | | | | | | | | | | | | | | | | | | | | | | |
| Asplenium | | | | | | | | | | | | | | | | | | | | | | |
| A. bradleyi | | | | | | ● | | • | | | | | | | | | | | | | | ● |
| A. montanum | | | | ● | | ● | • | ● | | | | | | | | | | | | | | ● |
| A. pinnatifidum | | | | | | | • | | ● | | | | | | | | | | | | | ● |
| A. platyneuron | ● | • | ● | ● | ● | ● | ● | ● | ● | ● | ● | • | ● | ● | • | ● | ● | ● | ● | ● | • | ● |
| A. rhizophyllum | • | • | • | • | • | | ● | ● | • | • | • | | | | | | | | | | | ● |
| A. rutamuraria var. cryptolepis | | | | | | | ● | ● | | | | | | | | | | | | | | ● |
| A. trichomanes | · | · | · | • | ● | • | ● | ● | ● | ● | • | · | | | | | | | | | | ● |
| A. X ebenoides | | | | | | | ● | ● | | | | | | | | | | | | | | ● |
| A. X trudellii | | | | | | | | • | | | | | | | | | | | | | | • |
| A. X wherryi | | | | | | • | | • | | | | | | | | | | | | | | • |
| Athyrium | | | | | | | | | | | | | | | | | | | | | | |
| A. filix-femina var. angustum | ● | ● | · | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | • | ● | ● | ● | • | • | ● |
| A. filix-femina var. asplenioides | | | | | | | | | | • | | • | ● | | • | • | • | ● | • | | • | ● |
| A. pycnocarpon | • | | | | | | ● | • | | | | | | | | | | | | | | ● |
| A. thelypterioides | ● | • | | ● | ● | ● | ● | ● | ● | ● | | • | ● | | • | | | | | | | ● |
| Cystopteris | | | | | | | | | | | | | | | | | | | | | | |
| C. bulbifera | | | | | | | ● | ● | · | | | | | | | | | | | | | ● |
| C. fragilis var. mackayi | ● | • | · | • | • | ● | ● | ● | ● | ● | • | • | • | | ● | • | • | | | ● | | ● |
| C. protrusa | | | | | | | ● | • | • | | | • | | | | | | | | | | ● |

TABLE 1. (concluded).

● = records 1950-1983, • = records 1900-1949, · = records before 1900.

| Taxon | Bergen | Essex | Hudson | Union | Passaic | Morris | Sussex | Warren | Hunterdon | Somerset | Middlesex | Mercer | Monmouth | Ocean | Burlington | Camden | Gloucester | Salem | Cumberland | Atlantic | Cape May | State |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dryopteris | | | | | | | | | | | | | | | | | | | | | | |
| D. carthusiana | ● | ● | · | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | • | ● |
| D. celsa | • | | | | | | | | | | | | | | | | | | | | | • |
| D. clintoniana | | • | | | ● | ● | ● | ● | | | • | | • | | | | | | | | | ● |
| D. cristata | ● | • | | ● | ● | ● | ● | ● | ● | | • | · | ● | • | ● | • | ● | • | • | • | • | ● |
| D. goldiana | • | · | | | | ● | ● | • | · | | | | | | | | | | | | | ● |
| D. intermedia | ● | • | · | ● | ● | ● | ● | ● | ● | • | | ● | ● | ● | ● | • | • | ● | ● | • | • | ● |
| D. marginalis | ● | ● | · | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | • | • | ● | • | ● | • | • | | ● |
| D. X benedictii | | | | | ● | ● | ● | | | | | | | | | | | | | | | ● |
| D. X boottii | • | • | | | ● | ● | ● | ● | • | | • | | ● | | | | • | | | | • | ● |
| D. X dowellii | | | | | ● | • | ● | | | | • | | | | | | | | | | | ● |
| D. X leedsii | • | | | | | | | | | | | | | | | | | | | | | • |
| D. X neowherryi | • | | | | | • | ● | | • | | | | | | | | | | | | | ● |
| D. X pittsfordensis | | | | | | | • | | | | • | | • | | | | | | | | | • |
| D. X separabilis | • | | | | | | | | | | | | | | | | | | | | | • |
| D. X slossonae | • | • | | | ● | ● | ● | ● | | | • | · | • | | | | | | | | | ● |
| D. X triploidea | • | • | | | ● | ● | ● | ● | • | | · | | ● | | | | • | ● | • | • | | ● |
| D. X uliginosa | • | | | | ● | ● | ● | ● | | | • | | • | | • | | | | | | | ● |
| D. carthusiana X celsa | • | | | | | | | | | | | | | | | | | | | | | • |
| D. celsa X cristata | ● | | | | | | | | | | | | | | | | | | | | | ● |
| D. celsa X goldiana | ● | | | | | | | | | | | | | | | | | | | | | ● |
| D. clintoniana X cristata | | • | | | ● | ● | ● | ● | | | | | | | | | | | | | | ● |
| D. clintoniana X goldiana | | • | | | • | | ● | · | | | | | | | | | | | | | | ● |
| D. clintoniana X marginalis | | • | | | ● | | ● | • | | | | | | | | | | | | | | ● |
| D. goldiana X intermedia | • | | | | | | | | | | | | | | | | | | | | | • |
| D. intermedia X marginalis | | | | ● | | | • | | | | | | | | | | | | | | | ● |
| Gymnocarpium | | | | | | | | | | | | | | | | | | | | | | |
| G. dryopteris | | | | | · | ● | ● | ● | • | | | | | | · | | | | | | | ● |
| Matteuccia | | | | | | | | | | | | | | | | | | | | | | |
| M. struthiopteris var. pensylvanica | • | | | | | • | ● | ● | ● | | | | ● | | • | | | | | | | ● |
| Onoclea | | | | | | | | | | | | | | | | | | | | | | |
| O. sensibilis | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Polystichum | | | | | | | | | | | | | | | | | | | | | | |
| P. acrostichoides | ● | ● | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | • | ● | ● | ● | • | ● |
| Woodsia | | | | | | | | | | | | | | | | | | | | | | |
| W. ilvensis | · | | · | ● | • | · | ● | ● | | ● | | | | | | | | | | | | ● |
| W. obtusa | ● | • | · | • | ● | • | ● | ● | • | ● | ● | • | • | | • | • | • | | | | | ● |
| Blechnaceae | | | | | | | | | | | | | | | | | | | | | | |
| Woodwardia | | | | | | | | | | | | | | | | | | | | | | |
| W. areolata | ● | • | • | · | • | • | • | • | | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| W. virginica | • | | · | | ● | • | ● | | | | ● | ● | ● | ● | ● | ● | ● | • | ● | ● | ● | ● |
| Azollaceae | | | | | | | | | | | | | | | | | | | | | | |
| Azolla | | | | | | | | | | | | | | | | | | | | | | |
| A. caroliniana | | • | | ● | | | | | ● | | ● | | • | | | | | | | | | ● |
| Marsileaceae | | | | | | | | | | | | | | | | | | | | | | |
| Marsilea | | | | | | | | | | | | | | | | | | | | | | |
| M. quadrifolia | | | | | | • | • | | | | | | | | | | | | | | | • |

Bergen (71), which are northern counties, have the next highest recorded numbers. The fewest pteridophyte records are from Hudson County, the smallest and most urbanized county in the state, with 28 taxa, only 6 of which are recent records. Cape May (36 taxa), Somerset (40), and Atlantic (40), which are central or southern counties, also have low numbers. There is a general decrease in number of taxa recorded as one travels from the northwest to southeast portion of the state.

This county distribution checklist represents our present knowledge, and thus is not the "final word." The authors would be pleased to have persons with additional knowledge of the ferns of the state contribute to updating or correcting our information to help all of us have available the most accurate and current understanding of the ferns of New Jersey.

## Literature Cited

ABRAITYS, V. 1980. A check-list of the flora of Hunterdon County, New Jersey. Bartonia 47: 23–30.

BRITTON, N. L. 1889. Catalogue of plants found in New Jersey. Geol. Surv. N.J., Final Rep. State Geol. 2: 27–642.

CHRYSLER, M. A. AND J. L. EDWARDS. 1947. The ferns of New Jersey. Rutgers University Press, New Brunswick, 201 pp.

FAIRBROTHERS, D. E. AND M. Y. HOUGH. 1973 (revised 1975). Rare or endangered vascular plants of New Jersey. Sci. Notes No. 14. N.J. State Museum, Trenton.

HOUGH, M. Y. 1983. New Jersey wild plants. Harmony Press, Harmony.

KNIESKERN, P. D. 1857. Catalogue of plants growing without cultivation in the counties of Monmouth and Ocean, New Jersey. "True American" Office, Trenton, 41 pp.

MONTGOMERY, J. D. 1975. *Dryopteris celsa* and *D. clintoniana* in New Jersey. Am. Fern J. 65: 65–69.

———. 1976. The distribution and abundance of *Dryopteris* in New Jersey. Am. Fern J. 66: 53–59.

———. 1981. *Equisetum variegatum* and *E.* × *trachyodon* in New Jersey. Am. Fern J. 71: 1–2.

NUTTALL, T. 1818. The genera of North American plants and a catalogue of the species to the year 1817. Vol. II, pages 247–254. D. Heartt Printer, Philadelphia.

SNYDER, D. B. 1984. Check-list of the native vascular flora of Middlesex County, New Jersey. Bartonia 50: 43–50.

SNYDER, D. B. AND V. E. VIVIAN. 1981. Rare and endangered vascular plant species in New Jersey. U.S. Fish and Wildlife Service.

STONE, W. 1911. The plants of southern New Jersey, with special reference to the flora of the Pine Barrens and the geographic distribution of species. Ann. Rep. New Jersey State Mus., 1910, part II: 21–828.

WAGNER, W. H., JR. AND F. S. WAGNER. 1966. Pteridophytes of the Mountain Lake area, Giles Co., Virginia: Biosystematic studies 1964–65. Castanea 31: 121–140.

WILLIS, O. R. 1874. Catalogue of plants growing without cultivation in the state of New Jersey. J. W. Schermerhorn and Co., New York. xxi + 71 pp.

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# Early Plant Succession on Marl Beds in the Byron-Bergen Swamp

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While there is a considerable body of knowledge about succession in upland sites, particularly old-fields, little is known of the early stages of primary succession in wetlands. This is unfortunate since many studies have noted long term changes in wetland communities as being associated with changes in substrate and water chemistry, topography, and water levels. Our studies in the Byron-Bergen Swamp (Bernard et al. 1983; Seischab 1984; Seischab et al. in press) have indicated changes which occur over the long-term and have identified the species which are most important in the early stages of primary succession on the marl beds of the Swamp.

In his study of the Swamp, Seischab (1984) indicated a successional-physiognomic vegetation gradient corresponding to gradients of microtopography, water table depth, soil organic matter, cation-exchange capacity, and bulk density.

Both direct and indirect gradient analyses have been used in numerous wetland studies (Vitt and Slack 1975; Slack et al. 1980; Van der Valk and Davis 1976). Using direct gradient analysis, these and other studies (Mandossian and McIntosh 1960; Beschel and Webber 1962; Nicholson and Aroyo 1975; Andrus et al. 1983) have shown the independent distribution of species along moisture, nutrient, and microtopographic gradients in wetlands.

In kettle-hole bogs of northern Michigan Vitt and Slack (1975) showed both bryophyte and vascular plant responses to a moisture gradient in a direct gradient analysis. In addition, ordinated community types corresponded to gradients of pH and ion concentrations of calcium and magnesium. In their study of rich fens in Alberta, Slack et al. (1980) showed bryophyte species responses to a gradient of water level variation. Karlin and Bliss (1984) concluded that, in weakly minerotrophic fens, plant distribution patterns along a hollow to hummock gradient responded to substrate moisture and biotic interactions. In strongly and moderately minerotrophic fens, gradients of substrate chemistry regulated species distributions.

Van der Valk and Davis (1976) showed that high water disturbance in a prairie pothole did not alter above ground standing crop but they did detect a shift in species positions along a coenocline shown by direct gradient analysis.

The purposes of this study were to document changes which had occurred in species distribution and importance on marl beds, and species diversity along a temporal gradient. In addition, we wanted to document forest encroachment on fen communities.

## STUDY AREA

The fens investigated in this study are a portion of a larger strongly minerotrophic mire, the Byron-Bergen Swamp. The site is located in the Salina Depression underlain by calcareous glacial till overlying Camillus shale. Waters from the Onondaga Escarpment of Onondaga limestone drain northward into the depression and hence through the mire and into Black Creek. To the north lies the Niagara Escarpment of Lockport dolomite which also drains into the depression.

Near the center of the mire the water surfaces and a portion of it evaporates, contributing to the deposition of marl (Seischab 1984) which is approximately two meters in depth.

Seischab (1984) has recently described the vegetation and successional relationships on the marl. He described four vegetation groups along a physiognomic-successional gradient from pools dominated by *Chara*, to sedge-moss mats, to shrub-scrub hummocks, to forests which are dominated by *Thuja occidentalis*,[1] *Pinus strobus*, and *Acer rubrum*. The earliest, non-pool community was dominated by small sedges, primarily *Eleocharis rostellata* and *Rhynchospora capillacea*.

Bernard et al. (1983) ordinated the marl bed vegetation using detrended correspondence analysis (Hill and Gauch 1980) a number of years after Seischab had done his original work. Their results were similar to those of Seischab (1977), but they found that *Cladium mariscoides* had joined *Eleocharis* and *Rhynchospora* as an important early invader of the marl beds.

Since Seischab (1977) had set up permanent transects for his study in 1972, we used these same transects in 1981 to determine changes in these three early invaders and to note invasion of the marl by the surrounding forest. We were also interested in whether any new species had invaded the marl beds in the nine years of record.

## Methods

Three permanent transects established on two marl beds in 1972 were reexamined in 1981. Three meter linear plots were established along each of these transects according to Wilde (1954), and percent cover by species was determined in each. Species richness of each plot (S), each transect ($S_c$) and the mean number of species per plot ($\bar{S}$) were determined. Beta diversity (BD) was determined for each transect and for the total data set according to Whittaker (1975) where $BD = S_c/\bar{S}$.

Differences in percent cover, species richness, and beta diversity between the 1972 and 1981 data, for each transect and for the total data set, were subjected to a Student t test (Sokal and Rohlf 1973).

## Results and Discussion

Cover values for 1972 and 1981 for the three transects are shown in Fig. 1. The longest transect (A), had the lowest cover of the three but there was a pronounced increase in cover in the first 40 meters, and in other locations along the line. Most of transect B and all of transect C had increases in cover over the nine years.

The average cover value for each transect (Table 1) increased in all three transects (15% in A and 44% in B and C). The average increase in cover was 28% and was brought about in part by an increase in species richness. Species richness increased by an average of one species per plot in transects A and B (Fig. 2 and Table 2) and by four species per plot in transect C. These additional species, none new to the Swamp (Muenscher 1946), presumably filled previously unoccupied space along the transects.

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[1] Vascular plant nomenclature follows Fernald (1950).

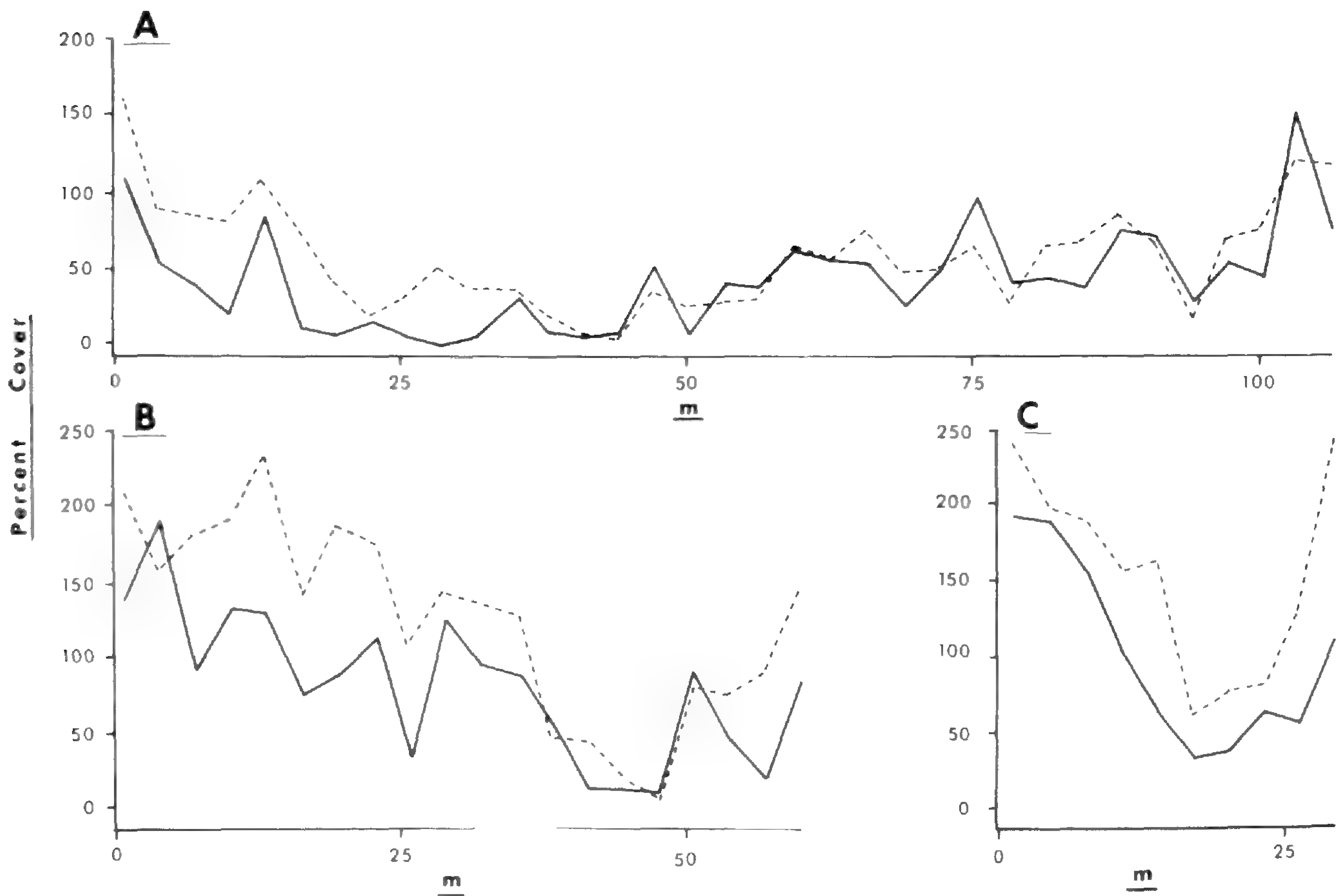


FIG. 1. Percent cover along transects A, B, and C in 1972 (solid line) and 1981 (dashed line).

Although the number of species per plot has increased, the species richness in each transect has changed very little (Table 2). The decrease in beta diversity in each transect (Table 2) is an indication of the community becoming more homogeneous.

The species with the greatest changes in cover values were the sedges *Eleocharis rostellata*, *Rhynchospora capillacea*, and *Cladium mariscoides*. Invasion of marl by *Rhynchospora* is by seed whereupon it forms low tussocks. *Cladium* is distributed by

TABLE 1. Percent cover in three transects on marl beds in the Byron-Bergen Swamp. All changes were significant at the 0.001 level.

| Transect | | Percent Cover 1972 | 1981 | +/− |
|---|---|---|---|---|
| A. 107 m | $\overline{X}$ | 42.9 | 58.0 | +15.1 |
| | s.d. | 33.3 | 34.9 | +1.6 |
| B. 61 m | $\overline{X}$ | 80.3 | 123.9 | +43.6 |
| | s.d. | 48.0 | 64.4 | +16.4 |
| C. 30 m | $\overline{X}$ | 99.1 | 142.6 | +43.5 |
| | s.d. | 55.8 | 67.6 | +11.8 |
| Total | $\overline{X}$ | 63.0 | 91.3 | +28.3 |
| | s.d. | 47.2 | 62.2 | +15.0 |

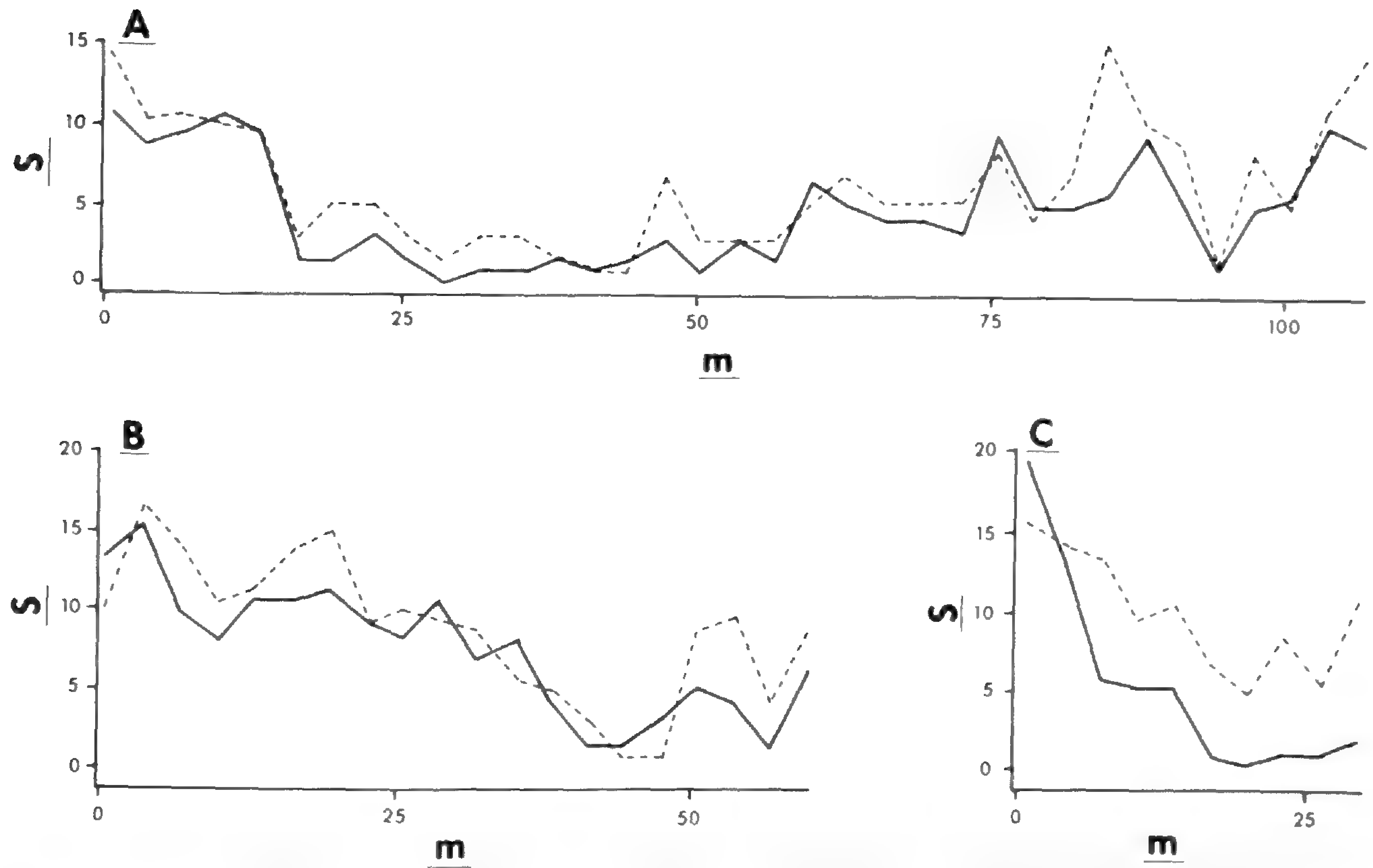


FIG. 2. Species richness (S) of all the three transects investigated in 1972 (solid line) and 1981 (dashed line).

seed and, upon establishment, spreads rhizomatously. Although *Eleocharis* produces seed, most invasion of marl is accomplished by tip layering culms which reach one meter in length (Seischab et al. in press). Once established it forms small tussocks, 5–8 cm in height.

In a portion of Transect A both *Eleocharis rostellata* and *Rhynchospora capillacea* increased in percent cover (Fig. 3, 25–35 m). This section of the transect contained large areas of bare marl and the increase in cover by these species represents primary

TABLE 2. Species diversity as measured by the total number of species in each transect ($S_c$), average number of species per plot ($\overline{S}$), and beta diversity (BD) are shown. Changes from 1972 to 1981 are also listed.

| Transect | | Diversity 1972 | 1981 | '72–'81 |
|---|---|---|---|---|
| A. 107 m | Sc | 28 | 28 | 0 |
| | $\overline{S}$ | 4.77 | 6.23 | +1.46 |
| | BD | 5.87 | 4.49 | −1.38 |
| B. 61 m | Sc | 38 | 39 | +1 |
| | $\overline{S}$ | 7.65 | 8.70 | +1.05 |
| | BD | 4.97 | 4.48 | −0.49 |
| C. 30 m | Sc | 36 | 38 | +2 |
| | $\overline{S}$ | 5.30 | 9.40 | +4.10 |
| | BD | 6.79 | 4.04 | −2.75 |
| Total | Sc | 47 | 44 | −3 |
| | $\overline{S}$ | 5.74 | 7.57 | +1.83 |
| | BD | 8.19 | 5.81 | −2.39 |

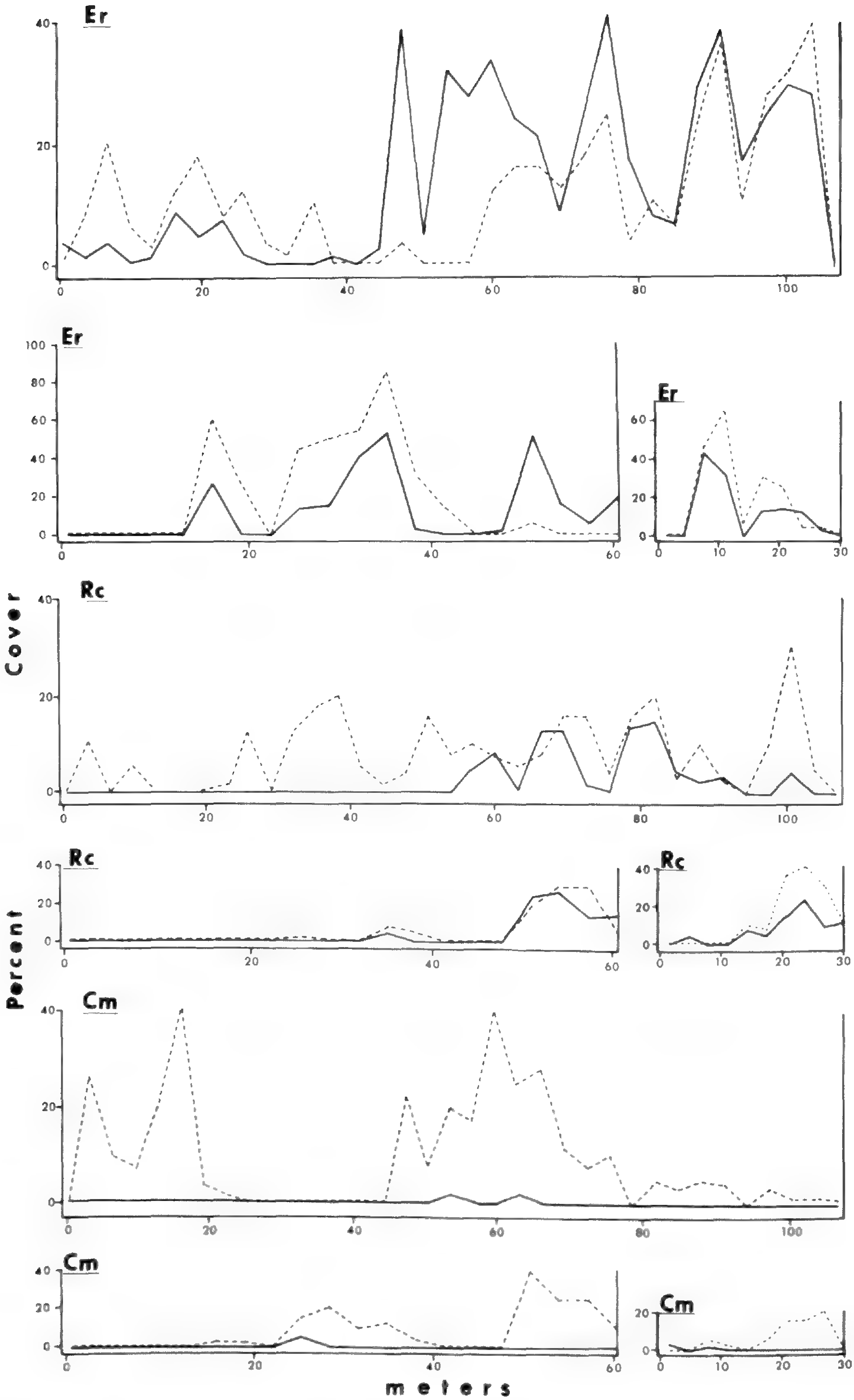


FIG. 3. Percent cover (solid line 1972, dashed line 1981) of *Eleocharis rostellata* (Er), *Rhynchospora capillacea* (Rc), and *Cladium mariscoides* (Cm) in the three transects investigated. Transects A, B, and C are 105, 62, and 30 meters long respectively.

successional invasion of marl. This process occurs in seepages and seasonal pools on the marl beds. Bare marl and pools have been reduced in area over the nine year interval between samplings. Bare areas are maintained, in part, by deer and human trampling which results in a shifting in position of these open areas.

