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A QUARTERLY DEVOTED TO FERNS

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American Fern Journal

Vol. 42 | January–March, 1952 | No. 1

Fern Symbols in a Trinidad Religion

Richard A. Howard[1]

In the northeast corner of the island of Trinidad, near the town of Matura on the Toco road, I met the "prophet" and was introduced to the symbolic use of the climbing fern, *Lygodium micans,* in a local religion. About five miles outside of Matura I slowed my jeep to observe a series of roadside crosses, religious signs, and finally a small house built up from the ground on stilts, the whole house covered with unusual metallic crosses and peculiar tangles of vines, obviously all man-made with considerable care. Since no one was in sight, I drove on slowly, observing the rich vegetation of the Mora forests crowding the highway. A short distance along the Toco road I saw the prophet walking along the roadside. My curiosity prompted me to halt the jeep and the next half hour was spent in conversation with this man of unusual dress and interesting philosophy.

The prophet wore a dark blue cloak of heavy felt which he called his uniform. Adorning the blue felt was a white belt from which hung a carved dagger-like instrument. Over his chest was a series of white crosses, coin medallions, religious pictures, and even his own photograph taken by an earlier tourist. All these hung from aluminum painted safety pins. Down the back of his

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[1] The information for this paper was secured during the course of an eight months field trip through the Lesser Antilles in 1950. The trip was supported in part by a grant from the Penrose Fund of the American Philosophical Society.

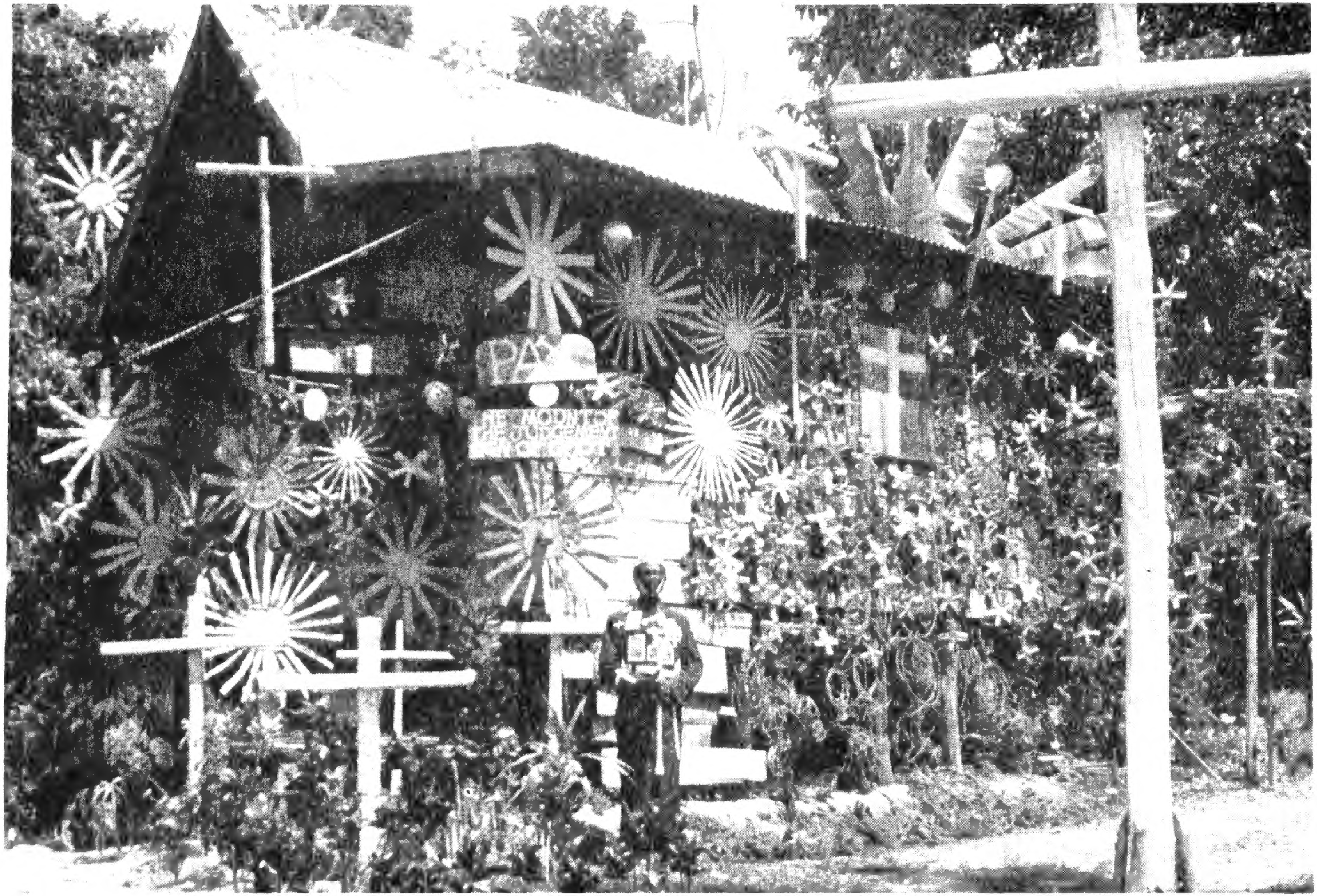
[Volume 41, no. 4 of the Journal, pp. 97–128, was issued Dec. 31, 1951.]

THE PROPHET

cloak was a longer chain of safety pins, also heavily painted, aluminum in color. His felt hat was a skull cap with a heavy chin strap. A cross was outlined in white across the top, the cross subtended by a white circular piece of material. His blue felt shoes bore the same cross and dot pattern on the instep and toes. The prophet carried a carved wooden, double-headed cross, but more striking to me, he carried three baskets woven from the rachises of the climbing fern.

The three Lygodium baskets (Plate 1) were intricate in design and were tightly woven. The largest was perhaps two feet in diameter and two feet high. The smallest one was about six inches square. Each had a woven handle across the top opening. A few inches below the opening of each basket there appeared a false bottom, opening only on one side and necessitating a severe twist of the wrist and subsequent contortion of the arm to pass this platform to reach the more spacious bottom compartment. The baskets were the signs of the prophet. Each had a special purpose. The small one, he told me, was for money and worldly things, the middle sized one for bread and the sustenance of life, the larger one for materials concerned with his work. A bottle of an undisclosed liquid protruded from the opening in the largest basket. A Bible was tucked in one corner and conspicuous in the middle of the platform were half a dozen penny candies. Each basket was decorated with a superimposed design of additional Lygodium rachises and ornamented further with seeds of *Abrus precatorius*.

The prophet, a literate and fluent person, had no hesitation in talking about himself and his work. He was self-ordained to preach the gospel and his directive was several phrases taken from the 21st chapter of the Gospel of St. Luke. These phrases concern "signs and wonders" as manifestations of the Lord. These he para-



THE PROPHET AND HIS HOUSE

phrased and expressed to me as a doctrine that "the Lord shall be revealed through signs and wonders" and he often referred to these as "mysteries." This explained his appearance and the decorations on his house. His flock numbered about 19 members, all living in the forest in the vicinity. Unfortunately, he explained, not everyone believed him or was sympathetic to his cause. In fact he had been investigated by both the British and American Intelligence agencies during the war but both agencies cleared him to continue his work.

When I inquired about the house I had passed a short distance back on the road he said it was his and invited me to stop and see it. I offered him a ride in the jeep and we returned to his parish. The house (Plate 2) was built on the crest of a small sandy hill. In construction it was no different from other native houses in the vicinity. In appearance, however, it was strikingly different. The approach to the house was a forest of crosses and signs all proclaiming the virtues of the scripture, with a few signs forecasting things to come. The grounds were well landscaped with colorful crotons, hibiscus, and bougainvillea. He expressed concern over the erosion in his front yard, especially since the steps, cut in the sand bank were becoming difficult to maintain.

The outside of the frame house with its galvanized iron roof was covered with the unusual metallic symbols I had observed earlier. Closer observation revealed that these were made from tin cans. Small cans such as bean cans were cut four times and the arms folded outward. The curved sections of the walls flashed in the sun. The larger crosses with more numerous arms were made from gallon to ten-gallon cans procured from the salvage dump at Waller Air Force Base. He preferred the square bottom cans since they made flatter and more attractive crosses.

Adorning some of the large wooden crosses in the yard and intermingled with the symbols on the walls of the house were a series of man-made tangles of vines. Most of these too were twining stems of *Lygodium micans,* although *Gouania, Coccoloba ascendens,* and *Smilax* were used. All of these he called symbols, inspired works or mysteries.

By this time the prophet had learned I was a botanist and interested in the plants. Grasping one of the tangles he asked, "What would you call this?" First I supplied the name of the plant material for him, but he had in mind a name for the object, not the material. I admitted I could find no name for the tangle. His face brightened as he declared, "There, you are an educated man and you do not know what they are. They are the mysteries. They are inspired words. Their meaning is revealed only to the prophet and his followers." I asked him how long it took to make such a mystery, but I learned they are not made, "they are created, inspired works and have no time." No two of these mysteries were alike, for each symbolized a different set of values. Then he explained that the more significant pieces of inspired works were kept inside the house. As we mounted the short series of steps at the rear of the house he pulled from his pocket a tremendous bunch of keys. He selected one to open a huge padlock for he explained again that those who did not believe were likely to damage his property. The door opened and we entered a small two-room house. Each room was crowded with more tin can symbols and numerous tangles of vines decorated with paper or wilted flowers. These were the high mysteries and were carried in his processions. The place was dark, dank, and had a musty smell. He explained the odor was from the incense he burned three times a day on the candelabra and on the two small altars in the house. I asked the composition of the incense and again learned it was mystical material gathered in the woods nearby and he could not reveal its origin or nature. It was burned in honor of his patron, Saint Michael. It was obvious from the odor that at least one component of the incense was the gommier, *Dacryodes excelsa*, a tree which yields a resinous inflammable material. Tucked in one corner of the first room was a small cot and over it a shelf holding a few books.

My attempts to purchase one of his Lygodium baskets were futile, for he could not part with a "mystery." So after listening to several verses of scripture and receiving his blessing as he held one of my hands and placed his other on the top of my head, I offered him a coin for his work and departed, having learned of a symbolic use for *Lygodium micans.*

HARVARD UNIVERSITY

Pteridophytes from Two Liberian Counties

W. T. WINNE

During June and July, 1949, the writer botanized in two rather small and widely separated localities in Liberia, West Africa. One county, Montserrado, is coastal, and the other, Sanokwele, forms a part of the Liberian hinterland adjoining the French Ivory Coast. An effort was made to collect all bryophytes and pteridophytes, and also those spermatophytes in flower or fruit. This work yielded over nine hundred sheets of dried specimens representing some three hundred species.

The collections may be most logically discussed in connection with the two localities where they were made: Bushrod Island, in Montserrado County, and Sanokwele Village, in Sanokwele County.

BUSHROD ISLAND

The northwest edge of Monrovia, on the Liberian coast, is bounded by a shallow inlet of the sea, Mesurado Lagoon. A segment of the coast some three miles long is cut off by the St. Paul River, which flows into the sea four miles north of Monrovia. A shallow estuary, Stockton's Creek, connects the Mesurado Lagoon with the St. Paul River, so that this coastal segment is quite surrounded by water and has been named Bushrod Island. Its east-west dimension as established by Stockton's Creek and the coast is approximately two miles. The modern wharf and harbor facilities for Monrovia are built at the southern tip of Bushrod Island, whose nearness to Monrovia and flat, accessible character have led to rather extensive development. There are scattered plantations of rubber, cassava, and coffee, with a considerable part remaining as dense first growth forest. Some of the previously cultivated tracts have been abandoned to "bush." The island supports three large Kru villages, whose people fish, farm, or work in Monrovia.

Located at 6° 20′ North Latitude, three hundred miles north of the equator, Bushrod Island has an annual rainfall in the range of one hundred and fifty to two hundred inches, with heaviest monthly precipitation in June, July, and August, when forty inches of rain may sometimes be measured over a thirty day interval.

A cool sea breeze comes in during most of the year and temperatures rarely exceed 90° F. A night low is 65° F. In general, the temperature is wonderfully uniform in a range between 75° F. and 85° F. During December, January and February, there is little rainfall and the weather shows extremes of heat and cold as the Sahara-derived harmattan wind sweeps down from the north.

The soil of Bushrod Island is chiefly the washed sea sand of old beaches and coastwise bars. The topography is characterized by low ridges alternating with swampy troughs all parallel with the western sea beach. The land elevation nowhere exceeds fifteen feet.

At the eastern side of the island by Stockton's Creek, vegetation is lush and thick with many great trees. This is gradually reduced coastward till at the beach there are widely separate stands of such shrubby forms as *Chrysobalanus, Heisteria, Chasalia,* and others. Lack of fertility seems the limiting factor, rather than salinity, since vegetation within reach of the surf spray shows no extensive halophytic modification.

The yield of ferns on Bushrod Island was comparatively poor in species, though the ones observed occurred in considerable masses. *Polypodium Phymatodes* L. (no. 196) formed extensive colonies in the sand within a stone's throw of the surf. While it grew well in open exposed sites, it reached a maximum of luxuriance in the half-shade of beach shrubs. Though usually on epiphyte, this species is strictly terrestrial on Bushrod Island.

Trichomanes cuspidatum Willd. (no. 222) was collected as an epiphyte on large tree trunks among the mossy growth on the half-shaded parts. Such *Trichomanes*-bearing trees were observed along estuarine runs rather than at the seaward side of the island.

Acrostichum aureum L. formed brakes six feet high at the edge of Mesurado Lagoon. This great salt water fern does best in the full sunlight and was found in open spaces together with great stands of *Avicennia nitida* Jacq.

A hundred yards east of the beach and extending to Stockton's Creek, the two most abundant pteridophytes are *Pteridium aquilinum* (L.) Kuhn (no. 17) and *Selaginella myosurus* (Swartz) Alston (no. 18). The *Pteridium* forms thickets in the mixed sand and humus of open places. It characterizes cutover areas which have been neglected. Forest clearing is progressing towards

Stockton's Creek, and it is on the seaward side of the still remaining forest that *Pteridium* is most abundant. *Selaginella myosurus* is one of the most common of Liberian pteridophytes. Except on the immediate beach, it is everywhere present over Bushrod Island as a delicate overgrowth on other plants or as a ground cover. The collector notices considerable variation in shade of leaf in a range from light green to bluish green. Frequently root connections of this *Selaginella* seem very tenuous, with the growth appearing partly or completely epiphytic.

SANOKWELE COUNTY

The second collecting region centered in Sanokwele County on the Liberian inland frontier. Climatological data for the region are wanting, but relative to the coastal regions precipitation is less than one half as great, with the dry season somewhat longer and more severe. Humidity is less than that along the coast but temperature variations are essentially the same. The soil is a uniform red laterite containing oxides of aluminum, silicon, iron, and calcium; it is of extremely variable fertility. The terrain is pleasantly rolling and dissected by many streams usually trending westward toward the coast. The mountains in the frontier regions reach elevations of nearly 5000 feet and are forested to near the summit, where the naked sandstone may sometimes be seen. The ground elevation about Sanokwele Village is approximately fifteen hundred feet.

The vegetable cover in Sanokwele has been extensively altered by the upland rice farming of the dense native population. The primal forest cover in Sanokwele has been largely cut or burned away to make clearings for rice culture. The land use is a very wasteful one, since the natives crop a piece of land only once in seven years. In the interim, a characteristic invasive "bush" growth takes over. It is this "bush" which determines the landscape character in Sanokwele. Along steep runs, on mountain sides and other inaccessible places, the original forest cover remains. On the sides of the higher mountains increased precipitation has led to typical rain forest associations. A botanist in Sanokwele collects chiefly by wandering over the myriad native trails which interlace the whole region.

The most conspicuous and first collected pteridophytes are the epiphytic members. Of these *Nephrolepis biserrata* (Swartz) Schott (nos. 60, 84) is the most abundant. It grows luxuriantly on the shaggy trunk of the oil palm, *Elaeis guineensis* Jacq., where the stiff persisting leaf bases offer good humus reservoirs. Since the oil palm is usually spared by the natives in their clearing operations, and since most specimens are invested with *Nephrolepis,* this is one of the most common of Liberian ferns. Other epiphytes are *Oleandra neriiformis* Cav. (no. 58) and *Drynaria Laurentii* (Christ) Hieron. (no. 25). The leathery simple leaves and woody twining stems of *Oleandra* make a much more figlike than fernlike appearance. Though uncommon, *Oleandra* makes a fiercely vigorous growth where it does occur. Frequently the supporting tree trunk is invisible. The highly dimorphic fronds of *Drynaria* were the largest plant specimens taken.

Lygodium scandens (L.) Swartz (no. 32) scarcely qualifies as an epiphyte since it rarely ascends higher than six feet. It usually scrambles over herbaceous plants or low shrubs in the half shade of forest margins where its light green succulent leaves are most attractive. *Gleichenia linearis* (Burm.) Clarke (no. 149) is also of scandent habit and grows sporadically along steep trailsides or creek banks.

In the Sanokwele countryside most pteridophytes are found in hollows between low hills. Such depressions at their lowest part are commonly swampy swales. Here there are zones of more constant moisture and richer humus accumulation as well as partial shade. Species collected about the margin of swales are *Lycopodium cernuum* L. (nos. 33, 44), *Dryopteris striata* (Schum.) C. Chr. (no. 28), *Pityrogramma calomelanos* (L.) Link (no. 148), *Polypodium polycarpum* Cav. (no. 41), *Nephrolepis cordifolia* (L.) Presl (no. 143) and *Pteris spinulifera* Schum. (no. 83).

A fern of remarkable habit and habitat was encountered in *Bolbitis Heudelotii* (Bory) Ching (no. 84), on submersed rocks in a swiftly flowing stream, its rhizomes being closely appressed to the seams in the downstream face of the rocks. The fronds are dark green and leathery.

As at the coast, *Selaginella myosurus* (Swartz) Alston (no. 94) was a most abundant element. The only other form common to coast and upland is *Pteridium aquilinum,* which rapidly establishes itself in abandoned rice fields. Tiny *Selaginella subcordata* A. Br. (no. 77) made a mosslike growth on the bare clay of trailsides.

Two mountain trips were made during the stay in Sanokwele. The first included an examination of Sopea Mountain, which has an elevation of approximately three thousand feet and is characterized by a naked domelike sandstone summit. A typical rain forest extends up the mountain to end abruptly at the exposed sandstone, which rises a few hundred feet higher to form the mountain top. *Dryopteris protensa* (Afzel.) C. Chr. (no. 126) and *Pellaea Doniana* Hook. (no. 123) grew in moist humus at the mountain base. These species were only weakly lighted under the dense, reeking forest cover. Somewhat higher on the mountain but still in the forested zone, great mossy boulders lay about. These were covered with thick growth of *Asplenium Dregeanum* Kunze (no. 116), *Asplenium formosum* Willd. (no. 118), *Vittaria guineensis* Desv. (no. 117), and *Selaginella ca-*

thedrifolia Spring (no. 131). At the very top of Sopea Mountain in a slight depression in the sandstone grew a remarkable clone of *Nephrolepis cordifolia* (L.) Presl (no. 110), with the fronds all stiffly upright and oriented in ranks with almost military precision.

The second mountain explored lies near the French Guinea frontier and rises to a height of over four thousand feet. It is called Billi Mountain or Bobei Mountain, after Bobei Village near its base. Though the forest cover is dense and primal with near-rain-forest precipitation, few pteridophytes were collected. *Dryopteris protensa* var. *speciosa* (Mett.) C. Chr. (no. 164) grew in the comparatively bare humus near the mountain base. *Selaginella versicolor* Spring (no. 163) and *Selaginella Vogelii* Spring (no. 165) were found in the same habitat.

The writer wishes to acknowledge the assistance of Mrs. Winifred Harley, of Ganta Mission, Liberia, a long-time student of Liberian ferns, and of C. V. Morton, in the identification of the specimens. The herbarium of the Smithsonian Institution supplied material for direct comparison in most cases.

UNION COLLEGE, SCHENECTADY, NEW YORK.

Sand Hill Ferns of Henderson County, Texas

ARCHIBALD W. ROACH AND BENJAMIN B. HARRIS

The central or sand hill portion of Henderson County, Texas, consists of an area of undulating hills of the coastal plain formation. This region is degraded by many branching, spring-fed streams, which serve, where the streamside forest synusia is closed, as estival and autumnal fern habitats, when surrounding counties are dry and non-productive. The county is in east-central Texas, bounded on the east by the Neches River and on the west by the Trinity River. The sand hills (located at 95° 50′ W. Long. and 32° 10′ N. Lat.) are at an elevation of 450 to 500 feet.

The substrates consist largely of the Norfolk and Portsmouth series. Norfolk fine sand is composed of a brownish gray topsoil, 5 to 8 inches in depth, with a loose pale yellow subsoil 5 to 15 feet deep. The loose topsoil acts as a mulch so that the moisture table is high when other soils of the county are dry to a great depth. The typical profile is developed under a post-oak (*Quercus stellata* Wang.)—blackjack-oak (*Quercus marylandica* Muench.) association. Around the springs and along the smaller creek branches, the soils are Portsmouth fine sand. The indefinite profile is one of gray sand grading down into smaller-increment layers innerbedded with thin lenses of peat. The soil is always wet because of seepage waters from the higher hills. The resulting vegetation is palustrophytic. Dominant and indicator species are sweet gum (*Liquidambar stryraciflua* L.), water oaks as red-oak (*Quercus falcata* Michx.) and Shumard's Oak (*Quercus Shumardii* Buckl.), many frutescent species, such as wax-myrtle (*Myrica cerifera* L.), and such paludophytes as sundew (*Drosera rotundifolia* L.) and pitcher plant (*Sarracenia sledgei* Macf.).

Specimens were obtained by Harris during July and August, 1927, and the area was re-collected by Roach in August, 1951. Numbers of the former are herbarium sheet numbers and those of the latter are collection numbers. The cited sheets are in the North Texas State College Herbarium.

OSMUNDACEAE

OSMUNDA CINNAMOMEA L. Cinnamon-fern, Buckhorn. Abundant on drainage slopes along creeks in deep shade, on Norfolk sand. 6 miles south of Athens, *Harris* 2189; 5 miles south of Athens, *Roach* 325.

OSMUNDA REGALIS L. var. SPECTABILIS (Willd.) Gray. Flowering or royal fern. Abundant around springs and along small creek branches in deep shade, on Portsmouth sand. 6 miles south of Athens, *Harris* 2194; 4½ miles south of Athens, *Roach* 321.

POLYPODIACEAE

ATHYRIUM FILIX-FEMINA (L.) Roth var. ASPLENIOIDES (Michx.) Farw. Lady-fern. Rare around spring in bed of orchids (*Habenaria ciliaris*), on Portsmouth sand. 6 miles south of Athens, *Roach,* 323.

ONOCLEA SENSIBILIS L. Sensitive fern. Rare along stream banks, scattered, on Norfolk sand. 6 miles south of Athens, *Harris* 2210; bank of Koon Kreek Klub Lake, 9 miles south of Athens, *Roach* 324.

PTERIDIUM AQUILINUM (L.) Kuhn var. PSEUDOCAUDATUM (Clute) Heller. Bracken. Common along Shelton Mill Creek, in upland post-oak stands, in local patches along smaller streams. 8 miles south of Athens, *Roach* 320.

WOODWARDIA AREOLATA (L.) Moore. Netted chain-fern. Abundant around springs and along small creek branches in deep shade, on Norfolk and Portsmouth sand. 6 miles south of Athens, *Harris* 2237; 5 miles south of Athens, *Roach* 322.

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NORTH TEXAS STATE COLLEGE, DENTON, TEXAS.

A List of Ferns from the North Shore of Lake Superior, Minnesota

OLGA LAKELA

From the sands of Minnesota Point, the sandbar islands of Duluth harbor, along the rugged lake coast to the gorge of Pigeon River on the Canadian boundary, there occur many types of habitats suitable for growth of ferns. The climate, moderated by the large body of water, ample rainfall and fogs, has been conducive to the development of a fairly rich and varied fern flora. In this area of moist sands, exposed rocks, sheer cliffs, shady forest, swamp, and mossy ledges have been collected forty-two different taxonomic entities. The present paper is based on collections in the herbarium of the University of Minnesota at Minneapolis and the herbarium of the Duluth Branch.

The genus *Botrychium* is represented by eight entities. Of these, *B. Lunaria* and *B. matricariaefolium* are local, only collected in Lake and Cook counties. *B. multifidum* and its varieties are encountered in the sands of Minnesota Point, at Duluth, and in grassy mats of vegetation on the lakeshore farther northeast. *Ophioglossum vulgatum* var. *pseudopodum* within our area is known only from a sandbar island in Duluth harbor, where it appeared in pioneer vegetation. Of the Osmundas the least frequent is *O. regalis* var. *spectabilis*, known only from Devil's Track, in Cook County. The rare *Asplenium Trichomanes* is in the interior of Cook County.

Athyrium Filix-femina var. *Michauxii* and its forms, *elatius* and *rubellum*, occur commonly throughout the area in moist habitats. In Gooseberry River Gorge on basaltic rocks, *Cryptogramma Stelleri* occurs sparingly; elsewhere it has been collected only from sedimentary rocks. On mossy rocks and in moist shady terrain grow

Cystopteris bulbifera and *C. fragilis,* the latter with varieties *Laurentiana* and *Mackayi.* Another collection of this genus from the high bluff at East Beaver Bay, Lake Superior, Lake County, was recently determined by C. V. Morton as *C. Dickieana* Sim, a recently recognized fern in North America.[1]

The genus *Dryopteris* is represented by nine entities. Typical crevice-growing species are *Dryopteris fragrans* var. *remotiuscula* and *D. Robertiana.* The remaining species are common throughout the area in moist mossy woods and swamps, where also may be encountered *Onoclea sensibilis* and *Pteretis pensylvanica.* Of general occurrence are *Pteridium aquilinum* var. *latiusculum* and *Polypodium virginianum.*

Seven species of the genus *Woodsia* are known in the area. In exposed situations occurs *W. ilvensis.* Less frequent are *W. alpina, W. Cathcartiana, W. glabella,* and *W. scopulina.*

Several of the species in the list have a wide general distribution; others are more restricted. Distinctly northern elements are *Botrychium multifidum, Dryopteris fragrans* var. *remotiuscula, D. Robertiana, Woodsia alpina, W. Cathcartiana* and *W. glabella.* *Woodsia scopulina* has primarily a western distribution. Species of the following genera, occurring elsewhere in the state, are unknown in the northeastern section: *Adiantum, Camptosorus, Cheilanthes,* and *Pellaea.*

BOTRYCHIUM LUNARIA (L.) Swartz
B. MATRICARIAEFOLIUM A. Braun
B. MULTIFIDUM (Gmelin) Ruprecht
B. MULTIFIDUM f. DENTATUM Tryon
B. MULTIFIDUM var. INTERMEDIUM (D. C. Eaton) Farwell
B. SIMPLEX Hitchcock
B. VIRGINIANUM (L.) Swartz

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[1] Alston, A. H. G. An overlooked North American fern. This JOURNAL 41: 76. 1951.

B. VIRGINIANUM var. EUROPAEUM Angström
OPHIOGLOSSUM VULGATUM L. var. PSEUDOPODUM (Blake) Farwell
OSMUNDA CINNAMOMEA L.
O. CLAYTONIANA L.
O. REGALIS L. var. SPECTABILIS (Willdenow) A. Gray
ASPLENIUM TRICHOMANES L.
ATHYRIUM FILIX-FEMINA (L.) Roth var. MICHAUXII (Sprengel) Farwell
A. FILIX-FEMINA var. MICHAUXII f. ELATIUS (Link) Clute
A. FILIX-FEMINA var. MICHAUXII f. RUBELLUM (Gilbert) Farwell
CRYPTOGRAMMA STELLERI (Gmelin) Prantl
CYSTOPTERIS BULBIFERA (L.) Bernhardi
C. DICKIEANA Sim
C. FRAGILIS (L.) Bernhardi
C. FRAGILIS var. LAURENTIANA Weatherby
C. FRAGILIS var. MACKAYI Lawson
DRYOPTERIS CRISTATA (L.) A. Gray
D. DISJUNCTA (Ledebour) Morton
D. FRAGRANS (L.) Schott. var. REMOTIUSCULA Komarov
D. PHEGOPTERIS (L.) C. Christensen
D. ROBERTIANA (Hoffmann) C. Christensen
D. SPINULOSA (O. F. Müller) Watt
D. SPINULOSA var. AMERICANA (Fisch.) Fernald
D. SPINULOSA var. INTERMEDIA (Muhl.) A. Gray
D. THELYPTERIS (L.) A. Gray var. PUBESCENS (Lawson) A. R. Prince
ONOCLEA SENSIBILIS L.
POLYPODIUM VIRGINIANUM L.
PTERIDIUM AQUILINUM (L.) Kuhn var. LATIUSCULUM (Desvaux) Underwood
PTERETIS PENSYLVANICA (Willdenow) Fernald
WOODSIA ABBEAE Butters
W. ALPINA (Bolton) S. F. Gray
W. CATHCARTIANA Robinson
W. GLABELLA R. Brown
W. GRACILIS (Lawson) Butters
W. ILVENSIS (L.) R. Brown
W. SCOPULINA D. C. Eaton

UNIVERSITY OF MINNESOTA, DULUTH BRANCH, DULUTH, MINN.

Shorter Notes

FERNS ON A PRISON WALL.—Circumstances have taken me rather frequently in the past three years to the town of Carlisle, in Cumberland County in central Pennsylvania. The town and county, both founded in 1751, were named after their English counterparts. The town has interesting historical records of George Washington's visits and of Civil War incidents, and is the site of Dickinson College, over 175 years old. It also has a War College, where colonels may study to become generals, on the site of the former Carlisle Indian School. Stone buildings of considerable age are numerous.

A county prison, patterned after a Norman castle of Carlisle, England, was built in 1754. This has a red-sandstone front; the back wall and the massive yard walls, about 18 feet high, are of gray limestone. These walls, enclosing a square yard, have a total length of upwards of 500 feet and are in fairly good condition, except for one small stretch a few feet in length. However, except where some recent repointing has been carried out on one side, the pointing mortar has fallen out. The resulting crevices have proved fine sites for hundreds of plants of cliff-brake (*Pellaea atropurpurea*). I first noticed the plants on the outer sides of the northern and eastern walls, where the plants are scattered at all levels, although most abundant near the top. Inside the yard, to which the officer in charge, Mr. Seiders, was good enough to admit me, the cliff-brake was seen to be on all the walls, but most copiously along the top edge of the eastern wall, where good sized plants formed a continuous fringe.

Perhaps this particular fern habitat has already been noted and reported. I am wondering whether there are any botanical records that indicate how long the ferns have been established there. Masonry walls are not infrequently reported as sites for lime-loving ferns. Only this one species of fern was noted as established.—R. C. BENEDICT.

A CROSS-COUNTRY DRIVE AND THREE FERN SPECIES.—If anyone had suggested in the past that I would be taking a trip across the country by automobile without making a single side field trip for ferns, I would have scouted the possibility. However, that is what happened during 1951, when a "family" expedition took me to southern California through the Colorado Rockies and to various national and other scenic spots, with a rapid return which started from Yosemite Valley and its eastern entrance, Tioga Pass.' An over-all recollection of the fern situation on the whole trip is that there just are no roadside species, such as are common in many eastern states.

The three ferns I saw were in gardens. Two of these were in a Santa Barbara garden, where they were used for filler, *Woodwardia spinulosa* and *Nephrolepis cordifolia*. I'd like to nominate the California native *Woodwardia* for possible preeminence as a garden species. Its chief competitor, in my view, would be the royal fern. Since they thrive chiefly under dissimilar climatic situations, perhaps no satisfactory basis for comparison may be available. The plants I saw had leaves six to seven feet tall, beautifully green at the middle of August. The other fern was the Australian *Dicksonia antarctica* in a Los Angeles garden.

Incidentally, another line of interest which I have followed through more than fifty years of fern interest, snakes, was equally unrewarded. I did make several roadside stops and enquiries from park rangers *et al.* to try to come upon a rattlesnake in its natural haunts, but to no avail.—R. C. Benedict, *Brooklyn College.*

Recent Fern Literature

Our member Mrs. Una F. Weatherby has published a biography of the late Mr. Weatherby.[1] This is not for sale, but a limited number of copies are available for distribution. Enquiries should be addressed to the Librarian, Gray Herbarium of Harvard University, Cambridge 38, Massachusetts.

One might say that the book is really written mostly by Mr. Weatherby himself, for it consists largely of extracts from his voluminous letters, which deal with many literary, musical, historical, and scientific matters. These letters reveal Mr. Weatherby's interesting character much better than a casual acquaintance with the man himself would have. Although obviously not "composed" with any thought of future publication, the letters stand up well from a literary viewpoint, for Mr. Weatherby was naturally a careful and lucid writer.—C. V. M.

American Fern Society

Report of the President for 1951

This report, my final one as an officer, may serve both to inventory progress for the past year and to carry some parting remarks about fern study and the Society. The year 1951 was one of quiet progress for the Society. The greatest event in pteridology was certainly the delivery to our hands during the year of Professor Irene Manton's outstanding book, Problems of Cytology and Evolution in the Pteridophyta,[2] truly a "monumental work." The four 1951 issues of the Journal highlight our continually widening knowledge of the precise distribution of North American ferns. The finding of

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[1] Charles Alfred Weatherby, A Man of Many Interests, by Una F. Weatherby. pp. 1–189. Portrait. 1951. Privately printed, Cambridge, Massachusetts.

[2] See this JOURNAL **41**: 88. 1951.

Dryopteris setigera in Texas, *Thelypteris pilosa* in Alabama, *Lygodium palmatum* in Vermont, *Thelypteris sclerophylla* in Florida, and *Cystopteris dickieana* distinguished from the common bladder fern on the Pacific Coast, made "news" in fern study. Perhaps the finding of *Onoclea sensibilis* in Colorado, as another instance on an eastern fern in the Rocky Mountain region, and reported by Harrington and Durrell in 1950, should be noticed in this connection, if belatedly.

Without much doubt the Journal is the heart of the Society, indeed, it practically *is* the Society. Your contributions as members constitute its blood supply, and our able editors maintain a healthy balanced metabolism between professional papers, essential to the progress of our science, and personal experiences in the field, garden, and library, essential to our Society and the comradeship that cames from our association together. Photographs, both good habitat shots (especially of southern and southwestern ferns) and photomicrographs of soral details, make a valuable contribution to the Journal. Growing gametophytes from spores—the kind of data that Professor Manton's work is based on in part—offers rewarding fun.

Our transcontinental distribution as members will prevent the Society from ever enjoying really large meetings with a national representation. But may I call your attention to our Treasurer's proposal of organizing local groups for the study of ferns; persons who might be interested in promoting such local groups are urged to write to Mr. Mann, who has had experience in the New York area in such local meetings, for suggestions.

And to those new members who have not discovered that back numbers of the Journal are still available at a modest price, I should like to remark that the past volumes hold exceedingly good reading. Then, too, remember the pages of the Journal are open to you for want lists of specimens and literature.

Finally, it is a pleasure to thank the officers of the Society, past and present, with whom I have been associated over the past decade in my capacity as Vice President and President, for their patience and genial cooperation.

JOSEPH EWAN, *President*

Report of the Secretary for 1951

The membership of the Society has been increased by 50 new members during the year 1951. Of this number eight were previous subscribers to the Journal. The new members came from 22 different states, New York and New Jersey leading, with California a close competitor. One joined the Society from Mexico, where there are already several members, and another from Australia to become the only representative on our list from that great island continent.

Altogether we find 27 members outside the United States, distributed widely throughout the Canadian provinces, Cuba, Jamaica, Mexico, the countries of Central and South America, England, Italy, South Africa, Indonesia, the Hawaiian Islands, and China.

The Society has lost by death seven members, all of whom joined during recent years: Mrs. Elsie Merz, South Orange, N. J., a member since 1942; Cecil Billington, Birmingham, Mich. (1945); Eugene R. Habermehl, Milwaukee, Wisc. (1948); Dr. H. H. Hazen, Washington, D. C. (1946); Alain White, Summerville, S. C. (1949); Mrs. Orra Parker Phelps, Gansevoort, N. Y. (1948), and Dr. DeWitt Stetten, Rushland, Pa. (1947).

There are always changes in membership from year to year through resignations and non-payment of dues, the names of 37 having been removed from the list during the year. This leaves a total membership of 430, a net gain of six during the year. Recently a new and revised membership list has been prepared by Mr. Morton, and printed for distribution to the members.

The appeal of our energetic Treasurer for sustaining members sent out early in the year met with a gratifying response, 37 regular members expressing their willingness to help the Society in this way. With the addition of one new life member the Society has now 23 life members, four honorary members, and two charter members —Miss Elmira E. Noyes and Dr. Campbell E. Waters.

A favorable vote was received to the question on the ballot regarding the membership of the Society in the International Association for Plant Taxonomy.

At the annual meeting of the American Institute of Biological Sciences held in Minneapolis, Sept. 10–13, some of the members of the Fern Society who were present came together for a breakfast, among them Dr. and Mrs. R. M. Tryon, Dr. Dwight Moore, Dr. and Mrs. W. H. Wagner, Dr. Nicholas Polunin, and C. V. Morton.

Last March and April I collected ferns in Costa Rica, that Central American country so small in extent, yet so varied in range of altitude and climate, and so unbelievably rich in the number of fern species. To Dr. L. R. Holdridge, Professor of Ecology at the Inter-American Institute of Agricultural Sciences at Turrialba, the only member of the Fern Society in Costa Rica, I am deeply indebted for his gracious hospitality, the benefit of his extensive knowledge of the country, his keen interest in my project, and stimulating help in many ways. At the home base Dr. W. H. Wagner gave much time and thought to "briefing" me before the trip and studying my collection later. He generously consented to look after Fern Society correspondence while I was far away. It is, therefore, a special pleasure to welcome him as the new Secretary for 1952!

Respectfully submitted,

EDITH SCAMMAN, *Secretary*

Report of the Treasurer for 1951

Once more the Society has come through this time of rising prices in good financial condition. Printing and distributing the Journal requires about 85% of our entire income and the costs of printing have risen with everything else. However, 37 of our members took out sustaining memberships for the year and their generosity and interest has been in a great way responsible for our avoiding a deficit. In addition, many of our members have been active in putting membership application blanks into the hands of friends who were interested in joining the Society. Unfortunately, for one reason or another, we do have a high turnover in our membership, which means that we should all search out those interested in ferns if we are going to continue to grow as we should. The subscription rate for non-members has been slightly increased to bring it in line with the membership rate.

Mrs. Verona Devine Burton, of Mankota, Minnesota, took out a Life Membership and this income was deposited in the Special Savings Bank Account. No withdrawals have been made from the two special accounts or from the reserve fund.

Receipts	*Amount*	*Total*
Cash on hand, January 1, 1951		$1,174.09
1950 membership arrears	$ 22.00	
1951 membership renewals	579.00	
1951 sustaining members	185.00	
1951 new members	83.10	
1952 membership renewals	27.00	
1952 sustaining members	5.00	
1952 new members	14.00	
1950 subscription arrears	3.10	

1951 subscription renewals	98.75	
1951 new subscriber	1.40	
1952 subscription renewals	221.20	
1953 subscription renewals	3.00	
Life membership	35.00	
Sale of back numbers, A. F. J.	121.72	
Sale of Vars. & Forms, Index, etc.	4.00	
1951 advertising	20.00	
Reprints	98.12	
Sale of surplus library books	76.35	
Miscellaneous	10.09	
		1,606.83
		$2,780.92
Deduction a/c agencies commission—(subscribers)*		39.33
		$2,741.59

* Deducted at source of subscription.

Disbursements	*Amount*	*Total*
Business Press		
A. F. J. Vol. 40, No. 4	$329.30	
A. F. J. Vol. 41, No. 1	284.41	
A. F. J. Vol. 41, No. 2	255.70	
A. F. J. Vol. 41, No. 3	267.30	
2,500 printed envelopes	38.00	
Reprints	127.47	
Printing membership list	53.50	
Life membership—to Special Account no. 2	35.00	
Refund on book sale	4.00	
Expenses		
President	1.80	
Treasurer	68.45	
Secretary	37.66	
Editor	18.40	
Curator of Herbarium	36.75	
		$1,557.80
Cash on hand, January 1, 1952		$1,184.79

STATEMENT DECEMBER 31, 1951

Assets	*Amount*
Cash on hand	$1,184.79
In Special Account #1	556.48
In Special Account #2	572.28
In Reserve Fund	1,523.01
Inventory A. F. J.	500.00
A. F. S. Library	300.00
	$4,636.56

Liabilities	*Amount*
Capital Account	$2,934.55
Suspense credit	
1952 membership	47.00
1953 membership	1.60
1952 subscription	191.27
1953 subscription	3.00
Distribution Vol. 41, No. 4	330.38
Bissell Herbarium Fund	556.48
Life Membership Fund	572.28
	$4,636.56

Respectfully submitted,
M. D. MANN, *Treasurer*

Report of the Judge of Elections

The results of the recent balloting for officers of the American Fern Society for the year 1952 are as follows:

For President	
R. C. Benedict	138
Joseph Ewan	1
For Vice President	
Donovan S. Correll	137
Miss Edith Scamman	1
For Secretary	
Warren H. Wagner, Jr.	137
For Treasurer	
M. D. Mann, Jr.	136

To support as a Voting Member the activities of the International Association for Plant Taxonomy:

Yes:	133
No:	3

I therefore declare the following candidates elected to the several offices: President, R. C. Benedict; Vice President, Donovan S. Correll; Secretary, Warren H. Wagner, Jr.; Treasurer, M. D. Mann, Jr.

I also declare that the American Fern Society membership approves the recommendation of its Council to join in support of the activities of the International Association for Plant Taxonomy.

Respectfully submitted,
BREMER W. POND, *Judge of Elections*

Report of the Auditing Committee

We, the undersigned, hereby certify that we have examined the books and accounts of the Treasurer, Mr. M. D. Mann, Jr., and find that they are correct, as set forth in detail in the Treasurer's statement.

Respectfully submitted,
BOUGHTON COBB
HENRY K. SVENSON
Auditing Committee

Report of the Curator and Librarian for 1951

The sale of surplus books from the Library has continued and, with the disposition of some floras and periodicals, the amount realized is a little more than twice that of the previous year. A number of members have availed themselves of the opportunity to borrow books and reprints, including some on tropical and Asiatic ferns as well as the more popular ones on local ferns.

Most of the unmounted material in the Herbarium was sorted through and several hundred specimens were mounted. Only a few collections remain unmounted. The representation of North American species in the Herbarium is almost complete except for some less common ferns. Collections of rare species would be a distinct addition to the Herbarium and especially specimens of varieties and named forms. There are approximately a thousand sheets in the Herbarium from outside of North America and although this material is not borrowed very often it is used from time to time. There are some of Heller's Hawaiian collections, many of Toppings's from various parts of southeastern Asia, some of Looser's Chilean ferns, and a considerable amount of material from Mexico and the West Indies. The latter areas are represented in many cases by classical collections, such as those of Palmer, Hinton, Pringle, and Fink in Mexico, and Pollard and Palmer, Gilbert, and Shreve in the West Indies.

Respectfully submitted,
ROLLA M. TRYON, JR., *Curator and Librarian*

Report of the Editors for 1951

Volume 41 of the Journal, just completed, contained 128 pages, the normal number in recent years. The additional income provided by our sustaining members will allow the publication of a somewhat larger number of pages in volume 42. A new membership list was issued at the end of the year. If you have not received yours, will you please write for one. Also, we should be glad to know of any errors in your names or addresses.

Four members of the Council for 1952, Dr. Benedict, Dr. Correll, Dr. Wagner, and the writer, met in New York for a meeting and discussed the affairs of the Society. We decided to add a member to the editorial board of the Journal, and are pleased to announce that Dr. A. C. Smith, an active member of the Society for the past twenty years, has accepted the appointment. Plans for a summer meeting and a field trip were discussed; announcements of these appear elsewhere in this issue. A general discussion of Journal policy was held. The Journal exists primarily as an organ for the publication of papers written and submitted by members, and consequently is not slanted in any way toward a preponderance of technical and non-technical papers, except by the interests of our members. However, if we have money for additional pages, we might be able to invite papers on subjects of especial interest to our members. Will you please write to the undersigned as to subjects which would be of particular interest to you?

Respectfully submitted,

C. V. MORTON, *Editor-in-Chief*

Report on the New Jersey Field Trip

A joint field trip was held on September 29, 1951, by members of the American Fern Society and the Torrey Botanical Club. Thirty-eight persons, members of the organizations and their guests, attended, some of these being from New York and Pennsylvania but the majority being from New Jersey. Many of these had attended a similar field trip some fifteen years back.

The trip began at Springdale, in Sussex County, under my leadership, and took us through a beautiful section of New Jersey where limestone outcroppings and cliffs dominate the landscape. The goal of the morning trip was a large tract of land owned by Mr. A. M. Whittingham, of Newton, New Jersey, artist and conservationist, who had kindly given permission for the visit. The route of the hike took us past Muckshaw Swamp to the slope where three plants of hart's-tongue fern had been set out on the earlier trip referred to above. After some searching one thrifty plant of hart's tongue was found, in good condition and with several fruiting fronds, but no sporeling or other plants were found.

A number of *Dryopteris* hybrids have been known from this locality, including a large clump of *D. Goldiana* × *marginalis,* first reported nearly fifty years ago by Dowell and named by him, and since noted a number of times. This clump has disappeared, but since Goldie's fern is common here the prospects for future hybrid plants are present. However, we did observe on this trip a number of apparent hybrids, including one with *Clintoniana* parentage and another of the general *Boottii* type. The ledges of this whole Sussex County region are excellent sites for a variety of lime-loving Aspleniums; we found *A. Ruta-muraria, A. Trichomanes,* and *Camptosorus.*

After lunch near "Big Spring," we proceeded to sites near Andover, under the guidance of Mr. J. L. Edwards, who, with Professor Chrysler, has produced one of the best fern floras published. We were pleased to find that the narrow-leaved spleenwort was holding its own along a railroad right-of-way, along with the ostrich fern, both of which are uncommon in New Jersey. Cliff-brake (*Pellaea atropurpurea* and *glabella*) grew on a cliff nearby.

R. C. BENEDICT, for the *Secretary*

A SUGGESTION FOR A COOPERATIVE STUDY BY MEMBERS OF THE AMERICAN FERN SOCIETY.—Most of the members of the Fern Society will be going out into the mountains and woods this spring and summer, as opportunity permits and the weather is propitious. The observation of living plants is one of the enduring joys of being a botanist, and most of our members can claim to be that, in spirit at least. However, it must be admitted that the mere observation of plants is not as satisfying to many as field study with a definite objective.

Many botanists who are not professional taxonomists have the idea that the plants of the United States are sufficiently well known, but this is surely not true in the case of the ferns at least, which may seem rather odd, since they have been the object of a good deal of study by a great many people for a very long time. Why is it that despite this long study we still do not know our ferns thoroughly? One reason is, of course, that the whole subject is complex and some problems only susceptible to investigation by the newest methods of cytogenetics. But this is not the whole answer. There are many questions that can be settled, at least with reasonable certainty, by the traditional methods of field, herbarium and laboratory study. As a matter of fact, many botanists have doubtless known the answers to certain questions but have not put their knowledge on paper, and so the information died with them and is as if it had never been. Moreover, it is obvious that the lifetimes of even a fairly large number of fern students are not sufficient time to give us a really thorough knowledge of our ferns.

Thorough knowledge is usually the result of focusing attention on relatively small problems and this concentration of interest has not appealed to many students, whose tendency has been (and the writer must emphatically include himself among the guilty ones) to "spread themselves too thin," to try to study all genera at once, and to jump all over the map in doing so. A certain amount of this type of work is inevitable, and also desirable, at least for the professional taxonomist, who needs to have at least a slight familiarity with most of the larger genera of plants of the world. Nevertheless significant contributions to knowledge will most likely result from attention to small projects that can be completed in a reasonable amount of time.

Our new president, Dr. Benedict, suggested to the writer recently that the Fern Society is an ideal group to undertake a cooperative project. Our members are distributed all over the country; they include taxonomists, ecologists, horticulturists, morphologists, cytologists, and other professionals, as well as many amateurs who are not any kind of specialist but who are anxious to learn and to assist, all united in a common interest in a relatively small and coherent group of plants. This is not the first time that Dr. Benedict has suggested a cooperative study, for back in 1914 in the Journal he posed the question "What is the Habitat of Ophioglossum vulgatum?", a matter on which there was some disagreement, and invited investigation. A good many members sent in observations on this matter, which were duly published in several subsequent numbers of the Journal. However, this particular project was a small scale one, appealing to a limited number of members.

A concerted attack by members of the Fern Society on a larger problem is not really a visionary project, provided that enough of our members are sufficiently interested to contribute of their time and knowledge. The Society contains many professional botanists well equipped to study certain aspects of a problem and to assist amateurs in special lines of investigation, and also a large number of amateurs, who sometimes have the idea that they can contribute nothing to the solution of scientific problems. But this is not so; given proper instruction and encouragement the amateur often has advantages over the professional—perhaps in time, possibly in money, and, one hates to say, sometimes in enthusiasm. A cooperative study is therefore by no means impracticable.

The fragile-fern (*Cystopteris fragilis*) suggests itself to the writer as a suitable subject. "Why fragile-fern?", some may ask. It is true that this is one of the best known of ferns, in the sense that most fern students recognize it when they see it (which is, of course, a decided advantage in a project of this kind), but, strangely enough, it is not well known at all in a scientific way. It is abundant where it does grow, usually, and it is almost cosmopolitan in distribution—almost throughout the United States, Canada and Alaska (it is the fern growing farthest north), tropical America, Europe, and Asia—everywhere in a maze of perplexing variations. As late as 1935 Mr. Weatherby found that the commonest form of the central United States was without a name, and described it as var. *protrusa.* (There is a possibility that this is more than a variety—a subspecies or even a distinct species.) At the same time Weatherby described var. *laurentiana* and forma *simulans* (this more recently considered as a variety by McGregor), and revived var. *Mackayi* Lawson for a common and widespread form. No critical study of the western forms has been published; the southwestern plant is loosely termed var. *tenuifolia* (Clute) Broun, but its relationships to the varieties mentioned above or to the typical form has not been elucidated. Mr. Weatherby pointed out in a note not long ago that glandular forms occur in the Rocky Mountains, but he did not decide on their names or relationships. Various European forms and varieties have been reported from the United States. Recently Professor Shaver has described a plant as *Cystopteris tennesseensis,* which needs further investigation as to its status and range. McGregor has considered it a variety of *C. fragilis* and assigned a range of Kansas, Missouri, and Tennessee; the range is doubtless much more extensive, for a similar form is mentioned by Professor Wherry as occurring in Pennsylvania.[1] In Mexico, and tropical America generally, a host of forms oc-

[1] This JOURNAL **34**: 94. 1944. This paper by Dr. Wherry, entitled "Cystopteris Bluff," indicates some of the problems which will be encountered in a study of fragile-fern. On this one bluff in Berks County, Pennsylvania, Wherry found var. *protrusa,* var. *Mackayi,* var. *genuina* (a presumed extension of range), a plant showing characters in part of var. *laurentiana* (not known otherwise south of Nova Scotia), and a bulblet-bearing form (considered by Wherry as possibly a hybrid with *C. bulbifera,* this being the plant that the writer has mentioned above as being doubtless similar to *C. tennesseensis*).

cur which are almost wholly unstudied. There are surely several varieties and conceivably several species involved.

The whole problem has been complicated recently by Mr. Alston's report[2] of another species, *Cystopteris Dickieana,* from the United States. What is this plant, indistinguishable from *fragilis* morphologically (or is it?), but with spores similar to those of *Woodsia?* Can a really valid species have the improbable range Scotland, Scandinavia, Siberia, Spain, Algeria, Turkey, Persia, Alaska, Alberta, California, and Mexico?[3] It seems as though "*Dickieana*" occurs sporadically throughout the range of *fragilis.* The study of this question will involve field work, as well as the examination of the spores from hundreds of specimens.

What are the relationships of the varieties mentioned above to each other and to those of Europe and Asia? What are their detailed ranges? What is the range of variation in the spores of these varieties, in the gametophytes, and in the young stages of the sporophytes? Are the various varieties particularly adapted to different ecological niches? (The writer thinks yes, surely.) What are the teratological and edaphic forms? What is the normal anatomical structure and what variations are exhibited? (The writer knows of no work on the anatomy of *Cystopteris.*) What are the cultural requirements of the various forms?

The writer poses these questions without suggesting at the moment how they may be answered. They can not be answered by any one of us, but all together we might be able to come up with at least some results worthy of publication in the Journal in individual and joint articles. The present note is for the purpose of

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[2] This JOURNAL **41**: 76. 1951.

[3] The writer has seen specimens from Ontario and Minnesota also.

asking for correspondence on the subject, with a view to finding out whether members are interested or not, and especially to finding out who might be willing to undertake anatomical studies on material submitted to them, who might germinate spores and study gametophytes and young sporophytes, who might be willing to undertake studies on the hundreds (really thousands) of specimens preserved in herbaria in universities and museums and prepare distributional maps, who might be willing to make mass collections[4] in their own vicinities or states for analysis, and who might be willing to undertake cultural studies.[5]—C. V. MORTON, *Smithsonian Institution, Washington 25, D. C.*

PROPOSED SUMMER MEETING IN ITHACA.—The Fern Society has been invited to participate in the annual meeting of the American Institute of Biological Sciences, which will be held in Ithaca September 8–10, 1952. The writer has agreed to organize the meeting and act as program chairman. There will be a session for the delivery of papers on ferns, perhaps preceded by a breakfast, if it can be arranged. All members who expect to attend are urged to send the writer the titles of papers that they can deliver. It is necessary to have these titles fairly soon, so that the program can be made up in time to be printed in the official A.I.B.S. program.

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[4] The writer is not suggesting that Fern Society members descend en masse on the poor fragile-fern armed with pickaxes and trucks. We are all only too keenly aware of the unfortunate activities of the commercial "fern-pickers" in New England, New York, and more recently in the Pacific Northwest. The writer is sure that Fern Society members are all conservationists. The term "mass collection" has a special significance, of course, which will have to be elucidated in a later notice, if it is unfamiliar to many of our members.

[5] E.g., to answer such questions as, will plants raised from the spores of Greenland or other arctic plants grow well in the warmer parts of the United States and what modifications result from these changed conditions?

On another day a field trip to view some of the interesting ferns that grow in the vicinity of Ithaca has been planned. A further notice of this trip will appear in the next number of the Journal.—ROBERT CLAUSEN, *Department of Botany, Cornell University, Ithaca, New York.*

PROPOSAL FOR A FERN FIELD TOUR.—Next September the Fern Society will have a scientific meeting and a field trip in the region of Ithaca, New York; Dr. Robert T. Clausen has accepted the task of planning the meeting and has a preliminary announcement on another page of this issue.

This note is to raise the question whether Fern Society members and friends might like to take a preliminary fern field tour to several localities, perhaps organized along the lines of the summer field meetings of the northeastern section of the Botanical Society of America. A tentative schedule might be: Sept. 2–3, Vermont or New Hampshire (or both), under the guidance of a local chairman to be selected, Sept. 4–5, Pilot Knob on Lake George (Washington County, New York), under the guidance of R. C. Benedict, Sept. 6, travelling, Sept. 7, Jamesville, near Syracuse, under the guidance of Dr. Mildred Faust, and Sept. 8, Ithaca. Each of these field meetings would be considered as a program in itself, where all fern lovers living nearby might be expected to foregather with the visitors from a distance who are making the whole tour.

As indicated by the late E. J. Winslow,[1] Vermont is one of the richest states for ferns. Among the ferns that occur in Vermont that many Society members may not have seen growing are: *Cryptogramma Stelleri, Asple-*

[1] Willoughby Lake, Vt., a Candidate for the Title of "Richest Fern Locality," by E. J. Winslow. This JOURNAL, 9: 107–109. 1919. See also, H. G. Rugg, Vermont, the Fern Lover's Paradise. This JOURNAL, 2: 83–93. 1912.

nium Ruta-muraria, Polystichum Braunii, Asplenium viride, Woodsia alpina, Woodsia glabella, Athyrium pycnocarpon, Dryopteris Filix-mas, D. simulata, and *Botrychium simplex.* The region of Lake George is also rich in ferns.[2] Among the interesting plants that might be found are *Woodwardia virginica, Athyrium thelypteroides,* various peculiar forms of *Polypodium vulgare, Dryopteris noveboracensis* forma *fragrans, D. Goldiana,* and *D. Boottii* and various other *Dryopteris* hybrids. The region of Jamesville is, of course, the home of the hart's-tongue fern and has been written up in various papers in the Fern Journal and the Fern Bulletin. The Fern Society held a three day field trip in this region in July, 1915, which was attended by about forty members, the writer among them.[3] The area is one of the "candidates for richest fern locality." The beautiful *Cystopteris bulbifera* is abundant here, and this is the type region for the rare *Botrychium Lunaria* var. *onondagense.*

Are you interested in such a tour, in whole or in part? If so, please write to the undersigned, not as a definite commitment, but merely to indicate whether or not there is a sufficient number of members interested to justify going ahead with the plans. Please indicate also if you would be driving your own car, and if so, if you would have room for the transportation of members without cars. Accommodations in tourist camps or hotels should be readily available, since the tour would be after Labor Day, which is early this year (September 1). Arrangements can be made in advance by the local chairman. A further announcement will appear in number 2 of the Journal.—R. C. BENEDICT, *1819 Dorchester Road, Brooklyn 26, New York.*

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[2] See Ferns of the Lake George Flora, by S. H. Burnham. This JOURNAL, **6**: 85–90, 97–105. 1916; **7**: 12–15, 54–63. 1917.
[3] See this JOURNAL, **5**: 118–123. 1915.

A MUSEUM MEETING OF THE SOCIETY PLANNED.—Dr. Henry K. Svenson invites members of the Fern Society and their friends to the American Museum of Natural History, Central Park West and W. 81st Street, New York, on May 3. Visitors will meet at 10 a.m. in Dr. Svenson's office in the Museum for informal discussion. Later they will be shown the new ecology exhibit that Dr. Svenson has been in charge of developing. Those gastronomically inclined will have the opportunity of trying some distinctive foreign food later. Please send a card to Dr. Svenson if you are coming.

A GARDEN MEETING PLANNED.—Mr. and Mrs. Edward D. Thurston, Jr., of Sharon, Connecticut, have invited Fern Society members to view their attractive and unusual fern garden.[1] This meeting will be in June or early July. For the details and exact date write to Mr. William S. Johnston, 65 Morris Lane, Scarsdale, New York.

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[1] For a description of the garden see "An Amateur's Fern Garden," by Edward D. Thurston, Jr., This JOURNAL **32**: 41–57. 1942.

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American Fern Journal

VOL. 42 APRIL–JUNE, 1952 No. 2

The American Species of Xiphopteris

E. B. COPELAND

The first publication of this genus is said to have been by Kaulfuss, in Jahrbuch für Pharmacie, 1820, p. 35, which I have not seen. Kaulfuss republished it in his "Enumeratio" of the ferns collected by Chamisso, 1824, page 85, where two species are named, *X. serrulata* (Swartz) and *X. myosuroides* (Swartz).

These are small ferns, with paleate rhizomes, narrow, pinnatifid or pinnate fronds, with a single simple or forked vein in each segment, and one exindusiate sorus on each fertile segment. It may be added that the pedicel is a single row of cells, that the annulus is of about 14 indurated cells, and that the spores are tetrahedral. The essential generic character was the restriction of the sori to a more or less entire apical portion of the frond.

There are six known species which conform to this strict original definition—four in America of which one ranges across Africa, one in Hawaii, and one in New Guinea. The distribution is flagrantly discontinuous, but it is still probable that they form a natural group.

The enlargement of the genus, to include species otherwise much like *X. serrulata*, the type, but without the differentiation of the fertile apical portion of the frond, is an idea as old as the genus. In an appendix to the Enumeratio, p. 275, Kaulfuss himself included a species, *X. setosa*, without such differentiation. Almost immedi-

[Volume 42, No. 1, of the JOURNAL, pp. 1–40 was issued April 15, 1952.]

ately, Blume[1] construed the genus in the broader sense —but reduced it to *Grammitis.*

In defining the genus now, I would begin by placing it in a family, Grammitidaceae. In my Genera Filicum, these ferns are treated as a subfamily, Grammitideae, of Polypodiaceae, but I agree with Ching and Holttum that the group is better given full family rank. As I treat the family, it consists of three apparently primitive genera—*Grammitis, Xiphopteris,* and *Ctenopteris*—and 8 or 9 small derived genera. As to the latter, there is reasonably general agreement, and nothing more needs to be said about them here.

As to the three primitive genera, *Grammitis* is distinguished by simple, more or less entire fronds, *Xiphopteris* by pinnatifid or simply pinnate fronds in which each segment has one simple or forked vein, and *Ctenopteris* by pinnatifid or pinnate fronds, each segment with a pinnately branched vein. These are not such differences as necessarily characterize or distinguish genera. Since the three are unquestionably related, there is no objection in principle to Ching's action in combining them in one genus—*Grammitis.* I do not follow him, because it appears to me to be more convenient to treat them as three genera than as one. And, if this be so, the nature of the character or characters serving for their distinction is of no importance.

Neither does convenience have to be sacrificed because, in a very few cases, the differences are not clear cut—that is, because the genera almost blend. If, however, the three genera are not natural entities, then they must be combined, and bear the oldest name, *Grammitis.* As I read the evidence, they have been distinct since Miocene time, a period roughly estimated at twenty million years. For so long a time, each genus has been evolving species independently in America and in the Far East.

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[1] Flora Javae 2: 118. Usually cited as 1828.

Of the 34 species herein recognized, 3 are described as new. All of these were so recognized by Maxon, and given provisional names, but not described. Of the remaining 31, only 5 have already been named in *Xiphopteris.* The effect is that 26 require new combinations. Every one of these species has already a name tenable in *Polypodium.* The reaction of every student to these many new combinations is one of discomfort, in which I share. But there is probably no student of these ferns who does not know that they do not belong to *Polypodium.* They must be transferred, either to *Xiphopteris* or to *Grammitis.* As *Grammitis,* without them, is a thoroughly natural genus of about 150 species, my preference is to hold *Xiphopteris* separate. That is a matter of choice. We do not properly have the choice of leaving them in *Polypodium.*

The conspicuous homogeneity of *Xiphopteris* is one chief reason for regarding it as a genus. Because the species are much alike in gross characters, particular attention has been directed to the minute differences. The group has been studied with the compound microscope by Mettenius, Hieronymus, and Maxon. So, species which look alike or nearly so to the naked eye are distinguished by differences in the paleae and details of the pubescence or sporangia.

It must be conceded that a peculiarity or difference justifying or demanding recognition of a species is equally a difference, whether evident to the unaided eye or visible only under considerable magnification. Whether we like the implication of the fact or not, it can hardly be disputed that two valid species may be distinguishable by microscopical characters and not otherwise.

However, differences are themselves of different kinds. Some are hereditary, properly diagnostic of species. But some are under the influence of the environment. And some are, as far as we know, merely fortuitous. We are used to evaluating differences in gross descriptive botany. Thus, each species of pine has a characteristic length, or range of lengths, of the needles, which is used in a definition, in spite of the fact that the needles of Spring and Summer on a single twig vary widely in length, and that the needles of a dry year are characteristically shorter.

I once described a *Grammitis,* as *G. heanophylla,* characterized by very small paleae; but later, in a more careful and comprehensive study of the genus, I came positively to the conclusion that the size of these paleae is correlated with the congestion of the stipe-bases. It is a sound generalization for *Grammitis* that dense fasciculation of the stipes results in some suppression of the paleae, which become smaller and fewer. And there are species in America, Malaya, and Africa which, with congestion and hairiness of the stipes, have completely lost their paleae. I find now that congestion of the stipes operates in the same way in *Xiphopteris.* In various species, vigorous young plants with few fronds have comparatively large and conspicuous paleae, but old plants with crowded stipes have smaller, inconspicuous paleae; and in several instances I have been unable to find any paleae at all. Certainly, there are characteristics of the paleae which distinguish species. But it is equally sure that there are features of the paleae which are subject to modification, and can not be used to identify species except with the exercise of judgment.

The forking of the vein in a fertile segment looks like a clear-cut specific characteristic, and is such if the fertile veinlet (branch of the forked vein) extends beyond the sorus; but it ceases to be so convenient a diagnostic item when the fertile veinlet is more or less completely suppressed. This suppression begins with the location of the sorus at the apex of the fertile veinlet, but the diagnostic usefulness of the forking is unimpaired if the veinlet is evident below the sorus. If the suppression goes farther, the sorus becomes lateral on the vein; but forking may still be predicated if the vein is abruptly bent at the sorus. Forking may still be affirmed, or at least is indicated, if the sorus is evidently lateral on the vein. But the location of the sorus, as lateral or dorsal on the vein, is sometimes too difficult of determination to be of any use in describing the species, or in keys. The sorus is dorsal on really simple veins.

There are characteristics which seem to be diagnostic without any qualification. For example, two species, and only two, bear setulae on the sporangia.

Contrary to my usual practice, I follow in this paper Maxon's example, letting the key serve as a description of the species, and, under each of the latter, adding such additional notes as may be useful supplements or explanations.

In the preparation of this treatise, I have of course used the comparatively meager material in our local herbaria. But the real basis of the work, without which it could not have been attempted, is the remarkably rich representation of the genus in the United States National Herbarium. The group was for many years a subject of particular interest to Dr. William R. Maxon. With ample material, he published in 1914 and 1916 papers on the species as then known. During the subsequent decades, the material in the National Museum has probably more than doubled, and a revision is evidently in order. I have undertaken this because I have long been particularly interested in the family, and because a study of *Xiphopteris* has almost necessarily been incidental to a study of the American species of *Ctenopteris*. For the opportunity to attempt this study with any prospect of success, I cannot express too strongly my obligation to Mr. Morton, Curator of Ferns, U. S. National Museum.

