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An Early Pennsylvanian Flora with *Megalopteris* and Noeggerathiales from West-Central Illinois

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Prepared in cooperation with the Illinois State Museum, Springfield

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AN EARLY PENNSYLVANIAN FLORA WITH *MEGALOPTERIS* AND NOEGGERATHIALES FROM WEST-CENTRAL ILLINOIS

Richard L. Leary[1] and Hermann W. Pfefferkorn[2]

ABSTRACT

The Spencer Farm Flora is a compression-impression flora of early Pennsylvanian age (Namurian B, or possibly Namurian C) from Brown County, west-central Illinois. The plant fossils occur in argillaceous siltstones and sandstones of the Caseyville Formation that were deposited in a ravine eroded in Mississippian carbonate rocks. The plant-bearing beds are the oldest deposits of Pennsylvanian age yet discovered in Illinois. They were formed before extensive Pennsylvanian coal swamps developed.

The flora consists of 29 species and a few problematical forms. It represents an unusual biofacies, in which the generally rare genera *Megalopteris*, *Lesleya*, *Palaeopteridium*, and *Lacoea* are quite common. Noeggerathiales, which are seldom present in roof-shale floras, make up over 20 percent of the specimens. The Spencer Farm Flora is an extrabasinal (= "upland") flora that was growing on the calcareous soils in the vicinity of the ravine in which they were deposited.

It is suggested here that the Noeggerathiales may belong to the Progymnosperms and that Noeggerathialian cones might be derived from *Archaeopteris*-like fructifications. The cone genus *Lacoea* is intermediate between *Noeggerathiostrobus* and *Discinites* in its morphology.

Two new species, *Lesleya cheimarosa* and *Rhodeopteridium phillipsii*, are described, and *Gulpenia limburgensis* is reported from North America for the first time.

INTRODUCTION

The Spencer Farm Flora (table 1) differs from other Pennsylvanian floras of the Illinois Basin. Many genera and species in the Spencer Farm Flora either have not been found elsewhere in the basin or are very

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TABLE 1—SPECIES FOUND IN THE SPENCER FARM FLORA IN BROWN COUNTY, ILLINOIS

		Page
LYCOPSIDS		6
	Lepidodendron wortheni	
SPHENOPSIDS		7
	Annularia cf. *vernensis*	
	Annularia cf. *asteris*	
	Asterophyllites longifolius	
	Asterophyllites cf. *equisetiformis*	
	Mesocalamites cf. *cistiiformis*	
	Calamostachys andanensis	
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	Alloiopteris gracillima	
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	Dactylotheca aspera	
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	Palaeopteridium reussii	
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	Megalopteris ovata	
	Lesleya cheimarosa spec. nov.	
	Alethopteris lonchitica	
	Sphenopteris preslesensis	
	Eusphenopteris morrowensis comb. nov.	
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	Cordaicarpus sp. B	
PROBLEMATICA		37
	cf. *Mariopteris*	
	cf. *Eremopteris*	

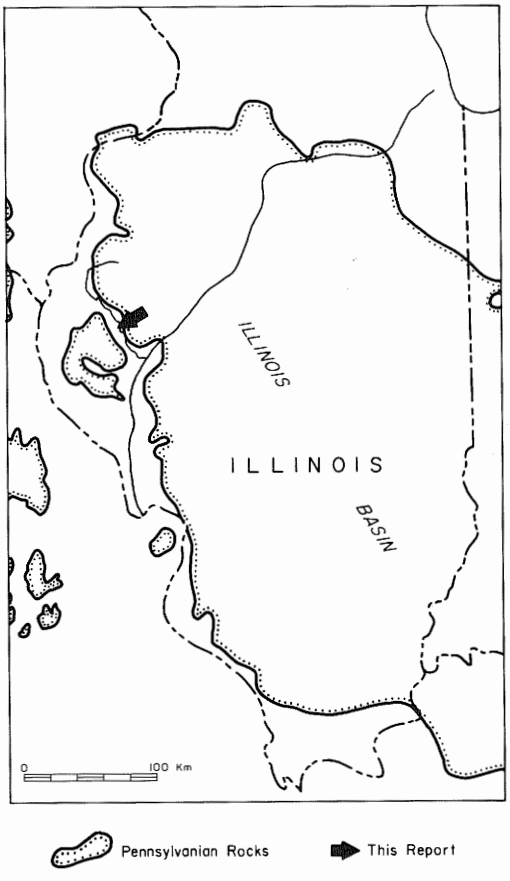
rare in other floras. Flora similar to the Spencer Farm was first observed in western Illinois by White (1908), who gave a preliminary list including the *nomen nudum* "*Lacoeia*." White (1931) suggested that this flora grew on the limestone plains of western Illinois. Leary (1973) reported on the systematic position and reconstruction of *Lacoea*.

The material used in this study comes from the northeastern edge of an outlier of Pennsylvanian strata that is separated from the main area of Pennsylvanian deposits by the erosion of the La Moine River Valley (text fig. 1). The collecting sites are in northeastern Brown County, Illinois (Rushville, Illinois 15-Min. Quad.; NW¼ SW¼ NW¼ SW¼ Sec. 12, and NE¼ SE¼ NE¼ SE¼ Sec. 11, T. 1 N., R. 3 W.), on the bluffs of the La Moine River (formerly "Crooked Creek"). One locality is along the road that runs northwest-southeast and parallels the river; the exposure is 15 meters northwest of the turn of the road. A second locality is located in a small ravine about 75 meters west of the first locality. The exposures at both localities are at the same elevation and stratigraphic position. The specimens described in this paper are housed in the collections of the Illinois State Museum (ISM).

Acknowledgments

We wish to acknowledge the assistance received from the Spencer family, who donated specimens to the Illinois State Museum and allowed the authors to collect on their farm.

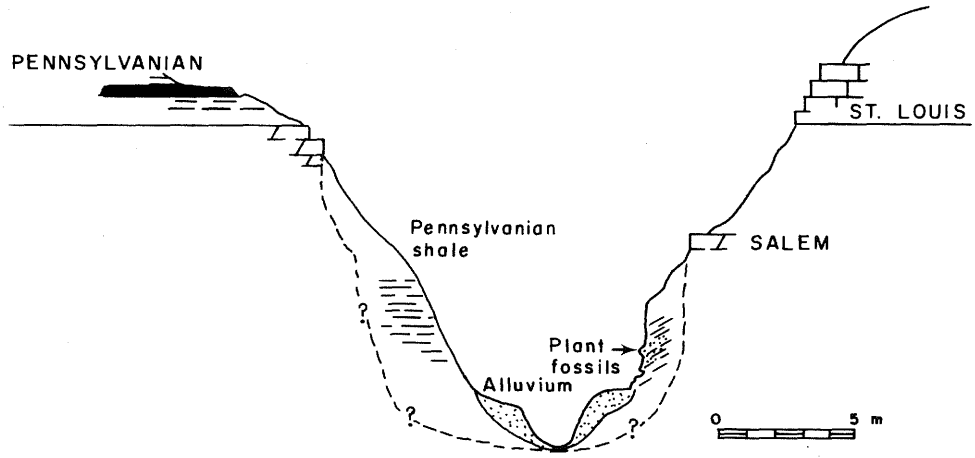
We wish to thank Dr. Tom L. Phillips of the University of Illinois and Dr. Sergius H. Mammay, U.S. Geological Survey, for their encouragement and for reviewing our manuscript. Dr. Russell A. Peppers, Illinois State Geological Survey, helped with paleobotanical and stratigraphic problems. Material was loaned by Dr. Dwayne D. Stone, Marietta College, Ohio, and by Dr. Herman F. Becker, The New York Botanical Garden. Mr. Rudolf Ewald, Datteln, Germany, helped us with the derivation of the new specific names. Dr. Leo J. Hickey, Smithsonian Institution, kindly supplied us with photographs of some of Lesquereux's type specimens.



Text fig. 1 - Map showing the relation of the Spencer Farm locality to the outcrop area of Pennsylvanian rocks.

GEOLOGY

Erosion of the sub-Pennsylvanian limestones in the area of the Spencer Farm produced a very irregular surface with relief of at least 12 meters. The earliest Pennsylvanian deposits filled low areas only. They are discontinuous and vary greatly in thickness and lithology. The deposits described in this report represent the early filling of a ravine in the Mississippian limestone and



Text fig. 2 - Geologic interpretation of cross section through the Spencer Farm locality.

dolostone. The early Pennsylvanian deposits were, as they are today, located between fairly steep bluffs of the St. Louis and Salem Limestones (text fig. 2). The geology of this locality has been described by Leary (1974a).

The geologic position of the flora-bearing beds is not directly obvious in the field because much of the area is covered and the Pennsylvanian as well as Mississippian strata are essentially flat lying. The first impression in the field is, therefore, that the plant-bearing beds are overlain by the Salem and St. Louis Limestones. The flora and the irregular predepositional surface, however, are clear indications of the Pennsylvanian age of the plant-bearing beds.

Caves, sinkholes, and channels containing Pennsylvanian age shale and sandstone are present in Ordovician, Silurian, and Devonian limestones in Rock Island (Savage and Udden, 1921), Whiteside (McGinnis and Heigold, 1974), La Salle (Willman, 1942), and Kankakee (Bretz, 1940) Counties. Plant megafossils have been found in deposits in Rock Island County since the last century (Worthen and Shaw, 1873). Caves containing Pennsylvanian age material are known from Missouri; Upshaw and Creath (1965) described a spore flora of early Pennsylvanian age from these deposits. Brill (1973) reported a linear deposit bearing fragmentary Pennsylvanian plant fossils in St. Louis County, Missouri, and he interpreted it as a fossil valley.

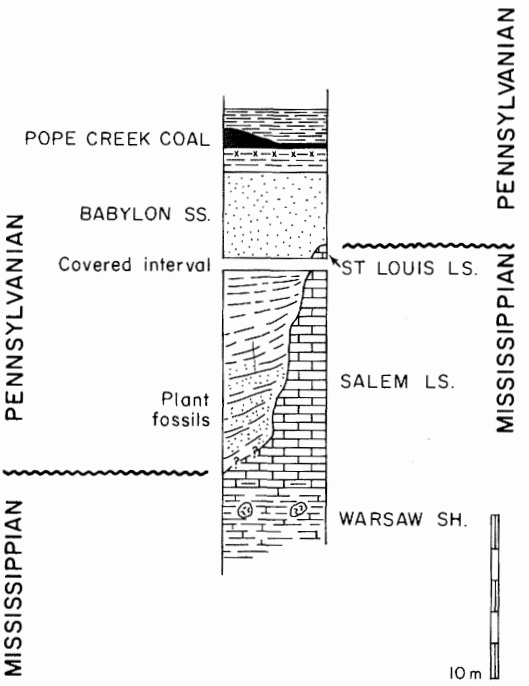
Leckwijck, Stockmans, and Willière (1955) described a locality in Belgium that shows many similarities to the Spencer Farm site. In that locality Namurian shales, which were deposited in solution cavities in Viséan limestone, preserved an unusual flora that is known from only a few other places.

Stratigraphy

A composite stratigraphic section of the deposits in the vicinity of the fossil locality is shown in text figure 3. Information on local

stratigraphy is found in Harvey (1964), Reinertsen (1964), and Leary (1974a).

The Warsaw Shale of Mississippian age is the oldest formation observed in the report area. It is exposed in a small creek southeast of the collecting localities, several hundred meters southwest of the point where the creek enters the La Moine River. The Warsaw consists primarily of light gray, bluish gray, or greenish gray calcareous or dolomitic shale. In some places it contains one or more beds of light gray earthy limestone that are massive, lacking obvious bedding planes, and that scale off in thin blocks upon exposure. Thin beds of dolostone, siltstone, and sandstone are interbedded with the shale. Contact with the overlying Salem Limestone is gradational.



Text fig. 3 - Stratigraphic column of the rocks in the vicinity of the Spencer Farm locality.

The Salem Limestone is exposed in the area of the collecting localities, forming part of the sides of the ravine in which the fossil-bearing Pennsylvanian sediments accumulated. The Salem Formation is predominantly a brown to light brownish gray limestone or dolostone. The limestone is dense to argillaceous, silty or even sandy, and commonly occurs in irregular thin beds. This limestone or dolostone may give way to a light gray or greenish gray dolomitic siltstone or sandstone, or a light greenish gray calcareous or dolomitic sandy shale that closely resembles the Warsaw. The Salem is 10 to 14 meters thick.

The youngest Mississippian formation in the report area is the St. Louis Limestone. Only part of the formation is present, pre-Pennsylvanian erosion having removed at least the upper portion, and in most areas, all of the formation. The St. Louis is a light gray, dense to lithographic limestone containing small amounts of white to light gray chert. Thin beds of light greenish gray shale are interbedded with the limestone. The limestone commonly is brecciated, consisting of angular fragments of light gray, dense limestone in a matrix that is darker gray and weathers rusty brown. The maximum thickness of the St. Louis observed in the immediate area is 4 meters.

The fossil-bearing strata are the lowermost Pennsylvanian deposits in the area and belong to the Caseyville Formation. They consist of very irregularly interbedded siltstone, fine-grained sandstones, and shales deposited in steep-sided depressions within the Mississippian limestones, primarily the Salem Limestone. The siltstones are gray and well sorted; however, lenses of coarse quartz sand grains in a matrix of

silt and clay occur. The sandstones are gray, well sorted, and composed of quartz; the shale lenses are gray. Where weathered, the shales, silts and sandstones become ochre to rust brown. The bases of some sandstone beds are conglomeratic with clay pebbles dominating. This lithology, together with the irregular and wavy bedding of the coarse cross-stratification, indicates deposition in rapidly moving water. Further indications of deposition in such water are the twisted and distorted plant fossils which often cross bedding planes. That the plants were brought in by fast-moving water is also indicated by the fact that they are most common in the coarser beds.

Overlying the fossil-bearing strata is a rust-colored shale. It overlaps the top of the Salem and caps the hill between the two collecting localities. Its thickness and exact stratigraphic relationship are not known; however, it probably underlies the Babylon Sandstone Member of the Abbott Formation. The Babylon Sandstone in the report area is approximately 4 meters thick, although elsewhere it is as much as 8 meters thick. It is composed almost entirely of medium to coarse quartz grains. For the most part, the sandstone is light gray to yellowish gray, but the weathered surface may be iron-stained a reddish brown. The upper part is thick and irregularly bedded to massive, and contains *Stigmaria* and *Lepidodendron* impressions. The lower part is cross bedded and contains carbonaceous partings. To the northeast, the sandstone intertongues with shale.

Overlying the sandstone is approximately 30 cm of underclay and shale, light near the top and darker and sandier near the base. A thin coal is exposed where a road crosses a creek about 300 m south of the collecting localities. The coal ranges in thickness from 45 cm to only 8 cm. The thinning is apparently the result of post-lithification channeling, as the base of the coal is even and the upper contact very irregular. The coal has been tentatively identified as the Pope Creek Coal Member of the Abbott Formation.

The hiatus between the Mississippian and Pennsylvanian beds is apparently quite long in Brown County. The St. Louis Limestone is the youngest Mississippian unit preserved, and the entire Chesterian Series is missing. The first widespread deposit of Pennsylvanian age is the Babylon Sandstone Member of the Abbott Formation. Thus the Caseyville is represented only by the plant-bearing beds.

The St. Louis Limestone has been tentatively correlated with the cu III α in Europe (Collinson, Scott, and Rexroad, 1962). The Babylon Sandstone is of Westphalian B age. Thus the upper part of the Viséan, the entire Namurian, and the Westphalian A are missing between these two units. This gap represents a time span of 10 to 20 million years (Francis and Woodland, 1964). The plant-bearing strata could have been deposited any time during that interval. Determination of the age of the flora is thus crucial for the dating of these beds.

LYCOPSIDS

Lepidodendron wortheni Lesquereux

Text fig. 4A; pl. 1, fig. 1

The single specimen of *Lepidodendron* from the Spencer Farm localities consists of nine leaf cushions in an area 3.5 by 1.5 cm. The

length-to-width ratio is about 2:1; the cushions are 1.3 to 1.5 cm long and 0.5 to 0.7 cm wide. Each cushion merges with those above and below.

There are transverse wrinkles on the lower portion of nearly all the cushions, and wrinkles are visible on the upper part of one. A prominent ligule scar, a short vertical slit, is seen just above the leaf scar. The outlines and details of the leaf scars are not clear. They are located just above the center of the cushions and appear to be nearly as wide as the cushions.

SPHENOPSIDS

Annularia cf. *vernensis*

Text fig. 4B, C; pl. 1, fig. 4

Description.—The leaves, averaging 12 in a verticil, are 5 mm long and 1 mm wide. Each leaf is slightly longer than the internode. The leaves are conspicuously lanceolate, more or less uniform in width, taper toward the base and toward the acute apex. They are equal in length, radiate from the node; they are straight or slightly curved. The midrib is 0.3 mm wide and is longitudinally striated. The stem is 1 mm wide, with internodes 3 to 4 mm long.

Discussion.—A single specimen referable to this species has been found at Spencer Farm. At first glance, the leaf arrangement appears to be that of *Asterophyllites*, an impression held originally by Arnold (1949) regarding his specimen from Michigan. However, closer examination of the Illinois specimen reveals that some leaves radiate from the axis at an angle greater than 90°. Abbott (1958) interpreted the leaves as radiating from the node in a single plane and transferred this species to *Annularia*.

The number of leaves per whorl is not determinable from the Illinois specimens. A maximum of six is observed although it is certain that others were originally present but are not visibly preserved. The ratio of width to length of the leaves is more like that of *Annularia* than *Asterophyllites*, as originially noted by Arnold (1949, p. 183) and Abbott (1958, p. 326).

Annularia cf. *asteris*

Pl. 1, fig. 6

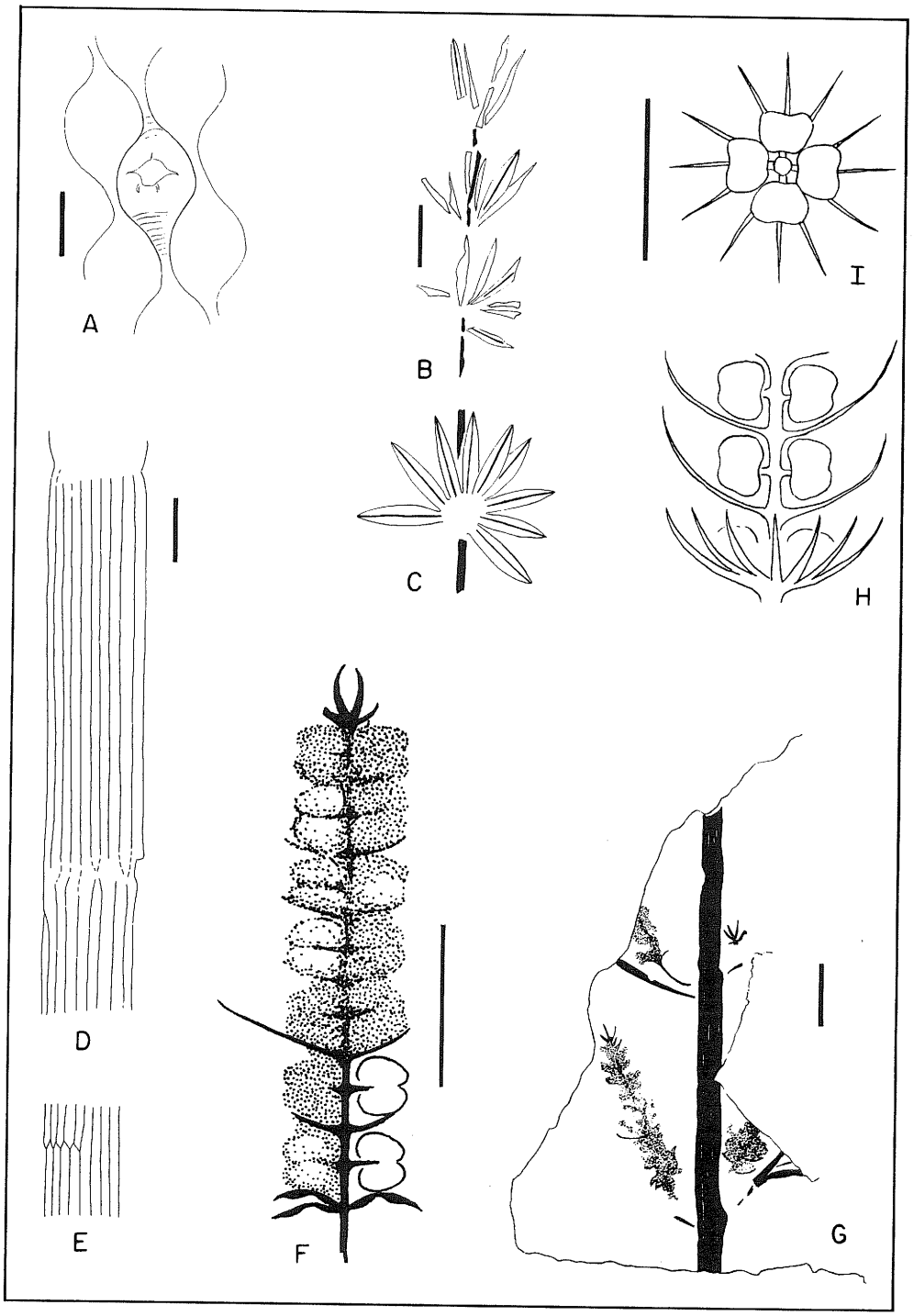
One specimen of *Annularia* has been found in the Spencer Farm Flora; it shows only a single whorl of leaves. The leaves are 3 to 4 mm long and about 1 mm wide. The midvein is not visible. There are eight leaves in the whorl, which is 7 mm in diameter.

