

## Chieftain No. 20 Flora (Middle Pennsylvanian) of Vigo County, Indiana

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### Abstract

The Chieftain No. 20 Mine located ten miles south of Terre Haute, Indiana contains a number of plant fossils usually within ironstone concretions. The concretions are mainly located in a shale phase of the Busseron Sandstone immediately above Coal VII.

The Chieftain No. 20 flora has many species in common with the Lower Allegheny Mazon Creek flora of Illinois. The floral composition, eg. abundant *Annularia stellata*, *Ptychocarpus unitus*, pecopterids and absence of sphenopterids as well as the stratigraphic position of the Shelburn Formation which contains the Busseron Sandstone indicate an Upper Allegheny or lower-most Conemaugh age.

### Introduction

This is a report on the fossil flora found in the Chieftain No. 20 mine located ten miles south of Terre Haute, Vigo County, Indiana. The Chieftain No. 20 mine is a large strip mine of the Peabody Coal Company. Coal mining began in 1956 and ceased in 1968. Two localities (A & B) contained many ironstone concretions similar to those reported from Mazon Creek, Will County, Illinois. Two other localities (C & D) had carbonaceous impressions of plants in shale. (Figure 1).

### Acknowledgment

I wish to thank Mr. Richard Leary of the Illinois State Museum, Dr. Francis M. Hueber of the Smithsonian Institution, and Dr. Eugene S. Richardson, Jr. of the Field Museum for their time and assistance in allowing me access to the collections of Mazon Creek fossils housed in their respective institutions. I also wish to thank Dr. Chester A. Arnold of the University of Michigan and Dr. Sergius Mamay of the U.S. Geological Survey for their valuable information about Upper Pennsylvanian floras. Dr. Eugene S. Richardson, Jr. of the Field Museum, identified the arthropods in the Chieftain No. 20 concretions and Dr. T. Covender of the University of Michigan identified the paleoniscid fish.

To Mr. Merton Young of Michigantown, Indiana I owe especial thanks for the donation of his entire collection of Chieftain No. 20 plants to Indiana University.

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### Geology

Most of the ironstone concretions occur in a shale section of the Busseron Sandstone Member of the Shelburn Formation immediately above Coal VII (Figure 2). The shale is light gray, thickness varying from 0-20 feet, minor amounts of rounded, quartz sand grains present,

fresh samples break into irregular blocks with no apparent bedding planes, upon weathering the shale disintegrates to clay. Contains abundant ironstone concretions which, in many cases, enclose plant fossils of Upper Allegheny-Lower Conemaugh Age, carbonized plant fossils also present in pockets of finely laminated, gray shale within the blocky shale matrix.

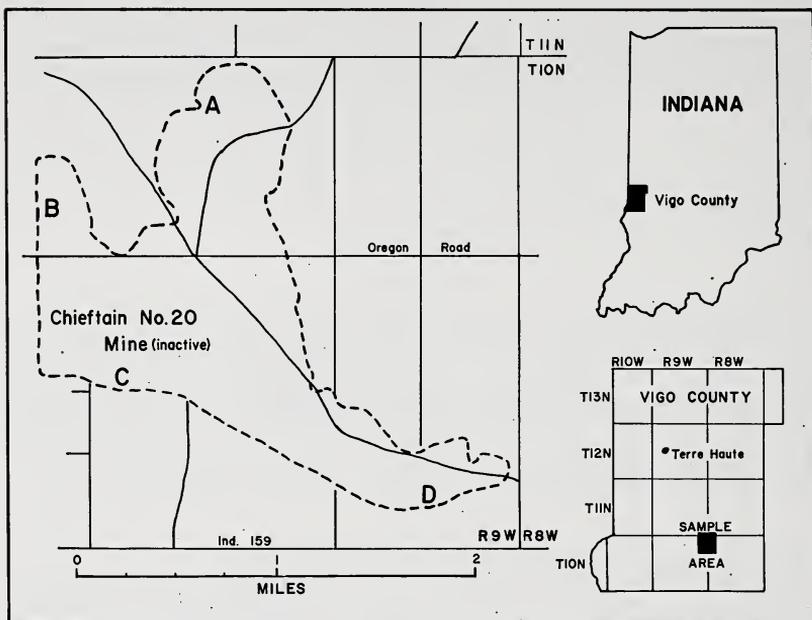


FIGURE 1. Map showing collection localities of the Chieftain No. 20 flora.

### Collecting Techniques

The concretions may be seen in a fresh cut and may be collected from the working face of the mine. However, the fresh concretions do not fracture along the plane in which a fossil may lie. They break in an irregular manner and it is impossible to obtain identifiable fossils. A fresh concretion is dull black on a broken surface and has the texture of a solid mass of chert. It was necessary to collect the weathered concretions from the spoil heaps which had been discarded in previous years. It is from these concretions that I obtained good plant specimens.

After a period of weathering, the concretions become reddish-brown in color and may be split along the plane of the enclosed fossil. The weathered concretions are composed primarily of quartz sand grains (size ca. 2 mm.). Possibly the shale sized particles have been leached by the weathering process.

Approximately 25% of the concretions contained well preserved specimens. These are all in the collection which is stored in the Botany Department of Indiana University at Bloomington. A small number

of specimens had galena or sphalerite partially filling the void spaces. This type of mineral filling totally destroyed the fine details of the original fossil and in all cases only the outline was preserved intact. Most of the specimens filled by galena or sphalerite were not worth keeping.

FIGURE 2. *Pennsylvanian System in Indiana (18).*

Series	Group	Formation	Member
Conemaugh	McLeansboro	Matoon	
		Bond	(Individual members not listed.)
		Patoka	
		Shelburn	West Franklin Ls. Pirtle Coal Busseron Ss.
Allegheny	Carbondale	Dugger	Danville Coal (Coal VII) Universal Ls. Hymera Coal (Coal VI) Providence Ls. Herrin Coal Bucktown Coal (Coal Vb) Antioch Ls. Alum Cave Ls.
		Petersburg	
		Linton	(Individual members not listed.)
Pottsville	Raccoon Creek	Staunton	
		Brazil	(Individual members not listed.)
		Mansfield	

Within the shale are pockets of carbonized fossils which may be indicative of a former backwash in which plant debris from the surrounding land accumulated. These pockets are seldom more than six inches thick and are usually less than six feet wide.

### Previous Work

The study of Pennsylvanian age plants of Indiana has had an uneven history. There have been long intervals in the last hundred years when nothing was published on the Pennsylvanian paleobotany of the state. The first mention of fossil plants from Indiana was published in 1843 (15, 16). Indiana plant fossils were not mentioned again for over thirty-five years after these brief reports. Lesquereux (10, 11,

12) in a series of reports for the Pennsylvania Geological Survey and a report (13) for the Indiana Geological Survey lists a number of plants from the Indiana coal-bearing formations along with many plants from other states. White (20) published a brief paper on some plants from the Hindostan Whetstone Beds.

Jackson (4, 5) published two papers on some Indiana plants. In the earlier paper (4) he published lists of fossils from two locations. In a later paper (5) he published a revised list of plants from the two previous localities and lists from some new localities along with descriptions of the plant fossils.

Benninghoff (2) described a coal ball flora from one mine in Indiana. It is noteworthy that although coal balls are present in a number of Indiana mines there have been very few studies on the floras of these coal balls.

Canright (3) published an extensive work on plant fossils which he collected from 93 localities in Indiana. This study is by far the most informative to date on the Pennsylvanian flora of Indiana.

Wood (22) reported upon a flora contained, primarily, within ironstone concretions from Indiana. These ironstone nodules are common in certain horizons of the Indiana coal formations but up until Wood's paper the floral content of none of these ironstone concretion horizons had been adequately studied.

#### Comparative Floras

The Chieftain No. 20 flora is similar to other floras in Canada and the United States. Bell (1) in his report on the Sydney coalfield flora of Nova Scotia identified two zones—the *Linopteris obliqua* zone (Westphalian C) and the *Ptychocarpus unitus* zone (Westphalian D *sensu* P. Bertrand).