*Eleocharis*, *Rhynchospora*, and *Cladium* have increased in cover in the first 20 meters and last 15 meters of Transect A, in the 20–40 meter interval of Transect B and in the 15–21 meter interval of Transect C. These areas were sparsely occupied by *Eleocharis* in 1972. All three species have spread into previously unoccupied plots increasing the total vegetative cover of the area. Successionally this process represents a temporal and spatial continuum of the *Eleocharis* and *Rhynchospora* areas described above.

*Eleocharis* has declined while *Rhynchospora* and *Cladium* have increased in cover in the 45–95 meter interval of Transect A, the 48–60 meter interval of Transect B, and the 15–21 meter interval of Transect C. There has been a corresponding increase in species richness in the same intervals (Fig. 2) indicating that these areas are farther along in the successional sequence.

The shrubs *Myrica pensylvanica*, *Gaylussacia baccata*, *Ledum groenlandicum*, and *Juniperus horizontalis* and the shrubby trees *Thuja occidentalis*, *Pinus strobus*, and *Larix laricina* were found at the fringes of the fens in the intervals 0–18 meters, 0–25 meters, and 0–17 meters in Transects A, B, and C, respectively. These segments represent shrub communities which have encroached on the fens in the past (Seischab 1984). The changes in cover values seen in the 1972–1981 interval were due to shifts in importance from one species to another with no discernable pattern to the shifts and very little change in the relative locations of these species along the transects. Therefore, encroachment upon the fen by surrounding shrub communities is either extremely slow or was undetected due to the length of our plots. *Potentilla fruticosa* and *Myrica pensylvanica* had become established at several locations previously unoccupied by shrubs in Transect A.

## Conclusions

Community changes in these marl fens are due primarily to an expansion of the area occupied by the three dominant sedges and an increase in species richness as species of lesser importance invade. Generally, the earliest invader, *Eleocharis rostellata*, has declined somewhat in relation to *Rhynchospora capillacea* and *Cladium mariscoides*. The latter species showed the greatest increase of the three.

The increase in species richness was due to invasion of species from other areas in the fens. Encroachment of the surrounding shrub and forest communities has not been significant over the nine years of record and has not contributed significantly to species changes along our transects.

## Acknowledgments

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## Literature Cited

Andrus, R. E., D. J. Wagner, and J. E. Titus. 1983. Vertical zonation of *Sphagnum* mosses along hummock-hollow gradients. Canad. J. Bot. 61: 3128–3139.

Beschel, R. E. and P. J. Webber. 1962. Gradient analysis in swamp forests. Nature (London) 194: 207–209.

BERNARD, J. M., F. K. SEISCHAB, AND H. G. GAUCH, JR. 1983. Gradient analysis of the vegetation of the Byron-Bergen Swamp, a rich fen in western New York. Vegetatio 53: 85–91.

FERNALD, M. L. 1950. Gray's manual of botany. 8th ed. VanNostrand Reinhold Co., New York.

HILL, M. O. AND H. G. GAUCH, JR. 1980. Detrended correspondence analysis: an improved ordination technique. Vegetatio 42: 47–58.

KARLIN, E. F. AND L. C. BLISS. 1984. Variation in substrate chemistry along microtopographical and water-chemistry gradients in peatlands. Canad. J. Bot. 62: 142–153.

MANDOSSIAN, A. AND R. P. MCINTOSH. 1960. Vegetation zonation on the shore of a small lake. Amer. Midl. Nat. 64: 301–308.

MUENSCHER, W. C. 1946. The vegetation of the Bergen Swamp. I. The vascular plants. Proc. Rochester Acad. Sci. 9: 64–117.

NICHOLSON, A. AND B. AROYO. 1975. A case study of hydrarch zonation. Vegetatio 30: 207–212.

SEISCHAB, F. K. 1977. Plant community development in the Byron-Bergen Swamp: a rheotrophic mire in Genesee County, New York. Ph.D. thesis, SUNY College of Environmental Science and Forestry, Syracuse, NY.

———. 1984. Plant community development in the Byron-Bergen Swamp: marl-bed vegetation. Canad. J. Bot. 62: 1006–1017.

———, J. M. BERNARD, AND K. FIALA. In press. Above and below-ground standing crop and partitioning of biomass by *Eleocharis rostellata* Torr. on three sites in the Byron-Bergen Swamp, Genesee County, NY. Amer. Midl. Nat.

SLACK, N. G., D. H. VITT, AND D. G. HORTON. 1980. Vegetation gradients in minerotrophically rich fens in western Alberta. Canad. J. Bot. 58: 330–350.

SOKAL, R. R., AND F. J. ROHLF. 1973. Introduction to biostatistics. W. H. Freeman and Co., San Francisco.

VAN DER VALK, A. G. AND C. B. DAVIS. 1976. Changes in composition, structure, and production of plant communities along a perturbed wetland coenocline. Vegetatio 32: 87–96.

VITT, D. H. AND N. G. SLACK. 1975. An analysis of the vegetation of *Sphagnum*-dominated kettle-hole bogs in relation to environmental gradients. Canad. J. Bot. 53: 332–359.

WHITTAKER, R. H. 1975. Communities and Ecosystems (2nd ed.). Macmillan Co., New York.

WILDE, S. A. 1954. Floristic analysis of ground cover vegetation by a rapid chain method. J. Forestry 52: 499–502.

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# Chromosomal Studies of *Physalis virginiana* var. *subglabrata* and *Physalis heterophylla*

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*Physalis virginiana* Miller var. *subglabrata* (Mackenzie and Bush) Waterfall and *Physalis heterophylla* Nees (Solanaceae) are morphologically similar species. They flower simultaneously and are sympatric in southeastern Pennsylvania where we studied five mixed populations.

A detailed, comparative karyotype analysis is presented to elucidate further the taxonomic relationships between these taxa and develop some of the observations in Menzel's (1951) monograph. Microsporogenesis was studied in these five mixed populations to seek evidence of hybridization as indicated by meiotic irregularities.

## MATERIALS AND METHODS

MITOTIC CHROMOSOMES. Mature fruits were collected from *Physalis heterophylla* plants and *Physalis virginiana* var. *subglabrata* plants. Seeds were removed from the dried berries, treated in a Chlorox solution (1 Chlorox:4 $H_2O$) to reduce mold growth, and germinated in sterile petri dishes. Temperatures of 30–40°C were required for *P. heterophylla* seed germination while *P. virginiana* var. *subglabrata* seeds easily germinated at room temperatures. Seeds of both taxa germinated within eight to ten days. Seeds with emerging hypocotyls 2–4 mm in length were placed on filter paper moistened with a saturated solution of paradichlorobenzene (PBD) for 2.5 hours (Menzel 1951) and fixed in 3:1 absolute ethanol:glacial acetic acid for 9.5 hours at room temperature. Root tips were then refrigerated and stored in 70 percent ethanol. Prior to their examination, root tips were hydrolyzed for 22 minutes in ten percent HCl at room temperature and soaked in distilled water for two or three minutes to swell the cells. They were then macerated in a drop of aceto-orcein with an iron needle for two to three minutes and squashed. One hundred and forty *P. virginiana* var. *subglabrata* cells in mitotic metaphase were examined and 45 were photographed. Of the 72 *P. heterophylla* cells examined, 26 were photographed. All photographs were taken at 1000× and enlarged to 8 × 10 prints. This allowed measurement of chromosomes up to 30 mm in length, to the nearest 0.5 mm. Measurements of five karyotypes, each from a separate hypocotyl, were used to calculate the centromeric index (CI) = $\langle p/(p + q)\rangle$, where p = short arm and q = long arm, and relative length (RL) = $\langle p + q \times 1000/\text{length of the haploid set}\rangle$. Average p and q values from these karyotypes were used to construct an idiogram for each species (Fig. 1). Numerical data were compared using the Student's t Test. Data were examined for skewness and kurtosis, and, when necessary, ratio and percentages were converted using the angular transformation into variables suitable for analysis.

MICROSPOROGENESIS. *Physalis heterophylla* and *Physalis virginiana* var. *subglabrata* flower buds were collected from at least ten plants of each species in each of

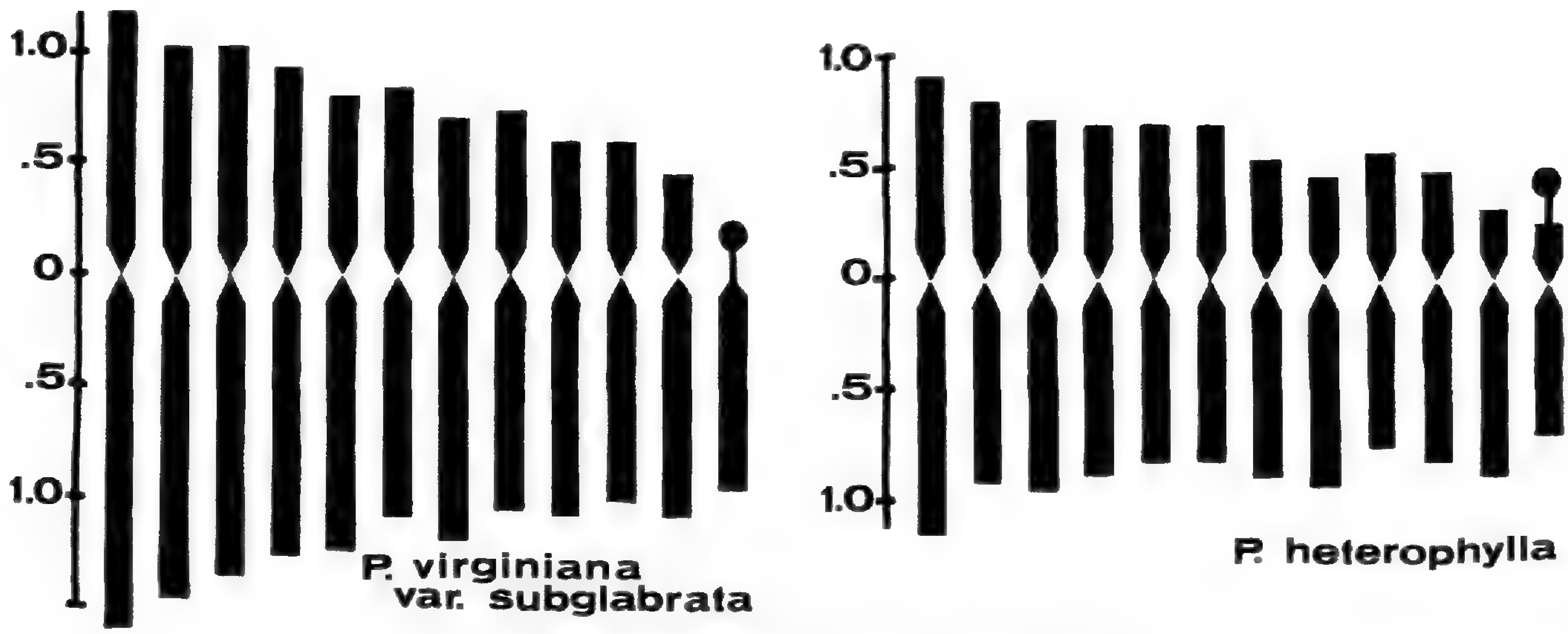
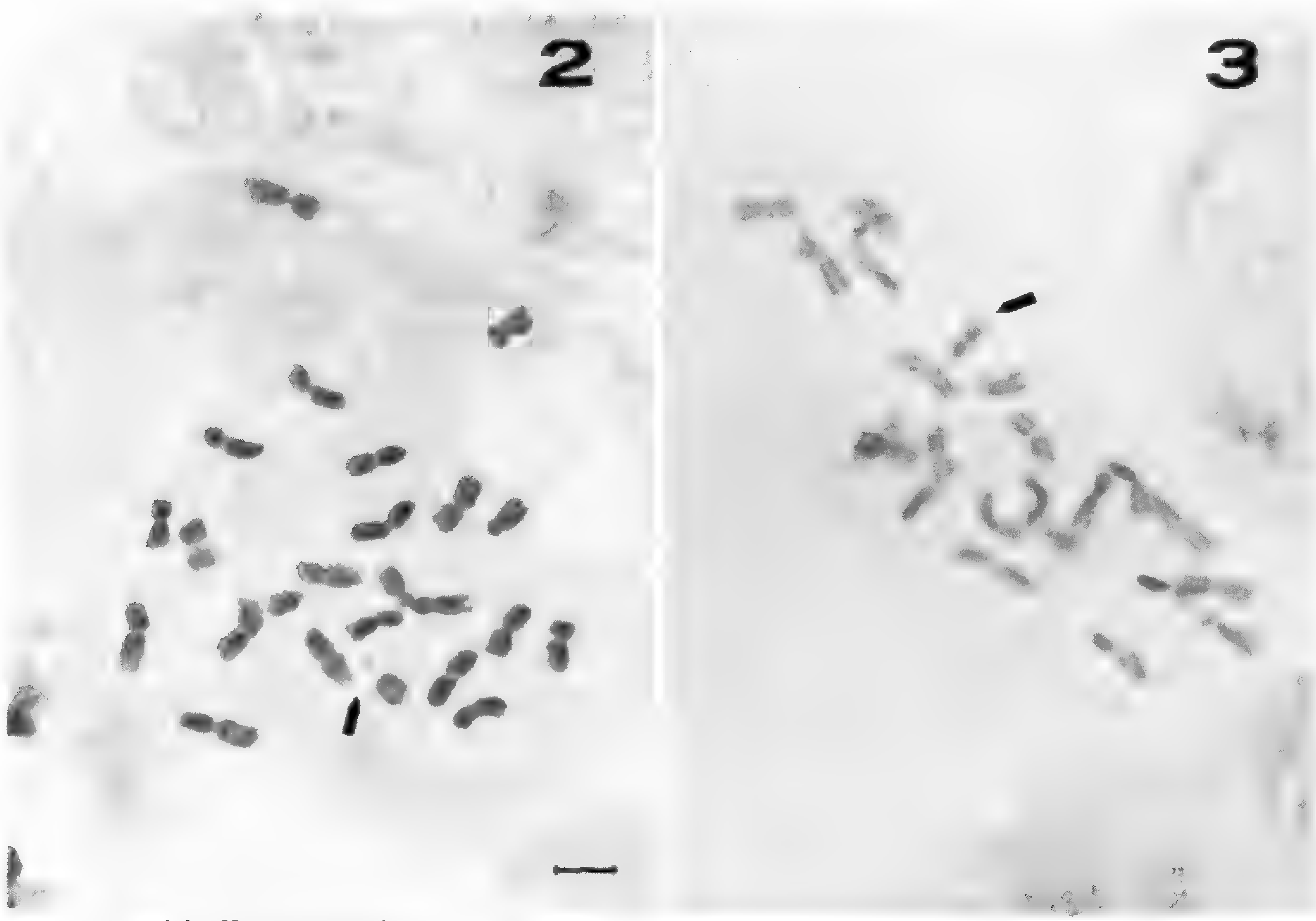



Fig. 1. Idiograms. Scale in relative length units.

the five mixed populations. Buds were fixed in the field using 9:3:1 (v:v:v) absolute ethanol, acetic acid, and chloroform and refrigerated until examination. White anthers removed from buds less than 4.5 mm in length which were collected between 9:00 and 10:00 am yielded the most meiotic divisions. The anthers were macerated in a drop of aceto-orcein stain and prepared for study using the familiar squash techniques. Approximately 160 meiotic cells of each species, representing the five populations, were examined.




FIGS. 2 and 3. Karyotypes (bar = 1.0 micron). 2. *Physalis virginiana* var. *subglabrata*; 3. *Physalis heterophylla*.

VOUCHERS. Plants of both taxa were collected from five mixed populations in Lancaster and Berks counties, Pennsylvania, pressed, and deposited in the Millersville University Herbarium.

## RESULTS AND DISCUSSION

MITOTIC CHROMOSOMAL MORPHOLOGY. The distinct differences in mitotic chromosomal morphology reported here augment differences in gross morphology and should assist taxonomists in delimiting these taxa. Chromosome 12 in *P. virginiana* var. *subglabrata* is quite distinct from the same numbered chromosome in *P. heterophylla*. In the former the entire short aim is threadlike and terminated by a small knob or satellite (Figs. 1 and 2) while in the latter, an acrocentric chromosome with a distinct satellite is present (Figs. 1 and 3).

Quantitative differences are striking. The average total length of the haploid chromosomal set in *P. virginiana* is 186.51 relative length units and that of *P. heterophylla* is 141.46. This difference is statistically significant ($P < 0.025$). When individual chromosomes occupying corresponding positions in their respective karyotypes are compared, numerous statistically significant differences are observed. For example, chromosomes 2, 3, 4, 5, 9, 10, and 12 are different in relative length (Table 1). This indicates that each of the chromosomes compared occupies a distinctly different fraction of its respective genome. These differences in chromosomal morphology suggest that meiotic irregularities could be expected during microsporogenesis in hybrid plants.

MICROSPOROGENESIS. Study of 160 meiotic cells from the five mixed populations confirmed the gametic chromosome number, $n = 12$, reported by Menzel (1951) for each species, but revealed no irregularities at any stage of meiosis in either species. Hinton's (1975) studies of microsporocytes at metaphase I and late prophase I in three putative hybrids, collected in the field, also indicated that pairing is normal. The study

TABLE 1. Centromeric index (CI) and relative length (RL) mean values for mitotic chromosomes of *Physalis heterophylla* and *Physalis virginiana* var. *subglabrata*.

| Chromosome Number | CI | | RL | |
|---|---|---|---|---|
| | *P. heterophylla* | *P. virginiana* var. *subglabrata* | *P. heterophylla* | *P. virginiana* var. *subglabrata* |
| 1 | 0.44 | 0.43 | 113.56 | 116.62 |
| 2 | 0.45 | 0.42* | 99.72 | 106.53** |
| 3 | 0.45 | 0.43 | 93.10 | 101.37** |
| 4 | 0.46 | 0.43 | 89.05 | 95.31*** |
| 5 | 0.47 | 0.40** | 86.41 | 88.37* |
| 6 | 0.46 | 0.44 | 83.91 | 84.64 |
| 7 | 0.39 | 0.38 | 79.90 | 81.17 |
| 8 | 0.36 | 0.42* | 78.25 | 77.28 |
| 9 | 0.45 | 0.38* | 75.54 | 73.32** |
| 10 | 0.42 | 0.38 | 73.32 | 69.58*** |
| 11 | 0.26 | 0.29 | 66.46 | 64.94 |
| 12 | 0.31 | 0.00*** | 60.79 | 40.76*** |
| Average | 0.41 | 0.37*** | | |

* Mean values are significantly different ($p < 0.10$).
** Mean values are significantly different ($p < 0.05$).
*** Mean values are significantly different ($p < 0.01$).

of microsporogenesis revealed no evidence that hybrids are present in these populations. The chromosomal differences, reported here, probably reflect genetic rearrangements of sufficient magnitude to preclude hybrid formation. Further, very few artifical hybrids have been produced and these bore virtually no seed (Hinton 1975; Menzel 1951). Our eleven unsuccessful reciprocal crosses, though few in number, support these findings.

## Literature Cited

Hinton, W. F. 1975. Natural Hybridization and Extinction of a Population of *Physalis virginiana* (Solanaceae). Amer. J. Bot. 62: 198–202.

Menzel, M. Y. 1951. The Cytotaxonomy and Genetics of *Physalis*. Proc. Amer. Phil. Soc. 95: 132–183.

Bartonia No. 51: 69–76, 1985

# Notes on *Erigenia bulbosa* (Apiaceae)

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*Erigenia bulbosa* (Michx.) Nutt. (Apiaceae) is the earliest-blooming native wildflower in the rich, moist, well-drained woodlands of eastern North America. We have collected it in flower in late February—weeks before the advent of spring—near Cincinnati, Ohio. At the southern edge of its verified range (Tuscaloosa County, Alabama) and even north to central Tennessee (Van Buren County), erigenia comes into anthesis as early as mid-February, as it does in southeastern Kansas (McGregor 1981). Steyermark (1963) reported that in Missouri this species usually appears three weeks before snow trillium (*Trillium nivale*), which starts to flower in mid-March (see also Anderson 1953). Appropriate, indeed, is one of the common names for this species, harbinger-of-spring, derived from Nuttall's (1818) explanation of the name *Erigenia:* "from the Greek [erigeneia], a name of Aurora, the harbinger of day or of the spring."

Since its description in 1803 (as *Sison bulbosum;* Michaux 1803), erigenia has received occasional note in literature but has been, in our opinion, rather infrequently collected. In 51 herbaria in eastern United States and adjacent Canada, we found only about 1200 specimens of erigenia (including many duplicates), an average of fewer than seven specimens collected per year since the plant was described. Our interest in erigenia—plus the sometimes contradictory information we encountered about the species—led us to seek and compile all we could about this insignificant member of the carrot family.

The data we obtained from literature, herbarium specimens, and field observations enabled us to get a general picture of erigenia's biology. Particularly helpful were accounts of the plant's life cycle and morphology by Theodore Holm (1901, 1925).

## Natural History

The embryo of erigenia, like that of many other Apiaceae, is minute, measuring ca. 0.1 mm long. (Martin (1946) included the species in his seed type having "rudimentary" embryos.) During germination, only one of the cotyledons develops, emerging from the soil and forming a stalked seed-leaf with an elliptic blade somewhat over 1 cm long. This seed-leaf is the only structure appearing above the ground during the plant's first year.

The name "pseudo-monocotyledon" has been applied to dicots like erigenia that exhibit such anomalous seedling development (see Hegelmaier 1878). These include, according to Holm (1908–1909), two of erigenia's woodland associates, *Claytonia virginica* and *Dicentra cucullaria*, and at least one other umbellifer, *Carum* (i.e., *Bunias*) *bulbocastanum*, a Eurasian species (see also Winkler 1895).

It is not until the second year that the plant develops a typical—though still relatively small—ternately divided leaf. Then each successive year the leaf produced is larger and more complex, becoming as much as 28 cm long by 20 cm wide and four times ternately divided. The leaves of non-flowering plants arise from the apex of a tuber; those of flowering plants arise at about ground level from a stem. Flowering stems bear one leaf each; of the 1200 specimens we studied, only one obviously aberrant plant had a two-leaved stem. In a number of colonies of erigenia in northern Kentucky the leaves of scattered plants are infected by a conspicuous rust, which may be *Puccinia erigeniae* (Orton) Arth. (McCain and Hennon 1982).

The tuber of young plants produces one stem only; that of older plants, up to nine stems. Developmental study of the tuber (Holm 1901) has shown that this structure, which may be as much as 25 mm in diameter, is derived directly from the primary root and is thus a root-tuber, verifying Nuttall's (1818) original assertion: "root a globular tuber."

It takes about 6 or 7 years for an erigenia plant to bear its first umbel of flowers. As the plant ages, it may produce more than one inflorescence per stem. Older individuals may have as many as four umbels on one stem—one terminal, the other(s) axillary—each in a different stage of development and composed of three to six umbellets, which in turn are made up of three to five flowers on short pedicels.

The flowers are protogynous, as was pointed out a century ago by Foerste (1882) (see also Lindsey and Bell 1980; Robertson 1892; Trelease 1882). Each has five white petals, 3 to 4.5 mm long, which are erect in early anthesis. As anthesis progresses, the petals spread, forming a highly contrasting background for the five bright maroon anthers. This contrast accounts for one of the common names applied to erigenia: pepper-and-salt.

Upon close examination of the flowers we noted nectar-secreting tissue at the base of the styles, indicating to us that this plant is probably insect pollinated in spite of the fact that its flowering is initiated at a time of the year not usually associated with insect activity. To investigate this probability, we made observations in a large colony of erigenia in Campbell County, Kentucky, on the frosty morning of 28 March 1981. Not long after sunrise the frost began to dissipate; by 1000 the temperature had risen to 8°C and the first of many insect visitors to erigenia appeared. We noted bees and flies travelling systematically from flower to flower (see also Robertson 1892). By 1200, with the temperature approaching 15°C, the insects became uncountable. We collected a number of them alive for later study in the laboratory.

The bees were found to have their pollen sacs filled exclusively with pollen of erigenia. In contrast, pollen was not evident on the flies, perhaps because it was dislodged as these insects flew about in the specimen jars. Later, however, we noted small round spots, fly specks, on the glass. Inspection showed that these were composed mostly of erigenia pollen.

Other insect visitors to the colony included two small butterflies and many tiny (ca. 3 mm) beetles. The butterflies landed briefly on the flowers and then flew away before we could carefully watch them. The beetles, though, were easily observed. As they crawled from flower to flower they did not contact the anthers but seemed interested only in the abundant nectar. Inasmuch as beetles do not have sucking mouth parts with which to take up fluid, this interest at first seemed odd. The mandibles, however, are close enough together to allow capillary action to bring nectar to the mouth.

Of all these insects the most likely pollinators are bees and flies. For pollinators and nectar thieves alike, erigenia pollen and nectar are probably a welcome food source, especially in the first part of erigenia's blooming season, when the species' hibernal and early vernal niche is contested by no—or but few—other wildflowers.

After pollination, the petals and stamens begin to shrivel, eventually falling from the plant. As the fruits grow, each develops into two strongly ribbed, seedlike mericarps that separate and simply drop to the ground at maturity (usually late spring).