The specimen is similar to *A. asteris* in the number of leaves in the whorl, in overall size, and in the general shape of the leaves.

Asterophyllites longifolius (Sternberg) Brongniart

Pl. 1, fig. 5

The linear leaves are 1.5 mm wide, except for a single specimen (ISM 416124) that has leaves only 0.25 to 0.375 mm wide; and they are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preserved up to 5 cm long. They extend from the stem at angles of 30° to 45°. In three specimens, they overlap two nodes. The leaves and stems are striated.

In our specimens, only six to eight leaves are visible in each verticil, but this may be the result of preservation. In other aspects, the specimens conform to published descriptions of *A. longifolius*.

Asterophyllites cf. *equisetiformis*

Three very small specimens of *Asterophyllites* have been found in the Spencer Farm Flora. They are too poorly preserved to allow a precise identification, but are similar to *A. equisetiformis* in overall proportion and form. At least 12 leaves were present on each verticil. The leaves extend from the axis at almost 90° and then curve upward. They are narrow and slightly overlap the node above. The leaves are 7 mm long and 0.5 mm wide, and the midvein is approximately 0.2 mm wide. Although no complete whorl is preserved, it is clear that originally there were at least 12 leaves per whorl. The internode length is 2.0 mm.

Mesocalamites cf. *cistiiformis* (Stur) Hirmer
Text fig. 4D, E; pl. 1, fig. 3

The Spencer Farm Flora contains 14 specimens of calamitean pith casts and impressions. All determinable data on these specimens are given in table 2. The most meaningful characteristics are (1) the continuity of the ribs, (2) number of ribs per centimeter, and (3) length-to-width ratio of the nodes.

On most specimens a majority of the ribs pass continuously across the node whereas the others alternate. The narrow stems, however, which bear the *Calamostachys* cones, do not show any alternating ribs. This variation seems to exist only on very thin, fertile branches, and does not indicate a specific or generic difference.

Calamostachys andanensis Stockmans and Williere
Text fig. 4F-I; pl. 1, figs. 2, 7

There are about ten specimens which can be attributed to *Calamostachys*; apparently all of the specimens belong to one species.

Description.—Whorls of bracts alternate with whorls of sporangiophores. The sporangiophores bear four sporangia which were probably attached to a plate. The axes of the sporangiophores form right angles with the main axis and are attached in the middle between two whorls of bracts. The measurements are given in table 3.

The specimens are well preserved in the siltstone and compaction during early diagensis was slight. Nevertheless only a few characteristics

Text fig. 4 - Fossil plants from the Spencer Farm Flora. A, *Lepidodendron wortheni* leaf cushions. B, C, *Annularia* cf. *vernensis*, C- partial reconstruction. D, E, *Mesocalamites* cf. *cistiiformis*. F-I, *Calamostachys andanensis*, F- complete cone, G- cones attached to *Mesocalamites* cf. *cistiiformis*, H- reconstruction of part of the cone, I- reconstruction, view into one verticil. Bar scales are 5mm long.

TABLE 2—MEASUREMENTS OF SPECIMENS OF *MESOCALAMITES* cf. *CISTIIFORMIS* FROM THE SPENCER FARM FLORA

Accession no.	Internode length (mm)	Width (mm)	Length/ width	Number of ridges	Ridges/ cm	Average width (mm)	Alternating Continuous*	Termination
416492	45	17	2.6	15	8	1.2	a/c	pointed
416493	17?	7	2.4	15	20	0.5	a/c	unclear
416432	50	20	2.5	20+	12	0.8	a/c	unclear
416606	30	4.5	7	10	20-25	0.5	a/c	unclear
416247	12	2.0	6	7	30	0.3	unclear	unclear
416605	28?	>8	3±	16	20?	0.5	unclear	unclear
416262	16?	4	4	7-8	30-40	0.25-0.3	cont. (a/c?)	unclear
416352	40	>8	ca. 5	18	25	0.4	a/c	pointed
416353	30	22	>1.4	24	10-12	0.8-1	a/c	pointed
416261	19	2.5-5	ca. 4	11±	17±	---	a/c	unclear
416495	20.5	3.5	ca. 6	6-8	25	0.4	a/c	pointed
			The following bear *Calamostachys*					
416487	20	4.0	5	12	30	0.3	cont.	---
416413	22	3.0	7	8	25	0.4	cont. ?	---
416511	30	3.0	10	7	25	0.4	cont.	---

* a/c = both alternating and continuous.

TABLE 3—MEASUREMENTS OF SPECIMENS OF *CALAMOSTACHYS ANDANENSIS* FROM THE SPENCER FARM FLORA

Specimen no.	Length of cone (mm)	Width of cone (mm)	Length of internodes (mm)	Size of sporangia (mm)	Length of bracts (mm)	Length of sporangiospore (mm)
416375	--	-	3.0	1.6 × 1.2 × 1.0	---	---
416513	--	-	2.2	0.8 × 0.8 × 0.5	2.4	1.2
416607	--	3	2.2	---	---	---
416413	20	3	2.0	1.5 × 1.0	3.5	1.4
416511	±20	3	2.5	---	---	---
416266	15	4	3.5	---	---	---
416609	15	5	3	---	---	---
416414	10	4	2.3	1.0 × 0.7	---	1.3
416416	±25	3	3	1.4 × 0.8	4.0	1.5
416608	--	-	3.5	---	---	---

are preserved in any one specimen. One specimen gives the impression that there were only four sporangiophores and six bracts per whorl. In another specimen there are four sporangiophores and probably 12 bracts. It is not certain whether the sporangia were attached to a plate or to small extensions of the sporangiophore. In one specimen there seems to be a plate, whereas in a second specimen the plate cannot be observed. The cone has at its tip a little tuft apparently of four bracts. The sporangia were oval and are now flattened.

Discussion.—The *Calamostachys* species described belongs to the *Mesocalamites* found in the same flora. There are three specimens that show cones attached to the axis. Leggewie and Schonefeld (1961) found *Calamostachys sengsensis* associated with *Mesocalamites cistiiformis*. Nine other species of *Calamostachys* that supposedly belong to *Mesocalamites* are known from the Namurian. Our specimens are similar in size and characteristics to *C. andanensis*. All other species of similar size can be excluded owing to differences in the shape of the bracts. In general appearance the Spencer Farm material resembles *C. binneyana*, which is known from petrifactions throughout the Upper Carboniferous. However, *C. binneyana* has six sporangiophores per whorl and the bracts are shorter than in our form. Purkyňová (1970) reported *C. ramosa* from the Namurian A of Czechoslovakia. Her figures and description fit our specimen very well. However, *Calamostachys ramosa* was used for the fructifications of *Calamites carinatus* (= *Calamites ramosus*), which occurs in the Westphalian A to C (Boureau, 1964, p. 273), and is quite different from the *Mesocalamites* in the Spencer Farm Flora.

Remy and Remy (1975b) demonstrated that material described as *Calamostachys* represents two different organizational plans, in which the vascularization of the sporangiophore differs. Our material does not show the vascular bundle; therefore, we must retain the genus *Calamostachys* sensu amplo.

FERNS

Alloiopteris gracillima (Newberry) D. White

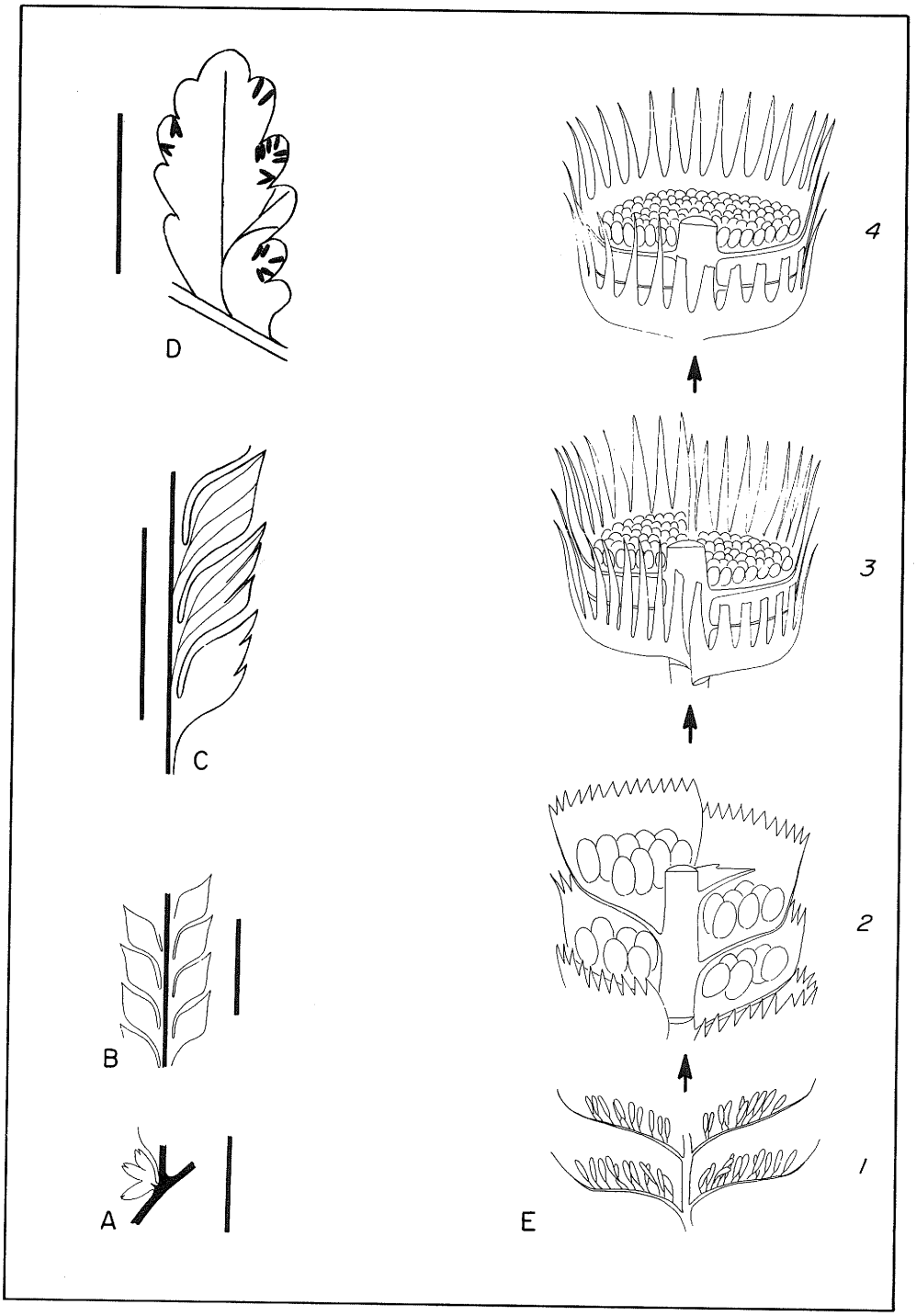
Text fig. 5A-C; pl. 2, figs. 1-4

Synonymy

1873 *Odontopteris gracillima* Newberry, p. 382-383, pl. 46, figs. 1-3a.

1908 *Alloiopteris gracillima* D. White, p. 269

Description.—Pinnules 4 to 5 mm long, 2 mm wide, inclined 45° toward the tip of the pinna; pinnule rhomboidal-shaped, smaller pinnules fused with neighboring pinnules; one vein enters each pinnule, and forks twice; older pinnules splitting up into three lobes; some pinnules have three teeth at the tip. Basal catadromic and anadromic pinnules are aphleboid and lacerated; contain about 6 to 10 teeth. Pinna long, strap-shaped, inserted at an angle of 35° to 70°; pinna more than 60 mm long and 3 to 5 mm wide; pinna of lower order more than 200 mm long and more than 100 mm wide; more than 26 pinnules on one side of a pinna.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1

Material.—The syntypes of Newberry (1873) are in the collection of the New York Botanical Garden (NYBG). The best-preserved specimen (NYBG 5914 G) is the one figured by Newberry (1873) on plate 46, figure 3. Specimen NYBG 8320 G is figured on plate 46, figure 1. The specimen of plate 46, figure 2, could not be located. The specimens from the Spencer Farm Flora have the ISM numbers 416509, 416530, 416531, 416434, 416450, 416451, 416452, and 416453.

Discussion.—Newberry (1873) recognized that this species did not belong in the form genus *Odontopteris*. He believed, however, that he should not make a new genus on the basis of one species. His description mentions that two veins enter the pinnules, and in plate 46, figure 2a, he even shows three veins originating on the pinna rachis. Examination of the syntypes shows that only a single vein enters the pinnules and gives rise to one or two lateral veins. The splitting up of the larger pinnules seems to occur along the veins, indicating that the splitting is a post-mortem phenomenon.

Newberry (1873) mentioned a fertile specimen (NYBG 1970). The specimen is small and does not preserve a sporangial or pinnule structure. It cannot be definitely identified. The pinnae are 3.5 mm wide and strap shaped and can therefore be compared with *A. gracillima*.

Alloiopteris gracillima has a close similarity to *A. plumosaeformis*, which was described by Gothan (1941) from the Namurian B of Germany. In *A. plumosaeformis*, however, the pinnules are smaller and the tips of the pinnules are blunt. Gothan compares *A. plumosaeformis* with *A. sternbergi*, which is, however, distinctly different by virtue of the rectangular insertion of the pinna at the pinna-bearing axis. The same is true for *A. erosa* (Lesquereux, 1880, pl. 44, fig. 1), which furthermore has concavely rounded recessions between the pointed lacerated tips instead of acute tips like those in *A. gracillima*. *A. thinnfeldioides* has larger pinnules and wider pinnae, but its outline is similar to that of *A. gracillima*. *A. radstockensis* is similar to *A. gracillima* in general aspect and in the fact that the vein dichotomizes shortly after entering the pinnule. The two are different, however, in the shape of the pinnule; *A. radstockensis* has rounded lobes, which do not occur in *A. gracillima*.

Alloiopteris cf. *quercifolia*

This specimen (ISM 416536) is not preserved sufficiently for a positive identification, but the general character of the well-pronounced

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Text fig. 5 - Fossil plants from the Spencer Farm Flora. A-C, *Alloiopteris gracillima*, A- basal aphleboid pinnule, B- pinnules in the middle of a pinna, and C- pinnules showing venation pattern and breakup of pinnules along veins. D, reconstruction of one pinnule of *Dactylotheca aspera*. Bar scales are 5mm long. E, hypothetical steps in the evolution of noeggerathialian cones: *1- Archaeopteris*-like fructification; *2- Noeggerathiostrobus*; *3- Lacoea*; and *4- Discinites*.

axis and the short pinnae is more like *A. quercifolia* than any other species of *Alloiopteris*. Measurements: pinna 4 mm long, 2 mm wide, 2 mm apart. Pinnules 0.8 mm long.

Dactylotheca aspera (Brongniart) Zeiller
Text fig. 5D; pl. 3, figs. 1-3

Description.—Frond two (or three) times pinnate. Pinnules 9 mm long, 2.5 mm wide, attached 3.5 to 4 mm apart; shape and attachment pecopteroid, slightly restricted at the distal side of the base. Pinnules lobed with five lobes on each side, tip rounded, lobes rounded and about 1.3 mm wide. Venation badly preserved, but apparently one midvein with two unforked lateral veins per lobe. Two to six sporangia per lobe; sporangia elongated, small, 0.8 × 0.2 mm.

Discussion.—This species bears pecopteroid pinnules with elongated, solitary sporangia that do not show any trace of an annulus. The arrangement of the sporangia is typically that found in the fructification genus *Dactylotheca* Zeiller. *Dyotheca* Hartung has also been used for these forms, and they are similar to *Renaultia* Stur in general appearance. The fragmentary specimens at hand, which are preserved in a relatively coarse matrix, do not allow a thorough revision. Thus for the present paper, *Dactylotheca* is used.

Pecopteris aspera is known from the Lower Carboniferous to the lower part of the Westphalian A (Remy and Remy, 1959, p. 63). Our specimens compare closely with the figures of the same species from the Namurian A of Czechoslovakia (Purkyňová, 1970, pl. 39, figs. 6, 6a). There is some similarity with *Pecopteris* (*Senftenbergia*) *namurica* Purkyňová (1970, p. 214, pl. 40, figs. 3, 3a, 3b). There is some overall similarity to *Pecopteris* (? *Dactylotheca*) *oregonensis* Arnold from the Namurian of Oregon. However, the latter species has smaller pinnules and thicker sporangia. Our specimens can also be compared with *Renaultia gracilis*. The position of the sporangia is very similar to that in *R. gracilis* but the sporangia are more elongated in our specimens.

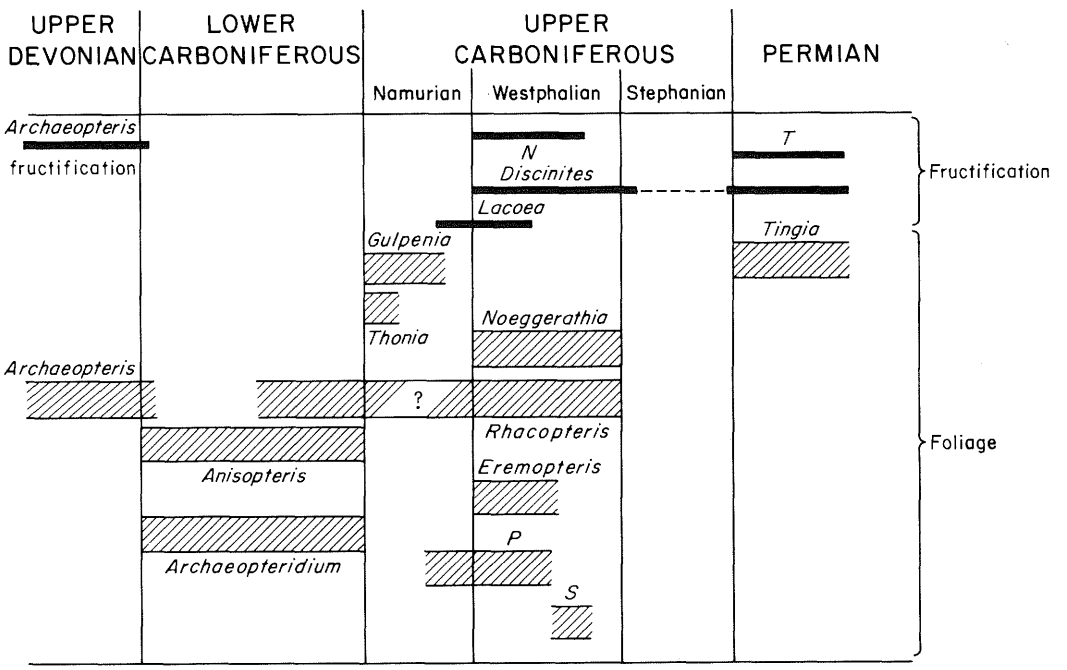
NOEGGERATHIALES
(? Progymnosperms)

The Noeggerathiales are a rare group of uncertain systematic position. The few forms belonging to this group are normally found in small numbers and as fragmented specimens. In the Spencer Farm Flora, however, they are the second most common group of plants after the Pteridosperms. As the geologic position of this flora (ravine deposit) indicates an "extrabasinal," or upland, flora and because Noeggerathiales are extremely rare in roof-shale floras (1 in 4000 specimens in the Illinois Basin), it is concluded that the Noeggerathiales were upland plants.

In the Spencer Farm Flora, three species, *Lacoea seriata*, *Palaeopteridium reussii*, and *Gulpenia limburgensis*, have been assigned to the Noeggerathiales. *Lacoea* is without a doubt a noeggerathialean cone, and *Palaeopteridium* has generally been regarded as a member of this group. However, we are tentatively associating *Gulpenia* with the Noeggerathiales for the first time.

The systematic position of the Noeggerathiales was always uncertain, and different workers arranged them quite differently in the system. Boureau (1964, p. 481) lists the older suggestions. The Noeggerathiales were compared with Ferns, Gymnosperms, and *Tmesipteris* (Browne, 1933; Bierhorst, 1971). Other authors considered them to be of uncertain position, and Boureau (1964) used a separate division, Noeggerathiophyta. Beck (1976) suggested the possibility that the Noeggerathiales might be the pteridophytic descendants of the Progymnosperms. We agree with Beck that the external morphological characters of several Noeggerathiales are very similar to the Archaeopteridales. The Noeggerathiales are characterized by heterospory, by cones of radial structure, and, in many specimens by wedge-shaped sterile pinnules (or leaves?) with open dichotomous venation. The sterile foliage closely resembles that of *Archaeopteris*. The heterospory is another characteristic common to Noeggerathiales and Progymnosperms. Structural and palynological information will be necessary to verify this hypothesis.

The age distribution of all fructification and foliage genera that have any morphological similarities to Progymnosperms or Noeggerathiales is shown in text figure 6. The figure shows that such forms are present throughout the Pennsylvanian and the lower Permian. It demonstrates at the same time how incomplete the record is. Any ideas about natural relationships between these genera would be premature. We do not even suggest that all genera shown belong to the same order or class.



Text fig. 6 - Stratigraphic ranges of foliage and fructifications of Progymnosperms, Noeggerathiales, and similar foliage. S = *Saaropteris*, N = *Noeggerathiostrobus*, T = *Tingiostachya*, P = *Palaeopteridium*.

The fructification genera of the Noeggerathiales, *Noeggerathiostrobus* Feistmantel, *Discinites* Feistmantel, and *Lacoea* Read 1946, emend. Leary 1973, can be arranged in a form-evolutionary sequence that requires only small transformations between the different forms (text fig. 5E).