KEY TO THE AMERICAN SPECIES OF XIPHOPTERIS

Fertile part of frond differentiated from sterile.
  Fertile apex shorter than sterile base.
    Rhizome elongate; sterile segments tooth-like ... 1. X. serrulata
    Rhizome short.
      Sterile segments oblong .... 2. X. myosuroides
      Sterile segments deltoid .... 3. X. Jamesonii
  Fertile apex as long as sterile base .... 4. X. Skutchii
Fertile portion of frond not differentiated.
  Lamina glabrous.
    Veins all simple.
      Segments very oblique .... 10. X. perpusilla
      Segments patent.
        Segments up to 2 mm. long .... 6a. Pol. nutatum
        Segments over 2 mm. long.
          Paleae 1.5–3 mm. long .... 6. X. Hartii
          Paleae smaller .... 5. X. delitescens
    Fertile veins forked.
      Sporangia naked.
        Paleae not ciliate.
          Lamina glabrous .... 11. X. Grisebachii
          Lamina pubescent .... 12. X. Mortonii
        Paleae ciliate.
          Lamina ca. 5 cm. by 4 mm., pinnatifid ... 8. X. Schenckii
          Lamina larger, merely lobed .... 7. X. organensis
      Sporangia setulose.
        Fronds under 4 cm. long .... 13a. Pol. Shaferi
        Fronds over 4 cm. long .... 13. X. Mitchellae
  Lamina setose.
    Veins simple.
      Fronds hardly 2 mm. wide .... 9. X. setosa
      Fronds wider.
        Pinnae or segments not contiguous .... 19. X. Williamsii
        Segments contiguous.
          Segments obliquely deltoid .... 18. X. serricula
          Segments oblong.
            Sides of segments parallel .... 14. X. Cookii
            Segments narrowed from base.

- Stipes stout .... 15. X. caucana
- Stipes slender.
  - Sorus above base of vein .... 16. X. zurquina
  - Sorus at base of vein .... 17. X. blepharidea

Veins forked.
- Lamina lobed.
  - Blades decurrent to rhizome .... 20. X. truncicola
  - Blades stipitate .... 20a. Pol. andinum
- Lamina pinnatifid to pinnate.
  - Segments conspicuously gibbous .... 21. X. trichomanoides
  - Segments slightly gibbous.
    - Stipe winged .... 31. X. Knowltoniorum
    - Stipe terete.
      - Segments oblong .... 33. X. blepharodes
      - Segments deltoid .... 32. X. blepharolepis
  - Segments not at all gibbous.
    - Paleae not setulose.
      - Fronds sparsely setose, minute .... 23. X. Sherringii
      - Fronds freely setose, larger.
        - Blades stipitate.
          - Segments short-oblong, contiguous .... 24. X. Killipii
          - Segments long-oblong, remote above base .... 25. X. Buesii
        - Blades decurrent to rhizome ... 22. X. basiattenuata
    - Paleae setulose.
      - Sori not quite contiguous to costa.
        - Fronds rarely 5 cm. long .... 26. X. nana
        - Fronds commonly 10 cm. long .... 27. X. daguensis
      - Sori contiguous to costa.
        - Hairs on paleae weak, hyaline .... 28. X. hyalina
        - Setulae on paleae firm, dark.
          - Fronds commonly 5 cm. long.
            - Blades long-attenuate downward. 29. X. setulosa
            - Blades more abruptly narrowed. 30. X. nimbata
          - Fronds larger.
            - Fronds pinnate .... 32. X. blepharolepis
            - Fronds pinnatifid .... 34. X. taenifolia

1. Xiphopteris serrulata (Swartz) Kaulf., Enum. Fil. (1824) 85. (*Plate 3A*).
   Acrostichum serrulatum Swartz, Prod. (1788) 128.
   Grammitis serrulata Swartz, Schrad. Journ. 1800[2] (1801) 18; Syn. Fil. 22; Schkuhr, Krypt. Gew. 9, *pl. 7;* Hooker, Exotic Fl., *pl. 78;* Presl, Tent. 208, *pl. 9, f. 2;* Fée, Gen. Fil. 100, *pl. 10B.*
   Asplenium serrulatum Swartz, Fl. Ind. Occ. (1806) 1607.
   Gymnopteris serrulata Bernh. Schrad. Neues Journ. **2**[2] (1806) 48.
   Micropteris serrulata Desv., Mém. Soc. Linn. Paris **6** (1827) 217.
   Polypodium serrulatum Mett., Fil. Hort. Lips. (1856) 30, *nec alior.*
   Micropteris orientalis Desv., Mém. Soc. Linn. Paris **6** (1827) 217.
   Xiphopteris orientalis Fourn., Compt. Rend. **81** (1875) 1140.
   Xiphopteris extensa Fée, Mém. Foug. 11 (1866) 14.
   Polypodium duale Maxon, Contr. U. S. Nat. Herb. **16** (1912) 61; **17** (1914) 399, *f. 8.*

Type from Jamaica.

The type species of *Xiphopteris,* this is one of the commonest ferns of the American tropics. It is in all West Indian islands, and on the continent from the state of Vera Cruz in Mexico south to Brazil (Santa Catarina); also in Africa and Mauritius, and reported even from Amsterdam Island. If *Xiphopteris* is not maintained as a genus, the name of this species must be *Grammitis serrulata* (Swartz) Swartz.

2. X. myosuroides (Swartz) Kaulf., Enum. Fil. (1824) 85. (*Plate 3B.*)

Polypodium myosuroides Swartz, Prod. (1788) 131; Mett., Pol. 33 in part; Hieron., Hedw. **44** (1904) 83; Maxon, Contr. U. S. Nat. Herb. **17** (1914) 401, *pl. 11, fig. 9.*

Grammitis myosuroides Swartz, Schrad. Journn. 1800[2] (1801) 18; Syn. Fil. 22, in part; Schkuhr, Krypt. Gew. 9, but not *pl. 7;* Presl. Tent. 208.

Polypodium Jamesoni Jenman, Bull. Bot. Dep. Jamaica II. **4** (1897) 112, *non* Mett.

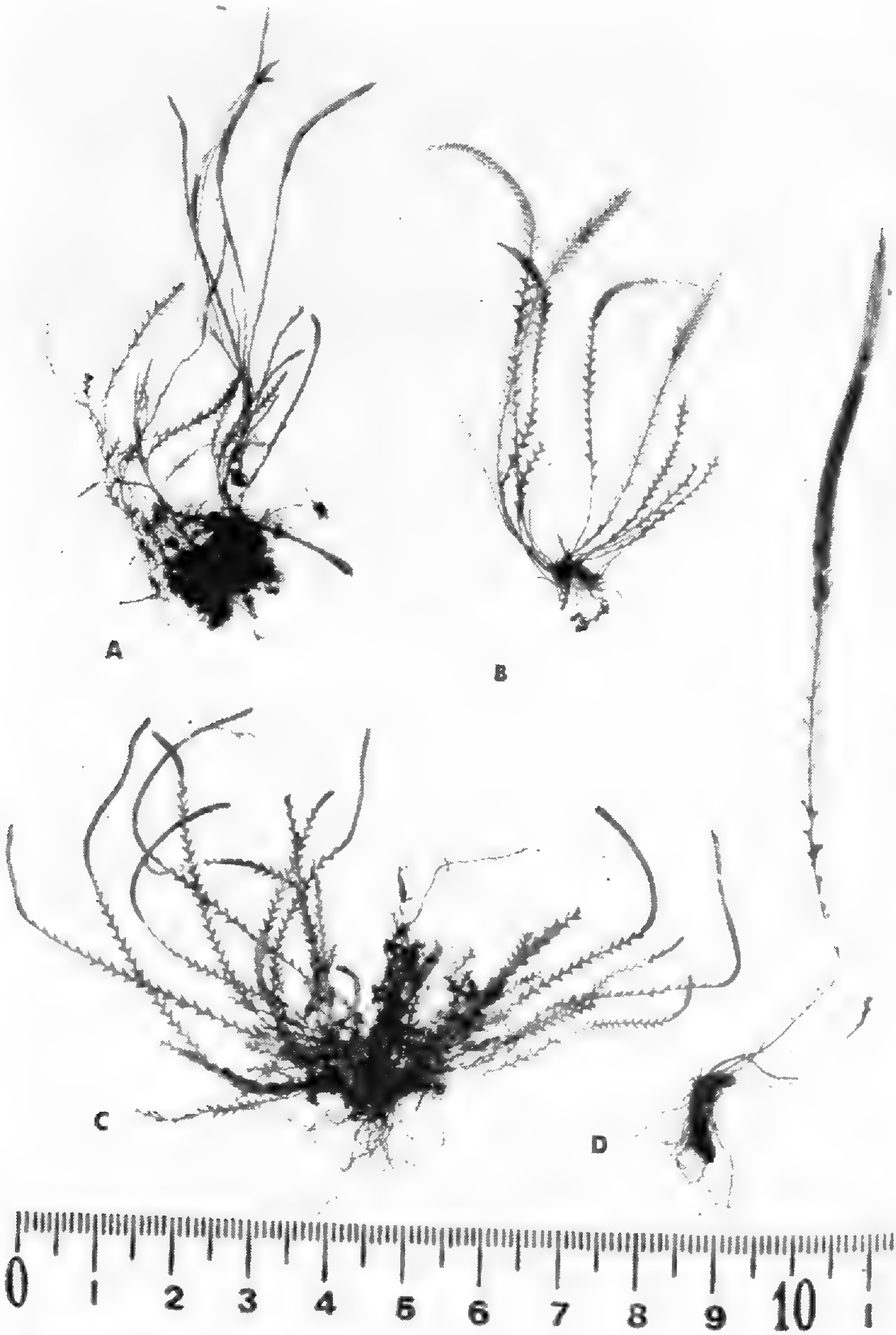
Type from Jamaica, whence the U. S. National Herbarium contains 17 collections. There are also collections from Brazil and East Africa ascribed to this species by Hieronymus (*l. c.*). From Brazil, he cites *Glaziou* 7480, which Maxon (*l. c.* 403), was disposed to regard as either new or a form of *X. setosa;* if not *X. myosuroides,* it is exceedingly like it. Mettenius ascribed his *Polypodium myosuroides* to Mexico, without citing any collection; a Schiede collection (U. S., fragment) may have been his evidence. *Pringle* 13676 is also this species rather than any other. A Guatemalan specimen, *Maxon & Hay* 3320, has the laminar segments intermediate in form between those of *X. myosuroides* and *X. setosa.*

3. X. Jamesonii Hook., Second Cent. Ferns (1861) *pl. 14.* (*Plate 3C.*)

Polypodium serrulatum var. *strictissimum* Hook., Sp. Fil. **4** (1862) 175.

Polypodium strictissimum Hieron., Bot. Jahrb. **34** (1904) 501; Hedw. **44** (1904) 84; Maxon, Contr. U. S. Nat. Herb. **17** (1914) 405.

Hieronymus distinguished three forms—*major, intermedia,* and *minor,* of which the last is the typical form. Maxon suggests that these may represent distinct species. The typical form was described from Ecuador, and is known from Colombia, Venezuela and British Guiana (Mount Roraima). Hieronymus (in Hedwigia) and



A. XIPHOPTERIS SERRULATA; B. X. MYOSUROIDES; C. X. JAMESONII; D. X. SKUTCHII

Maxon agree in citing Hooker, Garden Ferns (1862) *pl. 44,* as *P. strictissimum.* This may hardly be correct. The plate shows the rhizome and venation (but not the segment) of *X. serrulata;* and the text reads: "Others may think my *X. Jamesoni* . . . not more worthy of specific distinction. I have stated my opinion on the subject, and the habit of the plant indicates something peculiar."

✓4. **X. Skutchii** (Maxon) Copel., comb. nov. (*Plate 3D.*)
Polypodium Skutchii Maxon, Proc. Biol. Soc. Wash. **51** (1938) 34.

Type: Guatemala, in the Department of Chimaltenango, at an altitude of 3000 meters. Collected three times by Skutch.

Larger than its immediate relatives, and well distinguished by its long, narrowly linear, entire fertile apex.

The four preceding species represent *Xiphopteris* in the original sense, characterized by the differentiated fertile and sterile parts of the frond. There are two other such species—*X. Saffordi* (Maxon) Copel., from Hawaii, and *X. antipodalis* Copel. from New Guinea. Whether the six species are a natural group or the result of convergent evolution is an open question.

✓5. X. **delitescens** (Maxon) Copel., comb. nov.
Polypodium delitescens Maxon, Bull. Torr. Club **32** (1905) 74; Contr. U. S. Nat. Herb. **17** (1914) 403, *pl. 12, fig. 10.*
Grammitis myosuroides sensu Schkuhr, Krypt. Gew., (1804) *pl. 7, non* Swartz.
Polypodium myosuroides sensu Jenman, Bull. Bot. Dept. Jamaica II. **4** (1897) 112, *non* Swartz.
Polypodium limula Christ, Bull. Soc. Bot. Genève **1** (1909) 218; Maxon, Contr. U. S. Nat. Herb. **17** (1916) 546, *pl. 32.*

In commenting on his *P. delitescens,* Maxon (1914) wrote: "The species is well characterized by Jenman under the name *Polypodium myosuroides.* It is to be distinguished from the true *myosuroides:* (1) commonly by its pinnatifid condition throughout, though less deeply lobed in the upper (fertile) portion than below; (2) by its distinct sori, these never entirely confluent with age, a character consequent upon its pinnatifid condition; (3) by its *approximate* nearly deltoid lobes, these never remote or subspatulate as in *myosuroides;* and by numerous less obvious characters . . . Schkuhr's original plant, if existent, will stand as the type; otherwise the type will be sheet no. 427,770, in the U. S. National Herbarium. . . ."

Even if Schkuhr's plant be located, it will be better to regard U. S. Nat. Herb. sheet no. 427,770 as the type, since the description is Maxon's, applying to his collection no. 1513, whereas Schkuhr's text (p. 9) applies rather to the real *X. myosuroides.*

In his original publication and again in 1914, Maxon said this species was apparently confined to Jamaica, but the National Herbarium now contains specimens from Cuba (*Clement* 1406), from Mexico (Oaxaca, *Mexia* 9124a), from Guatemala (*Johnson* 371, determined by Maxon), and from Honduras (*Williams & Molina* 13600 and 13676, determined by Morton). There are 24 collections from Jamaica.

Except that in his study, in the preparation of two papers at different times, Maxon treated *Polypodium delitescens* as a member of his group of *P. duale,* and *P. limula* as a member of the group of *P. trichomanoides,* and thus missed a direct comparison, it is hard to explain his overlooking their identity. I do not find a word of text by which they might seem to differ.

(*To be continued*)

Notes on the Ferns of Kentucky, III. Cheilanthes feei on Silurian Limestone in Kentucky

CLYDE F. REED

One of the most unusual habitats in which to find ferns is the formation of limestone of Silurian Age upon which cedar barrens develop in Kentucky. Recently the author had occasion to study and collect the plants and ferns found on two of these outcroppings—one in Bullitt County, near Cedar Grove—the other, in Nelson County, near Bardstown, along Cedar Creek.

The flora on these barrens is distinctive and alike on both. The actual barren is made up of a grayish clay which is very slippery when wet, yet hard and brittle when dry, cracking to a depth of about a centimeter. This area is open and barren, having only occasional patches of *Rhamnus lanceolata* and *Rhus aromatica,* with an infrequent *Celtis* bush and cedar tree. Peeking out from under this shrubbery are delicate Shooting Stars (*Dodecatheon meadia*), pale blue *Sisyrinchium angustifolium,* white *Nothoscordum bivalve,* little *Scutellaria parvula,* and bright yellow-orange *Lithospermum canescens.* So it is in May. Later in the season, in August, the flora is quite different, the predominating species being *Agave virginica, Sabatia angularis* and its white form, several Rudbeckias, *Echinacea pallida, Ratibida pinnata, Petalostemon candidum, Thalictrum revolutum, Asclepias verticillata, A. tuberosa* and *Acerates viridiflora.*

Just back of this barren is a sort of transition zone of mesophytic woods containing chestnut-oaks, hackberry, and sassafras, canopying a humus-containing soil in which *Frasera caroliniana* grows, along with *Botrychium virginianum* and *Asplenium platyneuron.* Back in this wooded area is an outcropping of Silurian limestone,

CHEILANTHES FEEI

sometimes formed into a continuous ledge about five feet in thickness, sometimes broken up into huge blocks of various sizes. This rocky area also is canopied with trees and shrubs, most places being very dry, with a few other places quite damp. It is in the crevices of these rocks that one finds a peculiar but very interesting series of fern companions.

The most striking find was a fern new to Kentucky, *Cheilanthes feei.* This little fern, commonly known as the Slender Lip-Fern, is known to live on limestone and calcareous sandstone formations from central Texas to southern California, north to southwestern Wisconsin and British Columbia, according to Broun, Index to North American Ferns. Since that time (1938), this fern has been found in Illinois (five counties reported by Jones, 1945), extending the range considerably eastward. Now, this find in central Kentucky extends the distribution of the species about two hundred miles farther east. This little fern is quite frequent along many of these Silurian limestone ledges at Cedar Grove (Bullitt County) where it grows alongside *Polypodium polypodioides, Asplenium resiliens, A. cryptolepis,* and *Pellaea atropurpurea.* The plants of *Cheilanthes feei* grow in dense clusters, have practically no hairs on the stipe and rachises, and stand about three to five inches in height. The determination has been verified by C. V. Morton, of the U. S. National Herbarium. Finding it in Kentucky greatly extends its range as mentioned above.

At the location along Cedar Creek, near Bardstown, *Cheilanthes feei* was not found, but all the other ferns were found in formations similar to those described above: *Asplenium cryptolepis* grows alongside *Pellaea glabella* and *P. atropurpurea;* patches of *Polypodium polypodioides* and *Asplenium resiliens* vie for the drier rocks; and *Cystopteris bulbifera* (or what passes as *Cystopteris tennesseensis* Shaver, which may be a variety of *C. fragilis* or *C. bulbifera,* or a distinct species) and *Camptosorus rhizophyllus* are found on the damper ones. One peculiar feature about the many collections of *Cystopteris bulbifera* collected on this Silurian limestone throughout the peripheral region of the Knobs of Kentucky is that the fronds are deltoid when fruiting and stand erect up along the rocks, instead of being pendent. A later paper will discuss about one hundred collections of this species made by the author in Kentucky and will describe the many forms it takes on the various types of limestone in the state. *Woodsia obtusa* also grows on these rocks, and *Botrychium virginianum* is found just below the rocks on the soil.

These are truly unusual companions, since most of them occur elsewhere in Kentucky alone or only two or three in the same area. All these species are known only on calcareous soils or rocks in Kentucky.

Specimens of the following ferns found and collected at the cedar barrens in Bullitt and Nelson Counties, Kentucky, are in my herbarium.

West of Bardstown, along Cedar Creek, Nelson County, May 14, 1950: *Asplenium cryptolepis* (No. 20097), *Pellaea glabella* (No. 20099), *P. atropurpurea* (No. 20102), *Polypodium polypodioides* var. *michauxianum* (No. 20101), *Woodsia obtusa* (No. 20112), *Botrychium virginianum* (No. 20107).

Near Cedar Grove, between Shepherdsville and Samuels, Bullitt County, May 14, 1950: *Asplenium cryptolepis* (No. 20023), *A. resiliens* (No. 20022), *A. platyneuron* (No. 19999), *Pellaea atropurpurea* (No. 20021), *Cheilanthes feei* (No. 20020) (also in U. S. Nat. Herb.), *Cystopteris bulbifera* (Nos. 19997, 20005, 20007), *Botrychium virginianum* (No. 20004), *Camptosorus rhizophyllus* (No. 20002), *Woodsia obtusa* (No. 20001).

Near Cedar Grove, same locality, Aug. 7, 1950: *Pellaea atropurpurea* (Nos. 20934, 20953). *Cheilanthes feei* (No. 20957), *Camptosorus rhizophyllus* (No. 20950), *Polypodium polypodioides* var. *michauxianum* (No. 20951), *Asplenium cryptolepis* (No. 20952), *Cystopteris fragilis* ? (No. 20964) (may be *C. tennesseensis*).

BALTIMORE, MARYLAND.

New Stations for Asplenosorus ebenoides

P. A. DAVIES

In June, 1950, W. H. Shackleton showed the writer a single plant of the hybrid fern *Asplenosorus ebenoides* (Scott) Wherry (Scott's spleenwort) growing in a crevice of a calcareous outcrop on a high bank of Hite's Branch, a tributary of the South Fort of Harrods Creek in Oldham County, Kentucky. Leaves were taken without disturbing the roots and these leaf specimens are in the herbarium at the University of Louisville.

S. C. Thacher, an excellent amateur botanist of Louisville, informed the writer that he had discovered, in 1942, two locations of this hybrid, one in Clark County, Indiana, and the other in Bullitt County, Kentucky. The Clark County station is on a shady limestone outcrop above Fourteen Mile Creek, at the Tunnel Mill Boy Scout Camp. After two hours search with Mr. Thacher on June 10, 1951, only two plants were located. Originally this colony contained 13 plants but collectors have taken most of them. Previous reports from Indiana are those of Coulter[1] for stations in Crawford and Jefferson Counties, and Kriebel[2] for Lawrence County.

The Bullitt County station, which originally contained 3 plants, is on a shaded limestone outcrop near Indian Charles Spring at the Girl Scout Camp. A careful search of this area on September 28, 1951, did not yield a single one. As others knew of this station, they may have taken all the plants for specimens. Only one other report has been published for Kentucky: Linney[3] found it growing on a fallen mass of sandstone near Salt Lick Creek, in Marion County. McCoy omitted it from

[1] Indiana Geol. Nat. Hist. Surv. 1899, p. 2.
[2] This JOURNAL, 23: 53–56. 1933.
[3] Kentucky Geol. Surv II, 3: 57. 1882.

his *Ferns and Fern Allies of Kentucky*[4] because he was unable to locate a specimen. Clute, in his publication "Our Ferns,"[5] lists it from Kentucky, perhaps basing the record on Linney's report.

UNIVERSITY OF LOUISVILLE, LOUISVILLE, KENTUCKY.

Additional Notes on Selaginella utahensis

SEVILLE FLOWERS

Selaginella utahensis Flowers was described on the basis of two small specimens collected in southwestern Utah by Dr. W. P. Cottam.[1] Through an unfortunate error in copying the wrong line of data from the field catalog on the specimen label, the type locality became misstated by about thirty-two miles and the mistake was not discovered until after the description was published. A correction appeared in a later issue of the journal.[2] The type locality is on Lady Mountain, in Zion National Park, a high precipitous sandstone cliff arising about three thousand feet above the canyon floor, the latter being at an elevation of about four thousand feet at this point.

In June 1951 I made a special trip to Zion Park for further study and collecting. The National Park Service has blazed a trail up the face of this mountain for the benefit of the more zealous hikers. It is extremely steep and tortuous, often crossing slopes where mere footrests have been cut in the smooth sandstone or leading up improvised stairs and along narrow ledges with a hand-rail or chain to steady the footing as one crosses. There are several ladders leading from one narrow ledge to

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[4] This JOURNAL, **28**: 41–46, 101–110. 1938.
[5] J. B. Lippincott Co., Philadelphia, 1938, p. 212.
[1] Amer. Fern Journ. **39**: 83–86. 1949.
[2] *Op. cit.* **40**: 167. 1950.

the next higher one. At the foot of the trail a sign warns one of the distance, danger, and the necessity of carrying water—all sound advice, as I later found. So provided with a half gallon canteen of water, two sandwiches, and a supply of paper sacks I set out. The lower slopes did not appear promising and only a few stops were made to search for my plant; but scarcely a mile had been covered, which gained only about five hundred feet in elevation, when I found it. These plants were growing on a sandy loam in an open place between scattered Utah Juniper trees, quite away from rocks. The creeping stems were more or less covered with windblown soil with only the short erect branches exposed, forming a low tufty growth. More alert now, I found other examples with increasing frequency the higher the ascent, and at above five thousand feet elevation it is fairly common on this mountain. The best displays are found on sandstone ledges, particularly when there is an overhanging ledge above, so that the plant grows outward from the little cavern between the two layers of rock. In the shaded recesses, where moisture lingers the longest, the plants are dark green, more or less loosely matted and with the leaves quite loosely disposed. Then as the plant creeps outward on the exposed portion of the ledge, where it is very dry, the habit progressively changes to a densely tufted condition with short, erect or ascending branches, with the leaves closely imbricated and usually pale and glaucous. It also occurs on the brink of cliffs, particularly when there is a cap of soil on the slope or ledge above. Shrubs and grass often grow in such places and *Selaginella* may be found mingled with the latter in loose, dark green mats, and at the outer edge of the grass sod it may creep downward over the face of the cliff, usually assuming a tufted habit but occasionally becoming stringy.

The prize of the trip came later in the afternoon. Reaching the bottom of the trail, I decided to return to camp by way of the trail to Emerald Pool, another attraction of Zion Park. A little brook forms a series of pools and waterfalls on the north side of Lady Mountain, and arriving here, foot-weary and tired, I was taking a final drink from the canteen, which was the key incident to my discovery. As I tilted my head backward to drink my line of vision reached the brow of large rock, some twenty feet above, and there a great mat of *Selaginella* spread over several square feet of surface. The brook flows along the base of the rock and the branches of tall cottonwood trees partially shade it, forming a canopy just above the plants. The loose open mat, with only a slight tendency to become tufted, at first suggested a different species, but closer examination showed it to be *Selaginella utahensis.* Only a few samples were removed from selected points so as to leave this fine exhibit intact.

Further study of the material collected shows that the plant corresponds very well with the conclusions drawn from the rather meager type specimen and, aside from the above comments on the habit of growth, about the only other item that should be mentioned is the fact that narrowly obtuse leaves are less frequent in some plants than the original description implies.

Specimens have been deposited in the principal herbaria of the United States.

UNIVERSITY OF UTAH, SALT LAKE CITY

New Pteridophyte Records From Missouri

ERNEST J. PALMER AND JULIAN A. STEYERMARK

During 1951, the authors collected three pteridophyte additions to the flora of Missouri, the first two being found by the junior author, the third by the senior author.

LYCOPODIUM OBSCURUM L. VAR. DENDROIDEUM (MICHX.) D. C. EAT.

While botanizing a deeply dissected area of La Motte sandstone topography in Ste. Genevieve county in the southeastern portion of the Ozark Mountains, the junior author, in company with Dr. Robert Thorne, of the University of Iowa, discovered nearly fifty plants of *Lycopodium obscurum* var. *dendroideum*. The dark green, erect branches stood out in sharp contrast to the pale green color of the thick bed of *Sphagnum compactum* in which the plants were growing on the upper, shaded, steep slopes of one of the narrow bluff-rimmed sandstone gorges of the headwaters of the River aux Vases. The collection data are: *Steyermark 72506,* La Motte sandstone bluffs along upper reaches of River aux Vases, T 35 N, R 7 E, west part of sect. 34 and east half of sect. 33, 3½–4 miles northwest of Avon, Ste. Genevieve Co., August 30, 1951.

This discovery marks a new southwestern limit of distribution for the species and its variety, hitherto known southwestward to Georgia and Tennessee. The sandstone region in which the discovery was made is famous for its harboring of other eastern and northern relics, such as *Lycopodium complanatum* var. *flabelliforme, Dennstaedtia punctilobula, Goodyera pubescens,* and *Bryoxiphium norvegicum,* which are isolated here at or near their southwestern limits of dispersal. The addition of this species of *Lycopodium* brings to four the total number of this genus known from Missouri. The others are *L. lucidulum, L. porophilum,* and *L. complanatum* var. *flabelliforme.* All four have now been found in this general area, the first two mentioned having the broadest distribution in the state, although confined to sandstone substrata, either La Motte or St. Peter.

DRYOPTERIS GOLDIANA (HOOK.) GRAY

The discovery of Goldie's Fern in Missouri was made in a surprising manner, coming as it did at the close of day on the final hour of a week's botanical survey. The writer had been visiting a number of new localities in the state for a week during the latter part of September, 1951. It was decided to devote the last day of the trip to different parts of Warren County, just north of the Missouri River, in an unglaciated section, actually a part of the Ozark region. After spending most of the day exploring bluffs and ravines along various parts of Massa Creek, south of Jonesburg, topographical maps were studied and a decision made to follow a road leading to the valley of the Dry Fork of Charrette Creek, south of Warrenton. The road followed closely the stream bed of the narrow valley hemmed in by steep wooded slopes. St. Peter sandstone bluffs of Ordovician age were common in this area as in most other valleys of this region. As there was time only to explore a very limited section of this country before darkness set in, a particular bluff and ravine was marked on the topographical quadrangle for exploration.

Stopping the car to make camp at a site opposite the spot marked on the map, the junior author left Mrs. Steyermark to get supper prepared while he hurried in the direction of the bluffs across the valley. Only about three-quarters of an hour remained before darkness would set in. After crossing the valley a wooded bluff was encountered. A moist ledge at the base of the sandstone bluff was covered with the usual association of

Saxifraga pensylvanica, Mitella diphylla, Cystopteris bulbifera, and *Dryopteris marginalis,* but a clump of large fronds attracted immediate attention. At first they brought to mind *Osmunda Claytoniana,* but the pinnae seemed quite different with a darker bluish-green color. Examining the plants more closely, it was apparent that the conspicuous dark brown scales towards the base of the stipes were not those belonging to an *Osmunda.* Soon, an examination of the lower side of the fronds revealed dark brown sori covered by a suborbicular indusium. The fern was obviously a *Dryopteris,* but certainly none known from Missouri.

Following down the north-facing bluff leading to a tributary ravine, the forest became denser and more shaded. Fruiting stalks of the rare *Allium tricoccum* protruded above the rich leaf mold. Ginseng (*Panax quinquefolius*) was common with *Dirca palustris. Lycopodium lucidulum* thickly covered portions of the mossy bluffs, everywhere green with *Dryopteris marginalis.* Several more plants of the large unidentified *Dryopteris* were found at the base of the shaded moist portions of the bluff. About this time darkness began to set in, and retreat was made back to camp. Study of the material collected left no doubt that the *Dryopteris* was indeed *D. Goldiana,* here in central Missouri at a new southwestern limit of distribution, and several hundred miles from the nearest stations known, in Iowa and Tennessee. The data for the Missouri collection are: *Steyermark 73069,* north-facing St. Peter sandstone ravine tributary to Dry Fork of Charrette Creek, T 46 N, R 2 W, sect. 19, 6 miles south of Warrenton, Warren Co., September 30, 1951.

MARSILEA MUCRONATA A. BR.

For reasons beyond his control the botanical activities of the senior author have been limited during the past few years to localities within a short distance of his home, and efforts have been largely concentrated on a few counties in southwestern Missouri, and particularly on Barton, Dade, and Lawrence Counties. The intensive exploration of these counties has resulted in the discovery of a number of interesting and unexpected plants, especially in Barton County, most of them near the northeastern corner of the county where Horse Creek and its small tributaries have cut channels through an upland area underlaid with Pennsylvania sandstone. The region is a rather rugged one, and it was originally all woodland. Parts of it have been cleared or cut over, and there are now some small areas in cultivation and more in abandoned fields, but the greatest part is still rather primitive and wooded.

On a trip to this region toward the end of September, 1951, a little marshy pond was noticed just east of the road and close to a small stream about a mile and a half north of the village of Milford. Several interesting plants were found about the margins of the pond, but the best and most unexpected of them was the little fernwort, *Marsilea mucronata.* There had been persistent rumors of this plant having been found somewhere in the state. But when the authors of these notes prepared the list of Ferns and Fern Allies of Missouri,[1] they were unable to find specimens of it in any herbarium, and so it was excluded from the list. Efforts to find living plants or herbarium specimens since that time have also proved fruitless. So it can now be recorded as an addition to our known fern flora. The small pond or pool where it was collected was in rather low alluvial ground. It was apparently an old channel or overflow from the nearby stream, and was quite shallow and without definite banks. The *Marsilea* was growing in shallow water

[1] Amer. Fern Journ. **22**: 105–122. 1932, and **23**: 65–66. 1933.

and mud along the margins, and although the plants were rather numerous, it was difficult to collect them and to disentangle them from the mud and the thick growth of grass and sedges, and so no roots were secured. But enough leaves were taken to make a few herbarium specimens. The collection is *E. J. Palmer* no. *53101*, September 22, 1951.

WOODWARDIA AREOLATA (L.) MOORE

On the same trip another fern collection was made that, although it was not of a species new to the state flora, seems well worth recording, since it constitutes a considerable extension of range for a fern that is rare in this part of the country. The locality was about a mile and a half northeast of the *Marsilea* station and along the wooded bluffs and steep hillsides on the west side of Horse Creek. Sandstone outcrops here for some distance, and while there are no precipitous bluffs, ledges several feet in thickness are found at different levels and some of them closely approach the stream. A large colony of some fern was noticed just below a thick ledge, and on closer inspection it proved to be the chain fern, *Woodwardia areolata.* At this place a spring that appears to be perennial issues from a clay or shale parting in the sandstone and spreads out over a nearly level bench making a little boggy area perhaps three or four square meters in extent. This permanently moist or wet area was monopolized by a colony of the fern, and there were, no doubt, several thousand fronds, a fair proportion of them being fertile ones. Except for a few scattered plants a little further along the same ledge, no other evidence was found of its presence in the region. This fern, which is common in many parts of the eastern and southern states, usually grows in low swampy woods or in acid bogs. The range given for it in the eighth edition of Gray's Manual has its western limit as the lowlands of southeastern Missouri. This is in accordance with our previous record, for the only locality known for it in the state was in Butler County, over two hundred miles eastward. So its discovery in a rocky upland station in western Missouri only a few miles from the Kansas border is of unusual interest. The collection record is as follows: *E. J. Palmer,* no. *53158,* wet springy ground below sandstone ledge, along Horse Creek, 3 miles northeast of Milford, Barton Co., September 22, 1951, alt. approximately 270 meters. A second collection was made at the same locality, under no. *53205,* September 25, 1951.

Collections of the plants discussed above are to be found in the Chicago Natural History Museum Herbarium, and it is planned to send duplicate material to Gray Herbarium, Missouri Botanical Garden Herbarium, and the United States National Herbarium. The *Marsilea* and *Woodwardia* collections are also to be found in the private herbarium of the senior author.

WEBB CITY, MISSOURI, AND CHICAGO NATURAL HISTORY MUSEUM AND MISSOURI BOTANICAL GARDEN.

Notes on the Spinulose Wood-ferns

EDGAR T. WHERRY

Publication of the 8th edition of Gray's Manual was long looked forward to, in the hope that it might establish generally acceptable taxonomic and nomenclatorial usage for our repeatedly reclassified and renamed Pteridophyta. The hope has proved unfounded.

One commendable action is the acceptance for the Toothed Wood-fern of the name *Dryopteris spinulosa* instead of *D. austriaca,* which has been taken up by some recent workers. The diagnosis of the mid-European taxon to which the latter epithet was assigned was not clear, and in view of the recent demonstration by Manton[1] that certain ferns of this alliance are coenospecies, the chances that it could really correspond to any American taxon seem slight. On the other hand, British *D. spinulosa* is so close morphologically and geographically to the North American taxon so named that their identity is at least probable.

A confusing procedure in the Manual is the placing of minor taxa exhibiting different sorts of relationship to major ones into a single category, designated by the term which seems to hold many taxonomists in a spell—"variety." This is exemplified on page 35 where 5 varieties are keyed out—named respectively *spinulosa, fructuosa, intermedia, americana,* and *concordiana.*

Attempts to apply the key-characters leading to "var. *fructuosa*" have not been successful: in several hundred herbarium specimens examined, no correlation has been found between relatively large indusia and gradually tapering pinnae. Field observation has indicated, however, two possible applications of the epithet. (1) Occasionally when a season has been dry, but late in summer there is considerable rainfall, a crown which has produced fronds with normal-sized indusia will send up a new frond on which the sori bear over-sized ones. Such fronds deserve an epithet, if at all, no higher in status than form. (2) Wherever vigorous colonies of taxa "*spinulosa*" and "*intermedia*" approach one another, sporadic individuals often appear, attaining a greater height than average members of either colony, and combining the features of the two to a striking degree. Over-sized indusia may be borne on the fronds of these plants, although no more frequently on those approaching the "*spinulosa*" pinna-outline than on those resem-

[1] Problems of cytology and evolution in the Pteridophyta. Cambridge, 1950. Cf. pp. 44 and 71.

bling "*intermedia*" in this respect. Here both simple hybridization and back-crossing to parents appear to be taking place, although cytologic study will be needed to establish the exact relationships.[2]

The third taxon, termed var. *intermedia,* forms vast uniform colonies in the forests of the "Canadian zone" and elsewhere, and constitutes, at least, what modern taxonomists term a subspecies. The fact that unlike other taxa here considered its fronds are fully evergreen and consistently glandular renders the view that it is distinct at the species level not unreasonable.

In var. *americana* the relations are again different: it represents an ill-defined segregate from the circumboreal *Dryopteris dilatata.* It sometimes seemingly hybridizes with taxon *spinulosa,* producing the intermediates the existence of which has led to the opinion that it does not deserve species status. In spite of the occurrence of such hybrids in Europe, Manton[3] unhesitatingly classed *D. dilatata* as "a good species."

The var. *concordiana* differs from all the others in representing a solitary clone, now extinct in the wild but maintained in fern gardens. To place it in the same category as abundant and even cosmopolitan taxa seems meaningless.

In order of magnitude of area occupied the five taxa here discussed are then:

Dryopteris dilatata (Hoffm.) Gray. Circumboreal.
D. spinulosa (Muell.) Watt. Nearly circumboreal.
D. intermedia (Muhl.) Gray. Eastern North America.

[2] Among some hundreds of specimens of these ferns in the University of Pennsylvania herbarium there is not a single one which agrees fully with the Manual description of var. *fructuosa.* Should anyone have a duplicate to spare, which does fit, its receipt would be appreciated. Even more acceptable would be word as to the existence of an accessible locality where this taxon occurs otherwise than as isolated individuals.

[3] *Op. cit.* 65.

D. intermedia f. *fructuosa* (Gilb.) Clute. Sporadic.
D. intermedia f. *concordiana* (Davenp.) Clute. Unitary.

It is hard to see how anything is to be gained by grading the first three down and the last two up in status.

UNIVERSITY OF PENNSYLVANIA.

Recent Fern Literature

An attractive 200-page bulletin on the Flora of Big Bend National Park, Texas, has been issued by the National Park Service.[1] Pages 15 to 21 are devoted to the two families of Pteridophytes present, comprising some 33 taxa. There are useful keys to genera and, in the larger of these, to the species. Photographs of 8 of the ferns taken with a dark gray background bring out the tures well. The one labelled *Cheilanthes tomentosa,* however, appears to represent some other species.—EDGAR T. WHERRY.

The well-known book by Dobbie on the ferns of New Zealand has been useful for the interested public; but now, in what passes as a fourth edition,[2] it has been augmented by almost everything the professional botanist might desire, thus making it the most perfect local fern flora of the reviewer's acquaintance.

What is this New Zealand that it is favored by such a book? It is an isolated group of islands in the far South Pacific, in area about 104,000 square miles, almost exactly the same as Colorado. It has 153 recognized species of ferns—more than Colorado, but only a minor fraction of the number in similar areas in good fern country in the tropics. But the ferns of New Zealand

[1] Plants of Big Bend National Park. W. B. McDougall and Omer E. Sperry. Gov't. Printing Office, Washington, D. C. $1.00.

[2] New Zealand Ferns, by H. B. Dobbie and Marguerite Crookes. Whitcomb and Tombs Ltd., Auckland, New Zealand, 1951. XIX + 406 pp.

are a more conspicuous part of the flora than in the accessible tropics; the people appreciate, cherish and cultivate them; and, on the whole, they are unusual, remarkable ferns. This gives the book a fine subject, of which it makes the most.

Illustrations make up half of the book and are unique in quality and usefulness. Three pages are used to describe the effort responsible for one plate, of *Leptopteris superba.* The keys to the genera and species are not of the conventional form, but are more descriptive, serving better to bring out the groups. The perfection of the illustrations makes keys superfluous for their usual purpose—that of finding the names.

As a matter of incidental interest, the origin of the scientific names is given. Here may be noted one error: the name of the genus *Craspedophyllum* (p. 86) is derived from *kraspedon,* a border, not from *crassus,* thick. This should have been explained when the name was published.

If this review runs to superlatives, it merely reflects its subject. *Leptopteris superba* is "the most beautiful fern in New Zealand." *Cardiomanes reniforme* is "the most remarkable fern in New Zealand." *Apteropteris Malingii* is (quoting Holloway) "certainly the most peculiar species of the New Zealand family." *Loxsoma* is "the most interesting fern in New Zealand." In our Californian lingo, we would write "in the world" instead of "in New Zealand."

Remarks on adaptability to culture, and on particular demands of the individual species testify by their number to the attention New Zealanders have given to their ferns, attention which has made such a book possible. One item: the prothallia of many species are described.

It may be a result of this attention that miscegenation seems to be commonplace in New Zealand ferns. Hybridization is known or suspected in *Botrychium, Leptopteris, Mecodium, Hymenophyllum, Lindsaea, Hypolepis, Pteris, Cheilanthes, Pellaea, Adiantum, Blechnum, Doodia* and *Asplenium.*—E. B. COPELAND.

American Fern Society

SUMMER FIELD TRIP.—The following notes supplement the preliminary announcement of the proposed summer field trip that appeared in number 1 of the Journal. There has been a good deal of interest manifested and the trip will be carried out; it may be mentioned that each portion may be considered as complete in itself, and it is hoped that at each stop a good number of local residents may join with the Society. The trip has been announced also to members of the Torrey Botanical Club, with which the Fern Society has often carried out successful joint meetings.

REGISTRATION: Those planning to take the entire trip may register their names with me, together with a stamped, addressed return envelope (my address in July and August: Pilot Knob, New York). Those planning to be with the party on specific days should register with the leader for that portion of the trip.

SCHEDULE: The schedule at present is as follows. A final announcement will be sent out after August 1 to those who have registered. September 2: Start from Woodstock, Vermont, for trip through Green Mountain region, through Randolph and Northfield Gulf to Stowe, Vermont for the night. Leader Harold G. Rugg, Box 187, Dartmouth College, Hanover, New Hampshire.

September 3. Exploring Smuggler's Notch, on Mount Mansfield, Vermont. Night stop to be announced. Leader: Robert A. Doray, 560 White Street, Springfield, Massachusetts.

September 4. Drive of about 100 miles from Vermont to Pilot Knob, on Lake George, via the Lake Champlain Bridge, reaching Pilot Knob by midday. Botanizing in the region of Lake George. Leader at Pilot Knob: R. C. Benedict.

September 5, 6. Lake George region and north through the higher Adirondack Mountains, via the road to the top of Whiteface Mountain, one of the highest of the Adirondacks, and then through rolling farm country to Syracuse, New York. Leader: R. C. Benedict.

September 7 (Sunday). Jamesville, New York, in the plunge-basin of a river of glacial times, the habitat of the hart's-tongue fern. Leaders: Mildred Faust, Syracuse University, Syracuse 10, New York, and Nettie Sadler, 503 Allen St., Syracuse 10, New York. Later, to Ithaca, New York, through Finger Lakes region.

September 8, 9. Scientific meetings of the American Institute of Biological Sciences (or, if desired, additional field trips in the Finger Lake region).

September 10. Ithaca. Luncheon and annual meeting of the Society for delivering papers. Program chairman: Robert T. Clausen, Department of Botany, Cornell University, Ithaca, New York.

September 11. Field trip in the region of Ithaca. Leader: Robert T. Clausen.

ACCOMMODATIONS: Since the trip is after Labor Day, overnight accommodations should be readily available. When registering please indicate the kind and number of accommodations desired.

COLLECTING: The trip will afford opportunities to see some species from which no whole plants or even herbarium specimens should be collected. Even for some not so rare there must be some restrictions imposed, and all visitors will be expected to refrain from collecting except as the leaders may give permission. In these days when many members are raising ferns from spores, it should be relatively easy to start cultures and carry on exchanges of young plants of the rarer species.

Transportation: Will members who plan to come in their own cars and who will have some spare space please let me know? Also, those desiring transportation should let me know soon. It may be possible to arrange for a pooling of car space from the various centers, or from the starting point (Woodstock). Also, if there are some who would like to attend some one meeting but will have to come by bus or train to the nearest stop, please let me know and if possible transportation for the day will be arranged.—R. C. Benedict, 1819 Dorchester Road, Brooklyn 26, New York.

Special Regional Committees.—In addition to those named as leaders of the several meetings and field trips that have been announced in the New York–New England areas, the following members have agreed to give information regarding possible additional field trips in their respective areas: Mr. William S. Johnston, 65 Morris Lane, Scarsdale, New York, (the state-line counties of New York, Connecticut, and Massachusetts); Mrs. Elsie G. Whitney, 104 Adams Place, Delmar, New York (Albany and environs); Mr. Walter S. Allen, 144-19 35th Avenue, Flushing, New York (Long Island counties); and Dr. Elva Lawton, Department of Botany, Hunter College, New York, N. Y. (Manhattan and the Bronx).—R. C. Benedict.

Membership Committee.—A new committee designed to aid in obtaining new members for the Society and new subscriptions to the Journal has been appointed, consisting of Dr. and Mrs. Van De Water, 82 Essex Road, Summit, New Jersey, and Mr. and Mrs. Dale G. Oechler, c/o J. F. Anderson, Short Hills, New Jersey. Do you know botanists, gardeners, prospective naturalists in high schools and colleges, and others who would find the Fern Society interesting and useful? Do you know libraries that ought to subscribe to the Fern Journal and to have a file of back numbers on their shelves? By the large number of new members that are listed in each issue of the Journal, it would appear that there are many such. It is hoped that our members will think of many more and will aid the committee by enlisting new members and subscriptions directly or by sending in leads for the committee to follow up.—R. C. BENEDICT.

FERN GARDEN REGISTER.—Members of the Society interested in some particular field of fern study often find it profitable to correspond with others of like interests. In order to facilitate such correspondence among those interested in fern gardens and in raising ferns from spores, I have asked Dr. M. R. Sharpe, Uxbridge, Massachusetts, to serve as a registrar in this field. Members interested may send their names to him.—R. C. BENEDICT.

REPORT ON THE MEETING AT THE AMERICAN MUSEUM OF NATURAL HISTORY.—In response to Dr. Svenson's invitation, extended in number 1 of the Journal, 16 members of the American Fern Society and their friends met in Dr. Svenson's office at the American Museum of Natural History at 9:30 a.m. There followed an informal "get-acquainted hour," during which herbarium specimens of interesting or unusual ferns were examined, and also some excellent photographs of ferns in the wild and copies of several old and new books on ferns.

Dr. Benedict outlined several proposed fern field trips for the coming summer, to which all Fern Society members and friends are invited. These include:

(1) A garden meeting at the home of our Treasurer, Mr. M. D. Mann, Jr. on June 28. Members who visited

Mr. Mann's garden a year ago will recall his remarkable display of native ferns and especially crested varieties.

(2) A garden meeting in July at the home of Mr. and Mrs. Edward D. Thurston, Sharon, Connecticut. Those who saw the splendid exhibit by the Thurstons at the 1939 New York Flower Show will bear witness to the attractiveness of their arrangement and to the wide variety of ferns exhibited. For details and exact date write to Mr. William S. Johnston, 65 Morris Lane, Scarsdale, New York.

(3) Field trip to northern Vermont and New York, noticed in detail elsewhere in this issue.

Dr. Svenson conducted our group through the recently developed Warburg Memorial Hall of Local Landscape at the Museum. This new ecological exhibit was developed under his direction and has many features of much interest to Fern Society members as well as to botanists generally.

Following the Museum meeting 12 of the group, with the addition of Mrs. Svenson and Mrs. Chu, enjoyed a trip to Chinatown and a most enjoyable dinner in a Chinese restaurant.

Those who attended this successful Society meeting were: Walter S. Allen, Dr. R. C. Benedict, Kate P. de Bruyne, Mrs. Charles W. Crane, Dr. and Mrs. F. O. Holmes, W. S. Johnston, Mr. and Mrs. M. D. Mann, Jr., Jane Meyer, Marjorie Mutchler, Alice A. O'Connor, George H. Peters, Hester M. Rusk, Victor Schechter and son, and Dr. H. F. Swenson.—WALTER S. ALLEN, for the Secretary.

THE ANNUAL MEETING AT ITHACA IN SEPTEMBER.—Arrangements have now been made for a luncheon for members of the American Fern Society at 12: 30 P. M. on Wednesday, September 10. The place will be the Kimball Room of Willard Straight Hall on the campus of Cornell University. The price of the meal, depending on the menu, probably will be from $1.10 to $1.50. Following the luncheon, a meeting will be held for which a program of interesting papers already has been prepared. All members who can be in Ithaca are encouraged to attend both luncheon and meeting.—Robert T. Clausen, *Department of Botany, Cornell University, Ithaca, N. Y.* (Program Chairman)

THE ITHACA FIELD TRIP AND THE FERNS OF THE CAYUGA REGION OF NEW YORK.—An all day trip for ferns will be made on Thursday, September 11, the day after the Ithaca meeting of the American Fern Society. All interested are invited to attend. Members with cars should plan to drive. The group will assemble at the south door of the Plant Science Building on the Cornell Campus at 8 A. M. and will leave shortly thereafter. Those attending are urged to bring lunches and to come dressed for rough and possibly moist terrain. The trip will include several localities where one can see most of the species of ferns known from the region of Cayuga Lake. Places to be visited probably will include the headwaters of Six Mile Creek southwest of Dryden, where occur five species of *Lycopodium, Botrychium lanceolatum* ssp. *angustisegmentum, B. matricariaefolium, B. multifidum* spp. *silaifolium, B. dissectum* and *Ophioglossum vulgatum;* Woodwardia Bog, a spruce-tamarack bog northwest of Dryden, with *Woodwardia virginica,* and nearby *Dryopteris goldiana;* and the ravine of Mack Creek, on the west side of Cayuga Lake, a good place to see *Athyrium pycnocarpon, Camptosorus rhizophyllus, Matteuccia struthiopteris* and other species characteristic of ravines in the Finger Lakes Region. The U. S. Topographic Sheets of the 7½ minute series, Dryden, Groton, Ovid and Sheldrake, show the area to be covered.

A complete list of the species of ferns known from the

Ithaca region follows below. This is taken, with a few nomenclatural changes, from my "Checklist of the Vascular Plants of the Cayuga Quadrangle, 42°–43° N., 76°–77° W."[1] Copies of this checklist may be obtained for 25¢ from the Mailing Room, Roberts Hall, New York State College of Agriculture, Ithaca, N. Y. In the following list, synonyms are provided only when the name in the checklist is different from the one recorded here. The frequency of each species is indicated according to the following criteria: abundant, known from 51 or more localities or with a nearly continuous distribution; common, 21–50; frequent, 11–20; scarce, 6–10; and rare, 1–5. When plants of a species occur at places 6 or more miles apart, with nothing of the same species in between, they are regarded as separate occurrences. The following enumeration may be useful as a checklist for the trip on Sept. 11.

1. *Botrychium multifidum* ssp. *multifidum,* rare (overgrown slope of hill southwest of Labrador Pond, elev. 1850 ft.) ; ssp. *silaifolium,* scarce.

2. *Botrychium dissectum* ssp. *dissectum,* abundant (Vars. *dissectum, obliquum* and *oneidense* all occur).

3. *Botrychium simplex,* scarce (Plants in this area are var. *laxifolium* and var. *tenebrosum*).

4. *Botrychium matricariaefolium* ssp. *matricariaefolium,* common.

5. *Botrychium lanceolatum* ssp. *angustisegmentum,* common.

6. *Botrychium virginianum* ssp. *virginianum,* abundant.

7. *Ophioglossum vulgatum,* frequent.

8. *Osmunda regalis,* frequent.

9. *Osmunda claytoniana,* common.

10. *Osmunda cinnamomea,* abundant.

[1] Cornell Univ. Agr. Exp. Sta. Mem. 291. 1949.

11. *Marsilea quadrifolia,* common on shores of Cayuga Lake and its larger tributaries.

[*Azolla caroliniana,* not surely native, but has been introduced and temporarily naturalized.]

12. *Dennstaedtia punctilobula,* common.

13. *Pteridium aquilinum* ssp. *latiusculum,* abundant.

14. *Adiantum pedatum,* abundant.

15. *Pellaea atropurpurea,* scarce.

16. *Cryptogramma stelleri,* rare (ravines of Fall Cascadilla and Enfield Creeks; cliffs along west shore of Seneca Lake north of Glenora; cliffs near southwest corner of Skaneateles Lake).

17. *Onoclea sensibilis,* abundant.

18. *Matteuccia struthiopteris,* common.

19. *Woodwardia virginica,* rare (Woodwardia Bog, northwest of Dryden; peat bog northwest of Waterloo; also reported by Clute from north of Barton, but not found there recently).

20. *Athyrium pycnocarpon,* frequent.

21. *Athyrium thelypteroides,* common.

22. *Athyrium filix-femina* ssp. *angustum,* abundant.

23. *Asplenium trichomanes,* common.

24. *Asplenium platyneuron,* frequent.

[*Asplenium ruta-muraria* ssp. *cryptolepis,* reported from Apulia and Jamesville by House, but not seen recently at either locality.]

25. *Camptosorus rhizophyllus,* common.

26. *Phyllitis scolopendrium,* rare (now known only from the region of West Green Lake, Jamesville).

27. *Cystopteris fragilis,* abundant.

28. *Cystopteris bulbifera,* common.

29. *Woodsia ilvensis,* scarce.

30. *Woodsia obtusa,* frequent.

31. *Polystichum acrostichoides,* abundant.

32. *Thelypteris palustris* (*Dryopteris thelypteris*), abundant.

33. *Thelypteris simulata* (*Dryopteris simulata*), rare (known only from the boggy swamp just east of the Ringwood Preserve, where first found on July 30, 1946).

34. *Thelypteris noveboracensis* (*Dryopteris noveboracensis*), common.

35. *Dryopteris cristata,* common (Var. *clintoniana* is frequent, but sometimes seems to grade into typical *cristata.* It may be the result of hybridization between *D. cristata* and *D. goldiana.*)

36. *Dryopteris goldiana*), frequent.

37. *Dryopteris spinulosa,* common.

38. *Dryopteris austriaca,* abundant (where *D. austriaca* and *D. spinulosa* occur together, they commonly produce hybrids, but these may not be completely fertile).

39. *Gymnocarpium dryopteris* (*Dryopteris disjuncta*), frequent.

40. *Phegopteris polypodioides* (*Dryopteris phegopteris*), scarce.

41. *Phegopteris hexagonoptera* (*Dryopteris hexagonoptera*), common.

42. *Polypodium virginianum,* abundant.

The total list of species of ferns known from the Cayuga Quadrangle thus stands at 42. Of these, with good luck, we should see about 32 on September 11.—Robert T. Clausen, *Department of Botany, Cornell University, Ithaca, New York.*

The University of Pennsylvania Press, Philadelphia 4, Pa., announces that the price of Guide to Eastern Ferns, by Edgar T. Wherry, is now $2.50. This is a third edition of the pocket-size booklet formerly published by the Science Press Printing Co.

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American Fern Journal

VOL. 42 JULY–SEPTEMBER, 1952 NO. 3

Juvenile Leaves of Two Polypodies

WARREN H. WAGNER, JR.

The juvenile leaves of ferns are frequently entirely unlike the adult leaves of the same species. This is true, for example, of the common bracken, *Pteridium aquilinum.* Also, the leaves of closely related ferns in the immature state are often remarkably different from each other. A peculiar case is that of *Osmunda regalis,* the young leaves of which on casual observation are so like those of *Onoclea sensibilis* that they may be easily confused; on the other hand, the leaves of sporelings of *Osmunda cinnamomea* are entirely distinct from either in cutting and outline.

In the study of ferns relatively little attention has been focussed on the juvenile leaf stages, but it is likely that much can be learned by examining and comparing them. Even some of our commonest species are practically unknown from this standpoint. This paper represents a brief record of the changes that take place in progressively more complex juvenile fronds of two of the common polypodies, *Phlebodium aureum,* which occurs in Florida and practically throughout tropical America, and *Polypodium virginianum,* the familiar rock-cap fern of Newfoundland to Arkansas and Georgia.

The transitions in patterns which are observed from frond to frond in successive juvenile leaves, starting with the first leaf formed by the embryo and continuing until the mature frond plan is reached, have often been con-

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sidered to shed light on the evolutionary origin of fern leaves. One of the two main theories of fern-leaf origin suggests that the frond is actually quite different from the leaf, say, of *Lycopodium* in evolution. The leaf of *Lycopodium* is believed to be an "enation," that is, a projection of the surface of the stem of some ancient, leafless plant. According to this theory, fern leaves on the other hand were derived from *groups* of forking branches of some primeval plant which branched like *Psilotum nudum,* by repeated, equal forking. At first the individual dichotomous branches were separate, but "webbing" (the formation of lamina) took place between the branches, and produced in this way the first leaf blades. The *veins* of these blades corresponded to the original branches. In later evolution, however, instead of the veins remaining equally forked, *alternating* shanks of each forking became emphasized so that the appearance was given of a zig-zag rachis with veins coming off laterally. In the end, the rachis became a straight midrib, and finally, in some cases, the lateral veins formed oppositely.[1]

The other theory of the origin of the fern leaf is simply that the ancestral leaf was not a branch system but rather a small leaf like that of *Lycopodium* with a single midrib and no lateral veins, and that the form of the fern leaf was developed by an increase in the complexity of such a leaf, i.e., by the formation of lateral vein-branches from the midrib.

It has been frequently said that successive young leaves of a fern summarize the branch system theory since the earliest leaves tend to have equally forked veins, the later ones unequally forked, and the latest formed juvenile leaves midribs and lateral veins. Accordingly, in

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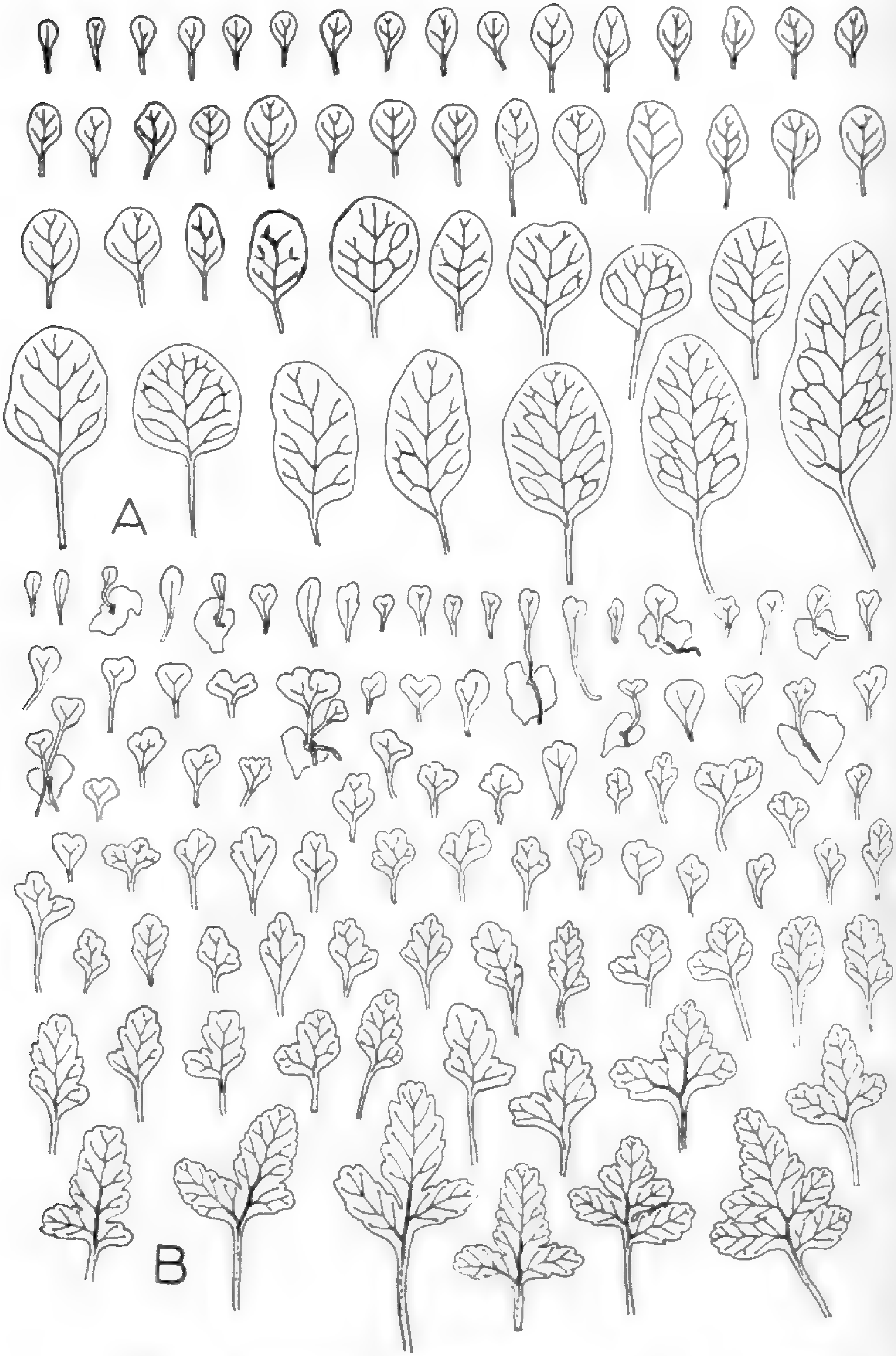
[1] This theory is illustrated diagrammatically by Zimmerman, in Verdoorn's Manual of Pteridology, p. 579, 1938.

the present case, it was interesting to take a long series of young leaves, arrange them in order of increasing complexity, and see whether these changes can be observed in a gradual progression.

The first thing that will be noticed on examining the plate, however, is that the two polypodies are quite different in respect to arrangement of veins and blade outline. In adult leaves of *Phlebodium aureum* (A) the veins are subopposite, and the same is true of the majority of the juvenile fronds, this condition appearing at a very early stage. In adult leaves of *Polypodium virginianum,* on the other hand, the veins are alternate, and this, likewise, shows up in extremely small fronds (B). The question then arises whether these leaves do show a gradual transition from equally forking veins to alternate veins and from alternate veins to opposite veins; but the answer is that in these two species they apparently do not, or, if they do, it is not a very clear-cut process. All that one can say for these series is that the species which has opposite veins in the adult state has them likewise in the early stages; and the species which has alternate veins develops that condition very early.

Three other points are of interest in these two series. The first is that both of the species have free veins in the early stages, but one, *Phlebodium aureum,* develops loops when the fronds become larger that lead finally to reticulate venation. Another contrast brought out by comparing these two ferns is that the characteristic margins of the adult leaves are different, and these differences appear at a very early stage. In *Polypodium virginianum* the margins of adult fronds, especially large sterile fronds, tend to be more or less toothed; but in *Phlebodium aureum* the margins are always entire. In both, fronds of great simplicity show these differences. Finally, the lateral lobes appear in *Polypodium virgin-*



A. JUVENILE LEAVES OF PHLEBODIUM AUREUM; B. JUVENILE LEAVES OF POLYPODIUM VIRGINIANUM.

ianum much earlier than they do in *Phlebodium aureum.* In the latter the progressive fronds reach a stage of considerable complexity in venation and relatively large size before the lobes arise in a series. The first lobes appear when the fronds are approximately twice the size of the largest one illustrated. But in *Polypodium virginianum,* the lobes appear when there are only three or four pairs of lateral veins, and the fronds are only several times as long as the earliest ones.

Better understanding of what changes take place in leaves from the simplest to the most complex will come only after we know in detail the successive juvenile fronds of more species of ferns. To do this, series of fifty or more juvenile fronds from very young plants are needed to give a clear idea of the variation. Often, when juvenile ferns are discovered in nature, they are quite abundant, and it is rather easy to find practically all the possible variations. Because many of our ferns have not been described from this standpoint, help from students of ferns is earnestly desired to fill in the gaps in our knowledge. The leaves of *Polypodium virginianum* illustrated here were collected with prothallia on damp rocks in Middlesex Fells, Massachusetts, in the spring of 1951; and those of *Phlebodium aureum* were taken from "volunteer" juvenile plants in the greenhouse of the Biological Laboratories at Harvard University at the same time. By studying series of different frond types of various species of ferns it is hoped that more can be learned of the nature of the fern leaf, and in individual cases that information which bears on the relationships of species and genera of ferns may be obtained.

DEPARTMENT OF BOTANY, UNIVERSITY OF MICHIGAN

Reproduction in Nephrolepis cordifolia

W. N. STEIL

Nephrolepis cordifolia (L.) Presl is a native of the West Indies and is found as an escape from cultivation in this country only in the state of Florida. It is similar in many respects to the common Boston fern (*N. exaltata* var. *bostoniensis*). It differs in two respects: the more nearly erect position of the leaves and the fronds (*Pl. 6, fig. 1*), and in the formation of tubers (*Pl. 6, fig. 2*) by means of which the plant may be reproduced. Propagules of this nature are formed in only a few other ferns, but are, no doubt, familiar to most readers of the Journal.

The reproduction of the fern has been studied by the writer for several years and will be briefly described. As in all other ferns which belong to the Polypodiaceae, the fronds of *N. cordifolia* bear numerous spores from each of which upon germination is produced the sexual phase or the gametophyte generation, the small heart-shaped prothallium familiar to every one interested in ferns. As is well known, the prothallium bears on its under surface the sex-organs (antheridia and archegonia) which produce the gametes, the sperms and the eggs. After fertilization, the asexual phase, or sporophyte generation is formed. About three years later, the plant, thus formed, reaches maturity, when it produces spores.

The spores are microscopic in size and are always composed of single cells, in contrast to seeds, which are in most plants macroscopic in size and are composed of thousands of cells. The seeds of most plants contain at maturity a single embryo each. No living ferns produce seeds, although many millions of years ago, "seed" ferns (Pteridosperms) constituted the dominant vegetation of the earth.

The formation of a fern plant from the ordinary cells of the gametophyte is known as apogamy, which was first described by Farlow (1874) in *Pteris cretica* var. *albolineata.* The phenomenon has been discovered in numerous other genera of ferns. However, the writer finds that in *Nephrolepis cordifolia,* and also in some other species of the genus, fertilization occurs in the life cycle and hence the sporophyte owes its origin to the sexual process, and not to a direct vegetative outgrowth of the prothallium.

Although spores are produced in great abundance in *N. cordifolia,* environmental conditions are frequently unfavorable for the germination of the spore, the development of the gametophyte, the fertilization, or the young embryo. Since ferns require in their natural habitat about three years to complete their life cycles, it is not surprising that only a few spores in a million produce prothallia which function and produce fern plants. If *N. cordifolia* failed to produce spores, it could readily propagate itself by other means. However, it would then be considerably limited in its distribution.

