PRELIMINARY REPORT ON FOSSIL PLANTS FROM THE CHESTER SERIES (UPPER MISSISSIPPIAN) OF ILLINOIS

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ABSTRACT. — Numerous localities at various geological horizons in the Chester Series (Upper Mississippian) of southern Illinois have yielded a diverse flora preserved as extensive impressions, compressions including cuticle, and pyrite petrifactions. Included are: *Lepidodendron veltheimii, L. volkmannianum,* and *L.* sp. with attached foliage, *Lepidostrobus, Lepidostrobophyllum, Stigmaria ficoides, S. stellata, Archaeocalamites* including attached foliage and cones, *Fryopsis, Rhodea, Sphenopteris, Sphenopteridium, Adiantites, Botryopteris,* c.f. *Telangium, Rhynchogonium, Trigonocarpus.* This flora provides important floristic, morphological, and anatomical information about Upper Mississippian plants of North America.

Knowledge of Upper Mississippian vascular plants from North America is very incomplete. Most previous reports (Nóe, 1923; White, 1937a, 1937b; Bell, 1944; Read, 1955; Arnold and Sadlick, 1962) have dealt with small collections of rather fragmentary impressions-compressions. Well preserved compressions (Eggert and Taylor, 1968; Taylor and Eggert, 1968b) are still largely undescribed. The only previously described petrified plants from the North American Upper Mississippian have come from northwestern Arkansas (Mapes, 1966; Taylor and Eggert, 1967a, 1967b, 1968a).

Despite the presence of a well developed Upper Mississippian (Chesterian) stratigraphic sequence in Illinois, the published record of fossil plants in these rocks is scant. Early work by Lesquereux (1866; 1870) included a description of a few sandstone casts. Subsequently, Janssen (1940) restudied certain of Lesquereux's specimens, and made several revisions. Recently, Lacey and Eggert (1964) made further revisions based on Lesquereux's published figures and, after subsequent collecting, added four new taxa. The list of Chester plant from Illinois reported in these papers includes: *Lepidodendron volkmannianum, L. veltheimii, Stigmaria ficoides, S. stellata, Bergeria* sp., *Knorria imbricata, Archaeocalamites radiatus, Megaphyton frondosum, Dictyoxylon, Rhynchogonium fayettevillense,* and *Trigonocarpus* sp. It should be emphasized that all of this material previously described has consisted of structureless sandstone casts and molds of the resistant plant parts, and that the more delicate plant parts, particularly foliage, have been conspicuously absent. Recent collecting indicates that the Chester flora of Illinois is considerably more diverse than the previous literature shows. The present paper describes representative examples illustrating the major groups of plants present in the flora and the various modes of preservation encountered.

Stratigraphic Occurrence

The Chester Series in southern Illinois is a sequence of strata, primarily shale, sandstone, and limestone, that reaches a maximum aggregate thickness of approximately 1400 feet (Atherton et al., 1960). The Chester is subdivided into 20 formational units (Fig. 24) according to the most recent classification (Swann, 1963). With the exception of the Grove Church Formation, these units are all named for either their included sandstone or limestone, which often possess distinguishable lithologic characters and outcrop fairly frequently, rather than for their included shale, although this constitutes about half of the series (Potter, 1963). Although plant fossils occur in all three lithologies, the well preserved compressions and petrifactions come largely from shale associated with the sandstone formations. Individual localities are somewhat isolated; however, intensive field work has revealed them to be widespread, both stratigraphically (Fig. 24) and geographically (Fig. 25). Thus far, plant material has come from thirty-three localities in southern Illinois, whose stratigraphic determinations are based on Lamar (1925); Weller and Weller (1939); Weller and Krey (1939); Baxter and Desborough (1965); Amos (1966); Baxter, Desborough and Shaw (1967); and Knight (1968). Terminology follows that presented by Swann (1963) and terminology used in the older reports has been revised in accordance with this.