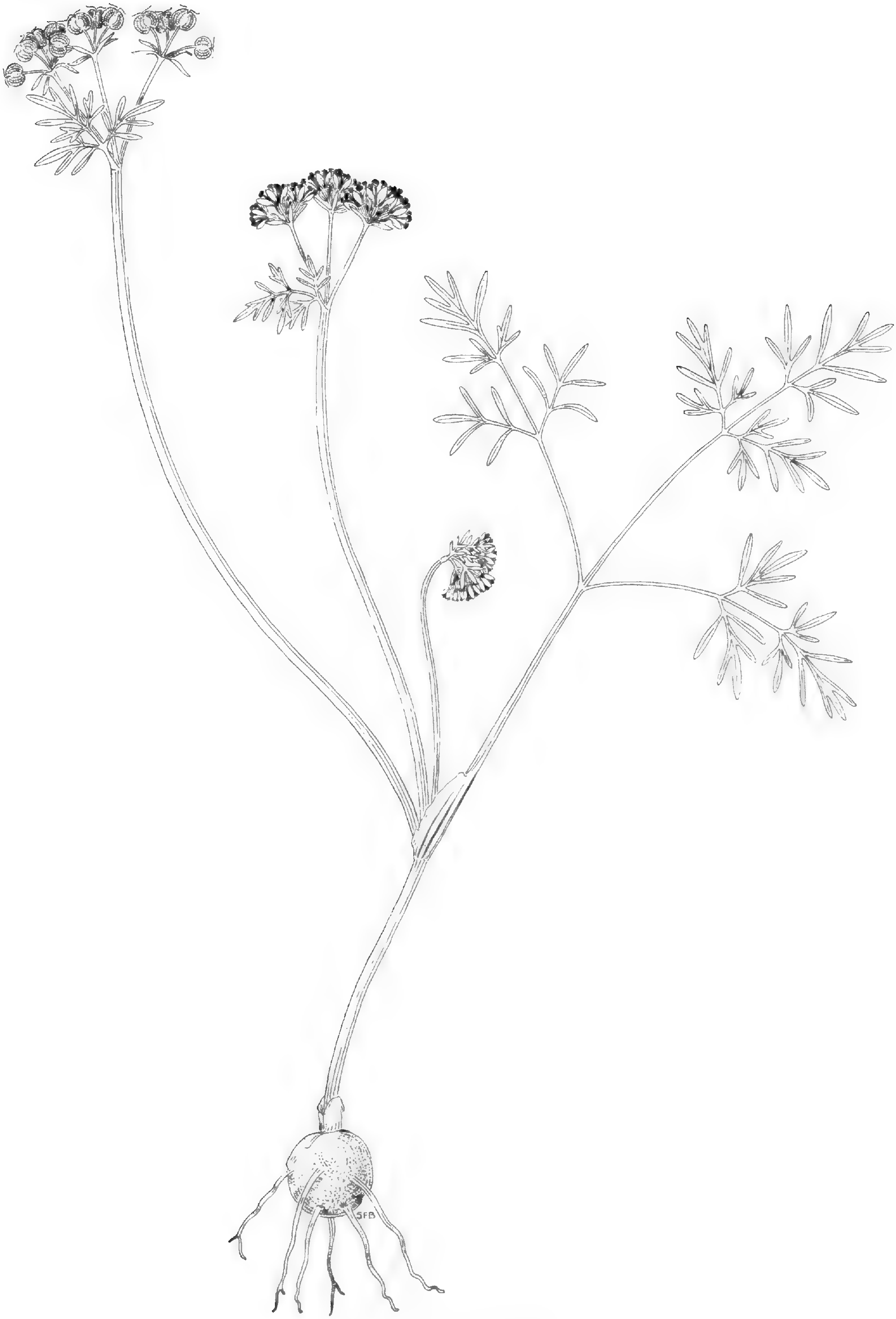


FIG. 1. *Erigenia bulbosa*. ×1.

Erigenia occurs in colonies because its disseminules are not carried away from the parent plant by any special dispersal mechanism. We have measured colonies covering ca. 210 square meters of woodland and containing thousands of individual plants. A random sample disclosed as many as eight mature plants in a 10-square-centimeter plot.

By the second week in June, most erigenia plants have disappeared from view. During the final days of the year's growing season, the flowers of at least the terminal umbel of the following year form underground, where they await the early part of the next season to start the annual above-ground cycle again. This cycle is strikingly different from that of most species that grow with erigenia—indeed, from that of most species in eastern United States.

Native herbaceous plants commonly occurring with *E. bulbosa* include: *Anemonella thalictroides, Arisaema atrorubens, A. dracontium, Cardamine hirsuta, C. pensylvanica, Chaerophyllum procumbens, Claytonia caroliniana, C. virginica, Dentaria laciniata, Dicentra canadensis, D. cucullaria, Erythronium albidum, E. americanum, Isopyrum biternatum, Jeffersonia diphylla, Mertensia virginica, Podophyllum peltatum, Polemonium reptans, Sanguinaria canadensis,* and *Trillium sessile.*

Erigenia tubers are edible and rather pleasant tasting. Of course it does take quite a few of them to make their collection worthwhile. They may be eaten out of hand, peeled and sliced into a salad, or boiled a few minutes and served, like mini-potatoes, with butter and, of course, pepper and salt. Nelson (1918) reported that children in northern Kentucky eagerly sought the tubers, calling them "turkey-peas" and forming "regular hunting parties" to collect them ("by the quart"). To see if the possible descendants of these children would also like turkey-peas, we took some freshly dug and washed tubers to Northern Kentucky University in spring 1980, prevailing upon several students to sample them and give us their opinion of the flavor. All participants commented on the "nutty" texture and flavor, some comparing the taste to fresh coconut or to hazelnuts. There was variation in perception of the tubers' degree of sweetness.

## Range

*Erigenia bulbosa* is limited to eastern North America. The current range may be smaller than that indicated in Fig. 2. We suggest, for example, that the species may well be extinct in Wisconsin inasmuch as the most recent specimen we have seen from that state was collected in 1898.

*Gray's Manual of Botany* (Fernald 1950) gives a range that differs from our map in that Minnesota is included. We believe the Minnesota record is based on a specimen of *E. bulbosa* in the Gray Herbarium that bears the label data: "Detroit, Minnesota. S. Minns 18 ." This specimen is suspect since there is no Detroit, Minnesota, even though there are, in Becker County of that state, a "Detroit Lakes" (a city), a "Detroit Lake," and a "Ft. Detroit." If the specimen actually came from Becker County, it would extend the verified range of erigenia by 400 miles to the northwest, an extension we do not accept. It is more likely that the specimen is from Detroit, Michigan, where the plant is known to occur, and that the "Minnesota" is a lapsus calami.

The following list gives the most recent dates for erigenia specimens we have seen from the range extremes. Georgia, 1982; Alabama, 1980 (see Harper 1932); Michigan, 1980; Arkansas, 1979; Virginia, 1979; Kansas, 1974; Maryland, 1967; Oklahoma, 1963

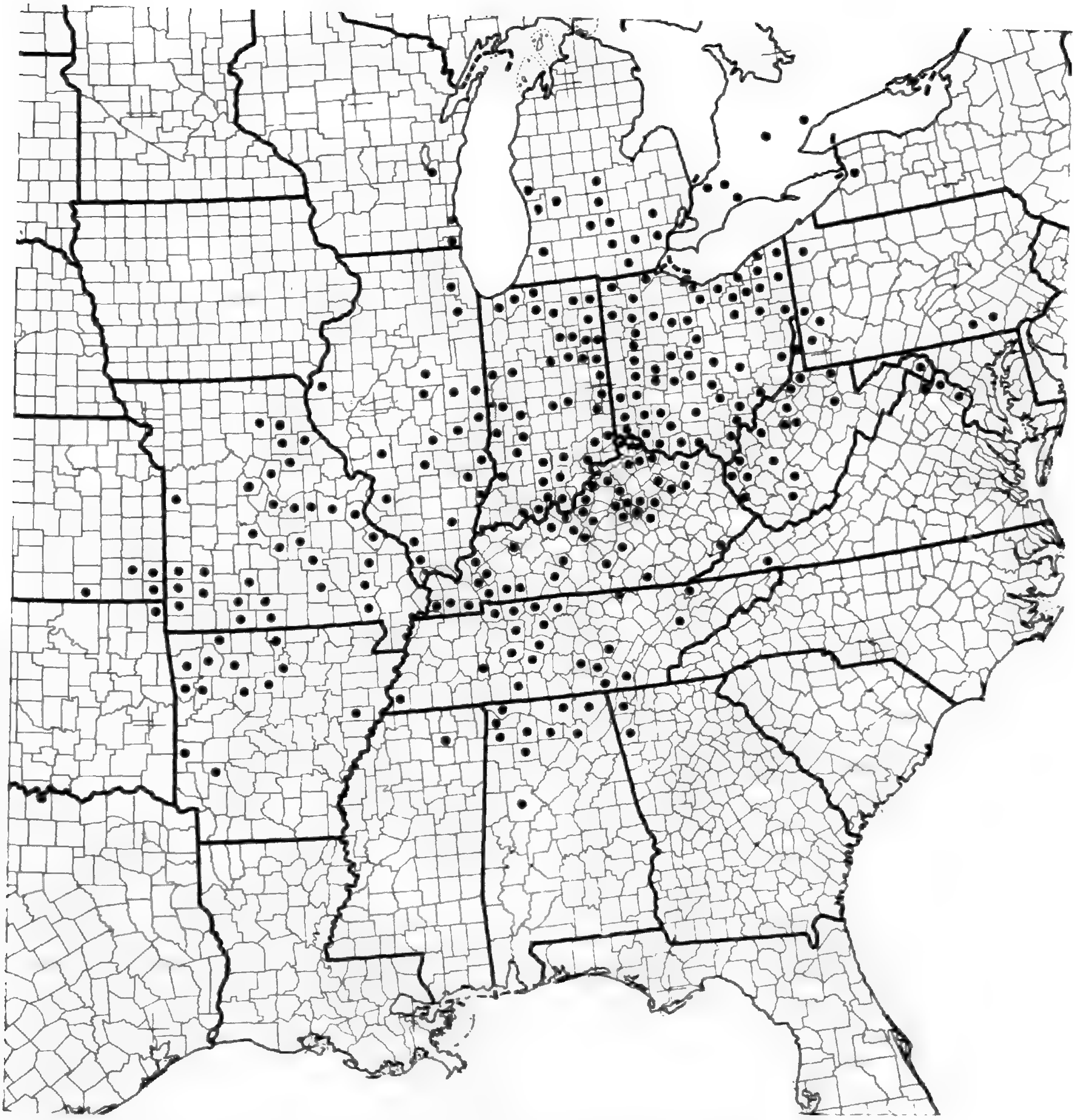

FIG. 2. Documented distribution of *Erigenia bulbosa*.

(see Wallis 1964); Ontario, 1958 (see Soper 1962); eastern Pennsylvania, 1956; New York, 1942; Mississippi, 1913; and Wisconsin, 1898.

## TAXONOMY

Taxonomic and other data on *E. bulbosa*—the sole species of its genus—are included in monographs on world Apiaceae (Bentham and Hooker 1867; Candolle 1830; Drude 1897), in monographs on North American Apiaceae (Coulter and Rose 1887, 1888, 1900; Mathias and Constance 1944–1945; Nuttall 1818; Torrey and Gray 1840), in some state and regional floras for eastern United States and adjacent Canada (e.g., Fernald 1950; Jennings 1953; Steyermark 1963), and in non-technical articles (Anderson 1953; Buddell and Thieret 1982; Clute 1942; Laughlin 1905; McGregor 1981; Wherry 1945). The description below is offered as a supplement to and emendation of existing literature.

## ERIGENIA Nutt., Gen. N. Am. Pl. 1:187. 1818

TYPE SPECIES. *Erigenia bulbosa* (Michx.) Nutt. (*Sison bulbosum* Michx.).

### **Erigenia bulbosa** (Michx.) Nutt., Gen. N. Am. Pl. 1:188. 1818.

*Sison bulbosum* Michx., Fl. Bor. Am. 1:169. 1803.
*Ligusticum bulbosum* Pers., Syn. Pl. 1:315. 1805.
*Hydrocotyle bipinnata* Raf., Med. Repos. II. 5:353. 1808. (Nomen nudum)
*Hydrocotyle dissecta* Raf., Med. Repos. II. 5:353. 1808. (Nomen nudum)
*Hydrocotyle ambigua* Pursh, Fl. Am. Sept. 732. 1814.
*Hydrocotyle composita* Pursh, Fl. Am. Sept. 190. 1814.
*Erigenia shortiana* Raf., First Cat. Bot. Gard. Transylvania Univ. 24. 1824. (Nomen nudum)
*Hydrocotyle bulbosa* Eaton and Wright, N. Am. Bot. 277. 1840.
*Sium pusillum* Mathias and Constance, pro. syn., N. Amer. Fl. 28B:74. 1944. Not *S. pusillum* Poiret 1810 or *S. pusillum* Nutt. 1840.

Perennial, root-tuber geophyte (McDonald 1937), 4–21 cm tall. Tuber more or less globose, to 25 mm in diameter, bearing 1–9 stems. Foliage leaves 1 (rarely 2) per flowering stem, 1–3(4) times ternately divided, expanding to 28 cm long and 20 cm wide, the sheath 0.5–2 cm long; ultimate leaf segments linear to elliptic, to 21 mm long and 7 mm wide, with acute to rounded tips; scale-like leaves 1–several at base of stem. Umbels compound, of 3–6 unequal rays to 62 mm long; umbellets 3–5 flowered, the pedicels to 5 mm long. Bract 1(2), simple and linear to 1–2 times ternately divided, to 47 mm long and 46 mm wide, sometimes accompanied by 1–3 smaller bracts similar to bractlets; bractlets simple and linear or spatulate to deeply lobed, to 14 mm long. Calyx obsolete. Corolla of 5 petals, these white, obovate, somewhat concave, erect to spreading, without an inflexed apex, entire, 3–4.5 mm long. Androecium of 5 alternate stamens, these slightly exceeding the petals; anthers bright maroon, darkening with age; pollen ellipsoid, tricolporate. Gynoecium of 2 (rarely 3; Harper 1932) united carpels; styles 2, persistent, exceeding the petals, not or slightly enlarged at base, recurving with age; nectariferous disc prominent; ovary inferior; carpophore absent. Fruits oblate, broadly elliptic in side view, laterally compressed, strongly 10-ribbed, to 3 mm long; mericarps reniform; embryo straight, 0.1 mm long. Chromosome number: $n = 10$ (Constance et al. 1976).

In Nuttall's (1818) protologue for *E. bulbosa* he alluded to a drawing, by C. W. Short, of an erigenia plant from the "banks of the Kentucky river the 15th of March." The drawing evidently seemed to Nuttall to be different enough from his concept of *E. bulbosa*—especially in leaf form—to suggest that the two were not conspecific. (It was perhaps for such a specimen that Rafinesque (1824) proposed a name for a second species of the genus but provided no description.)

The leaves of erigenia change dramatically in size as the growing season progresses. A plant seen in June might suggest a species different from that represented by the same individual in March or April. (We believe that Pursh's *Hydrocotyle ambigua*, long recognized as a synonym of *E. bulbosa*, represents such a late-season plant.) There may also be much variation in shape of the ultimate leaf segments within a single leaf and among leaves in a colony; these segments range from 1 to 7 mm wide and are acute to rounded at the tip. We conclude that leaf form is highly variable in *E. bulbosa*; it is not a reliable character on which to base recognition of a second species of *Erigenia*.

"*Sium pusillum*," ascribed to Poiret (1810) and introduced into the synonymy of *E. bulbosa* by Mathias and Constance (1944–1945), is a name that has gotten into said synonomy by error. It was not published by Poiret as a binomial for erigenia at all—"pusillum" was not intended by him to be a specific epithet but was merely the first in a series of descriptive terms he applied to our species, which was known to him by its original name, *Sison bulbosum* Michx. Poiret wrote (repeating Michaux's text): "*Sium* (sison bulbosum), *pusillum, radice globoso-bulbosa;*" etc. Indeed, he had already used the name *Sium pusillum*—it was clearly intended as a binomial—for Michaux's *Sison pusillum*, the plant now known as *Spermolepis divaricata*.

Besides "pepper-and-salt" and "harbinger-of-spring," which occur repeatedly in the literature, we have noted the following common names for *E. bulbosa:* bulbous-rooted erigenia (Torrey 1843), daughter-of-spring (Wood 1870), erigenia (Buddell and Thieret 1982), turkey-foot (Clute 1934; a name only "ignorance could account for"), and the most venerable true common name of all those given to erigenia, turkey-pea (Riddell 1834).

## Acknowledgments

Herbaria we checked and/or received specimens from are: APSC, BUF, CAN, CANI, CINC, DAO, DHL, DUKE, DUL, DUR, FARM, GA, GH, GMUF, GRI, ILL, IND, ISC, KANU, KNK, KSC, KY, LCU, MARY, MICH, MISS, MPPD, MSC, MU, MUHW, NCU, NY, OKLA, OS, PAC, PM, TENN, TER, UARK, UMO, UNA, US, VDB, VPI, WARM, WILLI, WIS, WSFA, WUD, WVA and Morehead State University, KY.

## Literature Cited

Anderson, E. 1953. Pepper and salt, our earliest wild flower. Missouri Bot. Gard. Bull. 41: 45–46.

Bentham, G. and J. D. Hooker. 1867. Umbelliferae. Genera Plantarum 1: 859–931.

Buddell, G. F., II and J. W. Thieret. 1982. Harbinger-of-spring. Explorer 24(1): 24–26.

Candolle, A. P. de. 1830. Umbelliferae. Prodromus Systematis Naturalis Regni Vegetabilis 4: 55–250.

Clute, W. N. 1934. The meaning of plant names. LVII. The umbellifers II. Amer. Bot. 40: 64–71.

———. 1942. The harbinger-of-spring. Amer. Bot. 48: 39–40.

Constance, L., T.-I. Chuang, and C. R. Bell. 1976. Chromosome numbers in Umbelliferae. V. Amer. J. Bot. 63: 608–625.

Coulter, J. M. and J. N. Rose. 1887. Notes on Umbelliferae of E. [sic] United States. I. Bot. Gaz. 12: 12–16.

——— and ———. 1888. Revision of North American Umbelliferae. Herbarium of Wabash College, Crawfordsville, Indiana. 144 pp.

——— and ———. 1900. Monograph of the North American Umbelliferae. Contrib. U.S. Nat. Herb. 7: 9–256, I–VII.

Drude, O. 1897. Umbelliferae. Pages 63–250, 271 *in* A. Engler and K. Prantl. Die Natürlichen Pflanzenfamilien III. 8.

Fernald, M. L. 1950. Gray's Manual of Botany, 8th ed. American Book Co., New York. 1632 pp.

Foerste, A. F. 1882. Dichogamy of Umbelliferae. Bot. Gaz. 7: 70–71.

Harper, R. M. 1932. *Erigenia bulbosa* and some associated and related plants in Alabama. Torreya 32: 141–146.

Hegelmaier, F. 1878. Vergleichende Untersuchungen über Entwicklung dikotyledoner Keime mit Berücksichtigung der Pseudo-monokotyledonen. E. Schweizerbart'sche Verlagshandlung (E. Koch). Stuttgart. 211 pp.

Holm, T. 1901. *Erigenia bulbosa* Nutt. A morphological and anatomical study. Amer. J. Sci. IV. 11: 63–72.

———. 1908–1909. Observations on seedlings of North American phaenogamous plants. Ottawa Nat. 12: 165–174, 235–244.

———. 1925. Hibernation and rejuvenation, exemplified by North American herbs. Amer. Midl. Natur. 9: 439–512.

Jennings, O. E. 1953. Wild Flowers of Western Pennsylvania and the Upper Ohio Basin. University of Pittsburgh Press, Pittsburgh, Pennsylvania. 2 vol.

LAUGHLIN, E. E. 1905. Harbinger of spring. Amer. Bot. 8: 6–7.

LINDSEY, A. H. AND C. R. BELL. 1980. Protogyny and associated reproductive characters in Apiaceae. Page 269 *in* Abstracts, Second International Congress of Systematic and Evolutionary Biology, The University of British Columbia, Vancouver, Canada, July 17–24, 1980. The University of British Columbia, Vancouver.

MCCAIN, J. W. AND J. F. HENNON. 1982. Notes on biogeography and new records of rust fungi in the Great Lakes region. Proc. Indiana Acad. Sci. 91: 504–514.

MCDONALD, E. S. 1937. The life-forms of the flowering plants of Indiana. Amer. Midl. Natur. 18: 687–773.

MCGREGOR, R. L. 1981. The harbinger of spring. Kansas Wildfl. Soc. Newsletter 3(1): 6–7.

MARTIN, A. C. 1946. The comparative internal morphology of seeds. Amer. Midl. Natur. 36: 513–660.

MATHIAS, M. E. AND L. CONSTANCE. 1944–1945. Umbelliferae. North American Flora 28B: 43–295.

MICHAUX, A. 1803. Flora Boreali-Americana. Vol. 1. Levrault, Paris. 330 pp.

NELSON, J. C. 1918. *Erigenia bulbosa*. Amer. Bot. 24:31.

NUTTALL, T. 1818. The Genera of North American Plants and a Catalogue of the Species to the Year 1817. Vol. 1. D. Heartt, Philadelphia. 312 pp.

POIRET, J. L. M. 1810. *Sium (sison bulbosum)*. Page 622 *in* M. Lamarck, Encyclopédie Méthodique. Botanique. Supplement, Tome I. H. Agasse, Paris.

RAFINESQUE, C. 1824. First Catalogues and Circulars of the Botanical Garden of Transylvania University at Lexington in Kentucky for the Year 1824. Lexington, Kentucky. 24 pp.

RIDDELL, J. L. 1834. Synopsis of the flora of the western states [part 1]. West. J. Med. Phys. Sci. 2(3): 329–374.

ROBERTSON, C. 1892. Flowers and insects—Umbelliferae. Trans. Acad. Sci. St. Louis 5: 449–460.

SOPER, J. H. 1962. Some genera of restricted range in the Carolinian flora of Canada. Trans. Roy. Canad. Inst. 34: 3–56.

STEYERMARK, J. A. 1963. Flora of Missouri. Iowa State University Press, Ames. 1725 pp.

TORREY, J. 1843. A Flora of the State of New York. Vol. 1. Carroll and Cook, Albany, New York. 484 pp.

——— AND A. GRAY. 1840. A Flora of North America. Vol. 1. Wiley and Putnam, New York. 711 pp.

TRELEASE, W. 1882. [Note on dichogamy in *Erigenia*.] Bot. Gaz. 7: 71.

WALLIS, C. S. 1964. *Erigenia*, a genus new to Oklahoma. Rhodora 66: 311–312.

WHERRY, E. T. 1945. Pepper-and-salt. Bull. Amer. Rock Gard. Soc. 3(1): 1.

WINKLER, A. 1895. Anomale Keimungen. Abhandl. Bot. Ver. Prov. Brandenburg 36: 123–140.

WOOD, A. 1870. The American Botanist and Florist. Part Fourth, Descriptive Botany. A. S. Barnes and Company, New York. 392 pp.

Bartonia No. 51: 77, 1985

# *Montia chamissoi* Rediscovered along the Delaware River in Wayne County, Pennsylvania

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*Montia chamissoi* (Ledb.) Greene, a member of the Portulacaceae, was previously known from two locations in Wayne County, Pennsylvania where it was collected in 1894 and 1950. However, this plant, described by Wherry as "the most disjunct species in Pennsylvania," could not be relocated at either site in the 1960's (Wherry 1964). At that time Wherry suggested that a search of rock ledges along the northern portion of the Delaware River might result in the discovery of additional *Montia* populations.

The main range of this species is from Alaska south to the mountains of California and Arizona. The closest site to Pennsylvania is in Minnesota (Fernald 1950).

During July and August 1984, while conducting a survey of rare plant species for the Pennsylvania Department of Environmental Resources and the National Park Service Upper Delaware Scenic and Recreational River, a field team from the Morris Arboretum of the University of Pennsylvania discovered two previously unreported populations of *Montia chamissoi.*

The newly found sites are in the vicinity of Long Eddy and Hancock, New York, approximately 20 and 30 miles north of the earlier locations. Both consist of dripping outcrops of Devonian sandstone situated at the base of steep, wooded slopes along the Pennsylvania side of the Delaware River. One site has a north facing aspect and the other, more northerly one, faces east. *Montia* occurs approximately six to eight feet above the water line and appears to be restricted to areas where spring water trickles down over the rocks throughout the year. Typical associated species include: *Chrysosplenium americanum, Ranunculus repens, Impatiens capensis, Hydrocotyle umbellata, Myosotis scorpioides, Onoclea sensibilis, Sagina procumbens, Gratiola aurea,* and *Sphagnum, Mnium,* and *Polytrichum* species.

Both *Montia* populations are small, comprising less than 100 plants. A few flower buds and immature fruits were observed as were the slender stolons produced by this species. Voucher specimens have been placed in the herbarium of the Morris Arboretum.

## Literature Cited

Wherry, E. T. 1964. The most disjunct species in Pennsylvania. Bartonia 34: 7.
Fernald, M. L. 1950. Gray's Manual of Botany. 8th ed. D. Van Nostrand Co., New York.

# Additions to the Flora of Monomoy Island, Massachusetts

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On a trip to South Monomoy Island, Massachusetts on 7 August 1983, I collected some plant specimens that had not been previously reported as growing there (Bailey 1965; Moul 1969; Svenson & Pyle 1979). The following collections were made south of the Old Monomoy Light Tower: *Potamogeton perfoliatus* L., edge of fresh water pond at south end of island, *Schrot 261*. *Danthonia spicata* (L.) Beauv., sand flats at southern tip of island, *Schrot 257*. *Cyperus strigosus* L., dunes at south end of island, *Schrot 258*. *Rhynchospora capitellata* (Michx.) Vahl., swale at south end of island with *Vaccinium macrocarpon* Ait., *Schrot 256*. *Juncus bufonius* L., muddy border of Big Station Pond, *Schrot 265*. *Linum striatum* Walt., swale at south end of island, *Schrot 262*. *Lindernia anagallidea* (Michx.) Pennell, muddy border of Big Station Pond, *Schrot 260*. *Limosella subulata* Ives., muddy border of Big Station Pond, *Schrot 263*.

All of the above, with the exception of *Limosella subulata,* have been reported for other areas of similar habitat on Cape Cod (Svenson and Pyle 1979); *Limosella subulata* is within its expected range (Fernald 1970).

In addition to the above, several species were collected that had been listed by Bailey (1965), but not by Moul (1969) nor by Svenson and Pyle (1979) specifically for Monomoy Island: *Polygonum glaucum* Nutt., beach at south end of island, *Schrot 298*. *Mollugo verticillata* L., open muddy border of Big Station Pond, *Schrot 296*. *Hibiscus moscheutos* L., bordering fresh water pond, abundant, *Schrot 283*. *Epilobium glandulosum* var. *adenocaulon* (Haussk.) Fern., sand flat at south end of island, *Schrot 272*.

Specimens have been deposited in the Gray Herbarium. I thank Robert Prescott, Director, Massachusetts Audobon Society Wellfleet Bay Wildlife Sanctuary and Nature Center, who was a most helpful and hospitable guide on Monomoy Island.

## Literature Cited

Bailey, W. 1965. Plant list of Monomoy National Wildlife Refuge, Chatham, Massachusetts. Contribution Monomoy Light Research Station No. 2.

Fernald, M. L. 1970. Gray's Manual of Botany. 8th ed. D. Van Nostrand Co., New York.

Moul, E. T. 1969. Flora of Monomoy Island, Massachusetts. Rhodora 71: 18–28.

Svenson, H. K. and R. W. Pyle. 1979. The Flora of Cape Cod. The Cape Cod Museum of Natural History.