The line started possibly with a hypothetical form similar to *Archaeopteris*. The pinnules of this hypothetical form would form *Noeggerathiostrobus* after the formation of laminae (webbing). A shortening of the axis between the attachment points of the fertile pinnules would yield a fructification of the *Lacoea* type. Further shortening and fusion of two pinnules would produce the disc-shaped sporangiophore of *Discinites*. It has to be emphasized that this conclusion is purely hypothetical and indicates only a possible trend.

Lacoea seriata Read emend. Leary
Pl. 4, figs. 6-8

Description.—Cone consisting of semicircular sporophylls, which alternate on a rather thick axis. Sporophylls attached close to each other, thus creating a very dense cone. Each sporophyll surface is covered with numerous diamond-shaped sporangial scars arranged in oblique rows forming a distinctive pattern. Margin of each sporophyll bends toward the distal end of the cone and bears a fringed border. Sporophylls often found detached.

Discussion.—The genus *Lacoea* was recognized by David White before 1908, but he never described it (White, 1908, p. 269). Read (1946) described *Lacoea*, but misinterpreted its morphology and systematic position. The genus was redescribed and reinterpreted by Leary (1973), who recognized that it belongs to the Noeggerathiales.

Lacoea is in appearance very similar to *Discinites*. The pattern of sporangial attachment and the fringed margin are identical. The only difference is that *Lacoea* has semicircular sporophylls whereas *Discinites* has disc-shaped sporophylls.

Lacoea has so far been found only in the lower part of the Pennsylvanian and has been reported or has been found in the following localities:

Dutch Mountain, Pennsylvania (Read, 1946)
Youngstown, Ohio (Read, 1946)
Rushville, Ohio (seen in photograph of collection specimen)
Brown County, Illinois (this report)
northwestern Illinois (D. White, 1908)
Rock Island County, Illinois (field observation)

In at least five of these six locations, *Lacoea* occurs with *Palaeopteridium reussii* or a very similar form. Nemejc (1941) reported that *Discinites* and *Palaeopteridium* nearly always occur together and concluded that there was at least a good chance that *Discinites* might be the fructification of *Palaeopteridium*. It is possible that *Lacoea* is just another fructification of *Palaeopteridium*-like foliage.

Palaeopteridium reussii
(Ettingshausen) Kidston
Text fig. 7A-C; pl. 4, figs. 1-5

S y n o n y m y

1852 *Asplenites Reussii*, Ettingshausen, p. 16, pl. 1, figs. 8 and 9

1869 *Palaeopteris Reussii*, Schimper, p. 478

v. 1875 *Archaeopteris stricta*, Andrews, p. 418, pl. 49, figs. 2, 2a

v. 1884 *Archaeopteris denticulata*, Lesquereux, p. 774

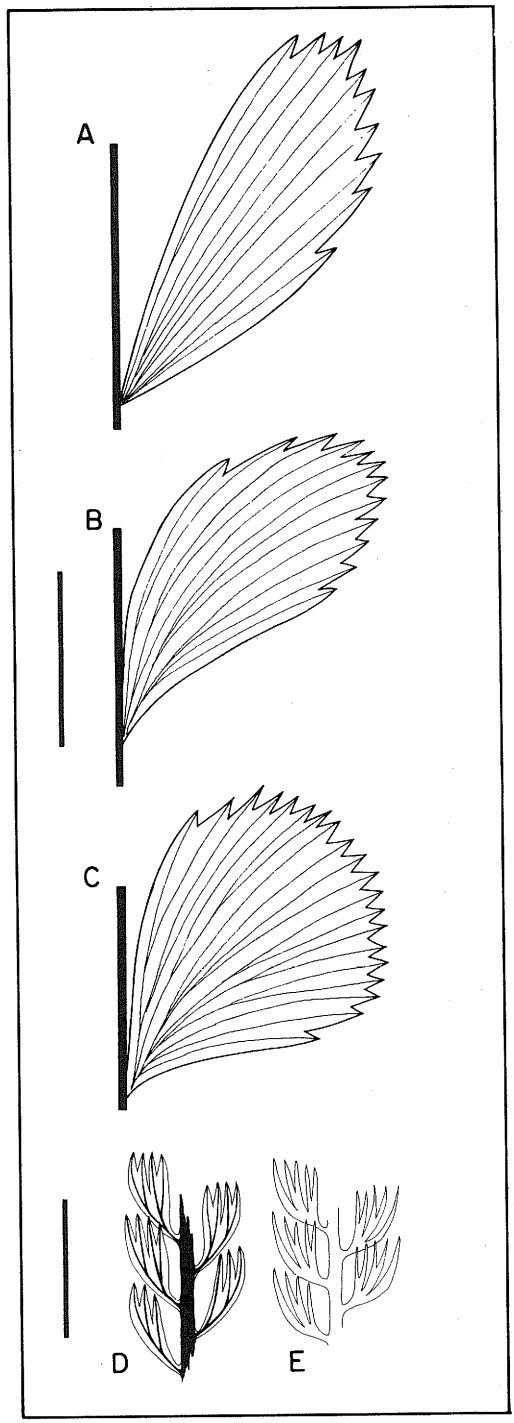
1894 *Archaeopteris Reussii*, Kidston, p. 242

1914 *Archaeopteris Reussii*, Kidston, p. 95, pl. 5, figs. 7, 7a

1923 *Palaeopteridium Reussi*, Kidston, p. 201-203, pl. 55, figs. 1-3

v. 1949 *Palaeopteridium Reussi*, Arnold, p. 219-220, pl. 26, fig. 6

Description.—Outline of pinnules wedge-shaped, spatulate, or diamond-shaped (text fig. 7A-C). Some pinnules have stalk-like base, some are attached with a larger part of the base. Open dichotomous venation. Veins forking once or



Text fig. 7 - Fossil plants from the Spencer Farm Flora. A-C, variation of *Palaeopteridium reussii* pinnules according to their position on the frond or branch system. D, E, *Gulpenia limburgensis* pinnules. Bar scales are 5mm long.

twice. Basal anadromic pinnule on each pinna longer and narrower than normal pinnules. Only one vein enters each pinnule, but it may appear as if there were two. The dentation of the outer margin of the pinnules is very delicate and is not visible in some types of preservation. The frond is twice pinnate as far as can be judged from the largest preserved specimens. There are no intercalary pinnules ("Zwischenfiedern," or rachial pinnules) known. Other data are found in table 4.

Discussion.—The pinnules of *Palaeopteridium reussii* show distinct differences according to their position in the leaf or branch system (text fig. 7A-C). The pinnules that are narrower and smaller occur near the tip of the frond. They have a somewhat *Tingia*-like appearance. The pinnules of more mature parts become wider and attain a diamond shape (rhombohedral). The adaxial margin thus becomes more and more parallel to the axis. In the widest pinnules, the margin rests on the axis or even overlaps it. The wider pinnules overlap one another also.

TABLE 4—COMPARISON OF MEASUREMENTS OF *PALAEOPTERIDIUM* SPECIMENS FROM THE SPENCER FARM FLORA AND OTHER LOCALITIES

			Palaeopteridium reussii				
	P. macrophyllum Nemejc, 1928	*P. sessilis* Leggewie, 1966 pl. 1, pl. 2	Arnold, 1949 pl. 26, fig. 6	Kidston, 1923 pl. 55, figs. 1-3	Indiana Univ. IU-277	Spencer Farm specimens	Rushville, Ohio, specimens
Pinnules							
Length L (mm)	17	4-5.5	7	10,8,5	9	9,9,9,7,9,10,7,8	9,6.5,8
Width W (mm)	9	2.5-3	4.5	6,3,5	4	7,6,2.5,3.5,5,6	3,2,2.5
L : W	1.9	1.8	1.5	1.7	2.2	1.3-3.6 (2.0)	3.2
Distance between centers of pinnules (mm)	10	4	4	8,4,4,5	5		2.5
Angle of attachment	35°-60°	40°	40°	40°,30°, 40°,60°	35°	30°-55° (42°)	30°-40°
Pinna							
Width (mm)			11			11,12	10
Distance between pinna axes (mm)	20	9	-			12, 7	10
Angle of attachment						50°-55°	55°-60°

Kidston (1923) mentioned the foot stalk of the pinnules of *P. reussii*. However, the foot stalk can be seen only in some specimens. The broad pinnules especially appear to be attached to the axis with a wider part of their base.

In all three known species of *Palaeopteridium*, the anadromic (posterior) basal pinnule is narrower and longer than any of the other pinnules. This characteristic is also present in the specimens from Spencer Farm. Kidston (1923) furthermore reports "aphleboid posterior basal pinnules forming three lobes with sharper teeth." This arrangement might occur in the lower portion of a leaf, but has not been observed in the Illinois material.

Two species belonging to *Palaeopteridium* were described under the generic name *Archaeopteris* from the Rushville flora: *A. stricta*, Andrews (1875) and *A. denticulata*, Lesquereux (1880). Neither has intercalary pinnules, and both show all other characteristics of the genus *Palaeopteridium*. Specimens coming from the type locality of both species have been studied, including the holotype of *A. stricta* (specimen at Marietta College). *A. denticulata* was never figured, and no holotype was assigned, but the specimens studied were identified by Lesquereux and D. White [specimens in the Field Museum of Natural History, Chicago: first specimen UP 1354 (= UC 40143 = No. 319 Lacoe Coll.); second specimen UP 1200 (= No. 319 Lacoe Coll.)]. Neither species mentioned above differs from the other or from *P. reussii*; they are therefore put in synonymy here. Andrews (1875) did not describe the teeth on the upper margin of the pinnule. However, in the specimens these teeth are clearly present. Lesquereux (1880) stated correctly that there were no intercalary pinnules. However, the catadromic (posterior or proximal) basal pinnule is attached directly at the base of the pinnule axis and might thus confuse the observer.

One specimen of *P. reussii* (IU-277) in the collection of the University of Indiana comes from the base of the Pennsylvanian below Cataract Lake Dam (NW½ NW¼, Sec. 13, T. 12 N., R. 5 W.) in Putnam County, Indiana.

Three species, *Palaeopteridium reussii*, *P. macrophyllum*, and *P. sessilis*, have been described in this genus. The measurements available have been summarized in table 4. The genus is known from Illinois, Indiana, Michigan, Ohio, and Pennsylvania in the United States and from Staffordshire (Great Britain), the Ruhr District (Germany), and the Pilsen Basin (Czechoslovakia) in Europe. *P. reussii* was known from the Westphalian (up to the Westphalian C) in Europe. Its range now has to be extended down to the Namurian B. *P. sessilis* occurs in the Ruhr District from the Namurian C to the Upper Westphalian B.

Gulpenia limburgensis Gothan and Jongmans in: Jongmans
Text fig. 7D, E; pl. 5, figs. 1-4

Description.—Small cuneiform pinnules (or leaves) spirally attached to a small axis; appear to alternate; pinnules lacerated or toothed with open dichotomous venation; pinnules bend upward and often cover the base of next higher pinnule; pinnules 4 to 8 mm long. Axis 0.6 to 1.0 mm thick. Superficial similarity with *Sphenophyllum*, but pinnules clearly alternating in side view.

Discussion.—The two fragmentary specimens found in the Spencer Farm Flora are 7 and 8 mm long. This fragmentary state has been typical of the specimens found in Europe, too. The Illinois specimens are similar to but smaller than the specimens from the Netherlands and Belgium. Considering the normal variability of plants, the size does not constitute a taxonomic difference (table 5). Stockmans and Willière (1953) could show on detached pinnules that the pinnules are relatively broadly attached and have as many as eleven lobes. In lateral view (if the pinnules are attached to an axis), only about five lobes can be seen.

Gothan and Jongmans (in: Jongmans, 1927) described *Gulpenia limburgensis*, but did not include a figure. In 1928 (in: Jongmans, 1928), they described it again without giving a generic diagnosis. In 1955, Stockmans and Willière (in: Leckwijck, Stockmans, and Willière, 1955) described the genus *Thonia* from beds of the Namurian A. They mentioned the similarity between the two genera. The only difference is that the pinnules of *Gulpenia* are deeply lacerated whereas those of *Thonia* have only short teeth. Considering the fragmentary character of the specimen and the small amount of information available, this difference does not warrant the establishment of a new genus. It would probably be more appropriate to transfer the only species of *Thonia*, *T. dentata*, to the genus *Gulpenia*.

In Europe, *Gulpenia* is known only from the Namurian A. The occurrence in Illinois constitutes the extension of its range into the Namurian B. *Gulpenia* has been found in Limburg (The Netherlands), near Argenteau and Thon-Mosseroux (Belgium), and in Brown County, Illinois (U.S.A.). *Gulpenia* has always been found above an unconformity in the basal beds of a sedimentary sequence with an unusual flora. In Belgium it was found in sinkhole fillings at the base of the Silesian (European Upper Carboniferous) section in a position very similar to that of the Spencer Farm Flora. This position might indicate that *Gulpenia* was an upland plant.

The natural relationship of the genus *Gulpenia* is uncertain. It has been placed with the Noeggerathiales in this paper because the few morphological features known do occur only in that group. The pinnules

TABLE 5—MEASUREMENTS OF *GULPENIA* AND *THONIA*

Name of plant:	*Thonia dentata*	*Gulpenia limburgensis*	*Gulpenia limburgensis*	*Gulpenia limburgensis*
Locality:	Belgium	Belgium	Illinois	Illinois
Author: Year:	Stockmans and Willière, 1955	Stockmans and Willière, 1953	This report ISM 416498	This report ISM 416499
Width of whole plant	4 mm	5-8 mm	5 mm	4 mm
Thickness of axis	0.4 mm	1 mm	0.7 mm	0.6 mm
Distance of pinnules	2.3 mm	5 mm	2.3 mm	2.0 mm
Length of pinnules	2.3 mm	7 mm	3.5-3.8 mm	3.0 mm
Number of lobes	4-5 (?)	7-11 (?)	4 (?)	5 (?)
Length of lobes	0.5 mm	3.5-5.0 mm	1.8-2.0 mm	1.5 mm
Width of lobes	0.2 mm	0.25 mm	0.3 mm	0.2 mm

(or leaves ?) are broadly attached and are not spread out in the plane of the frond. They resemble the fertile leaves of the noeggerathialean cones in their three-dimensional arrangement.

PTERIDOSPERMS

Genus: *Megalopteris* (Dawson) Andrews

S y n o n y m y

1828 *Cannophyllites*, Brongniart, Prodr., p. 130 (nomen rejiciendum; see Stafleu et al., 1972, p. 376)

1865 *Neuropteris*, Hartt in: Bailey, p. 550

1871 *Neuropteris* (*Megalopteris*) Dawson, p. 51

1875 *Megalopteris* (Dawson) Andrews (nomen conservandum; see Stafleu et al., 1972, p. 376) p. 415

Description.—Simple pinnate leaf, pinnules often attached at irregular distances and at irregular angles, giving the impression of a pedate frond near the top; pinnules strap-like or lanceolate, generally large; strongly decurrent base of pinnule with unequal sides; midvein thick, longitudinal striations often present; lateral veins dense and forking one to three times, curved or straight.

Discussion.— *Megalopteris* has repeatedly been compared with *Alethopteris*. There are indeed a number of similarities, like the venation in some species, the decurrent base of the pinnules, and the overall shape of the pinnules. However, there are distinct differences. *Alethopteris* has pinnules that are very regular in their angle of attachment, and the leaf shows several orders of pinnate divisions whereas the leaf of *Megalopteris* is only simple pinnate.

The notion that *Megalopteris* has a pedate leaf has been derived from a specimen of *Megalopteris fasciculata* Lesquereux, which was figured by Lesquereux, 1879 (Atlas), on plate 24, figure 2. The specimen (USNM 11704) is reproduced photographically here on plate 6, figs. 1 and 2. The leaf appears to be pedate at the base, but is clearly pinnate higher up. All specimens at our disposal were pinnate.

Pinnules vary greatly in size within one leaf. This variation is expressed in nearly every characteristic of the pinnules. In several species the angle of lateral veins, for instance, changes within one pinnule. It is thus quite difficult to find any consistent characteristics that are useful in the delineation of species. There are 15 species of *Megalopteris* mentioned in the literature, but only six seem to be distinguishable on the basis of reasonably objective characteristics. Only two species, *Megalopteris dawsoni* and *M. ovata*, occur in the Spencer Farm Flora.

Megalopteris has been reported from only a few localities:

Wyoming Hills, Iowa - Noé, 1925
Port Byron, Illinois - Lesquereux, 1880
Brown County, Illinois - this report
Greene County, Indiana - Canright, 1959; Wood, 1963
Putnam County, Indiana - oral communication, C. A. Arnold, collected in 1936
Rushville, Ohio - Andrews, 1875; Cross, 1962
Grand Ledge, Michigan - Arnold, 1934
Saginaw, Michigan - Arnold, 1934
Logan County, W. Va. - Arnold, 1947
New River, W. Va. - D. White, 1895
St. John, New Brunswick, Canada - Dawson, 1871; Stopes, 1914
Pictou, New Brunswick, Canada - Bell, 1940

In nearly half of these localities *Megalopteris* occurs with a peculiar flora which is distinctly different from a normal coal basin flora and probably lived on rather dry soils.

Megalopteris has never been found with any fructifications attached. Any conclusion about its systematic position must be based on indirect evidence. It is here included in the Pteridosperms because the leaf morphology compares with such well-established pteridosperm genera as *Alethopteris* and *Taeniopteris*. Florin (1933) showed that the structure of the epidermis and stomata of *Megalopteris* was very similar to that of *Neuropteris* and other pteridosperms.

Megalopteris dawsoni (Hartt) Andrews
Text fig. 8A; pl. 6, fig. 3

S y n o n y m y

1865 *Neuropteris* sp. nov., Hartt in: Bailey, p. 137

1868 *Neuropteris dawsoni*, Hartt in: Dawson, p. 551, fig. 133

1871 *Neuropteris* (*Megalopteris*) *dawsoni*, Hartt in: Dawson, p. 51, pl. 7, figs. 191-194

1875 *Megalopteris dawsoni*, Andrews, p. 415

1875 *Megalopteris hartti*, Andrews, p. 416, pl. 46, figs. 1 and 1a

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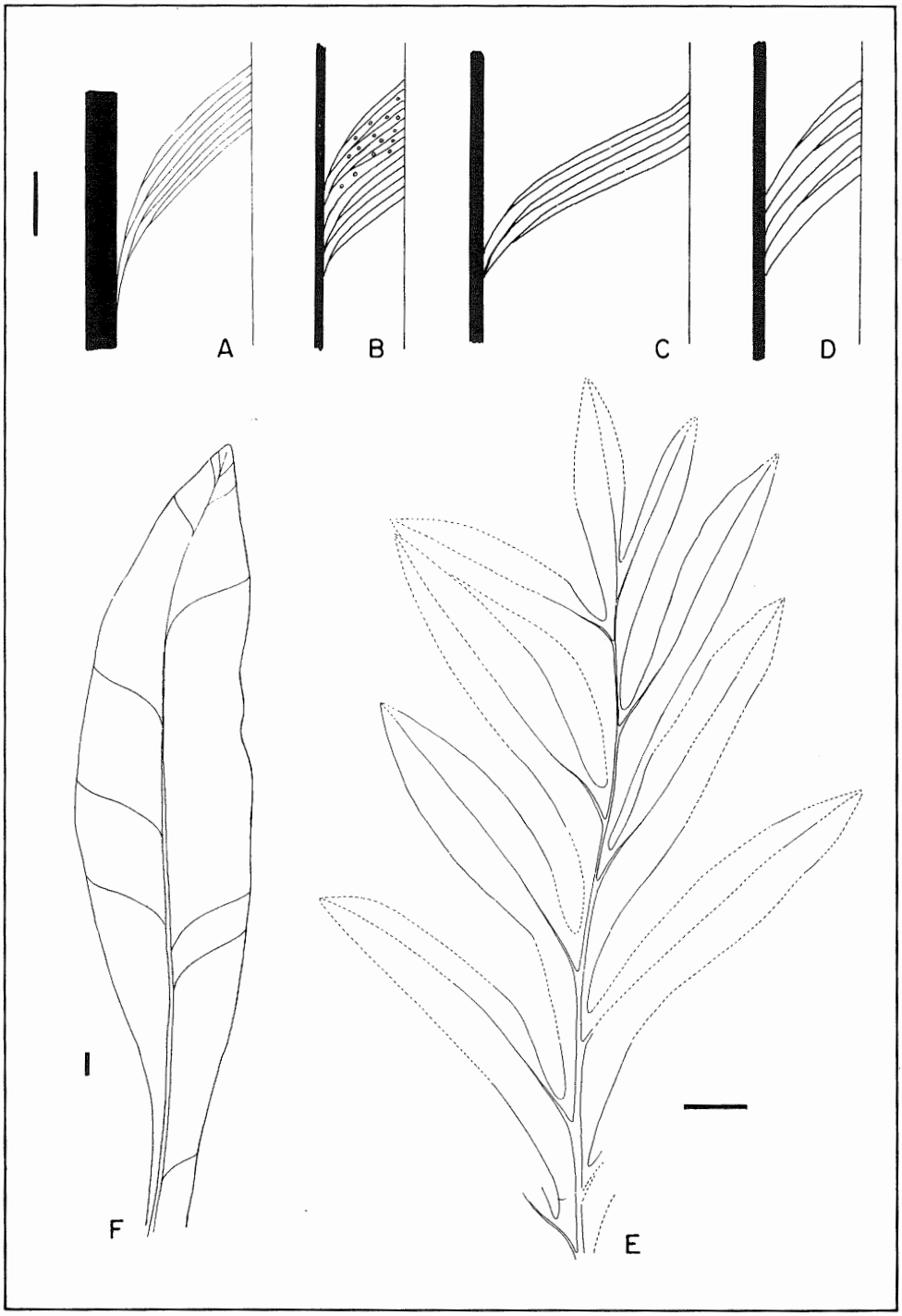
Text fig. 8 - Fossil plants from the Spencer Farm Flora. A-D, venation pattern in *Megalopteris*, A- *M. dawsoni*, B- *M. ovata*, C- *Lesleya cheimarosa*, D- *M. fasciculata*. E, reconstruction of a leaf of *M. ovata*. F, drawing of the holotype of *Lesleya cheimarosa* showing the variation in the shape of the lateral veins in different parts of the leaf. Bar scales are 5 mm long.