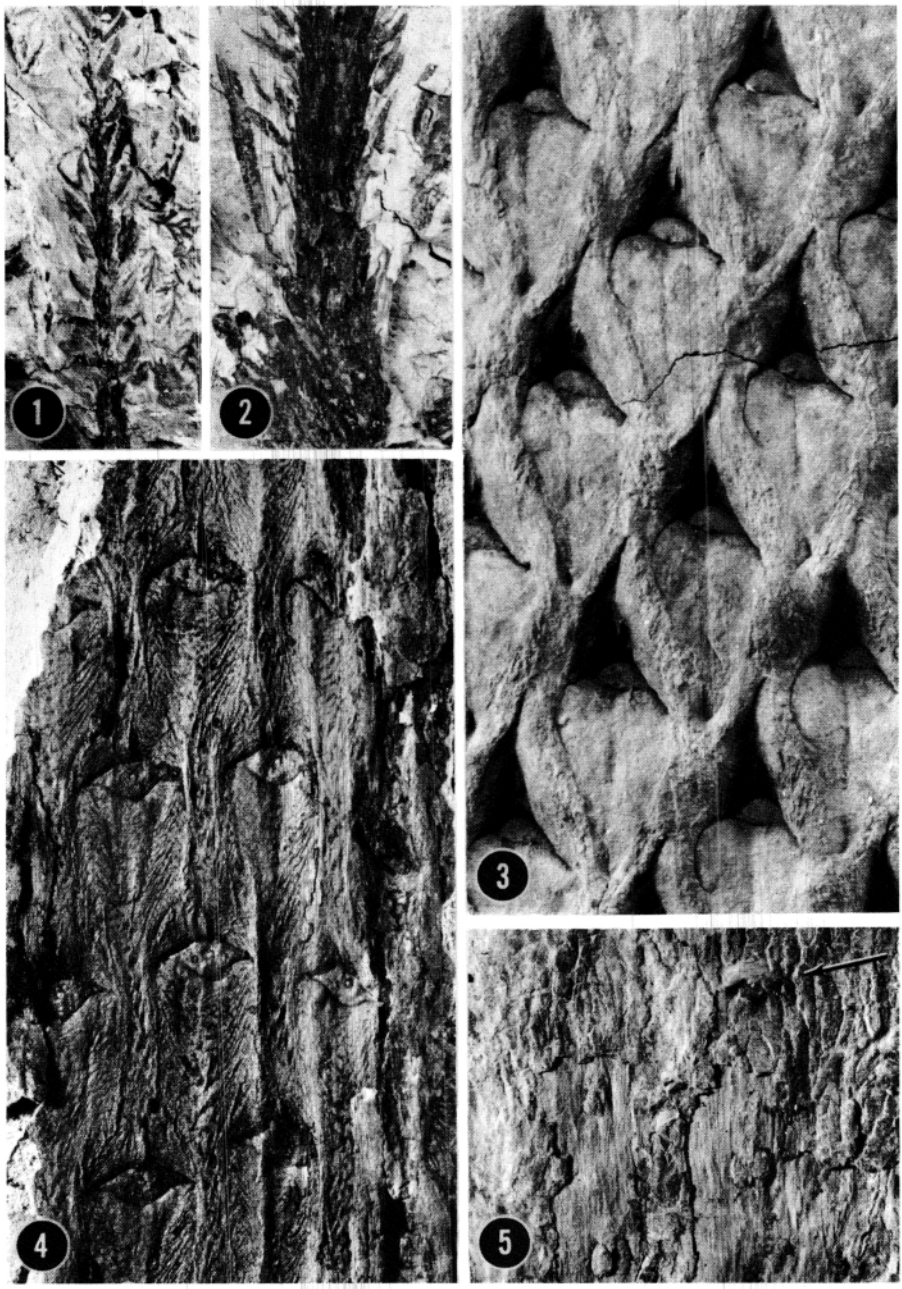
Formations that have yielded fossil plants are indicated by arrows in Fig. 24. Although floras occur from the Bethel Formation near the base, to the Grove Church at the top of the Series, the most important collections have been taken from the Cypress, Hardinsburg, Tar Springs, Waltersburg, Palestine, Degonia, and Grove Church Formations. Of these formations, the Waltersburg is the most important source of petrifactions to date.