Bartonia No. 51: 79, 1985

# Range Extension of *Goodyera tesselata* into Northwestern New Jersey

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On 15 July 1981, we discovered three flowering plants of Tesselate Rattlesnake Plantain (*Goodyera tesselata*) in western Warren County, New Jersey. Our identification was later confirmed by Vincent Abraitys and David Snyder. The plants were growing in two separate locations within a small, mature grove of planted Red Pine (*Pinus resinosa*) at an elevation of about 290 m. The site was mesic, shaded by the pines, and moderately sloping.

Several attempts by others to locate the species at this station in subsequent years were unsuccessful. None of the other Red Pine plantations in the area have been checked for the presence of this plant.

This is the first station reported for *G. tesselata* in New Jersey, and the first orchid to be added to the state's list in many years. This species ranges from Newfoundland and Quebec south to Connecticut, New York, and Ohio (Gleason and Cronquist 1963). It has also been recorded from western Pennsylvania based on a single specimen collected in 1944 (Henry et al. 1975). Within the past few decades, it has spread in the southern portion of its range where it is primarily associated with "wet" Red Pine groves (Vincent Abraitys pers. comm.). It remains to be investigated what, if any, relationship exists between *G. tesselata* and *P. resinosa*.

This station is in danger of being destroyed as it is located near the edge of the inundation zone of the proposed Merrill Creek Reservoir, recently approved for construction by the Delaware River Basin Commission.

## Literature Cited

Gleason, H. A., and A. Cronquist. 1963. Manual of Vascular Plants of Northeastern United States and Adjacent Canada. D. Van Nostrand Company, New York. 810 pp.

Henry, L. K., W. E. Buker, and D. L. Pearth. 1975. Western Pennsylvania orchids. Castanea 40: 93–168.

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# Colonial Maryland Plants in D. C. Solander's "Descriptions of Plants from Various Parts of the World"—an Unpublished 1767 Manuscript

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Daniel C. Solander (1733–1782) was the first naturalist to be employed at the newly established British Museum in London. Noted for his botanical work on the first Cook expedition, this pupil of Linnaeus died early in his career thus preventing him from publishing many of the new species of plants he had discovered in the holdings of the Museum. One of his manuscripts, "Descriptions of plants from various parts of the world," contained characterizations of numerous new species from temperate eastern North America. Many of these plants were subsequently published in *Hortus Kewensis* (Aiton 1789) without attribution to Solander, and no effort was made to use as type material the specimens examined by Solander. It is my hope to review all of the new names proposed by Solander for the eastern United States, and to account for the species he examined from this region. At present I shall concentrate upon the plants he examined from colonial Maryland, and will address the nomenclature as it relates only to these plants.

Elsewhere (Reveal et al. 1985), I and my colleagues have accounted for the pre-1753 collections of vascular plants from Maryland currently housed in the Sloane Herbarium at the British Museum (Natural History) in London (BM), and in the Special Collections in the Fielding-Druce Herbarium at the University of Oxford (OXF). Solander did not examine the holdings at Oxford insofar as we have been able to determine, but he did concentrate upon the many collections of Maryland plants housed in Sloane Herbarium gathered by Krieg, Vernon, Jones, and others who visited Maryland in the 1690s (Reveal 1983). The collections were obtained from these naturalists by various English gentlemen then in London, notably Petiver, London, Avery, Doddy, and Plukenet. Sloane had a substantial number of Maryland plants in his own right, and it was the fate of history that he was able to outlive all his contemporaries and secure—for a single vast herbarium of more than 334 volumes of plants—all the holdings of his colleagues. These volumes formed a nucleus around which the British Museum was established, and as one of its first curators, it was the duty of Solander to assist in the identification of the plants (Dandy 1958).

Sloane, over his long career, had employeed a variety of assistants to identify and catalogue the plants in his herbarium. As Sloane died in 1753, he was unaware of the Linnaean revolution which resulted in the concept of binomial nomenclature. Thus it fell to Solander to render into Linnaean binomials the polynomials of past workers. This he did in the form of elegantly written annotations attached to the folio pages of many of the Sloane volumes. In this way, Solander was able to review the vast holdings that Sloane had obtained, and at the same time to evaluate the many new specimens coming to England from such American naturalists as Bartram, Cree, and Garden. Unlike his mentor, Linnaeus, who never examined the Sloane Herbarium—certainly the largest then in the world—Solander was able not only to discover new species contained therein, but to examine the actual specimens used by the pre-1753 botanical authors whose nomenclature Linnaeus adopted but whose collections he never saw. In this way, Solander was able to correct many misapplications of names introduced into the literature by Linnaeus.

The fate of many of Solander's names was influenced by a series of events, not the least of which was his early death. Solander proposed many of his new names when he prepared the first two volumes of William Aiton's *Hortus Kewensis* (1789). As Stafleu and Cowan (1976) pointed out, the "botanical descriptions in vols. 1 and 2 are mainly by Solander (who died in 1782), edited and amended by J. C. Dryander." Over the years, nearly all of his names have come to be attributed to "Aiton," or in some instances to "Dryander in Aiton," largely due to the influence of Britten (1912). Although there is no direct indication on the title page as to Solander's role in the preparation of *Hortus Kewensis* (in fact his name does not appear anywhere in the first or second edition), Solander's participation in the publication of the work has never been questioned.

It may seem appropriate to follow the suggestion of Stafleu and Cowan and attribute some of the new species in the first two volumes to Solander, but what fashion should the citation take? Krok (1925), like Stafleu and Cowan, correctly noted that Dryander edited and amended Solander's text. Britten (1912) went further and stated that while "Dryander utilized largely the MS. descriptions of Solander, . . . Solander had no part in preparing the book for the press." He concluded that the work was Dryander's only and presented adequate arguments to support his conclusion. Contemporary correspondents of Solander, as quoted by Britten, make it clear to me, however, that while Solander had no direct role in the preparation of the actual text for *Hortus Kewensis* as published, he did take an active role in resolving both nomenclatural and taxonomic difficulties. Also Solander wrote and Dryander edited numerous manuscripts and today it is not unusual to see the writings of both men on the same pages of various Solander manuscripts (Diment and Wheeler 1984). Salisbury, according to Britten, actually saw the *Hortus* manuscript and both men's writing appeared on the same pages of that manuscript as well. Britten concluded that "Salisbury was familiar with the MSS., which indeed must be regarded as a joint production of the two botanists, whose handwritings are often combined in the same description—one having written the first draft which the other has added to or corrected."

One might argue, as Britten (1912) finally did, that "Aiton" is the sole author. There are sound reasons to accept this view: Only Aiton's name is on the title page, he assumed responsibility for the publication, and there are no provisions in the *International Code of Botanical Nomenclature* (Voss et al. 1983) to award authorships to "ghost writers" even when known. One can also argue that the authorships in volumes one and two ought to be "Solander in Aiton." This would acknowledge that Solander did have a role in the preparation of the original draft of the text. That role is supported by an examination of the 1767 manuscript under review here wherein a cross has been added to each new species treated in *Hortus Kewensis*. Unfortunately, there is no indication who made the crosses, and no doubt they were made after Solander's death. Finally, one may also argue that the authorship should read "Solander ex Dryander in Aiton." This, at least, expresses what Britten, Krok (1925), and Stafleu and Cowan (1976) have stated was the relationship among the three men. If indeed Dryander edited and amended the information prepared by Solander—which he certainly did following Solander's death in 1782—prior to publication of the book in 1789, this may account why none of the specimens Solander examined (at least in the 1760s) was cited in the descriptions for any of the new species. An examination of the types used for new species published in the Solander section of *Hortus Kewensis* shows that many arrived in London after his death. Therefore, if one is to award authorships to Solander, in any fashion, it can only be as Solander ex Dryander in Aiton.

Even if one accepts the concept of Solander ex Dryander in Aiton there are still problems: How can one ascribe Solander names to Solander, Dryander names to Dryander, and as Britten (1912) pointed out, the names of men such as Banks, the younger Linnaeus and L'Heritier with their own names—all published without credit in the first edition of *Hortus Kewensis?* In my opinion it is unnecessary and of little value to attempt to do so. The historical record is clear, William Aiton did not write *Hortus Kewensis,* others did. Other works—both books and speeches—of far greater historical importance have been the result of the talents of hidden men and women whose names are known yet do not appear. The scientific names in Aiton's *Hortus Kewensis* must be ascribed to Aiton. He took credit for the work in 1789; we today must acknowledge that fact however distasteful it may be to accept.

My purpose here is to account for the plants Solander considered to have been collected in Maryland or gathered by naturalists known to have visited Maryland. Diment and Wheeler (1984) stated the present manuscript to be "a transcript of some of Solander's descriptions of plants contained in his Manuscript Slip Catalogue." The latter, in Solander's time, was the equivalent of a modern "3 by 5" card file arranged in 57 boxes. The slips were eventually arranged into 24 volumes following Willdenow's edition of *Species Plantarum* (1797–1810). Marshall (1978) indicated that a number of amanuenses wrote entries for the Slip Catalogue, but only Herman D. Sporing wrote the manuscript under review here. Marshall believed Solander assigned the task of organizing this manuscript to Sporing in 1766. This seems reasonable as portions of the manuscript contained references to Linnaeus' second edition of *Species Plantarum* (1762–1763). However, I suggest the date of completion was 1767 based on the large number of new species mentioned which were gathered by John Bartram in Georgia and Florida in 1765 and 1766. Apparently Bartram did not send his specimens to Peter Collinson until mid 1766 (Cruickshank 1957), and it is likely Solander did not see them until early 1767 (Dandy 1958).

## Catalogue of Maryland Plants in Solander's 1767 Manuscript

In the following listing, entries are arranged according to the names proposed by Solander. The manuscript page number follows his name. Next is the modern name, or identification, of the plant in question insofar as it relates to Maryland material. If the plant was described as new in *Hortus Kewensis,* that name is then given in parentheses if not now nomenclaturally correct. Information taken from Solander's manuscript is in quotes. The number references (e.g., H.S. 74:43.2) alludes to a specific specimen or suite of specimens found in one of the bound volumes in the Sloane Herbarium (BM) termed "hortus siccus." The above refers to the 74th volume, folio page 43, and the 2nd number specimen. No attempt had been made, at this time, to consult the other volumes in the Sloane Herbarium where Solander examined collections of the same species.

*Acalypha virginica* L., p. 202. "Habitat in Marylandia." Solander annotated one Maryland specimen (H.S. 74:43.2) with the Linnaean name.

*Andromeda mariana* L., p. 91. = *Lyonia mariana* (L.) D. Don. "Habitat in Marylandia." Solander annotated two specimens (H.S. 74:11.1; 246:30.2) from Maryland with Linnaeus' name. Two varieties are proposed by Aiton (1789), but neither is mentioned in the manuscript.

*Andromeda pilosiuscula* Solander, ined., p. 92. = *Lyonia ligustrina* (L.) DC. "Habitat in Marylandia." Solander annotated one specimen (H.S. 74:11.3) with his name and the manuscript page where he characterized the species. No other Maryland collections of this species were annotated with this name so it is possible he was basing his characterization only on the one specimen.

*Arethusa verticillata* Solander, ined., p. 195. = *Isotria verticillata* (Muhl. ex Willd.) Raf. "Habitat in America Septentrionali et Marylandia." Solander annotated one Maryland specimen (H.S. 74:65.1) with his name and manuscript page number. He initially cited Linnaeus as its author, but deleted his name. Solander also cited a Plukenet (1700) name, Ray's (1704) reference to it, and a Plukenet illustration (t. 349, f. 3) published in 1705. This polynomial, *Helleborines affinis, Planta Mariana, Herbae Paridis facie, quinquefoliata*, is vouchered at H.S. 93:198. Ray based his description of the species on a specimen at H.S. 37:98.2. These were not annotated by Solander. There is no indication Muhlenberg or Willdenow (1805) had access to Solander's 1767 manuscript and therefore likely came to the same species epithet independently.

*Arum triphyllum* L., p. 196. = *Arisaema triphyllum* (L.) Schott. "Habitat in Virginia." Solander did not mention the Maryland specimens (H.S. 37:48.5; 74:63.2) he annotated with the Linnaean name. He added two synonyms, one from Gronovius (1762) and a second from Bobart writing in Morison (1699). Both could have been taken from Gronovius or even Linnaeus (1753). Solander noted two variants in garden material before him. He restricted his circumscription to North American material, and excluded the South American specimen included by Linnaeus.

*Asclepias floridana* Solander, ined. p. 57. = *Asclepias rubra* L. "Habitat in . . . Marylandia. Krieg. Vernon." Solander considered his new species to be wide ranging as he included specimens from Florida, the Carolinas, and Bahama as well as Maryland. All of the Maryland specimens annotated by him with this name are *A. rubra* (e.g., H.S. 37:44.5 and 37:110.2*).

*Asclepias sessilis* Solander, ined., p. 58. = *A. tuberosa* L. "Habitat in Marilandia. Krieg." Solander annotated a single Maryland specimen (H.S. 37:50.6) with this name. The specimen is typical of *A. tuberosa*, but Solander considered the species to be unique due to "umbellis sessilibus unde caulis flexuodus." There is no direct evidence the specimen was gathered by Krieg.

*Asclepias tuberosa* L., p. 59. "Habitat in . . . Maryland. Vernon. Jones. Krieg." Ray (1704) specifically mentioned this species was gathered in Maryland by Krieg and Vernon when he proposed *Apocynum Marilandicum foliis Salignis* (H.S. 37:100.2), but only a single specimen is apparently extant. Solander annotated other Krieg or Vernon specimens in H.S. 37 of this species (H.S. 37:18.2; 37:50.6), but Ray did not examine these specimens. A Vernon specimen is in the DuBois Herbarium (OXF) and there is a Vernon sheet in a volume of plants devoted to his specimens (H.S. 246:32.2; annotated by Solander). We have found no direct evidence Jones gathered the species. Solander comments that he found a variant in "H.S. 37.18" but does not give it a name on the sheet or in print. The collection is typical *A. tuberosa*.

*Asclepias variegata* L., p. 56. "Habitat in America Septentrionali (Petiver.) Jones. J. Bartram." We cannot account for the association of Hugh Jones with the specimen at H.S. 74:71.1 which is annotated with this name by Solander. Ray, who also annotated the species (H.S. 37:111.4), stated Vernon gathered the specimen he examined. Solander also saw the voucher for Plukenet's (1700) *Apocynum umbellatum album, latiore folio, tetraphyllon* (H.S. 94:147). I am of the opinion this is a Krieg collection (a duplicate is at OXF in the DuBois Herbarium) and not a Jones collection which Solander may have assumed.

*Asclepias verticillata* L., p. 58. "Habitat in . . . Maryland. Jones. Vernon. Marshall. Krieg." Solander annotated numerous specimens of this species. According to Ray (1704), Vernon collected the species (see *Apocynum erectum ramosum foliis tenuissimis Marilandicum* cited by Solander; a Vernon specimen is also at H.S. 246:24.2 and at OXF in the Dubois Herbarium). It is possible that the specimen Doody gave Plukenet (1700), when he proposed *Apocynum Marianum erectum Linariae angustissimis foliis umbellatum*, was a Jones collection (H.S. 92:16 or 94:148). As for Marshall (H.S. 158:290), Petiver so badly curated his collections that it is not always certain if he obtained a specific specimen in Maryland or Virginia. I seriously doubt the state of Petiver's volumes was any more orderly in Solander's day than it is now.

*Blechnum interruptum* Solander, ined., p. 217. = *Woodwardia areolata* (L.) T. Moore. "Habitat in Marylandia." Solander annotated one Maryland specimen (H.S. 74:28.1) with his name and the manuscript page number. He also questionably cited a Plukenet (1700) polynomial, *Filix Osmundae facie Mariana, segmentis minutim denticulatis*, which was illustrated (t. 400, f. 2) in 1705. Plukenet's voucher for his figure and description (H.S. 94:199) is a mixed collection of *Onoclea sensibilis* L. and *Osmunda cinnamomea* L. No doubt this confusion is what caused Solander to question his application of the Plukenet name.

*Carex folliculata* L., p. 197. "Habitat in Marylandia." Solander cited a Ray phrase name, *Gramen cyperoides Marilandicum, utriculis tumidis triangulis, 4 vel 5, in capitulum congestis in summo caule & superiorum foliorum alis.* Its voucher is at H.S. 37:76.3, but that specimen was not annotated by Solander. Solander annotated H.S. 74:23.1 with the Linnaean name.

*Carex longifolius* Solander, ined., p. 198. = *C. comosa* Boott. "Habitat in Marylandia." Solander annotated one Maryland specimen (H.S. 74:20.3) with his name and the manuscript page number. He included a Gronvius (1762) name who associated this new species with the Old World *C. pseudocyperus* L. Elliott (1824) was the first to formally describe this species, naming it *C. furcata*, a homonym. The plant was renamed by Boott in 1848.

*Chironia campanulata* L., p. 36. = *Sabatia stellaris* Pursh as to the Maryland references. "Habitat in . . . Marylandia. Krieg. Jones." Solander included Petiver's (1699) *Rapunculus Centaruroides, pentapetalus, Marianus* which is vouchered by a specimen at H.S. 158:218. This is likely the Jones collection Solander mentioned. Collections at H.S. 37:37.1 and 74:73.1 are annotated by Solander with *C. campanulata.* We (Reveal et al. 1985) have found no evidence to support Solander's statement that either of these collections was made by Krieg.

*Clematis ampliata* Solander, ined., p. 113 = *C. ochroleuca* Aiton. "Habitat in Marylandia." Solander cited Plukenet (1700, 1705) and Ray (1704) who used a Banister polynomial originally published by Ray in 1688. Ray based his concept on a Vernon specimen (H.S. 37:130.4) which is duplicated at 74:14.5 and 246:25.1. All are in fruit. Plukenet's voucher is at 93:103. This latter specimen was likely gathered by Vernon as well. Solander annotated all of the Maryland material with his manuscript name. His original description was clearly based on the fruiting material. Plukenet also had flowering specimens at hand which he called *Clematis erecta humilis non ramosa, foliis subrotundis, flore unico ochroleuco.* He took this name from Banister's catalogue of Virginia species published by Ray (1688). The latter name was cited in Aiton (1789) when the species was formally proposed. The Solander manuscript was marked with a cross signifying the entity was described in *Hortus Kewensis.* In the *Hortus* the origin of the species was credited to James Gordon who cultivated the plant in 1767. I have not discovered if Solander or Dryander altered the epithet. Krok (1925) attributed the published name to Solander.

*Coreopsis aspera* Solander, ined., p. 177. = *Helianthus angustifolius* L. "Habitat in Marylandia." Solander cited a Ray (1704) name in synonymy. That polynomial, *Chrysanthemum Marilandicum, foliis bijugis angustiformis, monanthes,* is vouchered by H.S. 37:99.1 which was annotated by Solander with his manuscript name. Other Maryland specimens annotated with his name are H.S. 74:48.3 and 246:9.1. The manuscript page number is found on the latter two annotation labels. Solander erred in his association of this species with *Coreopsis* rather than *Helianthus.*

*Coreopsis flammula* Solander, ined., p. 175. = *Bidens laevis* (L.) Britton. "Habitat in Marilandia." Solander annotated two Maryland specimens with this name where he attributed the binomial to Linnaeus (H.S. 37:100.5) in error, but corrected the oversight later (H.S. 74:48.1). In the latter instance, he cited the manuscript page number. He also cited a Ray (1704) polynomial, *Chrysanthemum Marilandicum monanthes, radio octapetalo,* which is based on H.S. 37:100.5. A Vernon collection of this species is in the DuBois Herbarium (OXF).

*Cypripedium album* Solander, ined., p. 194. = *C. reginae* Walter. (*C. album* Aiton) "Habitat in America Septentrionali." Solander recognized, in 1767, the distinctiveness of this most elegant of the showy lady's slippers. When the species was proposed by Aiton in 1789, no reference was made to the specimens Solander actually examined. Solander cited Plukenet's (1700) polynomial *Hellborine Calceolus dicta, Mariana, flore gemello candido, venis purpureis striato.* The polynomial was also cited by Aiton. Its illustration (t. 418, f. 3) is confusing. The voucher of the name, H.S. 93:198, is not all that similar to the figure. A specimen of *C. calceolus* L. var. *parviflorum* (Salisbury) Fernald (H.S. 92:84) is actually more similar to the published plate. The 1767 manuscript is not marked with a cross denoting the entity was published. Aiton stated the species was introduced into England by William Young in about 1770. Walter (1788) published his name a few months prior to the appearance of *Hortus Kewensis.*

*Cypripedium calapogium* Solander, ined., p. 193. = *C. calceolus* L. var. *parviflorum* (Salisbury) Fernald and *C. calceolus* L. var. *pubescens* (Willd.) Correll. "Habitat in America Septentrionali." Solander annotated several Maryland specimens with his manuscript name. Among the collections of Vernon and Krieg, Solander named two specimens of var. *pubescens* (H.S. 74:66.1 and 246:29.1). Solander cited a Petiver name published in Ray (1704). That polynomial, *Calceolus marianus glabra, petalis angustis,* is vouchered at H.S. 159:22; it is a specimen of var. *parviflorum.* A second Maryland-based synonym was also cited. This, *Helleborine Calceolus dicta, Mariana, caule foliosa, flore luteo minore,* was proposed by Plukenet (1700); it was illustrated (t. 418, f. 2) in 1705. The voucher, H.S. 92:84, is a specimen of *C. calceolus* var. *pubescens;*

it was not annotated by Solander. A sheet in the Sherardian Herbarium at OXF annotated with the Plukenet phrase name is a collection of *C. calceolus* var. *parviflorum*. The Petiver name was cited by Catesby in 1738. I have not determined the voucher for Catesby's name. It is clear that Solander was attempting to distinguish the North American specimens of *C. calceolus* as a distinct species from its European counterpart, but failed to appreciate the varietal differences now commonly recognized. First Salisbury in 1791 and then Willdenow in 1805 formally recognized the differences in the North American plants, but at the species rank.

*Cypripedium spectabile* Solander, ined., p. 194. = *C. acaule* Aiton. "Habitat in America Septentrionali. . . ." Solander annotated H.S. 74:67.3 with his name and the manuscript page number. He also cited, in his text, a Plukenet (1700) name: *Helleborine Calceolus dicta, Mariana, foliis binis è radice, ex advero prodeuntibus, flore purpureo*. That name, vouchered at H.S. 93:197, was also figured (t. 418, f. 1) in 1705. This polynomial was subsequently cited in Aiton (1789). The species was proposed formally by Aiton who made no reference to any of the specimens examined by Solander attributing the plant to William Hamilton who introduced it in 1786. The 1767 Solander manuscript is not marked with a cross, but there is no question in my mind that Dryander raided Solander's manuscript for the characterization.

*Cyperus ornatus* Solander, ined., p. 8. = *C. strigosus* L. "Habitat in Marylandia. Jones." Solander considered the species to be related to, and perhaps a variety of, *C. odoratus* L. He annotated one Maryland specimen (H.S. 74:22.2) with his name and manuscript page number. I have seen no evidence to support Solander's contention that Jones found this specimen.

*Erigeron serpentaria* Solander, ined., p. 164. = *Hieracium* × *marianum* Willd., as to a Maryland specimen. "Habitat in America Septentrionali. . . ." Solander annotated only one Maryland specimen (H.S. 74:53.3) with his name. That specimen, even in late anthesis, is clearly not an *Erigeron*. I have not determined if Solander consistently applied his name to *Hieracium* or mistakenly associated his name when he annotated H.S. 74. Solander stated his species was similar to *Erigeron caule simplicissimo, saepius bifloro*, a name proposed by Gronovius (1762) and based on *Clayton 375*. That name is not cited in Linnaeus (1753; see Reveal 1983). I have not attempted to locate the specimen at BM. Willdenow (1804) was the first to append a name to this plant.

*Eriophorum sessile* Solander, ined., p. 8. = *E. virginicum* L. "Habitat in Marylandia. Kreig." Solander considered the species to be related to, and perhaps a variety of, the European entity Linnaeus called *E. polystachion*, a confused name referrable to *E. angustifolium* Honckeny or *E. latifolium* Hoppe. In fact, the specimen (H.S. 74:20.1) is what Linnaeus called *E. virginicum*. It is difficult to understand why Solander failed to correctly identify the plant. There is no indication that it was Krieg who found this plant in Maryland and I have been unable to discover upon what basis Solander ascribed the collection to him.

*Fagus ferruginea* Solander, ined., p. 201 = *F. grandifolia* Ehrh. (*F. ferruginea* Aiton) "Habitat in Marylandia." Solander cited two Maryland-based polynomials in synonymy in his 1767 manuscript. The first was a Plukenet (1700) name, *Fagus Mariana Carpini rugosis foliis* which was based on a specimen given to him by Ayrey. No specimen of this species among the Plukenet volumes can be associated with this name, or with any of the Maryland collectors. In Ayrey's own volume of dried plants there is a specimen (H.S. 74:5.2) of the species, but there is no indication Plukenet examined it. The second name was proposed by Ray (1704) as *Fagus Marilandica folio acuto, circa margines undulato & serrato seu spinulis exasperato*. Solander did not annotate the Ray voucher (H.S. 37:127.4) which was gathered by Vernon, but he did label the specimen in Ayrey's volume. There is no indication who gathered the latter specimen. When Aiton (1789) formally proposed *F. ferruginea* he stated the species was introduced by John Kennedy and James Lee in 1766. The Solander manuscript is marked with a cross indicating the name was published in *Hortus Kewensis*. Ehrhart (1784) initially proposed *F. grandifolia* in a journal only to republish the name later (Ehrhart 1791; see Stafleu and Cowan 1976) in a book.

*Fagus pumila* L., p. 201. = *Castanea pumila* (L.) Miller. Although Solander annotated a Maryland collection (H.S. 74:9.5) with the Linnaean name, he ascribed the species to "Florida Occidentali" in his manuscript. Aiton (1789) stated the species was cultivated in England in 1699 at the garden of the Duchess of Beaufort. The source of this introduction was probably Hugh Jones of Calvert County, Maryland (Reveal 1984).

*Gentiana angustata* Solander, ined., p. 60. = *G. linearis* Froel. "Habitat in Marylandia. Krieg. Marshall. (Petiver)." Solander annotated one Maryland collection (H.S. 74:77.3) with the number 60, no doubt referring to the manuscript page. In his manuscript, he cited Ray (1704) and the polynomial *Gentiana major Virginiana, flore caeruleo longiore* which was originally proposed by Petiver (1698). The specimen used by Petiver to establish the name is a collection of *G. catesbaei* Walter (H.S. 158:213) which Solander annotated *G. saponaria* L. As we shall point out elsewhere (Reveal et al. 1985), however, this collection is not likely the original Jones collection from in Maryland. Solander erred in his inclusion of this phrase name, for at 158:213, Solander annotated another specimen of true *G. linearis* with *G. angustata*. That specimen was used by Petiver when he proposed *Gentiana major Virginiana, floribus amplis ochroleucis*. Today, the specimen is annotated with three different potential sources of its origin: (1) Jones from Maryland (the printed text of Petiver's 1698 Maryland paper is attached to the base of the specimen); (2) Marshall from Virginia (Petiver also wrote a Bobart polynomial published in Morison (1699), *Gentiana virginiana, saponariae folio, flore caeruleo longiore*, in addition); or (3) Richard Bradley, a Cambridge professor who sent garden specimens to Petiver. The name "Salvadore" is also added to the last two annotations. The Salvadores of Barcelona, Jaime and his son Juan, sent garden material to Petiver as well. There is no evidence that the specimen in H.S. 74 was gathered by Krieg, but it is clear Solander erred in associating Marshall's name with Maryland and not Virginia. The inclusion of Petiver in parenthesis may have been done to imply the species had been published by Petiver. It was not until 1796 that Froelich formally described the plant.