A most common method of reproduction of this fern is by means of runners (*Pl. 6, fig. 3*), modified stems, which are produced in all of the *Nephrolepis* species known to the writer. These propagules are produced in great numbers both above and below the soil surface. Similar runners are sometimes produced only below the surface of the soil, as in *Pteretis nodulosa* (Ostrich fern), which resemble more nearly rhizomes like those of *Pteridium aquilinum* var. *latiusculum* and many *Pteris* species. Runners are most effective means of reproduction, since more than 100 plants have been observed to form from the runners of a single plant in the course of a year.

Reproduction of this fern may also result in nature from the division of the main axis of the stem. Most

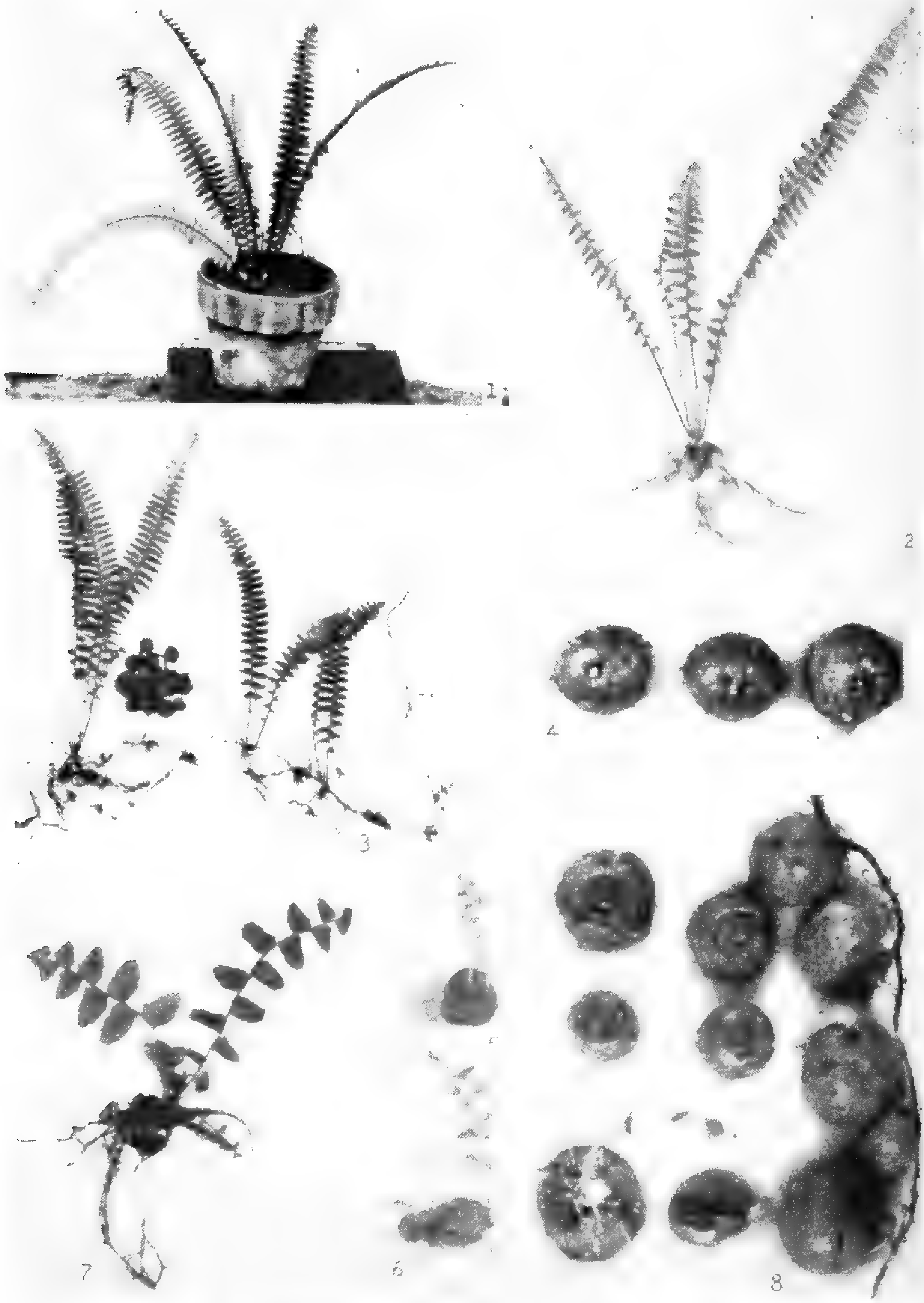


PLATE 6. *Nephrolepis cordifolia* (L.) Presl. Fig. 1. A one-year-old plant grown from a tuber. Fig. 2. A young plant grown from a runner. Several tubers have already been formed. Fig. 3. Young plants formed by a runner. Some of the tubers which have been removed from a portion of the runner not shown in the photograph. Fig. 4. Mature tubers. Figs. 5 and 6. Germinating tubers. Fig. 7. A young plant formed by a tuber. Fig. 8. Tubers from which the growing ends have been cut off. They still retain the power to germinate.

ferns and many seed plants are reproduced in this manner.

The most interesting method of reproduction of the fern is by means of the tubers produced by underground stems, or runners. These propagules are often formed in large numbers. Some of the older plants grown in the Marquette University greenhouse have been observed to produce over 200 tubers.

Fig. 9. *Nephrolepis cordifolia* (L.) Presl. A germinating tuber from each end of which a new plant has originated. The longer runner bears nine young plants.

The mature tubers resemble those of the common potato (*Pl. 6, fig. 4*). Their length generally exceeds slightly their width. The largest tubers are seldom more than 1¼ inches in length. When young, the tubers are almost white or silvery on account of the numerous scales which completely cover the surface of the tuber. When they come to maturity, the scales become dark brown in color. The tuber, like that of the potato, is characterized by two ends: the stem end and the opposite or growing end, where there is an active bud from which an independent plant may be formed when the tuber is planted. The stem end, however, may also produce a plant, especially if the growing end fails to function. About 5% of the tubers in culture form two plants, one from each end. A few tubers have been observed to form two plants from the growing end. Young tubers germinate immediately after they are planted; they never go into dormancy. While they remain attached, they fail to germinate, and hence, they serve as storage organs. Besides large amounts of water, the tuber contains sugar, proteins and a small amount of fat.

When the tuber germinates, leaves of the mature shape and roots are produced, usually from the growing end (*Pl. 6, figs. 5, 6, 7*). Even if a considerable portion of the end is cut off (*Pl. 6, fig. 8*) juvenile leaves are not formed by the new plant. Runners are produced at an early stage, from which a number of plants may originate (Fig. 9). Under favorable conditions of culture only about a year is required for growing a mature plant.

Since *Nephrolepis cordifolia* produces tubers and runners in great abundance, its chances for success in nature are much greater than those ferns which lack such propagules.

MARQUETTE UNIVERSITY, MILWAUKEE, WISCONSIN

Note on the Occurrence of Ophioglossum crotalophoroides Walt. in Louisiana

CLAIR A. BROWN

The bulbous adder's tongue is a diminutive member of the adder's tongue ferns which can be readily identified by its tuberous rootstalk. This fern has been considered rare, which may be in part due to its small size and to its seasonal occurrence. The object of this note is to mention the time and conditions under which it grows as an aid to others interested in finding it.

Collections of this plant from Louisiana date back into the early 1800's. The writer first found it on the Indian Mounds on the campus of Louisiana State University, in May, 1928. The same location was examined for several years in succession and the plant finally relocated in

OPHIOGLOSSUM CROTALOPHOROIDES

1940, after a lapse of 12 years. In the meantime, it was found in a few other parishes in the state.

It has been found every year for the past 5 to 6 years always growing in grassy places. It has been frequent on lawns in the Baton Rouge area. This spring it was found in two other parishes. These locations were on grassy clearings which are being invaded by trees. It has not been found in the woods adjoining the grassy fields. Some of the chief plants occurring with this fern are carpet-grass (*Axonopus affinis*), Bermuda grass (*Cynodon dactylon*), spurweed (*Soliva sessilis*), white Dutch clover (*Trifolium repens*), little hopclover (*Trifolium dubium*), black medic (*Medicago lupulina*), and *Dichondra repens*. The sterile fronds are usually nestled down among the grasses and are very difficult to find. The plants are most easily found when in fruit, in particular on lawns which were either closely mown the previous fall, or under conditions where a week to 10 days elapsed after the first spring mowing. This time interval allows the fruiting stalk to grow out above the grass. As the spores mature, the fruiting stalk changes from green to a yellowish green. Lawn mowing at regular weekly intervals undoubtedly reduces the chances of finding this plant.

The May collection in 1928 indicated the time of year to look for this plant. It has now been found as early as the middle of January. Under our normal spring growing conditions, it is most abundant the latter part of February into March. The later collections usually have the sporangia open. Thus as the result of the past few years observation, I believe the normal time for this fern to fruit in southern Louisiana is in February and March. It is hoped that this clue will aid others in their search for this plant.

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The American Species of Xiphopteris

E. B. COPELAND

(*Concluded*)

The U. S. National Herbarium has 46 collections named *P. limula* from Costa Rica, 11 from Panama, one from Guatemala, and one from Colombia.

✓6. X. **Hartii** (Jenman) Copel., comb. nov.

Polypodium Hartii Jenman, Journ. Bot. **24** (1886) 272; Bull. Bot. Dept. Jamaica II. **4** (1897) 105; Hieronymus, Hedw. **44** (1905) 95; Maxon, Contr. U. S. Nat. Herb. **17** (1916) 546, *pl. 33;* Proc. Biol. Soc. Washington **60** (1947) 125.

Described from Jamaica, and now known also from Porto Rico, Grenada, Guadeloupe (apparently common), and Dominica.

6a. *Polypodium nutatum* Jenman, Journ. Bot. **24** (1886) 272; Bull. Bot. Dept. Jamaica II. **4** (1897) 115; Maxon, Contr. U. S. Nat. Herb. **17** (1916) 547.

These two "species" were described at the same time, from the same place, and both have since been found on other islands. Of *P. nutatum*, Jenman wrote (1897): "It is a narrower species than the next (*P. Hartii*), both being very close allies". Maxon said his largest specimen of *P. nutatum* was twice the height of *P. Hartii*, but I can see no real difference between them.

✓7. X. **organensis** (Gardn.) Copel., comb. nov.

Grammitis organensis Gardn., Hook., Icon. Pl. **6** (1843) *pl. 509.*

Grammitis organensis Fée, Crypt. Vasc. Brés. 1 (1869) 264, *pl. 78, fig. 1.*

Polypodium organense Mett., Pol. (1857) 39 (no. 25); Fée, Crypt. Vasc. Brés. **1**: 90; Maxon, Contr. U. S. Nat. Herb. **17** (1916) 548.

Described from the Organ Mountains, and known only from Brazil. Fronds commonly 10 cm. long and 5 mm. wide, lobed hardly half-way to the costa, the lobes rounded. The treatment of this species by Fée is peculiar. On p. 90, he presents *P. organense* (Gardn.) Mett., on faith in Mettenius, but not seen. On p. 264, and *pl. 78, fig. 1,* he describes *G. organensis* Fée, as a new species. They seem to be identical; but, if they are not so, *G. organensis* Fée has no valid name. Its type is *Glaziou 3573* (isotype, US).

8. X. **Schenckii** (Hieron.) Copel., comb. nov.

Polypodium Schenckii Hieron., Hedw. **44** (1905) 87; Maxon, Contr. U. S. Nat. Herb. **17** (1916) 549.

Described from Santa Catarina, and known only in Brazil (northward to Minas Geraes). Uniformly smaller and much narrower than *X. organensis,* and incised rather than lobed. Besides the specimens cited by Maxon, the National Herbarium now contains *Pabst* 609, cited by Hieronymus in the original description.

9. X. setosa Kaulf., Enum. Fil. (1824) 275.

Grammitis setosa Presl, Tent. (1836) 208.

Polypodium setosum Mett., Pol. (1859) 33 (no. 6); Hieron., Hedw. **44** (1905) 91.

Polypodium micropteris C. Chr., Ind. Fil. (1906) 545; Maxon, Contr. U. S. Nat. Herb. **17** (1916) 546.

Described from Brazil, and known only from there. This species was described at the end of Kaulfuss' Enumeratio, and its inclusion in the genus makes the latter conform in definition, not to his diagnosis (p. 85), but to my present usage. Kaulfuss' expression is "Capsulae e basi frondis ad apicem usque . . ."; or, as rendered by Hooker,[2] "dentato-pinnatifid for its whole length."

Subsequent to the original publication (and perhaps then), the species has been known by poor material—"sehr mangelhafte Fragmente" (Hieronymus, *l. c.*). Maxon's key (p. 543) reads, "lamina slightly pubescent, or, if subsetulose, the hairs mostly short, brittle, or caducous." Maxon succeeded in getting from Berlin a fragment of Mettenius' fragment of the type. This fragment of a poor fragment justifies Maxon's "subsetulose, the hairs . . . caducous." But Mettenius wrote "folia . . . setis rigidis, nigricantibus, sparse obsita". And Kaulfuss used "setosa" in the description as well as in the name. It should be accepted as a fact that *X. setosa* is setose. Of recognized species, *X. perpusilla* seems most to resemble it. As to priority, *X. setosa* is the third oldest species of the genus.

10. X. **perpusilla** (Maxon) Copel., comb. nov.
Polypodium perpusillum Maxon, Contr. U. S. Nat. Herb. **17** (1914) 409, *pl. 13A.*

Known by a single collection (*Ule*), from Serra de Caraça, Minas Geraes, Brazil. Occasional veins are forked. It may be suspected that the specimen is abnormal, and that in a more adult or perfect form the forking of the veins will be characteristic.

11. X. **Grisebachii** (Underw.) Copel., comb. nov.
Polypodium Grisebachii Underw., in C. Chr., Index (1906) 531; Maxon, Contr. U. S. Nat. Herb. **17** (1916) 548.

[2] Sp. Fil. **4**: 175.

Xiphopteris Mortonii, type

Polypodium exiguum Griseb., Fl. Brit. W. Ind. (1864) 701; Hieron., Hedw. **44** (1905) 97, *nec alior.*

Described from Jamaica, whence there are many collections. Known also from Martinique and Guadeloupe.

12. Xiphopteris **Mortonii** Copel., sp. nov. (*Plate 8.*)

X. pusilla, rhizomate 1 mm. crasso erecto, paleaceo, paleis lanceolato-ovatis 0.5–1.2 mm. longis integris glabris sparsis, et basibus congestis stipitum et radicibus dense immersis; stipitibus ca. 1 cm. longis; lamina usque ad 5 cm. longa, ca. 3 mm. lata, obtusa, basi decurrente, tenuiter herbacea, pube minuta pallida vestita, demum glabrescente, $\frac{2}{3}$ ad costam lobata, lobis contiguis fere imbricatis, 1 mm. longis latisque, apice late rotundatis; venis perinconspicuis, fertilibus furcatis, ramo acroscopico basali brevi; soro parvo ad costam appresso, sporangiis nudis.

Cuba: Oriente: "Crest of Sierra Maestra, between Pico Turquino and La Bayamesa; alt. 1350 meters," *Morton & Acuña* 3547 (U. S., type).

Similar to *X. Grisebachii,* but distinguished by the (minute) pubescence, the broad, crowded lobes, and the position of the sorus, appressed to the costa. The veins are so inconspicuous that I would not be sure they were forked, except that the position of the elongate young sorus shows that the fertile veinlet is parallel to the costa.

13. X. **Mitchellae** (Baker) Copel., comb. nov.

Polypodium Mitchellae Baker, in Hemsl., Biol. Cent. Am. III (1885) 664; Maxon, Contr. U. S. Nat. Herb. **17** (1914) 410, *pl. 14;* (1916) 548.

Described from British Honduras, whence, and from Guatemala, several collections are now known; Nicaragua; Panama.

13a. *Polypodium Shaferi* Maxon, Contr. U. S. Nat. Herb. **17** (1914) 410, *pl. 13B;* (1916) 549.

Described from Cuba (type, *Shafer* 8071); also, *Shafer* 3475; *Clément* 2462, 4977, 5320; *Morton & Acuña* 3141; from Santo Domingo, *Ekman* 14884, *Abbott* 291a.

When *P. Shaferi* was described, it seemed different from *P. Mitchellae* in stature (the latter perhaps twice as large), pubescence of the lamina, and most notably in the paleae. In 1916, Maxon redescribed the paleae of *P. Shaferi,* showing them to be much alike in the two species. As to stature, some more recent continental collections—*Bartlett* 11727 and *Johnson* 888—are as small as *P. Shaferi.* The pubescence of the upper surface of the blade of *P. Shaferi* can be lost with age. Because of the densely crowded, hirsute stipe-bases, the paleae of both species seem to be completely suppressed in many specimens, a phenomenon already familiar in *Grammitis.*

14. X. **Cookii** (Underw. & Maxon) Copel., comb. nov.
Polypodium Cookii Underw. & Maxon, Contr. U. S. Nat. Herb. **17** (1914) 408; (1916) 547.

Type from Alta Verapaz, Guatemala, *Cook & Griggs* 80. Now known from Costa Rica also (*Standley* 37725, *Brenes* 4051). As described by Maxon, the sorus is almost axial on the acroscopic side of the vein. This position, on the side of the vein instead of on top of it, betokens an abortive branching of the vein.

15. X. **caucana** (Hieron.) Copel., comb. nov.
Polypodium caucanum Hieron., Bot. Jahrb. **34** (1904) 503; Hedw. **44** (1905) 96; Maxon, Contr. U. S. Nat. Herb. **17** (1916) 548.

Type from Colombia, Prov. Cauca, alt. 2300 m., *Lehmann* 3257. Now known also from Ecuador, Venezuela, British Guiana, Panama, Costa Rica, and Nicaragua.

Most similar to *X. Cookii.* The sorus is well above the base of the vein; but the bending of the vein at the sorus indicates in this case too a suppressed fork. In general, this species seems to be larger than *X. Cookii.* The shape of the segments is distinctive. The fronds are conspicuously stout and rigid.

16. Xiphopteris **zurquina** Copel., sp. nov. (*Plate 9.*)
Polypodium zurquinum Maxon, in herb.

X. gracillima, paleis rhizomatis lanceolatis 2 mm. longis integris (non ciliatis); stipitibus dense fasciculatis, 1–2 cm. longis, ca. 0.25 mm. crassis, decidue setosis; lamina ca. 6 cm. longa, vix 4 mm. lata, utrinque breviter angustata, setis 1 mm. longis adspersa, herbacea, ad costam gracilem pinnata; pinnis 1 mm. latis, apice rotundatis, basi paullo dilatatis, utroque latere costae 25–30; vena simplici, inconspicua, sub hydathodo terminante; soro infra mediam longitudinem venae imposito; sporangiis nudis, cellulis incrassatis annuli ca. 14.

Costa Rica: "Cerros de Zurqui, northeast of San Isidro, Provincia de Heredia, altitude 2000–2400 meters." *Standley & Valerio* 50495 (U. S. type); also, Cerro de Las Lajas, *Standley & Valerio* 51598.

Related to *X. caucana* and *X. Cookii,* but more delicate than either; like *X. caucana* in the position of the sorus, but the vein not so bent as to suggest a forking.

17. X. **blepharidea** (Copel.) Copel., comb. nov.
Polypodium blepharideum Copel., Univ. Calif. Publ. Bot. **19** (1941) 304, *pl. 64.*

Type and only known collection, *Mexia* 8147a, from Peru (Huánuco, Distr. Churubamba, Cresta Santo Toribio, alt. 2000 meters). The lower half of the frond is pinnate to the costa.

XIPHOPTERIS ZURQUINA, TYPE

18. X. **serricula** (Fée) Copel., comb. nov.

Polypodium serricula Fée, Gen. Fil. (1850–52) 238; 6e Mém. Foug. 6: 9, *pl. 7, fig. 1;* Maxon, Contr. U. S. Nat. Herb. **17** (1916) 550.

Described from Guadeloupe, where it seems to be very common, and known also from Dominica and Martinique. Mettenius (Pol. 40) reduced this species to *P. trichomanoides,* and was followed by his successors until Maxon. It is conspicuously different, however, in the shape of the segments, which are not gibbous in *X. serricula* because the fertile vein does not extend beyond the sorus. The fronds are about 5 mm. wide—not 5 cm. as misprinted by Fée in both of his texts. His figure is correct.

19. X. **Williamsii** (Maxon) Copel., comb. nov.

Polypodium Williamsii Maxon, Contr. U. S. Nat. Herb. **17** (1916) 547, *pl. 34.*

Because of the largely wingless rachis, this is in appearance the most distinct species of the genus.

20. X. **truncicola** (Klotzsch) Copel., comb. nov.

Polypodium truncicola Klotzsch, Linnaea **20** (1847) 374; Mett., Pol. (1856) 40; Hook., Sp. Fil. 4 (1862) 178; Maxon, Contr. U. S. Nat. Herb. **17** (1916) 553.

Ctenopteris truncicola J. Smith, Hist. Fil. (1875) 184.

Klotzsch cited two Venezuelan collections—*Moritz* 252 (forma *major*), from Colonia Tovar, and *Moritz* 333 (forma *minor*), from Mérida, any essential difference between them, as he understood it, being in size. Mettenius cited the same two collections. Hooker did also, and, in addition, *Fendler* 211, from Venezuela, two collections by Jameson from Ecuador, and a Jamaican collection (*Purdie*), likely to be *P. basiattenuatum* Jenman. He remarked that "Some of the Ecuador specimens are very fine, large, and bear long rich brown-coloured hairs very copiously, not only on the margins of the fronds, but on the superficies; still I have numerous samples showing, as it appears to me, a passage from the one species to the other" [i.e., *P. truncicola* to *P. trichomanoides*].

Maxon cited only *Moritz* 333 and *Fendler* 211. The National Herbarium now contains *Moritz* 252 and 333 (2 sheets); *Fendler* 211 (3 sheets); *Schlumberger,* from Guiana; *Pittier* 9997, from Venezuela; *Killip & Garcia* 33163, and *Daniel* 1727, from Colombia; *Steyermark* 53464, and *Wiggins* 10402 and 10412, from Ecuador. In my own herbarium is a good specimen of *Moritz* 252. Altogether, this is rich, as well as authentic, material. *Moritz* 252 must be the type collection, and is uniform; but the descriptions by both Klotzsch and Mettenius are compiled from both Moritz collections. Thus, "stipite nullo" applies to forma *minor,* but no. 252 has a short stipe, as described by Mettenius. The two might represent distinct species; but the specimens in hand and ascribed to *X. truncicola* are variable in a degree unfamiliar in the genus, wherefore I am disposed to regard forma *minor* as juvenile.

Forma *minor* is really sparsely setose. Forma *major,* the typical form, should never have been described as "sparsim" pilose. *Moritz* 252 is old material, moderately setose to the naked eye, but bearing so many broken bristles that it must in nature have been densely setose. The Wiggins collections from Ecuador are like those described from the same land by Hooker, setose beyond anything else in the genus, but the type must have been very similar when fresh.

Klotzsch described the segments as "integerrimis"; but Mettenius, with the same material, described them as "superne obtuse auriculatae vel semi-oblongae, obtusae, integerrimae vel hinc inde crenatae." One Wiggins plant has many segments incised on the acroscopic side.

All students of this group since Mettenius have treated the presence or absence of setulae on the paleae as specifically diagnostic. Mettenius described the paleae of *P. truncicola* as "sparse setosis." Maxon's key distinguishes *P. truncicola* from *P. trichomanoides* (and some other species) by "scales of the rhizome with bristle-like cilia"; and his specimen of *Moritz* 252 includes strongly ciliate paleae. I detect no cilia on my specimen of this collection, nor on most specimens bearing the same name. One sheet of *Fendler* 211 bears two plants, one, as annotated by Maxon, bearing "scales ciliate"; the other, "scales not ciliate," and therefore "not *P. truncicola*." But this plant is altogether like *Moritz* 333 (forma *minor*). My own impression is that in this case the cilia on the paleae are not a diagnostic character.

20a. *Polypodium andinum* Hook., Second Cent. Ferns (1860) *Pl. VI;* Hieron., Bot. Jahrb. **34** (1904) 500; Maxon, Contr. U. S. Nat. Herb. **17** (1916) 552.

Type from Ecuador; known also from Peru, Colombia, and Costa Rica.

"The fronds seem destitute of stipes, and are decurrent to their very base," (Hooker, *l. c.*). As far as the description shows, this is the most evident distinction from *X. truncicola.* If *P. andinum* is a distinct species, it includes forma *minor* of *X. truncicola.* It may be noted as a possible further distinction that *P. andinum* is lobed rather less than halfway to the costa, and *X. truncicola* somewhat more deeply.

21. X. trichomanoides (Swartz) Copel., Gen. Fil. (1947) 215.

Polypodium trichomanoides Swartz, Prod. (1788) 131; Syn. Fil. 33; Schkuhr, Krypt. Gew. 11, *pl. 10;* Hieron., Hedw. **44** (1905) 99; Maxon, Contr. U. S. Nat. Herb. **17** (1916) 550, *pl. 35.*

Ctenopteris trichomanoides J. Smith, Hist. Fil. (1875) 184.

Described from Jamaica, where it is very common, and known also from Cuba (*Clément* 1008), Guatemala (several collections), Venezuela (*Killip & Rohl* 37170), and French Guiana (*Leprieur*). A commonplace looking little plant except for the gibbous segments, a feature correlated with the prolongation of the fertile veinlet beyond the sorus. Because this was the first described of a very homogeneous group of species, its name has been misapplied to several others.

22. X. **basiattenuata** (Jenman) Copel., comb. nov.

Polypodium basiattenuatum Jenman, Bull. Bot. Dept. Jamaica II. **4** (1897) 114; Maxon, Contr. U. S. Nat. Herb. **17** (1916) 551, *pl. 36.*

Described from and common in the Blue Mountains of Jamaica; rare elsewhere in Jamaica. Its immediate relatives are *X. truncicola* and the comparatively unknown *X. Sherringii.*

23. X. **Sherringii** (Baker) Copel., comb. nov.

Polypodium Sherringii Baker, in Jenman, Journ. Bot. **20** (1882) 326; Maxon, Contr. U. S. Nat. Herb. **17** (1916) 552.

Jamaica: "Newton district of the Port Royal Mountains," rare; alt. 4000–5000 feet. Described as characterized by small stature ($1\frac{1}{2}$–2 inches long, 3 lines wide), densely congested fronds, sparse setae, and particularly by the "opaque, stiff" lamina, which eventually breaks away from the rachis. It is little known—perhaps by a single collection. I venture to transfer the name because if it blends with any other species it is with *P. basiattenuatum*, and *P. Sherringii* is the older name.

The National Herbarium contains three sheets from eastern Cuba—*Ekman* 5209, *León* 77715, and *Clément*

1736—identified as *P. Sherringii.* These are uniform—small (the largest frond 4 cm. long), not congested, not remarkably stiff, and notably sparsely setose. They can apparently be *X. Sherringii,* but hardly *X. basi-attenuata.*

24. Xiphopteris **Killipii** Copel, sp. nov. (*Plate 10.*)
Polypodium Killipii Maxon, in herb.

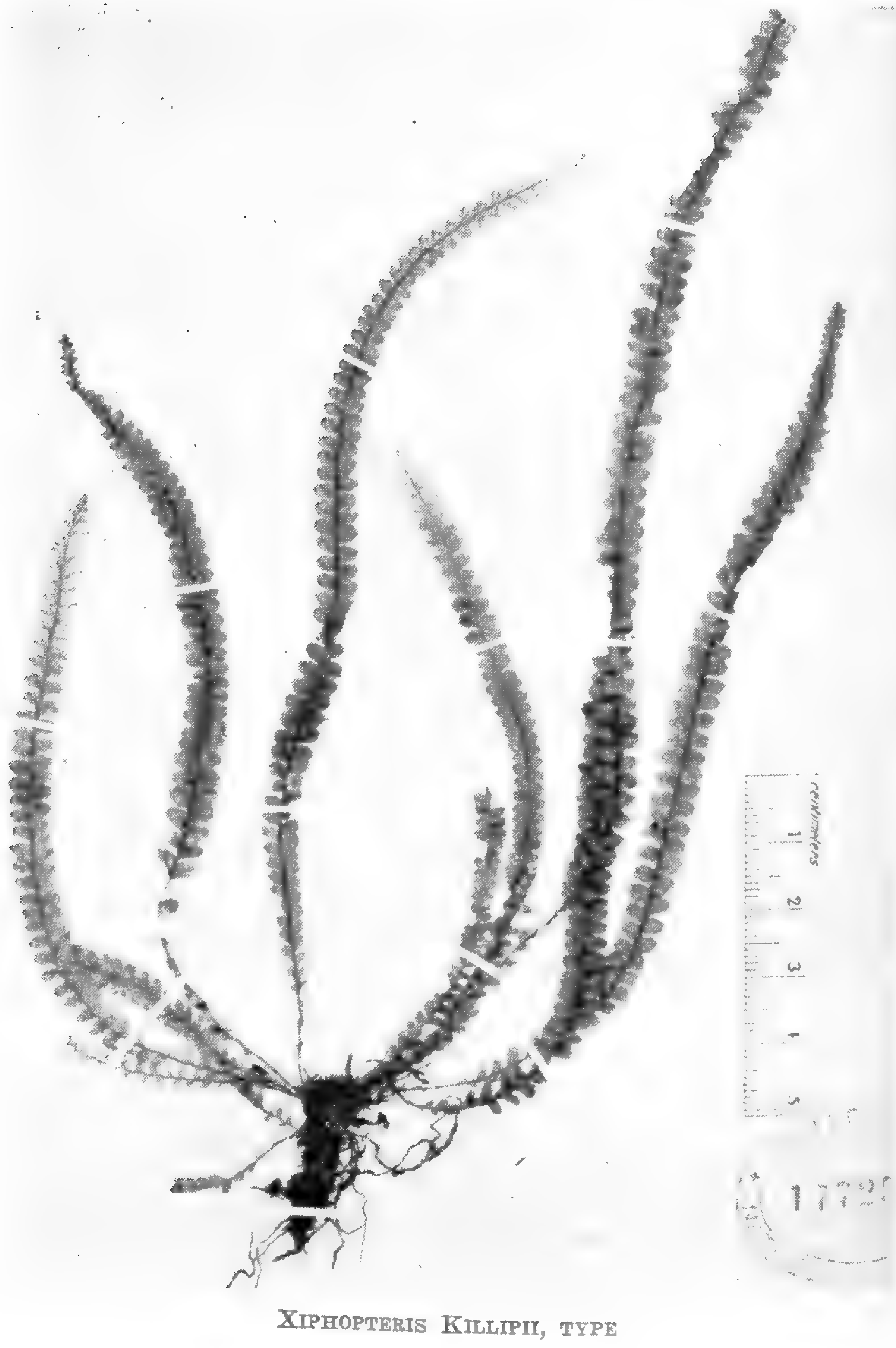
X. rhizomate erecto, valido, paleaceo, paleis parvis (plerumque infra 1 mm. longis), lanceolato-ovatis, subintegris, apiculatis, non ciliatis; stipitibus fasciculatis, 1 cm. longis, gracilibus (ca. 0.3 mm. crassis), setosis; lamina 15 cm. longa, 6–7 mm. lata, obtusa, basi angustata, tenuiter herbacea, setis 2 mm. longis sat dense vestita, ad alam angustam costae pinnatisecta; segmentis late oblongis, apice rotundatis et integris vel crenulatis, supra basin dilatatis et contiguis; venis omnino inconspicuis, furcatis sed ramo acroscopico tantum ad receptaculum sori sufficiente.

Colombia: "Dept. El Valle; San Antonio, west of Cali, near summit of Cordillera Occidental; alt. 1,900–2,350 meters," *Killip & Garcia* 33887 (U. S., type).

Near to *X. truncicola,* the most conspicuous distinctive feature being the shape of the segments, usually contiguous above the base, but with an open sinus. The microscopic characters are those of the genus—globose sporangium, filiform pedicel, annulus of about 13 indurated cells, and globose, granular spores.

25. X. **Buesii** (Maxon) Copel., comb. nov.
Polypodium Buesii Maxon, Contr. Gray Herb. **165** (1947) 72.

Peru: Type from Dept. Cuzco; Cerro Chuyapi, alt. 2400 meters. There is another specimen from the same place, and a third from Cabecera del Koribeni, all collected by Bues. Easily recognizable by the long attenu-



Xiphopteris Killipii, type

ation of the lamina to stipes which are themselves long for the genus. The paleae are mostly toothed, but not ciliate. The segments are narrowly oblong.

26. X. **nana** (Fée) Copel., comb. nov.

Polypodium nanum Fée, Gen. Fil. (1850–52) 238; Hieron. Hedw. **44** (1905) 102; Maxon, Contr. U. S. Nat. Herb. **17** (1916) 553.

Polypodium exiguum Fée, Crypt. Vasc. Brés. I (1869) 89, *pl. 37, fig. 1, nec alior.*

Polypodium Blanchetii C. Chr., Bot. Tids. **25** (1902) 78.

Type from French Guiana; known also from British and Dutch Guiana, Trinidad, Venezuela, Colombia, and Brazil. Remarkably small; from the several other diminutive species, this is distinguished by the setulose paleae; also, the segments are rather remote. As described and figured, *P. exiguum* Fée has one conspicuous peculiarity: the stipes are more or less half as long as the lamina. So long as it is known by a single collection, this is regarded as fortuitous, rather than as specifically diagnostic.

27. X. **daguensis** (Hieron.) Copel., comb. nov.

Polypodium daguense Hieron., Bot. Jahrb. **34** (1904) 504.

Type from the Dagua river, Colombia, at low elevations. A second collection, *Killip & Cuatrecasas* 38419, is from El Valle, "along highway from Buenaventura to Cali, alt. about 100 meters." While hardly contiguous, the segments are distinctly less remote than those of *X. nana*.

28. X. **hyalina** (Maxon) Copel., comb. nov.

Polypodium hyalinum Maxon, Contr. U. S. Nat. Herb. **17** (1914) 406; (1916) 554.

Costa Rica: Endemic (seven collections known). Fronds few; stipes terete; paleae conspicuous, up to 4 mm. long, their setulae small, weak, hyaline, inconspicuous (these setulae are distinct in character from those of species regarded as nearly related), segments erecto-patent, oblong, each fertile one with two conspicuous hydathodes.

✓29. X. **setulosa** (Rosenst.) Copel., comb. nov.

Polypodium setulosum Rosenst., Fedde Repert. Sp. Nov. **10** (1912) 277; Maxon, Contr. U. S. Nat. Herb. **17** (1916) 554.

Type from Costa Rica, whence there are 4 other collections. Endemic. The setae range up to 2.2 mm. in length.

✓30. X. **nimbata** (Jenman) Copel., comb. nov.

Polypodium nimbatum Jenman, Journ. Bot. **24** (1886) 271; Maxon, Contr. U. S. Nat. Herb. **17** (1916) 554, *pl. 37.*

Type from Jamaica, where it is said to be rare (6 collections in the National Herbarium); also in Cuba (9 collections), and Santo Domingo (*Ekman* H 12732, and *Valeur* 623). The setae are about 1.0 mm. long.

✓31. X. **Knowltoniorum** (Hodge) Copel., comb. nov.

Polypodium Knowltoniorum Hodge, Amer. Fern Journ. **31** (1941) 105, *pl. 1, figs. 4–6.*

Dominica: Several collections from the summit of Morne Trois Pitons; one collection from Guadeloupe. Fronds and segments broader than on most of its relatives; the lamina is attenuate downward for a third of its length, to a narrowly winged stipe. The bulge on the acroscopic side of the segment is more evident than is usual in *X. blepharodes.*

32. X. **blepharolepis** (C. Chr.) Copel., comb. nov.

Polypodium blepharolepis C. Chr., Ind. Fil. Suppl. I (1913) 58.

P. gracillimum Hieron., Hedw. **48** (1909) 250, *pl. 12, fig. 18, non* Copel. (1905).

Described from Ecuador; plants are at hand so determined from Peru and Colombia. Very close to *X. blepharodes,* even in such a detail as the setulae on the paleae. The shape of the segments seems to be distinctive. Both species are variable in the density of the pubescence. The presence of subgibbous fertile segments is in both cases due to extension of the fertile veinlet.

33. X. **blepharodes** (Maxon) Copel., comb. nov.

Polypodium blepharodes Maxon, Contr. U. S. Nat. Herb. **17** (1914) 407; (1916) 554.

Type from Costa Rica, whence there are 50 collections in the National Herbarium; also in Guatemala (4 collections), and Panama (7 collections).

34. X. **taenifolia** (Jenman) Copel., comb. nov.

Polypodium taenifolium Jenman, Bull. Bot. Dept. Jamaica II. **4** (1897) 114; Maxon, Contr. U. S. Nat. Herb. **17** (1916) 555.

P. Sintenisii Hieron., Hedw. **44** (1905) 101.

Type from Jamaica; type of *P. Sintenisii* from Porto Rico. Known also from Hispaniola, Montserrat, St. Kitts, Martinique, Guadeloupe, Grenada, Trinidad, Venezuela, Surinam, Colombia. A large plant, commonly 15 cm. and sometimes even 25 cm. tall, and rather stiffly erect.

DUBIOUS SPECIES

Polypodium gibbosum Fée, Mém. Foug. VI (1854) 8, *pl. 2, fig. 2;* Hieron., Hedw. **44** (1905) 100, at least as to the name; Maxon, Contr. U. S. Nat. Herb. **17** (1916) 556.

This species was based on a specimen sent misnamed by Galeotti to Fée, purporting to be from Oaxaca, Mexico. Nothing like it has been found again in Oaxaca. Comparison with the type, presumably in Rio de Janeiro, may show that it is some species, *X. blepharodes* for instance, now known by a later name.

EXCLUDED SPECIES

Grammitis wittigiana Fée, Crypt. Vasc. Brés. II (1873) 50, *pl. 95, fig. 1.*

This is included in *Grammitis* in my monograph of the genus, and is mentioned here because Hieronymus (Hedw. **44** (1905) 88) and Maxon (Contr. U. S. Nat. Herb. **17** (1914) 406) treat it as an immediate relative of *X. serrulata.*

Polypodium subflabelliforme Rosenst., Fedde Repert. Sp. Nov. **7** (1909) 306).

Polypodium flabelliforme Lam. var. *minus* Hook., Sp. Fil. IV (1862) 187.

The National Herbarium contains *Bues* 529, identified as this species. Each pinna has a strictly simple vein, making it, by definition, a *Xiphopteris.* Rosenstock describes the vein as simple, or once, or more rarely twice forked, and the sori as 1, 2 or 3 to the pinna. These features make it a *Ctenopteris,* which is the apparent affinity of Bues' specimen.

University of California, Berkeley.

Equisetum pratense Ehrh. in Arctic Alaska

NICHOLAS POLUNIN

In my attempted appraisal of "The Real Arctic and its Pteridophyta,"[1] I concluded (p. 44) that, "Among other Pteridophyta that require confirmation are reports of *Equisetum pratense* Ehrh. as persisting north of our southern boundary in some parts of Eurasia." This had reference especially to such modern reports as those of I. A. Perfilev[2] from Kolguev Island, and of V. N. Andreev[3] from two localities in the northeastern portion of the Kanin Peninsula, which left very little room for doubt that this plant indeed inhabited those low-arctic parts of eastern Europe. Andreev's reports were accepted by Prof. Eric Hultén, who also reported the species to go far north (possibly into the Arctic) in parts of Asia.[4] However, in view of the frequent misidentification of other species (in particular some phases of the notoriously variable *E. arvense*) as *E. pratense,* it was felt wisest to withhold judgment on the propriety of admitting the latter, mainly southern species, into the arctic flora.

This policy of caution stemmed *inter alia* from Hultén's experience in preparing his great Flora of Alaska and Yukon and from my own in other connections. Thus W. Trelease[5] reported *E. pratense* from "Reindeer Station, Port Clarence (Walpole, 1419a, 1814)," but Hultén pointed out (*op. cit.* p. 52) that Walpole's no. 1419a in the U. S. National Herbarium is *E. arvense.*

[1] This JOURNAL **41**: 33–46. 1951.

[2] Materialy k flore ostrovov Novoi Zemli i Kolguev, Arkhangelsk 1–74. 1928.

[3] Material k flore Severnogo Kanina, Trav. Mus. Bot. Acad. Sci. URSS **23**: 147–196. 1931.

[4] Flora of Alaska and Yukon **1**: 56. 1941.

[5] Ferns and fern allies of Alaska, Harriman Alaska Exped. **5**: 389. 1904.

Hultén appears to have made no mention of Walpole's no. 1814. Recently I had a similar, and now all too common, disappointment in Minneapolis when shown in the Herbarium of the University of Minnesota some sheets labeled "E. pratense" that had been collected during the last few years in other arctic parts of Alaska. My revision was confirmed on the spot by C. V. Morton, who kindly offered further assistance in the quest. My take-up was to ask whether he could not find Walpole's no. 1814 which did not appear to be in any of the other herbaria to which plants of the Harriman Alaska Expedition had been distributed and which might yet be in the U. S. National Herbarium. Some time after his return to Washington, Mr. Morton wrote: "We do have Walpole's no. 1814 from Port Clarence. It is a mixture. There are three plants on the sheet, one of which is *E. arvense* and the other two are *E. pratense*. . . . I am sorry to say that we have no specimens of *pratense* from Siberia nor from any part of Asia."

So ended my search, in herbaria of two continents, for a specimen of *E. pratense* from the real Arctic, to whose confirmed flora it should now be added—making a total of 36 species of Pteridophyta (8 of them Equiseta) so far known therefrom. Walpole's no. 1814 is before me as I write this note. The label reads "Equisetum pratense Ehrh. On tundra at Teller Reindeer Station, near Port Clarence. No. 1814, F. A. Walpole, collector. Aug. 12, 1901," but in spite of an annotation "E. pratense W. T. [release]" it is of course, as Mr. Morton reported, a mixture in which the largest, central specimen is clearly of *E. arvense* (as earlier noted in ink by, possibly, Hultén). *E. pratense* can scarcely be at all common in the vicinity of Port Clarence, as it has been missed by several good collectors—including, in 1949, Miss Edith Scamman, sometime Secretary of the American

Fern Society, who has recognized and collected the species very widely on numerous occasions in the subarctic parts of Alaska, and from whom there is in the Gray Herbarium a fine sheet from as near as Nome.

GRAY HERBARIUM OF HARVARD UNIVERSITY.

Shorter Notes

WILL FERNS GROW WELL UNDER BLACK WALNUT TREES?—The question in the title might well be restated in a somewhat broader form: Are there any tree species which render the soil around their roots unfavorable for ferns? The problem involved is not that presented by such voracious feeders as sugar maple and Norway maple, which speedily occupy any available soil with such a mass of rootlets that water and even soil space seem to be preempted. Rather, it concerns the possible excretion into the soil of substances toxic to other plants. That such a possibility may exist was first brought to my attention in the first decade of this century when the New York Botanical Garden staff members were considering whether the absence of undergrowth in their Hemlock Forest might be due to emissions from the roots of the hemlocks. More recently, the question has been revived by an article in a tree pamphlet in which a deleterious effect on white pines was ascribed to black walnuts, and also to "locusts," genus not specified.

The question is raised here as one on which some of our fern gardeners and field students may have observations to offer. It is further suggested that experimental studies should be fairly easy to set up. Basically, the problem is one of "antibiotics," in which the competitors are not moulds and bacteria or other microbiologic entities, but ordinary forest plants. However, aside from observations of the occurrence of flourishing fern patches in black walnut groves, an experimental line of attack will require competing cultures under controlled conditions, e.g., prothallial cultures of common ferns with treatment with infusions of black walnut root materials. —R. C. BENEDICT.

THE DECORATOR DISCOVERS FERNS.—"What captivated him most was the fernery. If only the grace and beauty of the Fern Leaf could be captured on fabric . . . it would lend sparkle and excitement to any room, and color scheme. . . . And so 'Fern' was born . . . a pattern that brings into your home the freshness and beauty of Nature herself. . . . At all leading department stores and drapery shops in the Metropolitan area and throughout the country."

So ran a page advertisement in the newspaper magazine supplement "This Week," Sunday, March 30, 1952, to record the origin of a new chintz. The page further told how the idea came to the advertiser, Kandell of Fifth Avenue, New York City, as the result of a visit to the fern house at the Brooklyn Botanic Garden.—R. C. BENEDICT.

THE COMMON BRAKE FOR BRIDES.—The writer did a "double take" the other day, while hurrying through a large New York department store (Gimbels may have this advertisement). Setting off a special cascade of bridal lace veiling, a much divided fern leaf registered on what had been unconscious vision. More surprising was the fact that the fern in question was the common brake, *Pteridium*. The leaf had been given the treatment used sometimes for florists' fern decorations, that of impregnation and coloring to a dark, metallic green, but there was no denying its effectiveness. Does anyone know just how this preservative process is carried out? It might be of interest to Journal readers.—R. C. BENEDICT.

Recent Fern Literature

One of our members, Dr. Arthur H. Graves, has just published a new tree book,[1] which follows the same general pattern as an earlier book that he published with Miss Hester Rusk, which was issued with the imprimatur of the Brooklyn Botanic Garden, where Dr. Graves served for many years. This new text, however, covers a wider territory, the northeastern states, and has the further advantage of being illustrated by the beautiful pen and ink drawings of Miss Maude Purdy.

Ferns and trees are almost invariably companions, with ferns the beneficiaries. However, in forestry soil studies, certain non-woody plants are designated as "indicators" and accepted as having significance in denoting a particular type of soil. That would probably be the only basis upon which some fern service to tree study might be claimed. Very rarely in the northern states is the relationship any closer that of shade and shelter, but farther south, trees are frequently the actual substratum upon which ferns may grow. Even in the north, tree trunks are sometimes made use of as fern habitat. Years ago, I reported such an instance in which the presumptive lime-demanding walking fern had established a healthy colony on the base of a tree.

At any rate, Dr. Graves has added a fine looking and I believe valuable new aid to the field of tree lore. One notable feature is the inclusion of the commoner cultivated trees.—R. C. B.

American Fern Society

GARDEN MEETING.—On June 29, Mr. and Mrs. M. D. Mann, Jr., entertained 32 members of the American Fern Society and their friends at a meeting in their garden in

[1] Illustrated Guide to Trees and Shrubs. pp. 1–240. pl. I–XLV. figs. 1–116. 1952. Published by Arthur H. Graves, Wallingford, Conn. $4.00.

Roselle, New Jersey. Among those present were our President, Dr. R. C. Benedict, and our former President, Mr. Joseph Ewan. Mr. Mann's fine garden contains about 150 different species and varieties of ferns, 135 of them indicated by name markers. One of the ferns that interested the visitors was the little New Zealand species *Blechnum penna-marina*. Mr. Mann demonstrated his method of raising ferns from spores, which contains some unusual features of interest. The meeting resulted in three new members for the Fern Society.

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American Fern Journal

VOL. 42 OCTOBER–DECEMBER, 1952 No. 4

Growing Ferns From Spores

WALTER F. KLEINSCHMIDT

Most workers who have occasion to raise ferns need to do so only in small lots, and they use one of several well-known methods: on a prepared culture medium (agar or liquid), or on flower-pot chips, sphagnum, peat, bark, or some other substratum. When it becomes necessary to raise young ferns in very large quantities, however, as for student classroom study in universities, a dependable standard procedure is needed. Certain important requirements must be met: the prothallia and young sporophytes should be relatively uniform in size and age, free from molds and algae, and available at a set time and in considerable numbers—enough for study by perhaps four or five hundred students. Also, it is desirable that the materials and equipment be relatively simple, standard, and easily available; complicated media and equipment such as those used in physiological research are impractical.

The following method, which I have developed and used at the University of Michigan, serves the above requirements most efficiently. It is simple, and if the technique is carefully followed, the results are gratifying. This method should be of value not only where materials are needed for classroom study, but in any situation where large numbers of plants are desired; and it may be suggested also to those who wish to raise

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ferns in smaller quantities but who have yet had no experience in actual practice. The materials required are listed first and then the procedure is described.

MATERIALS

1. VIABLE SPORES: In connection with the spores, several precautions should be taken which are obvious enough, once realized, but often overlooked by the beginner. Frequently a frond appears to be very fruitful, when in fact the sporangia have all discharged their spores, only occasional spores being left in a few sporangia. On such a frond the numerous brown sporangia, very small in size, give an illusion of copious spores, even though the spores themselves are actually very few. It is best, therefore, to pick a frond for spores on which at least some of the sporangia are still young and undeveloped. In most ferns, a sorus which is soft and white or pale green is still too young, while a sorus which is dry and dark cinnamon-brown is likely to be too old. As a rough rule-of-thumb, the tan sori are best. Examination with a good hand-lens is desirable, for in this way it can often be seen whether the sorus is too old. A sorus which has a mixture of immature whitish sporangia and sporangia which have discharged is ideal.

To obtain the spores, it seems best to place the whole fertile frond of small-leaved ferns, or several pinnae of large-leaved ferns, into a perfectly fresh, clean white envelope. If there is a chance of contaminating spores being attached to the frond (as there almost certainly is if the fern has been growing near other fern species), it is desirable to wash the under surface of the frond in a strong flow of water from a tap, and dry it quickly with paper towels or Kleenex before placing it in the envelope. If the envelope containing fern material to be raised is then kept in a dry place for a period of several days, the sporangia will automatically discharge, filling the envelope with the fine spore "dust." Tapping the envelope at this time will force the spores to pile up along one edge, and they may be collected here for sowing.

When preparing the spores for sowing, it is most important that all pieces of the dried leaf and plant material other than the spores themselves be removed as thoroughly as possible. A pair of fine, pointed forceps is desirable for this. The reason is that small pieces of leaves or other vegetative materials tend to become moldy very rapidly and infect the culture.

One other caution should be given if the materials are to be used for teaching purposes, where sex organs are to be examined by students. (If the objective is merely the raising of young ferns, however, this need not be considered.) This is the danger or growing ferns which are poor in female organs. Many of our commonest ferns in greenhouses have a peculiar method of reproduction known as apogamy, wherein the normal sexual fusion of sperm and egg is not required to form the new fern-plant; the new fern simply grows directly from the sexual plant. In these ferns, the sexual plants or prothallia bear abundant male organs (antheridia), but usually few, or even no, female organs (archegonia). Obviously such plants are not desirable for teaching the normal biology of ferns. It may be surprising to some to realize that all of the common ferns of greenhouses listed below are now known to be apogamous, and other species are constantly being found: *Pteris cretica* (and other brakes), *Adiantum hispidulum, Pellaea atropurpurea* (and other cliff-brakes), *Cyrtomium falcatum* (and other holly-ferns), and *Asplenium resiliens* (and other spleenworts). Therefore, in planning materials for classroom use, it is well to know beforehand whether a fern is apogamous. Complaints of difficulties of finding archegonia are perhaps due to this factor more than any other. When, however, it is only desired to obtain many young fern plants, apogamous species are often best, as these grow rapidly, not requiring fertilization for their production.

One last caution regarding spores is offered. Certain ferns, such as most examples of Scott's spleenwort (*Asplenosorus ebenoides*), various *Dryopteris* hybrids, and the Boston-fern (*Nephrolepis exaltata* var. *bostoniensis*) are sterile, even though they may have normal-appearing sporangia. The spores of such ferns are abortive and mostly incapable of germinating.

2. SOIL MEDIUM: A wide variety of soils may be used for growing fern prothallia. Some workers use peat. Others use ordinary dark humus soil collected in woods. In my own work, I use a humus of oak leaves that have thoroughly decayed. Using three parts of this with one part of coal ashes has been most successful. It is possible to grow ferns without sterilizing the soil, and some prefer to do their work with unsterilized soil. However, if uniform and dependable cultures are desired, it is preferable to sterilize the soil before using it, for otherwise there is the chance of the development of blue-green and other algae, as well as molds of various types, which interfere seriously with the growth and development of prothallia, and which may, in fact, kill the entire culture. Also, especially in teaching material, it is desirable to have prothallia as free as possible of distracting contaminants, even if they do grow successfully in association with these.

3. CONTAINERS: Flat, porous pots made of earthenware, 6″ to 12″ in diameter if circular, or along one side if square, are suitable. These should be approximately 1¾ inches deep for the best results in the procedure which I use. The pots should be covered with a

piece of glass, at least until the young sporophytes have reached the stage of having two or three leaves. In the earliest stages of growth of the prothallia from spores, the soil surface is exposed and especially subject to the growth of algae. A uniform and nearly continuous coverage by prothallia appears to limit the appearance of algal scums on the soil surface.

4. STERILIZATION: An ordinary kitchen oven is suitable for sterilization of culture dishes, and I have used one successfully for a number of years. However, if the greenhouse is provided with one, a standard autoclave for sterilization is probably more efficient.

5. FLAT METAL PAN: Galvanized sheet metal may be made up and soldered into a flat square pan about three inches deep, the size and shape depending on the need. The pan is filled with water about three quarters of an inch deep, and is used for wetting the cultures from below.

PROCEDURE

The soil mixture should be slightly damp, so that when squeezed, it forms a weak lump which breaks apart readily. It is put into the pots up to one-half inch from the top edge and *firmly* and evenly pushed down. Then, through a fine-mesh screen (the meshes about $\frac{1}{8}''$), a quarter-inch layer of the same soil is sifted over the surface. This layer is now pressed very smoothly and evenly with a flat board. (Other workers prefer a finer mesh screen than the one above.)

When the pots have been prepared in the way described, they may be placed in an oven for two to two-and-one-half hours at a temperature of 350° F., or in an autoclave under 15 pounds steam pressure, 240° F. temperature for an hour. At the same time, the glass covers for the pots may be sterilized, but they should not be put on the pots at this stage. At the end of the period indicated, the oven or autoclave is allowed to cool down to room temperature. The glass covers are put on the pots as soon as possible after removing them from the cooled sterilizer, without time for exposure of the soil surfaces to contamination.

The pots are then placed in the metal pan in enough water (approximately three fourth of an inch) to keep the soil thoroughly dampened. Before placing the pots there, however, it is well to clean out the pan very carefully by washing with a solution of one teaspoon of Lysol per gallon of water, and then rinsing thoroughly with tap water. The covered pots should remain in the pan for several days to reach the proper condition of moisture before the spores are actually sown. The square pot is tipped, with one side resting on the rim of the metal pan so that only about half the base of the pot is submerged at a time. By rotating the pot daily, all parts will soon be equally damp.

Sowing the spores may be done in either of two ways. Perhaps the better way is to place them in an ordinary atomizer, as in this way it is possible to cover the soil surface evenly. However, if the number of spores is somewhat limited and it is necessary to avoid losing any of them, they may be sowed by scattering them carefully from the edge of the envelope containing the spores. If the atomizer is used, it must be boiled and cleaned carefully between sowings of different species, otherwise mixed cultures will result. In sowing the spores it is desirable to avoid opening the pots longer than necessary. The pots should therefore be removed from the water pan and placed on a table, and when the spores are ready to be distributed, the glass covers should be removed only briefly. The air in the room must be still during the sowing, and the glass covers replaced as soon as the sowing is finished.

Once the spores are sowed, the pot is replaced in the pan of water. The cultures should not be exposed to direct sunlight nor to high temperatures of 85° or above. Direct sunlight will probably kill the prothallia. For this reason it is good to place the culture pan in a shady place. My procedure is to keep the pan under a wooden frame covered with a couple of layers of cheesecloth. This gives a diffused, soft light which promotes a good growth.

It takes roughly two or three weeks for germination to start. The actual germination of the spores is difficult to observe with the naked eye, as the small prothallia at first are made up of merely a chain of three or four green cells and two or three narrow, colorless cells (rhizoids) which become attached to the soil surface. At the end of a month, the soil surface should appear slightly greenish with the numerous very young prothallia. It takes about two more months for the prothallia to become full-sized, heart-shaped, sexual plants, about one-fourth to one-half of an inch long, the stage at which they are generally used by the classes.

Though in apogamous ferns, the new fern-plants appear simply by growing out of the notch of the prothallium into a leaf, fertilization is required in ferns with the normal sexual life-cycle. This depends on the presence of free water droplets, as the sperms produced in the antheridia must swim to the archegonia inside which they fertilize the egg. Free water, therefore, must be provided. In the evenings, when the surrounding air cools off enough to produce drops of water on the under side of the glass cover, a sharp shake of the pot will make the drops fall off and spatter on the prothallia below. In difficult cases it may be necessary to place the culture dish, cover off, under a box for several days until the surface becomes slightly dry, and then carefully spray the surface with about $\frac{1}{16}$th inch of water. This seems to stimulate the opening of the sex organs and makes possible fertilization. Another month or so is usually required for the young sporophytes, which develop from the embryos, to become large enough to be conspicuous.

The first leaves of most ferns tend to be more or less fan-shaped; but by the time the plants have several leaves, the leaf shape is more like that of the adult leaves —with a more or less distinct midrib. At the stage of one to three leaves per plant, the cultures are best for classroom study of the attachment of the young fern-plant to the prothallium. After this stage, the prothallium becomes brown; it soon shrivels up and the sporophyte becomes entirely independent. If any of the plants are wanted in the mature condition, they should be transplanted at the stage of from five to eight leaves, after the prothallium has withered.

BOTANICAL GARDENS, UNIVERSITY OF MICHIGAN.

Ferns Associated with Black Walnut Trees[1]

MAURICE BROOKS

The query of Dr. R. C. Benedict in the last number of the Journal "Will ferns grow well under black walnut trees?" is answered by studies of mine which have been recently published (Brooks, 1951). Dr. Benedict considered the possibility that black walnut trees (*Juglans nigra*) might give off toxic substances from their roots that would be deleterious to ferns. In the course of my study it became evident that many pteridophyte species find conditions favorable to their growth within the root-spread of standing black walnut trees.

To summarize briefly the methods used and results ob-

[1] Scientific Paper No. 463, West Virginia Agricultural Experiment Station.

tained: 300 mature black walnut trees in West Virginia, Virginia, Maryland, Ohio, and Michigan were selected for study. On a field data sheet all prominent vegetation within a 60-foot radius of the tree trunk (approximately one-quarter acre) was plotted. Detailed study was given to plots of one meter diameter located at the cardinal compass points within and without the root-spread of the trees. Tree species, woody shrubs and vines, and herbaceous species within the 60-foot radius plots were listed.

Striking differences were found in the vegetative makeup within and without the root-spread of walnut trees. Low-value grasses such as Broomsedge (*Andropogon virginicus*), Nimblewill (*Muhlenbergia Schreberi*), and Poverty Grass (*Danthonia spicata*) were of common occurrence outside the root-spread of walnuts, but were much less common within the trees' root-spread. Blackberry (*Rubus spp.*) occurred on the plots 94 times outside root-spread and only twice within root-spread. Black raspberry (*R. occidentalis*) was found on 37 of the 300 plots outside root-spread, and on 184 of the plots within root-spread. Within the root-spread high-value grasses such as Kentucky bluegrass (*Poa pratensis*), timothy (*Phleum pratense*), redtop (*Agrostis alba*), and orchard grass (*Dactylis glomerata*) were much more common than they were outside. The same was true of legumes having high forage value.

From the study it appears also that a genuine antagonism exists between black walnut and certain other plants of high agricultural or ornamental value. Potatoes, tomatoes, and alfalfa when planted within the root-spread of walnuts frequently wither and die. The same thing is true of apple trees and shrubs of the family Ericaceae. Actual contact between the roots of these plants and of living black walnut seems to be necessary before this effect is produced.

TABLE I

Pteridophyte Species of Frequent Occurrence under Black Walnut

Pteridophyte Species	Number of Occurrences Within Root-spread of 300 Walnut trees	Number of Occurrences Outside Root-spread of 300 Walnut trees
Ebony Spleenwort (Asplenium platyneuron)	73	21
Silvery Spleenwort (Athyrium thelypteroides)	23	4
Lowland Lady Fern (A. asplenioides)	36	13
Christmas Fern (Polystichum acrostichoides)	91	38
Marginal Shield Fern (Dryopteris marginalis)	41	16
Intermediate Shield Fern (D. intermedia)	54	20
Fragile Bladder Fern (Cystopteris fragilis)	11	5
Obtuse Woodsia (Woodsia obtusa)	18	11
Hay-scented Fern (Dennstaedtia punctilobula)	24	10
Sensitive Fern (Onoclea sensibilis)	12	5
Cinnamon Fern (Osmunda cinnamomea)	11	7
Dissected Grape Fern (Botrychium dissectum)	31	14
Common Grape Fern (B. dissectum var. obliquum)	78	14
Common Horsetail (Equisetum arvense)	12	4
Ground Pine (Lycopodium complanatum var. flabelliforme)	19	7
TOTAL OCCURRENCES	534	189

Turning now to the relationship between pteridophytes and black walnut, Table I lists species that occurred ten or more times within the 300 plots, together with the number of their occurrences within and without the root-spread of walnut trees.

From Table I it seems clear that standing black walnut trees produce a habitat suitable to the requirements of many pteridophytes. Persons seeking grape ferns might well conduct their searches within the shade of walnuts. Ebony spleenwort and lady ferns often grow with unusual vigor, and with great proliferation of varieties, under walnut.

In addition to the fifteen species listed in Table I, there were other pteridophyte species which occurred fewer than ten times on the 300 plots, but which are nevertheless worth noting. Some of these are discussed below.

Lance-leaved Grape Fern (***Botrychium lanceolatum*** var. *angustisegmentum*). This fern of moist cool woods is local and rare in the area covered by this study, but it was found under walnut on two occasions, once in Preston County, West Virginia, and once in Pocahontas County, West Virginia.

Rattlesnake Fern (***B. virginianum***). Comparatively few of the 300 walnut plots studied were in dense woods where this species is likely to occur. In such situations, however, it was found seven times. It occurred as frequently outside walnut root-spread as within it.

Adder's-tongue Fern (***Ophioglossum vulgatum***). This species, rare in the region, was found four times within the root-spread of walnuts, and twice in plots outside root-spread.

Interrupted Fern (***Osmunda Claytoniana***). For some reason, this species did not occur commonly under walnut, and was more frequently found in plots outside root-spread. Observations were, however, too few to warrant any conclusion from this.

Climbing Fern (*Lygodium palmatum*). Climbing Fern is rare and local in the area studied. It was found growing under walnut on two occasions, once in Preston County, and once in Upshur County, both in West Virginia. In view of its preference for intensely acid soils, this seems noteworthy.

Northern Maidenhair Fern (*Adiantum pedatum*). Were black walnut a more common tree in dense forests, this species would undoubtedly have been noted on the plots more frequently. There were no significant differences in its occurrence within and without walnut root-spread.

Eastern Bracken (*Pteridium latiusculum*). This species was found only once under walnut, although it occurred seven times in portions of plots outside root-spread. Apparently soils under walnut trees do not suit its needs.

Purple Cliffbrake (*Pellaea atropurpurea*). In sites examined there were occasional limestone ledges outcropping under walnut. On some of these, this species grew, along with other calciphiles. Since contact between these plants and walnut roots was usually impossible, their presence seemed to have no significance so far as the present study is concerned.

Narrow-leaved Spleenwort (*Athyrium pycnocarpon*). Occasionally found under walnut, this species was as likely to be outside as inside the root-spread.

Walking Fern (*Camptosorus rhizophyllus*). Exposed rock ledges under walnuts often shelter this species, but for reasons mentioned under purple cliffbrake, there seems to be no direct relationship between the fern and the tree. On two occasions, however, young walking fern plants were found growing on the base of walnut trunks. It is interesting, although probably not significant, that the only two colonies of the presumed hybrid, Scott's spleenwort (*Asplenosorus ebenoides*) which the writer has found have been under walnut trees.

New York Fern (*Thelypteris noveboracensis*). This species, so frequently associated with beech, seldom occurs under walnut. Within walnut root-spread it was found only three times; on plots outside root-spread fourteen times.

Broad Beechfern (*Phegopteris hexagonoptera*). This species was found under walnut nine times, just missing inclusion under Table I. It occurs as frequently under the shade of other trees outside walnut root-spread.

Some of the factors which operate to create habitats suitable to ferns under black walnut trees should be examined more closely.

Shade. According to Smith (1942) black walnut trees are usually high-crowned, and cast a lighter shade (by actual photometer tests) than any other common tree in the region. Naturally, a shaded area in a pasture field would favor the presence of ferns. On many of the plots examined, however, there were mature trees of other species. It seems significant that such species as Christmas fern, ebony spleenwort, and the grape ferns were much more common under walnut than in any other situations. Perhaps the light shade of walnuts may suit the needs of these species.

Soil pH. On limestone soils pH under walnuts was markedly higher than in surrounding areas. On acid soils the differences were even more conspicuous, 756 samples taken under 189 trees averaging 5.8, whereas the same number of samples taken outside walnut root-spread averaged 5.1. This higher soil pH would certainly be favorable to some fern species, and might tend to inhibit others. It is noteworthy, however, that even under walnuts pH is often low enough to permit the presence of many species which we regard as "acid-loving."

Other Chemical Factors. The inhibitory effect of contact with walnut roots on apple trees, potatoes, tomatoes, alfalfa, blackberry, rhododendrons and other heaths, and shrubby cinquefoil has been attested by many field observations in different parts of the range of black walnut. It is known that from walnut roots a substance called juglone may be extracted. Juglone is a napthaquinone, closely related to other substances which have been proved toxic to certain plants. Experiments have shown that *in vitro* juglone is capable of causing wilting and death of tomato, potato, and alfalfa plants. Perhaps juglone is the chemical agent responsible for antagonisms between walnut and certain other plants, or the picture may be much more complex.

The other aspect to the problem, which, so far as the writer knows, has received no investigative attention, is as to what there is in the soil under walnut trees that creates a habitat peculiarly favorable to the seeding and growth of certain plants. The presence of black raspberry under 184 of the 300 trees examined has already been mentioned. Kentucky bluegrass occurred under 215 of the 300 trees. It scarcely seems likely that shade, moisture, and soil pH are alone responsible for this. In the complexities of soil-chemistry there may lie the answer to the presence of so many ferns under black walnuts.

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Two Variations of Pteridium aquilinum[1]

BERNARD BOIVIN

The specimens cited below are preserved in the herbarium of the Department of Agriculture, Ottawa, Canada (DAO), or in the Marie-Victorin Herbarium of the Botanical Institute of the University of Montreal (Mtr).