Materials and Techniques

Compression specimens illustrated in this paper were photographed dry, since xylene causes most of the plant-bearing shales to disintegrate. The structurally preserved specimens are preserved as pyrite-marcasite petrifactions, occurring either in nodular structures or as isolated axes embedded in the shale. Petrified specimens were embedded in plastic prior to sectioning. After sectioning, the petrified specimens were polished, and etched in nitric acid to increase contrast.

Description and Discussion

The flora of the Chester Series of Illinois contains a relatively large number of plant forms in comparison with most floras of comparable age from North America. These remains represent several major groups of vascular plants. Arborescent lycopods are well represented by remains of both vegetative and reproductive organs. Impressions of large stems of *Lepidodendron veltheimii* Sternberg (Fig. 3) are most commonly found in sandstone. The figured specimen retains much of the original surface relief and shows the



FIGURES 1, 2. Representative branches of tree sized lycopods with attached leaves. X 1. FIGURE 3. Impression specimen showing characteristic leaf bases of *Lepidodendron veltheimii*. X 2. FIGURE 4. Stem surface pattern of *Lepidodendron volkmannianum* with longitudinally elongate leaf bases in vertical rows. X 2. FIGURE 5. A developmentally old specimen of *Lepidodendron volkmannianum* showing a leaf scar (at arrow) and *Syringodendron*-type subsurface features beneath. X 1.5.

elongate leaf cushions (more than twice as long as they are wide) and the leaf scars which are considerably elevated above the surrounding surface. *Lepidodendron volkmannianum* Sternberg is represented by a large number of branches of various sizes. Figure 4 illustrates a representative specimen showing the characteristic features of the species. Of special interest is a specimen of *L. volkmannianum* shown in Fig. 5 having distantly spaced leaf scars (at arrow) separated by regions of shallow, irregular furrows. The surface pattern of this specimen is interpreted as representing *Lepidodendron volkmannianum* in which the features of the leaf cushion were obscured by the growth of secondary tissue (Lacey & Eggert, 1964). Careful removal of some of the surficial carbon revealed a *Syringodendron* Sternberg subsurface pattern visible in the lower portion of Fig. 5. This apparently represents the first report of a *Lepidodendron* that produced *Syringodendron*-type subsurface features. In contrast to these developmentally old specimens, some of the smaller, presumably more distal branches retain attached leaves (Fig. 1, 2). Reproductive organs of the tree-sized lycopods include cones referred to *Lepidostrobus* Brongniart (Fig. 7) and at least two types of isolated sporophylls. One of these forms of *Lepidostrobophyllum* Hirmer with a lanceolate distal lamina is shown in Fig. 8. *Stigmaria* Brongniart is present both as petrified steles (Fig. 9) and either 3-dimensional casts or flattened impressions in sandstone or shale (Fig. 6, 10, 11). The latter types generally correspond to *S. ficoides* Brongniart (Fig. 6) or *S. stellata* Goeppert (Fig. 11). However, certain specimens that otherwise correspond to *S. ficoides*, occasionally show scars that are surrounded by radiating ridges which are identical to those that characterize *S. stellata* (Fig. 6 and Fig. 10 at arrows). The reticulate pattern that lies between the scars on typical *S. stellata* specimens is either absent or obscure on such casts. The obscurity of this pattern is believed to result from lack of preservation since the typical specimens of *S. stellata* occurring in shale show a well-developed reticulate pattern between the scars while those present in the coarser sandstones do not.