*Gerardia filiformis* Solander, ined., p. 120. = *Agalinis setacea* (Walter) Raf. No habitat data were given except as noted below. Solander cited a Plukenet (1696) name illustrated in 1691 and likely based on a John Banister collection from Virginia. He made no direct reference to Maryland, but did differentiate the Plukenet figure from other specimens of "American Septentrionali" he had before him. Solander annotated one Maryland specimen (H.S. 74:45.1) with his name, but ascribed the name to manuscript page 121 rather than 120.

*Gerardia purpurea* L., p. 121. = *Agalinis purpurea* (L.) Pennell. "Habitat in Carolina." Solander annotated two Maryland specimens (H.S. 74:44.3; 74:45.3) with the Linnaean name, but in his manuscript he made no reference to Maryland although he added the page number to his first annotation. Aiton (1789) stated this species was not introduced into England until 1772.

*Hedyotis purpurea* (L.) L., p. 14. = *Houstonia purpurea* L. Solander cited a Plukenet (1705) figure, and indirectly the polynomial *Rubia Mariana Alsines majoris folio*, based on a Maryland collection vouchered at H.S. 92:114. He made no direct reference to Maryland.

*Hedysarum alopecuroides* Solander, ined., p. 149. = *Lespedeza hirta* (L.) Hornem. Solander annotated three Maryland specimens of this species with his manuscript name (H.S. 37:103.4; 74:39.3; 246:27.2). The latter two annotations also mentioned the manuscript page. Interestingly, several other specimens of the species were not labelled. Solander made no attempt to differentiate this new species from other species of *Hedysarum* as he defined the genus.

*Hedysarum ellipticum* Solander, ined., p. 148. = *Desmodium rotundifolium* DC. "Habitat in Marylandia." Solander recognized the difficulty of interpreting Linnaeus' concept of this species and noted the differences 74:41.1) and clearly recognized the plant as representative of a new species. His characterization is brief. The species was not recognized until the 1825 revision of *Desmodium* by deCandolle.

*Hedysarum marilandicum* L., p. 148. = *Desmodium* cf. *canescens* (L.) DC. "Habitat in Marylandia." Solander recognized the difficulty of interpreting Linnaeus' concept of this species and noted the differences in the descriptions published by Ray (1704) and Dillenius (1732). The only specimen of *D. marilandicum*, as defined by present authors, among the Maryland specimens annotated by Solander, was termed *Hedysarum barbatum* (H.S. 37:104.2). As for H.S. 74:37.1, which Solander annotated as *H. marilandicum*, the specimen is difficult to assign to a given species. We (Reveal et al. 1985) have tentatively assigned it to near *D. canescens*. Schindler considered the specimen to be near *Meibomia viridiflora* (L.) Kuntze, a synonym of *D. viridiflorum* (L.) DC.

*Hedysarum* sp., p. 148. "Habitat in Marylandia." Solander did not provide a name for this species in his manuscript, but at H.S. 37:106.5, 74:39.2 and 246:26.2 are specimens annotated "pilosiusculum" which is a word used in Solander's description of the plant. The specimens in question are *Lespedeza* × *nuttallii* Darl. (H.S. 37), *L. procumbens* Michx. (H.S. 74), and *L. stuevei* Nutt. (H.S. 246). On the second annotation label, Solander has added the page number and a series of species numbers which corresponded to his manuscript. Although he mixed what is today considered to be several species of *Lespedeza*, all are closely related and separated only with some difficulty. None was proposed until the next century when Michaux (1803) established *L. procumbens*.

*Hedysarum spicatum* Solander, ined. p. 149. = *Psoralea psoralioides* (Walter) Cory. "Habitat in Marylandia." Solander annotated two Maryland specimens with this name (H.S. 37:103.5; 74:39.1). This plant has not been collected in Maryland since its original discovery in the 1690s (Brown and Brown 1984).

*Impatiens americana* Solander, ined., p. 190. = *I. capensis* Meerb. "Habitat in Canada et Pensylvania." Solander annotated one Maryland specimen (H.S. 74:74.2) with his manuscript name, adding to the label the manuscript page number. He made no reference to Maryland in his detailed description of what, in 1767, was still a new species.

*Inula mariana* L., p. 169. = *Chrysopsis mariana* (L.) Elliott. "Habitat in . . . Marilandia." Solander annotated H.S. 74:50.3 with the Linnaean name. He wrote a detailed description of the species which was taken from a number of collections. According to Aiton (1789), this species was introduced into England by Thomas Dale in 1742.

*Itea virginica* L., p. 49. "Habitat in Carolina. Catesby. Marilandia. Vernon." There is a specimen of *I. virginica* among the Krieg and Vernon specimens obtained by Sloane (H.S. 37:125.2), but this was not annotated by Solander. Solander cited a Plukenet (1700) name, *Cerasi similis Arbuscula Mariana*, and Ray (1704) who gave the polynomial as *Ceraso similis arbuscula Mariana*. In the latter, Ray stated "E Marilandia attulit D. Vernon." No doubt this is where Solander obtained his information associating Vernon with the species. Gronovius (1743) and Linnaeus (1753) followed Catesby (1730) in placing *Cerasi similis arbuscula Mariana* in synonymy under *Prunus virginiana*. As we shall point out (Reveal et al. 1985), this was due to an error in identification made by Sherard at Oxford. Sherard mistakenly associated the name with a specimen of *P. virginiana*, when he and Dillenius aided Catesby in his nomenclature. Clearly, Solander had examined the actual specimens seen by Plukenet (H.S. 92:27) and possibly Ray (H.S. 37:125.2) and corrected the error.

*Lepidium virginicum* L., p. 126. "Habitat in Marylandia." Solander annotated H.S. 74:53.5 with this name.

*Limodorum strictum* Solander, ined., p. 193. = *Calopogon tuberosus* (L.) Britton, Sterns, & Poggenb. "Habitat in Marylandia." Solander annotated a single Maryland specimen (H.S. 74:86.2) with his name and manuscript page number. He circumscripted the species as typified by the Linnaean herbarium specimen.

*Lithospermum virginianum* L., p. 20bis. = *Onosmodium virginianum* (L.) A. DC. "Habitat in Marilandia." Solander annotated a specimen at H.S. 78:75.1 with the Linnaean name.

*Lobelia cardinalis* L., p. 188. "Habitat in America Septentrionali, Virginia et Marylandia." The elegant cardinal flower was abundantly collected by early Maryland naturalists. It was well known in Europe, and in cultivation by 1629 (Aiton 1789). Solander annotated several of the early Maryland specimens (H.S. 74:78.1; 74:79.2; 246:13.2).

*Lobelia obtusata* Solander, ined., p. 188. = *L. spicata* Lam. var. *leptostachys* (A. DC.) Mackenzie & Bush. "Habitat in Marylandia." Solander annotated only a single Maryland specimen (H.S. 74:84.1) with this name; he also added the manuscript page number. The species was eventually described by Lamarck in 1789, and this particular variant in 1839.

*Melanthium graminifolium* Solander, ined., p. 71. = *Tofieldia racemosa* (Walter) Britton. "Habitat in America septentrionali in locis humidis proper Wateree." Solander annotated two Maryland specimens with this name (H.S. 37:68.1; 74:84.2). To the latter annotation Solander added the manuscript page number. His characterization was largely taken from newly obtained Bartram specimens. Walter (1788) proposed *M. racemosa*, the basionym.

*Mespilus arbutifolia* L., p. 108. = *Aronia arbutifolia* (L.) Elliott. "Habitat in Marylandia." Solander annotated H.S. 74:6.3 with Linnaeus' name. He characterized two varieties, one with glabrous and a second with villose calyx segments. Solander did not annotate the Maryland specimen as to which variant he considered it to belong. In Aiton (1789), three varieties were distinguished. They were separated on the basis of fruit color.

*Osmunda alternata* Solander, ined. p. 216. = Not determined. "Habitat in Marylandia." I have not discovered any Maryland specimen annotated with this name. The Solander manuscript is marked with a cross indicating the species was proposed in *Hortus Kewensis*, yet no species of ferns were proposed by Solander. The brief description is too sparse to determine which species he might have had at hand.

*Osmunda crassifolia* Solander, ined., p. 216. = *Botrychium dissectum* Sprengel. "Habitat in America Septentrionali et Marylandia." Solander annotated a single Maryland specimen (H.S. 74:25.3) with his name and added the manuscript page number to his label. He also cited a Plukenet (1700) polynomial, *Lunaria multifido folio crasso, racemo florum ex pediculo propè radicem prodeunte* which was illustrated (t. 427, f. 7) in 1705. Solander provided a detailed description of the new species. Linnaeus had some difficulty in distinguishing the several species of *Botrychium* found in eastern North America, and Solander was able to recognize the subtle differences between several of them. Sprengel did not propose the plant as new until 1804.

*Osmunda virginana* L., p. 215. = *Botrychium virginianum* (L.) Swartz. Solander does not give a habitat statement or cite a Maryland-based synonym. He annotated two Maryland specimens (H.S. 74:25.2; 246:10.1) with the Linnaean name.

*Panicum capillare* L., p. 9. "Habitat in Marylandia. Krieg." Solander annotated one Maryland specimen (H.S. 74:17.2) with the Linnaean name. There is no indication who collected the specimen and I cannot account for Solander's association of Krieg with the Maryland collection.

*Panicum tenuissimum* Solander, ined., p. 9 = *Dichanthelium* cf. *dichotomum* (L.) Gould var. *ensifolium* (Baldwin) Gould & Clark. "Habitat in Marylandia. Krieg." Solander annotated a single Maryland specimen (H.S. 74:19.2) with this name. I am uncertain as to the exact identification of the specimen. He cited in synonymy Plukenet's (1696) *Gramen Miliaceum Americanum minus, paniculâ parvâ* which was illustrated (t. 92. f. 6) in 1691. There is no indication that Krieg gathered the specimen annotated by Solander, and as Krieg was in Maryland in 1698, he certainly could not have gathered the voucher for Plukenet's name.

*Pedicularis dissimilis* Solander, ined., p. 119. = *P. canadensis* L. "Habitat in Marylandia." Solander annotated H.S. 74:46.4 with this name, and he cited two polynomials based on Maryland specimens. The first, a Plukenet (1700) name, *Pedicularis Mariana Agerati angustis serratis foliis,* was illustrated (t. 437, f. 3.) in 1705, but neither of the specimens at H.S. 92:103 or 94:35 exactly matches the figure. Solander questioned the figure, perhaps due to his inability to associate the figure with a specimen. The Ray (1704) name, *Alectorolophos aquaticus,* was based on both Krieg and Vernon specimens. Their specimens are at H.S. 37:68.1* and 37:90.1. A Krieg specimen is at OXF in the DuBois Herbarium. Solander did not annotate either specimen of *P. canadensis* in H.S. 37.

*Pedicularis pallida* Solander, ined., p. 120. = *P. lanceolata* Michx. "Habitat in Marylandia." Solander annotated H.S. 74:46.1 with this name and added the manuscript page to his label. The plant went unrecognized as distinct until Michaux (1803) proposed the species.

*Plantago pumila* Solander, ined., p. 17. = *P.* cf. *rugelii* Decne. "Habitat in Marylandia. Krieg." This remarkable collection made by Krieg and illustrated by Petiver (1702) was examined by Solander (H.S. 37:46.7 and 92:107), but never annotated. Solander stated the plant was certainly not *P. virginica* where Linnaeus (1762) had referred the illustration. The plant is unlike any temperate American species of *Plantago* and is likely still undescribed. Duplicates of the Krieg collection are at OXF in the DuBois Herbarium. The specimen originally illustrated by Petiver has not been relocated.

*Psoralea asphaltites* Solander, ined., 149. = *P. psoralioides* (Walter) Cory, as to Maryland reference. "Habitat in America in New Jersey." Solander cited Plukenet's (1700) *Onobrychis (sorte) Asphaltites* in synonymy; it is his only reference to Maryland. That name was based on a specimen of *P. psoralioides* (H.S. 92:100). I am uncertain what New Jersey plant Solander had at hand when he proposed his species. The species is known today only from southeastern Virginia southward, with no modern records of *P. psoralioides* known from Maryland.

*Rhexia mariana* L., p. 75. "Habitat in . . . Marilandia." Solander did not cite any Maryland specimens but expanded the characterization of the species over that given by Linnaeus (1753). Apparently he took his observations mainly from Bartram material. He did not annotate either collection of the species in H.S. 37.

*Sarracenia purpurea* L., p. 110. "Habitat in Marylandia." The northern pitcher plant was gathered in Maryland by Vernon (H.S. 246:31.1) and annotated by Solander with Linnaeus' name. A second Maryland specimen, H.S. 74:63.1, was also annotated.

*Scrophularia acuta* Solander, ined., p. 121. = *S. marilandica* L. "Habitat in Marylandia." Solander may have recognized the subtle differences between *S. marilandica* and *S. lanceolata* Pursh. His brief description of *S. acuta* fits H.S. 74:82.3, a flowering specimen, which he annotated with his name and page number of the manuscript. As Solander annotated the two fruiting specimens gathered by Vernon (H.S. 246:1.1 and 246:2.1) as *S. marilandica,* it is possible Solander was aware that the flowering specimen in the Linnaean Herbarium was *S. lanceolata.*

*Senecio obtusatus* Solander, p. 165. = *S. obovatus* Muhl. ex Willd. "Habitat in . . . Pensylvania." In his 1767 manuscript Solander failed to mention the Maryland specimen (H.S. 74:60.2) he annotated. For the most part, his brief description was based on Bartram material although he cited Ray's (1704) *Jacobea Virginiana, folius ad radicem integris* in synonymy. The Ray name was taken from Plukenet (1700) without comment. I have made no attempt to determine the identification of Plukenet's voucher, if extant. A reference to Ray was added, as a query, on the specimen in H.S. 74 by Johann Amman, an employee of Hans Sloane. It is possible Solander took the reference from this source. Willdenow (1804) took his name from a Muhlenburg manuscript that, like Solander's manuscript, established his circumscription of the species on Pennsylvania specimens.

*Serratula spicata* L., p. 153. = *Liatris spicata* (L.) Willd. "Habitat in Carolina et Marylandia." Solander annotated three Maryland specimens with Linnaeus' binomial (H.S. 37:8.1; 74:79.3; 246:9.2) but did not differentiate these by a varietal designation. In his manuscript he noted "Varietas Marylandia lecta floribus pedicellatis." No variety was proposed in Aiton (1789).

*Solidago scabra* Solander, ined., p. 168. = *S. rigida* L. Solander annotated one Maryland specimen (H.S. 74:51.2) with this name, but in his manuscript he considered the plant to be known only from "Carolina et Georgia." I have not determined the identity of the various Bartram collections Solander had at hand when he proposed the species. There is no question he took the majority of his characterization from Bartram notes and specimens. Solander stated his new species had affinities with *S. rigida*.

*Sophora tinctoria* L., p. 87. = *Baptisia tinctoria* (L.) R.Br. "Habitat in . . . Marilandia." Solander annotated two Maryland specimens (H.S. 37:19.1; 37:106.4) with the Linnaean name.

*Spigelia marilandica* (L.) L., p. 26. Solander wrote a detailed description of the species and cited an edition of Miller's *Dictionary* and Linnaeus' 1753 edition of *Species Plantarum*. It is obvious he had garden material at hand but there is no indication as to the source of his specimens. He does not mention Maryland directly. I strongly suspect the origin was Bartram who was sending seeds and specimens of this species to London even before 1767. Apparently Bobart had the species in cultivation in 1694 (Aiton 1789). His seeds probably came from Virginia.

*Stachys stricta* Solander, ined., p. 116. = *S. hyssopifolia* Michx. "Habitat in Marylandia." Solander annotated H.S. 74:47.3 with this name and manuscript page number. His description appears to have been taken from this collection. The manuscript was marked with a cross indicating the entity was described in Aiton's *Hortus Kewensis* where the name *Betonica stricta* Aiton was proposed. No reference was made to the original Maryland specimen examined by Solander for Dryander altered the text placing *B. danica* Miller in synonymy and thereby proposed a superfluous name. I cannot account for Dryander's actions. It is possible that he was not attempting to use Solander's name and Krok (1925) is incorrect in considering *B. stricta* to be a Solander name.

*Thapsia trifoliata* L., p. 63. = *Thaspium trifoliatum* (L.) A. Gray. "Habitat in Marilandia." Solander annotated one of the two Maryland collections of *T. trifoliatum* with the Linnaean name. One is at H.S. 74:89.2. A second collection, at H.S. 37:92.1, was described by Ray (1704) who took the name, *Hipposelinum Marianum foliis integris & trifidis*, from Petiver (1698). The Petiver name was actually established on a collection of *Zizia aptera* (A. Gray) Fernald. Ray stated that both Krieg and Vernon gathered the species, but only a single specimen is at 37:92.1.

*Vaccinium elevatum* Solander, ined., p. 76. = *V. stamineum* L. "Habitat in Americae Septentrionalis arenosis, Carolina et Marylandia." Solander annotated H.S. 74:11.2 and 246.35.1 with this name and manuscript page number. He considered the new species to be related to Linnaeus' *V. stamineum*, but that it differed "multo major, et folia subtus canescentia." The majority of his description was likely taken from Bartram specimens.

*Veratrum luteum* L., p. 210. = *Chamaelirium luteum* (L.) A. Gray. "Habitat in New Jersey, in Pensylvania et Carolina australi." Solander based his manuscript description mainly on Bartram material. He made no mention of the Maryland specimen at H.S. 74:60.1 which he annotated with the Linnaean name.

Solander proposed new genera to honor two of Maryland's early collectors, Dr. David Krieg, a ship's surgeon, and William Vernon of Cambridge University. Both men would ultimately have genera named for them, but neither would prove to be those suggested by Solander. They are as follows:

*Kriegia laevigata* Solander, ined., p. 49. = *Cyrilla racemiflora* L. Solander stated "Habitat in Carolina australi" and based this new genus and species on South Carolina collections gathered by Garden, Cree and Catesby. The description is detailed, and while I have not examined specimens annotated by Solander, there is no question as to the identity of the plant. Solander placed his new genus near *Itea*, and in Aiton (1789), *C. racemiflora* is referred to *Itea* following the opinion of L'Heritier. The gross similarities are there, but Solander, Dryander and even Linnaeus failed to appreciate the fine differences between what is now the Dilleniidae and the Rosidae. In 1767 Linnaeus formally described *Cyrilla* taking his name and characterization most likely from the Garden collection. The name *Krigia* was proposed by Schreber (1791) for a member of the Asteraceae. It is generally agreed that this was to honor Krieg.

*Vernonia villosa* Solander, ined., p. 51. = *Froelichia floridana* (Nutt.) Moq. Solander stated "Habitat in collibus arenosis Georgiae et Florida orientalis. J Bartram." He considered the herb to have affinities with *Achyranthes* (now *Alternanthera*), *Celosia* and *Illecebrum*. Had he published the name, *Veronia* would have predated *Froelichia* by nearly thirty years. Today, *Veronia* applies to a genus in the Asteraceae. Solander and Schreber (1791) both named the genus for Vernon.

## Conclusions

Solander had been schooled by Linnaeus in his methodology, and a major factor in his being employed by the British Museum was to bring his mentor's teachings to

England, and to resolve the chaos represented in the Sloane collections. Sloane and his employees had labored for years to identify his collections of plants, but without a uniform set of rules governing the naming of plants and application of those nomenclatural principles throughout the world to all plants—as was the situation throughout nearly all of Sloane's active career—it was nearly impossible to properly identify any species. Modern workers often are unaware of the confusion that existed before the Linnaean revolution. While Linnaeus is properly credited with establishing bionomial nomenclature with all its simplicity, this was minor compared to his role in establishing firm principles for naming plants and recognizing species.

Each nation had its champion—a leader who dominated systematic botany—so that any species recognized in one country may or may not be accepted or even known in another country. Even so, pre-Linnaean workers often had little or no concept of a biological species. John Ray, for all his fame in England, described more than 100 species of Virginia plants from 1688 to 1704 which he redescribed, as new to science, from adjacent Maryland during the same period of time. Ray, Plukenet, and other early workers tended to split species to a degree not realized by modern taxonomists. And, worse yet, they often named, renamed, and renamed again the same species based on the same specimen. With this the norm, then, it may give some impression of the level of difficulty Solander faced when he attempted to identify the Sloane collections as well as the new plants making their way yearly to the Museum.

Linnaeus was one of the earliest workers in systematic botany to have some concept of a biological species, and to realize that political boundaries did not make a species. In working with the world's flora, unlike Ray and Plukenet before him, Linnaeus was willing and able to put together disjunct populations and to define species properly. To be sure Linnaeus often faulted to the extreme and today many of his eastern North American-European species are divided into a Old and New World element. Still, his ability to formulate species in a manner far more rational than workers before him must be regarded as his foremost contribution to modern taxonomy.

For Solander his role was to apply the Linnaean concepts and principles to a vast array of plants Linnaeus never saw. Linnaeus would occasionally cite a Ray, Plukenet, Petiver, or Morison name in synonymy, but except for a brief visit to Oxford when Linnaeus examined what is now the Sherardian Herbarium, he had no firm concept of what these authors had in mind when they proposed their species. Solander, on the other hand, examined the original material of these early English naturalists and therefore had a far better concept of some species, and their synonymy, than Linnaeus was ever able to command. Likewise, unlike his mentor, Solander often had numerous specimens of a species from a variety of collections and locations to study at the same time. In this way, he was able to draw up much more exact species descriptions, differentiate between closely related species, and ascribe the distribution of many plants with a degree of exactness Linnaeus never could have achieved.

A reading of Solander's 1767 manuscript shows that he had a reasonable species concept. Often, when he described a new species which today is in synonymy under a Linnaean name, an examination of the syntypes will show that Linnaeus had two or more elements included in his circumscription. In general, Solander would describe one of those elements as new and often that one represented the expression not in the Linnaean Herbarium. For example, Solander distinguished between *Scrophularia marilandica* and *S. lanceolata*, describing the former as new. The specimen in the Linnaean Herbarium annotated *S. marilandica* is what is today called *S. lanceolata*, as noted by Pennell (1935) who dubiously lectotypified the Linnaean name on a Clayton specimen (BM) rather than Linnaeus' own specimen (LINN). This was done to preserve the modern application of the names.

Of a total of 65 Maryland plants mentioned directly or indirectly in Solander's 1767 manuscript, Solander considered 38 to be new species. Of that number 15 had been described previously by Linnaeus (at least as now typified), and one, *Psoralea psoraloides*, was noted twice, once as *Hedysarum spicatum* and again indirectly under *P. asphaltites*. Thus, in 1767, 22 species were new to science and had they been published at the time, both Solander and Maryland would have been better known as a source of botanical novelties than is now the case.

Solander names proposed in Aiton (1789) were antedated mainly by Walter (1788). In this fashion, several Solander names are in synonymy. New species that appeared in the 1767 manuscript which were successfully published today include only two species: *Clematis ochroleuca* and indirectly *Cypripedium acaule*. We (Reveal et al. 1985) have discovered other provisional names among the Maryland specimens. These were not included in the 1767 manuscript but may be found in the Slip Catalogue.

A modern examination of Solander's effort in temperate North American botany shows a man devoted to a detailed study of the flora. That he died early in life, was always far too occupied to publish fully his discoveries, and is remembered for his long and rewarding association with Sir Joseph Banks and Australia, it is little wonder that the name of Maryland and Solander are not the cornerstone of eastern North American botany they could have been had fate been more kind.

## Acknowledgments

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## Literature Cited

Aiton, W. 1789. Hortus kewensis. 3 vols. G. Nicol, London.

Britten, J. 1912. The history of Aiton's 'Hortus Kewensis.' J. Bot. 50(Suppl.): 1–16.

Brown, M. L. and R. G. Brown. 1984. Herbaceous plants of Maryland. Published by the authors, College Park.

Catesby, M. 1730. The natural history of Carolina, Florida and the Bahama Islands. Vol. 1, part 1–3, pl. 1–60. Published by the author, London.

Cruickshank, H. G., ed. 1957. John and William Bartram's America. The Devin-Adair Co., New York.

Dandy, J. 1958. The Sloane Herbarium. Balding & Mansell, London.

Dillenius, J. J. 1732. Hortus elthamensis. 2 vols. Published by the author, London.

Diment, J. A. and A. Wheeler. 1984. Catalogue of the natural history manuscripts and letters by Daniel Solander (1733–1782), or attributed to him, in British collections. Arch. Nat. Hist. 11: 457–488.

Ehrhart, J. F. 1784. Fagus grandifolia. Gartenkalender 3: 288.

———. 1788. Beitrage zur Naturkunde. Vol. 3. Schmidtische Buchhandlung, Hannover.

Elliott, S. 1821. A sketch of the botany of South-Carolina and Georgia. 2 vols. J. R. Schrenck, Charleston.

Gronovius, J. 1739–1743. Flora virginica. 2 vols. C. Haak, Leiden.

———. 1762. Flora virginica. Ed. 2. C. Haak, Leiden.

Krok, T. O. B. N. 1925. Bibliotheca botanica suecana. A. & W. Boktryckeri, Uppsala.

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

———. 1762–1763. Species plantarum. 2 vols. L. Salvii, Stockholm.

MARSHALL, J. B. 1978. The handwriting of Joseph Banks, his scientific staff and amanuenses. Bull. British Mus. (Nat. Hist.), Bot. Ser. 6: 1–85.

MICHAUX, A. 1803. Flora boreali-Americana. 2 vols. C. Crapelet, Paris.

MORISON, R. 1699. Plantarum historiae universalis. Vol. 3, by J. Bobart. Published by the author, Oxford.

PENNELL, F. W. 1935. Scrophulariaceae of eastern temperate North America. Acad. Nat. Sci. Philadelphia Monogr. 1: 1–650.

PETIVER, J. 1698. Remarks by Mr. James Petiver, Apothecary, and Fellow of the Royal Society, on some animals, plants, &c. sent to him from Maryland, by the Reverend Mr. Hugh Jones. Philos. Trans. Lond. 20: 393–406.

———. 1699. Musei petiveriani. Smith & Walford, London.

———. 1702. Gazophylaci naturae & artis. C. Bateman, London.

PLUKENET, L. 1691–1696. Phytographia sive Stirpium . . . icones. Published by the author, London.

———. 1696. Almagestum botanicum sive Phytographiae Pluknetianae [sic] onomasticon. Published by the author, London.

———. 1700. Almagestum botani mantissa plantarum novissime detectarum ultra millenarium numerum complectens. Published by the author, London.

———. 1705. Amaltheum botanicum. Published by the author, London.

RAY, J. 1688–1689. Historiae plantarum. 2 vols. Smith & Walford, London.

———. 1704. Historiae plantarum supplementum. Vol. 3. Smith & Walford, London.

REVEAL, J. L. 1983. Significance of pre-1753 botanical explorations in temperate North America on Linnaeus' first edition of Species plantarum. Phytologia 53: 1–96.

———. 1984. Hugh Jones (1671–1702)—Calvert County naturalist. Calvert Hist. 1(2): 1–11.

———, G. F. FRICK, C. R. BROOME, AND M. L. BROWN. In press. Botanical explorations and discoveries in colonial Maryland. Huntia 7.

SCHREBER, J. C. D. 1789–1791. Genera plantarum. Varrentrapp & Wenner, Frankfurt.