The species common to the Chieftain No. 20 flora and both the *Linopteris obliqua* zone and *Ptychocarpus* zone are nearly identical (Figure 3).

I believe the Chieftain No. 20 flora has a closer relationship to the *Ptychocarpus unitus* zone for the following reasons: *Ptychocarpus unitus* occurs in the Chieftain No. 20 flora; *Linopteris obliqua* does not occur in the Chieftain No. 20 flora; *Ptychocarpus unitus* and *Asterotheca miltoni* are abundant in both the Chieftain No. 20 flora and *Ptychocarpus unitus* zone and; sphenopterids are absent in the Chieftain No. 20 flora and are much reduced in number in the *Ptychocarpus unitus* zone as compared to the abundant sphenopterids in the *Linopteris obliqua* zone.

Bell (1) compared the *Ptychocarpus unitus* zone with the Staffordian and Radstockian floras of Great Britain. He concluded that the *Ptychocarpus unitus* zone most closely resembled the Radstockian floras.

Read and Mamay (17) describe a number of floral zones from Upper Paleozoic formations of the United States. The Chieftain No. 20 flora most closely resembles Zone 10 of Read and Mamay. This is the zone of *Neuropteris flexuosa* and appearance of abundant

*Pecopteris* spp. They classify Zone 10 as the upper part of the Allegheny Formation and lower part of the Conemaugh Formation in the Appalachian region. Read and Mamay (17) state:

"Zone 10, therefore, is best referred to as the zone of appearance of abundant species of *Pecopteris* and can be determined on the basis of this genus only by noting the floral succession in older strata in any sequence of rocks under investigation."

FIGURE 3. *Species common to the Chieftain No. 20 flora and other floras.*

Chieftain No. 20 Flora	Bell (1)			Wood (22)
	<i>Linopteris</i> <i>obliqua</i> zone	<i>Ptychocarpus</i> <i>unitus</i> zone	Stewart (19) Mazon Creek	Stanley Cemetery
<i>Lepidodendron obovatum</i>			X	X
<i>Lepidophyllum longifolium</i>			X	
<i>Lepidostrobophyllum ovatifolius</i>				X
<i>Sigillaria monostigma</i>			X	
<i>S. cf. S. mamillaris</i>		X		
<i>Calamites suckowii</i>	X	X	X	X
<i>Asterophyllites equisetiformis</i>	X	X	X	X
<i>Annularia stellata</i>	X	X	X	X
<i>A. radiata</i>	X	X	X	X
<i>Sphenophyllum emarginatum</i>	X	X	X	X
<i>Asterotheca miltoni</i>	X	X	X	
<i>A. oreopteridia</i>			X	X
<i>A. hemitelioides</i>			X	
<i>Pecopteris squamosa</i>			X	
<i>P. clintoni</i>				X
<i>Ptychocarpus unitus</i>		X	X	
<i>Palmatopteris furcata</i>			X	X
? <i>Dicksonites pluckeneti</i>		X	X	
<i>Senftenbergia pennaeformis</i>	X		X	
? <i>Crossothea sagittata</i>			X	
<i>Odontopteris cf. O. subcuneata</i>	X	X		X
<i>Aphlebia</i> sp.			X	
<i>Neuropteris cf. N. heterophylla</i>	X	X	X	X
<i>N. fimbriata</i>			X	
<i>N. scheuchzeri</i>	X	X	X	X
<i>N. flexuosa</i>	X	X	X	X
<i>N. rarinervis</i>	X	X	X	X
<i>Mariopteris nervosa</i>	X	X		
<i>M. muricata</i>			X	
<i>Cyclopteris trichomanoides</i>			X	
<i>Cordaites cf. C. borassifolius</i>				X
<i>Codonotheca caduca</i>			X	

The preceding quote appears to say that an isolated flora of upper Allegheny or Lower Conemaugh age cannot be precisely dated. Dr. Mamay (personal communication, 1967) explained to me that Zone 10 is difficult to identify for the reason that it is a transitorial phase and there are few if any guide fossils which occur exclusively in the zone.

I believe the Chieftain No. 20 flora falls within the definition of Read and Mamay's Zone 10 for the following reasons: *Neuropteris*

*flexuosa* is present in the Chieftain No. 20 flora, Read and Mamay (17) note that *N. flexuosa* rarely occurs in strata younger than Zone 10 and; approximately one-quarter of the identified specimens from the Chieftain No. 20 flora are pecopterids.

The Mazon Creek flora of Will County, Illinois contains ironstone concretions similar to those found in the Chieftain No. 20 flora. These two floras contain a large number of common species (Figure 3). The Mazon Creek flora was studied by Noé (14), Janssen (6, 7), Stewart (19), and Langford (8, 9).

Stewart (19) reported the species in the Carr and Daniels collections from Mazon Creek. Fortunately he also listed the number of specimens of each species in the collections. Noé (14), Janssen (6, 7), Stewart (19), and Langford (8, 9) all reported on the concretions found in the spoil banks of the coal mines from the area. These concretions are from the Francis Creek Shale just above No. 2 Coal of the Lower Carbondale Group (19).

In the Mazon Creek flora reported by Stewart (19), there are 1039 neuropterid specimens (ca. 27% of the flora), 1764 pecopterid specimens (ca. 44% of the flora), and 71 sphenoterid specimens (ca. 2% of the flora). Clearly the flora was dominated by neuropterids and pecopterids which comprise approximately 70% of the specimens. Just as clearly, the sphenopterids were much reduced in number.

The percentage of neuropterid specimens may not indicate their true percentage in the flora. There are 898 specimens of *Neuropteris scheuchzeri* in the collection but this large number is chiefly detached pinnules and does not necessarily indicate an overabundance of *N. scheuchzeri* in the living flora.

There are a number of common species between the Chieftain No. 20 flora and Wood's (22) Stanley Cemetery flora (Figure 3). Such might be expected since both floras are in the same basin of deposition and not too distantly separated in age. Wood (22) assigned the Stanley Cemetery flora as Upper Pottsville on the basis of its floral composition. There is no doubt that the Chieftain No. 20 flora is younger than the Stanley Cemetery flora. For example, there are many more specimens of *Annularia stellata* than *A. radiata*; *Ptychocarpus unitas* is abundant; and the sphenopterids are absent.

### Plants of the Chieftain No. 20 Flora

#### LEPIDODENDRALES

- Lepidodendron obovatum* Sternberg
- Lepidophloios* cf. *L. laricinus* Sternberg
- Lepidophyllum longifolium* Brongniart
- Lepidostrobophyllum* cf. *L. princeps* (Lesquereux) Hirmer
- L. ovatifolius* (Lesquereux) Hirmer
- L. affine* (Lesquereux) Hirmer
- Bothrodendron minutifolium* Boulay
- Sigillaria monostigma* Lesquereux
- S.* cf. *S. mamillaris* Brongniart
- Stigmaria ficoides* Sternberg

## CALAMITALES

- Calamites suckowii* Brongniart  
*Asterophyllites equisetiformis* (Schlotheim) Brogniart  
*Annularia stellata* (Schlotheim) Wood  
*A. radiata* (Brongniart) Sternberg  
*Macrostachya* sp.

## SPHENOPHYLLALES

- Sphenophyllum emarginatum* Brongniart  
*Sphenophyllostachys* sp.