The sphenopsids are represented by *Archaeocalamites* Stur, which was apparently widespread in North America (White, 1937a, 1937b; Bell, 1944, 1960; Arnold and Sadlick, 1962; Lacey and Eggert, 1964; Taylor and Eggert, 1968e) but remains poorly known inasmuch as all of this previously described material consists of structureless casts and impressions. In contrast, specimens of this genus from Chesterian shales in Illinois consist of compressions, petrifactions, or combinations of these two modes of preservation. Stems are found at most shale localities and many of these bear leaves (Fig. 12) which have not previously been demonstrated to be present in material of this genus from rocks of Mississippian age in North America. One to three dichotomies have been observed in the leaves. Cones borne in a whorl are shown attached to *Archaeocalamites* for the first time in North America (Fig. 14). The cone axis lacks any apparent hori-

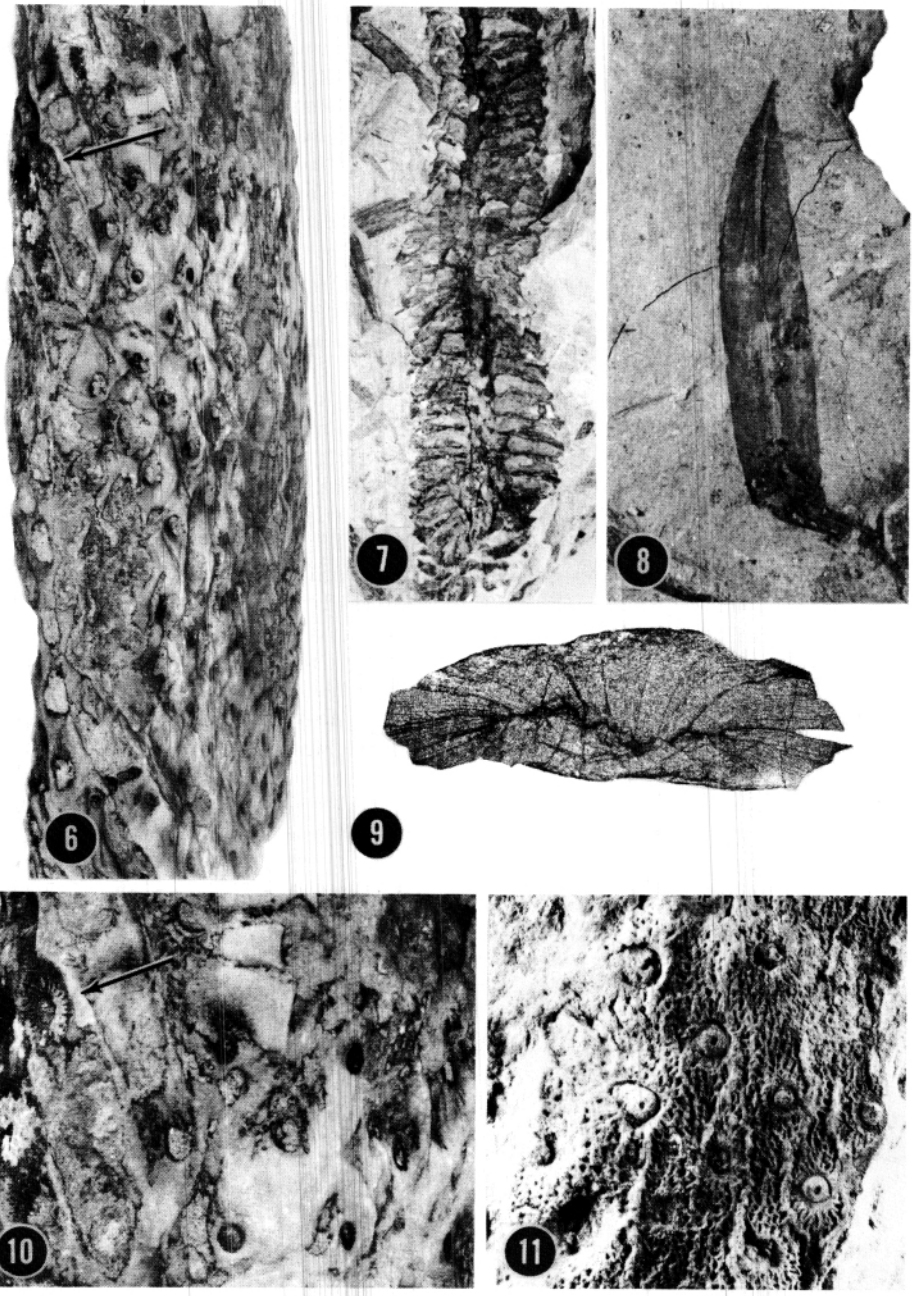


FIGURE 6. Sandstone cast specimen of *Stigmaria ficoides* with a scar of the *Stigmaria stellata* type (at arrow). X 0.5. FIGURE 7. A representative *Lepidostrobus*. X 1. FIGURE 8. Isolated sporophyll, *Lepidostrobophyllum*, with a lanceolate distal lamina. X 2. FIGURE 9. Petrified stele of stigmarian axis. X 2. FIGURE 10. Portion of stigmarian cast in Figure 6 showing detail of scars. X 1. FIGURE 11. Typical *Stigmaria stellata* illustrating surface pattern. X 1.

zontal segmentation indicative of nodes; instead, uninterrupted longitudinal ribs are present. Numerous petrified stems have been collected, one of which is illustrated in Fig. 13 showing its external features. Figure 15 shows a cross section of a similar stem that had eight protoxylem areas in the complete section, each of which was apparently developing a canal at the time of death. Even small branches, such as the one illustrated, possess a conspicuous zone of secondary xylem.

Pterophyte and cycadophyte remains constitute a diverse assemblage in the Chester of southern Illinois. Representative of the coenopterid ferns is the genus *Botryopteris,* remains of which have been found in pyritic nodules from the Waltersburg Formation. Foliar compressions representing pinnules of *Fryopsis* Wolfe (=*Cardiopteris* Schimper) (Fig. 17) are well represented in the