A
B
C
D
F
E

1888 *Megalopteris dawsoni*, Dawson, p. 76, fig. 26

1914 *Megalopteris dawsoni*, Stopes, p. 53-55, pl. 13, fig. 34 (first photograph)

Arnold (1934) and Wood (1963) also figured specimens that can probably be attributed to *M. dawsoni*.

Description.—The pinnules are strap shaped and have an acute tip. The margin is entirely or slightly undulate. The pinnules are more than 70 mm long (as long as 150 mm according to estimates) and at least 20 mm wide. The pinnules become unequal sided at the base, with a width of only 7 to 12 mm. The angle of attachment of the pinnules ranges from 16° to 46°. The midrib is strong and 1 to 2 mm wide. The lateral veins fork two or three times. There are 21 to 30 veins per cm on the margin, with an average of about 23. The lateral veins are curved in the first half of their course and beyond that continue straight to the margin. They form an angle of 12° to 20° with the midvein, of 35° to 45° in the middle, and of 75° to 85° (90° in one case) with the margin.

The measurements are based on seven specimens. The variation is certainly higher than indicated here and must be taken into account in establishing a synonymy.

Megalopteris ovata Andrews
Text fig. 8B, E; pl. 7; pl. 6, fig. 4

S y n o n y m y

1875 *Megalopteris ovata* Andrews, p. 417, pl. 47, figs. 1, 2

1884 *Megalopteris dentata* Lesquereux, p. 833 (no figure)

Description.—The pinnules are lanceolate and have an acute tip. The margin is entire to slightly crenulate. The pinnules are 30 to 70 mm long and 7 to 13 mm wide. They are unequal sided at the base and only 4 to 7 mm wide. The angle of attachment of the pinnules ranges from 18° to 52°. The midvein is distinct and 0.4 to 0.7 mm wide. The veins fork one to three times in many specimens, but are not clearly visible. Round bodies occur in the laminae between the veins. They are probably glands and are not always preserved. There are 14 to 23 veins per cm on the margin. The lateral veins are curved and form angles of 10° to 15° with the midvein, 45° in the middle, and 40° to 60° with the margin.

Discussion.—*M. dentata* was never figured but Lesquereux (1884) gave a relatively detailed description. The specimens (no. 783 of the Lacoe Collection) mentioned by Lesquereux in the original description are now in the collection of the Field Museum of Natural History in Chicago. They fit well the description of *M. ovata* given by Andrews (1875).

Megalopteris minima has a venation which is very similar to that of *M. ovata*. Another species that seems to be closely related to *M. ovata* is *Megalopteris abbreviata*.

Lesleya cheimarosa sp. nov.
Text fig. 8C, F; pl. 6, fig. 5; pl. 8, figs. 1-3

Description.—Simple leaf of considerable size, about 20 cm long and 4 cm wide, lanceolate with acute to attenuate tip. Base long and narrow (acuminate). Margin entire. Venation pinnate, midrib thick, 0.7 to 2 mm wide; lateral veins fork once or twice; lateral veins S-shaped with a 10° to 20° angle at the midvein, 30° to 70° angle in center, and 40° to 70° angle on margin; 24 to 36 veins per cm on margin.

Holotype: ISM 416488 a, b, on pl. 8, figs. 1, 2

Paratypes: ISM 416508, 416526

Derivation of name: From the Greek χειμαρρος (= cheimarros), periodical floods in rivers.

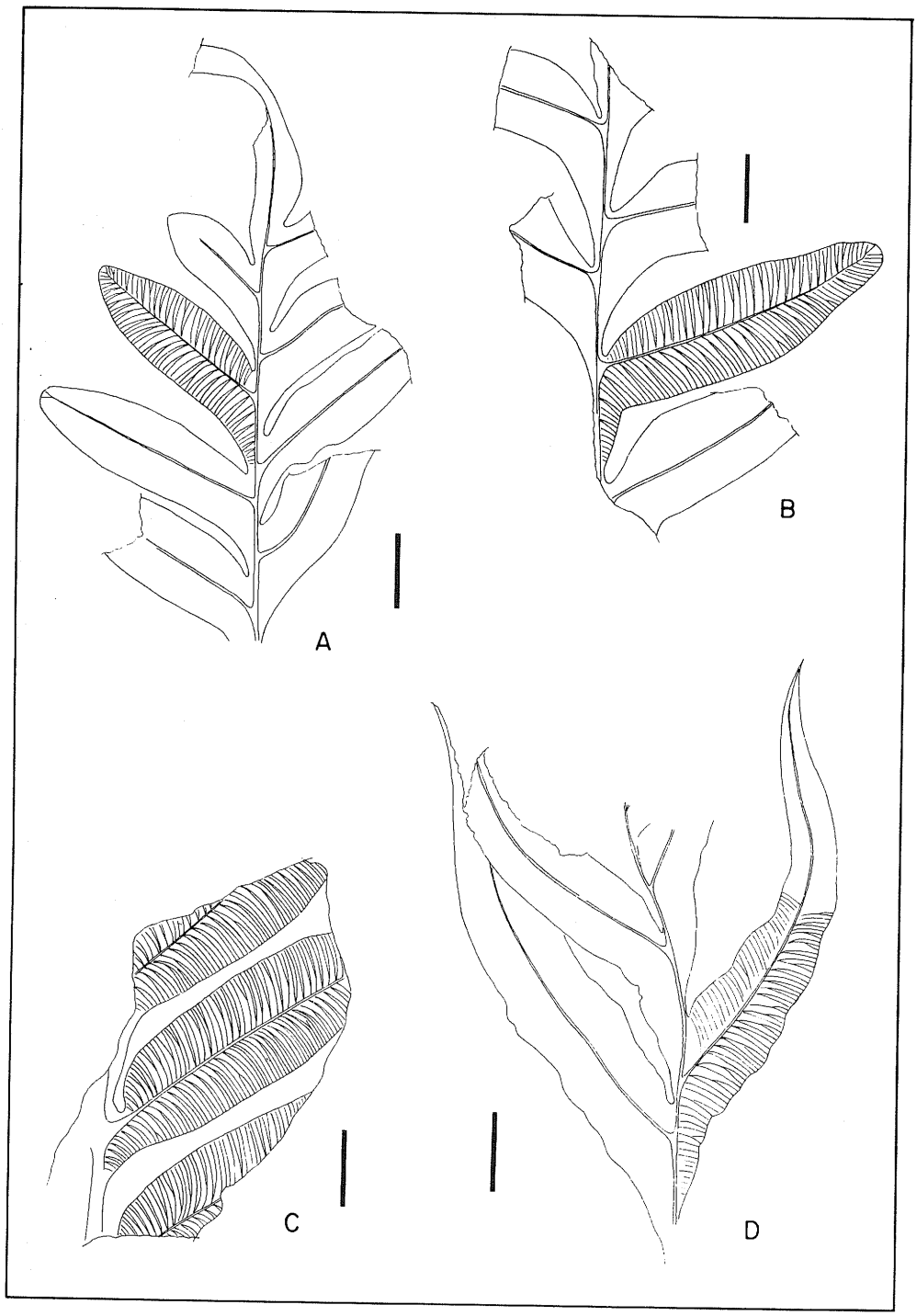
Discussion.—*Lesleya cheimarosa* is fairly common in the Spencer Farm Flora but only one complete leaf has been found so far. In text figure 7E the variation of the shape of the lateral veins on the holotype is shown. The density of the veins also differs in different parts of the lamina. It is not certain whether the asymmetrical base is typical or is, rather, a result of preservation.

This species is attributed to the genus *Lesleya* because the leaf is simple and not part of a compound frond. *Lesleya* was first described from Illinois from the level of the Rock Island (No. 1) Coal Member. All subsequent discoveries, however, were reported from France and Italy from beds of Westphalian D, Stephanian, or Permian age. The oldest form reported outside the United States is *Lesleya weilerbachensis* Remy and Remy (1975a) from the upper Westphalian C of the Saar area in Germany.

Alethopteris lonchitica (Schlotheim) Sternberg
Text fig. 9A-D; pl. 9, figs. 1-6

Description.—Pinnules linear-lanceolate or oblong, length to width ratio between 2.3:1 and 5:1 (average 3.2:1, based on 14 specimens); apex obtuse to acute; base decurrent on the proximal side and deeply incised on the distal side, both features highly variable in shape. Pinnules not connected with each other in lower parts of pinna, but become confluent towards the apex. Pinnules attached obliquely 25° to 85° (average about 60°).

Midvein thick, nearly reaching the apex. Lateral veins varied in their form, normally forked once, rarely simple or forked twice; their angle at the midvein ranges from 30° to 75° (average 50°); their angle with the margin ranges from 45° to 90° (average 70°). There are 32 to 50 veins per cm on margin (average 40).


A
B
C
D

Discussion.—*Alethopteris lonchitica* is very common in the Spencer Farm Flora. Several terminal portions have been found showing the long, lanceolate terminal pinnule. Some specimens are complete enough to show the change from simple pinnatifid structure at the tip to two orders of pinnatifid form farther down.

A single specimen (ISM 416129) of the near-terminal portion of a pinna has unusually long, lanceolate pinnules (text fig. 9D). The longest has a length of 3.2 cm and a length to width ratio of 5.3:1. Similar size variation is found in other species of *Alethopteris* (for example, *A. serli*).

Alethopteris lonchitica is most common in the Westphalian A and B, but is known from Namurian B through the Westphalian D (Gothan and Remy, 1957, p. 118). Our specimens compare closely with the forms found in the Namurian B of Vorhalle, Germany.

Sphenopteris preslesensis Stockmans and Willière
Text fig. 10A, B; pl. 10, figs. 1-5

Description.—Pinnules appear to be pedately divided, whereas the veins have a pinnate division. The incisions between the lobes are deep, and there is in many specimens a central incision that divides the pinnule into two halves. The tips of the lobes are rounded to acute, but often appear to be truncated owing to preservation. The size of the pinnules vary somewhat depending on their position in the frond or in the pinna. Pinnules are 4 to 6 mm long and 2.5 to 4 mm wide. They are attached at angles from less than 50° to 70°. Pinnules have 4 to 10 lobes; 6 lobes are most common.

Pinnae are 9 to 20 mm long and 5 to 10 mm wide. They are attached at angles of 50° to 90°. Pinna axes are 0.3 to 0.6 mm wide, straight to flexuous, and faintly alate. Axes of lower order are about 1 mm wide.

No aphleboid pinnules were observed.

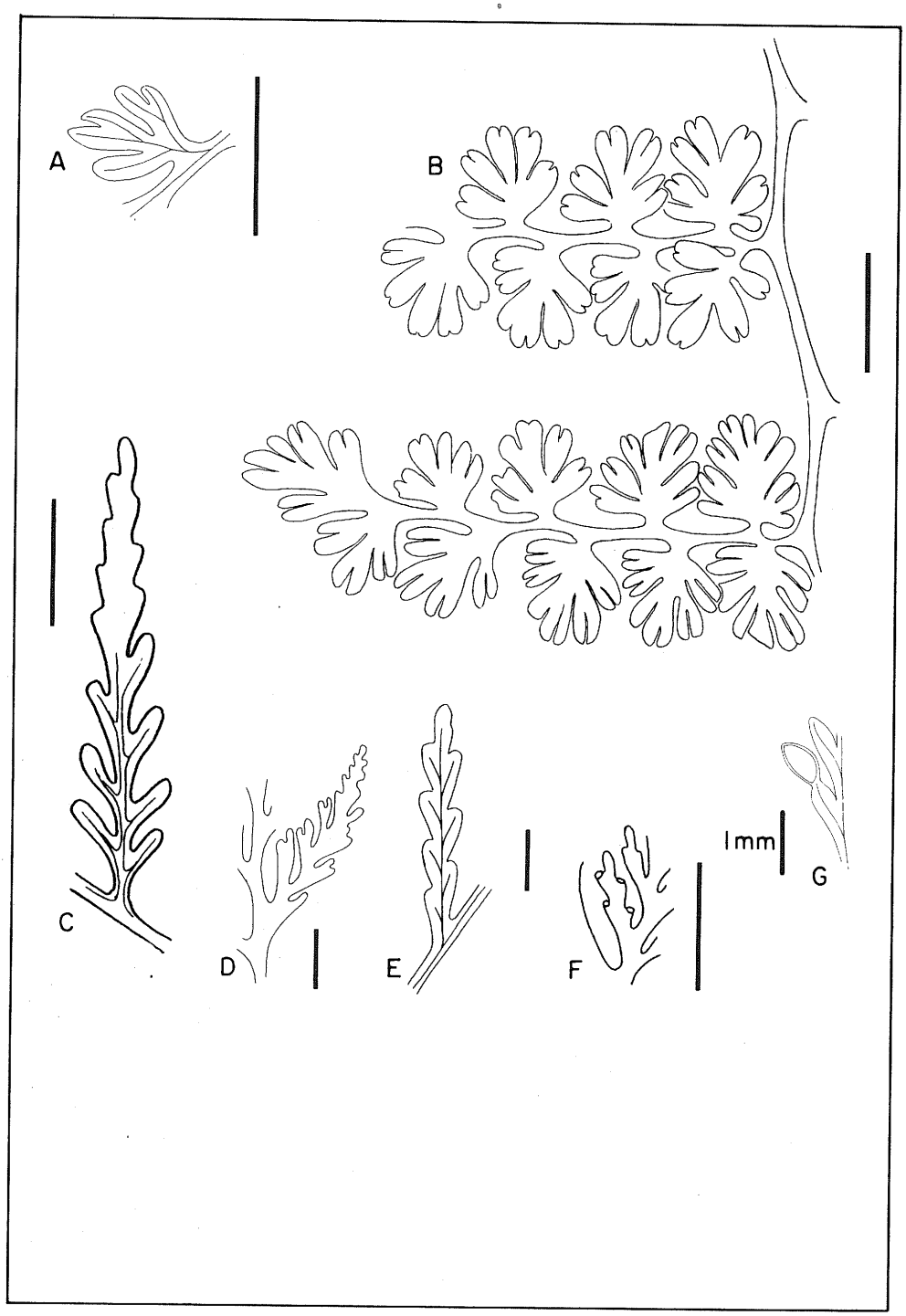
Discussion.—*Sphenopteris preslesensis* is one of several *Sphenopteris* species with highly lacerated foliage that occur in the Namurian and lowermost Westphalian. It is characterized by the fan-shaped appearance and nearly bilateral symmetry of the pinnules. *Sphenopteris preslesensis* is known from the Namurian B of Belgium and Germany.

Eusphenopteris morrowensis (D. White) van Amerom comb. nov.
Text fig. 11A, B, D; pl. 11, figs. 1-4

Basionym: *Diplothmema morrowensis*

1943 David White, Lower Pennsylvanian species of *Mariopteris*, *Eremopteris*, *Diplothmema*, and *Aneimites* from the Appalachian region: U.S. Geological Survey Professional Paper 197-C, p. 99-100, pl. 34, fig. 1; pl. 35, fig. 1

Text fig. 9 - Fossil plants from the Spencer Farm Flora. A-D, *Alethopteris lonchitica*. Bar scales are 5 mm long.


A
B
C
D
E
F
G
1mm

Description.--Size and shape of pinnules highly varied; depending on the position in the pinna. Pinnules slightly to strongly lobed; general outline diamond-shaped to ovoid; three to seven lobes per pinnule. At the base, pinnules are decurrent on the proximal side and deeply incised on the distal side; toward the tip of the pinna, pinnules tend to be attached along their entire base. Tips of pinnules obtuse, appearing nearly acute in some specimens.

Lobes are generally rounded and diamond shaped, and a continual morphogenic development from lobes into pinnules can be observed. The size of pinnules ranges from 5 × 3.7 mm to 12 × 9 mm, with an average of 8 × 7 mm. Pinnules barely touch each other or have space between them. They are attached obliquely and form an angle of 70° to 80° on the acroscope side and 50° to 60° on the basiscope side. Basal pinnules are sometimes larger in more mature parts of the frond, where they appear somewhat mariopteroid.

Venation is a mixture of open dichotomous and pinnate. The midvein is straight to undulate in the lower two-thirds of the larger pinnules and is not different from lateral veins in smaller (younger) pinnules. Only one vein enters larger pinnules, but in lobes and smaller pinnules several veins may enter. In larger pinnules the first distal lateral vein runs parallel to the pinna axis and can thus create the impression that the secondary lateral veins coming from it are actually entering the pinnule directly from the pinna axis. Lateral veins are curved outwards. Venation is distinct but not very coarse.

Between the veins there are numerous round bodies (probably glands) that are distributed over the entire lamina (pl. 11, fig. 2). These glands are visible only in certain kinds of preservation and thus cannot be used as a descriptive characteristic. Construction of frond unknown, but at least three times pinnate.

Discussion.--*Eusphenopteris morrowensis* is one of the most common fossils in the Spencer Farm Flora and therefore can be well characterized. However, all specimens are fragments, even where they cover entire bedding planes, and it is therefore not possible to reconstruct the frond. It is nevertheless clear from the shape of the pinnules that this species belongs to the genus *Eusphenopteris*, which was recently revised by Amerom (1975).

Our material is best comparable with *Diplothmema morrowensis*, which have therefore to be transferred to the genus *Eusphenopteris*. Amerom (1975, p. 62) actually mentions *D. morrowensis* as closely comparable to *E. aldrichii* (D. White) Amerom without proposing the new combination. Thus, Amerom (1975) recognized the proper position of the species, and the formal change is made here with the approval and under the name of Dr. van Amerom.

Amerom (1975) distinguishes several sections within the genus *Eusphenopteris*. Our material belongs in the section of *E. neuropteroides*. The Spencer Farm material is also comparable to *Sphenopteris cheathami*,

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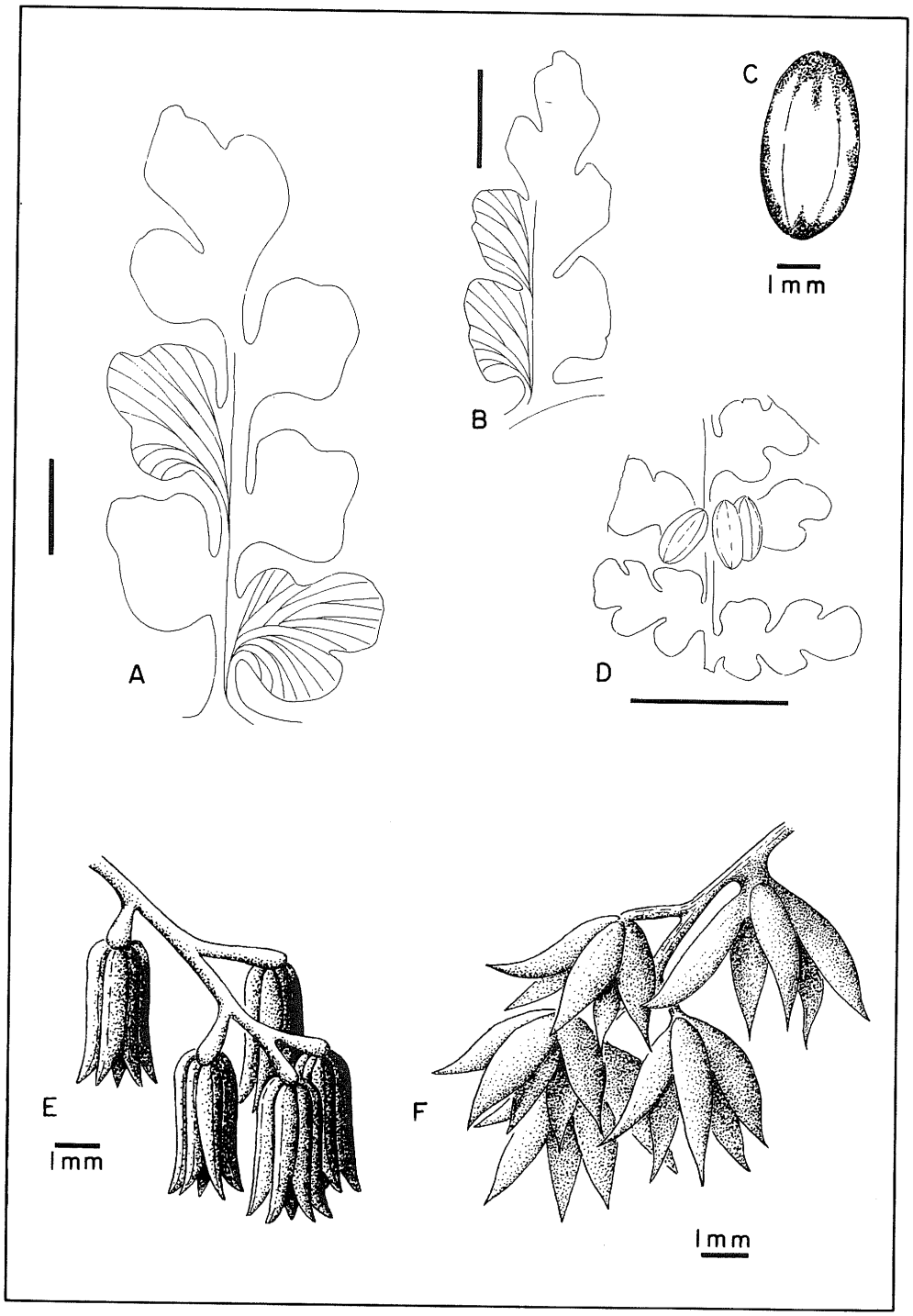
Text fig. 10 - Fossil plants from the Spencer Farm Flora. A, B, *Sphenopteris preslesensis*. C-G, *Rhodeopteridium phillipsii*. Bar scales are 5 mm long, except where noted.