Pteridium aquilinum (L.) Kuhn var. latiusculum (Desv.) Underw.

RANGE EXTENSION:

MANITOBA: Riding Mountain National Park, Forestry camp, roadside, common in patches, July 13, 1948, *J. S. Rowe* 330 (DAO); Victoria Beach, July, 1929, *M. G. Dudley* (DAO); Indian Bay, June 7, 1941, *M. G. Dudley* (DAO); Sandilands Forest Reserve, common in dry pine woods, July 13, 1949, *A. J. Breitung* 7905 (DAO); Lac du Bonnet, precambrian rock outcrops, common, July 7, 1949, *A. J. Breitung* 7478 (DAO).

ALBERTA: Waterton, woods above Cameron Creek, August 28, 1939, *E. H. Moss* 500 (DAO); Waterton Lakes Park, Lodgepole Pinewoods, August 21, 1941, *E. H. Moss* 1291 (DAO).

This variety has been known to occur in Manitoba for perhaps as much as half a century. However, it was not mentioned for that province in the monograph of the genus by R. M. Tryon, Jr.[2]

Pteridium aquilinum var. **champlainense** Boivin, var. nov.

Frons (3)–4–6–(10) dm. longa, vernatio aequalis; lamina (2.0)–2.5–4.0–(6.0) dm. longa, ovata vel late ovata nunquam ternata; rachis puberulenta; pinnulae supernae puberulentae, margine ciliatae, infernae pubescentes, saepius oblique insertae.

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[1] Contribution No. 1183 from the Division of Botany and Plant Pathology, Science Service, Department of Agriculture, Ottawa, Canada.

[2] Rhodora 43: 1–31, 37–67. 1941.

QUEBEC: CHARLEVOIX: Les Eboulements, Saint-Joseph, alt. env. 300 m., le long d'un fossé, 25 juin, 1937, *Boivin* 1066 (DAO type, Mtr.). ARGENTEUIL: Grenville Twp., Conc. 2, lot 21, Rouge River, path by river, August 13, 1941, *Minshall* 2600 (DAO). PONTIAC: Bristol Twp., Norway Bay, near Wharf Road, sandy places, August 4, 1941, *Zinck* 1035 (DAO). MONTCALM: Rawdon, 20 août 1927, *Roy* 95 (Mtr). BEAUCE: East Broughton, terrains serpentineux, 27 août, 1940, *Victorin, Boivin* and *Kucyniak* 4118 (DAO, Mtr). MEGANTIC: Black Lake, sur les collines de serpentine, 11 août, 1936, *Victorin, Rolland* and *Dominique* 46 688 (Mtr). TÉMISCOUATA: Lamy-sud, colline exposée, 8 juillet, 1938, *Kucyniak* and *Tardif* 199 (Mtr); id., endroit exposé, champ ouvert, 206 (Mtr).

ONTARIO: NIPISSING: North Bay, railway gravel, Sept. 13, 1945, *Groh* 2625 (DAO). THUNDER BAY: Sibley Twp., Lake Marie Louise, September 4, 1936, *Taylor, Losee* and *Bannan* 58 (Mtr).

MANITOBA: Hadashville, July 18, 1936, *E. T. Howe* (DAO).

MICHIGAN: KEWEENAW: Keweenaw Peninsula, Copper Harbor Cemetery, openings in woods in sandy soil, August 28, 1949, *Frankton* and *Senn* 1106 (DAO); open rocky summit of East Bluff, July 19, 1950, *C. D. Richards* 3737 (DAO).

This variety has the size, insertion of pinnules, and vernation characteristic of var. *latiusculum* (Desv.) Underw., but the ovate limb and non-ternate appearance characteristic of var. *pubescens* Underw. The pubescence is similar to that of the latter, but much less dense, the former being glabrous beneath or pubescent along the midnerves only. Other specimens reported as var. *pubescens* for Bruce Peninsula (Ontario) and Mackinac Island (Michigan) probably belong to this new variety.

Of the latter, R. M. Tryon, Jr., once wrote[3] as follows: "In Michigan, Ontario, and Quebec var. *pubescens* probably occurs as a pre-glacial relic on or related to local nunatak areas."

This statement of Tryon appears to be basically correct when applied to var. *champlainense*, but on the basis of the additional data now available it seems possible

[3] Rhodora **43**: 29. 1941.

to draw a fuller picture of the interglacial and postglacial history of this variety as follows:

Pteridium aquilinum (L.) Kuhn may have become transcontinental across Canada during the last interglacial stage. The advance of the Wisconsin glacier presumably destroyed a large part of the distribution of this species, especially the northern part, leaving var. *pubescens* limited to the western United States and perhaps adjacent Canada, var. *champlainense* more or less isolated around Lake Superior (Keweenaw, Sibley, and Bruce Peninsulas) and var. *latiusculum* with a split-up range, part along the eastern slopes of the Rockies, part in the eastern United States. As the glacier began to disappear, var. *pubescens* was able to move northward to a limited extent, and var. *champlainense* was able to spread along coastlines as far west as the eastern shore of Lake Agassiz (Hadashville), north and east along the north shore of Lake Algonquin (North Bay), along the north shore of the Champlain Sea (Norway Bay, Rouge River, Rawdon, Les Eboulements), and to some extent across on the south shore (East Broughton, Black Lake, Lamy-sud), thus reaching its maximum distribution during the Champlain Sea period, and hence the name.

With the further disappearance of the glacier and the regression of the Champlain Sea, the more aggressive var. *latiusculum* was able to move north and west into the newly available territory, to become by far the commoner variety from southern Manitoba eastward, while var. *champlainense* was able to persist only in a few isolated localities along former and present shorelines.

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The English Names of North American Ferns

UNA F. WEATHERBY

Mr. Weatherby, shortly before his death, asked me to write an article on the common names of ferns, as listed in Maurice Broun's Index to North American Ferns, using this book as a model. He said he thought such an article would be very useful, but he died before I had a chance to discuss the matter fully with him. Shortly after his death, I went through his rather extensive library and catalogued all common fern names, but business and other writing caused me to put it aside for two years. Last fall I went through all the pertinent books and journals at the Gray Herbarium. Doubtless I missed some but I trust not many. Not having Mr. Weatherby to consult I was fortunate in securing the generous aid and advice of one of his former students—Dr. Rolla M. Tryon, Jr., now one of the leading fern specialists.

In going through some of Mr. Weatherby's files, I came upon a typed list of common names of ferns by Mr. W. L. Dix, which had been made for Mr. Weatherby for a similar project but which was never completed. I wrote Mr. Dix and asked if he would like to make this a joint article, but he generously replied for me to go ahead and use his list if I wished.

One of the most natural sources of the common names of plants is merely an English translation of the Latin name: *Adiantum Capillus-veneris*—Venus'-hair Fern. Under this heading would also come cases where personal or place names are concerned—*Asplenium Bradleyi*—Bradley's Spleenwort; *Woodsia oregana*—Oregon Woodsia; or especial distinguishing features: *Asplenium viride*—Green Spleenwort.

The more picturesque names are less easily accounted for and often more locally used. Such names may be suggested by the shape of the frond or the sori. Thus the frond of *Scolopendrium* suggests a tongue, and the fruit of the *Botrychium* a bunch of grapes, and so these plants are called respectively Hart's-tongue and Grape Fern. The most localized names are often difficult to understand by those unfamiliar with the habits and customs of the region, but they add quite a bit of interest to the subject, especially the ones that came over from England, e.g.: *Osmunda regalis*—Heart-of-Osmund.

Unfortunately there is often duplication of names for several different ferns because the local people did not distinguish between the species. Also the names appear in many different forms; but to make them consistent and to economize space I do not give different variations of obviously the same name.

I have listed the English names of each fern alphabetically, distinguishing the one most generally used with an asterisk. All species or varieties for which no common name has been found are omitted. In general I have followed Broun's nomenclature, except where Dr. Tryon has made a few changes to bring it up to present day usage.

As to the orthography, I quote a letter of Mr. Weatherby's on the problem of compounds:

"Another matter with which we shall eventually have to deal is that of orthography, which, as Mr. Dix points out, is far from consistent in literature. We may, I think, profitably give it preliminary consideration now.

The chief problem relates to compounds—a category in which very many fern names belong. Scientific English suffers at present from two contradictory tendencies —an increased use of compound words and a decreased, and often unintelligent, use of hyphens. (Indeed the hyphen is at once one of the most useful and most misunderstood orthographic signs.) To print all compounds as single words, as is done in Standardized Plant Names, however logical, is to go so far beyond contemporary usage as to appear merely eccentric, and to make acceptance difficult. On the other hand to write what are really compounds as separate words is to invite obscurity and to throw too great a burden of interpretation on the reader. Thus, if we write Wall Rue Spleenwort, the reader is left in doubt whether we mean Wall Rue-spleenwort or Wall-rue Spleenwort, but if we hyphenate (Wall-rue Spleenwort) our meaning is obvious and unmistakable.

I would suggest that in all cases in which single-word compounds have not been definitely established by usage, we follow two rules: (1) that unit-modifiers should be hyphenated—Wall-rue Spleenwort, Narrow-leaved Spleenwort; (2) that names composed of two or more words must be hyphenated when preceded by a modifying adjective. Thus, Beech Fern standing alone *may* be written as two words, the 'Beech' being treated as a substantive used adjectivally, but in the phrase 'Long-Beech-fern' must be hyphenated."

I am following his suggestions as to the use of hyphens, and also his usage of capitals, which is, capitalizing those specific names derived from a personal name or an old generic name. He also preferred the genitive to the nominative in English names (e.g. Goldie's Fern not Goldie Fern), and the adjectival form rather than the substantive (e.g., Cut-leaved Grape-fern, not Cut-leaf Grape-fern). I have tried to gain consistency by following him in these respects.

ACROSTICHUM

AUREUM L.: Leather Fern.

ADIANTUM (Maidenhair)

CAPILLUS-VENERIS L.: Black Maidenhair, Dudder-grass, Lady's Hair, Lochair Fern, *Southern Maidenhair, Venus'-hair Fern.

JORDANII Müll. ex Kuhn: *California Maidenhair, Jordan's Maidenhair, Maidenhair Fern.

MELANOLEUCUM Willd.: Fragrant Maidenhair.

PEDATUM L.: American Maidenhair, *Common Maidenhair, Five-finger Fern, Lochair Fern, Northern Maidenhair, Umbrella Fern.

PEDATUM var. ALEUTICUM Rupr.: Alpine Maidenhair, *Western Maidenhair.

TENERUM Swartz: *Brittle Maidenhair, Fan Maidenhair.

TRICHOLEPIS Fée: Hairy Maidenhair.

ANCHISTEA

VIRGINICA (L.) Presl: Broad Chain-fern, Broad-leaved Chain-fern, Common Chain-fern, Giant Chain-fern, *Virginia Chain-fern.

ANEMIA

ADIANTIFOLIA (L.) Swartz: Pine Fern.

ASPLENIUM (Spleenwort)

ADIANTUM-NIGRUM L.: *Black Maidenhair-spleenwort, Black Spleenwort.

BRADLEYI D. C. Eaton: *Bradley's Spleenwort, Cliff Spleenwort.

CRISTATUM Lam.: Hemlock Spleenwort.

CRYPTOLEPIS Fern.: American Wall-rue, American Wall-rue Spleenwort, Rue Fern, Rue Spleenwort, Rue-leaved Spleenwort, Stone Fern, Taintwort Fern, Tentwort Fern, *Wall Rue, Wall-rue Spleenwort, White Maidenhair.

DENTATUM L.: Toothed Spleenwort.

×GRAVESII Maxon: Graves' Spleenwort.

MONTANUM Willd.: Mountain Spleenwort.

PALMERI Maxon: Palmer's Spleenwort.

PINNATIFIDUM Nutt.: Lobed Spleenwort, *Pinnatifid Spleenwort.

PLATYNEURON (L.) Oakes: Brown-stemmed Spleenwort, *Ebony Spleenwort, Screw Fern.

RESILIENS Kunze: Black-stemmed Spleenwort, Dwarf Spleenwort, Elastic Spleenwort, Little Ebony-spleenwort, *Small Spleenwort.

SEPTENTRIONALE (L.) Hoffm.: Forked Spleenwort.

SERRATUM L.: Wild Bird's-nest Fern.

×STOTLERI Wherry: Stotler's Spleenwort.

TRICHOMANES L.: Baby Fern, Black-stemmed Spleenwort, Dwarf

Spleenwort, English Maidenhair, *Maidenhair Spleenwort, Rock Maidenhair, Wall Spleenwort, Waterwort Fern.

× TRUDELLII Wherry: Trudell's Spleenwort, Susquehanna Spleenwort.

VESPERTINUM Maxon: Western Spleenwort.

VIRIDE Huds.: Green Fern, Green Maidenhair, *Green Spleenwort.

× ASPLENOSORUS

EBENOIDES (R. R. Scott) Wherry (*Asplenium ebenoides* R. R. Scott): *Scott's Spleenwort, Walking Spleenwort.

ATHYRIUM (Lady Fern); see also *Diplazium*.

ALPESTRE (Hoppe) Rylands ex Moore: Alpine Beech-fern, *Alpine Lady-fern, Alpine Polypody.

ALPESTRE var. AMERICANUM Butters: Western Lady-fern.

ANGUSTUM (Willd.) Presl: Female Fern, *Lady Fern, Northern Lady-fern, Upland Lady-fern.

ASPLENIOIDES (Michx.) Eaton: Lowland Lady-fern, *Southern Lady-fern.

FILIX-FEMINA (L.) Roth ex Mertens: Back-ache Fern, Female Fern, Female Spleenwort, *Lady Fern.

AZOLLA (Water Fern)

CAROLINIANA Willd.: Carolina Azolla, Mosquito Fern, *Water Fern.

FILICULOIDES Lam.: *Duckweed Fern, Fern-like Azolla.

MEXICANA Presl: Mosquito Fern, Water Fern.

BLECHNUM (Hard Fern)

OCCIDENTALE L.: Hammock Fern.

SERRULATUM L. C. Rich: *Marsh Fern, Swamp Fern.

SPICANT (L.) J. Smith: Deer Fern, Hard Fern, Herring-bone Fern, Snake Fern.

BOMMERIA

HISPIDA (Mett.) Underw.: Dancing Bommeria, *Hairy Bommeria.

BOTRYCHIUM (Grape Fern)

ALABAMENSE Maxon: Alabama Grape-fern.

BITERNATUM (Savigny) Underw.: St. John's Moonwort, *Southern Grape-fern.

BOREALE (Fries) Milde: Northern Grape-fern.

DISSECTUM Spreng.: Autumn Grape-fern, Cut-leaved Grape-fern, *Dissected Grape-fern, Finely-dissected Moonwort, Lance-leaved Grape-fern, Ternate Grape-fern.

DISSECTUM var. OBLIQUUM (Muhl.) Clute: Coarse-lobed Grape-fern, Common Grape-fern, Feathery Grape-fern, Oblique Grape-fern, *Ternate Grape-fern.

LANCEOLATUM (S. G. Gmel.) Ångström: Lance Grape-fern, Lanceolate Grape-fern, *Lance-leaved Grape-fern, Triangle Grape-fern.

LANCEOLATUM var. ANGUSTISEGMENTUM Pease & Moore: Narrow Grape-fern, Lance-leaved Grape-fern.

LUNARIA (L.) Swartz: *Moonwort, Shoeless-horse, Spring-wurzel, Tall Moonwort, Unshoe-the-horse Fern.

LUNARIA var. ONONDAGENSE (Underw.) House: Underwood's Moonwort.

MATRICARIIFOLIUM A. Br. ex Koch: Branching Grape-fern, Daisy-leaved Grape-fern, *Matricary Grape-fern, Meriden Grape-fern, Wood's Grape-fern.

MULTIFIDUM (S. G. Gmel.) Rupr.: Leather Grape-fern, *Multifid Grape-fern.

MULTIFIDUM var. CALIFORNICUM (Underw.) Broun: California Grape-fern.

MULTIFIDUM var. INTERMEDIUM (D. C. Eaton) Farw. [var. *silaifolium* (Presl) Broun]: Leathery Grape-fern.

PUMICOLA Coville ex Underw.: *Oregon Grape-fern, Oregon Moonwort.

SIMPLEX Hitchc.: Dwarf Grape-fern, Hitchcock's Grape-fern, Little Grape-fern, Little Moonwort, *Simple Grape-fern, Small Grape-fern, Small Moonwort.

SIMPLEX var. TENEBROSUM (A. A. Eaton) Clausen: Gloomy Grape-fern.

VIRGINIANUM (L.) Swartz: *Rattlesnake Fern, Rattlesnake Grape-fern, Virginia Grape-fern, Virginian Moonwort.

Camptosorus

RHIZOPHYLLUS (L.) Link: *Walking Fern, Walking-leaf, Wall-link.

Ceratopteris

DELTOIDEA Benedict: Floating Fern.

PTERIDOIDES (Hook.) Hieron.: Horn Fern, Floating Fern.

Cheilanthes (Lip Fern)

ALABAMENSIS (Buckley) Kunze: *Alabama Lip-fern, Smooth Lip-fern.

CALIFORNICA (Nutt.) Mett.: *California Lace-fern, Charming Lip-fern, Lace Fern.

CLEVELANDII D. C. Eaton: Cleveland's Lip-fern.

COOPERAE D. C. Eaton: Cooper's Lip-fern.

COVILLEI Maxon: Bead Fern, *Coville's Lip-fern.

EATONII Baker ex Hook. & Baker: *Eaton's Lip-fern, Scanty Lip-fern.

FEEI Moore: Baby Lip-fern, Fée's Lip-fern, Mountain Lace-fern, *Slender Lip-fern, Tiny Lip-fern, Woolly Lip-fern.

FENDLERI Hook.: Fendler's Lip-fern.

FIBRILLOSA Davenp. ex Underw.: Fibrillose Lip-fern.

GRACILLINA D. C. Eaton: *Lace Fern, Mountain Lace-fern.

INTERTEXTA Maxon: Coastal Lip-fern.

LANOSA (Michx.) D. C. Eaton [*C. vestita* (Spreng.) Sw.]: *Hairy Lip-fern, Clothed Lip-fern.

LINDHEIMERI (J. Smith) Hook.: Fairy-swords, *Lindheimer's Lip-fern.

PARISHII Davenp.: Parish's Lip-fern.

PRINGLEI Davenp.: Lace Fern, *Pringle's Lip-fern.

SILIQUOSA Maxon [*Cryptogramma densa* (Brack.) Diels]: Dense Cliff-brake, Indian's-dream, *Oregon Cliff-brake, Pod Fern.

TOMENTOSA Link: Webby Lip-fern, *Woolly Lip-fern.

VISCIDA Davenp.: Viscid Lip-fern.

WOOTONII Maxon: Beaded Lip-fern.

WRIGHTII Hook.: Wright's Lip-fern.

CRYPTOGRAMMA (Rock Brake)

CRISPA (L.) R. Br. var. ACROSTICHOIDES (R. Br.) C. B. Clarke: American Parsley-fern, American Rock-brake, Mountain Parsley, *Parsley Fern, Pea Fern, Rock Brake.

STELLERI (S. G. Gmel.) Prantl: Fragile Rock-brake, *Slender Cliff-brake, Slender Rock-brake.

CYRTOMIUM

FALCATUM (L. f.) Presl: *Holly Fern, House Holly-fern, Japanese Holly-fern, Licorice Fern.

CARYOTIDEUM (Wall. ex Hook. & Grev.) Presl: Toothed Holly-fern.

CYSTOPTERIS (Bladder Fern)

BULBIFERA (L.) Bernh.: Berry-bearing Fern, Berry Bladder-fern, Bulb-bearing Bladder-fern, Bulbiferous Bladder-fern, *Bulblet

Bladder-fern, Bulblet Cystopteris, Bulblet Fern, Bulbous Bladder-fern, Common Bladder fern.

FRAGILIS (L.) Bernh.: Brittle Bladder-fern, Brittle Fern, Common Bladder-fern, Cup Fern, *Fragile Bladder-fern, Fragile Fern, Prairie Fern, Upland Brittle-fern.

MONTANA (Lam.) Bernh.: Alpine Bladder-fern, *Mountain Bladder-fern, Mountain Cystopteris.

Dennstaedtia

PUNCTILOBULA (Michx.) Moore: Boulder Fern, Fine-haired Fern, Fine-haired Mountain-fern, Gossamer Fern, Hairy Dicksonia, *Hay-scented Fern, Pasture Fern, Sweet-scented Fern, Sweet-grass Fern, Sweet Pasture-fern.

Diplazium

PYCNOCARPON (Spreng.) Broun: Dagger Fern, Fancy Fern, Glade Fern, Narrow-leaved Glade-fern, *Narrow-leaved Spleenwort, Swamp Spleenwort.

ACROSTICHOIDES (Swartz) Butters [*Diplazium thelypterioides* (Michx.) Presl)]: Silvery Athyrium, Silver Fern, Silver Glade-fern, Silver-striped Fern, *Silvery Spleenwort, Silvery Toothed-fern, Thelypteris-like Spleenwort.

Dryopteris (Shield Fern, Boss Fern, Buckler Fern, Oak Fern, Wood Fern)

AMPLA (Hook. & Baker) Kuntze: Oak Fern.

ARGUTA (Kaulf.) Watt: *Coastal Wood-fern, Rigid Wood-fern.

AUGESCENS (Link) C. Chr.: Spreading Wood-fern.

×BOOTTII (Tuckerm.) Underw.: Boott's Fern, *Boott's Shield-fern, Boott's Wood-fern, Glandular Swamp-fern.

CAMPYLOPTERA (Kunze) Clarks. [*D. spinulosa* var. *americana* (Fisch.) Fern.]: American Shield-fern, Broad Shield-fern, Broad Wood-fern, *Broad-leaved Spinulose-fern, Dilated Shield-fern, Mountain Shield-fern, Mountain Wood-fern, Spreading Shield-fern, Spreading Wood-fern, Triangular Wood-fern.

CELSA (Wm. Palmer) Small: *Log Fern, Water Fern.

CLINTONIANA (D. C. Eaton) Dowell: Broad Swamp-fern, Clinton's Crested-fern, Clinton's Fern, *Clinton's Shield-fern, Clinton's Wood-fern, Large Crested-fern, Spreading Shield-fern.

CRISTATA (L.) A. Gray: Crest Fern, Crested Fern, *Crested Shield-fern, Crested Wood-fern, Cristate Wood-fern, Narrow Swamp-fern, Swamp Shield-fern.

DENTATA (Forsk.) C. Chr.: Downy Wood-fern.

DISJUNCTA (Ledeb.) Morton [*Phegopteris Dryopteris* (L.) Fée]: *Oak Fern, Tender Three-branched Polypody, Ternate Polypody, Three-branched Polypody, Triplet Fern.

FEEI C. Chr.: Downy Wood-fern, *Fée's Shield-fern.

FILIX-MAS (L.) Schott: Basket Fern, Dead-man's-hand, Knotty Brake-fern, Lucky-hands, *Male Fern, Sweet Brake, Vermifuge.

FRAGRANS (L.) Schott: Fragrant Cliff-fern, Fragrant Fern, *Fragrant Shield-fern.

GOLDIANA (Hook.) A. Gray: Giant Fern, Giant Wood-fern, *Goldie's Fern, Goldie's Shield-fern.

HEXAGONOPTERA (Michx.) C. Chr. [*Phegopteris hexagonoptera* (Michx.) Fée]: *Broad Beech-fern, Broad-leaved Beech-fern, Six-angled Polypody, Southern Beech-fern, Triangle Fern, Winged Beech-fern, Winged Polypody.

INTERMEDIA (Muhl.) A. Gray: American Shield-fern, Common Wood-fern, Common Shield-fern, Evergreen Shield-fern, Evergreen Wood-fern, Fancy Fern, *Intermediate Shield-fern, Intermediate Wood-fern, Spinulose Fern, Spinulose Shield-fern, Spinulose Wood-fern, Spring Shield-fern.

LUDOVICIANA (Kunze) Small: Florida Crested-fern, *Florida Shield-fern.

MARGINALIS (L.) A. Gray: Evergreen Shield-fern, Evergreen Wood-fern, Leather Wood-fern, Marginal Fern, Marginal-fruited Fern, *Marginal Shield-fern, Marginal Wood-fern.

NEVADENSIS (D. C. Eaton) Underw.: Sierra Water-fern, *Sierra Wood-fern.

NORMALIS C. Chr.: Pepper Fern.

NOVEBORACENSIS (L.) A. Gray: Bear's-paw, *New York Fern, New York Shield-fern, Tapering Fern.

OREOPTERIS (Ehrh.) Maxon: Heath Fern, Mountain Fern, *Mountain Wood-fern.

PHEGOPTERIS (L.) C. Chr. (*Phegopteris polypodioides* Fée): Beech Fern, Common Beech-fern, *Long Beech-fern, Narrow Beech-fern, Northern Beech-fern, Sun Fern, Triangular Polypody.

REPTANS (J. F. Gmel.) C. Chr.: *Creeping Fern, Florida Walking-fern.

ROBERTIANA (Hoffm.) C. Chr. [*Phegopteris Robertiana* (Hoffm.) A. Br. ex Aschers.]: Limestone Oak-fern, Limestone Polypody, Northern Oak-fern, *Oak Fern, Scented Oak-fern.

SERRA (Swartz) Kuntze: Parchment Fern.

SIMULATA Davenp.: Bog Fern, Dodge's Fern, Dodge's Shield-fern, Lance-leaved Marsh-fern, *Massachusetts Fern, Massachusetts Shield-fern.

SPINULOSA (O. F. Müll.) Watt: Fancy Fern, Prickly Shield-fern, Spinulose Fern, *Spinulose Shield-fern, Spinulose Wood-fern, Spiny Shield-fern, Spiny-toothed Shield-fern, Toothed Wood-fern.

THELYPTERIS (L.) A. Gray: Beaver Meadow-fern, Buckler Fern, Creeping Water-fern, Ground Fern, *Marsh Fern, Marsh Shield-fern, Quill Fern, Snuff-box Fern, Sweet Fern, Water Fern.

THELYPTERIS var. HALEANA (Fern.) Broun ex Weath.: Southern Marsh-fern.

THELYPTERIS var. PUBESCENS (Lawson) A. R. Prince ex Weath.: Northeastern Marsh-fern, *Northern Marsh-fern.

EQUISETUM (Horsetail)[1]

ARVENSE L.: Bottle-brush, Cat's-tail, Colt's-tail, *Common Horsetail, Corn Horsetail, Devil's-guts, Field Horsetail, Foxtail, Frog-pipes, Green Foxtail-rush, Jointed Rush, Mare's-tail, Meadow Pine, Pinetop, Pine-grass, Snake-grass, Snake-pipe.

FLUVIATILE L.: Paddie-pipes, Paddock-pipes, Pipes, *Swamp Horsetail, Water Horsetail.

FUNSTONII A. A. Eaton: California Horsetail, Funston's Scouring-rush.

HYEMALE L.: Dish-washings, Dutch Rushes, Pewterwort, *Scrub-grass.

HYEMALE var. CALIFORNICUM Milde: Shave-grass, Shaveweed, *Western Scouring-rush.

KANSANUM Schaffner: *Kansas Scouring-rush, Summer Scouring-rush.

LAEVIGATUM A. Br.: *Smooth Scouring-rush, Braun's Scouring-rush.

NELSONII (A. A. Eaton) Schaffner: Nelson's Scouring-rush.

PALUSTRE L. var. AMERICANUM Victorin: *American Horsetail, American Marsh-horsetail, Cat-whistles, Joint-grass, Marsh Horsetail, Marshweed, Shore Horsetail, Snake-pipes, Water Horsetail.

PRATENSE Ehrh.: *Meadow Horsetail, Shade Horsetail, Thickset Horsetail.

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[1] In "The Fern Allies," Clute lists all the following under *Equisetum:* Frog's Fishing-poles, Gunbright, Horse-pipes, Joint-grass, Naked Horsetail Bamboo, Jointrush, Pipes, Polishing Rush, Paddock-pipes, Scouring Rush, Scrub-grass, Shave-grass, Snake Rush, Snakeweed.

PREALTUM Raf.: American Scouring-rush, Common Scouring-rush, Great Scouring-rush, Prairie Scouring-rush, Stout Scouring-rush, *Tall Scouring-rush, Winter Rush, Winter Scouring-rush.

SCIRPOIDES Michx.: *Dwarf Scouring-rush, Sedge Equisetum, Sedge-like Equisetum, Sedge-like Horsetail, Sedge-like Scouring-rush, Smallest Rough-horsetail.

SYLVATICUM L.: Bottle-brush, *Wood Horsetail.

TELMATEIA Ehrh.: *Giant Horsetail, Great Water-horsetail, Ivory Horsetail, Mud Horsetail.

TRACHYODON A. Br.: Rough-toothed Scouring-rush.

VARIEGATUM Schleich.: Mottled Scouring-rush, Northern Scouring-rush, Variegated Equisetum, Variegated Horsetail, *Variegated Scouring-rush.

HYPOLEPIS

REPENS (L.) Presl: Beaded Fern.

ISOËTES (Quillwort)

BOLANDERI Engelm.: Bolander's Quillwort.

BUTLERI Engelm.: Butler's Quillwort.

EATONII Dodge: Eaton's Quillwort.

ENGELMANNII A. Br.: Appalachian Quillwort, *Engelmann's Quillwort.

FLETTII (A. A. Eaton) Pfeiffer: Flett's Quillwort.

FOVEOLATA A. A. Eaton ex Dodge: Pitted Quillwort.

HOWELLII Engelm.: Howell's Quillwort.

MACROSPORA Dur.: *Lake Quillwort, Merlin's-grass.

MELANOPODA Gay & Dur.: Black-based Quillwort.

MURICATA Dur. (*I. Braunii* Dur.): Braun's Quillwort, Spring-spored Quillwort.

NUTTALLII A. Br. ex Engelm.: Nuttall's Quillwort.

ORCUTTII A. A. Eaton: Orcutt's Quillwort.

PAUPERCULA (Engelm.) A. A. Eaton ex Maxon: Western Quillwort.

PIPERI A. A. Eaton: Piper's Quillwort.

RIPARIA Engelm. ex A. Br.: Mud Quillwort, River-bank Quillwort, Sugary Quillwort.

TUCKERMANII A. Br.: Tuckerman's Quillwort.

LORINSERIA

AREOLATA (L.) Presl: Chain Fern, Dwarf Chain-fern, Narrow Chain-fern, *Narrow-leaved Chain-fern, Netted Chain-fern, Net-veined Chain-fern, Traveling Fern.

LYCOPODIUM (Club Moss)

ADPRESSUM (Chapm.) Lloyd & Underw.: *Southern Club-moss, Chapman's Club-moss.

ALOPECUROIDES L.: Foxtail Club-moss.

ALPINUM L.: *Alpine Club-moss, Cypress Moss, Ground Fir, Heath Cypress.

ANNOTINUM L.: *Bristly Club-moss, Interrupted Club-moss, Stiff Club-moss.

CAROLINIANUM L.: Carolina Club-moss, *Slender Club-moss.

CERNUUM L.: *Staghorn Club-moss, Staghorn Lycopod.

CLAVATUM L.: Buck-grass, Buck-horn, Club Moss, Common Club-moss, Common Club-rush, Coral Evergreen, Creeping Burr, Creeping-Jenny, Elk Moss, Forks-and-knives, Foxtail, *Ground Pine, Hemlock Club-moss, Lamb's-tail, Robin-Hood's-hatband, Running Club-moss, Running Moss, Running Pine, Staghorn Club-moss, Snake-grass, Toadtail, Trailing Club-moss, Travelers'-joy, Wolf's-claw.

COMPLANATUM L.: Creeping-Jenny, Crowfoot Club-moss, Crow's-foot, Festoon Ground-pine, Flattened Ground-pine, *Ground Cedar, Ground Pine, Hog-bed, Princess Pine, Running Cedar, Trailing Christmas-green.

FLABELLIFORME (Fern.) Blanch.: Christmas-green, Ground Pine, Running Evergreen, *Running Pine.

INUNDATUM L.: *Bog Club-moss, Dwarf Club-moss, Foxtail Club-moss, Marsh Club-moss.

LUCIDULUM Michx.: Hemlock Club-moss, *Shining Club-moss, Staghorn Club-moss, Swamp Evergreen, Trailing Evergreen.

OBSCURUM L.: Bunch Evergreen, Crowfoot, Flat-branched Ground-pine, Ground Pine, *Staghorn Club-moss, Tree Club-moss.

OBSCURUM var. DENDROIDEUM (Michx.) D. C. Eaton ex A. Gray: Round-branched Ground-pine.

SABINIFOLIUM Willd.: *Alaskan Club-moss, Cedar-like Club-moss, Savin-leaved Club-moss.

SELAGO L.: *Cliff Club-moss, Cliff Staghorn-moss, Fir Club-moss, Fir Moss, Foxfeet, Mountain Club-moss, Virgin-Mary's Furze.

SELAGO var. PATENS (Beauv.) Desv. (*L. porophilum* Lloyd & Underw.); Cliff Club-moss.

SITCHENSE Rupr.: Alaskan Club-moss, *Tufted Club-moss.

TRISTACHYUM Pursh: Ground Cedar, Ground Pine, Northern Running-cedar, *Slender Ground-pine, Trailing Club-moss.

LYGODIUM

JAPONICUM (Thunb.) Swartz: Japanese Climbing-fern.

PALMATUM (Bernh.) Swartz: Alice's Fern, *Climbing Fern, Creeping Fern, Hartford Fern, Snake-tongued Fern, Watson's Fern, Windsor Fern.

MARSILEA (Pepperwort)

MACROPODA Engelm. ex. A. Br.: Water Clover.

QUADRIFOLIA L.: European Marsilea, European Pepperwort, *Water Clover, Water-clover Fern.

VESTITA Hook. & Grev.: *Clover Fern, Hairy Pepperwort, Nelson's Pepperwort.

MENISCIUM

RETICULATUM (L.) Swartz: Everglade Wood-fern.

NEPHROLEPIS

BISERRATA (Swartz) Schott: Sword Fern.

CORDIFOLIA (L.) Presl: *Sword Fern, Tuber Fern.

EXALTATA (L.) Schott: *Boston Fern, Ladder Fern, Sword Fern, Wild Boston-fern.

NOTHOLAENA (Cloak Fern)

CALIFORNICA D. C. Eaton: California Cloak-fern.

DEALBATA (Pursh) Kunze: Cloak Fern, *Powdery Cloak-fern, Powdery Notholaena, Whitened Notholaena.

JONESII Maxon: Jones' Cloak-fern.

PARRYI D. C. Eaton: Parry's Cloak-fern.

SINUATA (Lag.) Kaulf.: Long Cloak-fern, Wavy Cloak-fern.

STANDLEYI Maxon: Star Cloak-fern.

ONOCLEA

SENSIBILIS L.: Bread Fern, Dragon's-bridge, Leadwort, Meadow Brake, Oak-leaved Fern, Polypody Brake, *Sensitive Fern.

OPHIOGLOSSUM (Adder's-tongue)

CROTALOPHOROIDES Walt.: Adder's-tongue, *Bulbous Adder's-tongue, Bulbous-rooted Adder's-tongue.

ENGELMANNII Prantl: *Engelmann's Adder's-tongue, Limestone Adder's-tongue.

LUSITANICUM L. var. CALIFORNICUM (Prantl) Broun: *California Adder's-tongue, Western Adder's-tongue.

PALMATUM L., Hand Fern.

VULGATUM L.: Adder's-grass, Adder's-spear, Adder's-spit, *Adder's-tongue, Adder's-tongue Fern, Cock's-comb, Dragon's-tongue, Serpent's-tongue.

Osmunda

CINNAMOMEA L.: Buckthorn Brake, *Cinnamon Fern, Cinnamon Osmunda, Flowering Fern, Hog Brake, Snake Brake, Woolly Flowering-fern.

CLAYTONIANA L.: Clayton's Fern, Clayton's Flowering-fern, Clayton's Osmunda, *Interrupted Fern, Interrupted Osmunda, Interrupted Flowering-fern.

REGALIS L. var. SPECTABILIS (Willd.) A. Gray: Bog Onion, Christopher's Herb, Ditch Fern, Flowering Fern, Heart-of-Osmund, King's Fern, Locust Fern, Regal Fern, *Royal Fern, Royal Moonwort, Royal Osmunda, St. Christopher's Herb, Water Fernsmund.

Paltonium

LANCEOLATUM (L.) Presl.: Ribbon Fern.

Pellaea (Cliff Brake)

ANDROMEDIFOLIA (Kaulf.) Fée: Coffee Fern.

ATROPURPUREA (L.) Link: Blue Fern, Cliff Brake, Hairy Cliff-brake, *Purple Cliff-brake, Purple-stalked Brake, Purple-stemmed Cliff-brake, Winter Brake.

BRACHYPTERA (Moore) Baker ex Hook. & Baker: Cliff Brake, *Sierra Cliff-brake.

BREWERI D. C. Eaton: Brewer's Cliff-brake.

BRIDGESII Hook.: Bridges' Cliff-brake.

COMPACTA (Davenp.) Maxon: Desert Cliff-brake.

GLABELLA Mett. ex Kuhn: Cliff Brake, *Smooth Cliff-brake.

MUCRONATA D. C. Eaton: Bird's-foot Cliff-brake, Bird's-foot Fern, Black Fern, Poison Fern, Rock Fern, Tea Fern.

SUKSDORFIANA Butters: Suksdorf's Cliff-brake.

WRIGHTIANA Hook.: Wright's Cliff-brake.

Phyllitis

SCOLOPENDRIUM (L.) Newman: American Hart's-tongue, Burnt-weed-longleaf, Buttonholes, Buttonhole Fern, Caterpillar Fern, Christ's-hair, Hart's-tongue, *Hart's-tongue Fern, Hound's-tongue, Sea-weed Fern.

PILULARIA

AMERICANA A. Br.: American Pilularia, *Pillwort, Water Pepper.

PITYROGRAMMA

CALOMELANOS (L.) Link: *Silver Fern, Silver-backed Fern.
TRIANGULARIS (Kaulf.) Maxon: California Gold-fern, Gold-backed Fern, *Gold Fern, Golden-back Fern.

POLYPODIUM (Polypody)

ANGUSTIFOLIUM Swartz: Strap Fern.
AUREUM L.: Bear's-foot, *Golden Polypody, Hare's-foot Fern, Serpent Fern.
BRASILIENSE Poir. ex Lam.: Brazilian Polypody.
COSTATUM Kunze: Strap Fern.
HETEROPHYLLUM L.: Vine Fern.
PHYLLITIDIS L.: Strap Fern.
POLYPODIOIDES (L.) Watt var. MICHAUXIANUM Weath.: Gray Polypody, Hoary Polypodium, Little Gray-polypody, *Resurrection Fern, Resurrection Polypody, Scaly Polypody, Tree Polypody.
SCOULERI Hook. & Grev.: Coast Polypody, Leatherleaf, Leather-leaved Polypody, *Leathery Polypody.
VIRGINIANUM L.: Back-ache Brake, *Common Polypody, Female Fern-root, Rock-cap Fern, Rock Fern, Snake Fern, Wall Fern.
VULGARE L.: Adder's Fern, Golden-locks, Licorice Fern, Mountain Polypody, *Polypody, Snake Fern, Western Polypody.
VULGARE var. COLUMBIANUM Gilb. [Var. *hesperium* (Maxon) Nelson & Macbride]: Mountain Licorice-fern, *Western Polypody.
VULGARE var. OCCIDENTALE Hook. (*Polypodium glycyrrhiza* Hook.): Licorice Fern.

POLYSTICHUM

ACROSTICHOIDES (Michx.) Schott: Buckler Fern, Canker Brake, *Christmas Fern, Dagger Fern, Shield Fern, Winter Fern.
ANDERSONII Hopkins: *Anderson's Shield-fern, Vancouver Fern.
BRAUNII (Spenner) Fée var. PURSHII Fern.: *Braun's Holly-fern, Eastern Holly-fern, Holly Fern.
CALIFORNICUM (D. C. Eaton) Underw.: Bristle Fern, *California Shield-fern, Prickly Shield-fern.
DUDLEYI Maxon: Dudley's Shield Fern.
LEMMONII Underw.: Lemmon's Shield-fern.
LONCHITIS (L.) Roth ex Roem.: *Holly Fern, Mountain Holly-fern.

MUNITUM (Kaulf.) Presl: Shasta Fern, *Sword Fern, Western Sword-fern.

MUNITUM var. IMBRICANS (D. C. Eaton) Maxon: Imbricated Sword-fern.

SCOPULINUM (D. C. Eaton) Maxon: Eaton's Fern, Eaton's Shield-fern.

Psilotum

NUDUM (L.) Griseb.: Bush Moss, Whisk Fern.

Pteretis

PENSYLVANICA (Willd.) Fern. [*Pteretis nodulosa* (Michx.) Nieuwl.]: Ostrich-feather Fern, *Ostrich Fern, Shuttlecock Fern.

Pteridium (Bracken)

AQUILINUM var. CAUDATUM (L.) Sadebeck: *Bracken, Small Bracken, Tropical Bracken.

AQUILINUM var. LATIUSCULUM (Desv.) Underw. ex Heller: American Brake, Bracken, *Common Brake, Eastern Bracken, Eastern Brake, Hog Brake, Upland Fern.

AQUILINUM var. PUBESCENS Underw. [var. *lanuginosum* (Bong.) Fern.]: Adder's-spit, *Bracken, Brake, Eagle Fern, Erne Fern, Turkey-foot Bracken, Turkey-foot Fern, Umbrella Fern, Western Bracken, Western Brake, Western Brake-fern.

Pteris

CRETICA L.: Avery Fern, Cretan Fern, *Cretan Brake.

LONGIFOLIA L. var. BAHAMENSIS (Agardh) Hieron.: *Ladder Fern, Long-leaved Bracken, Ladder Brake.

MULTIFIDA Poir. ex Lam.: *Chinese Brake, Huguenot Fern, Saw-leaved Bracken, Spider Brake, Spider Fern.

TRIPARTITA Swartz: Giant Bracken.

VITTATA L.: Ladder Brake.

Salvinia

NATANS (L.) All.: Floating Moss, *Salvinia.

ROTUNDIFOLIA Willd.: Floating Moss, Floating Salvinia, *Round-leaved Salvinia.

Schizaea

PUSILLA Pursh: Atlantic Fern, *Curly-grass, Curly-grass Fern, One-sided Fern.

SELAGINELLA (Spike Moss)

APODA (L.) Spring ex Mart.: Basket Selaginella, Creeping Selaginella, *Meadow Spike-moss.

ARENICOLA Underw.: Sand-barren Selaginella, *Sand Selaginella.

ASPRELLA Maxon: Bluish Selaginella.

BIGELOVII Underw.: *Bigelow's Selaginella, Bushy Selaginella.

CINERASCENS A. A. Eaton: *Gray Selaginella, Pygmy Selaginella.

DOUGLASII (Hook. & Grev.) Spring: Douglas' Selaginella.

EREMOPHILA Maxon: Desert Selaginella.

HANSENII Hieron.: Hansen's Selaginella.

LEPIDOPHYLLA (Hook. & Grev.) Spring: Bird's-nest Moss, Resurrection Moss, *Resurrection Plant.

LEUCOBRYOIDES Maxon: Mojave Selaginella.

OREGANA D. C. Eaton: Festoon Selaginella, *Oregon Selaginella.

RUPESTRIS (L.) Spring: Dwarf Lycopod, *Dwarf Spike-moss, Festoon Pine, Rock Selaginella, Rock Spike-moss.

SCOPULORUM Maxon: Rocky-Mountain Selaginella, *Rocky-Mountain Spike-moss.

SELAGINOIDES (L.) Link: Low Selaginella, *Mountain Moss, Prickly Mountain-moss.

WALLACEI Hieron.: Wallace's Selaginella.

WATSONII Underw.: Alpine Selaginella, *Watson's Selaginella.

STENOCHLAENA

KUNZEANA (Presl) Underw.: Holly Fern.

TECTARIA

HERACLEIFOLIA (Willd.) Underw.: Halberd Fern.

MINIMA Underw.: Small Halberd-fern.

TRICHOMANES (Filmy Fern)

BOSCHIANUM Sturm ex v.d. Bosch: Appalachian Filmy-fern, Bristle Fern, *Filmy Fern.

KRAUSII Hook. & Grev.: Filmy Fern.

PETERSII A. Gray: Peters' Filmy-fern.

VITTARIA

LINEATA (L.) J. E. Smith: Beard Fern, *Grass Fern, Shoe-string Fern.

WOODSIA

ALPINA (Bolton) S. F. Gray: *Alpine Woodsia, Flower-cup Fern, Northern Woodsia, Rounded-leaved Woodsia, Scale Fern.

GLABELLA R. Br.: Smooth Cliff-fern, *Smooth Woodsia.

ILVENSIS (L.) R. Br.: Elba Woodsia, Fragrant Woodsia, Hair Fern, Hairy Woodsia, Oblong Woodsia, Oblong-leaved Woodsia, Ray's Woodsia, Rusty Cliff-fern, Rusty Polypody, *Rusty Woodsia.

OBTUSA (Spreng.) Torr.: Blunt-lobed Cliff-fern, *Blunt-lobed Woodsia, Common Woodsia, Large Woodsia, Obtuse Woodsia, Obtuse-lobed Woodsia, Rock Fern.

OREGANA D. C. Eaton: Oregon Woodsia.

PLUMMERAE Lemmon: Flower-cup Fern.

SCOPULINA D. C. Eaton: Allegheny Cliff-fern, *Mountain Cliff-fern, Rocky-Mountain Cliff-fern, Rocky-Mountain Woodsia.

WOODWARDIA (Chain Fern)[2]

FIMBRIATA J. E. Smith ex Rees: *Giant Chain-fern, Great Chain-fern.

CAMBRIDGE, MASSACHUSETTS

Shorter Notes

OPHIOGLOSSUM PETIOLATUM IN SOUTH CAROLINA.—On 22 April 1950 I collected a short distance south of Myrtle Beach, Horry County, South Carolina, a curious little *Ophioglossum* which has subsequently been identified by both C. V. Morton and Dr. R. T. Clausen as *O. petiolatum* Hook., a species not previously known, according to Dr. Clausen, north of Nassau County, Florida. The colony, which was a small one, was growing among scattered grasses and small herbs in an area of low old dunes in fine, compact, almost dust-like whitish sand which passed, at a depth of about two inches, to a slightly loamy brownish soil in which the roots were imbedded. About two years later, on 13 April 1952, I revisited the region and after considerable search found a small colony of the plant containing a few score speci-

[2] See also Anchistea and Lorinseria.

mens in an area about 6 or 8 feet square. This locality was only about 50 paces back from the upper limit of tide on the beach, but separated from it by a line of low, planted pine trees. Whether it was precisely the same station as the earlier one I do not know; the immediate surroundings seemed not quite as my wife and I remembered them.

The fronds of the two collections, usually 2 or 3 to a plant (in one case 4) and about 6 to 9 cm. in total height, were buried in the sand practically up to the base of the leaf blade, so that only about 2.5 to 3.8 cm. (in one case 5.5 cm.) of their length, including the spikes, stood up above the surface. The sterile segments were 2 to 2.5 cm. long by 9 to 13 mm. wide. Some of the specimens of the 1950 collection had already shed their spores, and the rest were about ready to. Those collected in 1952 were not quite so far advanced.—S. F. BLAKE, Division of Plant Exploration and Introduction, U. S. Department of Agriculture, Beltsville, Md.

CAN YOU STRIKE FIRE FROM EQUISETUM STEMS?—In Humphrey's "Elements," (1815), the author reports success in striking fire with steel against a rattan stem, the action having occurred in 1798. He mentions this in connection with a discussion of the outer layer of plant stems. In the same paragraph he refers to several kinds of *Equisetum*, and to oats and wheat also as having large amounts of silica in their outer layers, but does not report that he tested these plants as substitutes for flint. Are there any boy scouts among Fern Society members who might like to check the possibility that one of the subjects of our study might prove a valuable substitute for two pieces of dry wood in the process of making a camp fire? The record of the rattan and *Equisetum* structure is reported in the following paragraphs:

". . . The epidermis is not vascular, and it merely defends the inner parts from injury. In forest trees, and in the larger shrubs, the bodies of which are firm, and of strong texture, it is a part of little importance; but in reeds, the grasses, canes and the plants having hollow stems, it is of great use, and is exceedingly strong, and in the microscope seems composed of a kind of glassy substance, which is principally siliceous earth.

"This is the case in wheat, in the oat, in different species of equisetum, and, above all, in the rattan, the epidermis of which contains a sufficient quantity of flint to give light when struck by steel; or two pieces rubbed together give sparks. This fact first occurred to me in 1798, and it led me to experiments, by which I ascertained that siliceous earth existed generally in the epidermis of hollow stems.

"The siliceous epidermis serves as a support, protects the bark from the action of insects, and to perform a part in the economy of these feeble vegetable tribes, similar to that performed in animals by the shells of crustaceous insects."—R. C. Benedict.

American Fern Society

Report of Garden Meeting in July.—On Saturday afternoon, July 12, members and friends of the Fern Society met at the home of Mr. and Mrs. Edward D. Thurston, in Sharon, Connecticut. Here we were privileged to see a very successful fern garden, laid out in an upland pasture lot that must have looked originally rather unpromising. Hemlocks and paper birches are planted on the periphery, as windbreaks, and now, after thirteen years, are largely replacing the overhead lattice that was built to protect shade-loving ferns from the sun. There is an attractive artificial pool and outflowing brooklet, bordered with artistically arranged limestone rocks which had to be imported.

All the more usual native ferns find a congenial home here, and also a number of species, such as hart's-tongue and *Cheilanthes lanosa,* which require special care for survival in this region. Mrs. Thurston assured us that formerly, when she could spend more time in babying them, there were several other species in the garden that do not survive long without such constant care. Notable for their luxuriance were the hart's-tongue, maidenhair, narrow-leaved spleenwort, and holly fern.

Among those attending were: Dr. Ralph C. Benedict, Mr. Albert C. Benedict, Mr. and Mrs. Henry F. Dunbar, Mrs. Caroline A. Dunham, Miss Ann Dunham, Mr. and Mrs. H. Lincoln Foster, Miss Ruth Hardy, Miss Aletta Hegeman, Mr. and Mrs. Mortimer Higgins, Mrs. Lucy Hubbell, Mr. and Mrs. Eldon Johnson, Mr. and Mrs. W. S. Johnston, Mr. Edward Connery Latham, Mr. Clarence Lewis, Miss Grace Ludlow, Mrs. Spencer S. Marsh, Miss Elinor Merrell, Mr. and Mrs. S. E. Parker, Mr. and Mrs. John S. Patnode, Mr. Harold Rugg, Miss Jennie G. Skidmore, Mr. Jesse F. Smith, Mr. Nils Swanson and Mr. and Mrs. H. M. Turner.

Toward the close of the afternoon delightful refreshments were served on the terrace overlooking the garden and the distant fields and hills. The Society is truly indebted to Mr. and Mrs. Thurston for a profitable and most enjoyable afternoon.—HENRY F. DUNBAR.

A WINTER MEETING SCHEDULED.—The American Fern Society will hold a meeting on February 28, 1953, at the Brooklyn Botanic Garden, Brooklyn, New York, at 10 a.m. Miss Hester Rusk, of the Brooklyn Garden staff, will be hostess. Among the speakers will be Dr. Edgar T. Wherry, who will talk on "Some Dryopteris Problems," and Mrs. Fern W. Crane, who will speak on "Some New Studies of Fern Spores." There will be a demonstration of a new type of fluorescent box for growing ferns from spores, which is being constructed through the courtesy of the Brooklyn Botanic Garden, and spore cultures in various stages of development will be exhibited. Other exhibits will include the collection of ferns in the greenhouse of the Garden, which has a good representation of the peculiar sports of *Nephrolepis*. Members and friends living in the vicinity of New York are urged to make plans now to attend.—R. C. B.

Our member Mr. Robert Doray, 560 White Street, Springfield, Massachusetts, is disposing of his fern library and has the following books for sale: Fern Bulletin, vol. 5–20 (bound in 4 volumes), $20; Fern Bulletin, vol. 4 (unbound), $1; Fern Journal, vol. 1–39 (bound in 13 volumes), $50; Fern Journal, vol. 40–42 (unbound), $2; Cooke, A Fern Book for Everybody, $.50; Clute, Fern Collector's Guide (1902), $1; Wherry, Guide to Eastern Ferns (1942), $1; Woolson, Ferns (1909), $1.50; Underwood, Our Native Ferns (1893), $1.50; Clute, Fern Allies (1928), $1.50; Druery, British Ferns and Their Varieties, $6; Smith, Historia Filicum (1875), $1; Parsons, How to Know the Ferns (1899), $1.50; Tryon, Ferns of Wisconsin, $1; Roberts & Lawrence, American Ferns (1935), $1; Eastman, New England Ferns (1904), $1; collection of eight publications (Pteridophytes of West Virginia, Ferns of Oklahoma, Native Ferns of Iowa, Virginia Ferns, Ferns of Maine, Ferns & Fern Allies of Indiana, Ferns of Utah, Hardy Ferns & Their Culture), $1.50.

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Published by the

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American Fern Journal

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The Ten Best Ferns for Northeastern Gardens

R. C. Benedict

Annually, film critics compile lists of the "ten best" films of the preceding year, sports writers their lists of "all American" football selections, and literary critics have been known to offer their selections of the "ten greatest novels ever written." What about the ten best fern species which may be recommended for backyard gardens or porch corners?

A letter was received not long ago posing just about that question. Here is a try at answering it. There will be, I am sure, differences of opinion regarding the answer.

As preamble to the actual listing, the criteria of selection may be noted. The garden plot is assumed to be some shaded backyard space, in need of decorative planting, where flowering plants are scarcely suitable. The soil is assumed to be good average garden loam; the care given, to include occasional watering during dry spells. In other words, no elaborate rockery or distinctive soil is expected. The conditions are those which lead so many dwellers in small towns or in larger too, to bring in a few ferns, identity unknown, to serve as edging for a front porch corner or shady north border. The region covered is not just the northeastern states but all the territory north of the Mason-Dixon Line and west to past the Mississippi.

The qualifications of the fern species include capacity to grow well and to look well under the conditions indicated, and to be of fairly large size. Innumerable homes throughout the area named have just such fern corners or borders. If one were to list offhand the species most commonly grown, the list would probably stop with the following six: interrupted, cinnamon, ostrich, marginal, lady, and less frequently, but much prized, the maidenhair, the one native fern species a good many people know by name. Here follows my list of a first ten, with a few alternates or substitutes.

1. MARGINAL SHIELD FERN (*Dryopteris marginalis*). This wood-fern is given first position for a number of reasons: besides its general attractiveness, it is easy to transplant; it maintains a good appearance all summer; it makes no special demands; and it is evergreen.

2. INTERRUPTED FERN (*Osmunda Claytoniana*). Growing naturally in drier soil than either of the other Osmundas, the interrupted fern takes most kindly to the average shaded corner or border and also keeps a good appearance through the growing season.

3. ROYAL FERN (*Osmunda spectabilis* [or *O. regalis*]). In a recent note in the Fern Journal, I have already characterized the royal fern as potentially the best of eastern ferns for home garden cultivation. Its transplantation, however, is likely to be more difficult because of its massive root mass and its frequent location in wet situations. Its striking foliage and potentially large size make it a species to be prized. (All three Osmundas have large root masses.)

4. GOLDIE'S FERN (*Dryopteris Goldiana*). One of the less common wood ferns, known sometimes as "giant wood fern," Goldie's fern will do well if given a reasonable chance. Under better than average conditions, its leaves will approach five feet in length, and it takes kindly to a home garden.

5. OSTRICH FERN (*Pteretis nodulosa*). This species is already a favorite in many home gardens in regions where it may be a common plant along streams. No fern shows to greater advantage than the ostrich fern in the early season with its tall, vase-like plumes of bright green leaves. It has two disadvantages: In conditions of dry air and depleted soil water, its leaves frequently turn brown by midsummer; and it has the habit of sending offshoots widely underground so that it may appear several feet from its first site. But given moist enough air and plenty of water, it will stay green into September, witness the nearly six foot lengths of leaves I noted in Randolph Gulf in Vermont the past summer.

6. CHRISTMAS FERN (*Polystichum acrostichoides*). The "dagger fern" of the florist cut fern trade, the Christmas fern is a natural inhabitant of dry wooded hillsides, where it is often the only fern species to be seen. It does not like to be crowded but is at its best when it has a chance to spread and extend its plume of dark green leaves in all directions. As its name indicates, it is evergreen.

7. MAIDENHAIR FERN (*Adiantum pedatum*). This fern can be grown successfully to form vigorous, many-leaved graceful clumps if given a better than average, porous, leaf mould soil. It likes a dash of lime. Its hairlike leaf stalks combined with its almost diaphanous, distinctively cut foliage make it stand out as a prized growth in any garden. A letter just received reports "a bed of maidenhair almost 60 feet long and three to four feet wide" in the New Hampshire summer home of our member Miss Gertrude Phair.

8. SENSITIVE FERN (*Onoclea sensibilis*). The sensitive fern—a misnomer so far as general appearance goes—may not find acceptance in other lists. It is included here for several reasons. Though often a weedy species

of roadsides, its leaf cutting is attractive. It will grow well under less than the best conditions, and, given a boulder edging for footing, will self-sow and form a thrifty border.

9. LADY FERN (*Athyrium Filix-femina*). One of the commonly transplanted species, the lady fern has good and bad points. It is continually producing a succession of fresh green leaves and is easily transplanted and easily grown. At the same time, its older leaves are subject to gradual discoloration and to insect disfiguration.

10. DRYOPTERIS ERYTHROSORA. Literally the "red-dotted wood fern," this Japanese species is of medium to small size. It is suggested for attention because of the reddish color of its early leaf growth, and for its glossy, cleanly cut, mature development.

Every "all-American" list has always a list of substitutes or second-string candidates. Here are a few such fern nominations. Some of the following will have strong support for the "first team."

FANCY FERN (*Dryopteris intermedia*). Anyone who has attended a banquet or received cut flowers has probably seen this species in its commercial form, as an adjunct decoration used by florists. Finely and beautifully cut, evergreen, it lends itself to such use. Millions of its leaves are gathered annually by crews of pickers on New England's wooded slopes and kept in cold storage until sold. Its leaf cutting makes it attractive for garden growth and it can be grown successfully with a little more than average care.

MALE FERN (*Dryopteris Filix-mas*). Common in Europe but rare in eastern United States, the male fern has something of the appearance of a tall marginal fern. It is not evergreen and its sparse natural occurrence raises a question as to its suitability for the average garden.

CINNAMON FERN (*Osmunda cinnamomea*). Probably the commonest "brake," as the farmer would call it, along marshy road margins, often growing in open sun, this is one of our largest species and capable of good garden growth if given adequate moisture, especially near a pool. But drier conditions and competition with tree roots are likely to lead to early shrivelling and discoloration.

VARIEGATED ATHYRIUM (*Athyrium Goeringianum* f. *pictum*). A Japanese species, related to the lady fern, this species has been offered fairly often by florists for as long as fifty years. Dealers who offer any hardy ferns are likely to have it. It has rather small spreading leaves with whitish streaks of variegation which make it an interesting addition to the fern garden.

BULBLET BLADDER-FERN (*Cystopteris bulbifera*). The uneuphonious "common" name is merely a translation of the technical name. The leaves are long, slender, often resting on the ground on the rocky slopes it frequents. It is a species for a special spot in the garden —a few small rocks and soil slightly elevated and with a little spray or drip will make it happy and its distinctive little bulbils make it easy to multiply.

FERN GARDENS. So far, fern species have been discussed as possible adjunct plants in general garden planting. However, in the first ten species listed above, there was a gradual transition from a few of the largest and hardiest types to others for which greater care might be needed. It is a natural step further to an expanding interest in ferns for themselves, and to ferns as a hobby to be pursued in special gardens and in the natural haunts of native ferns. Then the objective comes to be, not merely what fern species will be good to fill a bare or otherwise uninteresting corner, but how many kinds of ferns can be grown and how can old and new types be brought to the peak of perfection.

The "fern corner" then becomes a fern garden with perhaps an ever-increasing number of species. It may be an acre of sunny meadow, like the Thurstons' at Sharon, Connecticut, where lath-shading and hemlock shelter-planting provide the conditions for a beautiful fern bower. It may be a good-sized yard like Matthew Mann's, in Roselle, N. J., where over one hundred fifty species and varieties find agreeable quarters. Or it may be a larger acreage like Harold Rugg's at Hanover, N. H., where many rare as well as commoner types flourish in the shady parts, in company with a botanic garden display of distinctive flowers and woody species in the sunnier areas.

How does one get fern plants for whatever purpose? Most of the commoner kinds can be found without too much searching over most of the Eastern States in woodland areas. The commoner and less common kinds may be obtained from a number of dealers.[1] But some care must be exercised. A correspondent has recently reported the offering of "hart's tongue" by a Florida dealer, as a plant common in Florida swamps! Raising ferns from spores has proved a fascinating part of a fern hobby and calls for only simple equipment. A surprising number of Fern Society members grow ferns as part of their hobby, and back numbers of the Journal offer many pages of their reports.

BROOKLYN, N. Y.

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[1] We hope to have a list of fern dealers in a future number of the JOURNAL.

Notes on Azolla caroliniana

JULIUS COHN AND ROBERT N. RENLUND

During the fall of 1949 *Azolla caroliniana* Willd. was collected from the Delaware and Raritan Canal at New Brunswick, New Jersey. Small patches of this aquatic fern were found along the banks of the canal. In 1950 the fern was found from early July to mid-December, again in discrete patches extending up the canal for a distance of about two miles. In 1951 it was first noticed in mid-July intermingled with *Lemna minor* L. and *Spirodela polyrhiza* (L.) Schleid.; by late August it had increased to such an extent that the canal was almost completely covered from bank to bank for a distance of nearly five miles. Dr. T. C. Nelson, of the Zoology Department of Rutgers University, informs us that he was unable to row a boat through the canal because of the thick growth of *Azolla*. Again, in 1952 the fern appeared during late July and by early September had covered the surface of the canal for a distance of over four miles.

This species is apparently a recent introduction to New Jersey. It is not listed by Britton (1889) nor is it mentioned by Stone (1912). Taylor (1915) lists it as being found "in the Morris Canal near Bloomfield, New Jersey" and Small (1935) mentions it as being present in Essex County as the "remains of plantings connected with mosquito-control activities." Chrysler and Edwards (1947) do not list this fern. Although its natural range is given as Massachusetts and New York to Louisiana and westward, Muenscher (1944) does not indicate its presence in New Jersey. It may be assumed then that this colony represents the first natural appearance of the fern in the state.

The plants agree well with the descriptions and figures as given by Svenson (1944), although our plants are somewhat more papillose. Careful search failed to disclose any fruiting material. This is similar to the experience of Svenson.

The plants are green from their first appearance in July to early September, at which time a color change becomes apparent. By mid-September they are a deep rusty-red, except for those plants that are shaded, these retaining their green color. The leaf tip of the green plant is bright red. During the color change this red hue is at first more intense in the tip of the lower lobe. Later, the entire plant becomes rusty-red. Different authors ascribe this change to varying environmental factors such as light, nutriment, and others.

Azolla displays a vegetative growth of explosive proportions. Brown and Correll (1942) mention that seven tons of it were removed from an area of one-quarter acre from June to September in New Orleans. The rapid growth and the marked color change of *Azolla caroliniana* suggested its use as experimental material. Experiments were set up in the greenhouses of the Plant Physiology Department at Rutgers University from October, 1951, to June, 1952. These experiments were concerned mainly with the effects of low phosphorus levels upon growth; other experiments included the growing of *Azolla* upon a nitrogen-free medium, and the effects of using 2,4-D both as a spray and as an addition to the culture medium. It is expected that these experiments and results will be published more fully elsewhere. However, a brief summary may be of interest at this time.

The plants were grown in glazed, two-gallon, coffee-urn liners in a Shive-Robbins 3-salt formula I (1948) with continuous aeration. On this nutrient medium the *Azolla* plants remained green and healthy, showed good vegetative growth, and doubled their area in approximately nine days. Concentrations of phosphorus varying from 16 ppm to as low as 0.00125 ppm were supplied to a replicated series of cultures. Gross morphological and color changes quickly became apparent. In the lower phosphorus media the plants did not grow as rapidly or ceased growth entirely; their roots became curled; color changes indicative of phosphorus deficiency quickly appeared. These color changes were similar to the changes noted in the plants in the canal.

The presence of the blue-green alga *Anabaena* in the upper leaf lobe has made *Azolla* the subject of several studies in nitrogen assimilation. "The association of the two organisms may be regarded as a conditional symbiosis." (Gregor, 1938) In our own nitrogen-free experiment the plants remained healthy, the roots were long and straight, and growth was even more rapid than in the Shive-Robbins solution. The plants eventually changed from a deep-green to a yellow-green, and the red coloration normally present in the leaf tips was markedly reduced or absent. Huneke (1933)—from an abstract by B. Lloyd—states that after "long cultivation in nitrogen-free solutions, *Azolla* becomes free from Cyanophyceae." Our plants did not exhibit this freedom from *Anabaena*.

The Delaware and Raritan Canal is a source of potable and industrial water. The possibility of controlling or eliminating the Azolla with 2,4-D was determined. Sprays of 1,000 to 10,000 ppm were used, as well as nutrient media containing 100 to 1,000 ppm 2,4-D. While the necrotic changes were proportional to the concentrations used, the authors feel that the elimination of *Azolla* from the canal is not feasible, nor might it be desirable, since the Johnson and Johnson plant, which uses canal water, has found that lesser amounts of materials are needed to purify the water during the times when *Azolla* is abundant.

Because of its very rapid vegetative growth, and its supposed high nitrogen content, *Azolla* is reported as being used in the rice fields of Tonkin, French Indo-China, as a green manure, and as a source of green food for poultry, swine, and ducks (Chevalier, 1926). Fosberg (1942) mentions the experience of a Hawaiian taro grower who "finds that a thick covering of *Azolla* on the surface of the water effectively prevents most other weeds from growing, and that if it gets too abundant it can be checked by temporarily draining the pond." *Azolla* has frequently been used for mosquito-control, whence comes its common name "Mosquito-fern."