flora. Isolated pinnules range from orbicular to ovate, with an acute to cordate base, and were borne on a slender stalk, part of which is visible in Fig. 17. Figure 19 shows several smaller, more elongate pinnules attached alternately along a slender rachis. Foliage of this type probably represents distal portions of *Fryopsis* fronds. Highly dissected foliage of the type placed in the genus *Rhodea* Presl is almost always present at shale localities (Fig. 16). Certain of the ultimate divisions are much broader than others on some of the specimens such as that figured. Although the reason for this variability is not clear, it must be considered in evaluating fragmentary specimens of *Rhodea.* Such specimens have been used as the basis for instituting several species of this genus from Mississippian age rocks of North America. Although somewhat less widely distributed, several types of *Sphenopteris* (Brongniart) Sternberg are present, forming an important element of the flora. The figured specimen (Fig. 21) is a common type that appears to conform to *S. mississippiana* White, although the very fragmentary nature of the type material (White, 1937a) renders the determination uncertain. Less commonly encountered is foliage of a type generally referred to as *Adiantites* Goeppert (Fig. 23) in which the pinnules are alternate, but highly variable in form. The number of primary lobes of the pinnules varies from two to eight and these lobes may be further subdivided distally. Striations paralleling the margins of the pinnules evidently reflect the venation pattern. A variety of other foliage types is present and includes specimens that are comparable to ones that have been described under the generic name *Sphenopteridium* Schimper (Fig. 22). Fructifications of the extinct cycadophyte group Pteridospermales also occur. A synangiate pollen organ of the type that is generally referred to the genus *Telangium* Benson is displayed in Fig. 17. Its parent plant is presently unknown; however, the branching pattern is similar to that found in *Rhodea.* Seed compressions are present at nearly all plant-bearing horizons. These include the specimen shown in Fig. 20 which is best assigned to the seed cast genus *Rhynchogonium* Heer, specimens belonging to *Trigonocarpus* Brongniart, and others which have not yet