## PTEROPHYTA AND PTERIDOSPERMALES

- Astrothea miltoni* Artis  
*A. oreopteridia* (Schlotheim) Kidston  
*A. hemitelioides* Brongniart  
*Pecopteris squamosa* Lesquereux  
*P. cisti* Brongniart  
*P. clintoni* Lesquereux  
*Ptychocarpus unitus* (Brongniart) Weiss  
*Palmatopteris furcata* (Brongniart) Potonié  
*?Dicksonites pluckeneti* Schlotheim  
*Senftenbergia pennaeformis* Brongniart  
*?Crossothea sagittata* (Lesquereux) Zeiller  
*Codonothea caduca* Sellards  
*Codonothea?* sp.  
*Odontopteris* cf. *O. subcuneata* Bunbury  
*Aphlebia* sp.  
*Neuropteris* cf. *N. heterophylla* Brongniart  
*N. fimbriata* Lesquereux  
*N. scheuchzeri* Hoffmann  
*N. flexuosa* Sternberg  
*N. rarinervis* Bunbury  
*N. violetta* Langford  
*?Mixoneura jenneyi* D. White  
*Linopteris?* sp.  
*Mariopteris nervosa* (Brongniart) Zeiller  
*M. muricata* (Schlotheim) Zeiller  
*Cyclopteris trichomanoides* Sternberg

## CORDAITALES

- Cordaite* cf. *C. borassifolius* (Sternberg) Unger

## Animals in the Chieftain No. 20 Mine

## ARTHROPODS

## CHELICERATA

- Euroöps danae* (Meek and Worthen)

## CRUSTACEA

- Acanthotelson* cf. *A. stimpsoni* Meek and Worthen  
*Palaeocaris* cf. *P. typus* Meek and Worthen

## INSECTA

undertermined insect

## CORDATE

## PISCES

*Elonichthys hypsilepis* Hay

## Conclusions

The Chieftain No. 20 flora resembles the Lower Allegheny Mazon Creek flora; the *Ptychocarpus unitus* zone of Bell (1) which he though resembled the Radstockian flora of Great Britain; and Zone 10 of Read and Mamay (17) which they placed as Upper Allegheny and Lower Conemaugh.

This flora clearly presents a problem as to its exact age. I believe it is Upper Allegheny Age for the following reasons: 1. The Chieftain No. 20 flora and the Mazon Creek flora have many common species. Therefore it is likely that both floras must have existed at similar times. The number of common species in these two floras is so great that if their stratigraphic relationship was not so well known I would consider the two floras as contemporaneous. 2. Both the Mazon Creek and the Chieftain No. 20 floras are in the same basin of deposition (Eastern Interior Coal Basin). It is likely that they represent two evolving floras subjected to similar environmental conditions. The nearest comparable floras are in eastern Canada and Great Britain. A comparison of the Chieftain No. 20 flora with floras of a thousand and more miles distance can only give speculative results. Undoubtedly the climatic conditions varied in such widely separated areas and the extent of plant migration between the Canadian and American floras is unknown.

## SYSTEMATIC DESCRIPTIONS

Kingdom Plantae  
Division Tracheophyta  
Subdivision Lycopsidea  
Order Lepidodendrales

*Lepidodendron obovatum* Sternberg

Plate 1                      Figure 1

**Remarks.**—Specimens of *Lepidodendron* are rare in the Chieftain No. 20 flora. There are only two specimens of *L. obovatum* Sternberg in this collection. The length of the leaf cushions is less than twice their width. Their ends are obtusely terminated. The leaf cushions of the specimens I have observed have no transverse wrinkles on the lower keel as in *L. aculeatum* Sternberg.

*Lepidophloios* cf. *L. laricinus* Sternberg

Plate 1                      Figure 2

**Remarks.**—This genus is uncommon in Chieftain No. 20 flora. The width of the leaf cushions is two to three times greater than their height. The leaf scars of the Chieftain No. 20 specimens are at the top of the leaf cushions.

*Lepidophyllum longifolium* Brongniart

Plate 1

Figure 6

**Remarks.**—This species is relatively common in the Chieftain No. 20 flora. Complete specimens are very rare but partial ones are easily identified. The blades are narrow, ca.  $\frac{1}{2}$  cm., in relation to their reported length, ca.  $\frac{1}{2}$  m.

*Lepidostrobophyllum* cf. *L. princeps* (Lesquereux) Hirmer

Plate 1

Figure 3

**Remarks.**—This species is rare in the Chieftain No. 20 flora. The specimens are recognized by their lanceolate outline and relatively broad midrib.

*Lepidostrobophyllum ovatifolius* (Lesquereux) Hirmer

Plate 1

Figure 5

**Remarks.**—This species is rare in the Chieftain No. 20 flora. The specimens are small, length ca. 1 cm. and the basal portions are nearly parallel. The sporophyll does not really begin to taper toward the apex in its lower half.

*Lepidostrobophyllum affine* (Lesquereux) Hirmer

Plate 1

Figure 4

**Remarks.**—This species is rare in the Chieftain No. 20 flora. The specimens are about 4 cm long with parallel margins for about three-fourths of their length. In the final quarter, they taper to a blunt apex.

*Bothrodendron minutifolium* Boulay

Plate 1

Figure 7

**Remarks.**—Few specimens of this genus are present in the Chieftain No. 20 flora. Both *Bothrodendron minutifolium* Boulay, and *Lycopodites meekii* Lesquereux are identified in the Pennsylvanian of America. They probably are identical plants. Both were herbaceous lycopods with no diagnostic characters yet recognized that may be used to separate them. Since *B. minutifolium* Boulay is the older name I have used it in this report.

*Sigillaria monostigma* Lesquereux

Plate 1

Figure 9

**Remarks.**—One specimen of this species is in the collection. I have studied Lesquereux's type specimen of *Sigillaria monostigma* in the collection of the U.S. National Museum and it agrees in every detail with the specimen from the Chieftain No. 20 mine.

*Sigillaria* cf. *S. mamillaris* Brongniart

Plate 2

Figure 1

**Remarks.**—One specimen of this species is in the collection. The specimen has a portion of the outer bark preserved as a carbonized compression. *Sigillaria* and *Lepidodendron* specimens are uncommon in the Chieftain No. 20 flora. However, this rarity may only be due to the

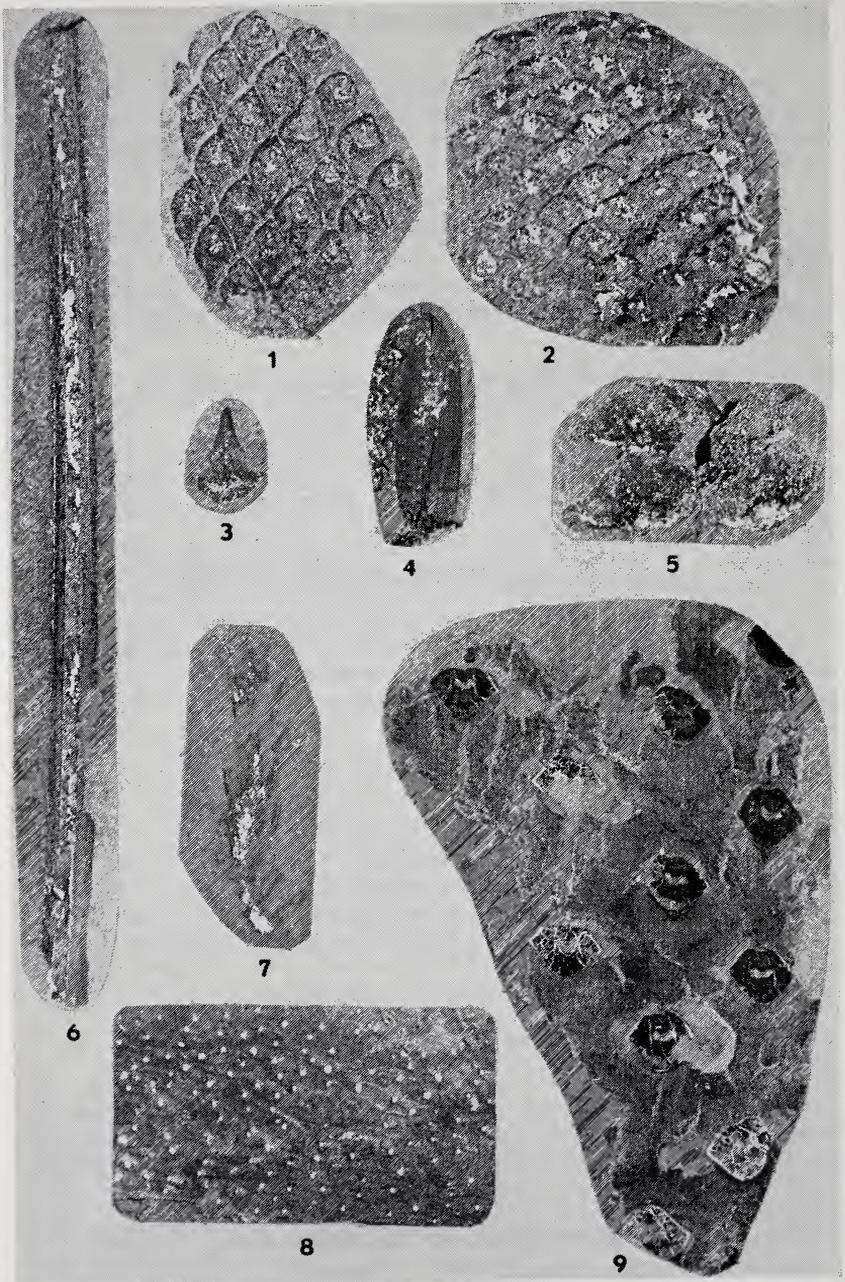


PLATE 1.