The authors desire to call attention to this interesting plant with its many potentialities for experimentation. It is easily grown in the greenhouse, requires no elaborate equipment, is readily photographed, and is quickly and easily harvested. Furthermore, since it lacks secondary tissues it is comparatively easy to study histologically. For certain types of experiments the presence of *Anabaena* may be a disadvantage but in the main, it may be disregarded.

We wish to express our thanks and appreciation to Dr. W. R. Robbins and Dr. Harold E. Clark of the Plant Physiology Department for their encouragement and many helpful suggestions during these experiments; and to Dr. M. A. Johnson and Dr. E. T. Moul of the Botany Department for their constructive criticism of the manuscript.

RUTGERS UNIVERSITY, NEW BRUNSWICK, NEW JERSEY

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New or Interesting American Ferns

E. B. COPELAND

Botrychium **Vargasii** Copel., sp. nov.

Species *B. virginiano* affinis; stipite 20 cm. longo; lamina sterili triangulari, 10–13 cm. lata et longa; pinnis infimis 10 cm. longis, 5 cm. latis, acutis, petiolulis 10–15 mm. longis, rhachibus angustissime alatis, pinnulis sessilibus decurrentibus, maximis suprabasalibus 4 cm. longis et 12 mm. latis, pinnatifidis, segmentis 4 mm. latis, obtusis, inconspicue serrulatis, dentibus minutis appressis utroque latere segmenti I vel II; lamina herbacea, glabra, laete viridi; stipite segmenti fertilis e basi sterilis oriente, 13 cm. longo; segmento fertili frondis 6 cm. longo, stricto, tripinnato; sporangiis vix 1 mm. diam.

Type in the herbarium of the University of California, Berkeley, collected at Vilcabamba, Province of Calca, Department of Cuzco, Peru, at an elevation of 2600 m., January, 1944, by C. Vargas (no. 4002).

The present species resembles typical *Botrychium virginianum* in the long petiolule of the fertile segment, but in this, as in other respects, *B. virginianum* is notoriously variable. In aspect it is rather like *B. cicutarium.* However, in color, texture, and dissection the new species is unlike both of these. The teeth are so inconspicuous that the segments look, superficially, to be entire. Clausen remarks (in his Monograph of the Ophioglossaceae) that Bolivian specimens ascribed to *B. cicutarium* have fertile spikes exceeding the sterile segments.

Cyclosorus **Reederi** Copel., sp. nov.

C. rhizomate adscendente, basibus stipitum radicibusque permultis occulto, paleis castaneis paucis integris lanceolatis acuminatis asperso; stipitibus 1–5 cm. longis; frondibus caespitosis, 35 cm. longis, 8 cm. latis, apice in caudam integrescentem contracto, deorsum longe fere ad rhizoma gradatim angustatis, pinnis infimis vestigialibus ovatis 3 mm. longis, medialibus 4.5 cm. longis, subcontiguis, sessilibus, acutis, basi acroscopice truncatis subhastatis, basiscopice late cuneatis, herbaceis, rhachi costisque et inferne venis setis albis 0.3–0.6 mm. longis ornatis, lamina inferne glandulis aureis sparsis praedita; venis infimis 1-paribus anastomosantibus et fertilibus, vena altera acroscopica cum vena excurrente anastomosante; soris subcostalibus uniseriatis, exindusiatis, sporangiis nudis.

Type in the U. S. National Herbarium (no. 2,018,134), collected at Finschafen, New Guinea, along bank of small stream in bamboo thicket, March, 1944, by John R. Reeder (no. 889).

Hyalotricha Copel., gen. nov.

Filix adhuc incertae sedis verosimiliter Aspideacea; rhizomate breviter repente, paleis fere diaphanis clathratis non peltatis vestito; frondibus approximatis, non ad rhizoma articulatis, parvis, oblanceolatis, integris, herbaceis, pilis pallidis debilibus pluricellularibus vestitis; venis conspicuis nullis, venulis gracilibus anastomosantibus, venulis inclusis paucis, ad apices soriferis; soris irregulariter utroque latere costae bi-triseriatis, superficialibus, orbicularibus, exindusiatis; sporangiorum pedicellis gracilibus, cellulis incrassatis annuli 12–14, sporis reniformibus hyalinis.

Type:

Hyalotricha **anetioides** (Christ) Copel., comb. nov. (*Pl. 1*)

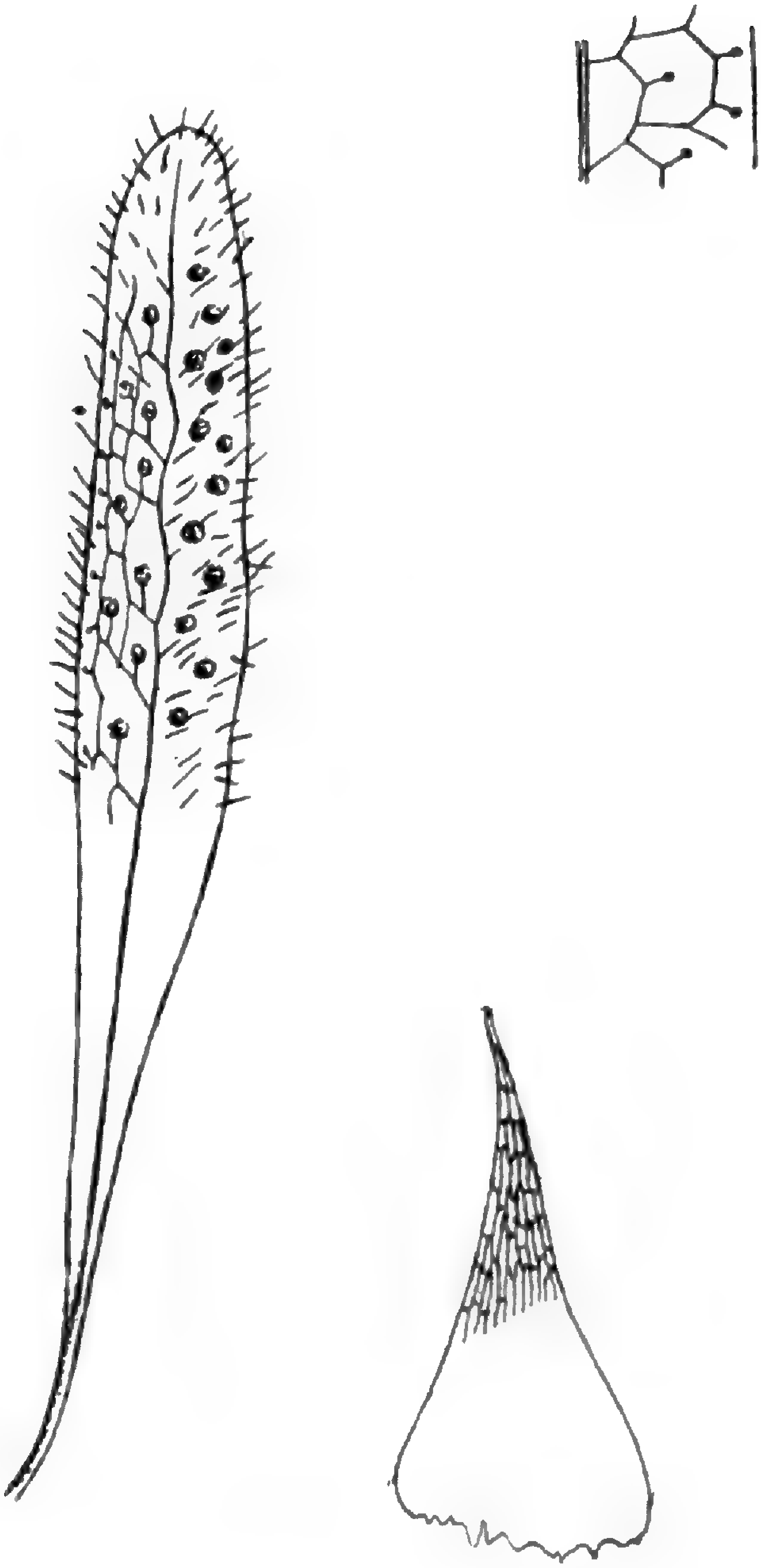
Polypodium anetioides Christ, Bull. Soc. Bot. Genève **2**: 219. 1909.

The type of the species was collected in Costa Rica by A. C. Brade (no. 177) at—"Candelaria-Geb. unterhalb des Weissen Steines um 1450 m., feuchte bemooste Steinwand."

In the original description, Christ said of this fern—"Espèce très originale méritent un groupe à part par le manque de nervures latérales prononcées," and "Il est difficile à attribuer cette espèce à l'apparance rudimentaire, à un groupe déterminé."

I have not found it easy to assign this fern to a family. At first sight it reminded me of *Glyphotaenium*, but the shape of the spores and the articulate hairs make it almost impossible to ascribe it to the Grammitidaceae. The second guess was to agree with Christ and place it in the Polypodiaceae, with which it agrees in shape of spores, but the articulate hairs and non-articulate stipes are objections to this treatment. The rather appropriate specific name might suggest a real affinity (with *Anetium*), but the Vittariaceae do not have hairy fronds, and moreover our plant is without the idioblasts of that family.

There remains the great family Aspidiaceae, with



HYALOTRICHA ANETIOIDES

reniform spores. The plants of this family are typically terrestrial, as in *Hyalotricha,* which grows on rocks, and with non-articulate stipes. *Hyalotricha* is a small fern and is presumably reduced in stature from its ancestors. Loss of size is commonly correlated with simplification of structure, so that the venation of *Hyalotricha* might be derived from that of *Tectaria.* The hairs, which bar its assignment to the other families considered, are like those of *Ctenitis* and its many derivatives. The evidence points clearly to Aspidiaceae as the proper family of *Hyalotricha.* I have been unable to detect an indusium, but one may be present on younger fronds than I have; and no few Aspidiaceae are exindusiate.

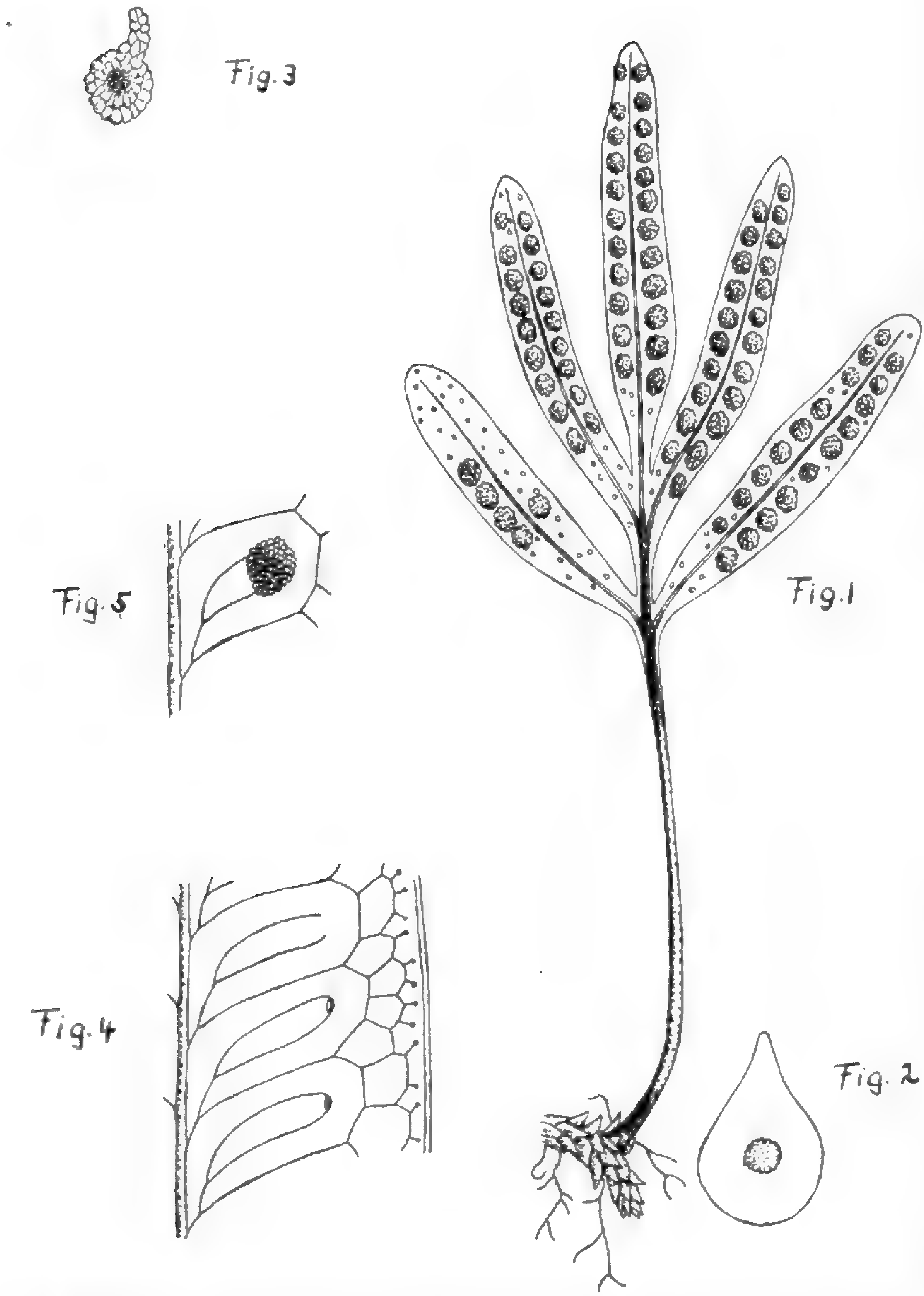
I have for study a good isotype of *H. anetioides,* and a collection from Panama (*Killip* 5013). A number of other collections are in the U. S. National Herbarium, but I have been unable to consult them as they are out on loan.

Microgramma **Munchii** (Christ) Copel. comb. nov. (*Pl. 2*).

Polypodium Munchii Christ, Bull. Herb. Boiss. II. **3**: 147. 1903.

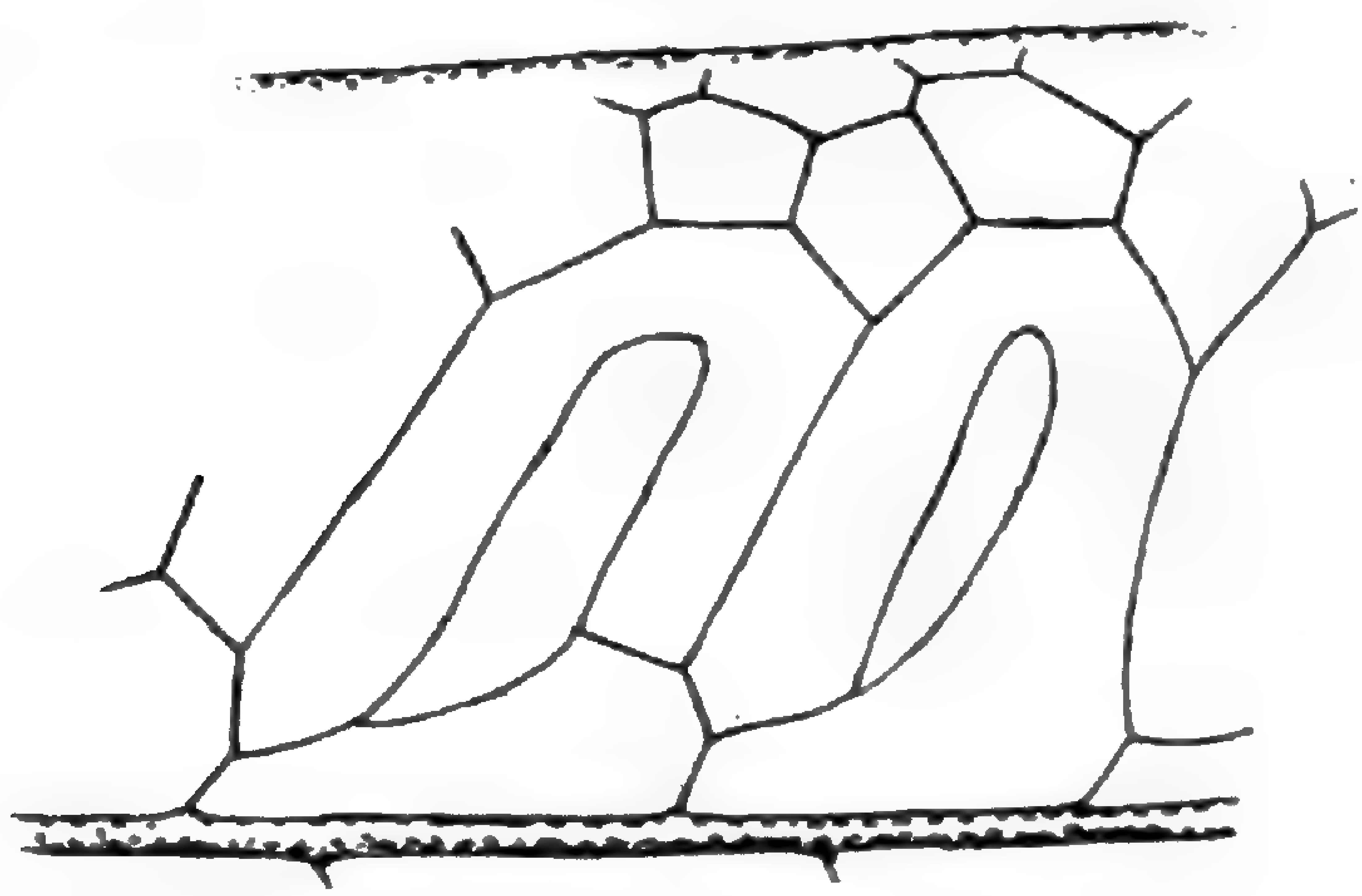
The material that I have studied was collected at the summit of Las Esmeraldas, Costa Rica, at an elevation of 9000 feet, by John Tucker, a former student at the University of California. It was identified by C. V. Morton as *Polypodium Munchii,* the type of which came from the vicinity of San Cristobal, Chiapas, Mexico (*Munch* 90).

This is clearly not a *Polypodium,* as I now restrict the application of that name. Christ compared it with *P. angustum* (H. & B. ex Willd.) Mett., calling it "une-sous-espèce de ce type isolé." *Polypodium angustum* is the type species of *Pleopeltis,* and the only species of



MICROGRAMMA MUNCHII: 1. FROND, NAT. SIZE; 2. PALEA OF RHIZOME (BROADER THAN USUAL), $\times 10$; 3. PALEA OF BLADE, $\times 50$; 4. VENATION, $\times 5$; 5. SORUS, $\times 5$.

that genus with approximately compound fronds, but the segments are dilated at base, and adnate and confluent, and so never become really pinnae. Those of *P. Munchii* are narrowed to the base, the lowest becoming pinnae.



VENATION OF PHLEBODIUM AUREUM

The most characteristic feature of *P. Munchii* is the venation. The primary veins fork near the base, and the major basiscopic veinlets branch again, $\frac{2}{3}$ or $\frac{3}{4}$ of the way to the margin. The divaricate branches bend and anastomose to form one series of major areoles comprising the larger part of the area of the frond. Outside the series of major areoles is a longitudinal series of minor areoles without included veinlets, and outside of these are short veinlets running almost to the margins.

The acroscopic veinlet of each primary vein runs into the major areole and forks not far above its base, its two branches running parallel to the sides of the areole and usually curving together and reuniting so as to enclose one elongate minor areole within each major areole. A sorus may be formed at or near the apex of each enclosed minor areole. In age, the sori become very large and almost cover the inferior surface of the frond. Perhaps because our material is limited, the pattern of venation seems to be very uniform.

In this group of genera and species (*Pleopeltis* and American relatives) there is usually a row of small areoles along the costa, each extending from one main vein to its neighbor. If major areoles are present, one is adjacent to each costal areole, and each major areole contains one sorus. This pattern is the rule in *Phlebodium,* as illustrated in the areole at the left in the accompanying text figure.[1] Its instability is illustrated by the adjoining areole at the right, which shows the pattern typical of *P. Munchii.* Presl might have regarded the difference between these details as generically significant, but their usual instability makes this hardly practicable. Every feature of our plant except the compound fronds indicates affinity with *Microgramma,* rather than to any other genus.

UNIVERSITY OF CALIFORNIA, BERKELEY, CALIFORNIA

Recent Fern Literature

The newest state fern flora is devoted to Michigan.[2] In the foreword it is recorded that Mr. Billington had prepared much of the manuscript, then laid it aside to await the appearance of the 8th edition of Gray's Manual. He died, however, before this came out, and the taxonomy and nomenclature were aligned with that work by Dr. Stanley A. Cain, who also prepared distribution maps of the taxa. If the publication could only have been delayed two years longer, advantage could

[1] See also, Mettenius, Fil. Lips. *pl. XXV, fig. 2.* 1856.

[2] Ferns of Michigan. Cecil Billington. Cranbrook Institute of Science (Bloomfield Hills). Bull. 32. Pp. 1–240. Pl. 1–16. Figs. 1–79. 1952. $5.00.

have been taken also of the treatment in the 3rd edition of Britton & Brown's Illustrated Flora. There might then have resulted more realistic arrangements of some groups, such as those of *Equisetum hyemale, Dryopteris spinulosa,* and the marsh and beech ferns, which are really unrelated to *Dryopteris.*

Since far more users of such a work identify specimens by comparison with pictures rather than laboriously working through keys, authors should make special efforts to have their illustrations accurate both as to features and names. The Ferns of Michigan is on the whole satisfactory in these respects. Plates 1 to 8 consist of magnificent enlargements of fertile portions of fronds by Charles Neidorf—too bad that such views could not have been published for all the taxa! Plate 9 is a good habitat view of "Trailing Christmas Green," but it is labelled *Lycopodium complanatum*, whereas it represents the dissimilar taxon *flabelliforme.* Other habitat views are fair. Ten pages are devoted to a novel and instructive "Pictorial Glossary"; on page 64 the drawing labelled "tripinnate" should be termed "ternate."

Most of the drawings of individual taxa are adequate, and only the following would call for replacement should there be a second printing: That of *Lycopodium inundatum* is enlarged and that of *L. obscurum* reduced so much that they will mislead the beginner. The figure labelled *L. complanatum* has most of the features of taxon *flabelliforme* (whether this is a species, subspecies, or variety is immaterial—the two do differ markedly). The indusium ascribed to *Cystopteris fragilis* is not like that of any representative of this taxon listed in the text. The frond on page 168 is not that of taxon *spinulosa* as labelled, but of taxon *intermedia* (again what category is favored for these makes no difference, but the fronds themselves are dissimilar). And the frond of *Asplenium viride* is too large in comparison with *A. trichomanes.*

Dr. Cain's distribution maps will prove of interest to all plant-geographers. One curious point they bring out is the way in which several taxa of generally southern range seem to skip the lower counties of Michigan, and turn up in the uppermost ones. While this behavior is known in other states bordering the Great Lakes, in at least one case there is some doubt as to the authenticity of the record. Some 15 years ago Mr. Arthur N. Leeds joined the writer on a visit to Mr. Oliver A. Farwell, who had retired and was living at Lake Linden, in Keweenaw County. He showed us his specimens of the several disjunct taxa, but was unable to furnish us definite directions for seeking them out for ourselves. We particularly wished to see the otherwise Appalachian *Asplenium montanum.* But Mr. Farwell related how he had gone to "The Cliff" to collect some Woodsias to send to a correspondent, and placed the specimens of these in a vasculum for the trip home. The next day, when he lifted the material out, behold, mingled with the Woodsias were some fronds of *Asplenium montanum.* And he never was able to relocate his exact collecting spot. One can not help wondering whether the *Asplenium* may not have been received from an eastern collector, and had been lying in the vasculum into which the Michigan ferns were placed.—EDGAR T. WHERRY.

American Fern Society

Report of the President for 1952

Of all the years of my membership, dating back to 1905, and including the several years involved in planning and launching the Fern Journal, 1952 stands out as my busiest year in Society work. The activities have not been different in kind from those of earlier years; there have just been more of them, particularly of some types, such as letter writing. Through all these years, intermittently, there have been field meetings, conferences, and fern study, in field and garden, in books and herbarium, alone and with others.

The latter aspect, the study and enjoyment of fern study *with others* stands as the underlying basis of the success of the Fern Society. Dr. Waters, one of our two remaining Charter Members (Miss Elmira E. Noyes, of Norfolk, Va. is the other), has written of the bonds of interest which held together the initial small group of the Society from its beginning in 1893; its meetings and correspondence, and the little germ of a publication which later developed into the Fern Bulletin. When the Bulletin editor, Willard N. Clute, as it approached its twentieth volume, began to feel that fern study had passed its zenith, a cooperative effort among Society members was responsible for starting the American Fern Journal, now well beyond its fortieth volume and going stronger than ever.

From about two hundred members in 1910, when the first Journal issues appeared, the Society is now pressing toward five hundred and enlisting new members at the rate of fifty or more each year. Its annual growth is steady, although not as spectacular as such annual increments might lead one to expect. As a matter of fact, the disparity between actual growth rate and the number of yearly additions presents a problem which I should like to pass on to the membership at large.

The American Fern Society, one of the oldest of American botanical societies, has achieved an international standing and membership. The Fern Journal circulation, to members and subscribing institutions, is more than six hundred per issue. We can be proud of the growth of the Society and of the success of the Journal. The pages of the latter present a diversity of reading matter, ranging from the most technical to the most elementary, a range that parallels the training and experience of the Society membership.

But in its growth in size and recognition, the Society and its Journal have lost some of the intimacy and informality which were characteristic of the earlier years. The officers and older members are still hospitable to enquiries for help and information from beginning members, but their numbers have declined greatly in proportion to the membership. Although annual meetings are scheduled with considerable regularity, in connection with the annual convocations of scientific societies, such meetings can mean little to the great majority of Society members.

In line with the problems just indicated, two suggestions are offered, intended to increase the value of the Society to members who may be starting fern study, and to restore and extend the atmosphere of friendliness and acquaintance which the increase in membership roll has tended to diminish. The first suggestion follows some correspondence on my part and is summarized in a preliminary list of members in different parts of the country to whom members are urged to submit problems relating to the identification of specimens. The list is given in the pages devoted to Fern Society notes. As part of this same program is the request made in an earlier number that members with fern gardens register their names with Dr. Sharpe, of Uxbridge, Mass. From this it is hoped to be able to assemble a list of centers of information for the benefit of fern gardeners.

The second suggestion was first made by our Treasurer, Mr. Mann, in Journal no. 4, for 1951, and was seconded by Joseph Ewan, as retiring President, in no. 1

of 1952. It calls for the activation of local regional groups for meetings, visits to gardens, field trips, and the development of the kind of local personal relationships which were feasible for the Society when it was much smaller. The New Jersey group, under Mr. Mann's leadership, has for some time had a successful program of promoting interest in any nearby fern meeting for the north Jersey members. An informal committee has taken the initiative in notifying members by postcard and telephone just before the meeting.

As a follow-up of the same method, in an adjoining area, three regional meetings were scheduled for the eastern New York and western New England area. Their successful accomplishment and the hosts and leaders involved, have been recorded in accounts in the Fern Journal. I want here to report the real contributions toward their success on the part of a special "area committee" which carried out its own notification of nearby members by postcard and other communications. Grateful acknowledgment is given to this committee: Mr. William S. Johnston, Mrs. Elsie G. Whitney, Mr. Walter S. Allen, and Dr. Elva Lawton.

During 1953, I hope other centers of local activity may arise—note the proposed Michigan–Wisconsin fern tour program already announced. No matter how small the group, the sharing of fern interests will add to the enjoyment of fern study. I shall be glad to hear from any potential committee members who may be ready to volunteer for their areas. Mr. Mann, the Treasurer, stands ready to send any enquirer a list of those members who reside within fair range of any given address.

. . . . . .

Suggested readings: Two fields of reading in fern literature may be mentioned:

(1). For beginners, and also for advanced students, especially in fern classification, the forty-odd earlier volumes of the Fern Journal, and also the twenty volumes of the preceding Fern Bulletin, contain a store of interesting and significant information. Members are reminded that the back volumes of both these magazines, together with an extensive list of other fern titles, are available for loan from the Library of the Fern Society. Application should be made to Dr. R. M. Tryon, Jr., Librarian and Curator of the Fern Society Herbarium, Missouri Botanical Garden, St. Louis, Mo. Back volumes of the Fern Journal are also available for sale.

(2). "Problems of Cytology and Evolution in the Pteridophyta" by Irene Manton. This has already been well reviewed by Dr. Wagner but its significance for American fern study is so great that this further note is added. Based almost entirely on material of species native in Great Britain or in Europe, its technical analyses of their cytology and indicated phylogeny shed little direct light on American species, even those identified under the same names. But the results achieved for the European material set a challenge for the application of similarly intensive methods to specimens collected in this country. Miss Manton's volume presents the equivalent of not a few graduate doctors' theses in the study of British ferns. With her work as a milestone, American material offers opportunity for an even more extensive series of master's and doctor's dissertations. Particularly is this true of genera like *Dryopteris*, in which different interpretations regarding species delimitation and hybrid types obtain. Another interesting case is *Polypodium vulgare;* European plants show recognizable vegetative differences which accompany diploid, tetraploid, and hexaploid chromosome numbers.

Respectfully submitted,
RALPH C. BENEDICT, *President*

Report of the Secretary for 1952

The annual meeting of the Society was held with the American Institute of Biological Sciences on the campus of Cornell University. A luncheon in the Kimball Room of Willard Straight Hall at noon on Wednesday, September 10, was attended by 26 members. Following the luncheon contributed papers were presented in Savage Hall. The first paper, by Miss Elizabeth A. Valentine of Philadelphia, was an account of investigations of different types of prothallia in several species of climbing-ferns, in particular *Lygodium microstachyum*. Descriptions of the young sporophytes of these plants, as well as the techniques the speaker used in her work, were also presented in this interesting report. An unusual Hawaiian spleenwort was then described by the writer, a fern which shows a remarkable resemblance to the fern genus *Diellia* in a number of respects, and which suggests a prototype of the latter genus.

Prof. W. N. Steil, of Marquette University gave a detailed review of the methods of reproduction in ferns, a subject of general interest to all students of ferns. He showed in a series of projection slides a wide diversity of types of reproduction, including origin of new plants by stems, tubers, roots, leaves, and bulblets in different species. Dr. James N. Soper of the University of Toronto followed Dr. Steil's paper with an unusually fine report on the distribution of the Hart's tongue and other ferns of Ontario, showing in particular their distributional relationship with the Niagara Escarpment. The photographs and distribution maps for the species discussed were of excellent quality. Dr. Marcel Raymond's talk which came next added further variety to the program by taking up the nomenclatural problem of the familiar plant of eastern North America, "*Selaginella apus, apoda,* or *apodum?*" Mr. Conrad

Morton then spoke on the Fern Society excursion which preceded the meetings, and this was followed by the final paper, presented by Prof. Robert C. Clausen on the ferns of the Cayuga Region. Prof. Clausen, a former President of the Society, managed this year's activities on the Cornell campus. Mr. Morton rose at the end of his paper to express the thanks of the Society to Prof. Clausen for his efficient arrangement of the Society program. The meeting, which lasted until 5:30, was attended during its course by over sixty persons.

On the following day Prof. Clausen led a group of 19 on a field trip in the vicinity of Ithaca, a report of which appears elsewhere in this issue of the Journal. I should also mention two unique field trips for A.I.B.S. visitors led by Prof. L. C. Petry for the collecting of *Lycopodium* gametophytes—an unusual opportunity indeed. Your Secretary obtained ten fine specimens under Prof. Petry's guidance, on the second of the trips carried out for this purpose.

The year 1952 has been unusually good for the membership of the Fern Society. Our Treasurer, Mr. Mann, should receive much credit for the present condition of our membership, which reached 490 at the end of 1952. We deeply regret the deaths of three of our members during the year: Mr. Charles L. Cass, of San Diego, California, who became a member only a year ago; Prof. S. H. Derickson, of Lebanon Valley College, who joined in 1935; and Mr. Hubert H. Brown, of Toronto, Canada, who became a member in 1926.

The plans for a Fern Society foray across northern Michigan in early September are beginning to take definite form, and will include visits to a number of unusual localities. The completed plans will be reported in detail in the second issue of the JOURNAL. We look forward to a good foray, a worthwhile and instructive session with the A.I.B.S. at Madison, as well as some interesting trips from the University of Wisconsin at the time of the meetings.

Respectfully submitted,
WARREN H. WAGNER, JR., *Secretary*

Report of the Treasurer for 1952

Two items have largely contributed to another successful year, first, the generous response of the sustaining members, and, second, our increased membership. Our list of subscribers continues to grow, but at a slower rate. We now have 129 colleges, libraries, museums, and other institutions in this country and 29 foreign subscribers, from Argentina, Belgium, Brazil, Canada, England, France, Holland, Indonesia, Jamaica, Mexico, Russia, Switzerland, and Sweden.

The sale of excess library books is a very real source of revenue to the Society. If all members would make sure that when they wander off to greener fields all the fern books in their libraries would go to the Society, it would serve two purposes: First, it would mean additional revenue to the Society, and, second, it would keep the books in circulation among the members. Some of the older books are hard to find these days.

Last fall Mr. Morton made an inventory of back numbers in stock. As of November 1st, we had on hand 17,240 numbers, back to volume 1. These have been given a nominal value of 20 cents each, and, in the future, the inventory value will be established by adding the actual cost of all additions to our stock and deducting total shipments from stock calculated at the average value of the inventory. Incidentally, there are only a few more complete sets of back numbers available, so anyone interested should act promptly.

No withdrawals have been made from the two special accounts or from the reserve fund.

We had gifts during the year of $115.00, of which $100.00 was from Mrs. C. A. Weatherby to help defray the cost of publication of her article on the common names of ferns, which appeared in No. 4, Vol. 42. The $15.00 was anonymous.

Receipts	*Amount*	*Total*
Cash on hand, January 1, 1952		$1,184.77
1951 membership arrears	$ 8.00	
1952 membership renewals	575.06	
1952 sustaining members	235.00	
1952 new members	83.00	
1953 membership renewals	16.00	
1953 new members	60.35	
1954 membership renewals	2.50	
1952 subscription renewals	109.90	
1953 subscription renewals	224.30	
1954 subscription renewals	2.00	
Sale of back numbers	146.77	
Sale of reprints	105.02	
Sale of surplus library books	61.53	
Sale of Vars. & Forms, Index, etc.	2.55	
1952 advertising	20.00	
Fern trip registration fees	19.00	
Gifts	115.00	
		1,785.98
		$2,970.75

Disbursements	*Amount*	*Total*
A. F. J. Vol. 41, No. 4	$330.38	
A. F. J. Vol. 42, No. 1	312.74	
A. F. J. Vol. 42, No. 2	339.92	
A. F. J. Vol. 42, No. 3	297.77	
2,500 printed envelopes	38.00	
Reprints	116.45	
Expenses		
President	15.75	
Secretary	30.53	
Treasurer	73.71	
Editor	17.76	
Curator of Herbarium	—	
		$1,573.01
Cash on hand, January 1, 1953		$1,397.74

STATEMENT DECEMBER 31, 1952

Assets

	Amount
Cash on hand	$1,397.74
Bissell Herbarium Bequest	570.48
Life Membership Fund	586.69
Reserve Fund	1,561.40
Inventory A. F. J.	3,448.60
A. F. S. Library	300.00
	$7,864.91

Liabilities

	Amount
Capital Account	$5,877.77
Suspense credit	
1953 memberships	76.35
1954 memberships	2.50
1953 subscriptions	224.30
1954 subscriptions	2.00
Distribution Vol. 42, No. 4	524.82
Bissell Herbarium Fund	570.48
Life Membership Fund	586.69
	$7,864.91

Respectfully submitted,
M. D. MANN, *Treasurer*

Report of the Auditing Committee

We hereby certify that we have seen the books and accounts of the Treasurer, Mr. M. D. Mann, Jr., and have obtained from the banks confirmation of the correctness of the Society's balances, which they are respectively holding, as set forth in detail in the accompanying report of the treasurer.

CHARLES NEIDORF,
ELINORE S. VAN DE WATER,
CLARENCE M. VAN DE WATER,
Auditing Committee

Report of the Judge of Elections

In the recent balloting for officers of the American Fern Society for 1953, 161 ballots were returned, of which three were blank. The results were as follows:

For President	
R. C. Benedict	157
C. V. Morton	1
For Vice-President	
Donovan S. Correll	158
For Secretary	
Warren H. Wagner, Jr.	158
For Treasurer	
M. D. Mann, Jr.	158

I therefore declare the following candidates elected to the several offices: President, R. C. Benedict; Vice-President, Donovan S. Correll; Secretary, Warren H. Wagner, Jr.; Treasurer, M. D. Mann, Jr.

Respectfully submitted,
DALE J. HAGENAH, *Judge of Elections*

Report of the Librarian and Curator for 1952

The sale of surplus books from the Library has continued successfully, amounting to $61.53 this past year. Although the stock of salable duplicates was nearly exhausted, it has been augmented by a substantial gift from Mrs. M. F. Somerville. It is hoped that the Library may continue to sell duplicates received from the members. The gift of such books has represented an important source of income to the Society—the total sales from donated books now amounts to nearly $300.00—and the donor may have the further satisfaction that the books are sold at a reasonable price and to those who will make use of them.

A request was received for a loan of kodachromes of ferns which I was unable to meet since we do not have such a collection. From time to time requests for material to illustrate talks on ferns have come to me and I think if the Society had a series of slides there would be a demand for them. This would be an effective way by which the Society could stimulate interest in fern-study. Such a collection can be started if members will send in their duplicate or unneeded fern kodachromes.

A considerable amount of recently mounted material has been incorporated into the Herbarium through the generosity of Mr. W. E. Liggett, who has donated his time to this work.

Respectfully submitted,
ROLLA M. TRYON, *Curator and Librarian*

THE SUMMER FIELD TRIP.—The field trip of the American Fern Society that was announced in the Journal earlier in the year began in Woodstock, Vermont, on the evening of Labor Day, September 1. There were 17 members and guests present on this first evening—Dr. and Mrs. Benjamin R. Allison, R. C. Bastress, Dr. R. C. Benedict, Mrs. Kathryn Boydston, Mrs. Hilda Castle, Walter Castle, R. A. Doray, Dr. and Mrs. Arthur W. Doubleday, C. V. Morton, Mr. and Mrs. M. D. Mann, Jr., Charles Neidorf, Harold Rugg, Miss Hester M. Rusk, and Dr. Henry K. Svenson. The evening was spent at the home of Dr. Doubleday. Mrs. Doubleday is an enthusiastic fern student and the members present were interested in inspecting her excellent herbarium of Vermont ferns, which includes a specimen that Mr. Weatherby had termed "the most nearly typical specimen of *Botrychium Lunaria* known from Vermont."

The next morning the party proceeded, under the direction of Mr. Rugg, to one of the few known localities in Vermont for the male fern (*Dryopteris Filix-mas*). This station is near Bridgewater. The plants are growing along a country roadside in a region only sparingly under cultivation; although apparently limited to a very small area they are not in danger of immediate extermination; they would be hard to locate even with rather specific directions. This species is known from a few other scattered stations in Vermont and one in Maine, but is not known elsewhere in the eastern United States.

In the afternoon we were invited to inspect the garden of Mr. Rugg, in Hanover, New Hampshire. This was indeed a pleasure. Mr. Rugg has over an acre under cultivation. Although there are many beautiful flowering plants in the garden, it is evident that Mr. Rugg's special interest is in the ferns, which have been carefully tended and provided with ideal growing conditions. One of the outstanding plants is one of two known specimens of the natural hybrid × *Osmunda Ruggii* Tryon (*O. Claytoniana* × *regalis*). Mr. Rugg told us that some marauder (evidently well-informed) had attempted to steal the plant and had taken most of it; fortunately, enough of the rootstock was left so that the plant has recovered and is now in a flourishing condition. However, it is not reproducing itself.

Mr. Rugg has in his garden most of the native species of true ferns of the eastern United States and also many exotic species. He has kindly supplied me with a list of some of the more interesting ones—*Osmunda Claytoniana* f. *Mackiana* and f. *dubia*, *Osmunda regalis* f. *orbiculata* (an exceedingly strange dwarf form with round segments), *Blechnum spicant*, *Blechnum penna-marina* (from New Zealand), lady-ferns in many forms, mostly of English origin, *Phegopteris Robertiana*, *Phegopteris Dryopteris* f. *plumosa* (from England), *Polypodium virginianum* f. *cambricoides*, *Dryopteris Thelypteris* f. *Pufferae*, *D. erythrosora* (from Japan), × *D. Leedsii*, *D. noveboracensis* f. *cristata*, *D. nevadensis*, × *D. celsa*, several crested and divided forms of *Polystichum acrostichoides*, and also *P. angulare*, *P. lobatum*, *P. Andersonii*, and *P. munitum*, *Adiantum pedatum* var. *aleuticum*, *Cryptogramma acrostichoides*, *Cryptogramma*

(*Pellaea*) *densa, Adiantum venustum* (from Asia), *A. Capillus-veneris, Cyrtomium falcatum, Asplenium Adiantum-nigrum,* and *Athyrium Goeringianum* and its f. *pictum.*

The party returned to Woodstock, where we were joined by Miss Alice Bristow and Miss Helen Bristow; these young ladies were primarily interested in ornithology, but our field trip turned them from bird-watchers into fern-watchers; they are now new members of the Fern Society. We proceeded in the afternoon north to Stowe, by way of the Randolph Gulf, stopping at various places where Mr. Rugg had found interesting ferns. Vermont is surely a fern-lover's paradise. The roadsides in many places are banked with ferns. Among the species that we saw on this first day were: *Adiantum pedatum* (abundant everywhere), *Athyrium Filix-femina* var. *Michauxii* (*A. angustum*), *A. pycnocarpon* (abundant in one locality), *A. thelypteroides, Botrychium virginianum, Dennstaedtia punctilobula, Dryopteris Clintoniana, D. Goldiana, D. intermedia, D. spinulosa, D. marginalis, Thelypteris noveboracensis, T. Phegopteris, Equisetum arvense, E. silvaticum, Lycopodium clavatum, L. complanatum* var. *flabelliforme, L. lucidulum, L. obscurum, Matteuccia Struthiopteris* var. *pennsylvanica, Onoclea sensibilis, Osmunda cinnamomea, O. Claytoniana, Polypodium vulgare* var. *virginianum, Polystichum acrostichoides, P. Braunii* var. *Purshii* (abundant locally) and *Pteridium aquilinum* var. *latiusculum.*

At the Green Mountain Inn, in Stowe, Vermont, where we spent the night of September 2 very comfortably, we were privileged to view in the evening the amazingly beautiful photographic enlargements of ferns made by Charles Neidorf; some of these photographs will appear in future numbers of the Journal. We also enjoyed looking over the fern herbarium of Mr. Doray, which he

Left to Right: Smith, Mann, Mitchell, Boydston, Svenson, Alice Bristow, Doray, Rusk, Mrs. Mann, Helen Bristow, Rugg, Bastress, Castle, Neidorf; Foreground: Morton, Marion Smith. Smuggler's Notch, September 3, 1952.

had brought along for our inspection. Mr. Doray has recently very graciously presented this herbarium to the Smithsonian Institution.

On the morning of September 3 we started out for Smuggler's Notch in a drizzling rain, the only bad weather that we had during the entire trip. The intermittent rain did not spoil the day at all, and may even have added to the spectacular appearance of the Notch. The swirling mists made the precipitous sides of this mountain pass seem to rise for thousands of feet. At the Notch we were joined by Mr. James Mitchell, Mr. and Mrs. Ernest Smith and Miss Marion Smith. Here at the Notch we saw the three chief rarities of the region.—*Dryopteris fragrans, Asplenium viride,* and *Woodsia alpina.* Many other ferns were abundant, including *Cystopteris fragilis* var. *Mackayi, Dryopteris dilatata, Gymnocarpium Dryopteris* (*Dryopteris disjuncta*), and *Lycopodium Selago* var. *patens.* Near the watchman's house in the Notch, Harold Thomas had planted a number of ferns that perhaps did not come from the immediate vicinity, including *Camptosorus rhizophyllus, Botrychium lanceolatum* var. *angustisegmentum, B. matricariifolium, B. dissectum* and *B. dissectum* var. *obliquum.*

We proceeded that afternoon to Burlington, on Lake Champlain, stopping on the way near Essex Junction to view a station for *Pellaea atropurpurea.* At this place the plants grow mostly out of reach on the rocks of a deep railway cut. We stopped also to view the fern garden of Mr. Harold Thomas, at Jeffersonville. Mr. Thomas has a plant that is thought to be *Polystichum acrostichoides* × *Braunii.* Later we paid a visit to the Gardenside Nursery, near Shelburne, where numbers of plants of different forms of the English hart's-tongue were under cultivation. We also visited a nearby place where a peculiar and perhaps unnamed undulate form of *Asplenium platyneuron* occurred. On rocks nearby we found *Asplenium Trichomanes, Camptosorus rhizo-*

phyllus, and *Woodsia obtusa*. In the evening we were entertained at the home of Miss Marion Smith, who showed her beautiful kodachrome slides of New England wild flowers and ferns. The part of the trip near Burlington was under the leadership of Mr. Doray.

On the next morning we made the rather long drive from Burlington around the south end of Lake Champlain and over to Pilot Knob, New York, on Lake George. In the afternoon we were joined by Mrs. Elizabeth Dubé, Miss Walling, and Mr. William Mann. We spent the afternoon exploring the woods on the property of Dr. Benedict at the foot of Pilot Knob. Dr. Benedict has written a short paper on the ferns of this interesting region which will appear in a later number of the JOURNAL. Among those we saw were many of those seen in Vermont, and also *Botrychium dissectum* var. *obliquum*, *B. multifidum* var. *intermedium*, *Cystopteris bulbifera*, *Thelypteris palustris*, *Equisetum hiemale*, *Onoclea sensibilis* f. *obtusilobata*, *Osmunda regalis*, *Selaginella rupestris*, and *Woodsia ilvensis*. Dr. Svenson and Mr. Neidorf showed an *Isoëtes* (probably *echinospora* var. *Braunii*) that they found in nearby Glen Lake. In the early evening we were pleased to have the chance of taking a boat ride around Lake George; later we were entertained by Dr. and Mrs. Benedict at the summer home they maintain here.

The morning of September 5 was spent in exploring some swamps near Lake George where Dr. Benedict has found hybrid *Dryopteris* at various times. *Dryopteris cristata* is common here and we found some specimens that are *D. cristata* × *marginalis* and × *D. Boottii* (*D. cristata* × *intermedia*). In the afternoon we took the long drive north through the Adirondack Mountains. We stayed the night near Wilmington and went up Whiteface Mountain, one of the higher peaks of New York, to see the sunset. We were joined here by Miss Orra

Phelps and Miss Elsie Putnam, both ardent mountain climbers, who had that day just finished their task of climbing all the some forty-six mountain peaks in New York over 4,000 feet high. Miss Phelps showed a specimen of *Cystopteris fragilis* var. *protrusa.*

The next day we proceeded leisurely on the 200-mile drive set for the day. During the morning we stopped at Quiver Pond, where Dr. Benedict had discovered Massachusetts fern (*Thelypteris simulata*) more than forty years ago. It is one of the few localities for this species in this part of New York. The plants are still there and were discovered after some search. They are prospering, apparently, in a more or less inundated section, growing with marsh-ferns, which they resemble closely by casual inspection. For lunch we stopped at a restaurant named, appropriately enough, "The Ferns." We spent the evening watching television at the Snow White Inn, near Pompey, New York, where we stayed. It was the only evening without some "botanical" diversion.

The next day we drove the short distance to the old plunge basin near Jamesville that is now Clark State Reservation, where we met a group who had assembled from Syracuse to meet us. There were Dr. Karl L. Brooks, of Albany, New York, Dr. and Mrs. Clair A. Brown, of Louisiana State College, Mrs. F. G. Dunham, a member from Ridgewood, New Jersey, Miss Ann Dunham, Dr. Mildred Faust and Miss Nettie Sadler, who organized and led the Jamesville trip, Mr. Marcel Raymond, of the Montreal Botanic Garden, Miss Dorothy Reynolds, Dr. Paul J. Sedgwick, of Syracuse University, and Mrs. A. H. Wright. This plunge basin is one of the last remaining homes of the American hart's-tongue (*Phyllitis Scolopendrium* var. *americanum*). Dr. Faust showed us that with the present protection it is enjoying the hart's-tongue is prospering. We observed

Group at Jamesville: Left to Right—Svenson, Faust, Reynolds, Brown, Sadler, Morton, Dunham, Ann Dunham, Wright, Sedgwick, Mrs. Mann, Boydston, Benedict, Alice Bristow, Rusk, Brooks, Helen Bristow, Mann, Raymond, Ryan.

thrifty plants with fronds over two feet long. Many other ferns grow in this vicinity; there was a tremendous colony of narrowleaf spleenwort and huge plants of bulblet bladder-fern. Maidenhair spleenwort (*Asplenium Trichomanes*) was abundant on the rocks.

We had lunch at Drumlins, a famous restaurant on the outskirts of Syracuse, as guests of the Department of Botany of Syracuse University. We appreciated the generous hospitality very much. Later we drove to Ithaca by a scenic route along Skaneateles Lake. The field trip officially ended that evening at Ithaca. A number of those in the party remained at Ithaca for the next few days to attend the summer meetings of the American Institute of Biological Sciences.

Altogether the trip must be accounted highly successful. It was certainly enjoyable for those who attended. There was a registration of 39 persons for all or part of the trip. We saw 52 species of ferns growing wild, many of them in magnificent condition, and a number of others in cultivation.—C. V. M.

REPORT ON THE ITHACA FIELD TRIP.—Thursday, September 10, was a warm, clear day. Nineteen persons, members of the Fern Society and friends, assembled at the south door of the Plant Science Building on the Cornell Campus at 8 A.M. The trip went as planned and included stops in the region of the headwaters of Six Mile Creek, southwest of Dryden, at Woodwardia Bog, northeast of Dryden, and the ravine of Mack Creek, on the west side of Cayuga Lake, north of Sheldrake Point. In all, twenty-eight species of ferns were observed, including five species of *Botrychium*, *Ophioglossum vulgatum*, *Dennstaedtia punctilobula*, *Woodwardia virginica*, *Athyrium pycnocarpon*, *Camptosorus rhizophyllus* and *Dryopteris goldiana*, and also five species of *Lycopodium*, as well as the supposed hybrid, *L. complanatum* ssp. *flabelliforme* × *tristachyum*. Some plants of *L. com-*

planatum ssp. *flabelliforme* had forked strobili and several exhibited the development of a proliferated vegetative axis above the strobilus.—R. T. CLAUSEN.

TENTATIVE SCHEDULE OF FIELD TRIPS DURING 1953.—The following field trips and garden meetings are under consideration. Further information may be obtained from the individuals indicated.

VIRGINIA: A visit to Dr. Paul Bartsch's fern garden on his 448 acre estate on the Potomac River about 20 miles south of Washington, D. C., to be followed possibly by a two day trip to Dismal Swamp in southeastern Virginia to study *Dryopteris celsa* and other ferns. Third or fourth week in May. Information from C. V. Morton, Smithsonian Institution, Washington 25, D. C.

NEW YORK: A visit to the fern garden of Mr. Johnston in Scarsdale. June 6. Information from William S. Johnston, 65 Morris Lane, Scarsdale, New York.

NEW JERSEY: A visit jointly with the Torrey Botanical Club, to the fern garden of our Treasurer in Roselle. June 27, at 2:30 p. m. Information from M. D. Mann, Jr., 625 Locust Street, Roselle, New Jersey.

CONNECTICUT: A visit to the Wild Life Sanctuary, Fairfield County, Connecticut. In July, date not settled. Information from Miss Helen Bristow, Silvermine Road, Norwalk, Connecticut.

NEW YORK AND QUEBEC: A five day trip, visiting Glens Falls and the Lake George region, Ausable Chasm, and the Montreal Botanical Garden and other parts of Quebec. Tentatively the third week in August. Information from R. C. Benedict, 2214 Beverly Road, Brooklyn 26, New York (Pilot Knob, New York, after June 15).

MICHIGAN AND WISCONSIN: A week's tour of the lower and upper peninsulas of Michigan, ending up in Madison, Wisconsin. August 30–Sept. 6. A mimeographed notice of the trip may be obtained from Mrs. Kay Boydston, Fernwood, Route 3, Niles, Michigan.

With the increased number of meetings and trips scheduled for the season it will be necessary to rely mostly on special cards or mimeographed notices. Additional information will be given in the Journal if received in sufficient time.—R. C. B.

WHAT IS THE NAME OF THIS FERN?—Following a suggestion in the report of the President, the editors offer below a list of individuals to whom members may refer problems in the identification of specimens. On the justifiable assumption that authorities are always willing to share their knowledge, this list has been drawn up in the main without previous correspondence with those named. It is obvious that many more members might have been included in the lists, especially in those states with a large representation in the Society. Others desiring to be listed may write the editors. We hope to supplement this first list, so that eventually every state will have at least one member available for consultation.

One caution should be observed—it is rarely desirable to try and give a definite identification from a description, or even from a photograph. Representative leaves, mature enough to be fruiting, if possible, should be collected and dried under pressure. Before mailing for identification, a label should be prepared giving date and place of collection and name of collector, and any other significant data as to habitat, abundance, and so forth. If the return of the specimen is desired, return postage and a packaging suitable for a return trip should be prepared.

This list has been prepared as part of an attempt to make membership in the Society more personal, and especially to identify for new members specific sources of help in one phase of fern study. It may be mentioned also in this connection that the pages of the Journal are always open to members who wish to acquire or dispose of living plants, spores, dried specimens, or fern books.

FERNS AND FERN ALLIES IN GENERAL

Robert T. Clausen, Department of Botany, Cornell University, Ithaca, New York: Eastern and southern United States; Ophioglossaceae

E. B. Copeland, Department of Botany, University of California, Berkeley, California: Asian, Malaysian, and Polynesian areas

C. V. Morton, Smithsonian Institution, Washington 25, D. C.: All geographic areas

Nicholas Polunin, Gray Herbarium of Harvard University, Cambridge 38, Massachusetts: Arctic ferns

Marcel Raymond, Montreal Botanical Garden, 4101 est rue Sherbrooke, Montreal, Canada: Canadian and arctic ferns

Rolla M. Tryon, Jr., Missouri Botanical Garden, St. Louis, Missouri: All geographic areas

Edgar T. Wherry, Department of Botany, University of Pennsylcania, Philadelphia, Pennsylvania: Eastern United States

BY STATES

Maine: Mrs. E. C. Ogden, 175 Adams Street, Delmar, New York

New Hampshire and Vermont: Harold Rugg, Dartmouth College, Hanover, New Hampshire.

New York: Stanley J. Smith, New York State Museum, Albany, New York

Pennsylvania: O. E. Jennings, Carnegie Museum, Pittsburgh, Pennsylvania

Delaware and Maryland: Clyde F. Reed, 10105 Harford Road, Baltimore 34, Maryland

Virginia: A. B. Massey, Virginia Polytechnic Institute, Blacksburg, Virginia

West Virginia: Maurice Brooks, Department of Forestry, West Virginia University, Morgantown, West Virginia

North Carolina: H. L. Blomquist, Department of Botany, Duke University, Durham, North Carolina

South Carolina: Dr. Velma D. Matthews, Coker College, Hartsville, South Carolina

Georgia: Wilbur H. Duncan, Department of Botany, University of Georgia, Athens, Georgia

Michigan: W. H. Wagner, Jr., Department of Botany, University of Michigan, Ann Arbor, Michigan. (Also Hawaiian Islands)

Wisconsin: Douglas Dunlop, University of Wisconsin, Milwaukee 3, Wisconsin

Minnesota: John Moore, Department of Botany, University of Minnesota, Minneapolis, Minnesota

Indiana: C. C. Deam, Route 3, Bluffton, Indiana

Illinois: George Neville Jones, Department of Botany, University of Illinois, Urbana, Illinois

Kentucky: Thomas N. McCoy, Todd County High School, Elkton, Kentucky

Tennessee: Jesse M. Shaver, Peabody College, Nashville, Tennessee

Louisiana: Clair A. Brown, Department of Botany, Louisiana State College, Baton Rouge, Louisiana

Nebraska: William F. Rapp, Crete, Nebraska

Missouri: Ernest J. Palmer, Webb City, Missouri

Arkansas: Dwight Moore, Department of Botany, University of Arkansas, Fayetteville, Arkansas

Nebraska: Ronald L. McGregor, Department of Botany, University of Kansas, Lawrence, Kansas

Texas: Donovan S. Correll, Mount Pisgah Road, Avenel, Silver Spring, Maryland

New Mexico: Sister Teresita Kittell, Holy Family College, Manitowoc, Wisconsin

Arizona: Walter S. Phillips, Department of Botany, University of Arizona, Tuscon, Arizona

Colorado: Joseph Ewan, Department of Botany, Tulane University, New Orleans, Louisiana

Utah and Idaho: Seville Flowers, Department of Botany, University of Utah, Salt Lake City, Utah

Pacific States: Ira L. Wiggins, Dudley Herbarium, Stanford University, California; also, Joseph Ewan, Department of Botany, Tulane University, New Orleans, Louisiana

British Columbia: T. M. C. Taylor, Department of Botany, University of British Columbia, Vancouver, B. C., Canada

For identification of specimens from states not specifically mentioned above enquiries may be addressed to members from adjacent states or to the members listed at the beginning of this article as interested in ferns in general.—R. C. B. and C. V. M.

SPECIMENS DESIRED.—Mr. A. H. G. Alston, British Museum (Natural History), Cromwell Road, London S. W. 7, England, desires living material of *Osmunda regalis, Dryopteris Filix-mas, Cystopteris* hybrids, *Polystichum Braunii* var. *Purshii, Dryopteris spinulosa* from Greenland, and *Azolla caroliniana.* He would like also dried specimens of *Dryopteris spinulosa* var. *fructuosa.*

CALL FOR PAPERS.—Dr. Herbert M. Clarke, Biology Building, University of Wisconsin, Madison, Wis., asks for titles of papers that members will deliver at the Fern Society meeting this September.

SUMMER FERN STUDY.—Some of our members may be interested in knowing that the University of Michigan is going to offer a special course in pteridophytes (taught by our Secretary Dr. W. H. Wagner, Jr.). This will be given at the Biological Station on the shores of Lake Douglas. This region of the northern Lower Peninsula is rich in lycopods, horsetails, moonworts, and ferns. Gametophytes of a number of genera can be found and also hybrids of various sorts. Among the interesting plants of the region are *Botrychium minganense, Equisetum litorale, E. Jesupii, Selaginella selaginoides, Dryopteris pittsfordensis,* and *Cystopteris Dickieana.*

The following communication from one of our European members to our Treasurer may be of interest.

Phs. Van Ommeren (Hamburg) G. M. B. H.
Raboisen 40
Hamburg 1, Germany
October 6, 1951

Mr. M. D. Mann, Jr., Esq.
Treasurer, American Fern Society
625 Locust Street
Roselle, New Jersey

Dear Mr. Mann:

Having had the pleasure of reading the American Fern Journal for more than three years, I should like to express my gratitude to have been able to enter the ranks of the Fern Society. In this connection I would also like to mention my sister, Mrs. de Joncheere-Heiden, who has been faithfully paying my subscription, which owing to currency regulations I am unable to do.

I must also say that I feel a bit guilty towards your Society, as, when entering as a member, I received a very nice letter from Mr. Allen, your predecessor, to my sister in which I was asked to write a small article on my time in the Japanese Prisoner of War camp in connection with fern collecting. As up until now I was always too lazy or busy or both, I have never written a syllable, but as this is a load on my mind, I am really intending on this Sunday afternoon to get things over.

Before I start I must rectify one misunderstanding: I did not become interested in ferns when a P. O. W., but started fern collecting when in the Netherlands Indies as a civilian, when I was employed by one of the large shipping companies "out East" for nearly fifteen years. I used to go to the port of Batavia, and—having been a rather keen botanist nearly all my life—I was quite astonished at seeing the mangrove-ferns (*Acrostichum aureum* and *Stenochlaena palustris*) growing in profusion in an environment where the European ferns I knew could never exist.

After that I became interested and as soon as the Java fern flora (of Backer and Posthumus) was published, I started collecting in the mountains, and became even more enthusiastic when I saw the indescribable profusion and variety of tropical ferns in one of their optimum environments—the Malaysian primary rain-forest. To give an example, quite near our weekend house on one of the volcanos of eastern Java was a small ravine about 200 yards long and not more than a few yards wide; this was almost covered with ferns and I collected over 40 species in a short time one Sunday morning. *Egenolfia bipinnatifida* was the gem of this ravine association, for it is considered rare in Java. I am sorry that I can not give you more specific names for these ferns, because the Japs took my herbarium of over 200 Javan species and I never got it back. That they took all my furniture, silver, and car also was an even worse loss, according to my wife's viewpoint, but from a sentimental point of view I think I regret the ferns the most.

I don't think I would have started fern collecting in Changi Gaol (on the East-point of Singapore Island), where I was a P. O. W. during practically the whole duration of the war, had I not done so before. Although it was quite a big camp and a lot of the original (I mean pre-war) vegetation of lalang fields, belukar (secondary scrub and forest), mangrove, and even some poor remnants of rubber plantations were enclosed within the now famous barbed wire, the fern flora was very poor indeed. Nothing but the ordinary roadside ferns were found by my botanical friends and myself. It clearly shows again to what extent ferns, with a few exceptions, are bound to the natural environment of the primary and to a lesser extent of the older secondary forests.

To give you an idea of the fern flora in Changi I shall subdivide the ferns according to the various vegetation types that were found in Changi and which determine to a large extent the fern flora.

LALANG FIELDS.—In the fields of lalang (*Imperata,* a coarse grass), no ferns were ever found by me. However, in those places where the ground had been exposed to serious erosion and only a poor vegetation of lalang or *Schizachyrium* (another grass) could exist some xerophytic ferns were met with: *Cheilanthes tenuifolia, Pteris ensiformis, Gleichenia linearis,* and *Pteridium aquilinum.* It was curious to see how the bad substratum and the drought affected the last two of these species, which in ordinary circumstances are rather large, hardy, and nearly ubiquitous in the tropics. *Gleichenia* would develop one or a maximum of two pairs of pinnae only, and the bracken would be only a foot high. Fertile fronds were rare. The long and wiry rhizomes sometimes had the ground above them completely washed away but they were still clinging desperately to life.

BELŬKAR.—This shrub vegetation, which invariably succeeds the lalang association if no burning or cutting takes place, is slightly more favorable to the common ferns, although the dense vegetation tends to crowd out practically anything on the ground, and the shrubs are apparently too young to allow epiphytic ferns to get a foothold. There were huge thickets of *Gleichenia linearis* and *G. dichotoma,* and *Blechnum orientale* and *Pteris biaurita* could be found in those places that offered some air and light for low-growing forms. The climbing *Lygodium scandens* was able to become very successful in this vegetation.

RUBBER PLANTATIONS.—The plantations within the premises of the camp were only the poorest type, almost all humus having been washed away by careless management. *Schizaea dichotoma* was an interesting find here, preferring the driest and most inhospitable places, but definitely needing some shade. It was always a joy for me to see this strange archaic form before me when I was going out with a working party with a shouting Corean behind me. Some species of *Dryopteris* were also rather common, as were also *Pteridium aquilinum* and *Pteris biaurita.* A few epiphytes were conspicuous in these plantations, namely *Platycerium diversifolium,* with its quaint cup-shaped fertile leaf, *Drynaria quercifolia,* and a species of *Davallia.* Two small epiphytes were very common—*Drymoglossum heterophyllum* and *Cyclophorus lanceolatus.* In the shadiest places even *Asplenium nidus* would grow, as a kind of reminder of what the Malaysian fern flora really can be.

MANGROVE.—In addition to the usual mangrove-ferns (*Acrostichum aureum* and *Stenochlaena palustris*), *Lygodium japonicum* was a conspicuous element, with its yellow-green leaves; it is certainly more common than

Stenochlaena, although in most publications this *Lygodium* is not mentioned as being able to withstand mangrove-swamp conditions so well.

I think that this is all I can derive from the scanty notes I made while in captivity. It is a pity we had so little freedom to investigate further, but Japanese captivity was rather a bad one. If you think it worthwhile you can publish the above in the American Fern Journal, although from a purely scientific point of view there is not much new in my account.

Yours very truly,
G. J. de Joncheere

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Matter for publication should be addressed to C. V. Morton, Smithsonian Institution, Washington 25, D. C.

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American Fern Journal

VOL. 43 APRIL–JUNE, 1953 No. 2

Close-Up Photography of Ferns

CHARLES NEIDORF

The methods previously described by this writer[1] are suitable primarily for medium-view photography of fern specimens (whole fronds or large portions of fronds). This paper describes a technique for close-up photography of freshly-collected specimens, particularly fertile fronds. The same method is applicable, of course, to any specimen, sterile or fertile, in order to show details of pinna-cutting, venation, indument, or any other diagnostic feature requiring a moderate amount of magnification.

If ever there was a subject that could be considered a "natural" for close-up photography, surely it is a fertile fern specimen at the very peak of its development. Any one can testify to this who has ever used a magnifier to examine the marvellous wealth of detail revealed in the structure of the intact indusia (sometimes studded with glistening glandular hairs), in the ripe but still unbroken sporangia, to say nothing of the strikingly decorative arrangements of sori and veins and the delicate cutting of the pinna-margins. Moreover, the wealth of detail thus revealed is located on a surface so flat as to be practically two-dimensional. As a result, the problem of obtaining overall sharpness, in the face of the increasingly shallow depth of field that inevitably accompanies increasing magnification, is thereby greatly simplified.

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[1] Neidorf, Amer. Fern Jour. 37: 67–77. 1947.

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Essentially, the principle involved in producing the close-up photographs is simple enough: the combination of a fairly large-size view camera ($4 \times 5''$), with its long bellows fully extended, and a short focal-length lens (three or four inches) produces a magnified image on the negative up to five times natural size. Such a negative needs to be enlarged less than three diameters to produce an $11 \times 14''$ print, suitable for exhibition, which is filled with a wealth of sharply rendered detail that could never be duplicated by greater enlargement of a small image.

To say that the principle is simple, however, is not equivalent to saying that the technique is easily mastered. Production of first-rate close-ups of *any* subject is a problem likely to tax the ingenuity and patience of even the most experienced nature photographer, and this is particularly true of fern photography. It may appear unusual, perhaps, in a paper intended to encourage others to tackle new procedures, to lay stress at the very outset upon the difficulties likely to be encountered. To do otherwise would, however, be misleading. For what they are worth, the methods used by this writer are discussed in some detail as a guide to others who may like to try their hand, whether because of a need for fern close-ups for scientific purposes, or because they are on the lookout for unhackneyed subject matter for prints to be submitted to photographic exhibitions, or simply because they want unusual material for exercises in close-up photography.