STAFLEU, F. A. AND R. S. COWAN. 1976. Taxonomic literature. Volume 1: A–G. Regnum Veget. 94: 1–1136.

VOSS, E. G. ET AL. 1983. International code of botanical nomenclature. Regnum Veget. 111: 1–472.

WALTER, T. 1788. Flora caroliniana. J. Fraser, London.

WILLDENOW, C. L. 1797–1830. Species plantarum. 6 vols. G. C. Nauk, Berlin.

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# New Plant Records for Chester County, Pennsylvania—1982–1984

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The following plants were collected by me, except where otherwise noted, from 1982 to 1984. All voucher specimens are in the local plant collections of the Darlington Herbarium of West Chester University, West Chester, PA. Nomenclature follows the *Atlas of the Flora of Pennsylvania* by Wherry, Fogg, and Wahl (1979).

*Acer palmatum*, seedlings commonly established from planted trees, on campus, West Chester University. *Acer pseudo-platanus*, roadside, West Chester by-pass, just east of Route 100; seedlings are commonly established in alleyways in the borough of West Chester. *Aesculus pavia*, roadside, Route 29 just south of Route 30, coll. Jack Holt. *Akebia quinata*, abundant as understory in Norway Maple plantation, Goshen Road, West Chester. *Ajuga reptans*, established, roadside, North New Street by golf course, West Chester; also noted as occasional as a garden escape in Chester County. *Albizia julibrissin*, seedlings established from planted trees, Price and Wayne Streets, West Chester. *Arthraxon hispidus* v. *cryptantherus*, roadside ditch south of Oxford near Route 1 on serpentine; locally abundant. *Asplenium platyneuron* v. *incisum*, Black Rock near Phoenixville, coll. Jack Holt. *Atriplex arenaria*, locally established near Pennsylvania highway department salt dump at junction of Route 29 and West Chester by-pass. *Broussonetia papyrifera*, fence row near old foundation, one tree not spreading, Pennsbury Township near Delaware line, probably persisting from an early planting. *Cardamine hirsuta*, Fern Hill serpentine barrens, disturbed area, one half mile north of West Chester on West Chester by-pass; also noted at Brinton Quarry serpentine barrens. *Cedrus libani*, 11 ten inch seedlings established in alley and vacant lot near old cedar of lebanon, no seedlings noted at this site for many years, just east of junction of Church and Barnard Streets, West Chester. *Cleome houtteana*, floodplain of Schuylkill River near South Pottstown. *Convallaria majalis*, spreading from old home site along a small stream, Pennsbury Township about one mile north of Route 52 near Delaware line, locally common. *Coronilla varia*, roadside West Chester by-pass near old Route 29; commonly established along roadsides in recent years. *Descurainia sophia*, locally abundant, weedy edges of yard and roadside, 500 Taylor's Mill Road, West Chester. *Elodea canadensis*, locally abundant, unnamed branch of Plum Run, south campus, West Chester University, West Chester. *Euonymus alatus*, floodplain of Taylor Run near junction of North New Street, West Chester; also noted on Brandywine floodplain and as occasional in rich woods. *Euonymus yedoensis*, locally established and spreading, Brinton serpentine quarry, three miles south of West Chester on South New Street. *Epipactis helleborine*, Diamond Rock Road, roadside colony of about 30 plants, 1983, coll. Jack Holt. *Eupatorium hyssopifolium*, dry slope above old quarry site, Avondale. *Euphorbia dentata*, off first street, .8 mile above railroad bridge, Coatesville roadside, 30–40 plants in colony, coll. Jack Holt. *Galeobolen luteum*, spreading aggressively on a rich moist slope along French Creek near Kennedy Bridge, south side of creek, north of Kimberton. *Hibiscus palustris*, one plant in ditch, Route 322 just inside Chester County line by Lancaster County; found in 1983, not noted in

1984. *Hibiscus syriacus,* established in alley by Dague Building, Market Street, West Chester. *Lonicera × bella,* Fern Hill serpentine barrens, one half mile north of West Chester on West Chester by-pass. *Lunaria annua,* 202, West Chester by-pass near High Street, coll. Jack Holt; noted also as garden escape on Taylor's Mill Road, West Chester. *Lycopersicon esculentum,* established in alley east of Church Street, near Denny Rayburn factory, West Chester. *Koelreuteria paniculata,* commonly established as seedlings from planted tree, campus, West Chester University, West Chester. *Macleaya cordata,* roadside along small stream, Route 29 just south of U.S. 30, about 10 plants; colony located by Jack Holt. *Nasturtium microphyllum,* Schuylkill River, Black Rock Dam, coll. Jack Holt. *Nymphoides peltata,* quarry pond, Brinton's Quarry, three miles south of West Chester on South New Street, locally abundant. *Pinus nigra,* established and spreading from planted trees, Fern Hill serpentine barrens, one half mile south of West Chester along West Chester by-pass. *Pinus sylvestris,* established and spreading from planted trees, Fern Hill serpentine barrens, one half mile south of West Chester along West Chester by-pass. *Populus deltoides,* established on banks of Goose Creek, near bridge on Gay Street, West Chester. *Pueraria lobata,* alley east of 400 block on Church Street, West Chester; it is still only occasionally found in the County. *Pennisetum alopecuroides,* Route 926 just east of Conservatory Road near Longwood Gardens, coll. Jack Holt. *Philadelphus grandiflorus,* roadside lower slope, Church Road. *Quercus macrocarpa,* seedlings commonly established from planted trees, campus, West Chester University, West Chester. *Sedum acre,* on serpentine bank along roadside at junction of Tigue Road and Route 52, coll. Jack Holt. *Sorgum halepense,* locally established near junction of Routes 41 and 926; locally established in County, becoming more common. *Stylophorum diphyllum,* Swedsford Road at main branch of Valley Creek, thousands of plants on shaded slope appear to have spread from old planting, colony located by Jack Holt. *Taxus cuspidata,* seedling established on exposed rock cut, North Walnut Street, West Chester; seedlings and an occasional small shrub have been found at several sites in the county. *Ulmus pumila,* roadside, Route 100 approximately one half mile south of Boot Road, one sapling. *Viburnum plicatum,* floodplain, Taylor Run near junction of North New Street; noted also as occasional on Brandywine floodplain. *Yucca smalliana,* spreading from old planting along old entrance to Sharples estate, West Chester by-pass, just west of old Route 29. *Wisteria sinensis,* spreading from old planting along old entrance to Sharples estate, West Chester by-pass, just west of old Route 29.

## Literature Cited

Wherry, E. T., J. M. Fogg, Jr. and H. A. Wahl. 1979. Atlas of the flora of Pennsylvania. The Morris Arboretum, Philadelphia.

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# Additions to New Jersey's Flora

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Field botanists have found a number of supposed lost New Jersey plant species during the past few years. Among the species rediscovered have been *Asplenium pinnatifidum, Triglochin maritima, Carex foenea, Hemicarpha micrantha, Spiranthes odorata, Ranunculus pusillus, Glaux maritima, Scutellaria leonardii, Aster radula, Cirsium virginianum, Liatris scariosa,* (*L. novae-angliae* Lunell), and *Pluchea foetida.*

In addition, there have been a number of additions to the ever growing list of native New Jersey flora. Some species, like *Scirpus microcarpus, Goodyera tesselata,* (see note this issue), *Silene nivea,* and *Amelanchier humilis* have had their discoveries published in recent issues of *Bartonia*. In this paper seven taxa that I discovered in New Jersey between 1981 and 1984 are discussed. Five are additions to New Jersey's flora and two are confirmations of species dubiously reported for the state.

Nomenclature follows Kartesz and Kartesz (1980), except for *Fraxinus tomentosa* Michx. f. Voucher specimens for the seven taxa discussed have been deposited in the author's private collection as well as in the Chrysler Herbarium of Rutgers University. Specimens, except for *Botrychium simplex* var. *simplex* and *Monarda clinopodia,* also have been placed in herbaria of the Academy of Natural Sciences of Philadelphia and the New York Botanical Garden.

### **Botrychium simplex** var. **simplex**

A small colony of this tiny grape fern was discovered 7 June 1981 in Warren County atop the Kittatinny Mountain near the town of Millbrook. Scattered plants were growing on a grassy seepage slope in full sun. Occurring with it were a number of wetland species of which the following are notable: *Ophioglossum vulgatum, Liparis loeselii, Platanthera clavellata,* and *Senecio aureus*. On a return visit made 18 June 1981 with Dr. James Montgomery, nearly two dozen plants were counted among taller grass and sedge species. Photocopies of specimens collected by Dr. Montgomery were sent to Dr. W. H. Wagner, Jr. who confirmed the identification. While both var. *laxifolium* and var. *tenebrosum* are well documented for the state (Chrysler and Edwards 1947), this represents the first collection of the typical variety for New Jersey (James Montgomery pers. comm. 1984).[1]

### **Carex plantaginea**

This species was collected 1 May 1984 on Pohatcong Mountain, two miles north of Riegelsville in Warren County.[2] A colony of about 30 plants occurred in one small area at the base of a wooded, rocky west facing slope. Associated species in this rich, moist woods included *Dentaria diphylla, Dicentra cucullaria, Panax quinquefolium, Hy-*

[1] A specimen of *Botrychium simplex* var. *simplex* attributed to New Jersey by Clausen (1937) has since been rejected (Chrysler and Edwards 1947).

[2] Tom Halliwell identified my specimens of *Carex plantaginea* after he rescued them from the bottom of a bag of week old collections.

*drangea arborescens*, *Rhododendron maximum*, *Sambucus pubens*, *Tsuga canadensis*, and *Liriodendron tulipifera*. Although this species occurs in similar habitats just across the Delaware River in adjacent Bucks and Northampton counties, Pennsylvania (Wherry, Fogg, and Wahl 1979), it apparently has not been collected previously from New Jersey. The species is not listed for New Jersey by Mackenzie (1931–1935) and no New Jersey specimens were located in several local herbaria.

**Fraxinus tomentosa (profunda)**

During early August 1983, in a little explored area along Crosswicks Creek near Walnford, Monmouth County, ten mature trees of this species were counted in addition to several scattered saplings. All trees observed were growing on, or very near, the river's bank at the edge of a broad and fairly densely wooded floodplain. On a return visit on 12 September 1983 to triangulate height and measure DBH, the taller of the three trees measured had a height of 24 m and a DBH of 49.4 cm. They were in ample fruit, and a good supply was obtained by gathering those fallen at the base of the trees. Of the fruit collected, the largest had a length of 7.7 cm and a width of 10 mm, while the smallest measured 6.5 cm long and 8 mm wide. Both had fruiting calyces of 3 mm. Previously published accounts of *Fraxinus tomentosa* in New Jersey are erroneous. The specimens cited by Stone (1911) and by Taylor (1915) for Gloucester County (PH), as well as those collected by Mackenzie from Burlington County (CHRYS, NY), are *F. pennsylvanica* var. *austinii*. *Fraxinus tomentosa* is a species primarily of the Interior Plains, with a scattered distribution throughout much of the southeastern United States (Miller 1955). Prior to its discovery in central New Jersey, the known northeastern limit of its range was western Maryland (Dan Boone pers. comm. 1984) and southern Ohio (Roberts and Cooperrider 1982).[3]

**Monarda clinopodia**

Small colonies of this species were discovered 23 July 1982 in a damp thicket at the edge of an old field along the Delaware River near Raven Rock, Hunterdon County. Associated in this field with *M. clinopodia* is a diversity of other uncommon or rare New Jersey plant species including *Panicum oligosanthes*, *Euphorbia corallata*, *Hypericum pyramidatum*, *Sabatia angularis*, *Stachys tenuifolia*, *Aster ericoides*, and *Aster praealtus*. *Monarda clinopodia* was not reported for the state in the early floras of Britton (1889), Stone (1911), and Taylor (1915) or included in such recent works as Anderson's check list (1979) or Hough's catalog (1983). However, a herbarium search produced a specimen collected by James Kezer in 1936 from the Watchung Mountains near Summit in Union County (NY). An attempt to relocate Kezer's station was made in 1983, but it appears to have been destroyed by the recent extension of Interstate 78.

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[3] The record for *Fraxinus tomentosa* as native in New York State is tenuous and is apparently based on two collections: a wild tree growing in the meadows of the New York Botanical Garden (Britton 1908) and a station at the head of Cayuga Lake in Ithaca (Miller 1955). Of the last, Miller writes "this population may be an introduced one." In a recent conversation with Dr. Mitchell (pers. comm. 1984), the occurrence of *F. tomentosa* in the state could not be confirmed.

**Aster × amethystinus**

*Aster × amethystinus* is a natural occurring hybrid between *A. ericoides* and *A. novae-angliae* that ranges from Massachusetts to Pennsylvania in the east, west to Iowa, and south to Kentucky and Missouri (Fernald 1950). Although the hybrid should be expected wherever the parent species co-occur, its distribution is spotty and rather local. Both parents occur in New Jersey, but no previous collections of the hybrid for the State were located in a search of local herbaria. In the late summer and autumn of 1982, I searched the northwest corner of New Jersey along the shore of the Delaware River in Sussex and Warren counties where *A. ericoides* and *A. novae-angliae* occur in some abundance. A number of *A. × amethystinus* were discovered on 5 October 1982 growing in low vegetation on the gravelly upper shore of the Delaware River, northeast of Smith Ferry in Sussex County. While both parent species were present, *A. ericoides* was the most frequent and also the species that *A. × amethystinus* was immediately associated with.

**Aster praealtus**

*Aster praealtus* has long been credited to the flora of New Jersey. Britton (1889) lists it as *A. salicifolius* and cites a location for Warren County. Taylor (1915) also lists it as *A. salicifolius* and states it is occasional in the northern counties. However, this species has often been confused with *A. simplex* and this is the case with the specimens cited by Britton and by Taylor. Except for a few isolated eastern disjuncts, notably from Maryland and Massachusetts (Wiegand 1933; Fernald 1950), the species is western. There are no records for it in adjacent Pennsylvania or the rest of the state (Wherry, Fogg, and Wahl 1979). Nonetheless, a sizable colony of this *Aster* was discovered 18 September 1982 along the Delaware River in the Raven Rock area of Hunterdon County. The colony was growing in moist soil in a somewhat overgrown section of the field described under the above discussed *Monarda clinopodia*. An earlier New Jersey collection by H. L. Fisher in 1896[4] was found in the herbarium of the Academy of Natural Sciences. The locality was Byram, Hunterdon County, which is located about three miles east-northeast of the site found at Raven Rock. Yet another station for *Aster praealtus* was discovered on 10 October 1982 in a roadside thicket near Mount Bethel, Somerset County. Unlike the Raven Rock colony, which had rays colored a rich purple, the rays of plants in this extensive colony were white. All New Jersey material of *Aster praealtus* is referable to the variety *angustior*.

**Aster tradescantii**

Early reports of *Aster tradescantii* for New Jersey by Britton (1889) and by Taylor (1915) were based on misidentifications and a confused nomenclature. The species is northern and current manuals exclude New Jersey. Gleason and Cronquist (1963) and Fernald (1950) give the range as southeastern Canada to northern New England, northern New York and northern Michigan. The discovery of *A. tradescantii* in northwest New Jersey during the summer of 1982 came as an unexpected surprise. The species was first observed (although considered as early flowering *A. simplex*) on 8

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[4] This specimen of *Aster praealtus* is cited by Wiegand (1933), but with a question as to whether it might have been introduced. On what Wiegand based this is not known, but it seems doubtful that the species was deliberately introduced. It could be adventive in New Jersey, but there is no strong evidence for this.

August 1982 along the shore of the Delaware River north of Millbrook in Warren County. It was next encountered several miles downstream near Dimicks Ferry on 15 August 1982. A specimen was collected and its identity as *A. tradescantii* was confirmed by Dr. Cronquist. Further searching added four more localities. All stations are on the Delaware River shore, and occur from Wallpack Center in Sussex County, south to the Delaware Water Gap in Warren County. The habitat was commonly dry rock ledges or gravelly rock strewn shores, but at a few sites, the species grew on sandy alluvium. While the discovery of *Aster tradescantii* in northwestern New Jersey represents a fairly substantial southward extension in its range, the species most likely has been overlooked or misidentified elsewhere. Based on the presence of suitable habitat and the close proximity of New Jersey stations, *A. tradescantii* almost certainly occurs in adjacent northeastern Pennsylvania. To fully understand the distribution of this *Aster,* some additional searching in both the field and herbaria is needed.[5]

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## Literature Cited

Anderson, K. 1979. A check list of the plants of New Jersey. Rancocas Nature Center, Mount Holly.

Britton, N. L. 1889. Catalog of plants found in New Jersey. Geol. Surv. N.J., Final Rep. State Geol. 2: 27–642.

———. 1908. North American Trees. Henry Holt and Co., New York.

Chrysler, M. A. and J. L. Edwards. 1947. The ferns of New Jersey including the fern allies. Rutgers University Press, New Brunswick.

Clausen, R. T. 1937. The Ophioglossaceae of New Jersey: a study in local distribution. Bull. Torrey Bot. Club 64: 269–285.

Fernald, M. L. 1950. Gray's manual of botany. 8th ed. American Book Co., New York.

Gleason, H. A. and A. Cronquist. 1963. Manual of vascular plants of the northeastern United States and adjacent Canada. D. Van Nostrand Co., New York.

Hough, M. Y. 1983. New Jersey wild plants. Harmony Press, Harmony.

Kartesz, J. T. and R. Kartesz. 1980. A synonymized checklist of the vascular flora of the United States, Canada, and Greenland. University of North Carolina Press, Chapel Hill.

Mackenzie, K. K. 1931–1935. Cyperaceae-Cariceae. North American flora 18: 1–478.

Miller, G. N. 1955. The genus *Fraxinus,* the ashes, in North America, north of Mexico. Cornell Univ. Agric. Exp. Sta. Mem. 355. 64 pp.

Roberts, M. L. and T. S. Cooperrider. 1983. Dicotyledons *in* T. S. Cooperrider, ed. Endangered and threatened plants of Ohio. Ohio Biol. Surv. Biol. Notes No. 16: 48–84.

Stone, W. 1911. The plants of southern New Jersey, with especial reference to the flora of the Pine Barrens. Ann. Rep. New Jersey State Museum, 1910, part II: 21–828.

Taylor, N. 1915. Flora of the vicinity of New York. Mem. N.Y. Bot. Gard., vol. 5.

Wherry, E. T., J. M. Fogg, Jr., and H. A. Wahl. 1979. Atlas of the flora of Pennsylvania. The Morris Arboretum, Philadelphia.

Wiegand, K. M. 1933. *Aster paniculatus* and some of its relatives. Rhodora 35: 16–38.

[5] R. L. Schaeffer, Jr.'s no. 30730 (CHRYS) collected on alluvium one mile northwest of Columbia, Warren County, New Jersey is *A. tradescantii.*

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# The Flora of Hunting Island, Beaufort County, South Carolina

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Hunting Island, comprising 1,784 ha, is a Holocene beach ridge Island. It is located 26 kilometers east southeast of Beaufort, South Carolina, in Beaufort County, at 32°24′N latitude, 80°31′W longitude. The island has a variety of habitats, which support three major plant communities: the salt marsh community, evergreen maritime forest, and sand dune community. Two minor communities, the freshwater marsh and shrub community are also present. Beach erosion is severe in many areas while man's activity on the island is confined to the beaches, camping area, and a small picnic area.

METHODS. The dune vegetation of Hunting Island was sampled in the summer of 1970. The rest was sampled from December 1971 to October 1973. Species were collected, identified, and placed in the herbarium at St. John's University; additional plants were deposited in herbaria at the University of South Carolina, The Citadel, and the Baptist College at Charleston.

The vegetation on dunes was sampled by 35 1 $m^2$ quadrats spaced at 10 m intervals at five sites: (1) the ocean facing side of the primary dune, (2) the crest of the primary dune, (3) the depression behind the primary dune, (4) the crest of the secondary dune, and (5) the depression behind the secondary dune system. Frequency values for species occurring in quadrats in each of these five areas were calculated and appear in Table 1.

Arborescent vegetation of the maritime forest was sampled using 20 $10 \times 10$ $m^2$ quadrats. These quadrats were located in the least disturbed and presumably the most mature portions of the forest. Density, relative density, frequency, relative frequency, basal area, relative dominance, and importance values (important value = the sum of the relative density + relative frequency, basal area, and relative dominance) were calculated for arborescent species (Table 2).

Tree seedlings, saplings (a sapling being defined as a tree whose DBH is less than 3 in), shrubs, vines, and herbs were sampled by 20 $4 \times 4$ $m^2$ quadrats. These smaller quadrats were located in the corners of the larger ($10 \times 10$ m) quadrats used to sample the arborescent vegetation above. Frequency values for saplings, tree seedlings, shrubs, vines, and herbs can be found in Table 3.

THE DUNE COMMUNITY. *Uniola paniculata* is the dominant species of the dune community, and attains high frequency values on portions of the dunes that are most exposed to salt spray (Table 1). Other species found in the dune community are *Euphorbia polygonifolia, Heterotheca subaxillaris, Iva imbricata, Strophostyles helvola, Erigeron canadensis, Salsola kali, Croton punctatus, Atriplex arenaria, Spartina patens,* and *Cenchrus* spp. *Spartina patens* is common in the depression behind the primary dune while *Cenchrus* thrives in the depression in back of the secondary dune system. *Sabatia stellaris, Spartina patens, Muhlenbergia* spp., and *Fimbristylis spadicea* occasionally occupy dune depressions infrequently flooded by salt water.

THE SHRUB COMMUNITY. This community borders the dune and salt marsh communities. Shrubs found in both areas are similar. High tide bush, *Iva frutescens*, oc-

TABLE 1. Frequency data for species occupying 5 dune sites Hunting Island, South Carolina. Site 1 (front of fore dune), Site 3 (depression behind for dune), Site 4 (top of second dune), Site 5 (depression behind second dune).

| | Dune Sites | | | | |
|---|---|---|---|---|---|
| Species | 1 | 2 | 3 | 4 | 5 |
| *Uniola paniculata* | 91 | 83 | 31 | 94 | 34 |
| *Euphorbia polygonifolia* | – | 6 | 9 | 6 | 6 |
| *Heterotheca subaxillaris* | 6 | 3 | 11 | 31 | 23 |
| *Iva imbricata* | 23 | 11 | 3 | – | 6 |
| *Strophostyles helvola* | – | – | 3 | 3 | 3 |
| *Cenchrus* spp.* | 6 | 17 | 66 | 31 | 40 |
| *Erigeron canadensis* | – | – | 6 | 3 | 17 |
| *Spartina patens* | 9 | 20 | 46 | 20 | 34 |
| *Salsola kali* | 3 | – | 3 | – | – |
| *Oneothera humifusa* | – | – | – | – | 3 |
| *Croton punctatus* | 3 | 3 | 3 | – | 3 |
| *Atriplex patula* | 9 | – | – | – | 6 |
| *Triplasis purpurea* | 3 | – | 3 | – | 6 |
| *Yucca aloifolia* | – | – | – | 3 | – |
| *Limonium carolinianum* | – | – | – | – | 3 |

* Includes C. tribuloides.

cupies the upper occasionally flooded fringe of the salt marsh, but is absent in shrub communities bordering the dunes. *Baccharis halimifolia,* is much more common in the shrub community bordering the salt marsh than in the community bordering the dunes. *Ilex vomitoria* and *Myrica cerifera* are the most common members of the shrub community. Generally, the shrubs bordering the dunes form an impenetrable thicket while shrubs bordering salt marshes are more widely spaced. Shrubs of the dune community are often severely sculptured and vines such as *Smilax auricularia, Toxicodendron radicans, Ampelopsis arborea* often festoon the shrubs making travel through this community impossible.

THE FRESHWATER MARSH AND TEMPORARY PONDS. Temporary ponds and freshwater marshes cover less than two percent of Hunting Island. *Bacopa monieri, Eleocharis* spp., *Lemna* sp., and *Scirpus* sp., occupy the ponds and marshes. *Scirpus robustus* may mix with the aforementioned species in slightly brackish marshes. *Cladium jamaicense* may also be locally common in these areas. Shrubs that surround the temporary ponds and marshes include *Myrica cerifera* and *Baccharis* spp., while *Ampelopsis arborea, Parthenosissus quinquefolia,* and *Toxicodendron radicans* are often associated with the frutescent species.

THE SALT MARSH COMMUNITY. An extensive salt marsh exists at Hunting Island; over 95% of the marsh consists of *Spartina alterniflora.* As elevation above datum increases one usually encounters a mixed *Spartina alterniflora, Salicornia, Batis* community. These taxa may merge with *Limonium* spp. and *Distichlis spicata.* The fringe of the former community is usually bordered by *Borrichia frutescens,* which in turn is bordered by *Spartina patens. Iva frutescens* and *Baccharis* are shrubs that border the aforementioned vegetation of the marsh and merge with the shrub community described earlier in this paper. *Spartina patens, Fimbristylis spadicea, Scirpus* spp. and *Juncus* spp. may be associated with the aforementioned shrubs in the upper flooded portion of the salt marsh. *Cynanchum palustre* and *Ipomoea sagittata* are usually found on the upper borders of the marsh. *Juncus roemerianus* is dominant in brackish marshes.

THE EVERGREEN MARITIME FOREST. *Quercus laurifolia* is the dominant tree on mature sites at Hunting Island with *Quercus virginiana* the co-dominant species (Table 2). The dominance of *Q. laurifolia* suggests that forest on Hunting Island is mature since *Q. laurifolia* usually replaces *Q. virginiana* on unburned undisturbed coastal plain. *Quercus virginiana* occurs where salt spray is moderate, and has been described by Wells (1939) and Braun (1950) as a tree "of the coast" though work by Stalter et al. (1981) indicates that it is dominant on an inland site, Highlands Hammock State Park, Florida.

*Sabal palmetto* may accompany *Q. laurifolia* and *Q. virginiana*, and is most common in depressions between old dunes. *Persea borbonia* is the most common subcanopy species. Saplings and seedlings are best represented by *Persea borbonia, Sabal palmetto* and *Q. laurifolia* (Table 3).

The shrub stratum is poorly developed in the deep shade of the maritime forest on Hunting Island. *Serenoa repens, Ilex vomitoria,* and *Myrica cerifera* are common shrubs while *Pteridium aquilinum* is the most frequently found herb (Table 3). *Smilax bona-nox* is the most common vine.

Plant succession on Hunting Island proceeds from a preclimax pine forest of *Pinus elliottii,* to a mixed pine oak forest, to evergreen maritime forest of *Q. laurifolia* and *Q. virginiana*. *Pinus elliottii* is probably more important on Hunting Island than indicated in Table 2, since the most mature sites in the forest were sampled by quadrats.

## List of Species

Two hundred seventy one species in seventy five families including thirty six new records for Beaufort County, South Carolina have been identified. Nomenclature mostly follows that of Radford et al. (1968).

### Pteridophytes

POLYPODIACEAE: *Polypodium polypodioides*. PTERIDACEAE: *Pteridium aquilinum*.

### Gymnosperms

CUPRESSACEAE: *Juniperus silicicola*. PINACEAE: *Pinus elliotti*.