fact that most of the material which I found was in the ironstone concretions, an unlikely source of tree-sized material. In the shales, I have seen slabs of bark from both these genera but they were only impressions and could not be collected without destroying them.

*Stigmaria ficoides* Sternberg

Plate 1                      Figure 8

**Remarks.**—One specimen of this genus is in the collection. I have referred the specimen to this species because it has priority over all other species. Since this genus denotes roots, a very conservative organ, it seems unlikely that the various species have much botanical or stratigraphic value.

Subdivision Sphenopsida

Order Calamitales

*Calamites suckowii* Brongniart

Plate 2                      Figure 2

**Remarks.**—One specimen of this genus is in the collection. It is a pith cast of the lower part of a branch.

*Asterophyllites equisetiformis* (Schlotheim) Brongniart

Plate 2                      Figure 4

**Remarks.**—This species is relatively common in the ironstone concretions of the Chieftain No. 20 flora. Since this is the only species of *Asterophyllites* in the flora it is easily recognized by its long, needle-like leaves which are usually as long as, or slightly longer than, the distance between nodes.

*Annularia stellata* (Schlotheim) Wood

Plate 2                      Figure 5

**Remarks.**—Specimens of this species are common in the Chieftain No. 20 flora. The variation in leaf size is pronounced. But since all have the spatulate leaf form characteristic of the species the size difference is probably attributable to growth stages or position on the branch.

*Annularia radiata* (Brongniart) Sternberg

Plate 2                      Figure 6

**Remarks.**—This species is fairly rare in the Chieftain No. 20 flora. The specimens of *Annularia radiata* (Brongniart) may be

FIGURE

1. *Lepidodendron obovatum* Sternberg IUPB 11908
2. *Lepidophloios* cf. *L. laricinus* Sternburg IUPB 11993
3. *Lepidostrobophyllum* cf. *L. princeps* (Lesquereux) Hirmer IUPB 12084
4. *Lepidostrobophyllum affine* (Lesquereux) Hirmer IUPB 12058
5. *Lepidostrobophyllum ovatifolius* (Lesquereux) Hirmer IUPB 12051
6. *Lepidophyllum longifolium* Brongniart IUPB 12079
7. *Bothrodendron minutifolium* Boulay IUPB 12081
8. *Stigmaria ficoides* Sternberg IUPB 12041
9. *Sigillaria monostigma* Lesquereux IUB 12043

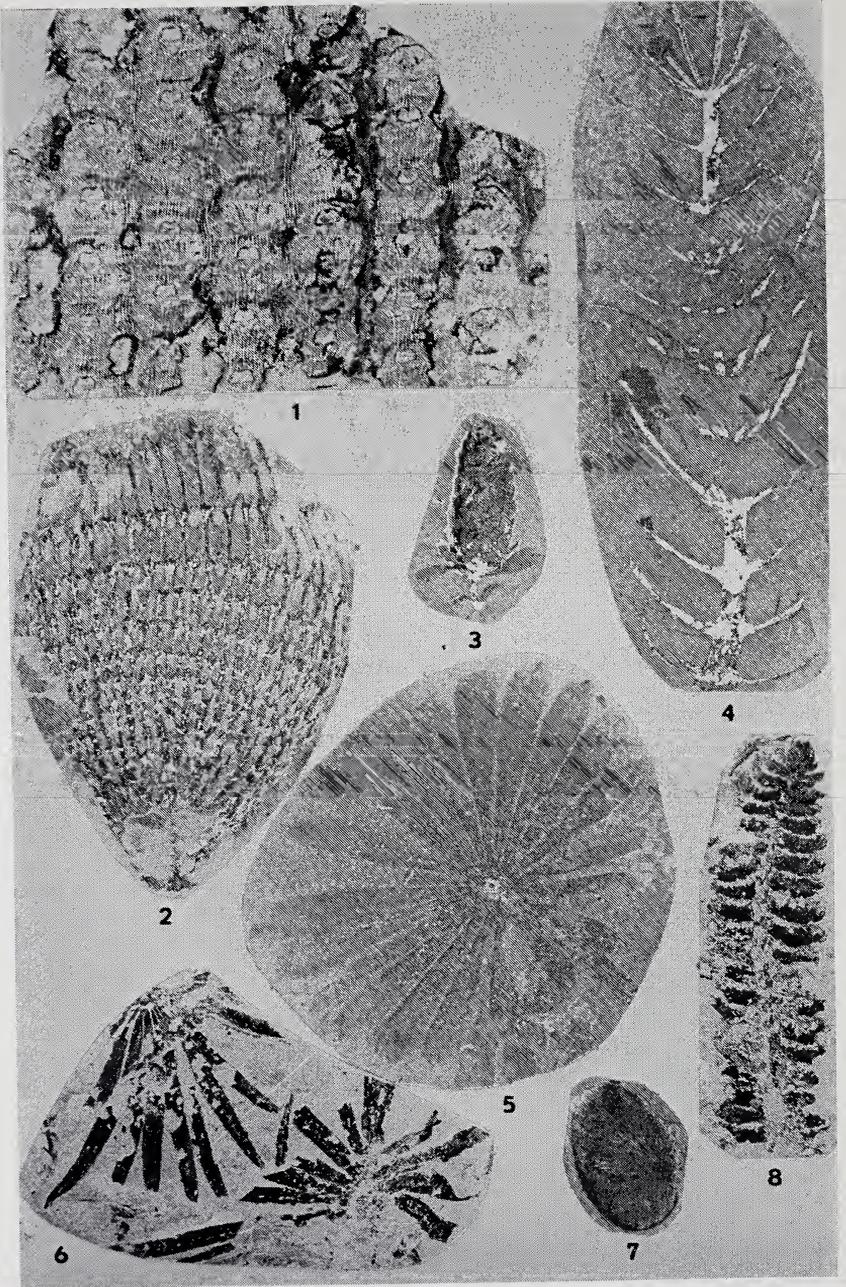


PLATE 2.

readily separated from those of *A. stellata* (Schlotheim). In the Chieftain No. 20 flora, the *A. radiata* (Brongniart) specimens have the sharply tapering tips ascribed to the species. Wood (22) in his study of ironstone concretions from Indiana noted that *A. radiata* (Brongniart) was much more common than *A. stellata* (Schlotheim). This is the opposite of the Upper Allegheny Chieftain No. 20 flora.

*Macrostachya* sp.

Plate 3                      Figure 1

**Remarks.**—One specimen of this genus was found in the Chieftain No. 20 flora. It is incomplete but easily recognized by its large size as compared to other calamite fructifications.

Order Sphenophyllales

*Sphenophyllum emarginatum* Brongniart

Plate 3                      Figure 2

**Remarks.**—This species is common in the Chieftain No. 20 flora. It is easily recognized since it is the only species of *Sphenophyllum* present. The leaves have rounded serrations characteristic of *S. emarginatum* Brongniart rather than the pointed serrations of *S. cuneifolium* (Sternberg) Zeiller. In this flora the leaves of this species are often slightly cleft at midmargin.