A
B
C
1mm
D
E
1mm
F
1mm

especially specimen USNM 15025 from Tracy City, Tennessee, which was identified by Lesquereux. However, the figures of *S. cheathami* in Lesquereux (1884) and D. White (1943) do not compare well with our material.

The foliage of *Eusphenopteris morrowensis* occurs with a small seed (*Lagenospermum* = *Nudospermum*) and a *Telangiopsis*-like male fructification on the same bedding planes. An organic connection between the foliage and either of the fructifications could not be established in any specimen, but the association suggests the possibility of a natural connection. The same association of foliage and fructifications has been observed in other species of *Eusphenopteris* (Amerom, 1975, fig. 7).

There are observable similarities between the foliage of *Eusphenopteris morrowensis* and the reconstructed foliage of *Schopfiastrum decussatum* (Stidd and Phillips, 1973). Even though sizes and shapes of the pinnules are somewhat different, the two plants are alike in three other, more important aspects. The venation pattern is identical. Glands in both forms are in the same position on the lamina. The interrupted transverse striations (= transverse inner cortical plates) are present. For instance, the transverse striation is visible in the axis shown in plate 11, figure 1.

Lagenospermum sp.
Text fig. 11C, D; pl. 12, figs. 5, 6

Description.—Ellipsoidal seeds, 6.25 mm long, 3.38 mm diameter. Faint ridges (probably eight in all) extend along the length of the seed.

Discussion.—Three small ellipsoidal seeds are intimately associated with a pinna of *Eusphenopteris morrowensis* (specimen ISM 416522). One of the seeds is located immediately to the left of the pinna rachis and at the base of a pinnule. It is possible but not certain that it is organically attached to the rachis. Two seeds are to the right of the rachis, one seed partially overlapping the other and both lying upon the laminar portion of the pinnule. They do not appear to be attached to the frond. An isolated fourth seed agrees in all characteristics with the other three.

The form genus *Lagenospermum* was established for small ellipsoidal seeds that appear externally similar to seeds belonging to the petrifaction genus *Lagenostoma* but that do not preserve the morphologic characteristics necessary to justify their inclusion in that genus. The generic name *Nudospermum* has also been used for similar seeds. *Nudospermum* has been considered to be the seed of Lyginopterideae as well as Eusphenopterideae (data summarized by Amerom, 1975, fig. 7). The seeds in the Spencer Farm Flora are only slightly larger than *Nudospermum kidstoni* and are therefore very similar to a seed that has been linked to the genus *Eusphenopteris*.

Text fig. 11 - Fossil plants from the Spencer Farm Flora. A, B, *Eusphenopteris morrowensis*. C, *Lagenospermum* sp. showing indications of several ribs. D, *L.* sp. occurring with *E. morrowensis*. E, F, two interpretations of *Telangiopsis* sp. Bar scales are 5 mm long, except where noted.

Telangiopsis sp.
Text fig. 11E, F; pl. 12, figs. 1-4

Description.—Monopodially branching axis bearing terminal synangia with five sporangia. Individual sporangia 3 to 4 mm long and 0.5 to 1.0 mm wide, with an acuminate tip.

Discussion.—Thirteen specimens bearing sporangia have been found. They are preserved as molds with little or no organic material present; no spores have been found within the sporangia. Each specimen contains two or more sporangia; some specimens preserve five in a cluster and several contain two or more clusters.

One specimen (ISM 416521) does contain four and possibly five clusters and some trace of the connecting axis, indicating the mutual arrangement of the synangia. Two specimens (ISM 416460, 416280) preserve the bases of sporangia. One of these (416460) also contains two sporangia exposed in profile. The sporangia are roughly banana-shaped and do not appear to be fused to each other. The different positions of the sporangia, shown in text figure 11E and F, may represent changes during maturity or positions before and after anthesis.

Nine specimens of *Telangiopsis* occur on the same bedding plane as *Eusphenopteris morrowensis*; this concurrence may indicate that the two species belong to the same plant.

Rhodeopteridium phillipsii sp. nov.
Text fig. 10C-G; pl. 13, figs. 1-5

Description.—Deeply divided leaf at least three times pinnatifid; alate axis; pinnules elongated and strongly lobed; lobes either oval, elongated oval, or wedge-shaped with a long side attached to the axis; one vein per lobe. Pinnules 5 to 9 mm long and 1.5 to 2 mm wide; about five lobes per pinnule. Pinnules distant from each other, rarely overlapping. Fructifications (sporangia ?, seeds ?) occupying the end of a lobe. They are bean shaped and 0.5 by 0.7 mm.

Holotype: Specimen ISM 416527, figured on pl. 13, figs. 1, 4.

Paratype: Specimen ISM 416530.

Derivation of name: The new species is named in honor of Professor Tom L. Phillips, University of Illinois, in recognition of his contributions to our knowledge of Pennsylvanian age plants and his encouragement of young paleobotanists.

Discussion.—The form genus *Rhodeopteridium* (formerly known as *Rhodea*) is well characterized by the highly dissected foliage. The genus is nevertheless artificial and several distinct kinds of fructifications have been found on different species of *Rhodeopteridium*. None of those fructifications is identical with the one found in the Spencer Farm Flora.

The fructifications of *Rhodeopteridium phillipsii* are preserved as casts. The bean-shaped bodies are surrounded by a very thin edge of lamina. Thus, we would interpret them as seeds rather than sporangia.

The sterile foliage shows certain similarities to *Rhodeopteridium tenue* (Gothan) Purkyňová (1970). However, *R. phillipsii* is strictly pinnatifid and shows a much more regular construction of the leaf.

Holcospermum sp.
Text fig. 12A; pl. 14, figs. 6, 7

A single fragment of this genus has been found; it is 12 mm wide and is preserved to a length of 10 mm, but it is obvious that this is less than one-half the original length. The nucule was probably ovoid-elongate and radially symmetrical. The four visible ribs are 0.5 mm wide; eight were probably present around the entire circumference. This fragment is similar to specimens of *H. mansfieldi* figured by Arnold (1949, pl. XXIX, fig. 2) from Michigan and by Wood (1963, p. 11, fig. 3) from Indiana.

CORDAITALES
Cordaites cf. *principalis*
Pl. 15, figs. 1, 2

Cordaites leaves are a common element in the Spencer Farm Flora. However, they are fragmentary and poorly preserved. The surface is marked by coarse linear ribs separated by one to three fine ribs. The striation is the only characteristic on which the tentative identification can be based.

Platyspermic Seeds

Two of the most commonly encountered genera of the platyspermic seeds are *Samaropsis* and *Cordaicarpus*. *Samaropsis* Goeppert includes impressions of flat, more or less circular seeds. The seed is surrounded by an oval or heart-shaped border called a wing, which is formed by the soft tissue of the sarcotesta. *Cordaicarpus* Geinitz includes seeds that are similar to *Samaropsis*, but that do not possess a definite sarcotesta or that show only a very narrow one. Table 6 gives the available data about the specimens, which are classified on the basis of overall shape. It should be pointed out that the *Cordaicarpus* sp. B and the "miscellaneous nucelli" may in fact be parts of other forms, separated only because of incomplete preservation.

The platyspermic seeds are treated under Cordaitales because some of them belong to *Cordaites*. It should be realized that a connection has not been shown in most cases and that the arrangement is partly a matter of convenience.

Samaropsis sp. A
Text fig. 12B; pl. 15, figs. 5, 6, 7

These seeds are large, ovate to heart-shaped with a wide wing. In the better preserved specimen (pl. 15, fig. 6), the base is cordate and the nucellus is marked with lines roughly paralleling the margin. Also visible on this specimen is a V-shaped slit at the apex of the sarcotesta. On one specimen (pl. 15, fig. 5), a fairly wide (0.5 mm) line

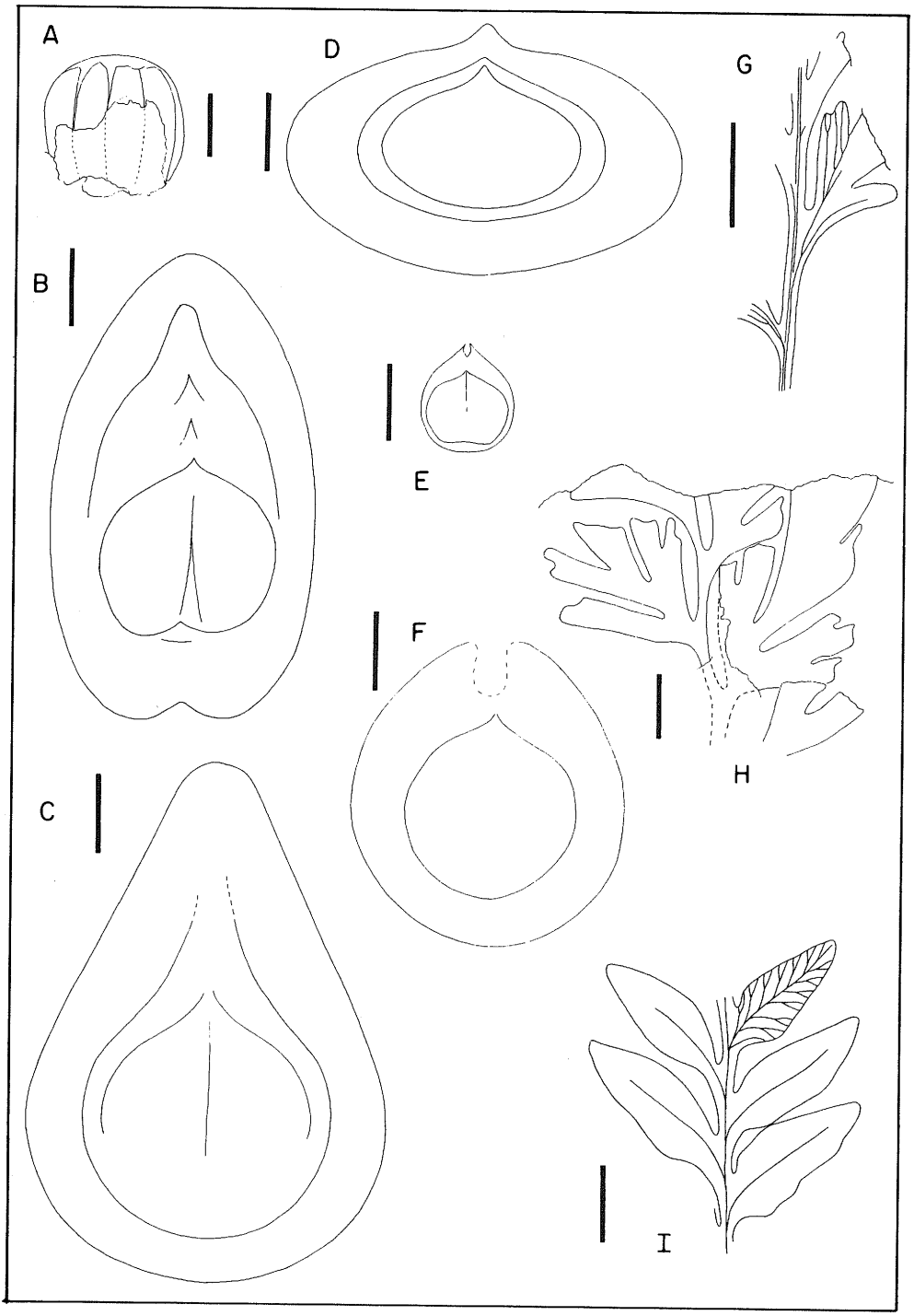

A
D
G
B
E
F
H
C
I

TABLE 6—MEASUREMENTS OF PLATYSPERMIC SEEDS OBSERVED IN THE SPENCER FARM FLORA

		Accession no.	Nucellus width (mm)	Nucellus length (mm)	Overall width (mm)	Overall length (mm)	Sarcotesta width (mm)
Samaropsis	Sp. A	416365	12	9	26	20	7
		416361	12	12	33	25	10
		416463	14	13	--	--	--
	Sp. B	416468	20	25	30	40	5
		416469	16	22?	22?	40?	3
		416364	14?	--	16?	--	--
	Sp. C	416462	11	11	17	19	3
		416494	11	12	16	18	2
Cordaicarpus	Sp. A	416610	8	8	9	15	0.5
		416467	11	10	13	23	1
		416522	5	7.5	6	12	0.5
	Sp. B	416134	5	5	6	7	0.5
		416362	5	6	6	7.5	0.5
		416611	5	4.5	6	7	0.5
		416300	6	7	--	--	--
		416363	4.5	6	--	--	--
Miscellaneous nucelli		416465	12	13			
		416612	12	10			
		416360	11	9			
		416489	9	9			

(sclerotesta ?) separates the nucellus from the wing, or sarcotesta. This species is similar to *Cardiocarpus dilatatus* Lesquereux (1884, p. 806-807, pl. 110, fig. 2); in our specimens, however, the sarcotesta appears to possess a more acute point. In their overall shape and large size, our specimens are similar to *Cardiocarpon akroni* Read (1946, p. 22, pl. 2, fig. 5), although the latter is slightly larger and the form of the apex is not clear.

Text fig. 12 - Fossil seeds occurring in the Spencer Farm Flora. A, *Holcospermum* sp. B, *Samaropsis* sp. A. C, *Samaropsis* sp. B. D, *Samaropsis* sp. C. E, *Cordaicarpus* sp. A. F, *Cordaicarpus* sp. B. G, H, ?*Eremopteris*. I, ?*Mariopteris*. Bar scales are 5 mm long.

Samaropsis sp. B
Text fig. 12C; pl. 14, figs. 1, 2

Only a single well-preserved specimen of this form has been found in the Spencer Farm Flora; two poorly preserved specimens are similar enough to be included. The nucellus is heart shaped and large (20 mm wide and 25 mm high). The sclerotesta and sarcotesta have elongated apices, the sarcotesta being pear shaped. In size and some other aspects, notably the lack of residue or relief, these resemble *Cardiocarpon phillipsii* Read (1946, p. 22, pl. 2, figs. 1-3). However, Read described the wing of *C. phillipsii* as having a distinct V-shaped slit extending to the apex of the nucellus. Read also stated that the wing measures only 0.5 cm at the micropylar end; on our specimen, however, the sarcotesta is more than 1 cm wide at the apex. Lesquereux (1884) also described and figured a very large, elongate form, *Carpolithes perpusillus* (pl. 110, fig. 22-24). The variation within his figures and incomplete preservation of our specimens do not permit further comparison.

Samaropsis sp. C
Text fig. 12D; pl. 14, fig. 3

This group is represented by two relatively small oval seeds and the outline of a third. The nucellus is almost completely circular, the apex being only slightly pointed. The overall form is circular, the sarcotesta being 2 to 3 mm wide all around the seed except for possibly a broad V-shaped incision at the apex.

These seeds bear strong resemblance to *Cardiocarpon annulatum* Newberry, *Cardiocarpus diverges* Lesquereux, and *C. patens* Lesquereux. The differences between these are minor variations in the form of the wing at the base and/or apex, differences that may be the result of preservation.

Cordaicarpus sp. A
Text fig. 12E; pl. 15, figs. 3, 4

Two specimens are preserved which show an ovate nucellus with a small point at the apex and a slightly cordate base, a sclerotesta (?) closely fitting at the base of the nucellus but extending considerably above the nucellus, and a narrow sarcotesta (?) around the entire body. The "wing" is not considered wide enough to warrant placing the seed in the genus *Samaropsis*. The overall form is elongated oval except for the slight indentation at the base. The best specimen shows much relief, but where the specimen is broken, it consists of a very thin film and thus the relationship of the present form to the original shape is unknown.

Cordaicarpus sp. B
Text fig. 12F; pl. 15, figs. 8, 9

This group includes seeds with a small (5 × 5 mm) heart-shaped nucellus and a slightly larger cordate to tear-drop-shaped sclerotesta,

the latter being 0.5 mm to 1.0 mm wide on the sides, thicker at the apex and thinner at the base. In some instances the nucellus, as is the surrounding sclerotesta, is preserved only as a thin, flattened carbon film. In other cases, the nucellus is preserved in three-dimensional form and is about 1 to 2 mm thick. Such differences are probably preservational and make comparison of specimens difficult. These specimens bear a strong resemblance to *Cardiocarpon late-alatum* Lesquereux.

PROBLEMATICA

The Spencer Farm Flora contains a number of fragmentary specimens that do not belong to any of the species described above. They are too incompletely preserved to be identified with any degree of confidence. However, these fragments may be recognizable if more material becomes available from here or other locations. Therefore, we include short descriptions and figures.

Specimens ISM 416380 and ISM 416258 (text fig. 12I; pl. 5, fig. 5; pl. 14, figs. 4, 5) are *Sphenopteris*- or *Mariopteris*-like. The pinnules are subtriangular to triangular to lanceolate with an only slightly lobed margin on the largest pinnule. The pinnules are arranged obliquely and alternately on the pinna rachis. The pinnules are decurrent, but the base is constricted slightly on the lower side, more so on the upper. The nervation of the two specimens is indistinct; the midvein originates at an acute angle and arches outward. The veinlets divide at least once as they curve outward to the margin. The measurements are:

	ISM 416258	ISM 416380
pinnule length (mm)	9, 12, 14, 12+, 14	6, 7
pinnule width (mm)	4, 4, 4.5, 4.5, 4.5	2, 3, 3

Another specimen, ISM 416529 (text fig. 12G, H; pl. 5, fig. 6), is an *Eremopteris*-like form. It has an alated rachis; pinnules are alternate and overlapping. The pinnule bases are very narrow and decurrent. The pinnules are deeply trilobed, and each lobe is further distinctly subdivided, each sublobe being either linear or slightly triangular.

It appears that a single vein enters each pinnule and divides one or two times to give rise to two or three nearly parallel veins in each lobe.

DISCUSSION

The Spencer Farm Flora is remarkable with respect to its mode of occurrence and the taxa present. The flora did not grow in a coal-forming environment, and the differences between this flora and normal roof-shale floras are thus in part due to the environmental differences. White (1931) was the first to point out that the basal Pennsylvanian floras of this kind were growing on the limestone plains and hills in western Illinois in early Pennsylvanian time. Leary (1974a, 1974b) gave

more detailed descriptions and reconstructions of the environment. At the present, the Spencer Farm Flora is the oldest Pennsylvanian flora known in the Illinois Basin, and certain differences from other floras are due to age differences.

During late Mississippian and early Pennsylvanian time a karst topography developed in northern Illinois with sinkholes or ravines which had very steep sides. Plants grew on the less eroded limestone hills. Rain storms would then wash broken-off plant fragments into the ravines and sinkholes. The floods would carry away the coarser clastics and rework the clays into clay pebbles. During times without rain a fine mud was deposited; it does not contain any plant megafossils. This reconstruction can be developed from the geologic position and the sedimentology at the site. The setting explains the unusual composition of the flora. The plants were growing on calcareous soil that might have been rather dry during part of the year. In contrast, the plants we find in roof-shale floras were growing on alluvial soils that were not limy but were often marshy and wet the year round.

Some taxa that occur only rarely in other beds in the Illinois Basin are common in the Spencer Farm Flora. These are *Megalopteris*, *Lesleya*, *Palaeopteridium reussii*, and *Alloiopteris gracillima*. These are the taxa that probably belong exclusively to an upland flora.

A count of the occurrence of genera is presented in table 7. This count was done during two collecting trips and does not include all specimens at our disposal. The pteridosperms are clearly dominant, and the Noeggerathiales are the second most common group. Cordaitales, Sphenopsids, and Ferns are much less common, but are well represented. Remarkable is the scarcity of *Lepidodendron*, which is represented by only three specimens. In roof-shale floras Lycopsids are usually more common (generally around 10 percent), and Noeggerathiales are not present at all. The predominance of Pteridosperms, however, can be observed in the majority of roof-shale floras (Peppers and Pfefferkorn, 1970; Pfefferkorn, Mustafa, and Hass, 1975).

Comparable Floras

There are a few floras known which contain some of the taxa found in the Spencer Farm Flora. Table 8 summarized the occurrence of the more important taxa in these floras.

White (1908) gave a list of a flora from northwestern Illinois without citing a precise locality. This floral list is very similar to the list of the Spencer Farm Flora if a few names are translated into their modern equivalents. White's flora certainly came from a similar setting and might be comparable in age. White mentioned *Danaeites*, which does not occur in this stratigraphic interval.

Lesquereux (1884, Coal Flora III, p. 852) lists a flora found in a sinkhole near Port Byron, Illinois. *Megalopteris* is present, but several of the other taxa are not.