TABLE 2. Frequency (F), relative frequency (RF), density (D), relative density (RD), basal area (BA), relative dominance (RD), and importance value (IV) for arborescent species greater than 3 in DBH (7.6 cm DBH) at Hunting Island, South Carolina. – = less than one percent.

| | F | RF | D | RD | BA | RD | IV |
|---|---|---|---|---|---|---|---|
| *Quercus laurifolia* | 90 | 31 | 1.55 | 31 | 18,197 | 42 | 104 |
| *Quercus virginiana* | 60 | 20 | 1.10 | 22 | 13,901 | 32 | 74 |
| *Persea borbonia* | 55 | 19 | 1.35 | 27 | 4,265 | 9 | 55 |
| *Sabal palmetto* | 45 | 15 | .50 | 10 | 3,604 | 8 | 33 |
| *Pinus elliottii* | 35 | 12 | .35 | 7 | 3,719 | 8 | 27 |
| *Morus rubra* | 5 | 1 | 5 | – | 97 | – | 2 |
| *Liquidambar styraciflua* | 5 | 1 | .05 | – | 97 | – | 2 |

TABLE 3. Frequency values for tree seedlings and saplings under 7 cm DBH (1), shrubs and vines (2), and herbs (3) at Hunting Island, South Carolina found in 20 2 × 4 m quadrats.

| Species | Frequency Value |
|---|---|
| 1 *Sabal palmetto* | 55 |
| 1 *Persea borbonia* | 80 |
| 1 *Quercus laurifolia* | 50 |
| 2 *Parthenocissus quinquefolia* | 10 |
| 2 *Ilex vomitoria* | 20 |
| 2 *Smilax rotundifolia* | 5 |
| 2 *Serenoa repens* | 25 |
| 2 *Vitis rotundifolia* | 20 |
| 2 *Berchemia scandens* | 15 |
| 2 *Smilax bona-nox* | 70 |
| 2 *Myrica cerifera* | 20 |
| 2 *Vaccinium arboreum* | 15 |
| 2 *Toxicodendron radicans* | 5 |
| 3 *Pteridium aquilinum* | 55 |
| 3 *Uniola laxa* | 15 |

## ANGIOSPERMS

AZOACEAE: *Mollugo verticillata, Sesuvium portulacastrum.* AMARANTHACEAE: *Froelichia floridana, Iresine rhizomatosa.* ANACARDIACEAE: *Rhus copallina, Toxicodendron radicans, Toxicodendron toxicarium.* APIACEAE: *Centella erecta, Chaerophylum tainturieri, Hydrocotyle bonariensis, Hydrocotyle umbellata, Hydrocotyle verticillata.* AQUIFOLIACEAE: *Ilex opaca, Ilex vomitoria.* ARALIACEAE: *Aralia spinosa, Hedera helix.* ARECACEAE: *Sabal palmetto, Serenoa repens.* ASCLEPIADACEAE: *Cynanchum palustre.* ASTERACEAE: *Ambrosia artemisiifolia, Aster dumosus, Aster tenuifolius, Aster* spp., *Baccharis angustifolia, Baccharis halimifolia, Bidens bipinnata, Borrichia frutescens, Carduus spinosissimus, Carduus* sp., *Chaptalia tomentosa, Elephantopus carolinianus, Elephantopus tomentosus, Erechtites hieracifolia, Erigeron canadensis, Erigeron quercifolius, Erigeron strigosus, Eupatorium capillifolium, Eupatorium hyssopifolium, Eupatorium leucolepis, Gnaphalium obtusifolium, Gnaphalium purpureum var. falcatum, Haplopappus divaricatus, Helenium amarum, Heterotheca graminifolia, Heterotheca subaxillaris, Hieracium gronovii, Iva frutescens, Iva imbricata, Krigia virginica, Lactuca graminifolia, Liatris graminifolia, Mikania scandens, Pluchea foetida, Pluchea odorata, Pyrrhopappus carolinianus, Solidago rugosa, Solidago sempervirens, Solidago tenuifolia, Sonchus asper.* BATACEAE: *Batis maritima.* BIGNONIACEAE: *Campsis radicans, Catalpa* sp. BORAGINACEAE: *Heliotropium curassavicum.* BRASSICACEAE: *Cakile harperi, Lepidium virginicum.* BROMELIACEAE: *Tillandsia usneoides.* CACTACEAE: *Opuntia compressa, Opuntia drummondii.* CAMPANULACEAE: *Specularia perfoliata.* CAPRIFOLIACEAE: *Lonicera japonica, Viburnum dentatum.* CARYOPHYLLACEAE: *Cerastium viscosum, Stellaria media.* CHENOPODIACEAE: *Atriplex arenaria, Atriplex patula, Chenopodium album, Chenopodium ambrosioides, Salicornia bigelovii, Salicornia virginica, Salsola kali, Suaeda linearis.* CISTACEAE: *Lechea villosa.* CONVOLVULACEAE: *Ipomoea sagittata.* CORNACEAE: *Cornus stricta.* CYPERACEAE: *Carex albolutescens, Carex lurida, Cladium jamaicense, Cyperus ovularis, Cyperus pseudovegetus, Cyperus* sp., *Dichromena latifolia, Eleocharis* sp., *Fimbristylis spadicea, Fuirena squarrosa, Rhynchospora cephalantha, Scirpus pungens, Scirpus robustus, Scleria triglomerata.* EBENACEAE: *Diospyros vir-*

*giniana.* ERICACEAE: *Vaccinium arboreum.* EUPHORBIACEAE: *Acalypha gracilens, Croton glandulosus* var. *septentrionalis, Croton punctatus, Euphorbia polygonifolia, Euphorbia supina, Sapium sebiferum, Tragia urens.* FABACEAE: *Cassia fasciculata, Centrosema virginianum, Desmodium* sp., *Desmodium paniculatum, Erythrina herbacea, Galactia volubilis, Glottidium vesicarium, Indigofera caroliniana, Lespedeza repens, Medicago lupulina, Rhynchosia difformis, Strophostyles helvola, Trifolium carolinianum, Vicia angustifolia, Wisteria frutescens.* FAGACEAE: *Quercus falcata* var. *pagodaefolia, Quercus incana, Quercus laurifolia, Quercus marilandica, Quercus pumila, Quercus virginiana.* GENTIANACEAE: *Sabatia stellaris.* GERANIACEAE: *Geranium carolinianum.* HAMAMELIDACEAE: *Liquidambar styraciflua.* HYPERICACEAE: *Hypericum stans.* JUNCACEAE: *Juncus dichotomus, Juncus effusus, Juncus roemerianus.* LAMIACEAE: *Monarda punctata, Salvia lyrata, Teucrium canadense, Trichostema dichotomum.* LAURACEAE: *Persea borbonia, Sassafras albidum.* LEMNACEAE: *Lemna perpusilla, Spirodela polyrhiza.* LENTIBULARIACEAE: *Utricularia* sp. LILIACEAE: *Allium* sp., *Smilax auriculata, Smilax bona-nox, Smilax laurifolia, Smilax rotundifolia, Yucca aloifolia, Yucca filamentosa.* LOGANIACEAE: *Gelsemium sempervirens, Polypremum procumbens.* LORANTHACEAE: *Phoradendron serotinum.* LYTHRACEAE: *Rotala ramosior.* MALVACEAE: *Hibiscus moscheutos, Kosteletskya virginica, Sida rhombifolia.* MELIACEAE: *Melia azedarach.* MORACEAE: *Morus rubra.* MYRICACEAE: *Myrica cerifera.* NYMPHAEACEAE: *Nymphaea mexicana.* OLEACEAE: *Ligustrum japonicum.* ONAGRACEAE: *Gaura filipes, Ludwigia alternifolia, Oenothera biennis, Oenothera humifusa, Oenothera laciniata.* OXALIDACEAE: *Oxalis dillenii.* PASSIFLORACEAE: *Passiflora incarnata, Passiflora lutea.* PHYTOLACCACEAE: *Phytolacca americana.* PLANTAGINACEAE: *Plantago aristata, Plantago heterophylla, Plantago virginica.* PLUMBAGINACEAE: *Limonium carolinanum, Limonium nashii.* POACEAE: *Andropogon elliotii, Andropogon ternarius, Andropogon virginicus, Aristida longespica, Aristida purpurascens, Arundinaria gigantea, Briza minor, Cenchrus echinatus, Cenchrus longispinus, Cenchrus tribuloides, Chloris petrea, Cynodon dactylon, Digitaria sanguinalis, Distichlis spicata, Eleusine indica, Elymus virginicus, Erianthus alopecuroides, Erianthus giganteus, Festuca octoflora, Muhlenbergia capillaris, Oplismenus setarius, Panicum amarum, Panicum anceps* var. *rhizomatum, Panicum dichotomum, Panicum lanuginosum, Panicum laxiflorum, Panicum virgatum, Panicum* sp., *Paspalum boscianum, Paspalum dilatatum, Paspalum floridanum, Paspalum setaceum, Poa annua, Setaria geniculata, Setaria magna, Sorghastrum nutans, Spartina alterniflora, Spartina patens, Sphenopholis obtusata, Sporobolus poiretii, Sporobolus virginicus, Stenataphrum secundatum, Triplasis americana, Triplasis purpurea, Uniola laxa, Uniola paniculata.* POLEMONIACEAE: *Phlox drummondii.* POLYGONACEAE: *Polygonum aviculare, Polygonum setaceum, Rumex crispus, Rumex hastatulus, Rumex verticillatus.* RHAMNACEAE: *Berchemia scandens.* ROSACEAE: *Prunus angustifolia, Prunus caroliniana, Prunus serotina, Rubus argutus, Rubus trivialis.* RUBIACEAE: *Diodia teres, Galium tinctorium, Houstonia procumbens, Mitchella repens, Richardia scabra.* RUTACEAE: *Zanthoxylum clava-herculis.* SALICACEAE: *Salix nigra.* SAPOTACEAE: *Bumelia tenax.* SCROPHULARIACEAE: *Agalinis fasciculata, Agalinis purpurea, Aureolaria virginica, Bacopa monnieri, Linaria canadensis, Verbascum blattaria, Veronica arvensis.* SOLANACEAE: *Physalis viscosa* ssp. *maritima.* TAMARICACEAE: *Tamarix gallica.* TYPHACEAE: *Typha angustifolia, Typha domingensis.* ULMACEAE: *Celtis laevigata, Ulmus americana.* URTICACEAE: *Boehmeria cylindrica.* VERBENACEAE: *Callicarpa americana, Lippia no-*

*diflora, Verbena brasiliensis, Verbena scabra.* VIOLACEAE: *Viola* sp. VITACEAE: *Ampelopsis arborea, Parthenocissus quinquefolia, Vitis aestivalis, Vitis rotundifolia.*

## LITERATURE CITED

BRAUN, E. L. 1950. Deciduous forests of eastern North America. Blakiston Co., Philadelphia. 596 pp.

RADFORD, A. E., H. E. AHLES, AND C. R. BELL. 1968. Manual of the vascular flora of the Carolinas. The University of North Carolina Press, Chapel Hill. 1183 pp.

STALTER, R., S. DIAL, AND A. LAESSLE 1981. Some ecological observations of the arborescent vegetation in Highlands Hammock State Park, Florida. Castanea 46: 30–35.

WELLS, B. W. 1939. A new forest climax: the salt spray climax of Smith Island, North Carolina. Bull. Torrey Bot. Club 66: 629–634.

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# Influence of Fire on Reproduction of *Scirpus longii*

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*Scirpus longii* Fern. is a wetland sedge known from Nova Scotia, Maine, Massachusetts, Connecticut, New York, and New Jersey. It is rare over this range except in the New Jersey Pine Barrens where it is widespread and often locally abundant. Even here, however, it usually goes unrecognized because culms with inflorescences are usually lacking and only clumps of leaves are present. Charred basal leaves on culm-bearing specimens preserved in herbaria indicate that fire influences culm formation, and it has been suggested that this may enable *S. longii* to distribute and establish itself when conditions are at an optimum (Schuyler 1963). An opportunity to observe the effects of fire on culm formation and reproduction was provided when an intense fire burned over an extensive area of pitch pine lowland forest containing stands of *S. longii* near Atsion, New Jersey, late in the summer of 1983.

## HABITAT OF *SCIRPUS LONGII*

*Scirpus longii* grows in open peaty swales with fluctuating moisture conditions. In the Atsion area, these swales appear to be intermittent streams, although even when water is present, there is no apparent directional flow. The very slight stream gradient combines with minor topographic features and other obstacles, sometimes man-made, to form pools. After a prolonged dry period, the blackish peaty substrate is exposed, sometimes with a dried algal mat veneer and with considerable areas lacking vascular plants. *Scirpus longii* may grow in pure stands or mixed with other species. *Carex walteriana* frequently occurs with or near *S. longii*, and *Carex bullata*, *Carex livida*, *Chamaedaphne calyculata*, *Cladium mariscoides*, *Juncus canadensis*, *Muhlenbergia torreyana*, and *Woodwardia virginica* are also often present. *Sphagnum* is usually absent.

## OBSERVATIONS IN UNBURNED AREAS IN 1983 AND 1984

Stands of *Scirpus longii* were observed at five locations in the vicinity of Atsion during 1983. The location of these stands in the unburned area had nothing to do with their selection because the fire had not yet occurred. Culm-bearing plants were found at only one locality where they were numerous, but developing two months later than usual. The culms developed from plants with thick rhizomes. No seedlings were found here or at any of the other locations.

In 1984 stands of *S. longii* were observed at eight locations, including the one that had numerous culms in 1983. Four late developing culms were observed at the latter location and no culms were present at the other locations. As was the case in 1983, no seedlings were observed at any of the unburned locations.

## Observations in the Burned Area in 1984

In the late summer of 1983 a major fire swept southeast from U.S. Highway 206 near Atsion and consumed most of the vegetation between the Mullica River and Sleeper Branch. About two square miles of this area not only were stripped of shrubs and had most trees killed but also had its peat layer consumed; what remained was carbon and ash on mud, sand, and bog ore. Botanical exploration of this area began in July 1984.

*Scirpus longii* stands that survived the fire were easily found: prolific culm formation apparently occurred in June. About 75 dense monospecific stands, the largest covering about 400 $m^2$, were scattered throughout the swale system. By midsummer many of these stands had abundant seedlings close by (Fig. 1) that often extended beyond the swales into areas that had woody plants prior to the burn. Substrates varied from coarse sand to muddy sands and mud. The tallest seedlings were in drier areas and by mid-August some (a few hundred out of tens of thousands) had produced culms.

## Discussion

The comparative data from burned and unburned locations of *S. longii* support the contention that this species is adapted to fire. Culms were abundantly produced in burned stands and were lacking in all but one of the unburned stands. Extensive reproduction from seed, apparently during the same year seeds were produced, was demonstrated by the abundant seedlings in the vicinity of the mature stands in the burned area (Fig. 1) while no such reproduction was apparent in the unburned area. Many of these seedlings occurred in habitats that are only available in burned areas

Fig. 1. Stand of *Scirpus longii* that survived fire (plants on left with pendulous inflorescences) with abundant seedlings (most of the shorter plants lacking inflorescences).

because many plants of competing species (e.g. *Chamaedaphne calyculata*) were eliminated by the fire. Thus, *S. longii* is producing seeds when it has the most available habitat in which to become established.

Much remains to be learned about the details of how fire influences reproduction in *S. longii*. What does fire do to cause the culms to develop? Does alteration of the substrate by fire provide more suitable conditions for seed germination? The elimination of shade plants by fire probably is beneficial for reproduction because seed germination of many species of *Scirpus* is enhanced by light (Isely 1944; Schuyler unpubl.). Presumably some of the young stands formed in 1984 will be eliminated as woody plants return to the burned area. However, we do not know how fast this will happen or how many of these young stands will persist. We also do not know how much culm formation, if any, will occur in mature or young stands two years or more after a fire. Similarly, we do not know whether or not the seedlings that produced culms later than usual during 1984 will continue to do so in future years.

The occurrence of late season culm formation in one stand in the unburned area may be related to environmental factors having effects similar to fire. In the hot dry summer of 1983, this stand produced numerous culms, while in the comparatively cooler and wetter summer of 1984, only four culms were produced. When culms develop late in the season, the flowering time of *Scirpus longii* overlaps that of *Scirpus cyperinus* (L.) Kunth, two species that are known to hybridize (Schuyler 1967).

## Acknowledgments

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## Literature Cited

Isely, D. 1944. A study of the conditions that affect the germination of *Scirpus* seeds. Cornell Univ. Agric. Exp. Sta. Mem. 257. 28 pp.

Schuyler, A. E. 1963. Sporadic culm formation in *Scirpus longii*. Bartonia 32: 1–5.

———. 1967. A taxonomic revision of North American leafy species of *Scirpus*. Proc. Acad. Nat. Sci. Philadelphia 119: 295–323.

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# Greenbrook Sanctuary

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In 1946, the Palisades Interstate Park Commission of New Jersey and New York set aside a wild, rugged, 165-acre section of the Park and designated it Greenbrook Sanctuary. Administered by the private, non-profit Palisades Nature Association, the Sanctuary has thrived since that time as a refuge for native plants and animals, an environmental education center for adults and school children, and an outdoor laboratory for field scientists and amateur naturalists.

Located atop the world-famous Palisades cliffs (declared a National Natural Landmark in 1983), the Sanctuary boasts magnificent views of the Hudson River and New York City skyline. Waterfalls cascade hundreds of feet over the cliffs into the river, after winding through ancient forests of 250-year-old oaks and 130-foot-tall tulip trees. The sanctuary is largely a mixed-oak forest (red, black, white, scarlet, and chestnut oaks, with pignut and mockernut hickories), but there are also well-developed hardwood cove forests (sugar maple, beech, black birch, hemlock, and tulip tree), red maple-sweet gum-tupelo swamps, hemlock ravines, black birch talus slopes, and storm openings covered with blackberry, raspberry, wild grape, and poison ivy. In addition a 5 acre pond and small sphagnum bog were created 30 years ago to further increase the sanctuary's habitat diversity. A few small meadows and vernal pools are also maintained to prevent plant succession from converting them to forest.

Among the more exciting nesting birds in the Sanctuary are great horned owl, pileated woodpecker, wood duck, ruffed grouse, scarlet tanager, worm-eating warbler, and indigo bunting. In a single day it is possible to see as many as 90 species of birds during the peak of the spring migration in May, and thousands of hawks (and an occasional eagle) soaring along the cliffs in their fall migration. The Sanctuary's bird list contains 235 species. Common mammals include red fox, raccoon, red, gray, and flying squirrels, chipmunk, cottontail, white-footed mouse, short-tailed shrew, and both common and star-nosed moles. White-tailed deer, striped skunks, opossums, long-tailed weasels, and red bats are also among the 25 species of mammals occasionally seen here.

Each March the bog and vernal ponds fill with the egg masses of spotted salamanders and wood frogs, and shortly afterwards the voices of spring peepers, American toads, pickerel frogs, green frogs, and bull frogs fill the spring evenings with mating songs. The dominant reptiles are the eastern garter and northern water snakes, and painted and snapping turtles. Ring-necked, milk, and copperhead snakes, 5-lined skinks, and musk and box turtles are also present. 29 different reptiles and amphibians have been recorded in the Sanctuary.

Since its very beginnings, Greenbrook has attracted both professional and amateur naturalists who have studied its flora, fauna, and ecology. Their studies, together with the observations and censuses of the sanctuary's full-time professional naturalist, have resulted in the publication of many articles in scientific journals, popular magazines, and P.N.A.'s own printed materials. Greenbrook is one of the few natural areas which has maintained careful, long-term records of its breeding birds, butterflies (53 species), wildflowers (over 400 species), biotic communities, and changing tree associations. Comparative studies of its flora and fauna over 40 years have proven invaluable in assessing local and regional environmental changes.

All professional and popular publications are made available to members and guests of the Palisades Nature Association, who visit the sanctuary either to attend the nature walks which are conducted by the naturalist every Saturday, most Sundays, and spring weekdays, or to hike along the sanctuary's $6\frac{1}{2}$ miles of trails and enjoy its beauty and serenity. For further information about Greenbrook Sanctuary, write to: Palisades Nature Association, Box 155, Alpine, New Jersey 07620.

OBITUARY

**Ruth McVaugh Allen (1913–1984).**—Ruth Allen, conservationist and botanist, of Riverton, New Jersey, died on April 10, 1984 at the age of 71. She had been a member of the Philadelphia Botanical Club since 1957.

Mrs. Allen received her training in botany at the Barnes Arboretum, under the tutelage of Drs. Edgar T. Wherry and John Fogg, during the early 1950's. An interest in mycology began with courses at the Morris Arboretum under Dr. Pat Allison, plant pathologist.

Ruth was particularly well known as a photographer, and her collection included 10,000 slides, many of them of botanical specialties of the New Jersey Pine Barrens. Her photos appeared in many publications, among them the Time-Life *Encyclopedia of Gardening* and H. W. Rickett's *Wild Flowers of the United States*.

She was an authority on the Myxomycetes, and she painted the color plates for the book *The Myxomycetes* authored by Drs. G. W. Martin and C. J. Alexopoulos, published by the University of Iowa in 1969. Her personal collection of 1800 specimens is being donated to the National Fungus Collection of the U.S. Department of Agriculture, in Beltsville, Maryland.

Ruth Allen was also known as a teacher and a conservationist. She taught courses in Field Botany at the Cherry Hill Adult School for several years. She was founder, in 1963, and President of the Pompeston Creek Watershed Association; and was one of the original members of the Pine Barrens Coalition, the first citizen's group to actively campaign for Pine Barrens preservation. In addition to her Botanical Club membership, she was a member of the New Jersey Conservation Foundation, the New Jersey Audubon Society, and the South Jersey Orchid Society.

She is survived by her husband Jack Allen, a sister, two brothers, a daughter, two grand-daughters, and by the memories of her friends, students, and associates. KARL H. ANDERSON

**John Abbot in Georgia: The Vision of a Naturalist Artist (1751–ca. 1840),** by Vivian Rogers-Price. 149 pp. Madison-Morgan Cultural Center, Madison, Georgia. 1983. $15.00 (plus $2.00 postage from Cultural Center, 434 South Main Street, Madison, GA 30650).

As part of a celebration of Georgia's 250th anniversary in 1983, Madison-Morgan Cultural Center arranged a fine exhibition of the works of the early American naturalist, John Abbot; Vivian Rogers-Price was Guest Curator. A symposium was held in connection with the exhibit; Professor Ewan's excellent paper from this symposium appears elsewhere in this issue.

The catalogue for this exhibit, *John Abbot in Georgia,* provides us with an excellent natural history resource. An introduction by Professor Ewan is followed by Vivian Rogers-Price's fine biographical essay on John Abbot and introduction to his work, illustrated with 10 figures not in the ensuing catalogue. The chronology of Abbot's life is helpful, particularly in that it emphasizes Abbot's relationships with contemporary naturalists. The catalogue of the 116 items in the exhibit includes not only Abbot watercolors but also the books which he illustrated at least in part and even actual bird specimens. Each item is clearly illustrated in black-and-white and well annotated.

Mrs. Rogers-Price discusses Abbot as both artist and as naturalist. She touches on Abbot's watercolor technique and the artistic influences upon him . . . the naturalist-illustrators: Eleazar Albin, Mark Catesby, and particularly George Edwards. She places Abbot in the context of his scientific friends who, like Augustus Oemeler, taught him to be more precise in his botanical observations. All this helped his development. Perhaps more important, it is Abbot's unsung contribution to natural history through the work of others which is the heart of the essay. Whether it was descriptions and specimens to ornithologists like Alexander Wilson, or to a variety of European entomologists, who used them as a basis for publication and naming of new species, Abbott made a great contribution to natural science in a seminal period.

Most of Abbot's 1000 bird watercolors remained unpublished. Therefore it is delightful to have them illustrated, albeit in black and white except for the charming mockingbird on the cover. Mrs. Rogers-Price emphasizes throughout the influence of George Edwards on Abbot's compositions. The bird-on-the-stump-technique is common in 18th century illustrations; what is unusual is the use of appropriate landscape background, which was typical of both Abbot's and Edwards' styles. Since there are few examples of Edwards' work outside of rare book libraries, one would have appreciated examples of his illustrations for comparison.

The entomological examples in the catalogue fortunately show not only Abbot's original watercolors but also the publications of James Edward Smith and others, where the etchings "accurately reproduce Abbot's watercolor(s)." Abbot illustrated the metamorphosis of each butterfly, and its relationship to the food plant. Although he did not invent this technique, he brought it to perfection. One does not know if Abbot saw the work of Maria Sibylle Merian, who was the first well-known naturalist-illustrator to use the technique. Abbot was certainly influenced by Elezar Albin, according to Mrs. Rogers-Price's description; again, it would have been nice to be able to see the comparison.

Mrs. Rogers-Price has produced a catalogue of permanent value, which enriches our understanding of a previously unappreciated American naturalist and his contribution to 19th century natural science. ELIZABETH P. MCLEAN

Bartonia No. 51: 112–115, 1985

# NEWS AND NOTES

JOINT FIELD MEETING. The annual Joint Field Meeting of the Northeastern Section of the Botanical Society of America, the Torrey Botanical Club, and the Philadelphia Botanical Club will be held on June 23 to 27, 1985 in East Stroudsburg, PA. Accommodations will be at East Stroudsburg University. There will be field trips to boreal bogs, limestone dells, upland forests, and swamps at various sites in the Pocono Mountains and Delaware Water Gap Area of Pennsylvania, as well as adjacent New Jersey. Space is limited and PRIOR registration is required. Full details available after February 1, 1985, by writing the chairman, James K. McGrath, Vice President, Delaware Valley Conservation Society, Box 393, Lansdowne, PA 19050.

TWO RARE PLANTS ON THE PALISADES OF NEW JERSEY. During the course of my botanical forays along the cliffs, talus slopes, swamps, and cove forests of the Palisades, two species of plants were discovered which are currently listed in "Rare and Endangered Vascular Plant Species in New Jersey," by David B. Snyder and V. Eugene Vivian (1981). Both species represent new locations.

A fairly extensive area of paper birch (*Betula papyrifera* Marsh.) exists on the lower talus below the extremely steep cliffs in the Forest View section of the Palisades, just about one mile south of the New York State line. Many of the trees are 4 to 4½ feet in circumference at breast height, although many smaller size classes are also represented. The trees are growing in an extremely rugged, secluded jumble of fallen diabase blocks, just above the Shore Path (a hiking trail which winds along the banks of the Hudson River below the Palisades). Growing near the birches are large hemlocks, sugar maples, black birches, tulip trees, and a few white pines. According to the "Rare and Endangered" list, paper birch has been reported in New Jersey only from a few mountain sites in Sussex and Warren counties, where they exist at the southern limit of the species' range (except for a southward extension in the mountains). This Palisades location, then, may well represent one of the most southerly sites for this species.

The second plant is rattlesnake master (*Eryngium yuccifolium* Michx.), which, according to the "Rare and Endangered" list, was last collected in New Jersey in 1912 by C. S. Williamson in Camden County (a second site from before 1900 in Burlington County is listed as extirpated). I discovered a single plant of this species in July, 1981, growing in Greenbrook Sanctuary, a 165 acre nature preserve on the Palisades in Tenafly, NJ. The plant was growing along the sanctuary's entrance road, in very open sunlight in sandy, cindery soil. Associated with it are goldenrods, Deptford pink, evening primrose, and great mullein. In each of the succeeding two summers, the plant has produced a minimum of three flower heads. JOHN SERRAO.

*CAREX MITCHELLIANA* IN CRAWFORD COUNTY, PENNSYLVANIA. While examining collections of *Carex crinita* Lam. complex at the Carnegie Museum of Natural History (CM) in Pittsburgh, Pennsylvania, I found a sheet of *Carex mitchelliana* M. A. Curtis identified as *C. crinita*. This collection, as well as a duplicate, was collected by John Bright from Pymatuning Swamp near Hartstown in Crawford County, Pennsylvania. Subsequently, another collection of *C. mitchelliana* was found at the Academy of Natural Sciences of Philadelphia (PH). This specimen was also collected from Crawford County, though from Linesville, north northeast of the Pymatuning Swamp.