*Sphenophyllostachys* (?) sp.

Plate 2                      Figure 3

**Remarks.**—I found two specimens of this genus in the Chieftain No. 20 flora. Both are poorly preserved, only their outline is discernible. Possibly they are fructifications of *Sphenophyllum emarginatum* Brongniart since *S. emarginatum* Brongniart is the only sphenopsid found thus far in the flora, and the leaves attached to the cones appear to be those of *S. emarginatum* Brongniart. Until better preserved material is available I prefer to questionably assign the fructifications to the genus *Sphenophyllostachys* (?).

Orders Pterophyta and Pteridospermales

*Asterotheca miltoni* Artis

Plate 3                      Figure 3

**Remarks.**—This is one of the most common species in the Chieftain No. 20 flora. On some of the specimens, pinnules of *Asterotheca miltoni*

FIGURE

1. *Sigillaria* cf. *S. mamillaris* Brongniart IUPB 12037
2. *Calamites suckowii* Brongniart IUPB 12046
3. *Sphenophyllostachys* ? sp. IUPB 12055
4. *Asterophyllites equisetiformis* (Schlotheim) Brongniart IUPB 12056
5. *Annularia stellata* (Schlotheim) Wood IUPB 12075
6. *Annularia radiata* (Brongniart) Sternberg IUPB 12095
7. *Cyclopteris trichomanoides* Sternberg IUPB 12053
8. *Linopteris* ? sp. IUPB 12067

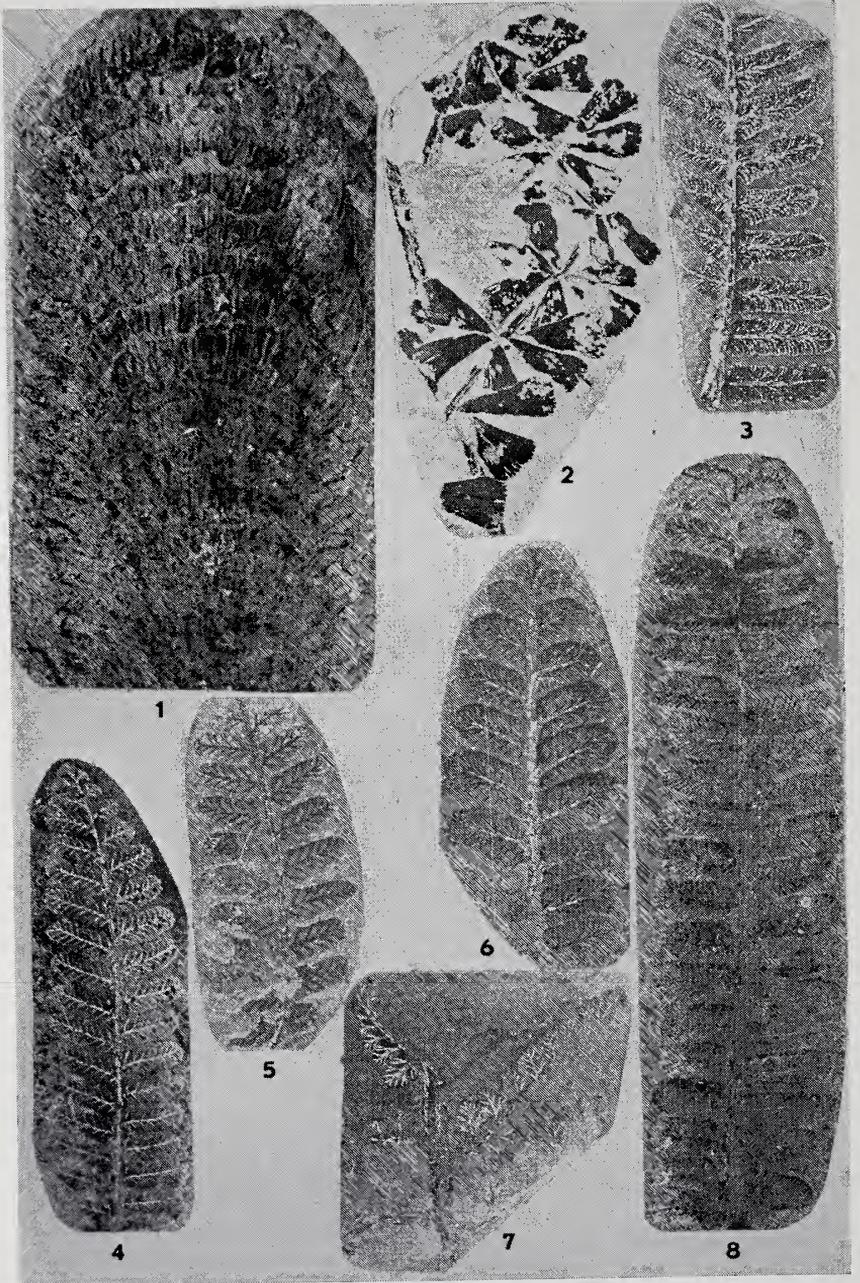


PLATE 3.

Artis and pinnules of what appears to be *Pecopteris vestita* Lesquereux are attached to the same rachis. It seems likely that these two species with identical venation patterns are different leaf forms of a single species. Since *A. miltoni* Artis is the older taxon I have used it in this paper. The venation of this species is not constant, generally the veinlet forks once after leaving the midrib and only the upper form divides again near the margin. However, in some specimens the lower fork will also divide near the margin.

*Asterotheca oreopteridia* (Schlotheim) Kidston

Plate 3                      Figure 5

**Remarks.**—This species is fairly common in the Chieftain No. 20 flora. The veinlets fork only once after leaving the midrib. The outline of this species is similar to that of *Asterotheca miltoni* Artis. Indeed, when the venation pattern of the pinnules is obscured, the two species cannot be separated.

*Asterotheca hemitelioides* Brongniart

Plate 3                      Figure 4

**Remarks.**—This species is fairly common in the Chieftain No. 20 flora. The pinnules are relatively long for this genus and have a blunt apex. The venation is distinctive. The veinlets are quite broad and do not fork after leaving the midrib. In this flora, a high percentage of the specimens have veinlets filled with a white material which is probably one of the clay group minerals.

*Pecopteris clintoni* Lesquereux

Plate 3                      Figure 8

**Remarks.**—This species is rare in the Chieftain No. 20 flora. The venation of this species is the same as *Pecopteris cisti* Brongniart. However the pinnules of *P. clintoni* Lesquereux are about twice as long as broad.

*Pecopteris cisti* Brongniart

Plate 3                      Figure 6

**Remarks.**—This species is rare in the Chieftain No. 20 flora. The distinguishing character of this species is the pinnules which are only slightly longer than they are broad. The pinnules are broadly ovate with the widest portion near their midmargin. Each veinlet forks once near the midrib and each fork divides again near the margin.