SELECTING THE SPECIMENS

Choice of a particular specimen to be photographed is, of course, very largely determined by the calendar. The various species reach maturity at different times during the year, so that at any given moment from May through October at least one or more ferns can be found at just the right stage to be photographed (although the ones which happen to be available at a particular time may not necessarily be the most striking or most easily photographed species).

What this means is that the occasional fern photographer or the person merely curious about close-up photography can always find something at which to try his hand. When it is a question of photographing a particular species, however, and even more so when a comprehensive pictorial record of the local fern flora is attempted, matters are not nearly so simple. Some ferns ripen their spores over relatively long periods of time, so that it is possible to find plants with very immature, fully ripe, or long-since mature fertile fronds, all on the same day, and one may continue to find ripening fertile fronds for a month or more. Moreover, some ferns produce two crops of fertile fronds during a single season. Thus, if a first attempt at close-up photography is unsuccessful, additional suitable material can be collected on the next field trip or at a later date. Other species, on the other hand, seem to bring every single fertile frond to maturity at about the same time, within a period not exceeding two weeks during the entire year. Thus, photographing them becomes a "now or never" proposition. If the first attempt goes wrong it may not be possible to find any more suitable material during the remainder of the growing season. Moreover, certain of the scarcer species may not be located at all until it is far too late to do anything with them, whereupon it becomes a matter of "better luck next year."

Therefore, the task of making a comprehensive series of photographs of the local fern flora may easily, in fact undoubtedly will, require several years to complete, even though the number of species may be quite small (thirty or less)—as good an example as any of the challenge presented by fern photography.

DRYOPTERIS MARGINALIS

The emphasis on collecting suitable material needs to be amplified. It is obvious that irregular or insect-chewed or otherwise damaged specimens should not be selected; also, that once the sporangia have burst and shed their spores and the indusia have shriveled up it is much too late to attempt to photograph the frond. But even perfect specimens which have just reached maturity cannot be used successfully either, on account of the extreme sensitivity of mature sporangia to changes in humidity and temperature. Upon removing such a specimen from the humid atmosphere of the vasculum for examination at close range with a magnifier, ripe sporangia will be observed bursting open here and there over the surface of the pinnae and scattering their spores. The only alternative, then, is to collect specimens which are somewhat short of maturity and to make certain to collect enough material, perhaps as many as ten or more fronds of a single species. Experience will show that if only the very best material is to be photographed it is practically impossible to collect too much perfect material of many of the more difficult species.

Not only must the ferns be perfect specimens, they must also be suitable, esthetically, for photography. In selecting them, attention must be paid to such considerations as how far apart the pinnae are from one another and the proportion between the average size of the sori and the width of the pinnae or subdivisions thereof which will be included in the photograph. It is inadvisable to have too much blank space showing, whether in the background (if the pinnae are too far apart) or in the pinnae (if there are too few or too small sori or if the pinnae are too broad). But crowded, overlapping pinnae are equally undesirable because the effect is too confusing. Then too, care must be taken to select pinnae which are not too large—neither too long nor too broad

—otherwise the magnified view will show the pinnae or pinnules so severely cropped as to be difficult to interpret.

These are problems which the photographer will probably become aware of only when he sees the image on the ground glass of the camera. As he gains experience, however, he will learn to give some thought to these factors in the field. To be sure, it is rather difficult at first to visualize how a specimen will look when it is magnified four or five times. The collector will no doubt feel that he has enough to worry about just trying to find specimens that are at the right stage of development. Still, there is sufficient variation between different plants of any given species, to say nothing of the differences in size between the upper and lower pinnae on a single frond, to enable the collector, with a little effort, to select a wide range of material.

EQUIPMENT

The major items needed are a view camera, a lens whose focal length is shorter than that of the lens which would normally be used for that particular size camera, a spotlight, and a photoflood lamp in a reflector on a light stand. The particular items used by the writer are: a $4 \times 5''$ Korona view camera (with 22 inches of bellows extension), a 101 mm. (four-inch focal length) f/4.5 Kodak Ektar lens, taken from a $2\frac{1}{4} \times 3\frac{1}{4}$ Speed Graphic camera, a 500 watt Golde spotlight with "Bamtam Super-Spot Snoot," used as the main light, and a No. 2 photoflood in a $10\frac{1}{2}''$ aluminum reflector, used as a fill-in light. Other sizes and models of cameras, lenses, and lighting equipment will, doubtless, serve the purpose equally well.

In addition, a number of accessories specifically designed for close-up photography are needed. The most important are:

1. Specimen holder. This is not available ready-made. Some ingenuity may be required to devise a satisfactory equivalent in the home workshop, but in one form or another it cannot be dispensed with and it need not be elaborate. "The Camera Magazine" for May, 1950, has an article, entitled "Ultra Close-Up Photography," by H. W. Moore, which includes two photographs of an excellently designed specimen holder that could be adapted for this type of work and that would not be too difficult to duplicate. (Incidentally, this article is highly recommended to anyone interested in close-up photography. In addition to many striking examples of what can be accomplished, particularly with much enlarged views of seeds, it discusses equipment and technique and includes a photograph showing how all of the equipment is set up, something which, however valuable it might be for anyone who has never tried his hand at this sort of work, must be omitted here because of limited space.)

The specimen holder devised by this writer, several years before he came across Moore's design, is built around a monocular microscope with all optics removed, only the coarse adjustment focusing movement being of interest for this purpose. At the upper end of the tube into which the ocular fits, a second stage, taken from an old dismantled instrument, is screwed on by means of a threaded flange. Onto this second stage a mechanical stage is attached. The fern specimens are mounted on regular glass $3 \times 1''$ or $3 \times 2''$ microscope slides which are placed on the mechanical stage. The microscope is then bent over at right angles, so that the stage is vertical, and placed in front of the horizontally arranged camera. The net result is that turning the coarse adjustment knob on the microscope moves the specimen toward or away from the camera and turning the two adjustment knobs on the mechanical stage moves the specimen up or down or from side to side, thus ensuring complete three-dimensional control. This arrangement serves the following purposes:

(a) It provides a focusing system independent of the adjustment knobs on the camera, allowing the camera to be used with fixed bellows extension. The movements on the microscope are much finer than those on the camera, so that much more accurate focusing is possible. This is vitally necessary because the depth of field is so shallow. Then too, the camera controls need not be adjusted and tightened before each exposure, which saves time. And using a fixed bellows extension makes it a simple matter to produce a series of negatives with uniform magnification.

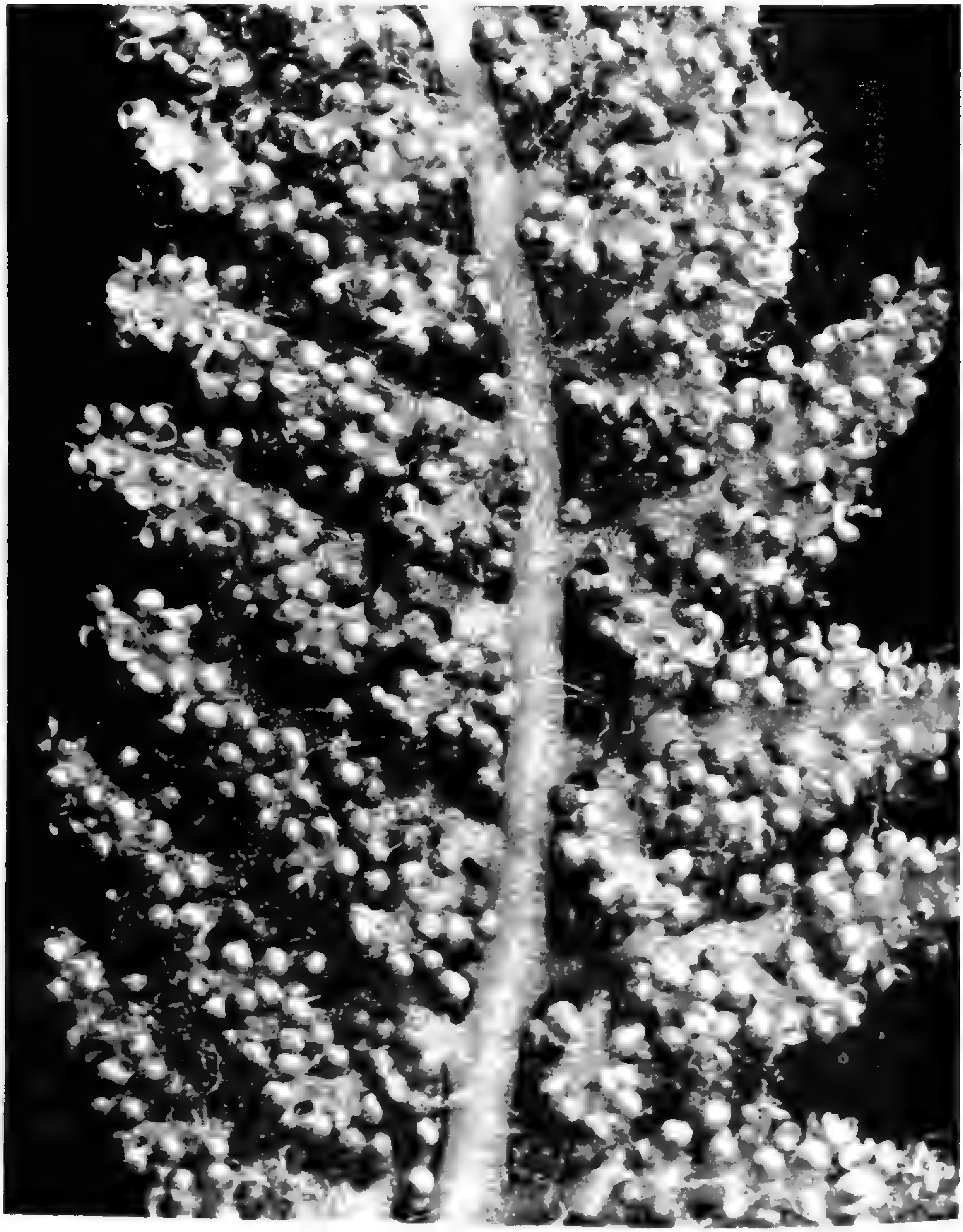
(b) It provides a means for manipulating and systematically exploring the entire specimen so that the best area can be brought into the field and kept there.

(c) It provides a means for holding the specimen parallel to the focal plane, insuring over-all sharpness.

The original intention was to have the opening in the second stage, directly over the opening in the microscope tube, serve as a black background for the specimens. It turned out, however, that with the particular focal length lens in use, the diameter of the hole was a trifle too small, cutting off part of the field on either end of the long dimension of the negative. Rather than use a shorter focal length lens, this problem was solved by attaching the mechanical stage to an L-shaped piece of wood and clamping this to the edge of the second stage, leaving the background entirely clear. A better solution, admittedly, would be to redesign a one-piece stage. The actual specimen-holder portion of the mechanical stage is an old-fashioned design which provides a frame for the microscope slide, holding the latter by means of tiny clips at either hand. Most modern designs, on the other hand, do not provide any means for holding the slide independently, off the microscope stage. A suitable device would not be too much trouble to prepare in the home workshop or might even be found in the second-hand stock of a microscope dealer.

2. Vibration Control. The long exposures required (about 25 seconds at f/16 with the particular set-up used by the writer) make it absolutely imperative that every effort be taken to eliminate movement of any portion of the arrangement. In part, this problem was solved by using a horizontal arrangement and what amounted to an optical bench: a wooden plank six feet long by nine inches wide, to which the camera and the base of the microscope were firmly clamped. But even this was considered insufficient. In order to eliminate the possibility that vibration of the entire building, fairly obvious when a heavy truck was passing nearby, might affect the exposure, thick sponge rubber pads were placed under the plank, one at either end and one in the middle, and a heavy weight placed on top of the plank at either end. This constituted a shock-absorbing system in which the function of the rubber pads was to absorb the vibrations from the surroundings and that of the heavy weights was to dampen these vibrations. In order to save time in setting up the apparatus and to have fewer parts to keep track of, the rubber pads were fastened permanently to the under side of the plank with rubber cement.

The length of the plank used, six feet, is by no means excessive, in view of the required sequence of heavy weight at one end, background, microscope bent over horizontally, camera with bellows fully extended, and second heavy weight at the opposite end. Between the ground glass of the camera and the second weight space



OSMUNDA CINNAMOMEA

must be allowed for placing a mirror at an angle of forty-five degrees, for viewing the image. Observation directly on the ground glass is not feasible, for one thing because the weight obstructs the view, and for another because if one attempted to stand behind the camera, the coarse adjustment knob on the microscope would be too far away to manipulate for focusing.

3. Background. A black background, while far superior to any other, is not without its disadvantages. Every one has at one time or another observed how a shaft of bright sunlight against a darker background will reveal a swirling mass of countless brilliantly lit dust particles that would otherwise be invisible. Similarly, the spotlight used as the main light will cause the minutest particles to show up very conspicuously against the black background—tiny pieces of lint, fragments of sporangia, even individual spores scattered by an occasional bursting sporangium. This means that the glass slide must be scrupulously clean and must be carefully dusted with a camel's hair brush just before the exposure is made. But even the greatest care frequently does not suffice to eliminate every last particle. Nothing short of actually etching out the resulting tiny black spots on the negative with a retouching knife will eliminate them. This, in turn, determines the kind of negative that must be made. If the negative is thin, all attempts at retouching are likely to show up in the print as scratches on the background. If the negative is fully exposed and somewhat dense scratches are invisible.

In order to be really black the background must be effectively shielded from all extraneous light. The device used by the writer is makeshift, but effective and simple to prepare. It consists of a cardboard box painted matte black inside, rather like a shoebox in shape and size, except that one end is missing. This fits over the microscope, with the open end of the box near the mechanical stage. When the lights are properly set, the exact focus determined and the exposure ready to be made, a second piece of cardboard, its front surface likewise painted matte black and with a hole cut in just big enough to let the glass slide show through, is set up in front of the mechanical stage, thus very effectively shielding the background.

White or neutral gray cards can also be used as backgrounds, provided they are placed far enough back to avoid shadows of any portion of the set-up falling upon them. While their use is not plagued by the necessity for maintaining scrupulous cleanliness, they are frequently accompanied by their own set of problems, notably, the contrast between a brightly lit specimen and a white background may be so low that the two tend to blend together, whereas the same specimen against a black background stands out vividly defined.

TECHNIQUE

1. Mounting the specimen. Specimens should be examined carefully under a bright light with a magnifier in order to select those portions which are most suitable. The transfer from the dark, humid interior of the vasculum into the brightly lit, dry room-atmosphere will quickly make it evident which specimens are too mature to be photographed successfully. Then too, the dimensions of the glass slide, to which the specimens must be fastened in order to keep them as flat as possible, will serve as a limiting factor in deciding how large a portion to select. Several slides should be prepared; a final choice can only be made by examining the image on the ground glass.

The technique of properly attaching a specimen to a glass slide requires some practice. Only a strong liquid glue, not mucilage, should be used. A small amount is poured onto a sheet of glass (or any other smooth, impervious, easily cleaned surface), diluted with a drop or two of water, and spread out into a thin layer which is allowed to become tacky. While this process is going on, the specimen is examined and suitable portions snipped off with a pair of scissors. Each portion in turn is then dropped on the layer of glue (ventral or non-sporangia bearing side down, of course) and tapped gently with a finger to make certain that all portions of the underside are reached. Then it is lifted off with a pair of sharp-pointed forceps, turned over, with the glued side up, and placed on the surface of the work table, after which a clean slide, properly oriented, is carefully dropped on it and pressed down gently for a moment or two.

Everything depends on preparing a layer of glue of the right consistency. If it is too thick it will overlap the edges of the specimen and ruin it. If it is too thin it may not cover the under side of the specimen adequately and in any event will have to be renewed quickly. Too watery a consistency will cause the glue to spread out beyond the margins of the specimen onto the glass slide as soon as any pressure is applied, which will certainly add to the job of retouching the negative, if not actually ruining the preparation. If detected in advance, before the slide is dropped on it, such a specimen can sometimes be saved by allowing it to stand until the glue becomes tacky enough. One can easily be fooled into allowing this process to go on too long, however, since parts of the glue layer may dry out completely, yet be indistinguishable in appearance from other areas which are still tacky.

Most exasperating of all, though, is to attempt to work with glue that has become too tacky. If not actually so tenacious as to make it impossible to remove the specimen from the sheet of glass without damage, its presence will be indicated by the fact that the specimen cannot be lifted off without causing long, thread-like filaments of glue, adhering to every projecting point along the margins of the pinnae or pinnules, to be pulled off at the same time. These filaments of glue, being quite long and extremely light, wave around with the slightest motion and may spoil the surface to be photographed, producing artifacts similar to spiderweb fragments, or they may extend over two or more pinnae on the under side and have to be retouched out on the negative.

Thick, coriaceous fronds, such as those of *Polystichum acrostichoides* or *Polypodium virginianum*, require special handling. When the glass slide is dropped down on such a specimen a moment's pressure will certainly not be sufficient to glue it down completely. As a matter of fact, a relatively heavy weight (e.g., a pair of pliers) should be placed on the glass slide after it has been dropped onto the specimen and allowed to remain there for several minutes. Almost invariably there is little or no danger of crushing the sori.

It must be emphasized that, although any or all of the various annoying contingencies involved in the use of glue *may* arise from time to time, in actual practice it is really not too difficult to learn the proper technique for mounting specimens.

Every effort must be made to obtain complete overall contact between the underside of the specimen and the glass slide. Otherwise, trouble will arise from two sources. Obviously, if the unglued portion does not lie flat it may stick out so far that it cannot be brought into sharp focus along with the rest of the specimen. Stopping down the lens will increase the depth of field somewhat, perhaps sufficiently to overcome this problem, but will have no effect on the other difficulty, that of reflections from the glass slide. Every portion of the margins of the specimen which is not in close contact with the glass will produce a dim reflected image immediately adjacent to it, the degree of prominence of this reflection depending upon the degree of separation between specimen and glass and on the distance away from the optical axis. Nothing short of etching out these reflected images on the negative will eliminate them, hence the importance of taking every reasonable precaution in mounting the specimen, if this added chore is to be avoided.

2. Lighting. The specimen is now ready to be photographed. The glass slide is clipped in place in the mechanical stage and the main light switched on. Focusing should be a simple matter, without too much movement of the microscope tube, for in setting up the apparatus it is easy enough to remember that the distance between the lens and the mechanical stage should approximate the focal length of the lens in use (four inches in this case). It is important to orient the specimen properly, so that the shadows in the print will point south-east or south-west. Shadows pointing up would be most unnatural. Since the mechanical stage is so arranged that the long dimension of the slide is horizontal, this means that the specimen must always have the outer end of a pinna or the upper end of a frond point to the left if the main light is on the left side, or to the right if the position of the light is reversed. Assuming that the main light is on the left, the shadows will almost invariably point to the south-east (on the print) because the light is placed to one side and pointed down. (It *could* be placed below the level of the specimen, causing the shadows to point to the south-west, but there would be

little point in attempting to do so systematically; the light is much easier to manipulate pointing down.)

Specific instructions about the placing of the main light cannot be given. Differences in size, arrangement, and prominence of details require differences in handling, and in any event results must be judged on their merits on the ground class. There are, however, certain general instructions which can be kept in mind:

(a) The concentrated spotlight beam must be well centered on the specimen or the lighting will be excessively uneven. (Actually, regardless of where the light is placed, it is impossible to avoid *some* unevenness in the lighting and a certain amount of dodging of one corner of the print is invariably required when making an enlargement.)

(b) Placing the main light too high or too far to one side will cause excessive unevenness of illumination, and placing it too close will cause excessive contrast also.

(c) The heat produced by the concentrated spotlight is bound to be excessive, so that the specimen is in danger of moving during the course of a long exposure, if the light is brought in too close.

Having decided on the position of the main light, the fill-in light is switched on. Generally speaking, it should be set almost directly in back of the camera and fairly high in order to cover the specimen adequately, the distance between the outer end of the lens shade and the surface of the specimen being quite short. Balancing the dense shadows cast by the spotlight without completely obliterating them is best achieved by having the two lights about 90 degrees apart. The position of the fill-in, shining down almost directly above the mirror in which the image is observed, will necessitate the use of a good focusing cloth or perhaps a more elaborate shielding system. As a matter of fact, the problem of shielding the mirror when both lights are on may prove so troublesome that there is a natural tendency to bypass it by foregoing any attempt to observe the effect of turning on the fill-in, the latter being placed in very nearly the same spot and raised to the same height time after time. A short-cut of this kind may be justified if at the same time the position of the main light remains pretty much unchanged, but cannot be recommended as a general policy. (The set-up illustrated by Moore indicates that it is entirely feasible to use a light very much weaker than a No. 2 photoflood as a fill-in, permitting it to be moved in much closer to the specimen and thus avoiding the above-mentioned problems.)

Since the exposures required are so long, it is entirely impractical to use a cable release. The procedure is as follows: Both the spotlight and fill-in light are plugged into the end of a cord equipped with an off-on switch and this cord is plugged into an outlet. Having decided on the lighting, the glass slide on which the specimen is mounted is given a final dusting on both sides with a camel's hair brush, the focus is set, the light shield (the piece of cardboard with the hole in it) is placed in front of the mechanical stage, the diaphragm of the lens is closed down to f/16 or f/22, a film holder is inserted in the back of the camera, the switch on each light is pushed to the "on" position, and the switch on the cord leading to the outlet is pushed to the "off" position. In addition to turning off both lights, illumination from any other source in the room, whether from window, door, or ceiling light, should also be eliminated as far as possible, after which the slide is pulled out of the film holder, the switch on the cord is flipped "on" and the exposure made by counting off the required number of seconds.

How long the exposure should be can be determined either by a preliminary process of trial and error, as in the writer's case, after which exposure times will remain fairly constant, since the set-up will also remain fairly standardized, or else, more systematically, by taking a meter reading and then applying a formula which takes into account the added exposure factor introduced by the fully extended bellows.[2]

Film and developer should be as fine-grained as possible (Panatomic film and Kodak Microdol developer are recommended). The difference in quality of the final results, as compared with those obtainable with coarser-grained, high-speed films and rapidly-acting developers, is worth the added exposure and developing times entailed.

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Woodsia oregana on Sentinel Butte, North Dakota

ROBERT T. CLAUSEN

In June, 1952, while searching for outlying colonies of *Sedum lanceolatum* in the southwestern part of North Dakota, between 46° and 47° N. and 103° and 104° W., I explored the north face and summit of Sentinel Butte. This remarkable butte is a dominating feature of the landscape just west of the Little Missouri Badlands, rising abruptly above the plains south of the village of Sentinel Butte. The summit of the butte is 1046 m. above the sea. The southern slopes and summit are dry, with a vegetation of grasses and a few species of herbaceous dicotyledons which can tolerate the xerophytic conditions. The shaded northern slopes, in contrast, have several draws in which *Fraxinus pennsylvanica* is frequent. *Cystopteris fragilis* flourishes in the shade of

[2] Moore, *op cit.* 102.

these trees, but seems to be lacking from the more exposed rocks between the draws. At the bases of boulders, on a northwest facing slope, towards the east end of the butte and up below the base of the main cliffs, *Woodsia oregana* is frequent. It and the *Cystopteris* are the only ferns that I found on Sentinel Butte. The leaves of the *Woodsia,* still expanding on June 14, had some long white trichomes characteristic of *W. scopulina,* but not unlike the condition found in young fronds of *W. oregana* from other localities. The segments of the indusia are narrow and moniliform. The backs of the leaves and stipes are somewhat glandular. Specimens of my collection, R. T. C. no. 8216, are being placed in the Wiegand Herbarium of Cornell University, the United States National Herbarium and the herbarium of the North Dakota Agricultural College.

Bergman (1912) listed *Woodsia oregana* from Sentinel Butte, where it was first collected by Bishop Mann in 1903, and also from Wade, Grant County, N. D. Stevens, in his useful Handbook (1950), listed only one species of *Woodsia* from North Dakota, namely *W. obtusa,* but in recent correspondence, he has expressed the opinion that this listing probably is wrong. Professor Stevens has now very kindly made available for study the series of specimens of *Woodsia* available at the North Dakota Agricultural College. All from localities in North Dakota are *W. oregana.* The oldest is the collection by Mann in 1903. Others include the one from Wade collected in 1907 by W. B. Bell (no. 361); a collection of Stevens in 1938, from the north side of a butte near Watford City, in McKenzie County; another obtained by Stevens in 1918, from Marmarth, Bowman County; and a collection of J. Lunell, June, 1916, from a crevice of limestone, Butte near Leeds, Benson County. These occurrences indicate that *W. oregana* exists today at widely separated localities in the northern plains; also probably at other places still not discovered. The significance of this distribution in North Dakota becomes apparent if one will consult the map of the range of the species published by Fernald (1925). On that map, no North Dakota stations are indicated. In fact, the only stations shown between Bic in Quebec and the Rocky Mountains are the Keweenaw Peninsula and the Black Hills. Today, with the knowledge of the occurrence of *W. oregana* on the west side of Canandaigua Lake in western New York, in Wisconsin and Minnesota as well as in Michigan, and at five different places in North Dakota, it is apparent that this species has a series of stepping stones or relic colonies across the central part of the Continent. Its eastern occurrences are less remote than was formerly supposed. Further, all North Dakota specimens are var. *cathcartiana* (B. L. Rob.) Morton, as are all from farther east. In other words, the eastern extension of the range of *W. oregana* is by a single morphological variation of the species, possibly suggesting that the dispersal eastward has been recent, that is since the last deglaciation.

For aid with the expenses of my trip to North Dakota, I am grateful to the Faculty Committee on Research of Cornell University.

WIEGAND HERBARIUM, DEPT. OF BOTANY, CORNELL UNIVERSITY.

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Further Observations on the Putative Hybrid Dryopteris filix-mas × oreopteris

THOMAS M. C. TAYLOR

In the course of a detailed study of the pteridophytes of British Columbia, the writer has had the opportunity of making a careful examination of the specimen described by Ewan[1] as *Dryopteris filix-mas* (L.) Schott × *oreopteris* (Ehrh.) Maxon. Reed,[2] in view of the apparent absence of one of the putative parents from the area, is inclined to doubt the hybrid origin of the specimen. He also draws attention to a unique character of *D. oreopteris* which was not commented on by Ewan, viz. the prickly exospores.

During the past summer, Mr. Alan Morkhill, of Victoria, B. C., kindly allowed the writer to study a living plant of the original collection made in 1934 by Lohbrunner and Nichols at Alice Arm, B. C. Fronds from this plant were carefully checked with the type sheet (*Lohbrunner & Nichols* 9555) in the herbarium of the Provincial Museum at Victoria[3] with complete agreement in all essential details. There can be no doubt of the authenticity of Mr. Morkhill's plant.

The following table gives the result of a detailed comparison of the Lohbrunner and Nichols plant with a specimen of *D. filix-mas* (*W. B. Anderson* 16, from Chilliwack, B. C.).

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[1] Amer. Fern Journ. 34: 115. 1944.

[2] Amer. Fern Journ. 37: 53–54. 1947.

[3] Ewan (*l.c.*) made an understandable slip in stating that the type is located "in the herbarium of the Victoria Memorial Museum." Actually the Victoria Memorial Museum is in Ottawa while the herbarium in Victoria is in the Provincial Museum. All Ewan's references in this article should read "Provincial Museum, Victoria, B. C." where they now read "Victoria Memorial Museum."

	Lohbrunner & Nichols 9555	*Anderson* 16
Distribution of sori.	Practically from base of frond and to extreme tip of pinnae.	Limited to upper half of frond and lower three fourths of pinnae.
Pinna segments.	Margins entire, hyaline-papillose; no teeth.	Margins not hyaline-papillose; few, rather coarse teeth.
Backs of pinnae.	Sparsely glandular, with subsessile, globular glands; whitish, or occasionally, brownish, hairs more or less evenly distributed on all veins.	Eglandular; glabrous, except for a few long, hairlike scales towards the base of the mid-vein.
Indusia	Thin, soon deciduous; walls of cells somewhat waved but not sinuous.	Firm, persistent; walls of cells quite sinuous.
Sporangia	Annulus 14–16 cells.	Annulus 13–14 cells.
Spores	Exospore markedly echinulate.	Exospore wavy.

It will be seen from the above that the Lohbrunner & Nichols specimen shows no significant features in common with *D. filix-mas*, but does agree in detail with *D. oreopteris* (Ehrh.) Maxon. The writer concludes, therefore, that there is no question of hybridity in this case and that the Lohbrunner & Nichols specimen is *D. oreopteris* showing some slight deviations from its typical morphology.

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The Generic Name Anetium

C. V. MORTON

The genus *Anetium* Splitgerber contains a single species, which is common and widespread almost throughout tropical America. In 1947, Dr. E. B. Copeland proposed a new name for the genus, *Pteridanetium,* rejecting *Anetium* Splitg. (1840) because he supposes it to be a homonym of *Anetia* Endlicher (1839).

This procedure is not justified by the International Code of Botanical Nomenclature (1952), nor was it under the third edition of the International Rules. Article 82 reads, "The original spelling of a name or epithet must be retained, except typographic or orthographic errors. When two or more generic names are so similar, and the plants so closely related, as to cause confusion, they are to be treated as variant of the same name."

In the present instance there is no risk of confusion, for *Anetium* is a fern of the American tropics and *Anetia* a phanerogam of Africa, considered a synonym of *Byrsanthus* Guillem. (1837).

Nor is it provable that *Anetium* and *Anetia* are orthographic variants of the same name, for neither Splitgerber nor Endlicher gave the etymology of their names. The meaning of either name is not certain and they have been interpreted differently by different authors.

The Code gives as an example of different generic names *Peponium* and *Peponia;* these two names are exactly comparable to *Anetium* and *Anetia.* Therefore, it may be definitely stated that Copeland's name *Pteridanetium* was superfluous when published and consequently illegitimate. The citation will be as follows:

ANETIUM Splitg. Tijds. Nat. Gesch. 7: 395. 1840.

Pteridanetium Copel. Gen. Fil. 224. 1947 (illegitimate).

SMITHSONIAN INSTITUTION, WASHINGTON, D. C.

Pteridophytes from Lowndes County, Georgia

ELSIE QUARTERMAN

Lowndes County lies in the lower coastal plain of Georgia near the center of the southernmost tier of counties. It includes in its eastern part large areas of flatwoods such as are typical of the lower coastal plain in the south, a sandy limesink region in which are many lakes and ponds, and in the west, a region of rolling uplands. The collections reported here were made in the rolling western portion of the county.

McVaugh and Pyron, in their recently published "Ferns of Georgia" (1951), list nine species of pteridophytes from Lowndes County. This apparent paucity is due to lack of botanical exploration, not to scarcity of ferns, a situation that McVaugh and Pyron suggest may be true of many counties in the state. Unless otherwise stated, references to previous records are based upon "Ferns of Georgia."

The following list adds nine species and one form to the previously published records for Lowndes County. The form is a new record for the state.

POLYPODIUM POLYPODIOIDES (L.) Watt. Frequent on trunks and branches of trees; occasional on soil. Six miles east of Hahira, on pecan tree (no. 4325); 3 miles west of Hahira, near Miller bridge, over Little River, on oak tree (no. 4326).

ASPLENIUM PLATYNEURON (L.) Oakes. Frequent and abundant. Fourteen miles north of Valdosta at edge of drainage ditch (no. 518).

DRYOPTERIS DENTATA (Forsk.) C. Chr. Locally abundant under hardwoods 3 miles west of Hahira, near Little River (no. 4322). This is the fifth county from which it has been reported and represents a slight eastward extension of its range in the southern part of the state.

POLYSTICHUM ACROSTICHOIDES (Michx.) Schott. Abundant in one dry limesink near the confluence of Cat Creek and the Withlacoochee River, about 10 miles north of Valdosta (no. 4396); 3 miles west of Hahira, under hardwoods near Little River (no. 4324).

POLYSTICHUM ACROSTICHOIDES f. INCISUM (Gray) Gilbert. Abundant in the same dry limesink as the species (no. 4397). Not previously reported from Georgia.

BOTRYCHIUM DISSECTUM Spreng. var. TENUIFOLIUM (Underw.) Farwell. Under hardwoods, 3 miles west of Hahira, near Little River (no. 4323). Rare.

LYCOPODIUM ADPRESSUM (Chapm.) Lloyd and Underw. Locally abundant in moist roadside ditches which are not well sodded with grass. The furcate form is of common occurrence in colonies of this lycopod. Five miles east of Hahira, near Withlacoochee River (nos. 4308, 4309). Observed in other moist ditches between this station and Hahira.

LYCOPODIUM PROSTRATUM Harper. In similar habitats to the preceding, 5 miles east of Hahira, near Withlacoochee River (no. 4310).

LYCOPODIUM CAROLINIANUM L. Moist roadside ditch 5 miles east of Hahira, near Withlacoochee River, (no. 4312). The habitats of these three lycopods in this and in other southern counties of the state suggest that they may be successional species, especially since they do not occur in moist grassy woodlands where their frequent associate *L. alopecuroides* L. becomes a permanent part of the community.

LYCOPODIUM CERNUUM L. Found in one station on a clay roadcut near a small permanent spring 12 miles north of Valdosta, near Cat Creek (nos. 4202, 4321). This is only the fourth station known in the state, although Small (1931) includes "coastal plain of Georgia" in the range without specifying localities.

All specimens are on file in the herbarium at Vanderbilt University. The numbers cited are my own collection numbers.

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Small, John Kunkel. 1931. Ferns of Florida. 237 pp. Science Press, New York.

Fern Miscellany: Pilot Knob, N. Y.

R. C. BENEDICT

Some years ago, an article was prepared under the above title, but, left for some modification, was mislaid during the war years and has not since been found. It recorded a series of miscellaneous observations regarding the ferns and other pteridophytes of the Pilot Knob area made over a period of some fifteen years. Now the time seems ripe for a somewhat similar record. This will not contain all the details assembled in the earlier paper but will have some additional items disclosed during succeeding years, the balance of the thirty summers of my acquaintance with that area.

Pilot Knob is a mountain, a post office and community, and a stretch of fairly flat shore on the east side of Lake George about ten miles north from the head of the lake. During the winter it has a population of twenty-five or thirty residents. Summers this rises to around three hundred, mostly cottage holders whose places are almost all in a fringe along the lakeshore for about three miles of bays and promontories. While along most of the east-shore of the lake, a long ridge of the eastern Adirondacks meets the lake at a steep angle, at the Knob a rather flat triangle extends about a mile along the shore, and nearly half a mile from east to west. Along the eastern edge of this triangle flows Butternut Brook, a sounding torrent in times of spring freshets but a rather mild trout stream most of the year. A little to the west are acres of abandoned pastures and meadows, now mostly repossessed by alder and other woody growth. White pine is seeding in and will presumably presently overtop and crowd out the present nurse vegetation and restore the forested conditions of the times of Uncas and the Deerslayer, whose exploits lay partly along Horicon, the Indian name for Lake George. Many other historic war parties once used the lake as a thoroughfare: French and British with their Indian allies; later, the American revolutionaries in their forays northward. However, the principal water route for the larger expeditions lies some eight miles eastward, in the narrow trough which separates the Adirondack mass from the Green Mountains of the Appalachian chain.

In those days, and even much later, the name "Pilot Knob" had not been applied. As late as a New York State atlas of 1869, the name "Palmerton Mountain" was given to the whole stretch of ridge in which today's Pilot Knob and Buck Mountain are the principal heights in the Knob region. From the lake level of 320 feet above sea level, these peaks rise 2,000 and 2,300 feet respectively above the lake level; other ridges, almost completely wooded, stretch in almost unbroken forest six to eight miles to the eastern edge of the Adirondack pile.

About 100 years ago, cultivated farmland covered much of the Pilot Knob shore and extended even some distance up the mountain slopes east of Butternut Brook. Now the only record of much of that cultivation is found

PILOT KNOB FROM THE NORTHWEST IN LATE AFTERNOON.
PHOTOGRAPH BY CHARLES NEIDORF

in occasional rather large cairns of glacial boulders; those farmers did not take time to mark field lines by stone walls as did their New England contemporaries, but their descendants tell of wonderful crops of corn which were grown on the steep slopes. Mountainside and most of the shore are now almost completely covered with forest growth which has seen several successive lumbering operations, the latest less than ten years back. Some of the flatter parts are underlain by heavy clay and present stretches of swampy woodland, interrupted by low ridges or lesser outcrops of gneissic rock. No limestone occurs at the Knob, although a few miles southward and on many lake islands limestone comes to the surface in low ledges and in flat, fissured areas. So much for the background of what follows.

PRESENT FERN INHABITANTS. This is intended as a tally of the ferns and other pteridophytes that I have found in the Pilot Knob area during the past 30 years. The actual area concerned is a limited portion of the triangle of shore described above, less than half a mile east and west, and a little more than a quarter of a mile north and south—an L-shaped area which would not add up to 40 acres.

In 1916, 1917, and 1923, Stewart H. Burnham published[1] in five installments his "Ferns of the Lake George Flora." His total list numbered 59 specific types and four hybrids. His studies covered a period from 1889 to 1923, and included careful documentation from several herbaria other than his own. The area involved the three counties Washington, Warren, and Saratoga, which have an east and west extent of at least 50 miles and a north and south range of about 90 miles. Actually, the real Lake George area is surprisingly small and only a fraction of the area of the three counties men-

[1] This JOURNAL, 6: 85, 97; 7: 12, 54; 13: 109.

tioned. Although the lake is over 30 miles long, it is only three miles at its greatest width, and its drainage basin ranges from about six to ten miles in its broadest extent. The confines of its drainage are comprised essentially by the top lines of the ridges that flank it to the east and west. Although water from Lake George flows northward into the St. Lawrence system, the tributary streams of the Hudson River are just over the western ridges.

Lycopodium lucidulum, L. clavatum, L. obscurum, L. complanatum, L. tristachyum.

Selaginella rupestris.

Equisetum hyemale, E. arvense, E. sylvaticum.

Botrychium angustisegmentum, B. matricariifolium, B. simplex (found only once), *B. virginianum, B. dissectum, B. obliquum, B. multifidum.*

Osmunda cinnamomea, O. Claytoniana, O. spectabilis.

Dryopteris dilatata, D. intermedia, D. spinulosa, D. cristata, D. Clintoniana, D. marginalis (and at least three hybrids—*D. boottii, D. cristata-× marginalis,* and *D. Clintoniana × intermedia*), *Polystichum acrostichoides, Thelypteris noveboracensis, T. palustris, Phegopteris polypodioides, P. hexagonoptera, P. Dryopteris, Woodsia ilvensis, W. obtusa, Cystopteris bulbifera, C. fragilis, Asplenium platyneuron, A. Trichomanes, Camptosorus rhizophyllus, Athyrium Filix-femina, A. thelypteroides, Adiantum pedatum, Pteridium aquilinum, Pteretis nodulosa, Onoclea sensibilis, Dennstaedtia punctilobula, Polypodium virginianum.*

The total number listed for the small area being discussed compares favorably with E. J. Winslow's famed Willoughby Lake region in Vermont. That it can be added to, with a slight extension of range, is indicated by Burnham's listing of occurrences around the actual lake basin itself, some of which are not far from Pilot Knob. A few miles away, in a boggy area of one of the lake tributaries, another *Lycopodium* and *Woodwardia virginica* are known. In Glen Lake, not far away, an *Isoëtes* was turned up last summer by Messrs. Svenson and Neidorf. By extending the search to the limestone area, and to the eastern slopes of the Pilot Knob range, it is almost certain that at least six additional species could be added to the list within walking range of Pilot Knob, these being species in the genera *Pellaea, Asplenium, Dryopteris, Athyrium, Equisetum,* and others. If supplemented by distinctive varieties a still larger number of additions might be made. Burnham cites a specimen of the *"cambricum"* type of *Polypodium* for "Dark Bay," a name applied to a portion of the Pilot Knob shore line.

THE MOST NOTEWORTHY FERN SPECIES OF THE AREA. Two species from the preceding list may be picked out for special comment. The walking fern has been found in three small colonies, two of which seem now to have disappeared. Its occurrence is cited as noteworthy because of the absence of limestone. The remaining colony, when last observed, showed vigorous growth on large boulders.

The other species is *Dryopteris dilatata,* the mountain spinulose fern. To find this species growing naturally at an altitude of less than 350 feet—its ordinary level in the Adirondacks is around 3000—was one of the surprises in my early fern hunting at the Knob. Originally, there were three nearby plants of good size. A misdirected transplanting of one plant to a lakeshore fern bed was unsuccessful, but the remaining two are as good as ever and compare favorably with those from higher altitudes. Every autumn their leaves show the characteristic tenderness and shrivelling weeks before those of typical *spinulosa* in neighboring plants. The evergreen *intermedia* is also close by, affording an excellent opportunity for comparison. To find *dilatata* in abundance, it would be necessary to travel perhaps two score miles westward where Adirondack peaks reach above 3000 feet. Many billions of their spores must be blown annually

A SPOT NEAR BASE OF PILOT KNOB WHERE BOTRYCHIUM MATRICARIIFOLIUM AND B. ANGUSTISEGMENTUM WERE ABUNDANT across the lower areas, but *dilatata* still remains a most unusual find at low altitudes.[2]

I should like to record my very strong agreement with the opinions recently expressed by Dr. Wherry as to the distinctiveness of the three spinulose dryopterids, and refer also to an earlier discussion of the same topic under the heading "Problems in the Study of the Spinulose Ferns."[3] That their discrimination offers real problems I am quite ready to admit. This is chiefly when they occur in overlapping ranges in the form of intermediates explainable as F-1 or later generation derivatives of crosses.

NEW FERN INTRODUCTIONS. Despite the possibility earlier expressed that somewhat more extended search might add a series of species reported elsewhere in the Lake George area, I have been unwilling to wait for that eventuality and have made a number of experimental introductions of favorite species for which appropriate surroundings seem available. They are reported here as a matter of record. To date, my attempts to aid nature are as follows:

From Richard Harlow's Pennsylvania fern garden, some years ago, I was privileged to receive plants of male and Goldie's ferns. A plant of each was set along an east-facing margin of a small wooded swamp in which *D. Clintoniana* now shows the largest colony I have ever seen; there are more plants of this species than of all the osmundas together. Neither of the two introduced plants could be found this summer. Some intervening wood-cutting may have been responsible for their disappearance. Two or three other Goldie's were set at the same time in what then seemed a permanently moist area where silvery spleenwort and the oak fern were in

[2] See Clarkson's report of *dilatata* in eastern Massachusetts, This JOURNAL **14**: 67. 1924.

[3] This JOURNAL, **14**: 69. 1924; see also **6**: 33. 1916.

good supply. These Goldie's have persisted as depauperate plants, but the oak fern and a large associated colony of narrow beechfern have almost completely disappeared after a succession of dry summers.

From M. D. Mann, Jr.'s New Jersey garden last summer, I obtained more *Goldiana*. These have been placed in a different habitat which I believe will be favorable. Two months after planting they were in thriving shape.

Through Harold Rugg later last summer, specimens of four species of distinction have been obtained and set out, near the Goldie fern from Mr. Mann: more *Goldiana, Dryopteris Filix-mas,* Braun's holly fern, and the narrow-leaved spleenwort. The latter is a frequent companion of *Goldiana* in nature and I have hopes that the right place for all may have been found.

From Quiver Pond, near Fourth Lake, in Hamilton County, plants of the Massachusetts fern were collected from what I believe is still the northernmost New York station for this species, and one which I had the pleasure of finding forty years ago. They were set in a low, wet situation not far from the site referred to in the previous paragraph. A few witch hazels and a small yellow birch were cut down to let in a little more light.

EFFECTS OF CLIMATIC VARIATIONS. Seven lean years and more have visited the Pilot Knob area in the form of a succession of drier than average summer months and seem to have left definite evidence in the reduction of the populations of several fern species. Besides the earlier reference to dwindling colonies of oak and beech ferns, I have noted with regret the decline of several other species:

DENNSTAEDTIA. As long as 30 years back, I noted a thriving colony of the hay-scented fern which fringed the top of a rounded outcrop. It has now completely disappeared from this site although the colony must have numbered scores of spreading rhizomes. Two small plants of marginal fern and a tuft of polypody are the only present fern denizens of this spot.

BOTRYCHIUM. Over a considerable number of years, I have watched particular plants and also localities where several *Botrychium* species occurred. Once, *B. matricariifolium* occurred in considerable numbers on the cottage lot close to the lakeshore. Under a single arbor vitae clump whose branches swept the ground, I once counted 25 plants. This tree is now trimmed higher, but the little botrychium had disappeared before the trimming. Within a hundred feet, I watched for several years a number of rather large plants of the same species and got good photographs of one of them. They were not there last summer. Both *B. matricariifolium* and *B. lanceolatum* were once abundant a few hundred feet to the eastward in the forest area, mostly in the court of a large, spreading "wolf" specimen of white pine. For the last several years, their numbers have diminished until last summer I was able to find only one small *lanceolatum* to show the fern tourists in September. For a good many years I had noted each year the persistence of the evergreen sterile portion and the August appearance of the new growth of a plant of *B. multifidum*. In the past two summers, not even a sterile leaf has developed.

While it may be accepted that for any one of the instances noted above, some specific habitat factor might have been the sufficient cause of the disappearance, it seems fair to draw the conclusion that what has occurred has been a general retreat of these fern species from habitats which had probably been occupied as new ground during a previous cycle of greater precipitation.

BROOKLYN COLLEGE AND BROOKLYN BOTANIC GARDEN.

Recent Fern Literature

A TEXT OF ECONOMIC BOTANY, AND SOME AFTER-THOUGHTS.—In the past, the Fern Journal has presented many instances of possible economic values of ferns and other pteridophytes, usually of their utilization from far away and long ago. Undoubtedly, some of the far-away uses still prevail locally, but a recent text in economic botany[1] covers everything relating to pteridophytes, so far as the United States is concerned, in two short paragraphs:

"LYCOPODIUM. The infinitely small and almost impalpable spores of *Lycopodium clavatum* and other club mosses contain about 50% fixed oils and so are little affected by water. They are much used as a cover for pills, as a diluent for insufflations, and as a dusting powder on abraded surfaces.[2] In industry, they are used in making pattern molds, and, because of their inflammability, in flares, fireworks, and tracer bullets. Formerly obtained chiefly from Europe, a considerable amount of Lycopodium is now produced in Maine."

"MALE FERN. The rhizomes and stalks of the male fern (*Dryopteris Filix-mas*) of Europe and North America and the marginal shield fern (*Dryopteris marginalis*) of eastern North America yield a drug known as *male fern* or *aspidium*. This is an oleoresinous substance which has been used for centuries for expelling tapeworms. The commercial supply comes from Europe."

To the writer, the use of lycopodium in tracer bullets adds another to the many single uses which have been cited from time to time; the other uses reported by Hill

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[1] Economic Botany, by Albert F. Hill. Second edition. McGraw-Hill Company, 1952. $7.00.

[2] In partial correction of this statement see Amer. Fern Journ. **31**: 100–102. 1941, where the possibility of slow inflammation from *Lycopodium* is cited.

are more familiar. It would be of interest to know, in these days in which billions of dollars and millions of tons are commonplace figures, just how great a production of lycopodium spores is required for war use. Incidentally, these spores are useful material in general science teaching to demonstrate the potential inflammability of dust in the air. Half a teaspoonful, spilled to fall on a burning match or Bunsen flame, will give a beautiful sudden flash.

Aside from ferns, the reader will find in the Hill text a wide range of interesting data relating to many common and uncommon plants.

THE AFTERTHOUGHTS. Reading the Hill account of *male fern* as a vermifuge derived from two common species of *Dryopteris* has raised more questions than it answers. I have consulted two druggists, my family doctor, and the U. S. Dispensatory,[3] a compendious volume that many druggists keep on their shelves for reference purposes.

The fact that this taenifuge or anthelmintic drug is derived from *Dryopteris Filix-mas* and *D. marginalis*, two species which have a number of points of resemblance, raises the question whether the same chemical ingredients might not be found in other related species of the woodfern group. The Dispensatory answers this question in a way which is both interesting in itself and also has taxonomic implications:

"It is probable that all the species of this genus possess more or less anthelmintic properties. The activity of *D. marginalis* is supported by the observations of Cressler. According to Rosendahl, *D. dilatata* is indeed four times as active a poison to the tape worm as the true *aspidium*. According to V. Penndorf, in Germany, the

[3] U. S. Dispensatory. 24th revised edition, edited by Osol and Farrar. Vols. 1 and 2. Lippincott, 1950. $25.00.

rhizomes of *D. spinulosa* and *Athyrium Filix-femina* are frequently mixed with those of the true male fern, in quantities varying from five to ninety per cent. The rhizomes of *A. Filix-femina* are easily recognized by having only two large dumbell-shaped steles. . . . On account of this substitution, many of the German extracts of the male fern are said to contain *aspidin*, a yellow crystalline substance having a melting point of 124 to 125° C., which is found only in *D. spinulosa.* Laurens, of Helsingfors, states that the extract of *D. spinulosa* is a very active tenicide, and is less apt to produce disagreeable symptoms in the patient than is the official drug. . . .

"On the Pacific coast *D. rigida* Underw. is used locally against the tape worm. . . . Popular belief has long ascribed tenicidal virtues to our native lady fern. . . . According to R. Kuersten, its active principle, pannic acid, is not closely allied to filicic acid. . . .

"Under the name *inkomankomo* or *uncomocomo,* the rhizome of *D. athamantica* has long been used by South African Kaffirs, and has entered European commerce as *Pannum.*"[4]

Four and a half of the large, closely printed pages are devoted to descriptions of the rhizomes, preparation of them for sale, and to the preparation of the oleoresin which is the commercial product sold for prescription purposes.

The active ingredient is described as a strong poison, usually not readily absorbable in the human digestive system, but with its absorption accelerated if associated with an oily purgative. Its effective action is to relax the non-striated muscle fibers of the parasitic worm, but its possible harm to man comes from a similar action on striated or voluntary muscle. One of the chief adul-

[4] Quotations taken from an older edition of the Dispensatory.

terants reported as used in the United States has been the rhizomes of *Osmunda Claytoniana,* a product completely ineffective for the purpose desired.

The much higher activity reported for the product of *Dryopteris dilatata* interests me as in line with Dr. Wherry's recent comments on the specific distinctiveness of this mountain spinulose fern. That point of view, which has frequently been supported in the pages of the Fern Journal, received one of its first broader adoptions in the revision of the ferns in the Illustrated Flora, contributed by W. R. Maxon over forty years ago.

The Dispensatory is authority for the statement that male fern has been used for over two thousand years, and that it "is mentioned as a vermifuge in the works of Dioscorides, Theophrastus, Galen, and Pliny." One may wonder how its value was first recognized, by what trial and error or other method of divination it was discovered that this common fern provides a specific for the dislodgment of parasitic worms. Much later, according to the "Doctrine of signatures," the shape of some part of the plant could be counted upon to furnish the clue to its divinely designed use. On that basis, maidenhair ferns were obviously the best specific for hair difficulties. Perhaps the air waves which now ring with the virtues of chlorophyll will some day resound with the values of maidenhair for baldness.

For the final question which came to mind, I had recourse to our family doctor and to two druggists. Is *Aspidium* or *male fern* still counted an effective specific for tape worm, or has it been replaced by some synthetic substance? The first druggist, in the Flatbush detached home section of Brooklyn, said he had had no call for it for a long time. He thought a new synthetic was preferred. The doctor, in the same section, said he had not had a case of tape worm for several years, but that he would expect to prescribe *aspidium* if he had occasion for it. The second druggist, a former student, now a partner in the Chinatown Pharmacy, showed me a container of the oleoresin product, and said it was not infrequently called for.—R. C. BENEDICT.

FERNS OF GEORGIA.[1]—A new book on the ferns (and fern allies) of Georgia fulfills a real need, for the species of this state have not been treated or even listed since 1905 (The Fern Flora of Georgia, by R. M. Harper, Fern Bull. Vol. 13). Dr. Harper reported 53 native species. Botanical exploration during the last forty-five years has added some 20 species to the list, some of which had been previously reported but without the preservation of substantiating specimens.

Among the additions are *Lycopodium Selago* var. *patens* (first collected in 1936 and so far known only from Rabun County), *L. lucidulum, L. complanatum* var. *flabelliforme, Selaginella tortipila, Pilularia americana, Psilotum nudum, Isoëtes melanopoda, Equisetum arvense* (an introduction?), *Trichomanes Boschianum, Vittaria lineata, Dryopteris Goldiana* (Union County, 1947), *D. Clintoniana* (Dade County), *D. intermedia, Cystopteris fragilis, Ophioglossum vulgatum, O. crotalophoroides* (Meriwether County, 1948), *O. Engelmannii,* and *Osmunda Claytoniana.* Some of these are large and conspicuous plants, so it must be assumed that they are mostly rare or local to have been overlooked so long.

One reported addition must be questioned, the record of *Equisetum laevigatum.* The definite report is based on specimens collected by Dr. Wilbur Duncan, through whose courtesy I have examined the material. In my opinion the specimens are *E. hiemale* var. *elatum* rather than *E. laevigatum.* Therefore, the Georgia record for

[1] Ferns of Georgia, by R. McVaugh and P. H. Pyron. pp. 1–195. Illust. University of Georgia Press, Athens, Georgia. 1951. $5.00.

E. laevigatum must rest on the inclusion of Georgia in the range on the map of the distribution by Prof. Schaffner.[2] The dot on the map shows approximately Polk County, Georgia. However, no specimen is cited, and there is none in the herbarium of Prof Schaffner, according to information received from Dr. Clara Weishaupt, Curator of the Herbarium, The Ohio State University. The record must therefore remain dubious.

The authors state that the first collection of *Dryopteris dentata* made in Georgia was in 1936. However, there is a specimen in the U. S. National Herbarium collected in Georgia, 2 miles north of Augusta, by Dr. Wherry in 1923. Incidentally, the authors indicate that this species is a "tropical American fern," which is not the whole truth; it was first described from Arabia, and is especially common in the Old World tropics.

The treatment is commendably conservative and in general accurate. Two full pages are devoted to each species, one for description and comments and one for maps and illustrations. The latter in particular are especially good.[3] The only notable omission is the failure to note Mr. Weatherby's description of the United States representative of the tropical *Polypodium polypodioides* as a distinct variety (var. *Michauxianum*).

All the species are provided with common names. Considering how little stability exists in the usage of Latin names, it is probably too much to expect uniformity in English names. However, when plants exceptionally do have really well-established common names it seems

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[2] Amer. Fern Jour. 29: 46. 1939.

[3] Except for the figure of the venation of *Ophioglossum Engelmannii*, which is inaccurate, and for the habit drawing of *Adiantum Capillus-veneris*, which is impressionistic rather than factual; it might be mentioned also that the solitary, unpaired pinnule on the lowest primary fork of the rhachis of *A. pedatum* has been omitted; the presence of this pinnule is important in interpreting the method of branching of this species, as demonstrated by Dr. Wagner.

too bad to have these arbitrarily displaced. Most readers know the narrow-leaved spleenwort, but they will hardly recognize it under the name "glade fern," or ebony spleenwort as "brownstem spleenwort."

Actually, however, there are very few things to criticize about "Ferns of Georgia." The description of *Adiantum* as having "the sori covered by strongly reflexed lobes" (p. 15) is not accurate; they are borne *on* the reflexed lobes, in contrast to such a genus as *Cheilanthes* in which they are covered by the lobes. *Vittaria* will hardly run down in the key to genera, as it is keyed with the group of genera having marginal sori; in the species concerned (*V. lineata*) the sori are distinctly intramarginal, in fact, almost medial. Incidentally, Ferns of Georgia uses the correct authority for this species, namely Swartz; a number of authors have ascribed the combination to J. E. Smith incorrectly, following Christensen (Index Filicum), e.g., Maxon (Pteridophyta of Porto Rico), and Copeland (Genera Filicum). However, the statement that *Vittaria* was established for another species is incorrect; *lineata* is the type of *Vittaria*, but J. E. Smith did not actually make the proper combination *V. lineata*. Another minor point is the statement (p. 68) that the pinnae of *Asplenium platyneuron* are easily distinguished from those of *A. resiliens* as they are not "oblique" in outline. The meaning is not clear (oblong?).

The book may be heartily recommended. It will be useful to all fern students, whether they live near Georgia or not.—C. V. MORTON.

Our librarian, Dr. Rolla M. Tryon, Jr., has published "A Sketch of the History of Fern Classification"[1] which will be of interest to members, professional and amateur alike. Dr. Tryon points out the place in history of Sir

[1] Annals Missouri Botanical Garden **39**: 255–262. 1952.

James Edward Smith, Olof Swartz, Karel Presl, Sir William Jackson Hooker, Antoine Fée, John Smith, H. Christ, Karl Goebel, Frederick Bower, E. B. Copeland, C. Christensen, and others. Dr. Tryon has had a number of reprints of his article made, and has kindly sent them for distribution gratis to Fern Society members. Those wishing a copy should address a request to me.—C. V. MORTON, *Smithsonian Institution, Washington, D. C.*

American Fern Society

NEWS NOTES

Harold Goddard Rugg, who joined the Fern Society in 1906, is retiring this year as Librarian of Dartmouth College after many years of service at that institution. He has served the Society in many ways, as President, as Treasurer, and also as leader (with Robert Doray) of the Vermont field trip held so successfully last summer.

Ralph C. Benedict, member of the Society since 1905, is retiring from the Biology Department of Brooklyn College. His total service in the public educational system of New York City has included 22 years at Brooklyn College and 19 and a half years in the city high schools.

We are sure that both of the members mentioned above will continue their fern activities, perhaps even more actively than heretofore.

We are sorry to note the death in Tokyo, December 6, 1952, of the distinguished Japanese fern student, Dr. T. Nakai.

We are also grieved to hear of the recent death of our Honorary Member, Dr. Douglas Houghton Campbell. A further notice of Dr. Campbell will appear in a future issue of the Journal.

One of our members, Mr. William S. Johnston, 65 Morris Lane, Scarsdale, New York, writes in:

"I have been having trouble in establishing some ferns, notably the ebony spleenwort. I have tried many times, but it never seems to flourish, even though planted in the shade among rocks or in black humus soil. I have dug up big, healthy plants in the Poconos, but I still have to keep replacing them. My experience with maidenhair spleenwort has been about the same. I have planted walking fern on limestone and even spread ground limestone around the ferns, but they do not spread and walk around; rather they contract and gradually disappear. I have not had much success either with climbing fern, but the trouble may have been partly mine, as I did not realize originally that it needs very acid conditions. Moreover, the last plants I bought were not particularly good stock."

Readers having comments on Mr. Johnston's problems are invited to send them in.—R. C. B. & C. V. M.

FIELD TRIPS SCHEDULED:

CONNECTICUT: Two of our members, Miss Alice Bristow and Miss Helen Bristow, will be leaders for a visit on July 18 to the three sanctuary areas established by the New Canaan Bird Protective Society. These areas are naturally wooded and partly swampy, and one is fenced. Numerous fern species occur naturally in the area, and there is a plan to introduce others, to give them the protection of the sanctuaries and to make them available for educational purposes. New Canaan is located near the southwest corner of Connecticut, in Fairfield County. At the meeting there will be a chance for the examination of photographs, books, and fern specimens. For further information write to Miss Helen Bristow, Silvermine Road, Norwalk, Connecticut.

NEW JERSEY MEETING CANCELLED. Because of the illness of Mr. Mann, the proposed meeting on June 27 has been cancelled.

New York and Montreal: The itinerary will include Wilton, Pilot Knob (on Lake George), Paradox Lake, Ausable Chasm, and Lake Champlain, in New York, and St. John and Montreal, in Canada. It will begin on August 14 and last for five or six days. A large number of native species of ferns, probably more than 60, will be observed during the trip, and the Montreal Botanical Garden has three large greenhouses filled with tropical species, as well as a large outdoor collection of hardy species and varieties. Leaders will include Miss Orra A. Phelps (Gansevoort), Mr. William H. Mann, Sr. (Glens Falls), Dr. R. C. Benedict (Pilot Knob), Dr. Stanley J. Smith (Lake Champlain), and Dr. Marcel Raymond (Montreal). For definite information and schedule send a self-addressed, stamped envelope to R. C. Benedict, Pilot Knob, New York.

Michigan: The summer foray of the American Fern Society will begin on Sunday evening, August 30, in Alpena, Michigan, and end Saturday evening, September 5, at Iron Mountain, Michigan. Altogether about 800 miles will be covered, mostly over good highways. It will be a delightful vacation, much of it near the shores of the Great Lakes, and there will be opportunity of seeing a large number of rare ferns and meeting many interesting people. Arrangements will be made in advance for accommodations and food, and expenses will be kept to a minimum. It is believed that there well be enough members present with cars to take along those lacking transportation. The trip will end in sufficient time for members to attend the annual meeting of the Fern Society in Madison, Wisconsin. The leaders for the Michigan trip are W. H. Wagner, Jr., Dale J. Hagenah, and Mrs. Kathryn Boydston, Fernwood, Route 3, Niles, Michigan. A detailed notice of the trip and reservation blank may be obtained from the last named.

INTERNATIONAL BOTANICAL CONGRESS.—The next international botanical congress will be held in Paris, France, July 2–14, 1954. An early announcement is made so that Fern Society members may make plans well in advance for attending. There will be special sessions for ferns, and those wishing to deliver papers are urged to communicate with Mme. Tardieu-Blot, Museum d'Histoire Naturelle, 57 rue Cuvier, Paris V, France. There will be excursions before the congress to Brittany, Normandy, Alsace, and other interesting regions, and excursions following to the Alps, the Pyrenees, and Nice. Tentative programs may be secured now by addressing the Secretariat General du 8e Congres International de Botanique, 292 rue Saint-Martin, Paris 3, France.—C. V. M.

LIST OF FERN DEALERS.—In response to some requests the following very incomplete list of nurserymen currently specializing in ferns is offered. The firms marked with an asterisk have Fern Society members in their establishment. The list has been prepared largely by Mr. M. D. Mann, Jr., and Mr. H. G. Rugg.

Aiken Nurseries, Putney, Vermont
*J. F. Anderson, Short Hills, N. J. (House ferns).
F. M. Crayton & Sons, Biltmore Station, Asheville, N. C.
Gardens of the Blue Ridge, Ashford, MacDowell County, N. C.
Hildemere Gardens, Wawa, Pennsylvania
Horsfords, Charlotte, Vermont
*Johnson's Nurseries, Southwick, Massachusetts
*William H. Mann, Sr., Queensbury Road, Glens Falls, New York
Mayfair Nurseries, Box 87, Hillsvale, N. J.

*Mitchell Nurseries, Barre, Vermont

*Red Cedar Wild Flower Nursery, Falls Village, Connecticut

E. C. Robbins, Ashford, MacDowell County, N. C.

*Julius Roehrs, East Rutherford, N. J. (House ferns)

Frank Rose, 1020 Polar Ave., Missoula, Montana

*Carl Starker, Hennings Lodge, Oregon (Western ferns; English varieties)

Wake Robin Farm, Askov, Minnesota

Will others desiring to be listed please write in?—R. C. BENEDICT.

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Mr. Alfred Byrd Graf, Julius Roehrs Co., East Rutherford, N. J.
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Mr. S. Charles Thacher, 2918 Brownsboro Road, Louisville 6, Ky.
Mrs. Frieda L. Wertman, 10613 Brunswick Ave., Kensington, Md.

Changes of Address

Mr. Rollin C. Bastress, 225 Park Way, Maywood, New Jersey
Mr. Bill Bauer, Botany Hill, Imperial, Missouri
Dr. R. C. Benedict, Pilot Knob, New York
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Dr. Donald M. Britton, 11105 87th Avenue, Edmonton, Alberta, Canada
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Mr. Peter Osterlund, Route 3, Luck, Wisconsin
Dr. Clyde F. Reed, 10105 Harford Road, Baltimore 34. Maryland
Dr. Jesse M. Shaver, 1706 Linden Ave., Nashville 12, Tenn.
Miss Lucille Evans Swendsen, 2129 E. Kenwood Blvd., Milwaukee 11, Wisconsin.

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Duplicates from the Fern Society Library

MATHEWS, F. S. Field Book of American Wild Flowers. 1912.	$2.00
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WOOD, A. Class-book of Botany. 1850.	$2.50
WOOD, A. Class-book of Botany. 1867. (Boards loose)	$2.00
EATON, A. and J. WRIGHT. North American Botany. 1840.	$2.00

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American Fern Journal

VOL. 43 JULY–SEPTEMBER, 1953 NO. 3

Douglas Houghton Campbell in the Classroom and on the Campus

IRA L. WIGGINS

The last survivor of the original faculty of Stanford University was a famous botanist, Douglas Houghton Campbell, who died on February 23, 1953, at the age of 93. He had been head of the Department of Botany at Stanford for thirty-four years and had trained scores of botanists when he retired from active teaching at the end of August 1925. He was an Honorary Member of the American Fern Society since 1915.

Dr. Bradley Moore Davis, who attended some of Campbell's classes at Stanford in 1891, is preparing, with the cooperation of other students and colleagues of Dr. Campbell, an account of Campbell's life and scientific accomplishments. I, as a member of his classes during his last year of active teaching, wish to record a few incidents connected with that final year of academic activity and to present some of the personal aspects of his association with his students and fellow botanists. These episodes and memories are presented with the hope that, through them, others may more fully appreciate the human attributes that added to the greatness of his stature as a scholar, a citizen, and as a friend of many botanists in both the New World and the Old.

Douglas Houghton Campbell entered his final year of teaching on the first of October, 1924, with a group of five graduate students enrolled in his course "The Mor-

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phology of Bryophytes." Two, and at times three, other advanced graduate students audited his lectures or occasionally studied some of the rare material he presented in the laboratory. It was my great privilege to be one of the five regularly enrolled in the course, and during the following quarter, in his equally stimulating course in "The Morphology of Pteridophytes."