Another flora that has similarities to the Spencer Farm Flora occurs in Perry County near Rushville, Ohio (Rushville itself is situated in Fairfield County). Reports on the flora were given by Andrews (1875), Lesquereux (1884), and Cross (1962). Even though this flora

TABLE 7—FREQUENCY OF GENERA IN THE SPENCER FARM FLORA

GROUP Genus	Number of specimens	Percentage of genera	Number of specimens of group	Percentage of group
LYCOPSIDS			3	<1%
Lepidodendron	3	<1%		
SPHENOPSIDS			40	9
Mesocalamites	17	4		
Annularia	1	<1		
Asterophyllites	22	5		
FERNS			33	7
Alloiopteris	30	6		
Dactylotheca	3	<1		
NOEGGERATHIALES			97	21
Palaeopteridium	13	3		
Gulpenia	4	<1		
Lacoea	80	17		
PTERIDOSPERMS			227	50
Alethopteris	47	10		
Sphenopteris + Eusphenopteris	117	26		
Megalopteris + Lesleya	36	8		
Rhodeopteridium	27	6		
CORDAITALES			54	12
Cordaites	54	12		
Total	454	100%	454	100%

occurs in a different type of rock (black shale) and contains more lycopsids, it has several aspects in common with the Spencer Farm Flora (*Megalopteris*, *Palaeopteridium*, and *Lacoea*). However, the typical Namurian forms contained in the Spencer Farm Flora have not been found.

Newberry (1873) described a flora from Youngstown, Ohio, that shows some similarities and Read (1946) reported a flora from the Dutch Mountain area in Pennsylvania with *Lacoea* and a species of *Palaeopteridium*.

In the Pocahontas Formation of Virginia and West Virginia no comparable floras have been reported. *Megalopteris* does occur there, but it is rare.

The Spotted Ridge Flora from the Lower Pennsylvanian of Oregon was described by Read and Merriam (1940), Arnold (1953), and Mamay and Read (1956). The flora contains *Mesocalamites* and a *Pecopteris* (*P. oregonensis*) that is very similar to *Dactylotheca aspera*.

Tidwell (1967) described a flora from the Manning Canyon Shale in Utah. This flora is of early Pennsylvanian age and contains a few forms comparable with species of the Spencer Farm Flora.

TABLE 8—OCCURRENCE OF IMPORTANT TAXA IN FLORAS COMPARABLE WITH THE SPENCER FARM FLORA*

	Spencer Farm Flora	Illinois, D. White 1908	Port Byron, IL, Lesquereux 1884	Rushville, OH, Andrews 1875	Youngstown, OH, Newberry 1873	Dutch Mountain, PA, Read 1946
Alloiopteris gracillima	x	x	–	–	x	–
Dactylotheca	x	–	–	–	–	–
Palaeopteridium reussii	x	x	–	x	x	x
Lacoea seriata	x	x	–	x	x	x
Megalopteris	x	x	x	x	–	–
Lesleya	x	x	–	–	–	–
Alethopteris lonchitica	x	x	–	–	–	–
Alethopteris	–	–	x	x	x	–
Orthogoniopteris	–	–	–	x	–	–
Neriopteris	–	–	–	–	x	x
Eremopteris	cf.	–	x	x	–	–
Sphenopteris	x	x	x	x	–	–
Mariopteris	cf.	x	–	–	–	x
Neuropteris	–	x	–	–	x	x

* The lists are not complete because they are based on the literature and on a few specimens consulted in old collections.

Age of the Flora

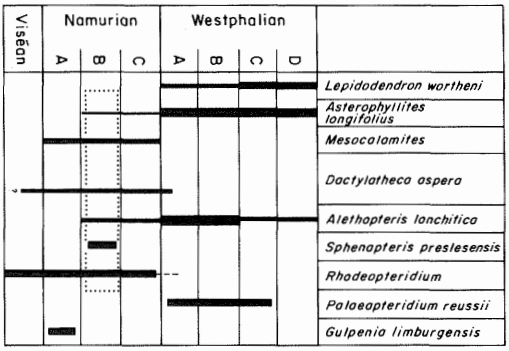
Prior to the discovery of the Spencer Farm Flora, the oldest deposits in the Illinois Basin could be correlated with the Westphalian A. Thus, it was assumed at first that the Spencer Farm Flora could be of the same age as other basal beds. This was in agreement with the Westphalian B age of the Babylon Sandstone, which was in turn derived from the correlation with other plant-bearing beds in the Illinois Basin.

However, preliminary investigations of the spore flora in the host rock of the Spencer Farm Flora indicated a Namurian age (Russel Peppers, oral communication). An analysis of the megaflora showed that the flora is most likely of Namurian B age.

The Spencer Farm Flora is difficult to date because it grew in an environment that is seldom represented in the fossil record. Stratigraphic ranges have been established elsewhere for only nine of the 28 plants occurring in the Spencer Farm Flora. All of these ranges are known from European coal basins only. Thus the ranges of those nine taxa were plotted against the time-stratigraphic scale of the European Carboniferous (text fig. 13). At first glance, the Spencer Farm Flora would seem to be a mixture of several ages. However, because all of the material comes from only two very close locations, this possibility can be excluded.

If we assume that first occurrence is the most meaningful parameter in biostratigraphy, the conclusion would be that the flora is of Westphalian A age and that the ranges of several Namurian forms would have to be extended considerably. This conclusion would contradict the overall Namurian character of the flora.

The long and differing ranges of the nine taxa (text fig. 13) led to the use of the concept of concurrent ranges. Six forms occur together in the Namurian B, excluding only three. Five are present in the Namurian C, excluding four. The numbers of concurring taxa are even lower for the Namurian A and Westphalian A. We have thus to conclude that according to material and information available at present, the Spencer Farm Flora is regarded as belonging to the Namurian B or possibly the Namurian C.



Text fig. 13 - Stratigraphic ranges in the European Carboniferous of genera and species occurring in the Spencer Farm Flora. (Data from Gothan and Remy (1957), Fossilium Catalogus, and other sources.) Dotted outline shows time of common occurrence of the majority of forms.

It follows that the range of *Gulpenia limburgensis* would now be Namurian A and B (C), the range of *Lepidodendron wortheni* would be Namurian B (C) to Westphalian D, and the range of *Palaeopteridium reussii* would be Namurian B (C) to Westphalian C.

The plant-bearing beds at Spencer Farm are approximately equivalent in age to the Pocahontas Formation in West Virginia. The flora would therefore belong in zone 4 of Read and Mamay (1964). However, none of the index fossils used for the definition of zone 4 occurs in the Spencer Farm Flora because of the unusual biofacies of the flora. On the other hand, the genus *Megalopteris* has been reported from zone 7. The Spencer Farm Flora, however, occurs stratigraphically clearly below the beds correlated in Illinois with zone 7. *Megalopteris* probably has an extended range. This extension is indicated by the occurrence in West Virginia of *Megalopteris* above the Fire Creek Coal, which lies at the base of zone 5 (White, 1895).

SUMMARY AND CONCLUSIONS

1) The Spencer Farm Flora was found in the basal beds of the Caseyville Formation (Pennsylvanian). These beds were deposited in a ravine eroded in Mississippian limestones. The plant-bearing beds are thus the oldest rocks of Pennsylvanian age in the area and represent the first deposits laid down after a hiatus.

2) The flora contains 29 species and a few problematical forms. Nine taxa are identical with or directly comparable with European forms with established stratigraphic ranges. Six of these have a concurrent range indicating a Namurian B (or possibly Namurian C) age. Thus, at present, Spencer Farm Flora is the oldest flora of Pennsylvanian age known in the Illinois Basin.

3) The flora represents an unusual biofacies, in which generally rare taxa (*Megalopteris*, *Lesleya*, *Palaeopteridium*, *Lacoea*) are common.

The Noeggerathiales, a very rare group, make up more than 20 percent of the specimens. The plants represented in the Spencer Farm Flora were growing on calcareous soils surrounding the ravine in which they were deposited. They are an extrabasinal (= "upland") flora which is distinct from the basinal floras found in roof shales.

4) It is suggested here that the Noeggerathiales should perhaps be classified as Progymnosperms. The noeggerathialian cones could be derived from *Archaeopteris*-like fructifications. Within the noeggerathialian cones a possibly evolutionary trend can be seen from *Noeggerathiostrobus* to *Lacoea* to *Discinites*.

5) Several organic connections are suspected. *Mesocalamites* cf. *cistiiformis* was found in organic connection with *Calamostachys andanensis*. *Lacoea seriata* and *Palaeopteridium reussii* might belong together. *Eusphenopteris morrowensis* has been found with a *Lagenospermum* (= *Nudospermum*) seed and a *Telangiopsis*-like male fructification. It is suspected that they belong together. *Eusphenopteris morrowensis* is in some characters comparable to coal ball material of *Schopfiastrum decussatum*.

6) Two new species, *Lesleya cheimarosa* and *Rhodeopteridium phillipsii*, are described; *Gulpenia limburgensis* is reported for the first time in this country.

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PLATES

AND

EXPLANATIONS

PLATE 1

Lycopsids and Sphenopsids

Figure

1 *Lepidodendron wortheni* Lesquereux
ISM 416510 scale 1.5:1

2 *Calamostachys andanensis* on *Mesocalamites* cf. *cistiiformis*
ISM 416413a scale 2:1

3 *Mesocalamites* cf. *cistiiformis*
ISM 416432 scale 1:1

4 *Annularia* cf. *vernensis*
ISM 416376b scale 1:1

5 *Asterophyllites longifolius* (Sternberg) Brongniart
ISM 416511 scale 1:1

6 *Annularia* cf. *asteris*
ISM 416512 scale 3:1

7 *Calamostachys andanensis* Stockmans and Willière
ISM 416513 scale 5:1

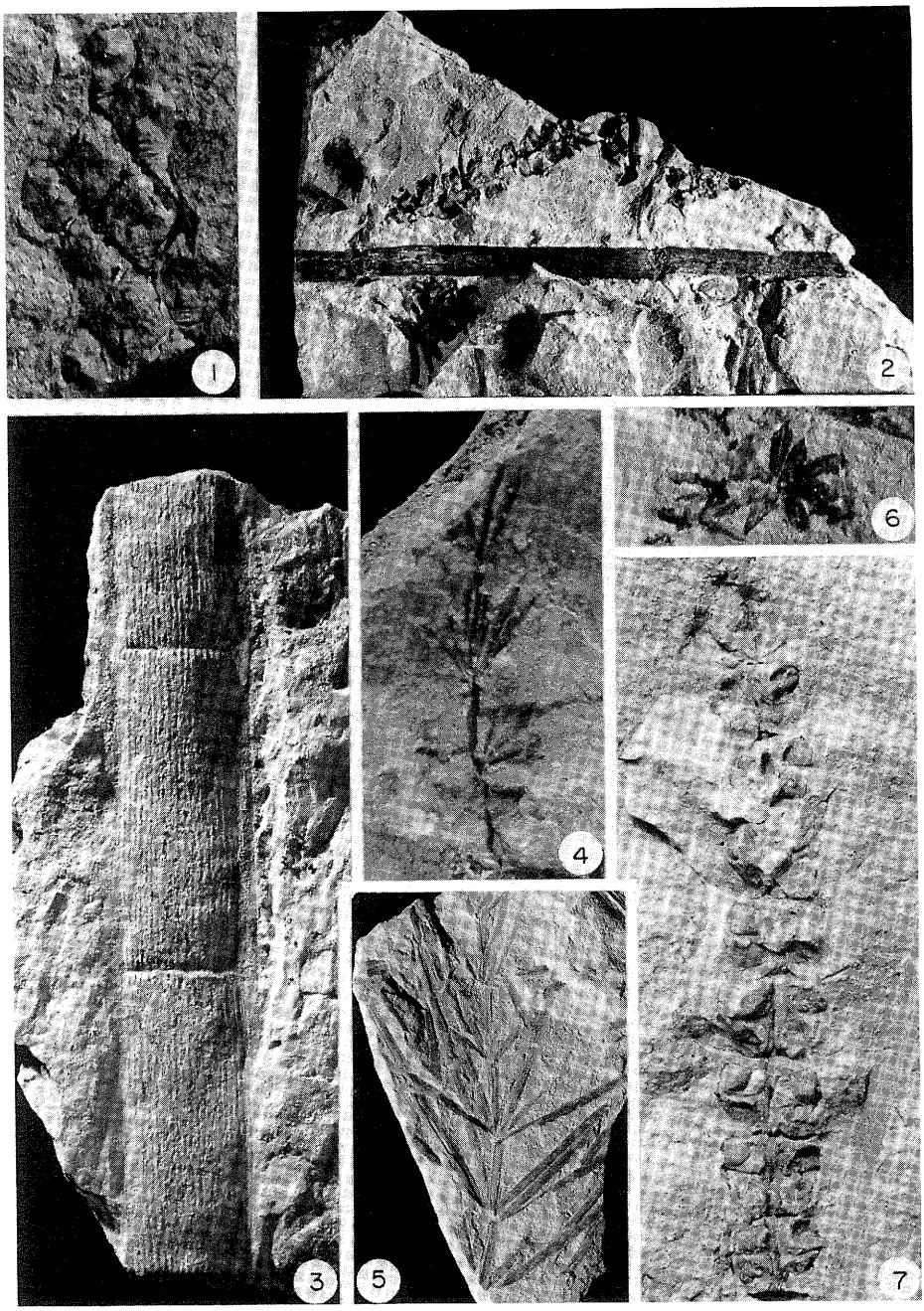
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PLATE 2

Alloiopteris gracillima (Newberry) D. White

Figure		
1	ISM 416509	scale 1:1
2,3	ISM 416530	scale 5:1
4	ISM 416531	scale 5:1

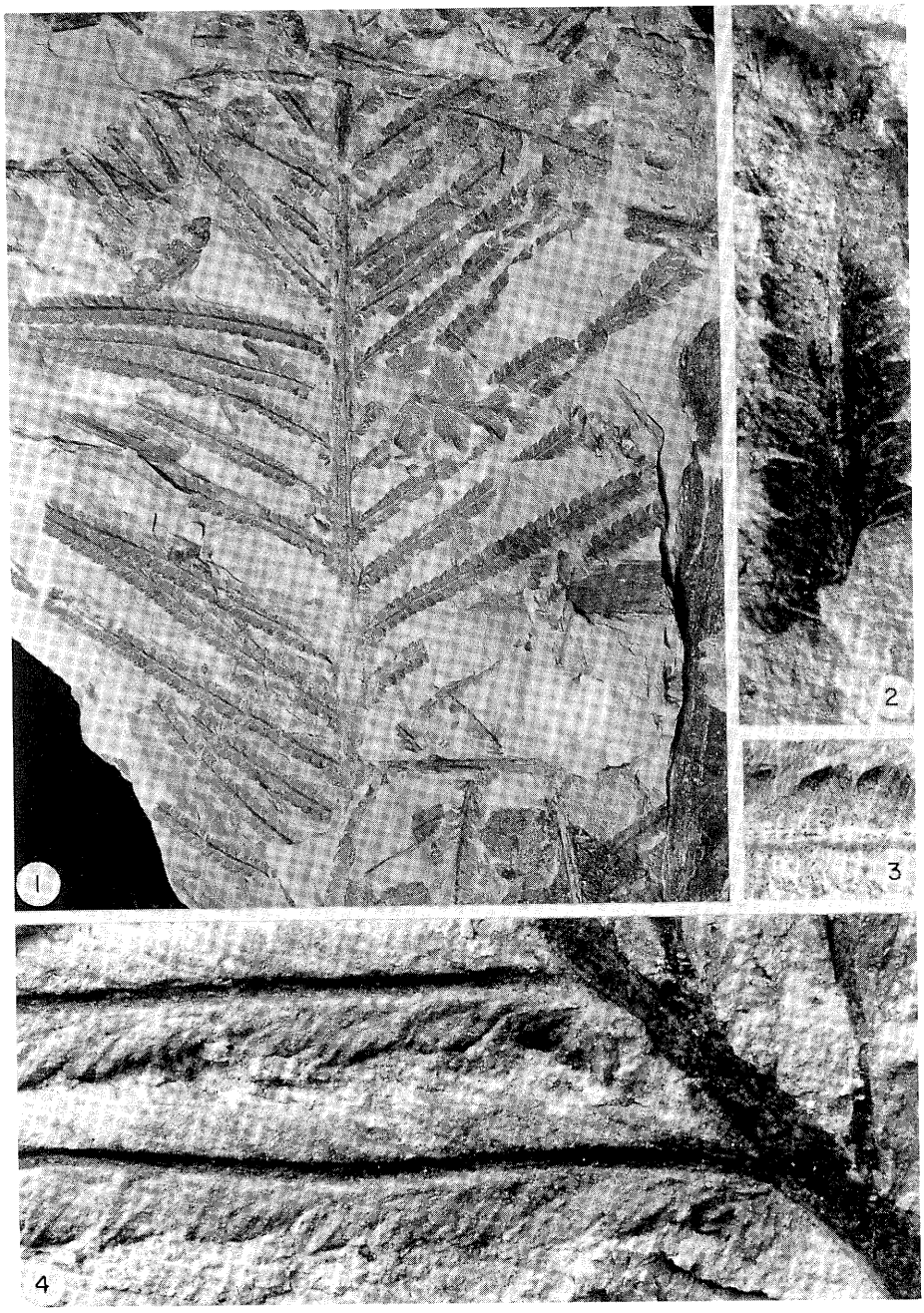
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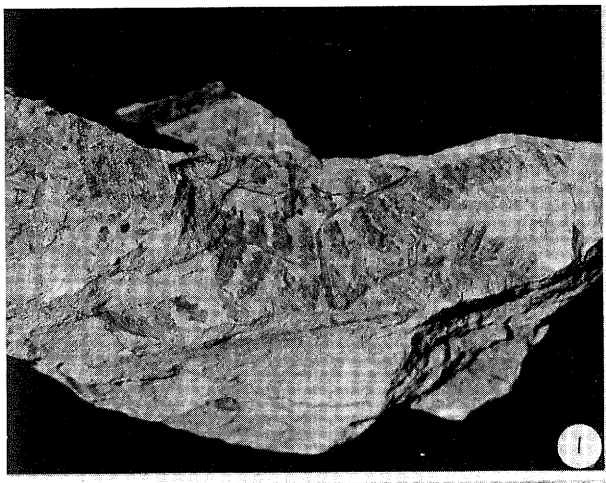
PLATE 3

Dactylotheca aspera (Brongniart) Zeiller

Figure		
1	ISM 416497	scale 1:1
2	same as fig. 1	scale 4:1
3	ISM 416514	scale 5:1



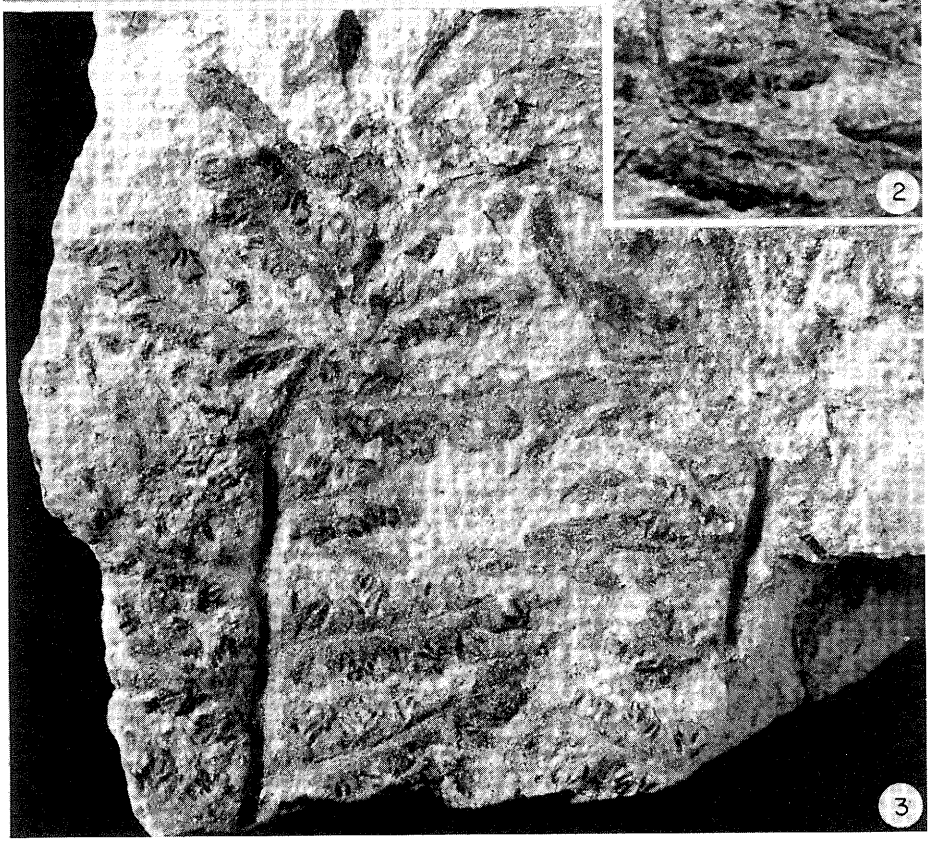


PLATE 4

Palaeopteridium reussii (Ettinghausen) Kidston

Figure		
1	ISM 416528	scale 1:1
2	coll. Marietta College (Rushville, Ohio)	scale 1:1
3	ISM 416436	scale 2:1
4	ISM 416528	scale 5:1
5	ISM 416	scale 5:1