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FIGURE

1. *Macrostachya* sp. IUPB 11953
2. *Sphenophyllum emarginatum* Brongniart IUPB 12068
3. *Asterotheca miltoni* Artis IUPB 12094
4. *Asterotheca hemitelioides* Brongniart IUPB 12087
5. *Asterotheca oreopteridia* (Schlotheim) Kidston IUPB 12057
6. *Pecopteris cisti* Brongniart IUPB 12088
7. *?Dicksonites pluckeneti* Schlotheim IUPB 12086
8. *Pecopteris clintoni* Lesquereux IUPB 11976

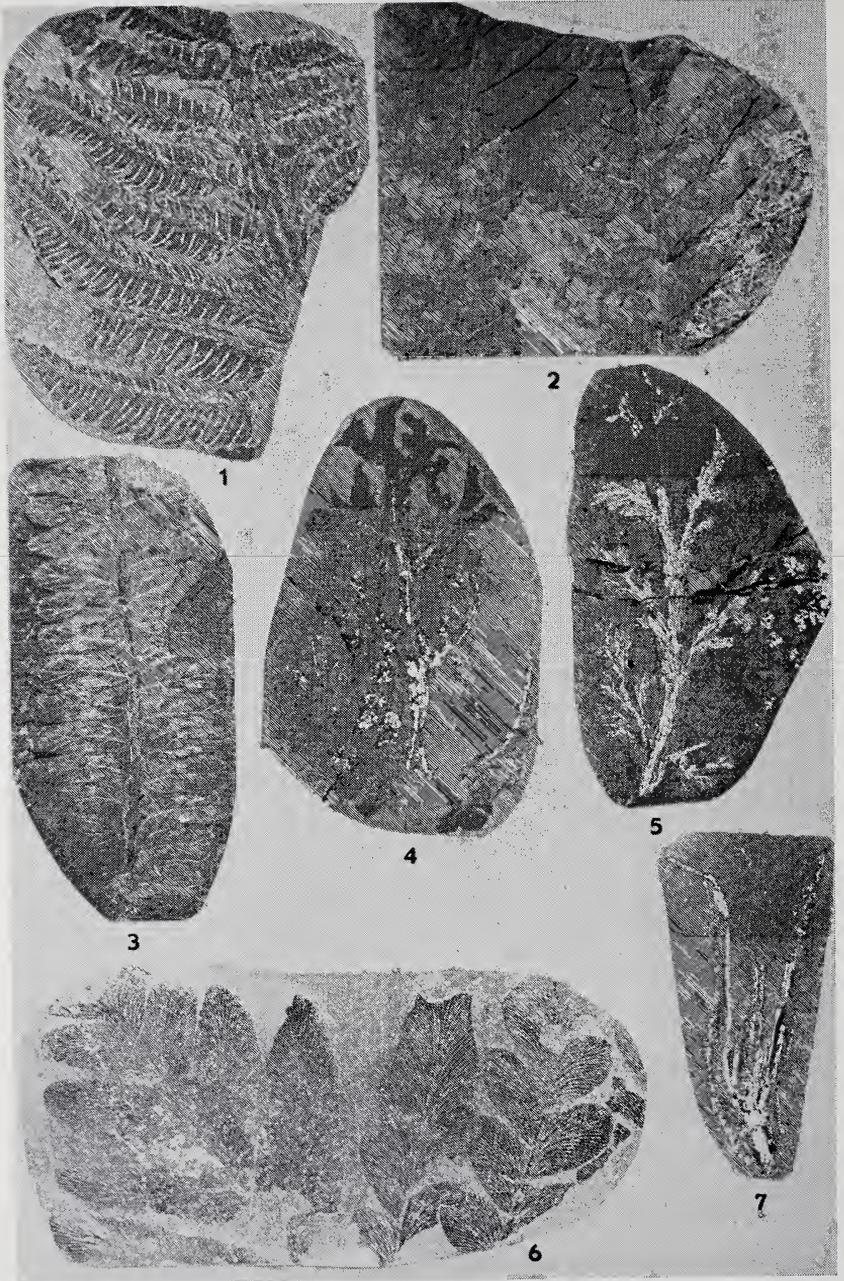


PLATE 4.

*Pecopteris squamosa* Lesquereux

Plate 4

Figure 1

**Remarks.**—This species is rare in the Chieftain No. 20 flora. The specimens have a thick rachis which is more or less covered by small scales. The pinnae which branch from the rachis are long and thin with numerous small pinnules. The pinnules have a midrib but usually have no veinlets. The feather-like appearance of the specimens make this species an easy one to recognize.

*Ptychocarpus unitus* (Brongniart) Weiss

Plate 4

Figure 3

**Remarks.**—This is one of the most common species in the Chieftain No. 20 flora. All of the specimens, except two, are sterile forms. The pinnules of this species may be united only near their base or the union may extend somewhat past their midmargins. The sterile leaflets have two venation patterns. In those pinnules which are united near their base, the veinlets are simple and leave the midrib opposite each other. In the pinnules which are united near their midmargins or beyond, the simple veinlets emerge alternately from the midvein and arch concavely to the upper margin.

The pinnules of both the fertile specimens have concave-arched, simple veinlets. The illustrated specimen (Plate 4 Figure 3) does not have sori on every pinnule. Possibly it is an immature form.

*Palmatopteris furcata* (Brongniart) Potonié

Plate 4

Figure 4

**Remarks.**—This species is rare in the Chieftain No. 20 flora. The specimens have deeply dissected pinnules which contribute to the palmate outline of the species. The midrib of each pinnule is prominent. It forks several times and a number of veinlets emerge from the midrib to extend the entire length of each pinnule segment. The segments have acutely pointed tips. Janssen (6), Stewart (19) and Langford (8) report the occurrence of *Diplothemema furcatum* (Brongniart) Stur in collections from Mazon Creek. I agree with White's discussion of Potonié's use of *Palmatopteris* for certain species formerly placed in the genus *Diplothemema* (21, p. 93-94) and so feel that *D. furcatum* (Brongniart) Stur should be dropped in favor of *Palmatopteris furcata* (Brongniart) Potonié.

## FIGURE

1. *Pecopteris squamosa* Lesquereux IUPB 12074
2. *Senftenbergia pennaeformis* Brongniart IUPB 12073
3. *Ptychocarpus unitus* (Brongniart) Weiss IUPB 12090
4. *Palmatopteris furcata* (Brongniart) Potonié IUPB 12085
5. *Aphleba* sp. IUPB 12092
6. *Odontopteris* cf. *O. subcuneata* Bunbury IUPB 12031
7. *?Codonotheca* sp. IUPB 12049

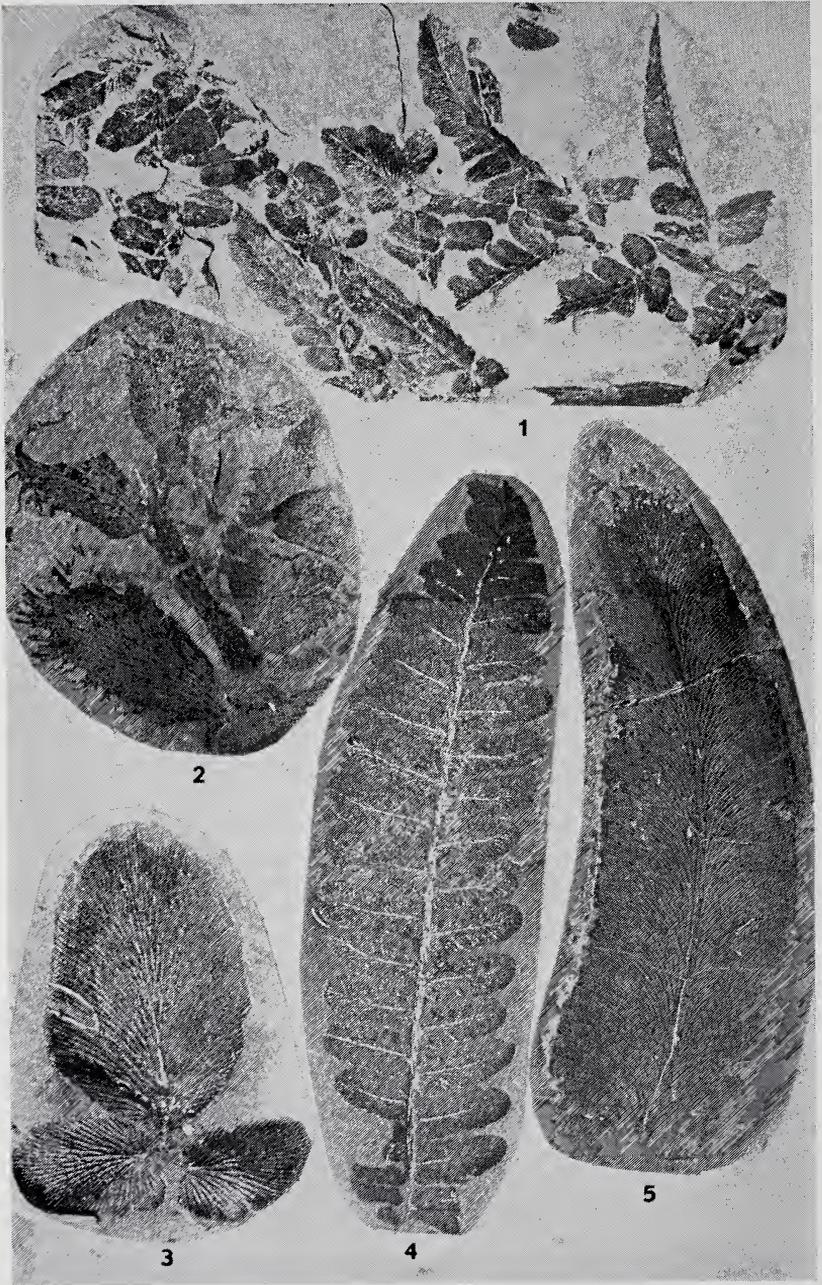


PLATE 5.