Dr. Campbell was a vigorous teacher, with a quickness of mind and a breadth of knowledge of the anatomy, morphology, and geographic distribution of the bryophytes and pteridophytes that kept his students fascinated and alert. The agility of his mental processes made him impatient with slowness on the part of students and sharpened his tongue when his explanations were imperfectly comprehended. He met his class thrice each week for a one-hour lecture, sat behind a scarred table on a dais-like platform in one corner of Room 472, and talked rapidly about the stages in the development of gametophyte and sporophyte, the evolutionary pattern revealed in various structures, and the geographic distribution of species he considered particularly significant. He frequently enlivened his discourse with brief accounts of incidents that had occurred on collecting trips to Java, New Guinea, the Philippines, Australia, and other far parts of the world.

He had two mannerisms that constantly amused or irritated members of his classes, depending on how the individual viewed his actions. He wore rimless pince-nez spectacles on a chain attached to a spring-actuated reel pinned to the lapel of his coat. Since he was near-sighted and wore the glasses to improve his distant vision, he removed the glasses when he turned to the blackboard to sketch some structure, jerked the chain slightly to release the catch in the reel, then dropped the spectacles, allowing them to whizz the length of the chain and snap against the metal case of the reel. Most of us soon ignored the periodic "zzi-i-z snap" of the rewinding reel, but the click of the lens against the case kept one young lady almost on the verge of nervous prostration. His other idiosyncracy was a habit of popping the knuckles of first one hand, then of the other, time after time during each lecture.

Regardless of our individual reactions to the snap of the spectacle lenses and the cracking of his knuckles, none of us let them interfere with our close attention to his lectures nor with our scribbling and the rapid reproduction of as many of his sketches as we could manage. Since he sketched and talked simultaneously, we often let *our* sketches form the skeleton around which we fleshed out the rest of the lecture later. The notes taken in the two classes on the mosses and ferns constituted a fairly full outline of Campbell's "Mosses and Ferns," and contained, in addition, comments on special segments of research he had carried on during his long period of productive writing.

Few teachers can successfully employ the methods Dr. Campbell used in the laboratory. He gave us no printed or mimeographed syllabus. He wrote almost no directions on the blackboard. At the beginning of each laboratory period he would bring one or more boxes of slides—almost all of which he had made himself in connection with his researches—and often several bottles of mosses, liverworts, or ferns preserved in fluid, into the laboratory. He then gave us a rapid-fire set of verbal directions covering the period's assignment. We were to study the slides, compare the sections with figures in his text or in reprints of research papers, and make certain drawings, sketches and diagrams. After giving the directions for the afternoon's work he retreated into his combination office-study-laboratory, from which he emerged two or three times during the course of the three-hour session to make quick inspections of the drawings being made and to answer questions bearing on the material under scrutiny. He disliked being asked to repeat instructions or an answer to a query. He wasted no time in inconsequential chit-chat. He worked steadily in his laboratory, we stuck to business in ours! We didn't quite fear him, but we held him in great respect and none of us ever thought seriously of playing pranks on him or in his laboratory.

Dr. Campbell left his office to walk to the post office, thence to his home, promptly at five each afternoon. The students rarely were able to depart within an hour of that time on laboratory days. If we fell behind in completing an assignment we simply stayed later to finish it, for we early learned that an incompleted laboratory task brought no diminution in the work laid out for the following laboratory period! At times one or another of us would become exasperated by Dr. Campbell's obliviousness to the claims other courses had on our time and energy, but such spells of temper were short-lived, for we appreciated the privilege of studying under his tutelage.

We watched him cut beautiful median longitudinal sections of moss sporophytes held lightly between thumb and forefinger, his glasses dangling on his lapel, the sporophyte four or five inches from the tip of his nose, and using two quick, deft strokes with a sectioning razor kept honed to perfection. Not once during the two quarters we watched him cut free-hand sections did he so much as nick a finger. He rarely discarded a section, and rarely was one too thick to be usable when mounted in water and glycerin as a demonstration slide. I strongly suspect that he took a secret delight in showing us what he could do with a hand-held sectioning razor, for he made numerous "demonstration sections" which we were permitted to examine briefly before making our own, but never permitted to draw directly. Several times he chuckled when one of us exclaimed about the precision of his razor strokes, and made some quiet remark to the general effect that when he first started to cut sections the rotary microtome was unknown to him and that if one wanted to do acceptable research in the anatomy of plants he jolly well had to learn to cut good freehand sections!

It would be easy to fill many pages with reminiscences about Dr. Campbell and our association with him during the twenty weeks of the two quarters we spent in his classroom and laboratory during his last year of formal teaching. But my own good fortune extended years beyond that period, for in 1929 I became the junior member of the faculty in the Department of Botany at Stanford and from that time until he quietly passed away, Douglas Houghton Campbell was my colleague, botanical adviser, and highly esteemed friend. In spite of my youthfulness, Dr. Campbell was neither condescending nor patronizing. He was straightforward, sometimes brusque, but kindly disposed toward anyone interested in botany and willing to exert himself to advance that field of study and research.

It would be a libel of his breadth of interests were one to give the impression that Dr. Campbell was concerned only with the fields of botanical endeavor. He loved good music and was a staunch patron of the opera and symphony. It was a tremendous disappointment to him when his doctor no longer permitted him to take a morning train to San Francisco, visit with fellow members of the Bohemian Club or critically examine the paintings in one of the art galleries, and then spend the evening at an opera or concert. Not only was he fond of the work of both old masters and modern artists, but all through the years as he journeyed about the world on collecting expeditions he made scores of pencil sketches and water color paintings. He painted with a quick deftness, a sureness of hand and eye, and with a fine knack for matching Nature's subtle colors on his sketch pad.

Throughout his years of active duty at Stanford and for nearly fifteen years after he joined the ranks of the emeriti, Dr. Campbell kept a saddle horse and regularly rode the equestrian trails west of the campus. Although he enjoyed riding on the back of a horse, he disliked automobiles and refused to acquire one. He preferred to walk from his home to the post office, to Palo Alto, or to his office, rather than accept a lift in a neighbor's car. At ninety he walked over a mile several times a week to get his mail, or to sit in his old laboratory-office and read botanical journals and current reprints. On his walks he refused to carry a cane, although he had a number of them in a rack beside his door, some of which he prized highly.

His home was set in the midst of a garden on a hillside and surrounded with a tremendous number of plants of many varieties. His Chinese houseboy helped him some with the planting, watering, and pruning, but he planted mainly those things that required a minimum of cultivation and care. He was keenly interested in growing things considered exotic in that part of the state and tried scores of introductions—only a few of which prospered. He was very proud of the few that did live on his protected hillside. He was proud, too, of the Coast Redwood which he planted as a nursery seedling less than three feet high in 1914, and which had attained a height of 126 feet and shaded a third of his front yard by 1950. His bush paeonias were probably the plants which gave him the most satisfaction and for many years he held open house for his friends on a Sunday afternoon when the paeonias were at their best.

As his physical strength waned—and his loss of vigor was not particularly apparent until after he had passed his eighty-fifth birthday—Dr. Campbell neither complained nor felt embittered. He once said to me, "I've had a very satisfactory life. I came to Stanford before the mosses and ferns of this region had been studied and found them a veritable treasure-house. Dr. Jordan let me go just about where and when I pleased, and I was fortunate in being able to indulge in a great deal of travel. My work here at Stanford was extraordinarily fascinating and afforded me a tremendous opportunity. I am well satisfied." (It might be added that Dr. Jordan once rather wryly admitted that he had let Campbell go on his extended field-trips whenever he asked for a leave of absence because he knew that if he had said, "No," Campbell would have gone anyway).

Dr. Campbell's mind remained actively clear and his memory excellent right up to the time of his passing. I saw him last on December 22nd, 1952, and at that time he related with glee his experiences with an ill-smelling staminate cone of *Cycas circinalis* which he had placed on a closet shelf in his hotel room to dry. Its stench permeated the entire building and when the source of the disagreeable odor was discovered Dr. Campbell was unpopular with the other guests and with the management alike!

As I was about to say good-bye to the venerable botanist he wished me good luck and then said, "Wiggins, I've never been in the Arctic. It didn't appeal to me as much as the tropics, but I wish I were fifteen or twenty years younger———. I'd like to go with you." That unquenchable interest in distant parts of the world, in new situations and strange plants, that had spurred Dr. Campbell to venture into many corners of the earth epitomizes the man in my memory. He was a great botanist, admired and highly esteemed by his friends, students and colleagues. We forget his death in the memory of his life and its accomplishments.

Observations on Members of the Genus Lycopodium, I. Germination of Gemmae of L. lucidulum

HERBERT M. CLARKE

During the past few years a number of experiments have been set up to determine the behavior of cuttings of *Lycopodium lucidulum* Michx. In one of these experiments terminal portions of the stems of *L. lucidulum* approximately one centimeter in length were inserted into mineral nutrient agar. The agar was slanted in square glass bottles which were closed with metal lids lined with either tinfoil or waxed cardboard. Prior to planting some of the cuttings were dipped in "Rootone" powder, others had a small amount of "Carbowax" containing 1 gram of indol-acetic acid per 50 grams of "Carbowax" applied at their bases, and still others were untreated. The bottles containing the cuttings were placed on a shelf in a north window.

Although a rather large number of cuttings died as a result of severe algal and fungal contamination, in several of the bottles there was a development of shoots from the bulbils or gemmae while they were still attached to the parent stem (Fig. 1). This development of shoots by the gemmae while they were still attached to portions of the parent plants occurred on the cuttings which had been treated according to the two methods described above and on the untreated cuttings as well. In nature the gemmae fall from the parent plant soon after their production and normally lie on the ground or among fallen leaves until the following spring when further development occurs.

A gemma is attached to a persistent base by a narrow isthmus of cells. This isthmus is traversed by a single vascular bundle, resembling, according to Smith (1920), a leaf trace that branches into the smaller leaf traces of the paired leaves composing the gemma. In nature, rain, mechanical disturbance, and wind are largely responsible for breaking the gemma loose from the base and allowing it to fall to the ground where it eventually germinates.

FIG. 1. TWO CUTTINGS SHOWING THE DEVELOPMENT OF SHOOTS FOLLOWING THE GERMINATION OF GEMMAE STILL ATTACHED TO THE CUTTINGS. ×1.

In the culture bottles, external factors which would disturb the connection of the gemmae to their bases were absent; hence the gemmae stayed in place. Since moisture was available in the agar and the room temperature was suitable for continued growth, the attached gemmae continued their growth while still attached. The number of gemmae that were found growing on a cutting varied from four to nine. In some cases they were all members of a single whorl, while in other cases some of the gemmae belonged to a basal whorl and others to a later formed whorl that grew out at a higher level. In most of the cuttings which bore these developing gemmae, the main axis elongated very little and was eventually exceeded in length by the stems produced from the developing gemmae. In the cases where the main axis did grow extensively, the new portion of the stem was more slender than the portion present when the cutting was made.

FIG. 2. LONGITUDINAL SECTION OF TERMINAL PORTION OF CUTTING AND ONE OF THE ATTACHED GERMINATED GEMMAE. ×20.

The cuttings whose lower ends were inserted into the agar have not produced roots. This may perhaps be partially explained by the fact that the oxygen content of the agar around the bases of the cuttings is low with the result that initiation of roots is inhibited. Further, the short portions of stem involved in the cuttings are relatively young; even field-grown mature plants are very scantily supplied with roots and these roots emerge only from older portions of the stem. In the normal development of a gemma, two root primordia are formed near its base. These root primordia form the first two roots of the plants developed from gemmae. Among those attached gemmae which developed, there was a single individual in which one of the root primordia of the gemma enlarged and grew out through the basal part of the gemma. This root extending out into the moist air of the culture bottle was about one half centimeter in length and bore many root hairs.

In order to make longitudinal sections showing the attachment of the developed gemmae to the bases, a few of the cuttings with their attached germinated gemmae were killed in a formalin-propionic acid-alcohol fixative, dehydrated through a graduated butyl alcohol series, and imbedded in paraffin. Two views of this relationship are shown in Fig. 2 and Fig. 3. Many of the branches broke away from the bases during the imbedding process since the attachment as is shown in the figures is a very delicate one. The single small vascular bundle surrounded by a narrow area of parenchyma cells is sufficient to support the small branch if it is undisturbed but this connection is easily broken if the branch produced by the outgrowth of the gemma is disturbed. In the cases where the gemmae have grown out the amount of tissue present at the junction point remains the same as when the gemmae were first formed; no indication of meristematic activity was found in the material which was sectioned.

The early investigators of the gemmae-producing species of *Lycopodium* have expressed various opinions regarding the nature of the gemmae. At present the prevailing idea is that these gemmae are morphologically equivalent in origin to leaves. This idea is based on the fact that in the gemma there is a single trace such as that found in an ordinary foliage leaf; likewise the earliest stages in the development of gemmae are indistinguishable from those of foliage leaf primordia.

Mrs. Arber (1941) has elaborated on de Candolle's view that the leaf is a partial-shoot, arising laterally from a parent whole-shoot. She points out that one of the mysteries of ontogeny lies in the fact that the leaf

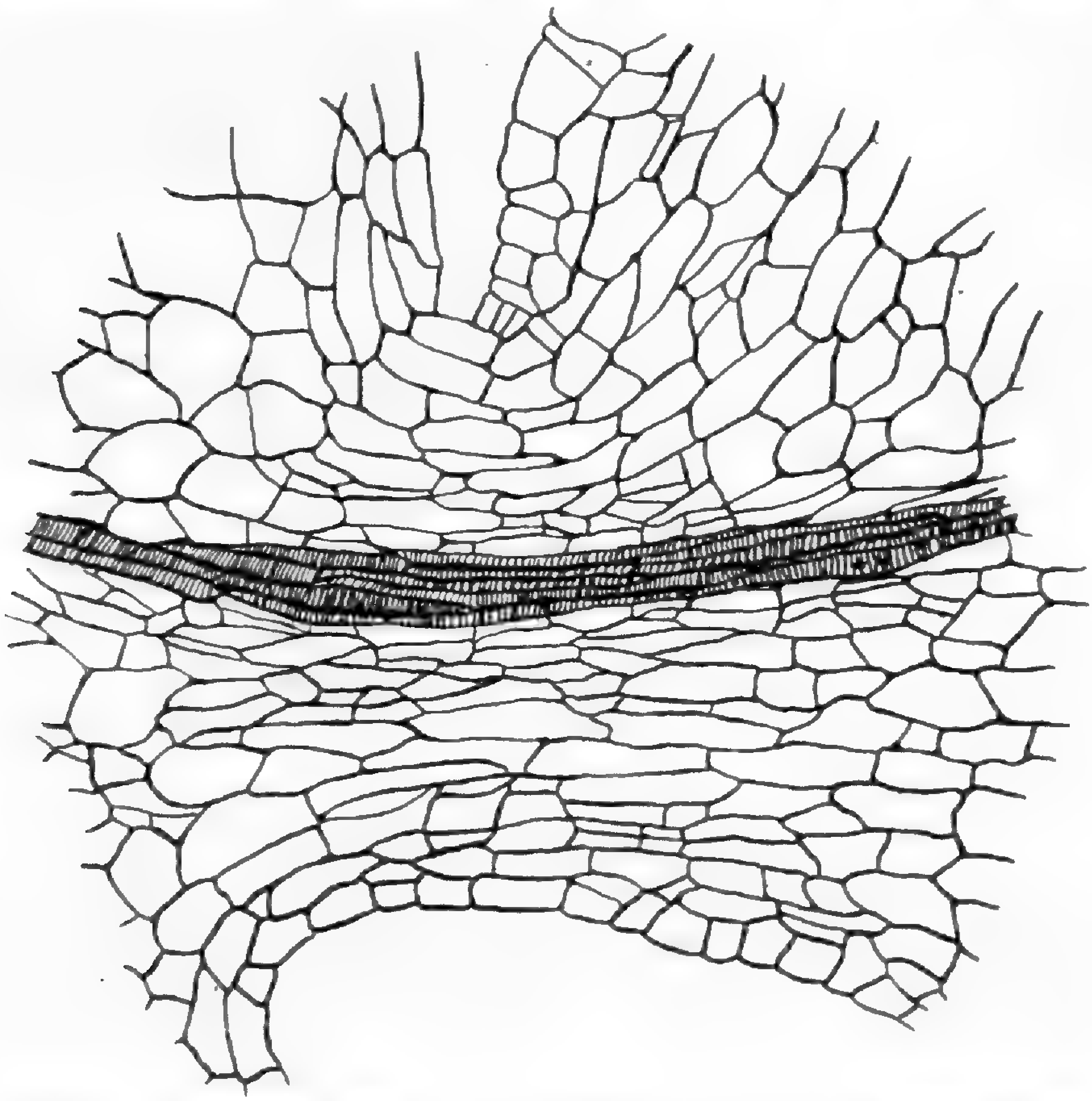

FIG. 3. CELLULAR DETAIL OF A PORTION OF FIG. 2 SHOWING THE NARROW ISTHMUS CONNECTING THE GEMMA TO THE PERSISTENT BASE. ×320.

develops to a certain point and becomes specialized whereas the adjacent axillary bud possesses the ability to become a whole shoot. In the genus *Lycopodium* there are no axillary buds, and branching is accomplished by a dichotomy at the stem tip. Here in *Lycopodium lucidulum,* the modified leaf, if a gemma may be considered as a modification from a leaf, becomes the whole shoot. In nature, the gemmae being easily detached initiate entire new plants rather than merely branches of the parent plant. In the cultures described above, however, factors causing the separation of the gemmae were absent and the gemmae developed into branches of the parent plant.

Botany Department, University of Wisconsin, Madison, Wisconsin.

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Arber, Agnes (1941). The interpretation of leaf and root in the Angiosperms. Biol. Rev. **16**: 81–105.

Smith, R. Wilson (1920). Bulbils of *Lycopodium lucidulum*. Bot. Gaz. **69**: 426–437.

A Cytological Study of the Appalachian Spleenworts

WARREN H. WAGNER, JR.

A preliminary report is made here of a study of the Appalachian spleenworts currently being carried out at the University of Michigan. The purpose of this report is to present some of the early results of the study of the chromosomes of these ferns, to bring to the attention of members of the American Fern Society the problems involved, in the hope that collectors will find some of the "missing links" of the approximately one dozen members of this complex.

The term "Appalachian Aspleniums" was proposed by Prof. Wherry to comprise the species and hybrids centering about *Asplenium montanum, A. bradleyi,* and *A pinnatifidum*. He pointed out[1] that they "form a series showing intermediates between certain long-recognized species," and has in collaboration with W. D. Gray illustrated a number of fronds to bear this out. In a

[1] This JOURNAL **15**: 47. 1925; **26**: 77. 1936.

recent review[2] the writer suggested the possibility that *Asplenium pinnatifidum* itself may be the hybrid *Asplenium montanum* × *Camptosorus rhizophyllus*. The further possibility that *Asplenium bradleyi* might have originated as a hybrid of *A. montanum* and *A. platyneuron* is suggested not only by morphological features, but by the fact that both of the presumed parents are believed to hybridize with *A. bradleyi*.[3] It is accordingly desirable to extend the concept of "Appalachian Aspleniums" to include two species which range far beyond the Appalachian region, *Camptosorus rhizophyllus* and *Asplenium platyneuron*, and this is being done in the present investigation. In recent years the number of different entities known in the entire complex has increased, and now includes the remarkable intermediate taxa *Asplenium gravesii* Maxon, *A. kentuckiense* McCoy, *A. stotleri* Wherry, *A. bradleyi* × *montanum* Wherry, *A. trudellii* Wherry, and *A. bradleyi* × *platyneuron* Wherry.

The best-known, and perhaps most bizarre, hybrid fern "is probably the American × *Asplenosorus ebenoides*, a bi-generic hybrid between *Asplenium platyneuron* and *Camptosorus rhizophyllus*."[4] This fern was the subject of considerable debate around the turn of the last century because, at that time, its hybrid origin was questioned. The problem was resolved by the well-known experiment of Miss Slosson, who produced the hybrid artificially.[5] Prof. Irene Manton has recently

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[2] *Ibid.* **41**: 90. 1951.

[3] It is interesting to note that in describing *A. bradleyi*, Eaton (in Bull. Torr. Bot. Club **4**: 11. 1873) pointed out that "in some of its more compound forms it is related to *A. montanum*." Clute (in Our Ferns, p. 205) actually refers to the hybrid theory.

[4] Alston, A. H. G. "Notes on the supposed hybrids in the genus Asplenium found in Britain." Proc. Linnean Soc. Lond., Session 152, **1939–40**: 132.

[5] Bull. Torr. Bot. Club **29**: 487. 1902.

shown the value of chromosomes in evaluating whether or not ferns are of hybrid origin.[6] In the case of the typical sterile hybrid *Asplenosorus ebenoides,* the chromosomes from the two, presumably distantly related, parents would be expected to be so dissimilar genetically that they would pair irregularly or not at all at the time of reduction-division in spore formation.

Living plants of *A. ebenoides* which had every indication of being sterile were collected by the writer at White's Ferry, Montgomery County, Maryland. Cytological studies of young sori of these show that there is indeed a seemingly complete lack of homology between the chromosomes, so that there are seventy-two "univalents," i.e., discrete chromosomes, 36 of these presumably derived from the one parent, *Asplenium platyneuron,* and 36 from the other, *Camptosorus rhizophyllus.* In a normal species of the genus *Asplenium* or *Camptosorus,* on the contrary, there are visible during spore formation only 36 units, each actually made up two closely paired chromosomes ("bivalents").

The question then arose as to whether the famous Alabama population of *Asplenosorus ebenoides,* which is fertile and capable of producing normal spores and gametophytes, might have an automatically doubled chromosome number, i.e., a total of 144 chromosomes, and 72 normal bivalents at time of spore formation, made possible by duplication of each of the chromosomes of the sterile hybrid. Through the kindness of Miss Mary E. Groff, who had been growing it for some years, a plant was made available for investigation. It proved indeed to show exactly this relation, that is, to possess twice the number of chromosomes of the ordinary sterile hybrid.

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[6] Problems of Cytology and Evolution in the Pteridophyta. Reviewed in this JOURNAL, 41: 88. 1951.

Living specimens of various populations sent by Mr. Neal W. Gilbert, Dr. Everett G. Logue, Dr. Edgar T. Wherry, Miss Clara S. Hires, Dr. Charles B. Heiser, and Mr. Floyd Bartley have made it possible to determine that the chromosome numbers of *Camptosorus rhizophyllus, Asplenium platyneuron,* and *A. montanum* are all $2n = 72$. But both *Asplenium pinnatifidum* and *A. bradleyi* have so far yielded, like the Alabama *Asplenosorus ebenoides,* the number 144. Such observations will enable us to diagnose the parentage of certain hypothetical hybrids. For example, if *Asplenium kentuckiense* is the hybrid *A. pinnatifidum* × *platyneuron,* then its chromosome number would be 108; but if it is *A. bradleyi* × *A. pinnatifidum* its chromosome number should be 144.

The method has thus far been profitably applied to *Asplenium trudellii,* which has been regarded both as a hybrid of *A. montanum* and *A. pinnatifidum,* and as a variety or form of *A. pinnatifidum.* If it is a hybrid, the chromosome number should be 108; if a form or variety, 144. Two populations of *A. trudellii,* one from Pennsylvania sent by Wherry and Trudell, and another from West Virginia sent by Gilbert, have actually yielded 108 chromosomes, confirming the hybrid interpretation. Especially interesting is the observation that chromosome pairing at the time of spore production (which must be complete to produce normal spores) is far from complete. Further attention is now being given to the behavior of these chromosomes, for this may be expected to provide evidence as to the nature of its parent, *A. pinnatifidum.* If the latter is itself a hybrid of *A. montanum* and *Camptosorus,* in which the entire chromosome complement has become doubled, then its prothallia should have cells each of which contain 36 chromosomes from the mountain spleenwort and 36 chromosomes from the walking-fern. If a sperm from such a prothallium should fuse with the egg of a prothallium of the mountain spleenwort, then there should be 72 (36 plus 36) chromosomes of *A. montanum* and 36 chromosomes of *Camptosorus* present in the embryo and the resultant free-living fern hybrid. Therefore one would expect to have about 36 pairs (bivalents) and 36 univalents at the time of spore production. Whether this is actually the case or not must be determined by making numerous drawings of cells undergoing reduction-division, and counting the bivalents and univalents.

An effort is being made to get as many different living populations of the Appalachian Aspleniums as possible, so that each taxon can be examined from several localities. During this investigation it has become evident that a number of herbarium specimens have been misnamed, or misinterpreted. The morphological characters of the members of this complex of ferns should be more clearly established in the course of the present work.

Throughout this work, I have been indebted to Mr. Walter Kleinschmidt, Superintendent of the Botanical Gardens at this University, for overseeing the cultivation and care of the 34 populations of Appalachian Aspleniums which are now growing here. Professor Wherry has given a number of valuable suggestions. Additions to the series are greatly desired; those most needed are the following: *Asplenium gravesii, A. kentuckiense, A. ebenoides* (both sterile populations, and fertile populations other than the Alabama one), *A. bradleyi* × *platyneuron*, and *A. bradleyi* × *montanum*. However, I well realize that these are extremely rare plants; thus Mr. Thomas Darling, Jr., of Washington, D. C., has been searching for localities of *A. gravesii* for many years without success.

While the evidence gathered so far on the evolution of this group of ferns has been of considerable importance in our understanding of them, there are still numerous problems which require solution. For one thing, it will be noticed immediately by persons familiar with these plants that two of the supposed hybrids occur in places where at least one of their putative parents do not. For another, even after detailed study of their chromosomes and anatomy, final and full confirmation of parentages of each of the hybrids can be established only after each of the "species" has been produced experimentally.

DEPARTMENT OF BOTANY, UNIVERSITY OF MICHIGAN.

Fern Notes

MARY W. DIDDELL

In a recent issue of the Fern Journal, the plant described in Small's "Ferns of The Southeastern States," as *Phymatodes heterophyllum*, was changed by Alex Hawkes to *Microsorium heterophyllum* on the strength of Copeland having included the genus *Phymatodes* in *Microsorium*. However, this fern is neither *Phymatodes* nor *Microsorium*, as a study of it in connection with Copeland's description of the combined genera will show, but is properly a *Craspedaria*, being closely related to *C. vacciniifolia*. It was first named *Polypodium heterophyllum* by Linnaeus, in 1753. The synonymy is too long to include all of it here, but following successive changes, it was placed in *Craspedaria* by Fée in 1852, as *C. serpens*. Underwood changed it to *Phymatodes exiguum* in 1903 and Small, in his "Ferns of Florida," retained Underwood's genus but restored Linnaeus' specific name *heterophyllum*. The name should be *Craspedaria* **heterophyllum** (L.) Diddell.[1]

Mr. Hawkes may say that this is no *Craspedaria*, since Copeland includes this genus in *Microgramma;* it is a

[1] *Polypodium heterophyllum* L. Sp. Pl. 1083. 1753.

matter of personal opinion. Mr. Hawkes is further mistaken in stating that this Fern is epiphytic: it is not altogether. It always grows with roots firmly anchored in the soil, the very slender, lax rhizome climbing the stems of trees to an approximate height of four feet, rarely more, and clinging, closely appressed to the bark by means of short, aerial rootlets. It is equally at home covering rotting stumps or forming a mat over rock heaps. Dr. Small states that it occasionally will climb to a height of twenty-five feet, but I have never seen it much over six. As it climbs it branches and rebranches, the lateral branchlets going around the tree trunk and covering the whole lower area with a close network of foliage.

The fern which heretofore has been known as *Dryopteris uliginosa,* is properly *Thelypteris uliginosa* (Kunze) Ching; it has the scales, venation and unicellular, whitish hairs of *Thelypteris;* the rhizome is simply dictyostelic, with two broad vascular strands entering the stipe, these uniting upwards in a gutter-shaped strand, becoming solid and terete in the rachis. In addition to differences in the scales and lack of hairs on the lamina, *Dryopteris* has a complicated dictyostelic rhizome with five vascular strands (three small and two large), entering the stipe and remaining distinct throughout. This species, as it occurs in Florida, is exindusiate. I have collected it over a widely scattered area from ditch banks within the city limits in Jacksonville, to a lime sink in Hillsboro County and have examined numerous specimens under the microscope, in various stages of maturity and immaturity, without ever finding a vestige of an indusium. This is one of the few decompound species of this genus.

T. uliginosa is sold in various Florida nurseries under the name *Cibotium barometz;* in a lot of ferns received from a California nursery was a plant of this species labelled *Dicksonia youngii*, a species name unknown to me. Another specimen of this fern, which had been bought for a *Cyathea,* was sent me from Texas for identification. It is a pity that the nursery associations cannot get together with a good pteridologist and get their fern names straightened out.

In a current issue of the Fern Journal, I note with interest Dr. Blake's collection of *Ophioglossum petiolatum* in South Carolina. I have been expecting to see this reported from South Carolina, as it has already been collected in Georgia. I have in my herbarium an unusually fine specimen, collected by Mr. E. P. Kearsley, a short distance north of the St. Marys River, in Camden County, Georgia. This species is widely prevalent in Duval and Nassau Counties, in Florida, occurring wherever the soil is damp enough; it may be found in almost any swamp, in low, open places, scattered among grasses and other low vegetation, or intermingled with grass in lawns. Once I saw it growing thickly about the base of a *Cocos australis* in a Jacksonville street planting.

Scientists are telling us that the world is growing warmer and the northward trend of some of our vegetation would seem to substantiate this: Water hyacinths, which a few years ago were considered to be confined to Florida, are now growing in streams and ditches about Savannah. I spent several weeks in Savannah in the spring of 1951 and on a Sunday afternoon drive to Isle of Hope, I noted a large plant of *Phlebodium aureum* growing in a palmetto tree beside the road. This is the only time that I have seen this fern north of the St. Mary's River. It does not occur too freely in Nassau County.

The old Colonial Cemetery in downtown Savannah has graves dating from Revolutionary times to 1850 and on many of the brick and cement tombs were growing *Pteris multifida* and depauperate plants of *Asplenium platyneuron.* The Savannah Cotton Exchange and other century old buildings have their rear elevations on the road that runs along the Savannah River and on these old brick walls I noted numerous dense colonies of *P. multifida,* the roots embedded in tufts of a common moss; apparently they had been growing there for a good many years. They all showed the effects of the then prevalent, excessively dry weather, but I collected a few of the best specimens for my herbarium, as I had not previously seen this species reported from Georgia.

A woman in northern Colorado sent a specimen to me for identification, which she wrote was a native Colorado fern, growing in rocks in wild and isolated places; the specimen, an exceedingly good one, was *Pteris multifida.* It would be interesting to know in what other states this is growing naturally.

LANSING, MICHIGAN

The Tallest United States Fern

R. C. BENEDICT

Red Smith, sports editor and columnist of the N. Y. Herald Tribune, in January was writing his dispatches from Chile. "Here it is midsummer and the trout season is on. That's the reason for this unlikely retreat from winter—the trout season. That and the basketball season. Six-thousand miles is no distance at all to travel to get to one and get away from the other." Speaking of rainbow trout, he goes on to say ". . . they throw the four-pounders back and cast for fifteen-pounders." And a twenty-three-pounder is said to be considered a "nice fish" in Chile.

Fishermen are noted for keeping track of the biggest fish ever caught, for each of the various game species. Forestry and conservation publications conduct contests to find the biggest specimens of different tree-species. What are the tallest and the longest fern-species in the

United States?

The distinction as to height and length has some significance. John K. Small, writing enthusiastically some years ago about Florida as "The Land of Ferns," cited leaves of *Nephrolepis biserrata,* a wild relative of the Boston Fern type, which measured over twenty-seven feet in length. And some of the Lygodiums which may grow in Florida almost certainly measure in comparable figures. Both these types reach their great lengths because the leaf tips continue to grow indefinitely unless injured; they never finish out a leaf. Both depend for support on other vegetation.

Fern books carry in the descriptions of various species statements as to the maximum dimensions of each species. Local books sometimes give only the figures to be expected within their range, but books covering wider territory usually cite also maximal sizes for each species. A little survey of a few fern books covering the northeastern states brought to light one favorite candidate for the title of "tallest fern" of that section. The fifty-year-old Parsons book "How to Know the Ferns" accords this honor to the ostrich fern. Parsons says simply "2–10 feet." This claim is subject to some question, since Gray's Manual cites royal ferns as reaching 3.5 m., the equivalent of 10½ feet, and the common brake (*Pteridium*) as reaching over 15 feet (in length, not height) in the case of the western var. *pubescens,* which has an eastern distribution limited to Michigan and parts of Quebec.

Does anyone know where ostrich ferns ten feet tall are to be found at the present time? The tallest I recall were some six-footers, seen along Randolph Gulf in Vermont during the 1952 Fern Society field-trip. However, a few years ago, the lower part of an ostrich fern leaf was shown me which was so thick that I could easily believe the whole leaf must have been ten feet long. I hope to track it down next summer to its lair near Lake George, and to make a camera record of it, with a tape measure for confirmation.

The preceding comments have been centered almost entirely about the eastern regions of the country. It will be understood that the best that can be claimed for the East is likely to be disputed in behalf of the southern and western regions. I am not prepared to cite even book statistics regarding western ferns, although I feel sure the beautiful western *Woodwardia* will be a competitor for the title. John K. Small (in his Ferns of the Southeastern States) gives figures which fully bear out expectations as to the large dimensions of many southern species. Apparently the palm for height goes to the leather-ferns, *Acrostichum aureum* and *A. danaeifolium*. A first trip to Florida in February of this year provided confirmation, as indicated in the illustration. The *A. danaeifolium* frond shown there was a good thirteen feet from top to its joining with the main stem. The particular specimen shown was collected at Vero Beach, in McKee's Jungle Gardens, one of the commercialized plantings of botanic garden type scattered about Florida. I would testify to its excellence, both in the parts through which guided tours are taken, and in the multitude of other paths where, when my botanical interests were known, I was free to wander. My thanks are due to its director, Dr. David Fairbarn, at one time on the staff of the Missouri Botanical Garden. Small cites fifteen feet as the maximum for these leather-ferns, which are likely to take the prize for sheer altitude, unless the western states have something taller to present.[1]

[1] Dr. T. M. C. Taylor has recently indicated to me that he has not seen any western ferns exceeding six feet in height, these being lady-ferns and *Polystichum munitum*, so the eastern record may remain unchallenged.

R. C. BENEDICT AND A 13-FOOT SPECIMEN OF ACROSTICHUM DANAEIFOLIUM

If the record for being the smallest U. S. fern is considered, books for the northern states seem agreed that the curly-grass has first claim. However, it would seem probable that one of the southern filmy ferns must have its claims. But both of these would be surpassed, on the small side, by the mosquito fern (*Azolla*), a whole plant of which, including many leaves, might be fitted on a dime. Because of its very different habit of growth, *Azolla* should probably be placed in a special class.

What are the tallest leaves which have ever been raised in fern gardens? Has any gardener ever tried the effect of heavy fertilizing? In the heyday of the cultivation of Boston Fern varieties (1905–1920), many florists were accustomed to use a potting soil with rotted manure as half the mixture and to add liquid plant food besides. Today, orchardists supplement soil-feeding by spraying nitrogen in solution on leaves of apples and other fruit trees. Probably many native ferns would not take kindly to forcible feeding, but it would be of interest to learn whether some of the rank-growing species would not respond by producing record-sized leaves.

Reverting to the fish story line of thought, and a recent report of a bonito mackerel over thirty-two pounds in weight, which won its captor over twenty-three hundred dollars in a season pool for 1952, one might envisage a future fern story about the "new record ostrich fern leaf, ten feet seven inches tall," raised (or found) by Harold Rugg, Hanover, N. H., which surpassed by three inches the best that Mr. M. D. Mann, Jr., of New Jersey, could offer. (The lushest fern growth I have seen in cultivation was in the Thurston garden at Sharon, Conn.) Beyond this I am restraining my imagination for the present.

BROOKLYN, NEW YORK

Shorter Notes

CULTIVATING THE APPALACHIAN QUILLWORT.—One day last spring, I visited the garden of Mr. Leonard J. Buck, at Far Hills, New Jersey, and observed in his pond an abundant growth of *Isoëtes engelmannii.* Two years before I had given him a culture of this quillwort from eastern Pennsylvania to try in his aquarium. He told me that he had put half of this into the pond, where it had thrived and spread. This proved fortunate, because the plants put in the aquarium were so attractive to the fish that they would get eaten up and had to be replenished from the stock in the pond from time to time.

As an experiment I once set a plant of this *Isoëtes* on a shallow layer of sand in an 8-inch tall pale yellow glass vase, which was then filled with water and placed on a south window-sill in the house. It grew there for several years, needing no attention other than the occasional addition of a little water to replace that lost by evaporation, and was the subject of admiration and inquiry from many a visitor.—EDGAR T. WHERRY, *Philadelphia, Pa.*

ADDITIONAL FERN FROM THE NORTH SHORE, LAKE SUPERIOR, MINNESOTA.—One more can be added to the ferns listed in the article by Dr. Olga Lakela, "A List of Ferns from the North Shore of Lake Superior, Minnesota."[1] Specimens of *Dryopteris campyloptera* (*D. spinulosa* var. *americana*) were collected at the base of a cliff, Lake Superior Terrace, near East Beaver Bay, Minnesota. An examination of the spores reveals the fact that some of the specimens are *D. campyloptera,* and others are the hybrid *D. campyloptera* × *spinulosa*. The spores and the fronds of the species are typical. Spores

[1] This JOURNAL **42**: 16–18. 1952.

of the hybrid are mostly abortive with a scattering of large potentially fertile ones, the latter exhibiting a mingling of characters from both parents. In the hybrid frond, the pinnae are ascending; the first and second inner pinnules of the lowest pinnae are approximately the same length, relating it to *D. spinulosa.* The *D. campyloptera* characters observed in the hybrid are: the large-sized lower pinnules on all pinnae, and the small, extra, upper inner pinnule of the lowest pinnae. The spore and the hybrid specimen will be illustrated in a paper now in preparation for publication.[2]—FERN WARD CRANE, *Summit, New Jersey.*

ASPLENOSORUS EBENOIDES IN INDIANA.—*Asplenosorus ebenoides* has previously been known only from Jefferson and Lawrence counties in Indiana; it may be of interest to record its collection from a third county. On September 6, 1948, I was exploring a rocky bluff at the junction of Beaver Creek and White River, about two miles west of Shoals, Martin County. The mossy sandstone rocks and cliffs abounded in ferns. On one large rock a single plant caught my attention. The specimen was rather high on the rock but it was obtained after some difficulty and then recognized as × *Asplenosorus ebenoides* (R. R. Scott) Wherry. *Camptosorus rhizophyllus* was abundant on the same rock and *Asplenium platyneuron* was common in rocky soil nearby. The plant had seven fronds, the largest with a blade 16 cm. long. A few pinnae were much larger than the others, up to 8 cm. long, with an elongate tip and an auricled base, appearing in fact like a small blade of *Camptosorus.* The specimen has been deposited in the Herbarium of the Missouri Botanical Garden.—P. F. TRYON.†

[2] The research project is supported by grants-in-aid from the Society of Sigma Xi and The American Philosophical Society.

SCHIZAEA GERMANI IN FLORIDA.—Early in March of 1952 I was exploring an extensive area of low pine flat-woods and cypress heads near Mecca, in Pinellas County, Florida. This is about 25 miles north of St. Petersburg and due west of Tampa. The pineland there is very rich in acid-loving plants of all types and so I was carefully examining an area near the southeast side of a large cypress swamp. While looking under a clump of saw-palmetto and gallberry (a black-fruited shrubby holly) I saw a little colony of *Burmannia* in bloom. When I got down to their level for a better look, I saw three tiny twisted stems rising out of the wet, rich earth. I dug them up for further examination, as they were unlike any plant I had ever seen before. When later examination showed a resemblance to the tropical "Curly Grass," *Schizaea* (*Actinostachys*) *Germani,* known in the United States only from Dade County, two hundred miles south and east), except for the terrestrial habit and solitary fronds, I sent the best specimen to Dr. Edgar Wherry. He replied that this was *Schizaea Germani* and added that young plants have solitary fronds and that only the older specimens have the tufted habit I had seen in herbarium specimens and illustrations. The habitat had apparently been altered by the climatic differences between Pinellas County and the Miami area.

It is of considerable interest that a number of tropical ferns are now known to have a disjointed range in Florida, being found in the Everglades and Keys region of Dade County, where the vegetation is generally tropical, and at sheltered spots, mostly in lime-sinks and hammocks, on the ancient highlands of the northwestern part of the peninsula, where an island arose in Oligocene times while the rest of Florida lay beneath the sea. One of these ferns is *Anemia adiantifolia,* a completely different-appearing relative of *Schizaea.* As the state began to rise another island appeared in Pinellas County around what is now the city of Clearwater. The "Pinellas Ridge District" from Bay Pines to Tarpon Springs, a long, narrow, sandy area of much greater elevation than the rest of the county, is the remains of this island. The locality where I found the Curly Grass is along what was once the eastern shore of this island. It is the only rare tropical fern I have ever found, however, in Pinellas County.

Since I first found *Schizaea* I have made a number of trips back to the spot to search for it but I have found only one more plant, about two yards from the first three. Due to its remarkably tiny and delicate form and the vast expanse of dense shrubby vegetation in the area, it is really a wonder I found any at all. Doubtless this explains why it could hide out so long in the most densely populated county of Florida while botanists and plant collectors scoured the area. But then, too, after having lived there for so many millions of years, why should it be in any hurry to be found?—JOHN BECKNER, *St. Petersburg, Florida.*

A RANGE EXTENSION IN CYSTOPTERIS.—A specimen of *Cystopteris fragilis* var. *simulans* (Weatherby) McGregor has recently been received by the U. S. National Museum through the courtesy of Dr. A. E. Radford, of the Department of Botany, University of North Carolina. This specimen (*Radford* 5720) was collected May 27, 1951, on marl outcrops in beech woods on Island Creek, Jones County, North Carolina. This variety has not been known previously in North Carolina, the easternmost locality previously reported being in Tennessee; it is much commoner in the midwest—in Kansas, Oklahoma, and Missouri. Dr. R. L. McGregor has discussed the status of this variety.[1]

[1] This JOURNAL **40**: 204. 1950.

The locality cited above is rather unexpected. *Cystopteris fragilis* (represented chiefly by vars. *Mackayi* and *protrusa*) is not uncommon in western North Carolina. It occurs in the Blue Ridge Mountains, in the provinces designated on the map of H. L. Blomquist and D. S. Correll[2] as Northern Mountains, Southern Mountains, and Northern Piedmont. The Jones County locality in which var. *simulans* was found is in the Southern Coastal Plain. It is northeast of Wilmington and not far from the Atlantic Ocean and is at least two hundred miles east of the nearest locality known in North Carolina for *Cystopteris*.[3]—C. V. MORTON, Washington, D. C.

CLUB MOSS FAIRY RINGS.—The peculiar "fairy rings" composed of species of *Lycopodium* that grow on a hillside near Ithaca, N. Y., have been briefly described and illustrated by A. J. Eames and L. H. McDaniels.[4] The authors compare them with similar formations by mushrooms. Of the four species that occur in the pasture, three—*Lycopodium tristachyum, L. complanatum* v. *flabelliforme*, and *L. obscurum*—were found to form rings, apparently because conditions were just right for uninterrupted growth. In some cases, growth back into the center of the ring occurred in some branches, and interlocking of adjacent rings was also found. The photograph was taken in October when the light-colored cones made the rings especially conspicuous—W. H. WAGNER, JR.

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2 A County Check List of North Carolina Ferns and Fern Allies. Jour. Elisha Mitchell Sci. Soc. **56**: 65. 1940.

3 Since this paper was written a paper by Dr. Redford has come to the writer's attention. "Range Extensions in the Flora of North Carolina," Journ. Elisha Mitchell Sci-Soc. 68: 105. 1952—in which C. fragilis var. Mackenzi is reported from Jones and Cravens Counties. Through the kindness of Dr. Redford, he has examined the specimen cited from Craven County (*Redford* 5618). The material is rather immature, but seems to represent var. simulans.

4 Cornell Plantations **9** **(1)**: 11, 12. 1952.

Recent Fern Literature

Of publications on, or including, the ferns of Hawaii National Park, the small but beautifully illustrated booklet[1] by Park Naturalist Douglass H. Hubbard[2] is without doubt the most attractive and easy to use for identification. The dedication of this pamphlet to Mr. Eugene Horner, whose interest in Hawaiian pteridophytes extends over sixty years, is especially appreciated by those who have enjoyed his advice and companionship in the field. Nearly sixty species of pteridophytes are shown in clear photographs of living leaves or whole plants, the species represented being as diverse as the minute "filmies" to the giant tree-ferns which so dominate the scene in parts of Hawaii National Park. The maidenhair spleenwort (*Asplenium trichomanes*) and the bracken (*Pteridium aquilinum*) grow in the company of such exotic plants as the pendent adder's-tongue (*Ophioglossum pendulum*), the flat-stemmed psilotum (*Psilotum complanatum*), and the elephant-tongues (*Elaphoglossum*, 4 spp.). The old Hawaiian names are used, along with the English common names; and the technical names are given in a separate list at the end, following mainly the Genera Filicum of Copeland. Naturalist Hubbard wisely arranged together in his figures the species which are likely to cause confusion, such as those of *Sadleria, Cibotium*, and *Nephrolepis*.[3] His use of living leaves for illustrations reminds us that fern leaves are never really flat, as we are sometimes prone to think of them, but rather are conspicuously oriented in three dimensions when they grow. For example, the photographs of

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[1] Ferns of Hawaii National Park. Douglass H. Hubbard. Hawaii Nature Notes **5 (1)**: 1–40. 52 photographs. 1952. $.50.

[2] Now Associate Park Naturalist at Yosemite National Park.

[3] On the page of *Ophioglossum* species, the word "left" was placed accidentally by "*Ophioglossum petiolatum* (1)" rather than by "*Ophioglossum nudicaule* (2)."

"pamoho" (*Asplenium unilaterale*) and "palapalai o kaumaapua" (*Lastrea globulifera*) show clearly that the small lower pinnae are oriented in a plane nearly perpendicular to that of the upper pinnae. Most curious of all are the twisted pinnae of the form of "ai" (*Polypodium pellucidum*) that occurs in dry, exposed places, the pinnae so twisted that they cannot be "straightened out" in pressing herbarium specimens. Appropriately, the brilliantly colored fronds of *Sadleria* have been used for the color plate on the cover. The ferns illustrated in this small paper represent more than one-third of all the pteridophytes known in the Hawaiian archipelago. —WARREN H. WAGNER, JR.

A NEW BRITISH FLORA.[1]—The new Flora of the British Isles here reviewed has been a desideratum for the past 50 years, according to Prof. A. G. Tansley, who contributes a preface. It is the product of relatively young men who have combined with their taxonomic treatment the basic advances of genetics of the past half-century. An illustration of this may be found in their citation of the chromosome numbers of the different species, when these are known (and they are mostly known in the British species). However, the treatment follows in general the usual pattern of floras, and chromosome counts are not required to discriminate species or genera fortunately.

American readers will be especially interested in a comparative study of the number of species and in notice of those growing both in the British Isles and the United States. Florida is credited with 127 species,[2] Texas with 103, Vermont and Michigan with 81. A survey of

[1] Flora of the British Isles, by A. R. Clapham, T. G. Tutin, and E. F. Warburg, pp. 1–1591. 1952. Cambridge University Press, Cambridge, England. $9.50.

[2] Figures from S. F. Blake, State and Local Fern Floras of the United States, Supplement I. Amer. Fern Journ. **40**: 148–165. 1950.

the British pteridophytes recognized as species shows 67 species, in 22 genera (15 of these in the Polypodiaceae). At least 46 of the British species are reported as also found in North America, most of these within the boundaries of the United States. A few of these are northern in range and reach the United States only sparingly; a few others show the well-known western Europe–western North America range.

Some differences in the British fern flora are worthy of note. There is only one *Osmunda, O. regalis,* and that has been exterminated in some parts of England by collection. There is only one *Botrychium, B. Lunaria. Dryopteris cristata* is very rare, and *D. intermedia* and *D. marginalis* do not occur at all. The species of *Lycopodium* and *Equisetum* are rather numerous and mostly duplicate our species. However, *L. complanatum,* although it has been reported from England, is very doubtfully present. The three species of *Isoëtes* are not known in the United States in their typical forms, although we have close relatives that are perhaps only varietally distinct.

The Flora recognizes a number of hybrids, notable among them three *Aspleniophyllitis* crosses between hart's-tongue and different species of spleenworts. The little annual species *Anogramma leptophylla* is an interesting departure from the usual perennial character of fern types.

American fern gardeners may be interested in obtaining spores of some of the British species not found with us. Presumably, most of them would be possible of culture in parts of this country, especially with some protection. Some of these are already available through dealers, especially numerous varieties of the lady-fern and of the English Polystichums. The genera *Asplenium* and *Dryopteris* perhaps offer the best possibilities.—R. C. BENEDICT.

American Fern Society

Report on the Brooklyn Meeting.—The first meeting of the Fern Society in 1953 took place at the Brooklyn Botanic Garden on February 28, with Miss Hester Rusk as host. About 50 members and guests were present, among the notables being Dr. Alma Stokey, Professor Emeritus of Mount Holyoke College.

Dr. E. T. Wherry, of the University of Pennsylvania, spoke on *Dryopteris,* and pointed out the inadequacy of external characteristics in the determination of species, and emphasized the greater reliability of internal anatomical features. Some notes were given also on problems in nomenclature.

Mrs. Fern Crane presented a paper indicating that the size, shape, and architecture of the spores provides valuable and often conclusive evidence for the identification of specimens of doubtful affinities. Her paper was illustrated by carefully hand-drawn plates, associated with the leaves from which they were derived.

Mr. Charles Neidorf exhibited photographs of fern leaf sections. By the use of an extended camera bellows he obtained images on the photographic plate several times larger than the actual specimens, thus minimizing the distortion often attending excessive enlargement. There is no doubt of the adequacy of this method for showing details of leaf and spore structure, but the superb excellence of the photographs shown by Mr. Neidorf could, doubtless, not be duplicated readily by the ordinary photographer.

Miss Clara Hires showed a wide series of spore photographs of superior quality.

Mr. Matthew J. Mann, Jr., exhibited a vivarium suitable for starting and raising ferns indoors, and also a small culture of American hart's-tongue plants.

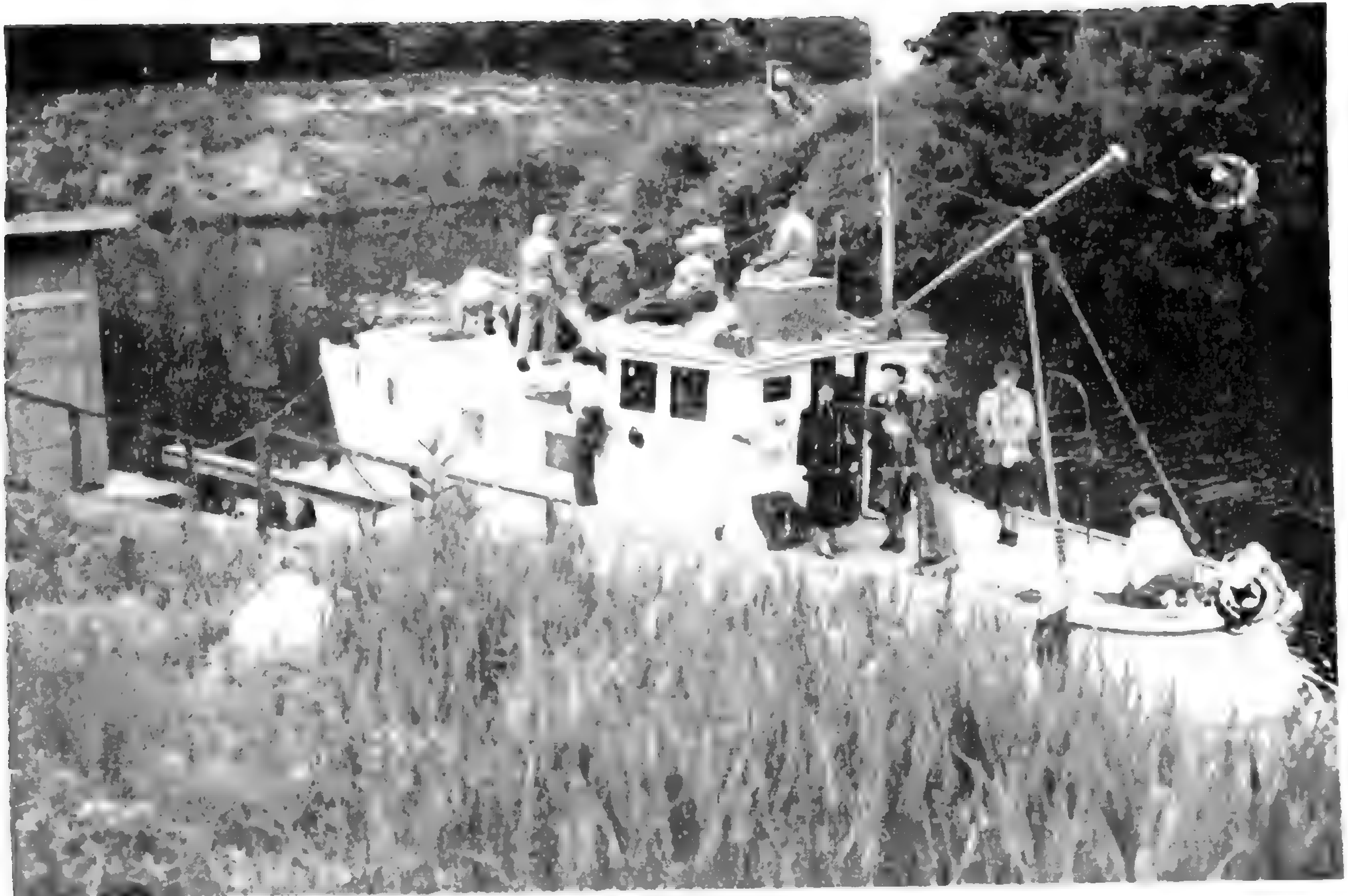
Dr. Clyde Reed read a paper on spores, sporangia, and indusia of the genus *Dryopteris* and pointed out that some errors in the interpretation of species were due to a lack of appreciation of environmental effects.

After the formal meeting, our President, Dr. R. C. Benedict, showed the group through the fern house of the Brooklyn Botanic Garden, where many unusual ferns have long been in cultivation, largely through his own efforts. Thirty-seven of the group then adjourned to Manhattan for a Japanese luncheon, which did nothing to lessen the good fellowship and enthusiasm which had marked the more formal part of the day.[1]—VICTOR SCHECHTER, *The City College of New York.*

REPORT OF THE VIRGINIA MEETING.—Members of the Fern Society met June 13 at the magnificent memorial to Thomas Jefferson in Washington and proceeded to Lorton, Virginia, where Dr. and Mrs. Paul Bartsch welcomed the crowd to "Lebanon," their glorious estate of some 465 acres. In this ideal spot, trees, shrubs, flowers, and ferns all seem to grow naturally into imposing examples of their kind. After explaining the historical associations of "Lebanon"—built before Mount Vernon—Dr. Bartsch led the party to the "fern valley." Here, a request to see any fern native in the eastern United States is all that is necessary; they are all here, in handsome robust examples. Dr. Bartsch knows and gives them their requirements, and the results are extremely satisfactory. Mrs. Bartsch served refreshments later in the delightful study, with its vista across the Potomac River.

On June 14, the party drove south to Williamsburg, where we were welcomed by Dr. John T. Baldwin. Through the courtesy of William and Mary College we were assigned accommodations in Thomas Jefferson Hall. Had there been no other feature of the trip, the Wil-

[1] During the meeting, our Treasurer, Mr. Mann, enlisted the 500th and 501st members of the Society, Miss Eva Sobol and Miss Anna E. Scudder. We can now set the 600 mark as a new goal.



Some Fern Society members on the Virginia Lee at the entrance to the feeder canal to Lake Drummond liamsburg part would have made it fully worth while. We all enjoyed the clever restoration of the atmosphere of early Virginia.

One June 15 we drove to Wallaceton, on the Dismal Swamp Canal. Dr. Baldwin had arranged for our transportation by boat up the canal to Lake Drummond. The ride afforded good views of the interesting plant association on the banks. At Lake Drummond is a well-kept picnic spot, carved out of the jungle. From here, Dr. Wherry led the party through the tangled woods among gigantic black gum, red maple, and tulip trees to some fine stands of *Dryopteris celsa.* Close search revealed a few plants of *D. separabilis* (suspected of being the hybrid *D. celsa* × *intermedia*); a plant of this was removed and is now under cultivation for cytological study. In one area there was a great display of chain fern. Returning to the locks, we enjoyed a bountiful lunch prepared by Dr. Bernice M. Speese, of William and Mary College. Later, we were transported across Lake Drummond to see a somewhat different plant association. Great Dismal Swamp is still a wild and mysterious realm containing many interesting trees, vines, and shrubs; a few hours are far too short to do justice to it.

In all there were 53 members and friends present on all or part of the trip—Martha Armstrong, Miller Armstrong, J. T. Baldwin, Dr. and Mrs. Paul Bartsch, Mr. and Mrs. W. A. Barnes, Dr. and Mrs. R. C. Benedict, Mr. and Mrs. James Benedict, Rachel Black, W. W. Cadbury, Gladys Clarke, Fern Crane, Thomas Darling, Frank Davenport, Dr. and Mrs. F. R. Fosberg, Mr. and Mrs. Neal Gilbert, Charles Goodwin, Muriel Hegwood, Walter Herkness, James W. Johnston, Jr., Mr. and Mrs. Allyn Loosely, Don Jenkins, Mr. and Mrs. David Lynch and son, Mr. and Mrs. Massman, Mr. and Mrs. A. B. McCray, Mrs. Charles Moon, Conrad Morton, Charles Neidorf, Elmira Noyes, Mayrea Noyes, P. L. Ricker, F.

H. Sargent, Bernice M. Speese, Edna Stone, Mrs. Philip Stone, A. V. Smith, Andrew Tarrell, H. Trudell, Rebecca Wagenar, Mr. and Mrs. David Wertman, E. T. Wherry, and Lillian Willier.—H. S. TRUDELL.

REPORT OF THE MEETING IN SCARSDALE.—Mr. William S. Johnston was the host for the Fern Society at his home in Scarsdale, New York, on June 6. Eighteen members and friends enjoyed viewing his extensive and carefully tended fern garden—Dr. and Mrs. Benjamin Allison, Dr. and Mrs. R. C. Benedict, Alice Bristow, Helen Bristow, Carol Crane, Fern Crane, Ruth Hardy, Mr. and Mrs. Norman Litchfield, Eleanor Merrell, Charles Neidorf, Mr. Scoville, Hope Sherman Smith, Dorothy Sterling, Miss Trueson, and Mr. Troubosky.

REPORT OF NEW CANAAN MEETING.—On July 20, 1953, a group of Fern Society members paid a visit to the New Canaan Bird Protective Society Sanctuaries. Some 46 species of ferns and fern allies were observed, and some *Dryopteris* hybrids. A few species have been planted in the areas. In the Sanctuary House an exhibit was set up illustrating the method of raising ferns from spores. The New Canaan Library displayed a series of the beautiful enlargements of photographs of ferns by Charles Neidorf and also a collection of fern books and periodicals. Those present were R. C. Benedict, Mrs. George W. Blood and Miss Blood, Leonard J. Bradley, Alice A. Bristow, Helen G. Bristow, Mortimer F. Brown, Laura A. East, Mr. and Mrs. Stanley O. Grierson, Ruth W. Hardy, Richard P. Holloway, Mr. and Mrs. Norman Litchfield, Harry Logan, Charles Neidorf, Anna E. Scudder, Eve Sobol, Mrs. Hope Sherman Smith, and Myra Valentine.

PROPOSED MEETING IN OCTOBER.—Saturday, October 24th has been set as the date for a meeting of the Fern Society at Short Hills-Millburn, N. J., two communities without any obvious dividing line, not far from New York City. The first part of the meeting, beginning at 1:30, will be held at the greenhouses of Mr. J. F. Anderson, Short Hills. Mr. Anderson has been growing ferns from spores for fifty-five years. Nearly fifty years ago, many nurserymen were in the business of raising a variety of tropical fern species for use in the then very popular fern dish culture. Special cut glass and silver dishes were designed to hold small assemblages of such ferns, perhaps with a small palm as the center. Of a sudden, the demand fell off; growers generally gave up the culture, but Mr. Anderson continued it because he loved working with these plants and has made a success of this specialized field. His daughter, Mrs. Dale Oechler, a member of the Fern Society, is associated with him in the business. They grow about one hundred species of tropical and subtropical ferns.

The meeting will be continued at the home and laboratory of Miss Clara S. Hires in Millburn. Since 1929, Miss Hires has been successfully starting ferns, orchids and other difficult seedlings on nutrient media under sterile conditions, and shipping them to college laboratories and growers in many parts of the world. The necessity of recognizing spores received for germination, at times incorrectly labelled, resulted in her keen interest not only in spore germination research but also in spore identification. Remarkable microphotographs of spores will be shown, and some motion pictures of spores slowly rotating to show all sides. Please advise Miss Hires, 152 Glen Avenue, Millburn, New Jersey, if you plan to attend either or both parts of the meeting.

Mr. John D. Lovis, Department of Botany, The University, Leeds 2, Yorkshire, England, is working on the races of *Asplenium Trichomanes,* and wishes spores of that species from localities anywhere in North America.

NEW MEMBERS

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Miss Lillian E. Willier, 320 Sheridan Street, N. W., Washington, D. C.
Mrs. R. J. Wilson, 4620 Evergreen Drive, Port Arthur, Texas

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Miss Gladys Clarke, 8211 Flower Avenue, Takoma Park 12, Md.
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Mr. Robert C. Lommasson, Department of Botany, University of Nebraska, Lincoln 8, Nebraska
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Vol. 43 October–December, 1953 No. 4

Salute to Our Charter Members

Donovan S. Correll

As the year 1953 comes to a close, we, the members of the American Fern Society, can look back with pride on the 60 years of its existence. From its humble beginning of nineteen members, who circulated written notes by mail to one another, the Society has gradually grown and matured through the years to its present-day large membership, that is informed by an excellent Journal with world-wide reputation and circulation. Among its members can be, and are, counted preeminent scholars of pteridology and serious amateur students of ferns as well as a host of just "fern lovers" who from the sheer joy of seeing and working with ferns gain some of life's most pleasant moments. We are grateful that as this sixtieth year comes to a close we have with us still two of our charter members—Campbell E. Waters, of Washington, D. C. and Elmira E. Noyes, of Norfolk, Virginia. It is these two illustrious members whom their fellow-members salute today!

Dr. Campbell Easter Waters was born in Baltimore County, Maryland, on September 14, 1872. His education in Baltimore culminated in 1899 when he received the degree of Ph.D. in chemistry from The Johns Hopkins University. While at the University he was the recipient of various scholarships. Although he did work in mineralogy and botany he did his major work in chemistry under Dr. Ira Remsen, one of the five original

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DR. CAMPBELL E. WATERS AT AGE OF 79

professors at the University. In 1900 he went to Storrs, Connecticut, as professor of chemistry and physics in the Agricultural College of that state for one year. He then returned to Baltimore to teach chemistry at The Johns Hopkins University and assist Dr. Remsen in editing the American Chemical Journal. In the latter capacity Dr. Waters developed an acute ability for good writing and meticulous editing which has constantly revealed itself in his many published papers and carefully prepared letters. In 1904 he moved to Washington, D. C., to work in the National Bureau of Standards from which agency he retired in 1942 after 38 years of exceptional service. At the time of his retirement Dr. Waters was Assistant Chief Chemist of the Bureau.

In May, 1951, a professional colleague of Dr. Waters wrote of him,[1] "In spite of the fact that his major work is in the organic field, he has a reputation as an inorganic analyst and is noted for his share in the development of the standard cell. His early work at the Bureau on inks, plastics, rubber, petroleum products, paper, and textiles laid the foundation for a rapidly expanding program during and after the First World War. By the time of the Second World War this work had expanded far beyond the confines of his own section or division. This must be a source of satisfaction to him. Dr. Waters served as president of the Chemical Society of Washington in 1913.

"His professional associates refer to Dr. Waters as a chemist, more particularly an organic chemist, but those who know him best might with almost equal propriety refer to him as a naturalist. He most certainly is a botanist. . . . He also has a remarkable knowledge of birds, minerals, geology, and meteorological phenomena."

Dr. Waters first became interested in ferns in 1888, five years before the formal organization of what later

[1] The Capital Chemist, p. 120.

became known as the American Fern Society. It was in this year that as a lad of sixteen he was spending the summer at the little village of Birmingham, Pennsylvania, while across the Juniata River from Birmingham a Miss Davis, who had studied under Asa Gray, taught in the local seminary. It was Miss Davis' habit to take the local children for long walks in the nearby fields and forests to identify ferns and other plants, and through these pleasant walks young Campbell developed a life-long interest in ferns. As he later wrote:[2] "... a botanist friend showed me that it was possible to become acquainted with the ferns and wild flowers without the tiresome school lessons in botany over which my sisters groaned."

Several years later, in 1890, while a student at the City College of Baltimore he was spending his Saturdays diligently searching the Maryland countryside for unique fern localities alone or with other members of the newly formed Agassiz Society. He regrets that the Loch Raven dam, supplying Baltimore with water, flooded many of his favorite haunts, such as two localities for the Ostrich Fern (*Pteretis pensylvanica*) and stations for the Running Clubmoss (*Lycopodium clavatum*) and Narrow-leaved Spleenwort (*Diplazium pycnocarpon*). What he considers to be his most unique and significant discovery was the finding of a glandular variety of the Cinnamon-fern (*Osmunda cinnamomea* var. *glandulosa* Waters) on the Coastal Plain at Glen Burnie, Maryland.

Considering his early and continued interest in ferns, it was to be expected that he should answer Willard N. Clute's advertisement for interested students of ferns to form the Linnaean Fern Chapter of the Agassiz Association devoted primarily to the study of ferns and

[2] Amer. Fern Journ. **11**: 16. 1921.

fern allies. Reminiscing in later years regarding this major incident in his fern career, Dr. Waters wrote:[3] "In 1893 my qualifications for membership in the nascent Fern Chapter of the Agassiz Society were not great, and it never entered my head that so many years later [1921] my fingers would be busy tapping out these reminiscences. My one fear then was that Mr. Clute might not accept my application for membership . . ." His fears proved groundless and, in 1893, when he was just completing his freshman year at The Johns Hopkins University, he became a charter member when he joined this forerunner of the American Fern Society, along with eighteen others. In 1895, he was elected Secretary of the Chapter, and in 1896 was elected President, an office he held in 1897 and 1898.