*C. mitchelliana* is known from the coastal plain and piedmont from Massachusetts to northern Florida and west to eastern Texas. It occurs in a variety of wetland habitats, both fresh and brackish, including swamps, meadows, bogs, stream and pond margins, and ditches. These recently uncovered collections represent disjunct populations nearly 460 km west northwest of the nearest historic population in Wilmington, Delaware, and 570 km from the nearest known extant population in Milford, Delaware.

*Carex mitchelliana* is often overlooked and misidentified. It is frequently mistaken for other members of the *C. crinita* complex, particularly *C. crinita* var. *brevicrinis* Fern. (with which it is sympatric) and *C. crinita* var. *gynandra* (Schw.) Dewey. It is best distinguished from these taxa by the perigynium which is uniformly papillate over the entire surface, only slightly inflated, and 2–4 nerved on both surfaces. Additionally, *C. mitchelliana* has a scabrous culm basally and lowermost inflorescence bract lengths of 0.8–3 dm.

Although *C. mitchelliana* has never been common in New Jersey and Pennsylvania, it appears to have become more uncommon in recent times; historically, 14 locations are known from Burlington, Camden, Cape May, Cumberland, Gloucester, and Ocean Counties in New Jersey, and the Crawford County collections reported here. LEO P. BRUEDERLE.

EASTERN PENNSYLVANIA RARE PLANT SURVEY UPDATE. For the third consecutive year, the Eastern Pennsylvania Rare Plant Survey has made several interesting discoveries including state and county records.

*Eleocharis parvula* was collected by Richard Mellon of the Morris Arboretum, A. E. Schuyler of the Academy of Natural Sciences, and Tom Smith of the Pennsylvania Natural Diversity Inventory. This is the first time this species has been reported in Pennsylvania. The plant was found in Bucks County in the intertidal zone of the Neshaminy Creek just upstream from its mouth. Several small stands were observed on firm mud associated with another rare species, *Sagittaria calycina* var. *spongiosa*. Specimens were identified by Dr. Schuyler and deposited in the herbarium of the Academy of Natural Sciences.

Collections which appear to be new county records include: *Carex collinsii* found near Grass Lake in Monroe County, *Goodyera tesselata* found at two sites in Wayne County, *Eleocharis robbinsii* and *Scirpus torreyi* in Wyoming County, and *Viola brittoniana* in Lancaster County. The discovery of *Erigenia bulbosa* in Lancaster County is reported in the next note of this issue of *Bartonia*.

Extant populations of two species previously believed extirpated in Pennsylvania were found during site visits by the rare plant survey team. The rediscovery of *Montia chamissoi* in Wayne County is described earlier in this issue. In addition, a healthy stand of *Asplenium resiliens* was found at the Franklin County site where Agborn last reported it in 1961. Once believed to have disappeared, this stand now contains approximately twenty plants growing at the base of a limestone outcrop in a wooded area along the Conococheague Creek. Two other species found nearby were *Ruellia strepens*, a southern member of the Acanthaceae considered rare in PA, and *Aster shortii*. The latter, while not included on the state rare plant list, has not previously been reported east of Bedford County.

A stand of approximately 75 clumps of *Trollius laxus* was found at a new site in Northampton County west of Portland. This brings to four the number of known populations of *Trollius* in eastern Pennsylvania, three are in Northampton County and one in southern Monroe County. *Trollius laxus* is classified as PA endangered and is under review (C-2) for federal listing.

*Carex polymorpha* Muhl, classified as PA threatened/federal C-2, was found to be locally abundant in moist soil in the Long Pond area of Monroe County. Exceptionally wet weather during the spring and early summer may have contributed to the large number of plants seen this year. Despite its abundance in Monroe County, *C. polymorpha* could not be found at four historical locations in Delaware, Chester, and Lancaster counties.

The Eastern Pennsylvania Rare Plant Survey is a project of the Morris Arboretum of the University of Pennsylvania in cooperation with the Pennsylvania Natural Diversity Inventory. Funding was provided by the Pennsylvania Department of Environmental Resources and also by the National Park Service Upper Delaware Scenic and Recreational River in Wayne and Pike counties. The survey team included Dr. Ann F. Rhoads, Assistant Director for Botany of the Morris Arboretum, Ann Newbold, Richard H. Mellon, and Roger E. Latham. Assistance was also provided by Dr. James Parks and Dr. A. E. Schuyler. ANN F. RHOADS.

*ERIGENIA BULBOSA* IN LANCASTER COUNTY, PENNSYLVANIA. *E. bulbosa* (Michx.) Nutt., harbinger of spring, is an early vernal herb of rich, moist woods. In Pennsylvania, it is found in the western tier of counties and has been known east of the mountains only from scattered stations along the Susquehanna River gorge in York County (Wherry, Fogg, and Wahl, *Atlas of the Flora of Pennsylvania*, 1979). In 1981, Parks discovered a small population of *E. bulbosa* in Lancaster County at Safe Harbor about one kilometer from the Susquehanna River. That this might be a significant discovery was first comprehended early in 1984 when a list of additions to the Pennsylvania Endangered Plant Species List was sent to Parks by Thomas Smith of the Nature Conservancy. A careful check of specimens at PH confirmed published records; no Lancaster County report. Checks at GH and NY also were negative. The specimens at US reported to be from Lancaster County proved to be from elsewhere. Accession no. 265372 is clearly from Wrightsville, York County, by A. P. Garber, May 4, 1868. This large collection was widely distributed with duplicates at PH and FMC seen by us. Another specimen from this collection is US accession no. 877081, labeled in someone else's hand as "*Erigenia bulbosa*, Nutt. Lancaster Co. Pa. by A. P. Garber." We think that this specimen is most likely a duplicate of Garber's Wrightsville collection or from that population. The third specimen at US (accession no. 81511) has no locality indicated, but was owned by John M. Bigelow, M.D., Lancaster, Ohio. Whether or not the somewhat ambiguous old records really document the early discovery of *E. bulbosa* in Lancaster County, its present existence in the county is herein reported. The presence of *Erigenia bulbosa* in Lancaster County is not as surprising as the fact that it has gone unrecorded for so long in this highly botanized region. As pointed out by Richard Mellon, the very early flowering time, local rarity, and otherwise nondescript morphology may have combined to keep the species unseen. When it would be noticed, few botanists are afield. The isolated occurrence of this umbellifer in the lower Susquehanna River gorge serves as another reminder that this area is a significant botanical refugium. JAMES C. PARKS AND ANN F. RHOADS.

FOGG/WHERRY MEMORIAL FUND. At the October 1982 meeting of the Philadelphia Botanical Club, members approved the initiation of the Fogg/Wherry Memorial Fund. The purpose of this fund was to purchase a historical herbarium and to help publish a commemorative issue of *Bartonia* (No. 49, issued 8 March 1983) as a memorial to Edgar T. Wherry (1885–1982) and John M. Fogg, Jr. (1898–1982). Both botanists greatly contributed to and were much involved with the life of the club.

A $2500 goal was set. All members of the Philadelphia Botanical Club were notified and the response was generous. An average personal contribution of $20.00 was received, with many contributions exceeding the average amount. Contributions were also received from non-members.

The Fogg/Wherry Fund came to a close at the April 1984 meeting when President William Klein announced that the fund goal had been realized. Sincere thanks are, and have been, extended to those persons who contributed to the Memorial Fund and helped to make it and its commemorative goals a success. KASIA FOGARASI.

MONTGOMERY COUNTY FLOWER. In September, 1984, as part of Montgomery County's Bicentennial Celebration the County Commissioners officially designated *Tulipa sylvestris* to be Montgomery County's flower. Commonly known as The Dutch Lily, it is a graceful yellow tulip of moist woods and meadows. Blooming for two weeks at the end of April and the beginning of May, it seems ubiquitous, brightening county landscapes near abandoned homesteads, at wood's edges, in damp ditches along country roads, and in open low-lying fields.

It arrived here with our forebears from the Palatinate region of South Europe; it is the flower so celebrated in Pennsylvania German painting, pottery, and fraktur. Its arching, nodding form is carved at the margins of old tombstones in graveyards dating back to the Revolution. Barns of the area display "Hex" signs wherein The Dutch Lily holds a prominent place. Hand-painted wedding certificates colorfully portray it. Pottery in the Pennsylvania German collections at the Philadelphia Art Museum and at the Smithsonian Institute proudly exhibit the tulip of Montgomery County.

*Tulipa sylvestris* is not one of the ancestors of our hybrid garden cultivars. It is botanically distinct from them in many ways. It is subscapose, linear-leaved, and widely opening, displaying subsessile stigmas and accuminate tepals. Unlike the cultivated hybrids, its bulb is apparently toxic and therefore eschewed by wild animals. It does not seem to reproduce readily from seed but rapidly propagates asexually from rhizomatus offset bulbs, thereby increasing from one bulb into a large patch in short order. This character, no doubt, accounts for its abundant-yet-local quality. *Gray's Manual of Botany* records it as established in southeastern Pennsylvania. The *Atlas of the Flora of Pennsylvania* shows its confines to be largely Montgomery County. What more deserving plant, then, could become its Official Flower? ANN NEWBOLD.

Bartonia No. 51: 116–120, 1985

# 1984 FIELD TRIPS

April 1: The Plains, Lebanon State Forest Area, NJ. The Botanical Club's first trip of the 1984 season was to the famous Pigmy Forest of the "Upper West Plains." The first stop was one mile south from Rt. 72 where a narrow sandy road runs westerly into the Plains from Stevenson Road. On the sandy banks are numerous scattered cushions of *Corema conradii* over a distance of about 150 feet that were beginning to flower with staminate and pistillate flowers on separate plants. Next we walked the sandy road westerly into the Plains through dwarfed *Pinus rigida* and *Quercus marilandica,* all only head high. Where the road ran out into a marshy creek, a branch of the Wading River, there were isolated bushes of *Kalmia latifolia* and *Ilex glabra*. Along the road were a few large patches of *Pyxidanthera barbulata,* pink, but not yet in bloom; creeping runners of *Arctostaphylos uva-ursi* carpeted the ground in abundance. In sandy places, *Hudsonia ericoides* and *Leiophyllum buxifolium* occurred in openings. Back to Stevenson Road, we drove south to its crossing of another Plains branch creek of the Wading River forming on the west side of the road. Here there is a very small but elegant close stand of *Chamaecyparis thyoides* and, on the other side of the road, a large pond. As the vegetation of the Plains came in contact with the wetter area, it assumed a Pine Barrens look with taller pines, an abundance of sheep laurel, inkberry, staggerbush, black huckleberry, and on a higher open place, patches of trailing arbutus in full bloom. *Clethra alnifolia* and *Myrica pensylvanica* grew close to the water, while in the water there were large stands of *Chamaedaphne calyculata* with buds ready to open. On the way home, Lou Harris took us to his favorite cranberry bogs north of Rt. 72 at Half Way House. Leaders: Ed Gallob and Lou Harris.

April 1: Kimberton Area, Chester County, PA. On a wooded slope owned mostly by Mr. Proctor Wetherill southwest of French Creek Road and southeast of Beaver Hill Road, West Vincent Township, the following species were collected: *Amblystegium tenax, A. varium, Anomodon attenuatus, A. minor, A. rostratus, Astomum muhlenbergianum, Atrichum crispum, A. undulatum, Aulocomnium heterostichum, Bartramia pomiformis, Brachythecium oxycladon, B. rivulare* (?), *Brotherella recurvans, Bryhnia novaeangliae, Bryoandersonia illecebra, Callicladium haldanianum, Campylium chrysophyllum, Climacium americanum, Dicranella heteromalla, Dicranum fulvum, D. montanum, Ditrichum pallidum, Eurhynchium hians, E. pulchellum, Fissidens* sp., *Grimmia alpicola* var. *rivularis, Hedwigia ciliata, Homomallium adnatum, Hypnum imponens, H. lindbergi, Isopterygium elegans, Leskea gracilescens, L. obscura, Leucobryum glaucum, Mnium cuspidatum, Orthotrichum* sp., *Physcomitrium pyriforme, Platygyrium repens, Polytrichum ohioense, Ptychomitrium incurvum, Pylaisiella selwynii, Rhynchostegium serrulatum, Schwetschkeopsis fabronia, Taxiphyllum taxirameum, Tetraphis pellucida, Thuidium delicatulum,* and *Weissia controversa*. Leaders: Nancy Kuntzleman and Anna Felton.

April 14: Tyler Arboretum, Lima, Delaware County, PA. The usual rich spring flora of this Arboretum was studied and we are pleased to report that the elusive blooming dates of previous years were vindicated when we found the Round-leaved Yellow Violet abundant and in full bloom! Leader: John Ballas.

April 29: Tyler Arboretum, Lima, Delaware County, PA. Our traditional moss/lichen walk continues to yield evidence of species diversity not found in other areas of the county. New additions to previous reports in Bartonia were: Mosses—*Fontinalis anti-*

*pyretica*, *Philonotis fontana* (rare), and *Auliocomnium palustre*. Lichens—*Cladonia capitata* and *Parmelia saxatilis*. An experimental planting of the unusual moss *Rhodobryum roseum* removed from an endangered area is flourishing happily in its new location. Leader: James K. McGrath.

May 5: Ridley Creek State Park, Delaware County, PA. The early spring flora was well represented. *Arisaema dracontium* was at its best stage of bloom with plants three feet in height testifying to the abundant rainfall this spring. *Juglans cinerea* (four trees), with prominent dead main limbs, is declining in vigor. It is a rare tree in this area. *Podostemum ceratophyllum* continues to persist despite some evidence of pollution in Ridley Creek. Leader: James K. McGrath.

May 26: Upper Perkiomen Park, Montgomery County Park, PA. The group saw a large, flourishing stand of *Jeffersonia diphylla*, and the same of *Trillium erectum* and *T. grandiflorum*. There were fine displays of *Phlox pilosa*, *Sisyrinchium mucronatum*, *Salvia lyrata*, *Valerianella olitoria*, *Senecio aureus*, and a few *S. pauperculus*. Other species included *Myosotis verna*, *Chamaelirium luteum* (not in bloom), *Anemonella thalictroides*, *Orchis spectabilis*, *Goodyera pubescens*, *Panax quinquefolius*, *Aralia nudicaulis*, *Viola conspersa*, *Anemone quinquefolia* (just past bloom), *Aristolochia serpentaria* (just breaking through the ground), *Thalictrum dioicum*, *Polygonatum pubescens* and *P. canaliculatum*, *Uvularia perfoliata*, *Pedicularis canadensis* and *Hypoxis hirsuta*. Members of Umbelliferae included *Sanicula marilandica*, *Osmorhiza claytoni*, *Zizia aurea*, *Z. aptera*, and *Thaspium barbinode*. *Staphylea trifolia* was in bloom. In the grass on a sunny hillside was a plant of *Orobanche uniflora!* Also we saw two scrubby specimens of *Quercus prinoides*, *Actaea pachypoda* in bloom, *Triosteum*, probably *aurantiacum* rather than *perfoliatum*, some *Hedyotis caerulea* still in bloom, and a variety of "Bedstraws": *Galium triflorum*, *G. aparine*, *G. asprellum*, *G. boreale*, *G. obtusum*, *G. circaezans*, and *G. lanceolatum*. On land belonging to the University of Pennsylvania, *Castilleja coccinea* was in bloom. Leader: Mariana McCabe.

June 1: Mason Run, Gloucester Township, Camden County, NJ. The region we botanized was on the divide between the Inner and Outer Coastal Plains, and we encountered many plant species associated with both the West Jersey flora and the Pine Barrens flora. We started the trip at a small bridge that crosses Mason Run on Little Mill Road and botanized the lower flood plain, the old lake bed, and the headwater areas. The following species are a small sampling of what we saw: *Agrimonia microcarpa*, *Galium triflorum*, *Galium circaezans*, *Sisyrinchium angustifolium*, *Poa sylvestris*, *Helonias bullata*, *Lycopodium lucidulum*, *Lycopodium obscurum*, *Lycopodium complanatum*, *Smilax pseudo-china*, *Carex debilis*, *Carex muhlenbergii*, *Carex annectens*, *Carex blanda*, *Carex swanii*, *Carex albolutescens*, *Carex communis*, *Carex pensylvanica*, *Carex walteriana*, *Carex trisperma*, *Carex seorsa*, *Carex vulpinoidea*, *Carex howei*, *Carex laevivaginata*, *Carex conoidea*, *Carex folliculata*, *Carex intumescens*, *Leersia virginica*, *Plantago virginica*, *Panicum dichotomum*, *Uniola laxa*, *Uvularia sessilifolia*, *Crataegus uniflora*, *Botrychium virginianum*, *Botrychium dissectum* (both varieties), *Woodwardia areolata* and *virginica*, *Asplenium platyneuron*, *Polygonatum biflorum*, *Medeola virginiana*, *Eleocharis tenuis*, *Stipa avenacea*, *Panicum* *depauperatum, Glyceria obtusa* and *striata, Cypripedium acaule, Juncus canadensis,* and *Juncus effusus*. Leader: Joe Arsenault.

June 17–21: Joint Field Meeting of the Northeastern Section of the Botanical Society of America, the Torrey Botanical Club, and the Philadelphia Botanical Club. The annual Joint Field Meeting was held at Salisbury State College, in Salisbury, Maryland. There were 96 participants, of which 92 took part in the full program.

On Sunday evening, Charles Wingo of Salisbury State College Biology Department welcomed the group and Elmer Worthley lectured on the "Vegetation of the Delmarva Peninsula."

On Monday, the group examined dunes, marshes, and forests in the Chincoteague Wildlife Refuge on Assateague Island, Virginia. The sites included a "remote" area that is generally closed to visitors. The leaders were William Sipple, Elizabeth Higgins, A. E. Schuyler, James McGrath, Elmer and Jean Worthley and Larry Klotz. The evening lectures were by William Sipple ("Landform Development and Wetland Succession on Assateague Island") and Larry Klotz ("Flora of Wallops Island and Wallops Mainland, Virginia").

On Tuesday, the group botanized at several sites in two areas of Maryland south of Salisbury: the Nassawango Preserve and Milburn Landing Area, Pocomoke State Park. The principal leaders were James Stasz for Nassawango, and Elmer and Jean Worthley for Milburn Landing. James Stasz's evening lecture on the "Natural History of Nassawango" was followed by a "Lichen Workshop" prepared by Allen Skorepa. The specimens were viewed with microsopes from the Biology Department of Salisbury State College. Participants also examined a display of references on Delmarva flora from Elmer Worthley's personal library.

The Wednesday forays took place north of Salisbury. Daniel Boone and the Worthleys led the trip to two distinctive locales near the Nanticoke River in Maryland: a sparse, sandy woods near Sharptown and a rich woods near Vienna. The other half of the day was spent in southern Delaware with the leadership of Arthur Tucker, Norman Dill, Robert Naczi, and Nancy Seyfried. The group walked in the "Box Huckleberry Site" near Bethel and canoed on Trussum Pond, a bald cypress swamp near Trap Pond State Park. After the evening banquet, a short business meeting was held. Arthur Tucker's evening lecture on "Natural Sources of Perfumes" was illustrated with both visual and olfactory aids. Norman Dill and Nancy Seyfried conducted a poster exhibit on "Methodology of Computer Access to Locations of Rare Plants in Delaware." The Delaware leaders also presented a brief slide show of "100 Delaware Wildflowers, April to October" from the collection at the Claude E. Phillips Herbarium. In addition, Werner Baum showed some of his slides from last year's Meeting. A second business meeting was held to determine the location for the 1985 Joint Field Meeting. Karl Anderson and James McGrath consented to organize it, probably at East Stroudsburg University in East Stroudsburg, Pennsylvania. Chairman: Larry H. Klotz.

August 4: Ponds near Bennett's Mill, Cumberland County, NJ. Abnormally heavy summer rains apparently were responsible for maintaining an unusually high water table, with the result that several of the ponds were not dry as they usually are at this time of the year. These ponds are a few of many such formations in the vicinity that form a fragile and valuable complex now threatened by the unplanned sprawl of housing. Among the plants observed were: *Coreopsis rosea, Carex albolutescens, Scleria reticularis, Eriocaulon septangulare, Proserpinaca palustris, Juncus militaris, Utricularia purpurea, Nymphoides cordata, Gratiola aurea,* and *Xyris smalliana.* Leaders: Dan O'Connor and Stevens Heckscher.

August 19: Piermont Marsh, Rockland County, NY. After getting an overview from Tallman Mountain, we canoed down Sparkill Creek and entered the marsh from the north. Along the shore of the Sparkill we saw a gradual change from high species diversity to low species diversity as we approached the Hudson River and encountered large stands of *Spartina alterniflora* and *Lilaeopsis chinensis. Myriophyllum spicatum, Potamogeton perfoliatus, P. pectinatus, P. crispus,* and *Elodea nuttallii* were submerged in the creek. The marsh is largely dominated by *Phragmites australis* but has some open meadows dominated by *Spartina patens* and *Scirpus americanus* (*olneyi*) among others. Scattered plants of *Hibiscus* were growing in the meadows. *Zizania aquatica* and *Scirpus cylindricus* were infrequent among *Phragmites* near the creek and ditch edges. We were able to locate most of the species previously reported from this marsh (*Sagittaria subulata, Diplachne maritima,* and *Polygonum glaucum* were not located) in the small portion that we botanized. A list of 62 species occurring in this marsh is available from the leaders. Leaders: A. E. Schuyler and Naomi Dicker.

August 26: Rancocas Nature Center, Westampton, Burlington Co., NJ. This trip to old fields, woods, and freshwater tidal marshes along the Rancocas Creek focused on late-summer grasses. Among the 30 species noted were *Phalaris arundinacea, Uniola laxa, Holcus lanatus, Leersia virginica* and *L. oryzoides, Muhlenbergia frondosa, Eragrostis spectabilis, Triodia flava, Leptoloma cognatum, Glyceria obtusa, Arthraxon hispidus, Cinna arundinacea,* and *Zizania aquatica.* A few of the non-grasses seen included *Magnolia virginiana* and *M. tripetala, Botrychium dissectum* and *B. obliquum, Sida spinosa, Heteranthera reniformis, Peltandra virginica, Pontederia cordata,* and *Lobelia cardinalis.* Leader: Karl Anderson.

September 16: Oak Island, New Gretna Area, Ocean County, NJ. We walked along the dirt road that leads from Rt. 9 to Oak Island, occasionally wandering in the wooded swamps that are just inland of the coastal marshes. Leaving the forested area, we continued along the dirt path across Dan's Island and four others before we reached Oak Island. Most of our time was spent botanizing the smaller islands that lead up to Oak Island. The more interesting species were: *Solidago stricta, Viola brittoniana, Habenaria clavellata, Cirsium virginianum, Cirsium virginianum* var. *revolutum* (first sighting in many years), *Sabatia dodecandra,* and *Linum* sp. Other species seen include: *Acer rubrum, Uniola laxa, Solidago rugosa, Solidago rugosa* var. *sphagnophila, Rubus hispidus, Eupatorium rotundifolium, Parthenocissus quinquefolia, Panicum virgatum, Quercus ilicifolium, Eleocharis rostellata, Carex hormathodes, Eleocharis tenuis, Gnaphalium obtusifolium, Bidens coronata, Cyperus ovularis, Drosera filiformis, Helenium autumnale, Atriplex patula, Calamagrostis cinnoides, Smilax glauca, Gaylussacia baccata, Elymus virginicus, Gerardia purpurea, Iris versicolor, Galium tinctorium, Cyperus strigosus, Verbena hastata, Salicornia europaea, Juncus biflorus, Lepidium virginicum, Juncus gerardi, Onoclea sensibilis, Smilax rotundifolia, Quercus alba, Clethra alnifolia, Diospyros virginiana, Solidago odora, Rhododendron viscosum, Leucothoë racemosa, Vitis labrusca, Juniperus virginiana, Aster umbel-*

*latus, Prenanthes trifoliolata, Helianthus angustifolius, Sassafras albidum, Eupatorium album, Osmunda cinnamomea, Lycopodium complanatum, Betula populifolia, Vaccinium corymbosum, Cassia nictitans, Eupatorium hyssopifolium, Triodia flava, Eragrostis spectabilis, Mitchella repens, Agrostis perennans, Agrostis perennans* var. *aestivalis, Chrysopsis mariana, Polygala nuttallii, Lechea racemulosa, Juncus scirpoides, Sericocarpus asteroides, Lobelia nuttallii, Liquidambar styraciflua, Myrica pensylvanica, Agrostis alba, Quercus phellos, Q. falcata, Lycopodium obscurum, Botrychium dissectium* var. *dissectum, Carex swanii, Cypripedium acaule, Pycnanthemum muticum, Monotropa uniflora, Bartonia virginica, Dryopteris thelypteris, Osmunda regalis, Panicum microcarpon, Juncus effusus, Pluchea odorata, Polygonum punctatum, Paspalum circulare, Solidago tenuifolia, Solidago graminifolia, Myrica cerifera, Setaria geniculata, Solidago sempervirens* var. *mexicana, Festuca rubra, Sabatia stellaris, Panicum sphaerocarpon, Erechtites hieracifolia, Aster novi-belgii, Scirpus americanus, Rhus radicans, Distichlis spicata, Spartina patens, Lythrum lineare, Iva frutescens, Teucrium canadense, Acnida cannabina, Polygonum prolificum, Aster subulatus, Aster tenuifolius, Cyperus filicinus, Sorghastrum nutans, Polygala lutea, Apios americana, Juncus greenei* (?), *Solidago fistulosa, Paspalum laeve, Comptonia peregrina, Lespedeza capitata, Andropogon scoparius, Andropogon virginicus* var. *abbreviatus, Carex tonsa, Danthonia spicata, Hudsonia ericoides,* and *Quercus marilandica.* Leader: Joe Arsenault.

September 23: Ridley Creek State Park, Delaware County, PA. This fall flora trip yielded an exceptional number of species (ca. 180) in a variety of habitats, rich woodlands, old fields, and creek edges. Noteworthy "finds" were: *Cacalia atriplicifolia, Chamaelirium luteum, Aster undulatus, Chelone glabra, Hackelia virginiana, Sedum ternatum, Juglans cinerea, Prenanthes altissima, Hydrastis canadensis,* and *Brachyelytrum erectum.* Leader: James K. McGrath.

Bartonia No. 51: 121–124, 1985

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*continued from front cover*



## Program of Meetings 1983–1984

| *1983* | *Subject* | *Speaker* |
| --- | --- | --- |
| 22 Sep. | Members Report on Summer Activities | |
| 27 Oct. | The Rise and Fall of the Flowering Forest | Stevens Heckscher |
| 17 Nov. | Cellular and Molecular Approaches to Plant Development | Andrew Binns |
| 15 Dec. | Great Gardens of the World and Their Contributions to Botanical Research | William M. Klein, Jr. |
| *1984* | | |
| 26 Jan. | Plant Collecting in the Orient | Paul W. Meyer |
| 23 Feb. | A Trip to the Top of the World: Travels in Nepal's Himalaya Range | Robert Peck |
| 22 Mar. | Botanical Activities in Israel | William M. Klein, Jr. |
| 26 Apr. | The Natural History of John Abbot | Joseph Ewan |
| 24 May | Botanical Club Field Trips 1983 | James K. McGrath Coordinator |
| 27 Sep. | Members Report on Summer Activities | |
| 25 Oct. | Vegetation Types of the Malay Peninsula | Benjamin C. Stone |
| 15 Nov. | About Wood—Structure, Properties, Uses, and Identification | Michael H. Levin |
| 20 Dec. | The Bartram Trail | Alfred E. Schuyler |