*? Dicksonites pluckeneti* Schlotheim

Plate 3

Figure 7

**Remarks.**—One incomplete specimen of what appears to be *Dicksonites pluckeneti* Schlotheim is present in the collection of the Chieftain No. 20 flora. The pinnules are nearly equal in length and width with a rounded apex. Each pinnule has a distinct midrib from which a number of simple veinlets depart and continue to the margin. The identification of this specimen must be considered tentative at this time.

*Senftenbergia pennaeformis* Brongniart

Plate 4

Figure 2

**Remarks.**—One specimen of this species is in the collection of the Chieftain No. 20 flora. The pinnules have a triangular shape but are longer than those reported for *Dactylotheca plumosa* (Artis) Zeiller whose outline *Senftenbergia pennaeformis* Brongniart otherwise resembles. The venation pattern is of two types. In some pinnules, simple veinlets branch from the midrib. In other pinnules, the veinlets fork once as they approach the margin.

*?Crossotheca sagittata* (Lesquereux) Zeiller

Plate 6

Figure 6

**Remarks.**—One small specimen of this species is present in the material from the Chieftain No. 20 flora. The specimen appears to be the top of an immature pinna. The pinnules are quite small and were it not for the fact that *Crossotheca sagittata* (Lesquereux) has such a characteristic form I would not have attempted to tentatively name this specimen.

*Odontopteris* cf. *O. subcuneata* Bunbury

Plate 4

Figure 6

**Remarks.**—One specimen of what appears to be *Odontopteris subcuneata* Bunbury is in the Chieftain No. 20 collection. The specimen is not complete but it agrees in all respects with a specimen in the U.S. National Museum identified by Lesquereux as *O. subcuneata* Bunbury.

*Aphleba* sp.

Plate 4

Figure 5

**Remarks.**—I found two specimens of this genus in the Chieftain No. 20 flora. Both are fragments preserved in ironstone concretions. It is not possible to identify either of these specimens to species since they are incomplete.

## FIGURE

1. *Neuropteris* cf. *N. heterophylla* Brongniart IUPB 12077
2. *Neuropteris fimbriata* Lesquereux IUPB 12076
3. *Neuropteris violetta* Langford IUPB 12014
4. *Neuropteris flexuosa* Sternberg IUPB 12089
5. *Neuropteris scheuchzeri* Hoffman IUPB 12070

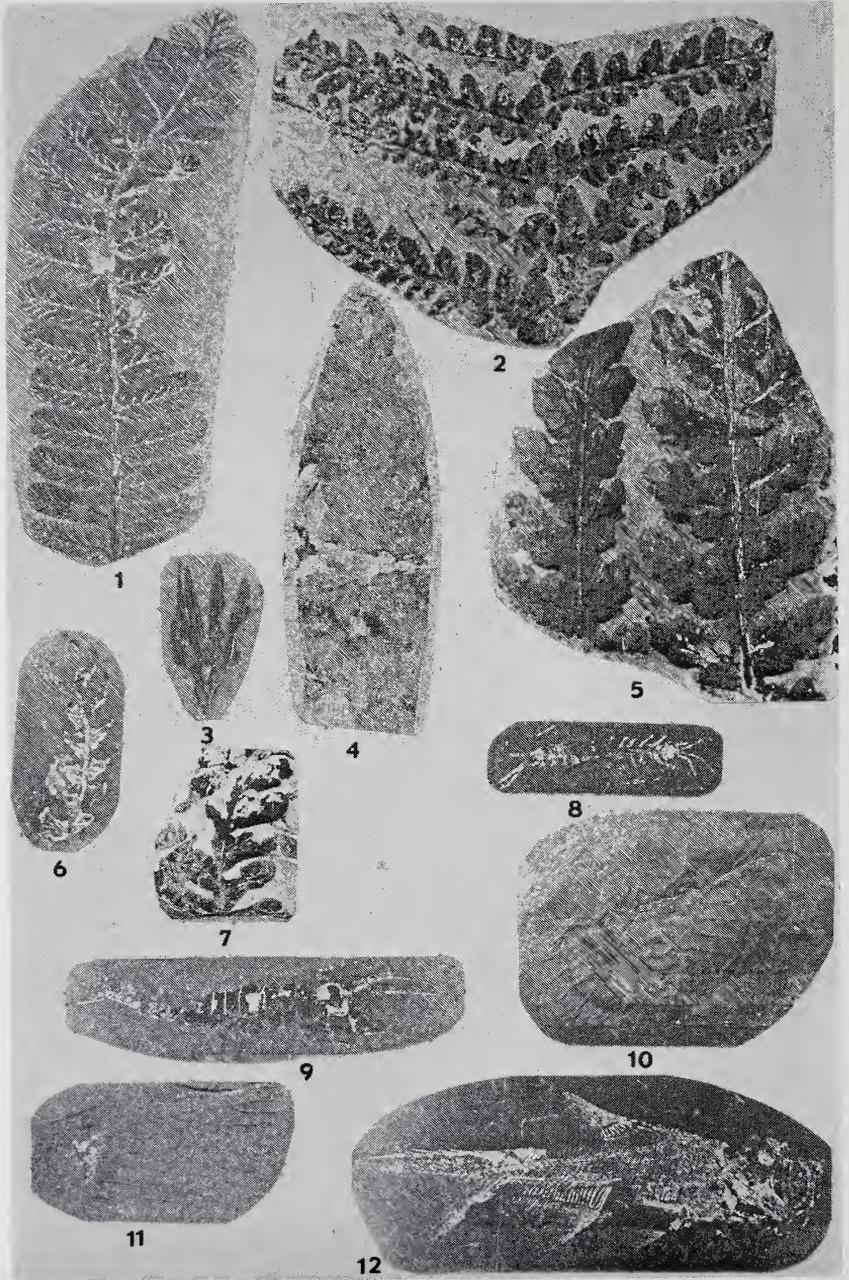


PLATE 6.

*Neuropteris* cf. *N. heterophylla* Brongniart

Plate 5

Figure 1

Remarks.—One specimen, broken into several parts, is present in the Chieftain No. 20 collection. The specimen is not sufficiently complete for certain identification.

*Neuropteris fimbriata* Lesquereux

Plate 5

Figure 2

Remarks.—One specimen of *Neuropteris fimbriata* Lesquereux is present in the Chieftain No. 20 collection. This species is easily identified by the fringed margins of the pinnules.

*Neuropteris scheuchzeri* Hoffmann

Plate 5

Figure 5

Remarks.—This is the most common neuropterid species in the Chieftain No. 20 flora. It is quite possible that the large number of specimens in the collection may not be indicative of the percentage of individual plants in the living flora since there is only one pinnule in each concretion. If the size of pinnules are a true indication of the size of the rachis then *Neuropteris scheuchzeri* Hoffmann must have been a large plant with many pinnules per frond. These pinnules must have been easily detached and some were preserved in ironstone concretions.