Lacoea seriata Read

6	ISM 416278	scale 2:1
7	ISM 416275	scale 2:1
8	USNM 26222 (Dutch Mountain, PA)	scale 1:1

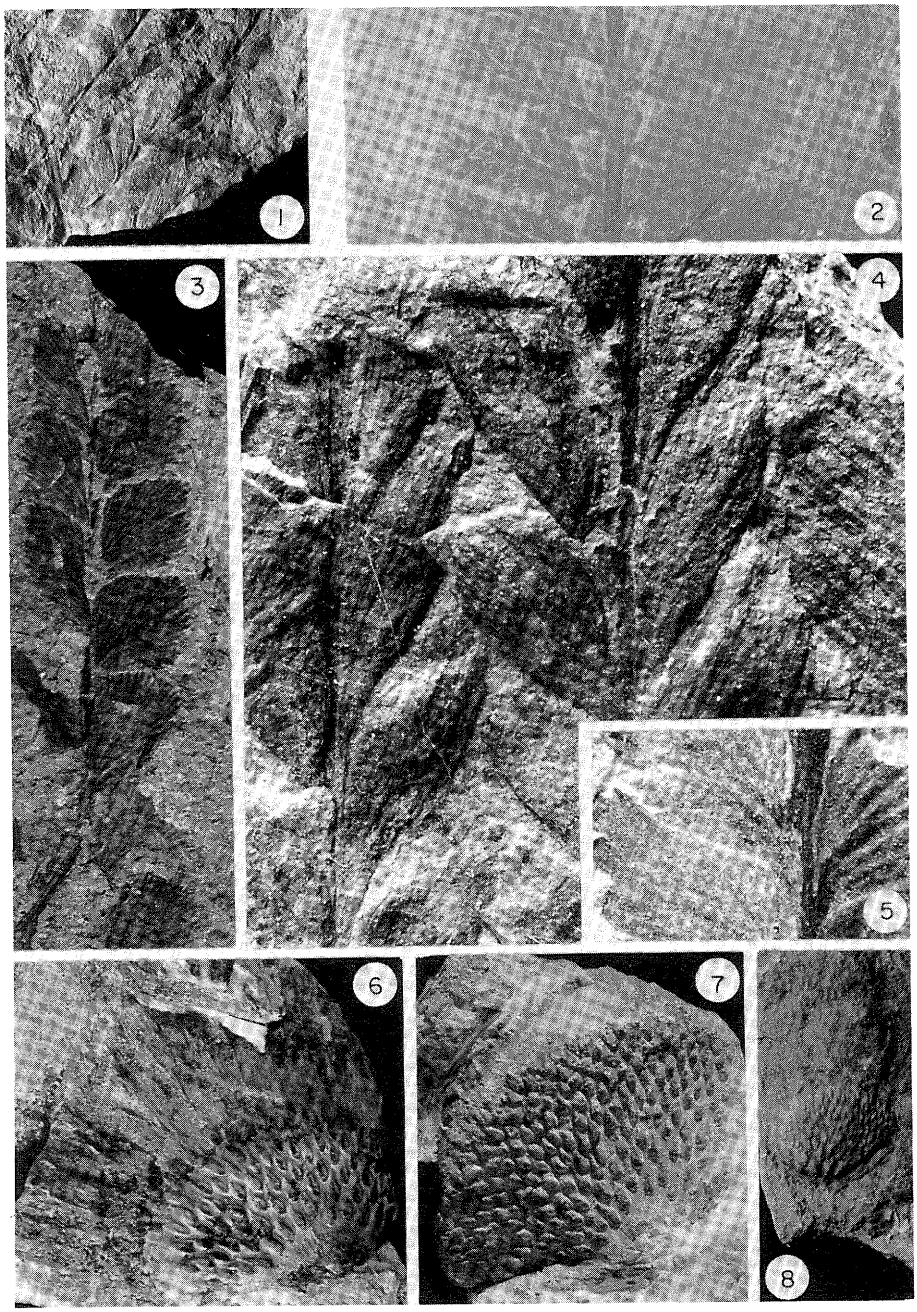

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PLATE 5

Gulpenia limburgensis Gothan and Jongmans

Figure		
1	ISM 416498	scale 1:1
2	ISM 416499	scale 1:1
3	same as fig. 2	scale 5:1
4	same as fig. 1	scale 5:1

Problematica

5	cf. "*Mariopteris*" ISM 416380	scale 3:1
6	cf. "*Eremopteris*" ISM 416529	scale 2:1

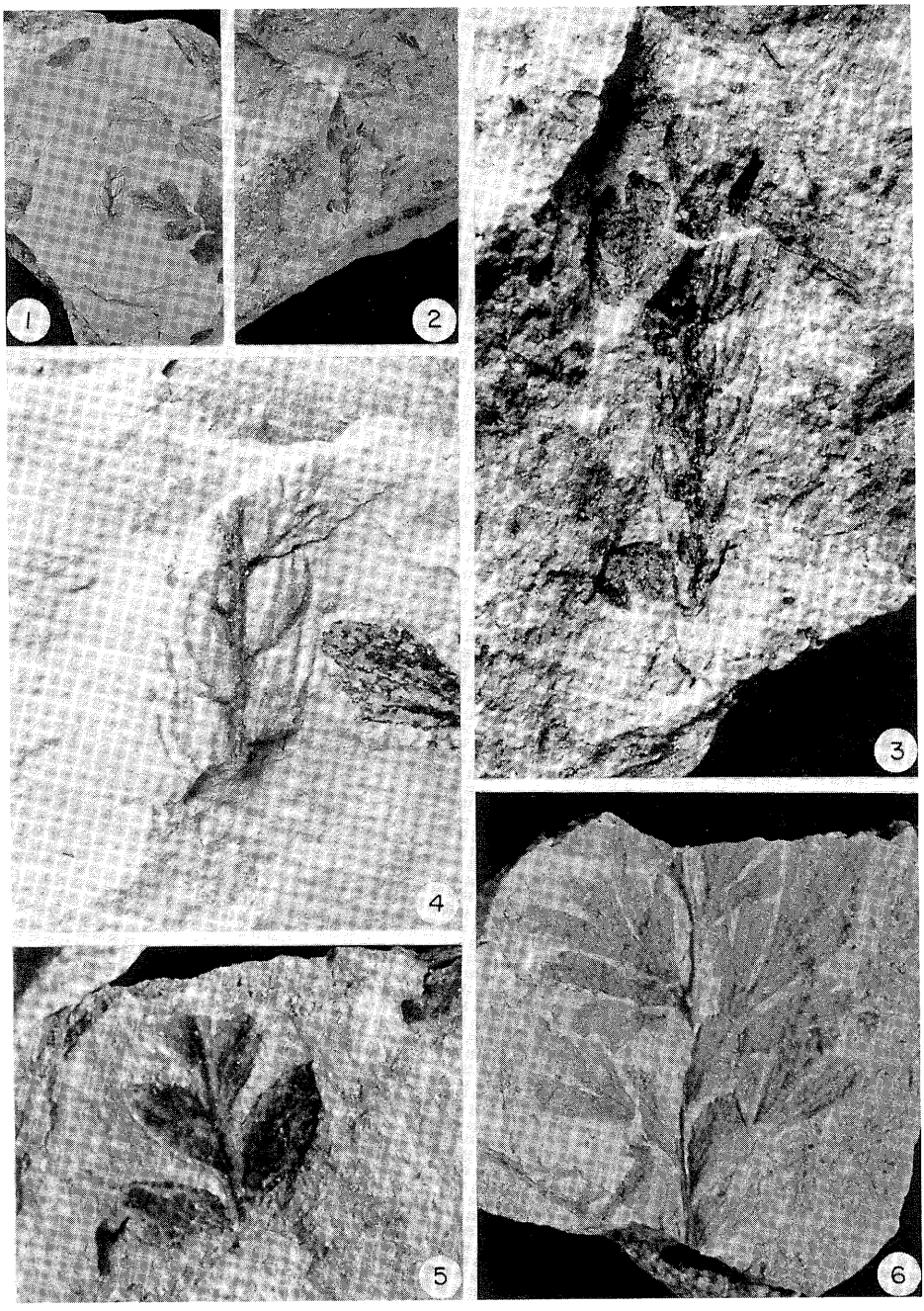
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PLATE 6

Megalopteris and *Lesleya*

Figure

1 *Megalopteris fasciculata* Lesquereux
holotype USNM 11704 scale 1:1
(Port Byron, IL)

2 same as fig. 1 scale 5:1

3 *Megalopteris dawsoni* (Hartt) Andrews
ISM 416525 scale 1:1

4 *Megalopteris ovata* Andrews
ISM 416524 scale 1:1

5 *Lesleya cheimarosa* sp. nov.
ISM 416508 scale 3:1


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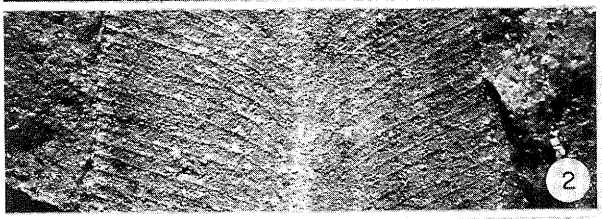
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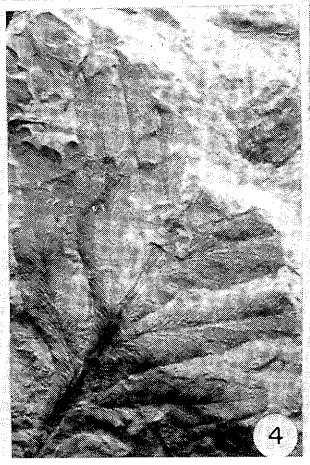
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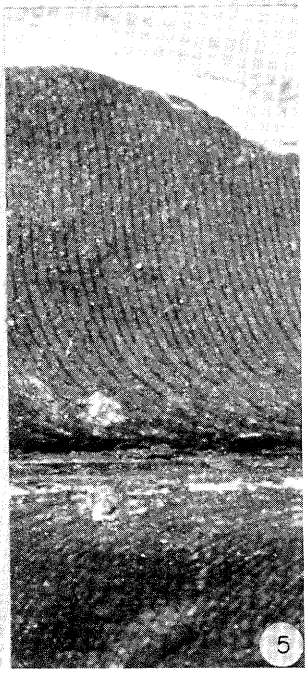
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PLATE 7

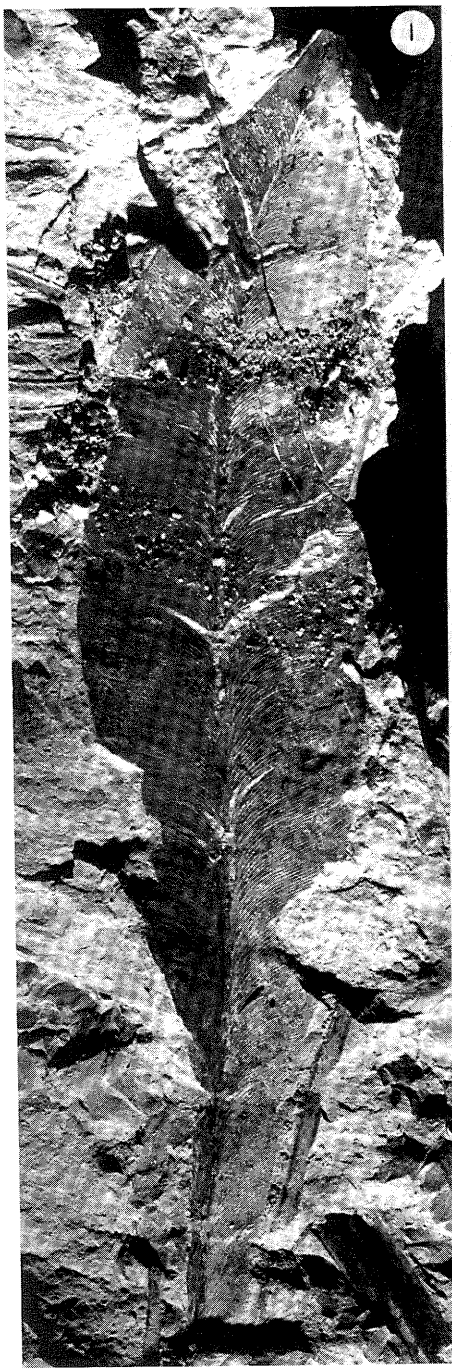
Megalopteris ovata Andrews

ISM 416523 scale 2:1

PLATE 8

Lesleya cheimarosa sp. nov.

Figure		
1	ISM 416488a	scale 1:1
2	ISM 416488b	scale 1:1 (counterpart of fig. 1)
3	ISM 416526	scale 1:1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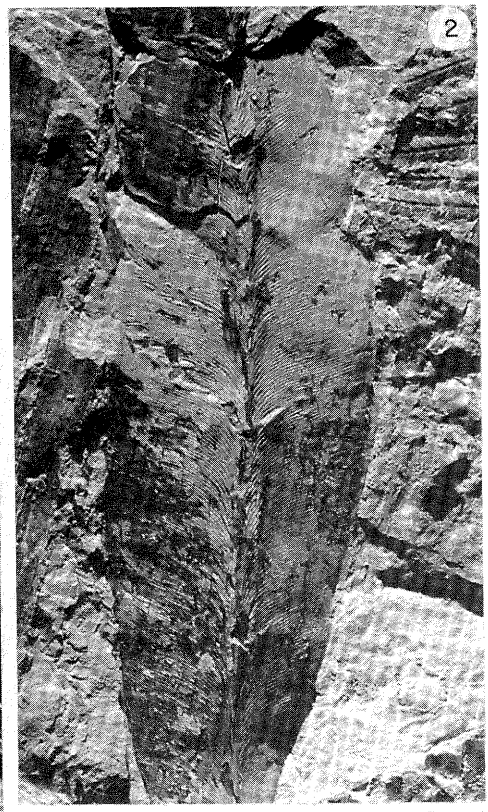
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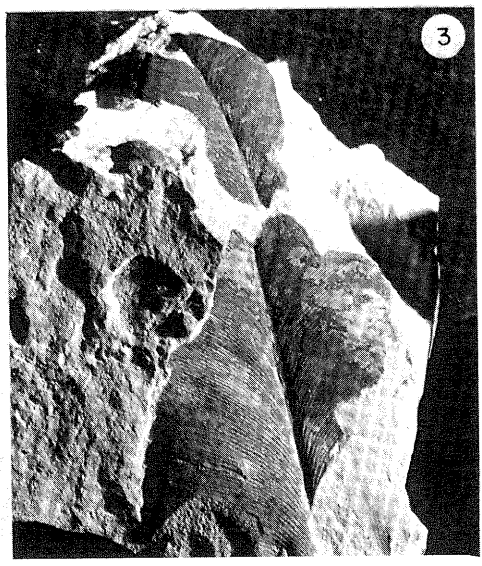
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PLATE 9

Alethopteris lonchitica (Schlotheim) Sternberg

Figure		
1	ISM 416515	scale 1:1
2	ISM 416124	scale 2.5:1
3	ISM 416130	scale 2.5:1
4	ISM 416129	scale 5:1
5	ISM 416516	scale 1:1
6	ISM 416517	scale 1.5:1

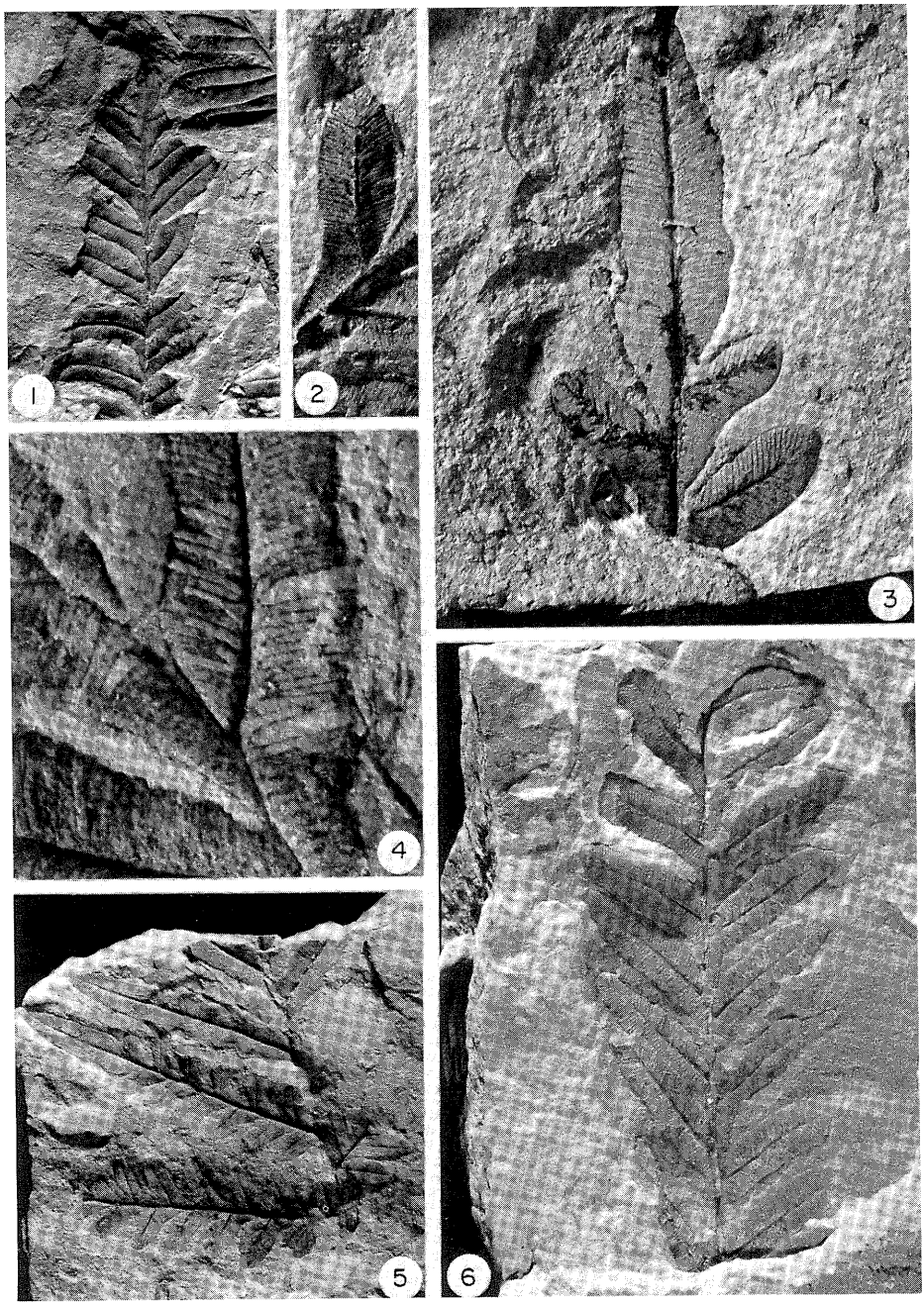
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PLATE 10

Sphenopteris preslesensis Stockmans and Willière

Figure		
1	ISM 416356	scale 1:1
2	same as fig. 1	scale 3:1
3	ISM 416417	scale 2:1
4	ISM 416376b	scale 2:1
5	ISM 416474	scale 2:1

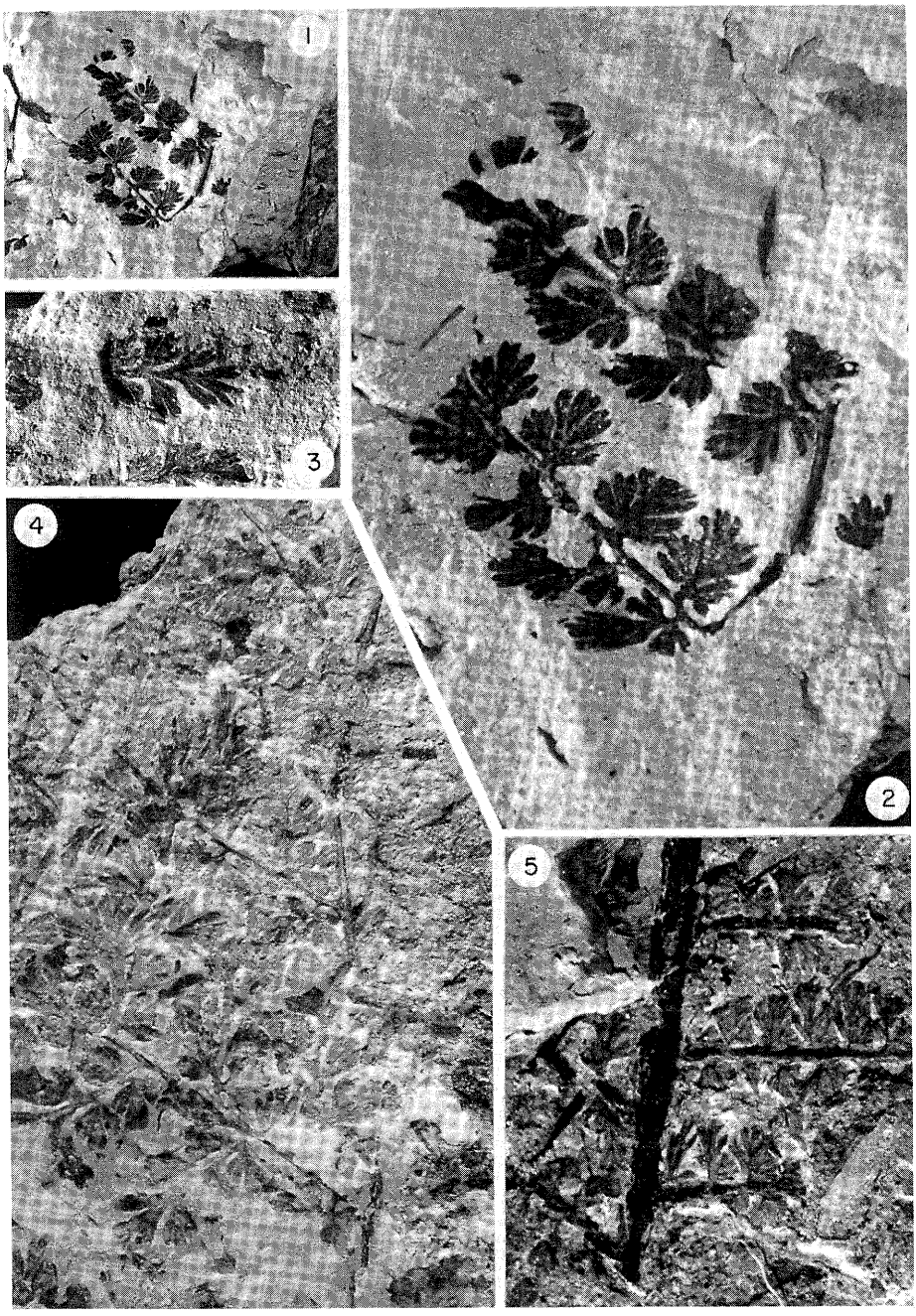
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PLATE 11

Eusphenopteris morrowensis (D. White) Ameron comb. nov.