In 1903, a photograph of young Waters was published in volume eleven of the Fern Bulletin, along with a brief sketch (by B. D. Gilbert) of his early activities in the field of ferns. Dr. Waters had just published his monumental book entitled "Ferns," which remains today an authoritative work on these plants in the northeastern United States. It was the first book on ferns to be illustrated by photographs of typical fronds, and especially, by enlarged photographs of the sori of the different genera. Gilbert wrote at that time: "For a young man, Dr. Waters has certainly accomplished a deal of work, and made an honorable name for himself both in chemistry and botany, and his career still lies before him." The wisdom of this prophecy was amply proved as the years passed.

In a letter of March 11, 1952 addressed to our President, Dr. R. C. Benedict, Dr. Waters writes: "The Fern Society has certainly prospered, and to an extent that none of us could have anticipated. I hope you will be successful in your attempt to stimulate field meetings.

[3] Amer. Fern Journ. **11**: 17. 1921.

. . . In after years most of my botanizing was done without companionship, but there was so much for me to see, that I was not lonely in the woods. Only once did I have a scare, and that for only a moment or two. I leaned over to pick up something, and felt something running up my back. Naturally it startled me, until I realized that an orange had rolled from one end of my vasculum to the other! The vasculum was on my back, of course.''

Although, as Dr. Waters says, most of his time in the field was spent alone this was not always so. Some of his friends came to know him well and to appreciate his fine qualities. One of these intimate friends later wrote:[4] ''His actions are guided by a sense of propriety, rather than expediency. If a thing is proper, he can be expected to do it; if it is not proper, he will not do it. He would rather fish than eat. He would rather go without a meal than be late for it. He has a sense of humor, which often manifests itself in the form of a pun. He has been known to write poetry, and would rather say '*Cercis canadensis*' than 'Judas tree' or 'redbud.' His conversation is always interesting, never trifling. Those of us who visit him in his home always come away with a feeling of mental refreshment.''

Unfortunately, as the years advance they are not attended solely with eminent success in the laboratory and high moments of pleasure in the field, but age also gradually takes its toll. Today, at 81 years of age, Campbell Waters is confined to his bed with a broken knee-cap. His greatest misfortune, however, developed several years ago when his eyesight gradually failed him to the extent that he was forced to give up his beloved field trips. Today, though unable to wander afield, he has sight enough left to read some and to carry on a vigorous

[4] The Capital Chemist **1**: 120. 1951.

correspondence with his children to whom he is extremely devoted. He and Mrs. Waters are cheery companions and a visit with them can be a highlight in anyone's life.

At the suggestion of Dr. Benedict, Miss Elmira Noyes wrote and forwarded the following account of her sixty years in the American Fern Society, which is here published as it was received.

"Probably the first ferns I remember were a large colony of *Onoclea Struthiopteris,* growing on 'The Island' at Fort Edward, N. Y. Individual fronds were as tall as I, who was then seven years old. They were the largest native ferns I have ever known.

"In 1893, after the charter members formed the Fern Chapter, my father enrolled me. Since I was only ten and a half years old, it was really my father who joined and for several years he was the one who carried on correspondence and did whatever was done in my name. I do not know when membership lists began crediting me with being a charter member. The point is, I was not, although my membership began the same year.[5]

"My grandfather was a well known mineralogist, a botanist too. We have his Gray's Manual of Botany inscribed to him by Asa Gray himself.

"In 1871, my father began making marginal notes in his own copy of Gray. The notes occur from beginning to end, showing the plants analyzed and noting where and when specimens were collected. The places range through ten states from Tallequah, Indian Territory, to the Eastern Seaboard, and the dates from 1871 through 1922, two years before his death. He was undoubtedly a botanist. My Gray attests no such devotion

[5] Miss Noyes was later voted a charter member by the Council. DSC.

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Miss Elmira Noyes in 1953

to botany, for I have been only an intermittent amateur botanist.

"When I joined the Fern Society, I was a child interested in plants. My sister, seven years my junior, and I were glibly calling many plants by their botanical names, which were the names we heard.

"Rambles in the country and woods, gathering wild flowers and observing the beauties and wonders of nature, were a part of our family living and are among my earliest memories. The flowers brought home were traced and named by my mother and father in a session with Gray's Botany, then used to deck the house. If there were not already herbarium specimens some were pressed. My father made me a small press like his and I pressed specimens of my own.

"There were many interesting places to walk about Lewistown, Pa., and a wealth of wild flowers, ferns, and mushrooms to be gathered, but the family was hampered with two small children less than four years old. The baby carriage could be pushed easily enough along the turnpike into the country, but the 1893 models were cumbersome affairs, impossible to use on cross country rambles. My father made a two-wheeled 'go-cart,' a thing unknown then, but which resembled a modern stroller. The go-cart could and did go anywhere, up and down hills and ravines, over fields and through the woods.

"The rocks in the woods about Lewistown were clothed in *Polypodium vulgare* and *Camptosorus rhizophyllus* and *Pellaea atropurpurea,* which we called *Pteris.* My small sister wrote about a 'Terras' in one of her earliest letters. I was naturally intrigued with the walking fern, searching at every opportunity for plants that had made a step and was ecstatic if I found one that had stepped twice. Another fern I learned and associate with Lewistown is *Osmunda Claytoniana.* Several of these had been transplanted to our yard.

"We came to Portsmouth, Va., in 1894. Ferns were close at hand. Across the street from where we lived first was an old Colonial Church, Trinity. Its church yard was surrounded with a very old brick wall, which was the habitat of three varieties of ferns, the already familiar *Pellaea* and two *Aspleniums—ebeneum* and *Trichomanes.* Furthermore, on some of the street trees (elms) at that corner were colonies of *Polypodium incanum.* The latter was also discovered, growing on the hip roof of an old house, in another part of the city. This fern was interesting to watch, so brown and withered in dry weather, uncurling and turning green after rains.

"A short walk over two footbridges brought us to a most beautiful pine woods, back of the Naval Hospital. There wild flowers grew, even arbutus, so scarce in this locality, and colonies of *Dryopteris noveboracensis,* to us the hospital fern.

"The country hereabouts is flat and there were lovely walks and woods in all land directions. The glistening oyster shell roads had deep ditches on either side, where wild growth was almost tropical and the royal and cinnamon ferns made magnificent specimens.

"When we wished to go farther afield, we rode to the end of a streetcar line and began our walk from there. The end of every line both in Portsmouth and Norfolk was a sparsely settled area with open country beyond. It is quite different now—bus lines terminate in housing developments and beyond are the homes of those who have their own means of transportation.

"I think we took advantage of the privileges of membership in the Fern Society. I have already mentioned correspondence, which my father carried on. The names of Mr. Clute, Mr. Eaton, Dr. Graves, and Mrs. Stevens are very familiar. Of course we collected specimens for my herbarium, which was started with sheets my father turned over to me. I was very proud of my 'Herbarium of Elmira E. Noyes' labels. Extra specimens were collected for distribution to society members and for exchange, which added unfamiliar and interesting specimens to my collection.

"In 1897, I acted as 'Judge of Elections.' Though there were 74 names on the membership list only 14 votes were cast. Will R. Maxon and C. E. Waters were the nominees for president and the vote was a tie, which the Executive Council decided in favor of Mr. Waters.

"The only member of the Society I ever met was Mr. Maxon. On a one day visit to Washington, my mother and I called on Mr. Maxon at the Smithsonian. My mother carried on most of the conversation, because I was just a shy high school student. Mr. Maxon was wonderful and showed us sheets of rare ferns. I have remembered the visit as a high light of my Fern Society experiences.

"One spring, 1895 or 96, quite on my own, I transplanted and brought into the house a dormant *Osmunda cinnamonea* and proceeded to observe its development, recording for each frond the inches of growth each date. The data quite filled the small notebook I used for the findings and impressed me deeply with the miracle of growth.

"Wherever we lived, there was always a fern corner and if we moved, the ferns moved too. We have, in our garden now, a *Cystopteris* descended from plants I sent back from Kansas in 1902–03, that has been moved five times. We have a maiden-hair brought from the Virginia mountains that delighted us with its beauty for twenty years. Our Osmundas are very handsome. It must be nearly thirty years since we brought them in from some roadside ditch. In my botany I find a list of sixteen ferns and fern allies that we found in earlier days in this area. We have only a few of them represented in our garden.

"In 1918 we were forced to move into an apartment that was much too small to allow each member of the family as much room as they had had for their collections. Many things went into storage. My fern herbarium was sent to the Fern Society. My father's collection of grasses and other plants went to the Smithsonian and the period of herbariums was closed.

"Two wars have changed the Norfolk-Portsmouth area. One has to go much farther to get into the country and we are older. An automobile is more cumbersome than an 1893 baby carriage and we don't get into the woods.

"Through the years I have especially enjoyed the shorter notes in the Journal and occasionally had the thought of contributing some observations, but nothing ever went beyond that 'thinking of doing it' stage. I have written this at the suggestion of Dr. Benedict. Some of my fern names may not accord with present nomenclature, but I have done no systematic work with ferns for many years and so must just be considered a plain fern lover."

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Ferns of a New Guinea Gully

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"New Guinea is the paradise of ferns," wrote Carl Christensen in 1936,[1] and added, "The number of species occurring there is probably not far from 2000, the island thus far surpassing all other countries." At that time Christensen described 40 new species and the new genus *Papuapteris* from collections I made on the first Archbold expedition to New Guinea in 1933–1934. My collections from two subsequent Archbold expeditions—in the Territory of Papua in 1936–1937 and Dutch New Guinea in 1938–1939—have yielded 118 new species and the new genus *Lepidocaulon* described by Professor E. B. Copeland in various papers, and in addition a number of new records for the island of species previously known from other parts of Malaysia. Substantial contributions to the total of known species have been made by others in recent years, but by far the greater part of New Guinea remains quite untouched by botanical collectors. As early as 1934, according to Lam,[2] 970 species of Pteridophyta, including 597 endemic species, were known from the mainland and adjacent islands.

New Guinea should be thought of as a great, diversified country rather than a mere island. Measuring 1500 miles in length and 450 in maximum width, its area of about 312,000 square miles is not much less than that of California, Oregon, and Washington combined and the high mountains of these states fall short by 2000 feet of the altitude of 16,500-foot Mount Carstensz in Dutch New Guinea. Carstensz, 4 degrees below the equator, is permanently capped with snow, as are five other eminences of the central range in the Dutch-owned western half of the country. Eastwards, in the United Nations

[1] Brittonia, **2 (4)**: 265–317. 1936.
[2] Blumea, **1**: 115–159. 1934.

Trust Territory and the Australian Territory of Papua, the great mountain-backbone is almost equally grand, but the 15,400-foot peak of Mount Wilhelm, in the Trust Territory, is only lofty enough to be temporarily covered with snow on its upper levels.

The habitats of New Guinea's higher altitudes do not contribute greatly to its wealth of ferns. The severe climate would lead one to expect this. There are few fern species between the nival zone and the upper limits of the subalpine forests. In my highest collecting, at about 14,350 feet on snow-capped Mount Wilhelmina in the Snow Mountains of Dutch New Guinea, I saw no ferns on the rocky alpine grassland slopes, and only 19 species of 14 genera were found in the downward extension of the grasslands to about 10,500 feet at Lake Habbema on the northern slopes of the range. These figures apply only to grassland and saxicolous species. A very much richer fern flora of the forests, diminishing rapidly with increasing altitude, extended up to tree limit at around 13,300 feet.

I have proposed the following preliminary classification of the major plant communities of New Guinea.[3] The altitudes given, other than for the savanna and savanna forest, are those between which the communities were observed on the Archbold expeditions:

Savanna and savanna forest	0–1700 m. (0–5600 ft.)
Monsoon forest	0– 450 m. (0–1500 ft.)
Rain forest	0–2400 m. (0–7900 ft.)
Mid-mountain forest	480–2350 m. (1600–7700 ft.)
Beech forest[4]	850–3100 m. (2800–10,200 ft.)
Mossy forest	1500–3200 m. (4900–10,500 ft.)
Subalpine forest	3000–4050 m. (9850–13,300 ft).
Alpine grassland	2900 m. up to permanent snow line (9500 ft. upwards)

[3] Journ. Arn. Arb. **22**: 271–295, 297–342. 1941.

[4] Better called Antarctic beech forest. The dominant trees are species of *Nothofagus*.

Beginning with the coast, we find a very few epiphytic ferns in the mangrove swamps, and *Acrostichum aureum* rooting on the banks of mangrove creeks and in other saline habitats. In the seasonally dry *Eucalyptus-Tristania-Melaleuca* savannas and savanna forests occurring on lowlands and lower mountains in some eastern and southern areas and occupying perhaps 3 to 4 per cent of the total area of the country, there are as few ferns, or fewer, in individuals and species, as on the alpine heights. The mixed rain forests which cover by far the greater part of the country, lowland and mountain, and reach highest in moist and sheltered valleys and ravines, vary from poor to very rich in their fern population in accordance with local climatic conditions. The mid-mountain forests of evergreen oaks (*Quercus s. l.*) and *Castanopsis,* developed on relatively dry slopes and spur ridges between upthrust extensions of the rain forest, are as a rule poor in variety of ferns, though ground cover may be largely of course species of the genera *Diplazium, Syngramma, Oleandra,* and *Nephrolepis.* The lower edges of the mid-mountain forests mark, generally, the lower limits of the daily cloud banks which settle on the mountains early in the afternoon. Above this zone are "mossy forests" of various kinds.

Mossy forest is a loose term convenient for a non-botanical climber of the mountains, but in the classification given above it is restricted to forests dominated largely by *Xanthomyrtus* and *Phyllocladus.* I have collected in "mossy forest" at an altitude of only 300 feet in the foothills of the upper Fly River area, in Papua. This was rain-forest, developed in a climate presumably wet throughout the year and certainly rainy, and often misty, when we were there in June and July, 1936, on the second Archbold expedition. Even in writings descriptive of the New Guinea vegetation the mossy forest may be anything from such mixed tropical rain-forest of climatically wet and cloudy foothills on up to the subalpine forest of *Podocarpus, Libocedrus,* and *Vaccinium.* The mossy rain forests of the upper Fly, incidentally, were not especially rich in ferns. The altitude was too low for a teeming representation of these plants.

The richest locality I have seen for ferns, in New Guinea or elsewhere, was in the vicinity of a camp of the third Archbold expedition at 5900 feet in the mountains west of the Middle Idenburg River, in Dutch New Guinea. This "1800 m. Camp" was in heavily mossed beech forest on the crest of a ridge. We were there in the wet season, in January, 1939. Clouds rising from the wide lowlands of the Idenburg valley usually misted in the ridge-top after 8 or 9 o'clock in the morning, and every day brought a driving drizzle or heavier falls of rain. Centigrade temperatures in camp were 17.0–20.5 maximum, 10.0–13.5 minimum.

Working generally in bad weather, in 18 mornings in the field I collected 226 species of vascular plants that have been determined and 137 numbers which still await identification. Fifty-eight of these species, among them 23 of the 116 ferns, have been described as new. And canopy trees were left largely for the attention of Mr. Chr. Versteegh, who, in collecting botanical vouchers for samples for the Netherlands Indies Forestry Institute, brought 12 more new species to botanical knowledge.

No less than 64 of my species of ferns from this locality, including 13 previously unknown, were collected in a gully on the south or leeward side of the ridge on which we camped. As far as I followed it, down to about 5000 feet in a distance of about 1000 yards, the gully dropped steeply between spur ridges clothed with moderately mossed beech forest in which oaks appeared on the broader and more gently sloping crests. Mixed rain-forest occupied the lower slopes and the bottom of the gully up to the 5850-foot level, where we drew our camp water from the head of a small stream. Though frequently cloud-shadowed, the gully for the most part was below the zone of daily mists.

Being handy to camp, this Fern Gully was reserved for collecting in especially bad weather, for parts of days left over from attending to accumulations of specimens in camp, or for mornings when I was chemical-sick after developing photographs in the darkness of my tent. It was a bounteous place from which I knew my drying ovens could be filled in short time. And from the very nature of my "off days" collecting in it, between forays generally farther afield, I did not take from the Fern Gully species I was sure I had from other parts of the camp area. The total number of ferns present must have been considerably greater than the 64 which were gathered.

Five species of tree-ferns (*Cyathea*), four of them new, grew in the gully. Exceeding all the local ferns in size, though short in its thick trunk, was *Marattia coronata*, conspicuous here under broken canopy, and in old windfall openings in gullies up to 9200 feet on the Snow Mountains, presumably as a rain-forest element. For beauty of form none could approach the delicately dissected ground species *Leptopteris alpina* var. *major* and *Orthiopteris trichophylla*, spreading graceful fronds two to three feet high in the forest undergrowth.

Collected from the gully were:[5]

[5] Abbreviations applying to the gully: T, terrestrial; E, epiphytic; a, abundant; p, plentiful; c, common; f, frequent; u, uncommon; r, rare. Personally observed occurrence elsewhere in New Guinea: RF, rain forest; MMF, mid-mountain forest; BF, beech forest; MF, mossy forest; SAF, subalpine forest. Altitudes preceded by ? are recorded in literature without reference to recognizable plant communities.

Tc	*Acrophorus stipellatus* (Wall.) Moore	SAF 10,600 ft.
Ec	*Asplenium acrobryum* Christ	RF 160–5300 ft.
Ec	" *amboinense* Willd.	RF 300–7900 ft.
Ep	" *bipinnatifidum* Baker	RF 3900–MF 9400 ft.
Ep	" *Cromwellianum* Rosenst.	RF 2800–BF 7550 ft.
Ec	" *ellipticum* (Fée) Copel.	RF 0–7200 ft.
Ec	" *ficifolium* Goldm.	
Ea, T	" *insiticum* Brack.	
Tu	" *normale* Don	MMF 4100–5800 ft.
T	" *scandens* J. Sm.	RF 500–4000 ft.
E	" *Schultzei* Brause	BF 7100 ft.
Tc	*Athyrium acrocarpum* (Rosenst.) Copel.	
Tc	" *latilobum* Copel., sp. nov.	RF 2800–4000 ft.
Tc	" *squamuligerum* (Rosenst.: Hieron.) Copel.	RF 2800–4000 ft.
Tf	*Blechnum deorso-lobatum* Brause	? 6800–BF 9200 ft.
Eo	*Ctenopteris eximia* Copel.	
E	" *integripaleata* Copel., sp. nov.	
Tc	*Cyathea horridula* Copel., sp. nov.	
Tr	" *pachyrhachis* Copel., sp. nov.	
T	" *parva* Copel., sp. nov.	
To	" *quadripinnatifida* Copel., sp. nov.	
Tc	" *Rosenstockii* Brause	? 4265 ft.
Tr	*Didymochlaena truncatula* (Swartz) J. Smith.	? 1000–3000 ft.
Tc	*Dryopteris canescens* (Blume) C. Chr. var. *novo-guineensis* Brause	
T	" *Cesatiana* C. Chr.	RF 2800–MMF 4100 ft.
T	" *gracilescens* (Blume) Kuntze	
Tf	" *Hunsteiniana* Brause	? 4400 ft.
Tf	" *paripinnata* Copel., sp. nov.	

Ef	*Dryopteris subnigra* Brause	? 5900–7100 ft.
T	" *truncata* (Poir.) Kuntze	RF 4100 ft.
Tc	" *vestigiata* Copel., sp. nov.	
Ec	*Goniophlebium demersum* (Brause) Copel.	MF 7900 ft.
Ef	*Grammitis subrepanda* (Brause) Copel.	RF 3900–SAF 10,600 ft.
E	*Histiopteris estipulata* v. A. v. R.	? 8100 ft.
Ep	*Hymenolepis novoguineensis* (Rosenst.) Copel.	BF 5700–RF 7200 ft.
Tc	*Leptopteris alpina* (Baker) C. Chr. var. *major* Rosenst.	RF 3900 ft.
Tc, Ef	*Lindsaea marginata* Brause	RF 2800–5700 ft.
To	" *microstegia* Copel.	? 1000–3300 ft.
Eo	*Lomagramma articulata* (J. Smith) Copel.	
E	*Loxogramme vittariiformis* (Rosenst.) C. Chr.	RF 7900 ft.
Tc	*Marattia coronata* Copel., sp. nov.	BF 7550–9200 ft.
To	" *Brassii* Copel., sp. nov.	
Ec	*Mecodium badium* (H. & G.) Copel.	
E	" *imbricatum* (Blume) Copel.	RF 2800–SAF 10,600 ft.
Ea	" *Reinwardtii* (v. d. Bosch) Copel.	RF 7200 ft.
E	*Meringium rubellum* (Rosenst.) Copel.	RF 4000–SAF 11,100 ft.
E	*Nephrolepis acuminata* (Houtt.) Kuhn	RF 4100 ft.
E	" *Lauterbachii* Christ	RF 2800–BF 7500 ft.
Ep	*Oleandra Sibbaldii* Grev.	RF 7200 ft.
Tp	*Orthiopteris minor* (Hoch.) Copel.	RF 4000 ft.
Tf	" *cicutarioides* (Baker) Copel.	RF 2300 ft.
Ta	" *trichophylla* Copel., sp. nov.	
T	*Paesia Lamiana* v. A. v. R.	? 7000–8100 ft.
Ef	*Pleuromanes retusum* Copel., sp. nov.	

Eo	*Polypodium albidosquamatum* Bl.	RF 2800–SAF 10,600 ft.
Ec	" *plebiscopum* Baker	RF 5250–BF 5900 ft.
E	" *polysorum* Brause	RF 2800–3900 ft.
Er	" *scolopendria* Burm.	RF 0-BF 9200 ft.
E	*Prosaptia Archboldii* Copel., sp. nov.	
T	*Pteris* sp.	
Tf	*Selenodesmium obscurum* (Blume) Copel.	RF 1900–4100 ft.
Tf	*Syngramma Hookeri* C. Chr.	RF 1500–MMF 4100 ft.
To	*Tectaria crenata* Copel.	RF 500–3600 ft.
Ta	*Vandenboschia maxima* (Blume) Copel.	BF 7000–RF 7900 ft.

Whatever the controlling factors in the altitudinal distribution of ferns in New Guinea may be, it is clear on consideration of the list of species collected in the Fern Gully that more is involved than the physiological influences of mere altitude. It would appear, too, that in the main the influences at work are those which determine the local and country-wide range of the recognizable dominants of the major plant communities in which the ferns occur. These major communities may be regarded as "belts," but they are extremely zig-zag on the mountains.

The fern species listed as occurring in the gully between altitudes of about 5000 and 5850 feet range in other collections of mine from sea level to 11,000 feet in New Guinea. Restricting the field virtually to my personal observations and recognition of the major plant communities, and eliminating the substantial number of new species which are known only from the Fern Gully at the present time and species not previously collected by me, there remain 32 species either restricted to rain-forest or found elsewhere in this type of forest. Nineteen species, 12 of them epiphytes, were found elsewhere in other types of forest, but only 6 of them solely in other types of forest. A rain-forest facies was most pronounced in an abundant terrestrial fern flora present under open to semi-open canopy conditions in the bottom of the gully. Exceeding all other species in altitudinal range, however, were epiphytic *Asplenium ellipticum* and *Polypodium scolopendria,* found from sea-level to 7200 and 9200 feet, respectively, in association with upthrust extensions of characteristic rain-forest elements such as *Syzygium, Garcinia,* and *Laportea,* which occur only in the shelter of gullies and ravines at the uppermost limit of their range.

Ferns which may be considered higher-altitude elements and not properly belonging in the rain forest of the gully include the epiphytes *Grammitis subrepanda, Ctenopteris eximia, C. integrifolia* and *Prosaptia Archboldii,* members of genera characteristic of the mossy, misty upper forest zones. These elements spilled down into the gully from neighboring mossy beech forest, while the rain-forest elements climbed into it in greater strength from lower levels.

The Fern Gully may be taken to illustrate wider personal observations which are not discussed in detail here, but seem to show that: (1) in New Guinea specific ferns generally are as much a part of the major plant communities as are the dominants and other characterizing plants of the assemblages in which they occur; (2) the mixed rain forests, which greatly predominate in area in the country, and have the greatest range altitudinally, are the richest community of all in ferns; (3) the Fern Gully is situated in a middle-altitude zone of interlacing major communities in which, throughout the country, the greatest spawning of endemic plant species occurs; and (4) Carl Christensen's estimate of 2000 fern species for New Guinea may have to be revised upwards long before examination of the country by botanical explorers nears completion.

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Spore Studies in Dryopteris, I

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Palynology,[1] a new term used currently to denote the study of pollen and spores, is becoming an increasingly significant branch of science. During recent years extensive research has been concerned with pollen identification relative to hay fever problems.[2] Erdtman[3] has combined applied palynology and plant taxonomy in a study of the angiosperms. Distribution of an earlier vegetation can be plotted when the pollen grains and spores found in bogs and glacial till are identified. McVaugh[4] has described the diagnostic differences between spores of a few eastern ferns. One of the few botanists to carry out investigations that relate spore morphology to the taxonomy of ferns is Reed.[5] His photographs of spores of numerous genera show many features, but they do not bring out certain details of sculpture as well as drawings can portray them.

Since plants can be identified by their pollen grains or spores, a thorough knowledge of the morphology of these microscopic structures is essential. In 1950, the author[6] gave a report at the Cleveland meeting of the A.A.A.S. describing spore studies of some dryopterids. Marked differences between spores of *Dryopteris, Thelypteris,* and *Phegopteris* were illustrated. The present

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1 Erdtman, G. Pollen Morphology and Plant Taxonomy. Angiosperms. The Chronica Botanica Company. p. 3. 1952.

2 Wodehouse, R. P. Pollen Grains. Their Structure, Identification, and Significance in Science and Medicine. McGraw-Hill Book Co., Inc., New York. 1935.

3 *Op. cit.*

4 McVaugh, Rogers. Spores of Some Northeastern Ferns. Amer. Fern Journ. **25**: 73–85. 1935.

5 Reed, Clyde. Comparative Morphology of Spores in Ferns and its Relationship to Taxonomy. Ph.D. Thesis, Harvard, 1942.

6 As Research Assistant, Mistaire Laboratories, Millburn, N. J.


I
II
III
IV

work[7] was begun during the summer of 1952 on entirely new material collected for or by the author or borrowed from herbaria.

The genus *Dryopteris,* in restricted delimitation excluding *Thelypteris* and *Phegopteris,* comprises species of world-wide distribution. Among the species found in the United States there are some which are readily differentiated by gross characters, and others about which there is a considerable difference of opinion. Most of these species are reported to hybridize and these putative hybrids offer puzzling problems when only macroscopic characters are used. In such hybrids, spore sterility has usually been associated. On the other hand, some specimens showing perfect spores have been interpreted as hybrids. Even when specimens of two recognized species appear to grade into one another, the spores are uniformly distinctive.

The purpose of this paper is to show what bearing spore studies of *Dryopteris* may have on the discrimination of species and hybrids. The following ferns with their spores are described and illustrated: *Dryopteris clintoniana; D. cristata; D. goldiana; D. spinulosa* complex; *D. celsa; D. clintoniana* × *cristata;* and forms of doubtful identification in the *spinulosa* complex, both hybrid and non-hybrid.

In the course of study many fronds of each species were observed. For uniformity and comparability only dried fruiting leaves were used. Permanent slides for each specimen were made from generous samplings of spores, employing the medium Permount. Since a ma-

[7] This study was financed by grants-in-aid from the Society of Sigma Xi and the Penrose Fund of the American Philosophical Society.

PLATE 13. I. DRYOPTERIS CLINTONIANA, *Crane* 5142, SPRINGDALE, N. J.; II. D. CRISTATA, NO. 5285, FOX HOLLOW SWAMP, PA.; III. D. GOLDIANA, NO. 5272, BEAUCE, QUEBEC; IV. D. CELSA, NO. 5271, GRADYVILLE, PA.


V

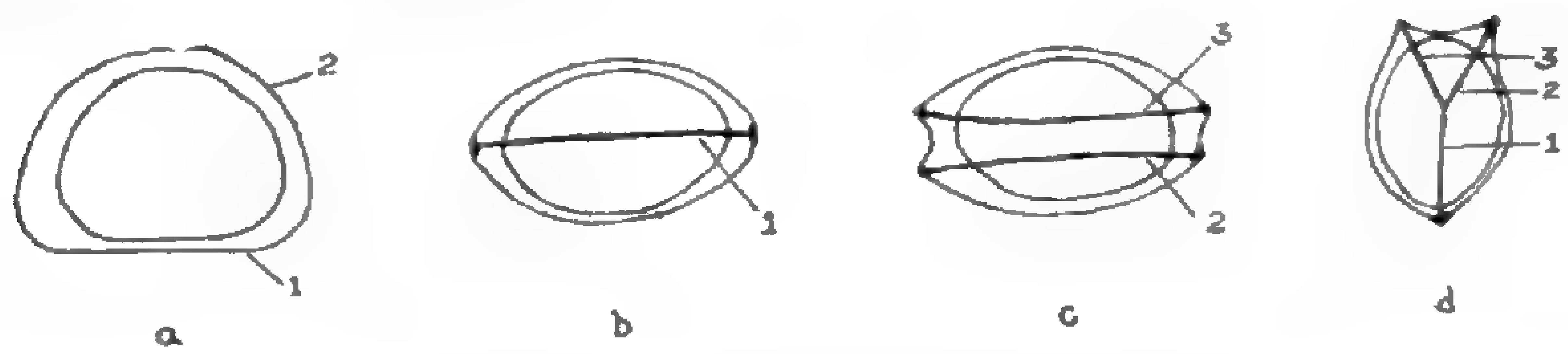

VI


VII


VIII

jority of these spores come to rest on one of two broad sides, all measurements and drawings were completed from that aspect. Average sized spores were drawn on graph paper to facilitate comparison. A measuring bar in the figures represents 30 μ. The silhouettes of typical fronds have been produced photographically; spore drawings were made from the specimens thus illustrated. Manton[8] has described several methods for duplicating drawings and leaf outlines.

The *Dryopteris* spore of a true-breeding species is surrounded by a close-fitting, tan-brown membrane, or perispore,[9] which is variously marked according to the species. Features of the perispore are depicted diagrammatically below. There are three principal wings



DIAGRAMS OF DRYOPTERIS SPORE

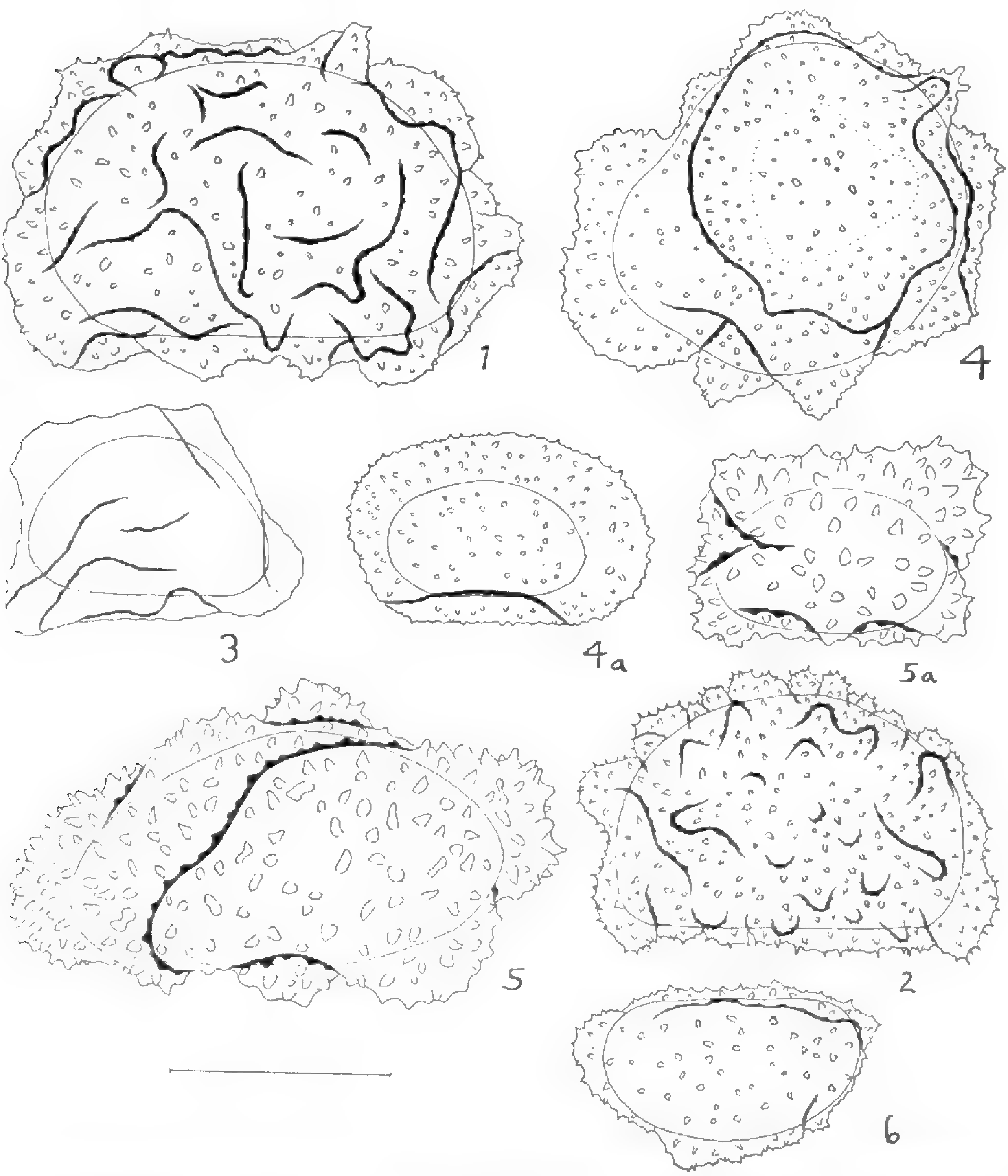
or ridges formed on the perispore: one at the base (1), and two (2, 3) on the upper surface a short distance apart. In Fig. a, the lower and one upper wing fuse and appear continuous around the spore wall. From another angle, Fig. b, the spore is elliptical in outline and the lower wing is evident. Fig. c shows a view of the two upper wings, and Fig. d depicts an end view with all three wings. In addition there are often dispersed at random small supplementary wings which may

[8] Manton, Irene. Problems of Cytology and Evolution in Pteridophytes. Cambridge University Press. London. p. 299. 1950.

[9] Bower, F. O. The Ferns (Filicales). Cambridge University Press. London. **3**: 125. 1928.

PLATE 14. V. DRYOPTERIS CLINTONIANA × CRISTATA, NO. 5286, FOX HOLLOW SWAMP, PA.; VI. D. INTERMEDIA, NO. 5225, PIKE LAKE, WIS.; VII. D. CAMPYLOPTERA, NO. 5022, BEAVER BAY, MINN.; VIII. D. SPINULOSA, NO. 5217, PIKE LAKE, WIS.

AMERICAN FERN JOURNAL VOLUME 43, PLATE 15



1. DRYOPTERIS CLINTONIANA; 2. D. CRISTATA; 3. D. GOLDIANA; 4. D. CELSA; 5. D. CLINTONIANA × CRISTATA; 6. D. INTERMEDIA.

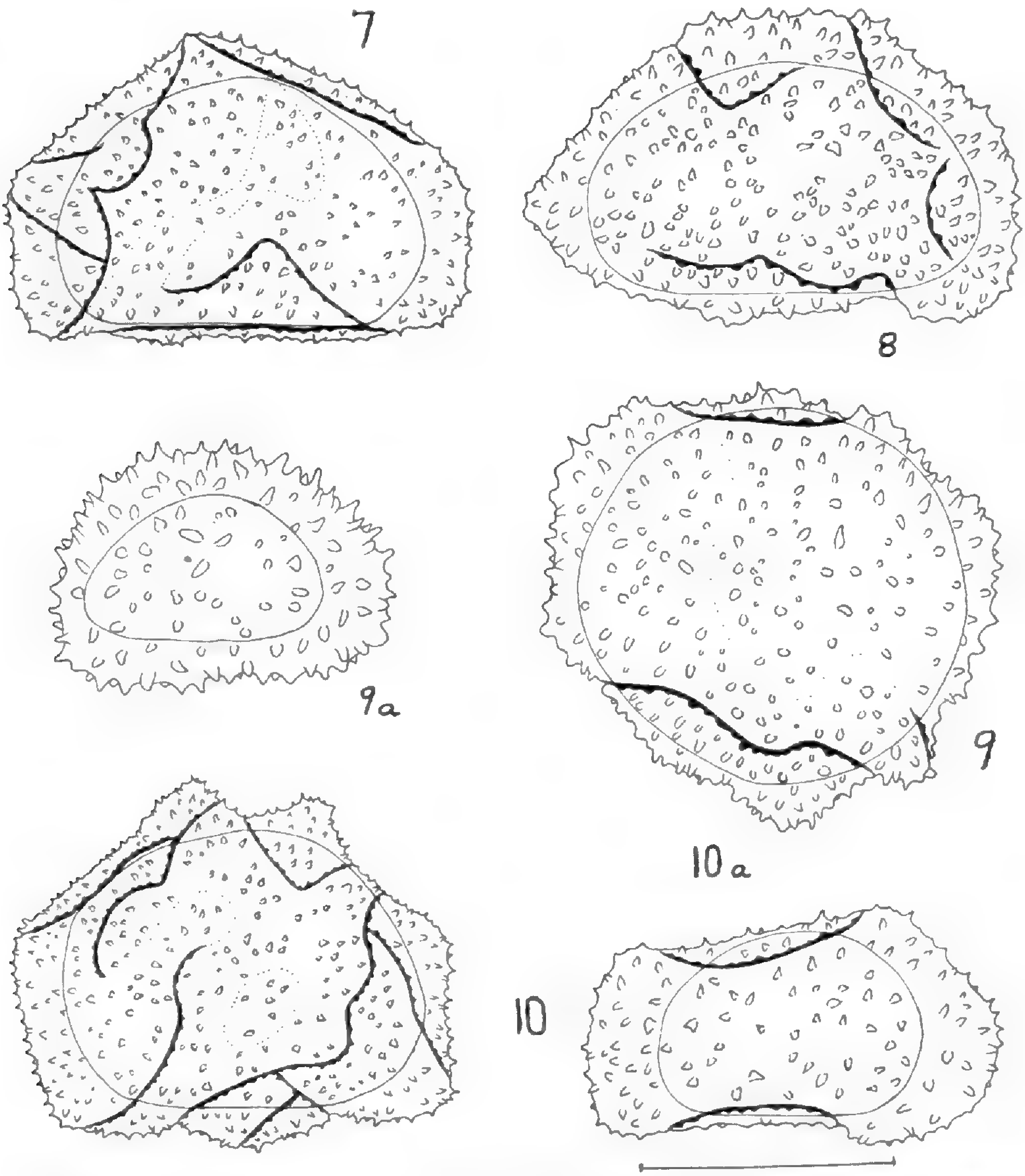
have rounded or angular lobes. The main wings may have lobes or may be entire. The perispore surface and wing edges may be set with spinules or they may be devoid of markings.

The few spores produced by *Dryopteris* forms usually considered to be hybrids can be promptly recognized, as Manton[10] has indicated. Most of them are small and abortive, presumably due to incomplete pairing of chromosomes. There are often formed a few very large, potentially fertile spores. It is entirely possible these contain the 2n number of chromosomes and may form a prothallus that can give rise apogamously to a sporophyte. Such large spores may be quite misshapen, but usually the perispore wings and the absence or presence of spinules give a clue to the parentage. In other cases, however, hybrid spores are not truly diagnostic for positive identification of the presumable parents.

Spore types in well-differentiated species are quite distinctive, even in taxa about whose specific separation there may be a difference of opinion. Thus, *D. clintoniana* and *D. cristata* are classified here as distinct species since the spores are so unlike each other. The size of their spores is one notable difference: respectively $36\,\mu \times 53\,\mu$ and $32\,\mu \times 46\,\mu$. The perispore in *D. clintoniana* (Fig. I and 1) is usually wide and angular-winged, the surface and edges set with widely spaced, blunt-tipped spinules. In contrast, *D. cristata* (Fig. II and 2) produces numerous supplementary, rounded wings well covered by slender, sharp-tipped spinules. *D. clintoniana* is reproducing itself by large fertile spores, although some taxonomists assert it is the hybrid *D. cristata* × *goldiana*. A count of the chromosome numbers should be illuminating. Spore production is fairly high but there is some evidence of abortiveness.

[10] *Op. cit.* p. 193.

AMERICAN FERN JOURNAL VOLUME 43, PLATE 16



7. DRYOPTERIS CAMPYLOPTERA; 8. D. SPINULOSA; 9. D. INTERMEDIA × SPINULOSA; 10. D. CAMPYLOPTERA × SPINULOSA.

Spores of *D. goldiana* (Fig. III and 3) are unmistakably different from the other species described. The perispore has wide simple wings and is entirely free from any markings. The spores are small and transparent.

There has been considerable difference of opinion[11] as to the status of *D. celsa* (Fig. IV and 4). A study of spores and specimens so named has confirmed its identification as a hybrid between *D. clintoniana* and *D. goldiana* which had been suggested earlier on morphological grounds. The perispore has the *D. clintoniana* type spinules and some angular wings, but most of the wings are wide and simple as found in *D. goldiana*. Different specimens of this hybrid vary morphologically and their spores are somewhat dissimilar, some exhibiting more characters from one parent than the other at times. This discrepancy may be explained if *D. goldiana* is considered the male parent in one, the female parent in another form.

A specimen identified on leaf characters as a hybrid between *D. clintoniana* and *D. cristata* (Fig. V and 5) produces the two types of hybrid spores: the abortive and the large forms which, in this case, are not diagnostic for the specimen nor the presumable parents. The leaf morphology exhibits intermediate characters.

In the non-hybrid *spinulosa* complex, *D. intermedia* and *D. campyloptera* (*dilatata*) are classified as varieties of *D. spinulosa* by Fernald[12] and Morton,[13] but as separate species by Benedict[14] and Wherry.[15] *D. inter-*

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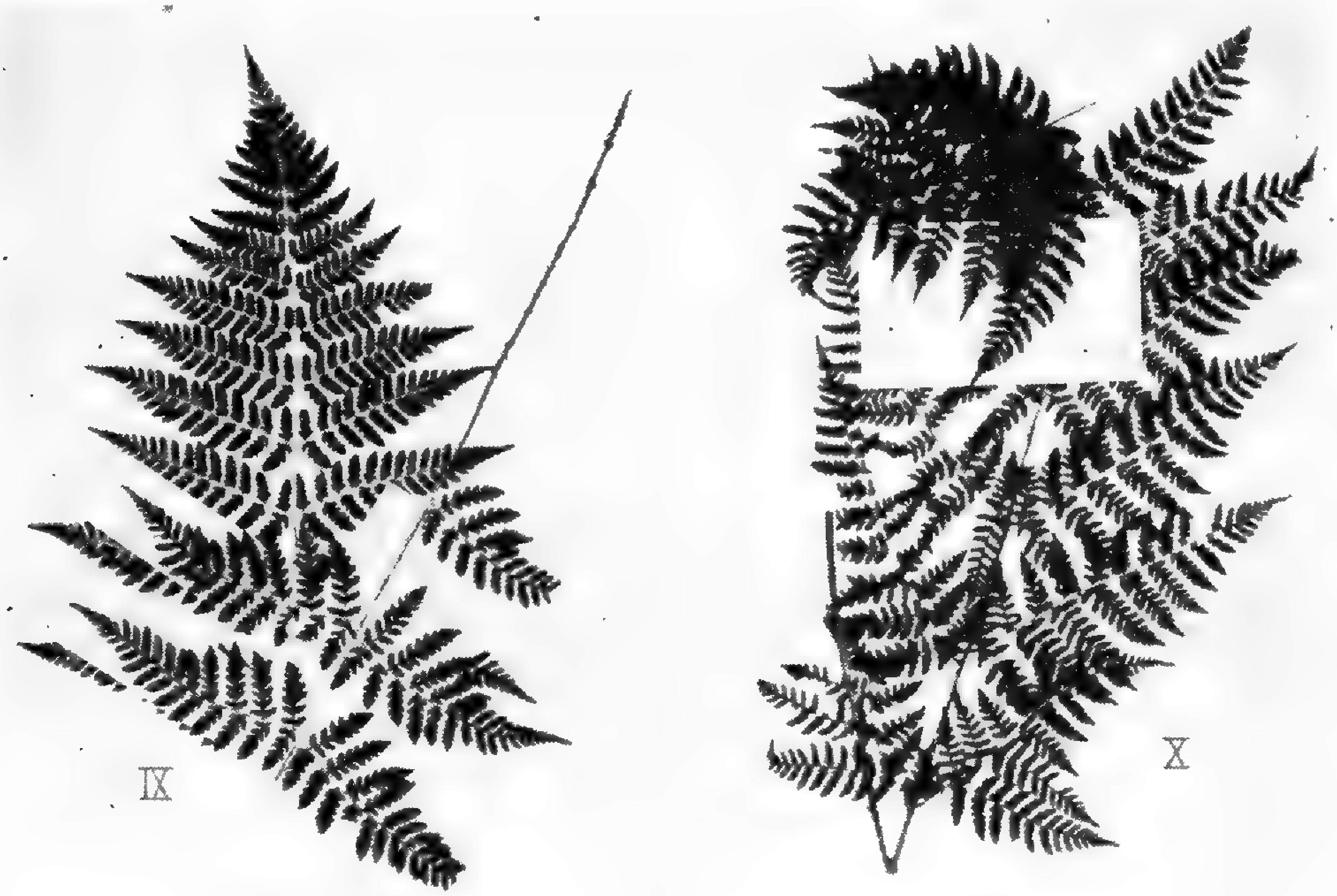
11 Wherry, Edgar T. A New Interpretation of the *Dryopteris clintoniana* Group. Amer. Fern Journ. **40**: 118–120. 1950.

12 Gray's Manual of Botany. 8th Edition. American Book Co., New York. 1950.

13 The New Britton and Brown Illustrated Flora of the Northeastern United States and Adjacent Canada. Lancaster Press, Inc., Lancaster, Pa. 1952.

14 Benedict, Ralph C. Problems in the Study of Spinulose Ferns. Amer. Fern Journ. **14**: 69–74. 1924.

15 Wherry, Edgar T. Guide to Eastern Ferns. Second Edition. University of Pennsylvania Press, Philadelphia. 1948.



IX. D. INTERMEDIA × SPINULOSA, NO. 126, LAKE MOHAWK, N. J.; X. D. CAMPYLOPTERA × SPINULOSA, NO. 5025, BEAVER BAY, MINN.

media (Fig. VI and 6) has characteristic small spores with narrow, simple-winged perispore, widely set with tiny, sharp-tipped spinules, and is easily recognized. Equally distinctive is the spore of *D. campyloptera* (Fig. VII and 7). Its spore is large and the perispore is mostly wide-winged with numerous larger spinules.

An accepted typical form of *D. spinulosa* (Fig. VIII and 8) is rather tall and slender. Its spores resemble those of *D. campyloptera* only in size. The wide and simple-winged perispore is set with large, rounded spinules.

Although a detailed description of *D. spinulosa* is being left for another paper, reference may be made here to a number of diverse, true-breeding forms that are included in *spinulosa* in the broad sense, but do not fit either *D. intermedia* or *D. campyloptera.* The author has observed in numerous collections that some variant morphological types of vegetative growth are matched by a remarkable difference in spores. In other words, even within the limits of "true *spinulosa*," it appears that several lesser taxa are involved. There is no evidence of hybridization in the specimens or the spores.

On the other hand, possible hybrid forms within the whole *spinulosa* complex are often the cause of doubtful identification of specimens. As previously noted, some *Dryopteris* species are difficult to tell from interspecific hybrids. Thus, one specimen from New Jersey appears to be a broad form of *D. spinulosa*. However, the indusia are glandular and the spores manifestly of the hybrid type, indicating it really represents *D. intermedia* × *spinulosa* (Fig. IX and 9). In another case, a frond from Minnesota, supposed to be *D. campyloptera*, produces hybrid type spores but glabrous indusia, and so the specimen is probably *D. campyloptera* × *spinulosa* (Fig. X and 10).

In conclusion it may be stated that

1. The species of *Dryopteris* observed can be separated on the basis of spore characters.
2. The hybrids are easily recognized as such by their peculiar spore production.
3. Hybrid spores are not in themselves completely diagnostic; the morphology of the specimen must be taken into consideration.

The author plans to continue the study of *Dryopteris* and related genera in order to assist the taxonomist in ultimately settling generic and specific lines. Grateful thanks are due the societies mentioned for their material assistance, Dr. Ralph C. Benedict for his editorial help, Dr. Edgar T. Wherry for his kindly advice and criticism, and those persons who have collected and sent specimens.

SUMMIT, NEW JERSEY

The Eastern United States Varieties of Equisetum hyemale

C. V. MORTON

In discussing, several years ago,[1] the names I expected to use in the projected new illustrated Flora, now published, I overlooked mentioning the varieties of *Equisetum hyemale.* It is perhaps desirable to do so briefly, since the names I adopted are entirely different from those used by Professor Fernald in the new Gray's Manual.

The first variety recognized by Fernald, namely var. *intermedium* A. A. Eaton, I do not consider closely allied to *E. hyemale* at all. It is *E. laevigatum* A. Br., which I think a valid species, which includes *E. kansanum* Schaffner, which Fernald recognizes as distinct. In this view, I am following Dr. George Neville Jones,[2] as well as my own study of a large number of herbarium specimens. However, further field studies and anatomical observations are surely to be desired.

Fernald's second variety is called *E. hyemale* var. *affine* (Engelm.) A. A. Eaton and the third var. *robustum* (A. Br.) A. A. Eaton. I recognize the same two varieties, but under the names var. *pseudohyemale* (Farwell) Morton and var. *elatum* (Engelm.) Morton. These two varieties are probably distinct, although this has been disputed (*e.g.* by Jones, op. cit.).

The variety commonest in Canada and the northeastern United States is usually rather low and slender, although this is variable, some plants being quite robust. The only distinctive character is in the regularly and promptly deciduous teeth of the sheaths of the main stems. Most southern and western plants are much

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[1] This JOURNAL, 40: 213–225, 241–252. 1950.

[2] An Enumeration of Illinois Pteridophyta. Amer. Midl. Nat. 38: 84. 1947.

larger and stouter; the teeth of the sheaths are persistent indefinitely, or only partially and irregularly deciduous. The ranges of these two varieties are not, however, mutually exclusive.

For the plant with deciduous teeth, Fernald adopts the name var. *affine,* following tradition. Through the courtesy of Dr. Rolla M. Tryon, it was possible for me to examine the type of *E. robustum* var. *affine* Engelm., which is preserved in the Missouri Botanical Garden (sheet 1314232). It was collected "on grassy clayey banks of the Mississippi, below Jefferson Barracks," [St. Louis], Missouri, by George Engelmann, in August, 1843. A duplicate type has very kindly been presented to the U. S. National Herbarium by the Missouri Botanical Garden. The type is a rather slender plant, but the teeth of the sheaths are all persistent; it is obviously a small specimen of the southern variety, and not distinguishable from var. *robustum.*

Apparently, the only previous author to realize that the epithet *affine* was being misapplied was Oliver Farwell, who proposed the new varietal epithet *Hippochaete prealta* var. *pseudohyemalis* Farwell for *Equisetum hyemale* var. *affine* sensu A. A. Eaton, Fern Bull. 11: 111. 1903, non *E. robustum* var. *affine* Engelm.[3] This is surely a valid publication, since Eaton gave a long and correct description of the variety that he was calling *affine*, and there is no question but that the description applies to the northeastern variety with deciduous teeth. A type for var. *pseudohyemalis* can be selected only arbitrarily; as lectotype I choose a specimen in Farwell Herbarium, Cranbrook Institute, collected by A. A. Eaton, in July, 1902, at Seabrook, New Hampshire, and distributed by him as No. 72 *E. hyemale affine* A. A. E. in his "Fern Bulletin Distribution" exsiccati set "The

[3] Farwell adopted the segregate genus *Hippochaete* for *E. hyemale* and its allies.

Genus Equisetum in North America.'' The specimen in the National Herbarium is marked ''Set 1'' by Eaton. Doubtless specimens of this distribution are in many herbaria.

My intention was to publish the new combination *E. hyemale* var. *pseudohyemale* in the Fern Journal, prior to its appearance in the Illustrated Flora, but this I neglected to do. Consequently, the above combination appears for the first time in the Illustrated Flora, without the citation of basonym. Such combinations, with the basonym to be determined only inferentially, are certainly not desirable; nevertheless, many such have been generally accepted and I believe rightly so. This is to be inferred from paragraph 2 of Article 42 of the new International Code of Botanical Nomenclature—''On and after 1 Jan. 1953, new transfers or new combinations, however, will be considered validly published only when the basonym (name-bringing or epithet-bringing synonym) in clearly indicated with its author and the place and date of publication.'' The inference is that combinations published before 1 Jan. 1953 are validly published even though the basonym is not clearly indicated. The Illustrated Flora was published in November, 1952.

The third variety of Fernald (*robustum*) finds an earlier varietal epithet in *elatum* of Engelmann.

The essential synonymy of these three entities is indicated below:

EQUISETUM LAEVIGATUM A. Braun. Amer. Journ. Sci. & Arts **46**: 87. 1844.

Equisetum hyemale var. *intermedium* A. A. Eaton. Fern Bull. **10**: 120. 1902.

Equisetum kansanum Schaffner. Ohio Nat. **13**: 21. 1912.

EQUISETUM HYEMALE L. var. PSEUDOHYEMALE (Farwell) Morton, in Gleason, New Ill. Fl. No. U. S. & Adj. Can. **1**: 16. 1952.

Hippochaete prealta var. *pseudohyemalis* Farwell. Amer. Fern Journ. **7**: 76. 1917.

Equisetum hyemale var. *affine* sensu A. A. Eaton. Fern Bull. **11**: 111. 1903; Fernald, Gray's Manual, 8th ed. 9. 1950, *et al.*, non *E. robustum* var. *affine* Engelm.

EQUISETUM HYEMALE L. var. ELATUM (Engelm.) Morton, Leafl. West. Bot. **6**: 156. 1951.

Equisetum prealtum Raf. Fl. Ludov. 13. 1817.

Equisetum robustum A. Braun. Amer. Journ. Sci. & Arts **46**: 88. 1844.

Equisetum laevigatum var. *elatum* Engelm. ex A. Braun. Amer. Journ. Arts & Sci. **46**: 87. 1844.

Equisetum robustum var. *affine* Engelm. Amer. Journ. Sci. & Arts **46**: 88. 1844.

Equisetum hyemale var. *robustum* A. A. Eaton. Fern Bull. **11**: 75, 112. 1903.

SMITHSONIAN INSTITUTION, WASHINGTON, D. C.

A new Thelypteris from Ecuador

C. V. MORTON

Among the many interesting plants brought back from Ecuador some years ago by Dr. Ira L. Wiggins is the following species of fern of the genus *Thelypteris.*

THELYPTERIS **minutula** Morton, sp. nov.

Rhizoma erectum, breve, tenue, 1–2 cm. longum, 1.5–2 mm. diam., sparse paleaceum, paleis minutis, 1.5–2 mm. longis, ca. 0.5 mm. latis, acuminatis, integris, cinnamomeis, concoloribus, parietibus superficialibus luteis, margine pilis minutis 2-cellularibus (cellulis apicalibus incrassatis glandulosis) praeditis; folia polysticha, numerosissima (ca. 25), stipitibus tenuissimis, elongatis, 9.5–14 cm. longis, 0.3–0.4 mm. diam., flaccidis, laete brunneis, teretibus, glabris, basin versus parce paleaceis, supra nudis; lamina stipitem plus minusve aequans, linearis, parva, 8–15 cm. longa, 1.3–1.8 cm. lata, deorsum pinnato-pinnatisecta (subbipinnata), apice pinnatifida, rhache straminea, epaleacea, subtus capitato-glandulosa, supra pilosula et glandulosa, pinnis 14–18-jugis, alternis, horizontalibus, sessilibus, oblongis, 8–10 mm. longis, 4–5 mm. latis (2 vel 3 infinis minoribus sed non auriculiformibus), obtusis vel leviter acuminatis, supra in costa parce pilosula et capitato-glandulosa, venis parce pilosulis, subtus in costa capitato-glandulosa, superficiebus perspicue glandulosis, glandulis aureis, globulosis, sessilibus, hinc inde pilis brevibus praeditis segmentis paucis, 4-vel 5-jugis, subrotundis, apice rotundatis, 2–3 mm. longis et latis, tenuiter membranaceis, pallide viridibus, marginibus ciliolatis, leviter incurvatis; venae simplices, (1) – 2-jugae, rectae, margines attingentes; sori in segmentis bijugi (vel sursum unijugi); indusium persistens, minutum, epilosum, perspicue rubro-glandulosum; sporangia pauca, magna, glabra.

Type in the U. S. National Herbarium, no. 1917909, collected in the páramo between El Angel and Tulcan, about 30 km. south of Tulcan, Carchi Province, Ecuador, August 16, 1944, by Ira L. Wiggins (no. 10572). Isotype in the Dudley Herbarium, Stanford University.

The only close relative of the present species is an extremely rare species of Hispaniola, *Thelypteris* **physematioides** (Kuhn & Christ) Morton, comb. nov.,[1] of which I have seen two specimens—*Ekman* H 7618 and H 13614. It differs by the short stipe (very much shorter than the blade), the obviously pilose stipe and rhachis, and particularly by the absence of large, reddish, sessile glands on the leaf surfaces beneath and on the indusia.

SMITHSONIAN INSTITUTION, WASHINGTON, D. C.

Shorter Notes

TWO MISINTERPRETED TROPICAL AMERICAN FERNS.—Through the courtesy of Dr. Rolla M. Tryon, Jr., I have been able to study authentic material of two species.

In my treatment of the species of *Elaphoglossum* in the French West Indies[1] I adopted the name *E. alismifolium* (Fée) Moore for a species closely allied to the Jamaican *E. latifolium,* going wholly on the original description by Fée. It is probably that Fée had more

[1] *Aspidium physematioides* Kuhn & Christ ex Krug, Bot. Jahrb. Engler 24: 115. 1897.
Dryopteris physematioides C. Chr. Ind. Fil. 284. 1905.

[1] This JOURNAL 38: 202–214. 1948.

than one species in hand when he described *Acrostichum alismifolium,* for he cites material from Guadeloupe, Venezuela, Cuba, and Brazil. I have now examined a specimen of the Guadeloupe plant (in the herbarium of the Missouri Botanical Garden), which was collected by L'Herminier. This, the first cited specimen, proves not to be the species to which I applied the name *E. alismifolium* but that named *Elaphoglossum martinicense* (Desv.) Moore. The proper typification of Fée's species can probably not be undertaken until the other material cited in the original description can be examined, but it is evident that the name can not be used in the sense in which I used it. The proper name to be taken up for *E. alismifolium sensu* Morton (*op. cit.* 211) is apparently *E. impressum* (Fée) Moore.

In my revision of the American species of *Hymenophyllum,* section *Sphaerocionium,*[2] I treated *Hymenophyllum tomentosum* Kunze as a dubious species, for I could not definitely identify it from the original description, and no authentic material was available for study. Dr. Tryon found an isotype of the species (Peru, *Poeppig* in 1829) in the herbarium of the Missouri Botanical Garden, which proves that the species is identical with the plant that I described as *H. fusugasugense* var. *aberrans.* Inasmuch as the epithet *tomentosum* has priority over *fusugasugense* it is necessary to adopt it. These plants will therefore be known as follows:

HYMENOPHYLLUM TOMENTOSUM Kunze. Linnaea **9**: 107. 1834; Farnkr. **1**: 160. *pl. 69.* 1844.

Hymenophyllum fusugasugense var. *aberrans* Morton. Contr. U. S. Nat. Herb. **29**: 187. 1947.

HYMENOPHYLLUM TOMENTOSUM var. **fusugasugense** (Karst.) Morton, comb. nov.

Hymenophyllum fusugasugense Karst. ex Sturm. Bot. Zeit. **1859**: 297. 1859; Karst., Fl. Col. **2**: 107. *pl. 155, fig. 1–8.* 1862–69.

C. V. MORTON

Smithsonian Institution, Washington, D. C.

[2] Contr. U. S. Nat. Herb. **29**: 188. 1947.

DECEMBER FERN NOTES.—The fertile leaves of the sensitive fern may be added to decorative material for Christmas. The tightly rolled and closed beadlike segments, firm and dried, seem well adapted to take a variety of colors. The silvered (or aluminated) leaves are seen in florists' shops in Brooklyn.

"Christmas Ferns" of great variety and luxuriance are described in the fourth edition of Dobbie's "Ferns of New Zealand," as revised by Marguerite Crooke. In an area no bigger than one of our smaller states 200 species of ferns are native, one with leaves 20 to 30 feet long and 15 feet wide! December would show these "Christmas Ferns" to their best advantage. A visitor from the United States would not find the ferns totally unfamiliar —the list includes some 20 genera found in the United States and even several of the same species, such as marsh fern, bracken, and moonwort.

Spinulose Fern (but not intermedia) has been noted as a volunteer in greenhouses, the latest example that I have seen being in the cooler house at Brooklyn College, where it has grown to spore-producing maturity in an ecological planting with trickling water and mosses. Presumably the moss had contained the spores. It would probably do well in Wardian cases in the house.

"Collecting Ferns is a Rewarding Hobby" is the title of a rather comprehensive article in the January, 1953, issue of "House and Garden." After about a page of general observations about collecting, situation, and planting (and even growing ferns from spores), the article proceeds to list about 30 species under such headings as: "For sunlight or shade," "For ground cover," "For very wet locations," "For rock crevices." In a supplementary list "For indoor window gardens" a few subtropical species suitable as house plants are named. The general advice and suggestions are good, although one might question the inclusion of a rarer type like *Dryopteris Boottii* (listed under the misleading name "Boot Fern").—R. C. BENEDICT.

Recent Fern Literature

A second edition of the well-known "The Ferns and Fern Allies of Wisconsin"[1] has just appeared. It has, apparently, been reproduced from the first edition by photo-offset. The beautiful half-tones of the original, especially the habitat photographs, have suffered and have lost a good deal in definition. However, they are still effective. Some changes have been made in the text, but these have been kept to a minimum. Some additional dots have been added to the distribution maps, but these do not reveal any startling additions to the known ranges. No additional entities are treated, but some have been renamed, to bring the nomenclature more in accord with Fernald's treatment in the eighth edition of Gray's Manual. However, Fernald is not followed in every instance, for the name *Cheilanthes lanosa* is adopted, rather than *C. vestita, Athyrium angustum* is maintained as a species rather than as a variety, *Azolla mexicana* is adopted, following Svenson rather than Fernald, and *Equisetum Nelsonii* contiues to be recognized as a valid species.

The following small matters may be mentioned for the record. Mr. Weatherby pointed out in his review of the first edition[2] that maps 75 and 76 had been interchanged; in the new edition they still remain interchanged. Exception may be taken to the spelling of var. *Mackayii* (of *Cystopteris fragilis*). Lawson's original incorrect ending has been adopted by Fernald and

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[1] By R. M. Tryon, Jr., D. W. Dunlop, N. C. Fassett, and M. E. Diemer. University of Wisconsin Press, Madison, Wis. $3.50.

[2] This JOURNAL 31: 25. 1941.

others; however, the International Code gives us authority to change orthographic errors, and this epithet ought to be emended to *Mackayi.* The Code indicates that the diaeresis sign should be used where required, and it *is* required in *Isoëtes*, for the "o" and "e" are here two syllables and not the diphthong "oe,"[3] i.e. the equivalent of German "ö". With his usual care in such matters, Dr. Fernald has it correct. The list of references has been expanded somewhat, but, to be more helpful, it might have been well to modernize the old entries. Thus, Wherry's Guide to Eastern Ferns is indicated as published by Science Press for $1.00, whereas it is currently published (3rd edition) by University of Pennsylvania Press for $2.50, and Maurice Broun's address is one that has not been correct for many years (Route 1, Orwigsburg, Pa.); the current address is Hawk Mountain Sanctuary, R.D. 2, Kempton, Pa. The "Glossary" has been reproduced verbatim from the first edition. A couple of the entries might well have been changed. "Glandular-pubescent" is defined as "with glands and hairs," which would be more correct as a definition of "glandular and pubescent"; the compound "glandular-pubescent," as commonly used, means "pubescent with glandular (or gland-tipped) hairs." The authors define "pinnule" as "The secondary division of a frond" and "pinnula" as "The tertiary division of a frond." This is a distinction that I have never known to be made and which is untenable; if one is writing in Latin the word is "pinnula" (plural: pinnulae), if in English, the Latin word could be used or (as ordinarily) its English derivative, pinnule (plural: pinnules). However, pinnula and pinnule are the same word and can not be made to mean different things arbitrarily. There is no one word

[3] This statement may seem incompatible with my usage in the new Britton and Brown, Illustrated Flora. The spelling *Isoetes* was an editorial emendation that I was not consulted about.

that will make the distinction that the authors intend; it is necessary to use a circumlocution. A "pinna secundaria" is a "pinnula primaria," a "pinna tertiaria" is a "pinnula secundaria," and so on.

These minor defects do not detract at all from the great value of this book, which is highly recommended to fern students everywhere.—C. V. MORTON.

"FERN GARDENS AS A HOBBY" is the title of a fairly extensive, well-illustrated article in the July issue of the National Horticultural Magazine. Since the present reviewer wrote the article, no more will be said about it other than it is about 2000 words long, that it carries a good deal of information about the American Fern Society, and that part of the article consists of material extracted from the Fern Journal.

The immediate occasion for this note was the election of the President of the Fern Society as an Honorary Vice-President of the American Horticultural Society and also the suggestion of the Managing Editor of the Magazine that they had been neglecting ferns and would be glad to remedy the deficiency. The National Horticultural Magazine is a quarterly of excellent appearance and content. It presents frequent semi-monographic articles on various groups of plants, such as azaleas, begonias, and geraniums. Membership is $5.00 a year. Address: 1600 Bladensburg Road, N. E., Washington, D. C.—R. C. B.

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Errata

Page 114, third line from bottom: For **"heterophyllum,"** read **"heterophylla."**

Page 126, footnote 2: For "Redford" read "Radford," and for "var. *Mackenzi*" read "var. *Mackayi.*"

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