*Neuropteris flexuosa* Sternberg

Plate 5

Figure 4

Remarks.—This species is rare in the Chieftain No. 20 flora. The Chieftain No. 20 flora most closely resembles Zone 10 of Read and Mamay (17) in that there are many pectopterid species present. However they also say that *Neuropteris flexuosa* Sternberg is abundant in Zone 10. This is not the case in the Chieftain No. 20 flora. Apparently *N. flexuosa* Sternberg was a minor element in this flora.

*Neuropteris rarinervis* Bunbury

Plate 6

Figure 1

Remarks.—This species is rare in the Chieftain No. 20 flora. The venation of this species is so distinctive that one is not likely to

## FIGURE

1. *Neuropteris rarinervis* Bunbury IUPB 12065
2. *Mariopteris nervosa* (Brongniart) Zeiller IUPB 12059
3. *Codonotheca caduca* Sellards IUPB 12063
4. *Cordaites* cf. *C. borassifolius* (Sternberg) Unger IUPB 12078
5. *Mariopteris muricata* (Schlotheim) Zeiller IUPB 12121
6. *?Crossotheca sagittata* (Lesquereux) Zeiller IUPB 12062
7. *?Mixoneura jenneyi* D. White IUPB 12069
8. *Acanthotelson* cf. *A. stimpsoni* Meek and Worthen IUPB 12080
9. *Palaeocaris* cf. *P. typus* Meek and Worthen IUPB 12082
10. *Euproöps danae* (Meek and Worthen) IUPB 12071
11. *Palaeodictyoptera* IUPB 12064
12. *Elonichthys hypsilepis* Hay personal collection of D. Barkley

confuse *Neuropteris rarinervis* Bunbury with any other neuropterid species.

*Neuropteris violetta* Langford

Plate 5

Figure 3

**Remarks.**—One specimen of this species is in the Chieftain No. 20 collection. As in the other *Neuropteris* species, the pinna is attached to the rachis by a narrow stem. The pinna is composed of a pair of small, rounded to ovate pinnules near the rachis and a relatively large tapering terminal pinnule. The venation of the pinnules forks two or occasionally three times and meets the leaf margin at an acute angle. This species bears a superficial likeness to *Neuropteris scheuchzeri* Hoffmann. However, the terminal pinnule is not as long as that of *N. scheuchzeri* Hoffmann and *N. violetta* Langford is not hirsute.

? *Mixoneura jenneyi* D. White

Plate 6

Figure 7

**Remarks.**—One specimen of this genus is present in the Chieftain No. 20 collection. The pinnules are attached to the rachis by their entire lower margin and have a mariopterid type of venation. That is the veinlets branch from the bundle of veinlets which resembles a midrib and also directly from the rachis.

*Linopteris* ? sp.

Plate 2

Figure 8

**Remarks.**—This genus is rare in the Chieftain No. 20 flora. A few isolated pinnules appear to have anastomosing veinlets over the entire surface. The preservation is poor so that I can only assign these specimens questionably to the genus *Linopteris*.

*Mariopteris nervosa* (Brongniart) Zeiller

Plate 6

Figure 2

**Remarks.**—This species is rare in the Chieftain No. 20 flora. The pinnules have a triangular outline, are attached to the rachis by their entire lower margin and some are united near their bases. Each pinnule has a distinct midrib from which veinlets branch and may or may not fork once before reaching the leaf margin. The margins are entire.

*Mariopteris muricata* (Schlotheim) Zeiller

Plate 6

Figure 5

**Remarks.**—This species is rare in the Chieftain No. 20 flora. The pinnules are dentate, are attached to the rachis by their entire lower margin and are united near their base. One veinlet enters each dentation of the pinnule from the midrib. The venation pattern and dentate leaf margin separates *Mariopteris muricata* (Schlotheim) from *M. nervosa* (Brongniart).

*Cyclopteris trichomanoides* Sternberg

Plate 2

Figure 7

**Remarks.**—This genus is fairly rare in the Chieftain No. 20 flora. A number of species have been assigned to *Cyclopteris* but few

of the isolated specimens are assignable to a given species of *Neuropteris*. The various cyclopterid species have little, if any, stratigraphic value and probably no taxonomic value. It is even possible that more than one form species of *Cyclopteris* may have grown on a single species of *Neuropteris*. Since *C. trichomanoides* Sternberg has priority over all other cyclopterid species, I have used this name exclusively.

*Codonotheca caduca* Sellards

Plate 6                      Figure 3

**Remarks.**—One specimen of this species is in the Chieftain No. 20 collection. It has the characteristically united sporangia but, unfortunately, there are no pollen grains on or surrounding the specimen. Also, the cup portion is missing.

? *Codonotheca* sp.

Plate 4                      Figure 7

**Remarks.**—These specimens are rare in the Chieftain No. 20 flora. They appear to be united sporangia of the *Codonotheca*-type. The sporangia (?) are tubular rather than flattened by compression. They are not attached to a cup-like portion and may never have been. I have questionably assigned them to the genus *Codonotheca*.

Class Coniferophyta

Order Cordaitales

*Cordaites* cf. *C. borassifolius* (Sternberg) Unger

Plate 6                      Figure 4

**Remarks.**—Numerous fragments of *Cordaites* leaves are present in the Chieftain No. 20 flora. For the most part, these fragments are not well preserved. One specimen has the outline of the leaf tip preserved. The specimen appears to be *Cordaites borassifolius* Sternberg, but since the venation is partially obscured I cannot be positive of the identification.

Kingdom Animalia

Phylum Arthropoda

Subphylum Chelicerata

Order Limulida

*Euproöps danae* (Meek and Worthen)

Plate 6                      Figure 10

**Remarks.**—Two specimens of this species are in the Chieftain No. 20 collection. They were given to me by Mr. Daniel Barkley of Terre Haute, Indiana. The figured specimen is the better of the two. It shows the wide head-shield, the curving post-ophthalmic ridges and the fringed, body outline. Unfortunately the telson is missing.

Subphylum Crustacea

Class Malacostraca

Subclass Syncarida

*Acanthotelson* cf. *A. stimpsoni* Meek and Worthen

Plate 6                      Figure 8

**Remarks.**—One specimen of this species is in the Chieftain No. 20 collection. The specimen has only three spines in its tail, the middle one is the telson, whereas *Acanthotelson stimpsoni* Meek and Worthen has five spines. Possibly this specimen lost two of its spines. All of the thoracic segments visible are equal in length.

*Palaeocaris* cf. *P. typus* Meek and Worthen

Plate 6

Figure 9

**Remarks.**—This species is the most common animal in the Chieftain No. 20 collection. The tail of *Palaeocaris typus* Meek and Worthen is in five parts. A broad telson is flanked by two pair of equally broad uropods. Unfortunately none of the specimens have well preserved tail sections. *P. typus* Meek and Worthen sometimes has an enlarged sixth thoracic segment. Nearly all of the Chieftain No. 20 specimens have such an enlarged sixth thoracic segment.

Subphylum Insecta

Order Palaeodictyoptera

Plate 6

Figure 11

**Remarks.**—One of the concretions in the Chieftain No. 20 collection contains part of an insect wing. The wing fragment shows large branching veins with a fine network of smaller veins. Dr. E. S. Richardson, Jr. has identified this specimen but does not feel justified in naming it below the level of order due to its incomplete form.

Phylum Cordata

Class Pisces

Order Crossopterygii

Family Palaeoniscidae

*Elonichthys hypsilepis* Hay

Plate 6

Figure 12

**Remarks.**—One specimen of this species was found at the Chieftain No. 20 mine by Mr. Daniel Barkley of Terre Haute, Indiana. It is in his personal collection. Dr. T. Covender identified this specimen.

Plates 1-6

Magnification of all figures is x1. All the specimens, with one exception, are in the Indiana University Paleobotany Collection (IUPB) stored at the Department of Botany. The one exception is *Elonichthys hypsilepis* Hay which is in the personal collection of Mr. Daniel Barkley, R. R. 24, Terre Haute, Indiana.

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