Figure		
1	ISM 416535	scale 1:1
2	ISM 416518	scale 2:1
3	ISM 416532	scale 5:1
4	ISM 416519	scale 2:1

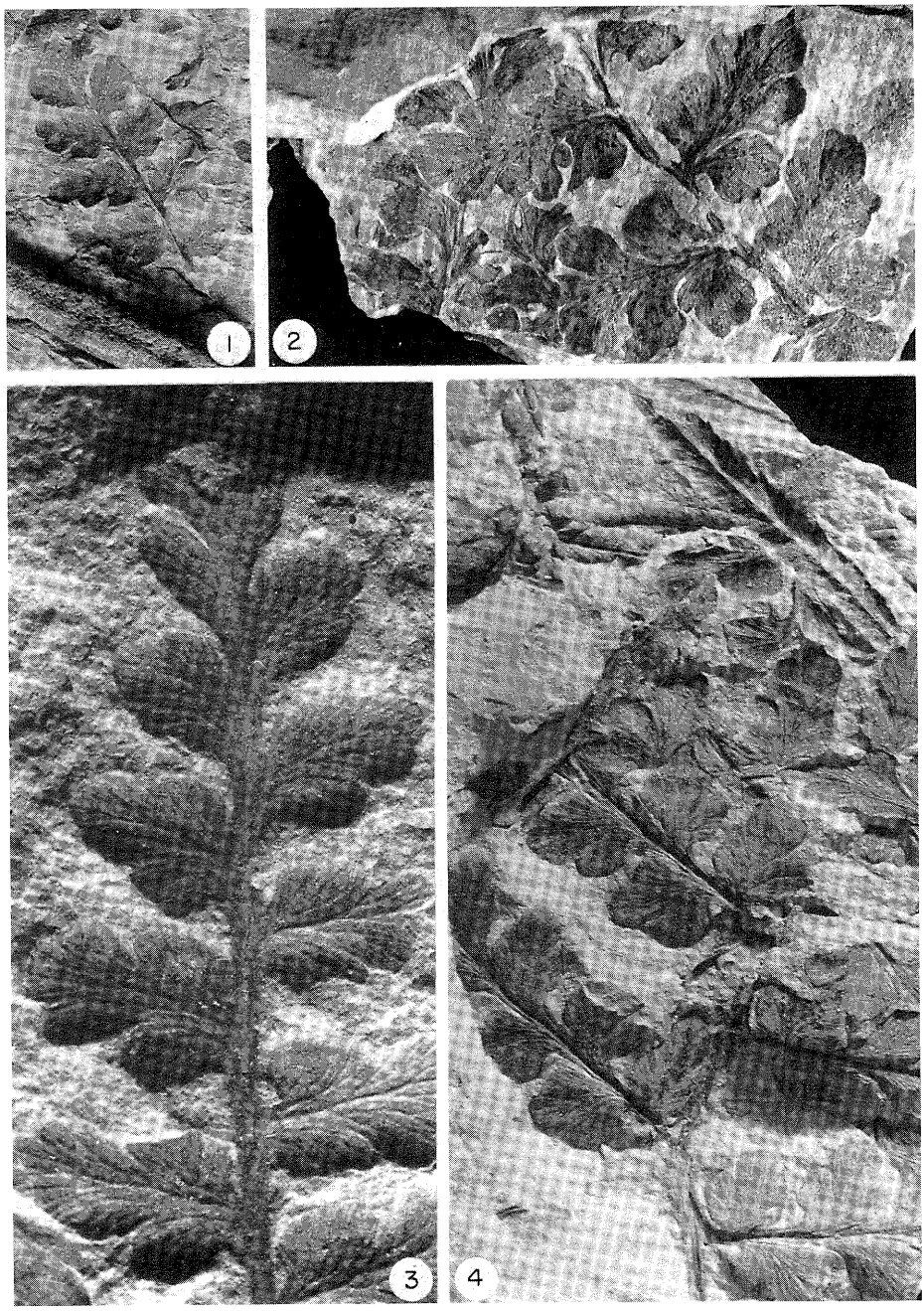
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PLATE 12

Telangiopsis sp.

Figure		
1	ISM 416520	scale 1:1
2	ISM 416485	scale 1:1
3	same as fig. 2	scale 3:1
4	ISM 416521	scale 5:1

Lagenospermum sp.

5	ISM 416522	scale 1:1
6	same as fig. 5	scale 2.5:1

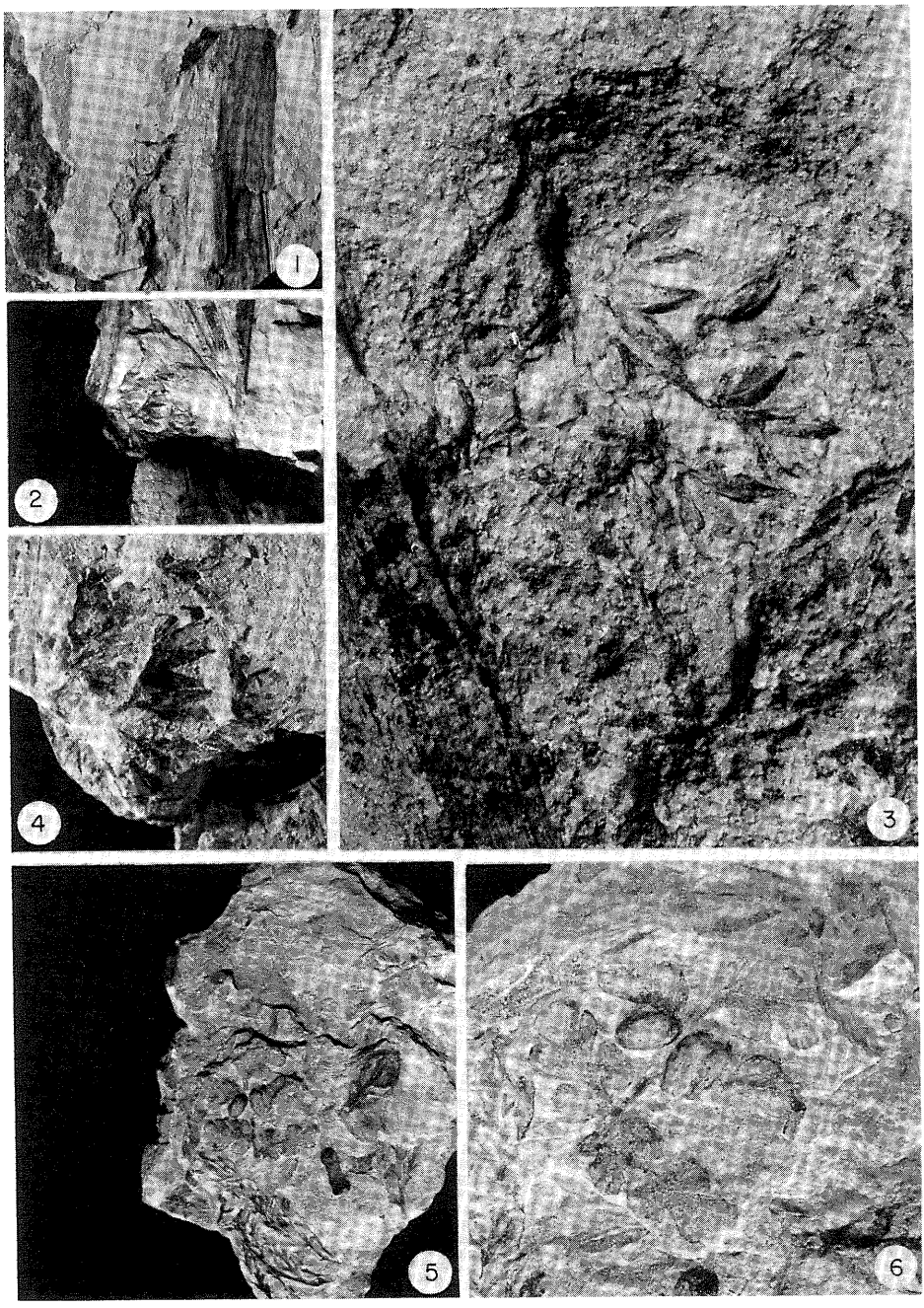
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PLATE 13

Rhodeopteridium phillipsii sp. nov.

Figure		
1	ISM 416527	scale 1:1
2	ISM 416527	scale 1:1
3	ISM 416530	scale 5:1
4	same as fig. 1	scale 5:1
5	same as fig. 2	scale 5:1

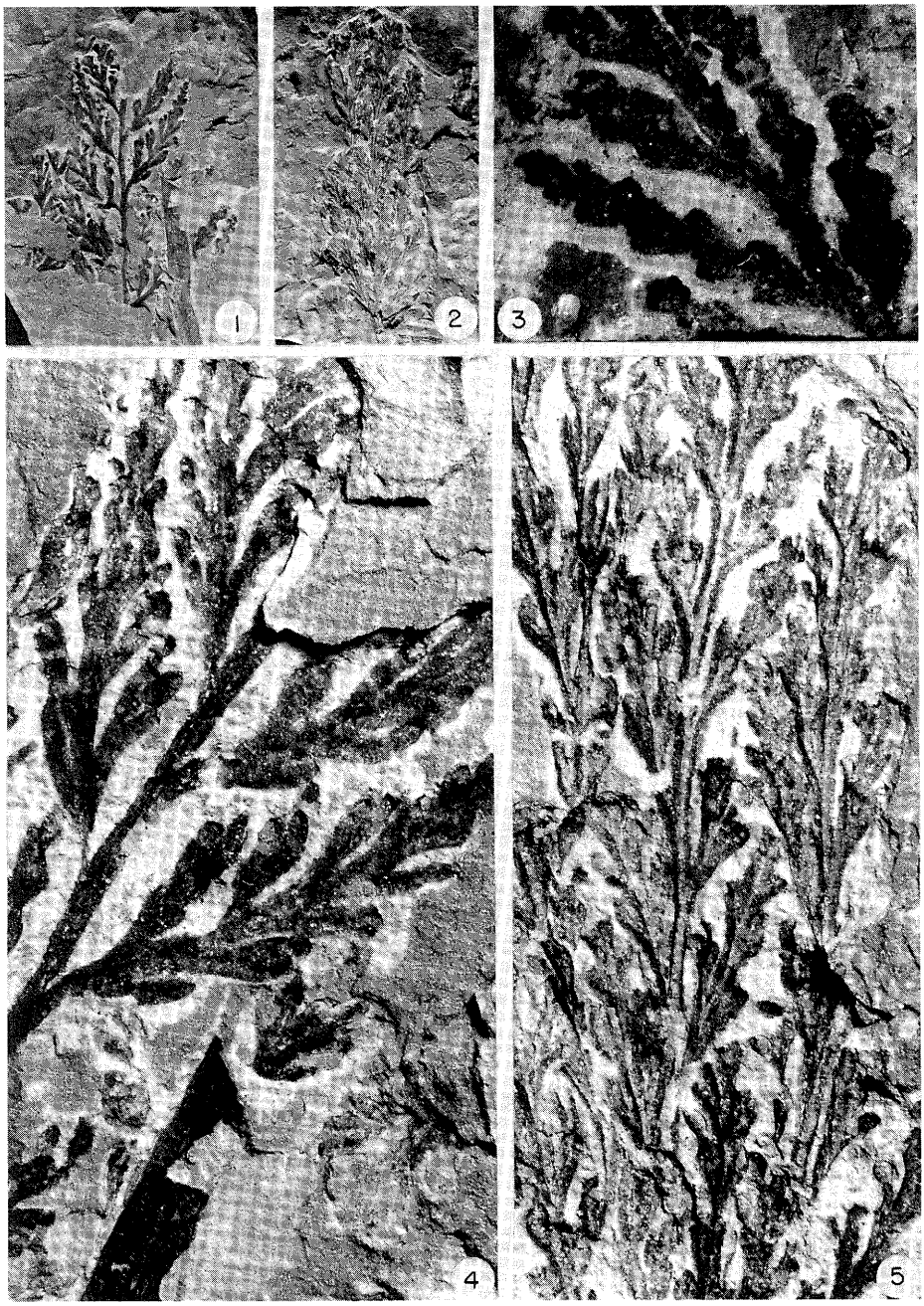
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PLATE 14

Samaropsis and Problematica

Figure		
1	*Samaropsis* sp. B ISM 416468	scale 2:1
2	same as fig. 1	scale 1:1
3	*Samaropsis* sp. C ISM 416462	scale 2:1
4	"*Mariopteris*" ISM 416258	scale 2:1
5	same as fig. 4	scale 1:1
6	*Holcospermum* sp. ISM 416483	scale 1:1
7	same as fig. 6	scale 2:1

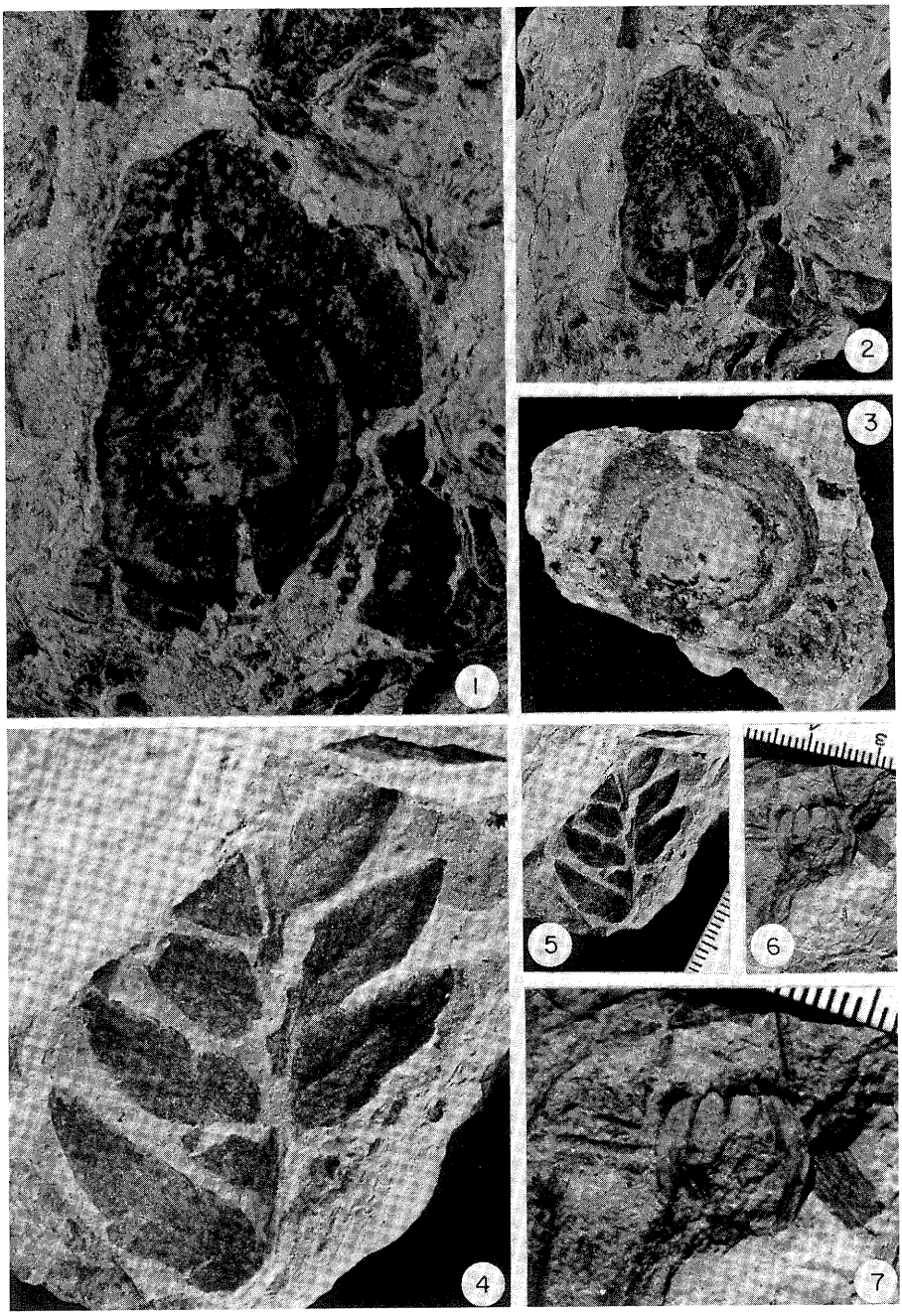
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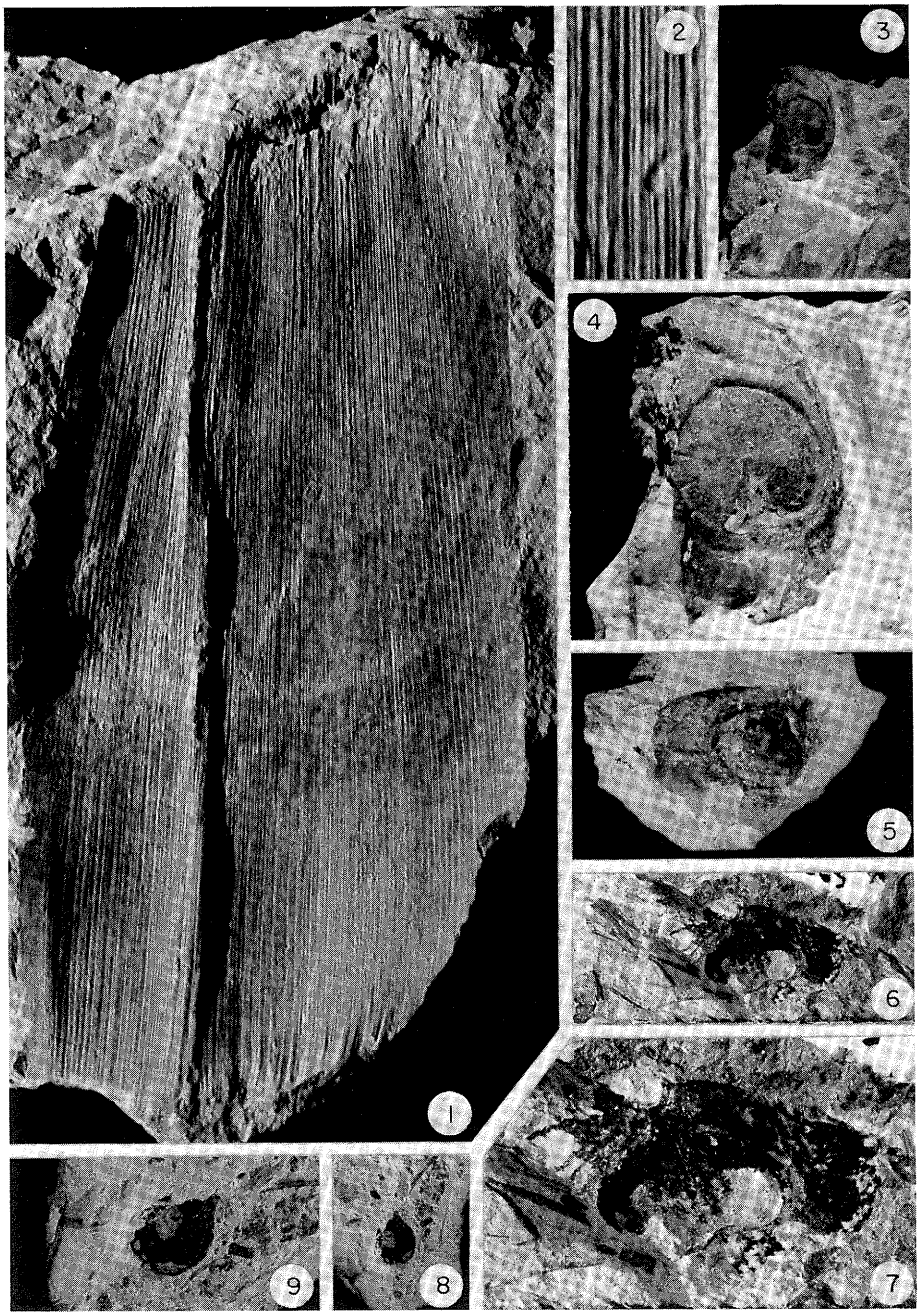
PLATE 15

Cordaites, *Cordaicarpus*, and *Samaropsis*

Figure		
1	*Cordaites* cf. *principalis* ISM 416533	scale 1:1
2	same as fig. 1	scale 4:1
3	*Cordaicarpus* sp. A ISM 416534	scale 1:1
4	same as fig. 3	scale 2:1
5	*Samaropsis* sp. A ISM 416361	scale 1:1
6	*Samaropsis* sp. A ISM 416365	scale 1:1
7	same as fig. 6	scale 2:1
8	*Cordaicarpus* sp. B ISM 416362	scale 1:1
9	same as fig. 8	scale 2:1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