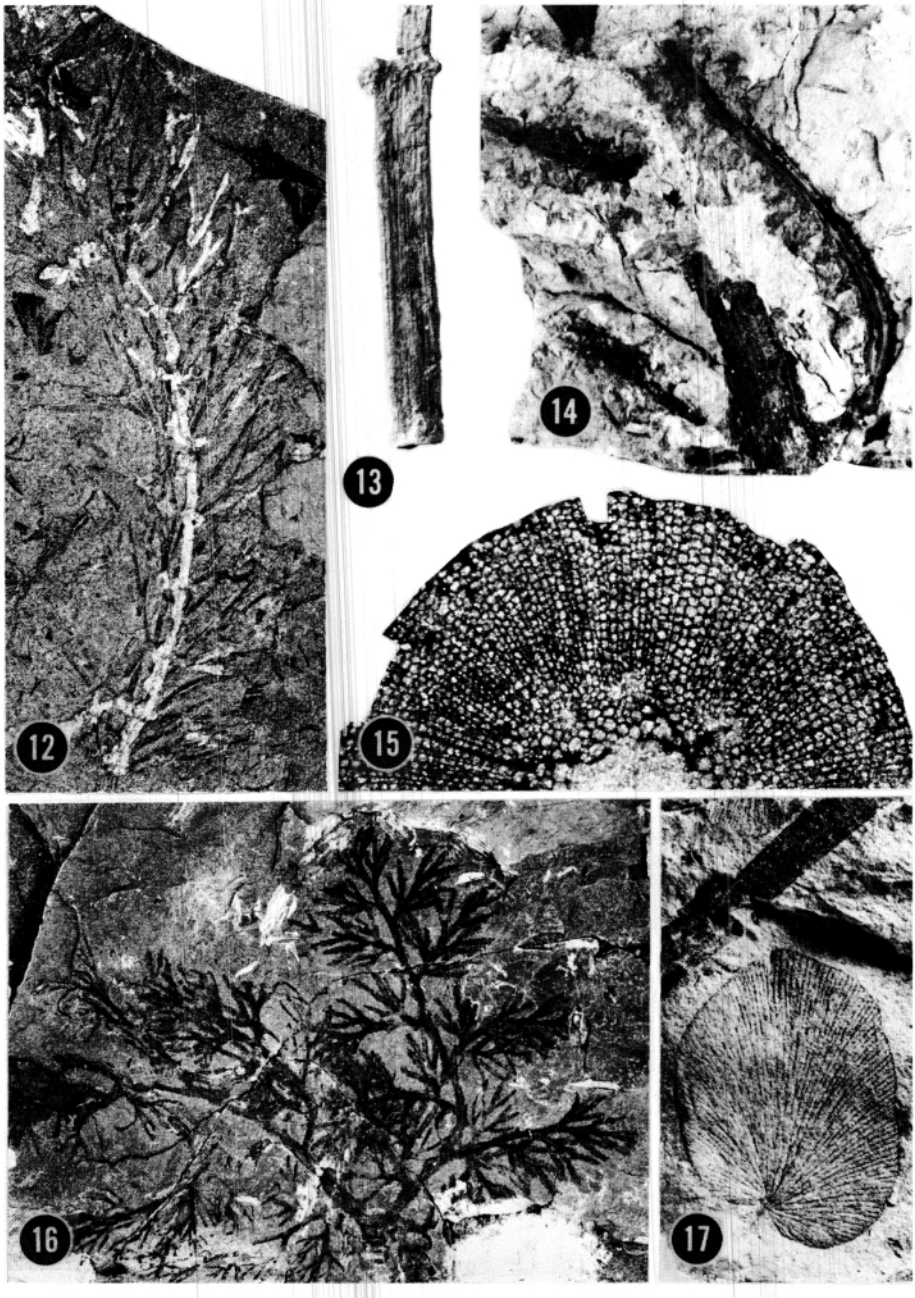


FIGURE 12. *Archaeocalamites*. Small branch combining pyrite petrifaction of the stem with compression of the attached leaves. X 1. FIGURE 13. External view of a petrified branch of *Archaeocalamites*. X 1. FIGURE 14. *Archaeocalamites* bearing a whorl of attached cones. X 1. FIGURE 15. Cross section of petrified stem of *Archaeocalamites*. X 55. FIGURE 16. A representative compression specimen of the genus *Rhodea*. X 1. FIGURE 17. Isolated pinnule of *Fryopsis*. X 2.

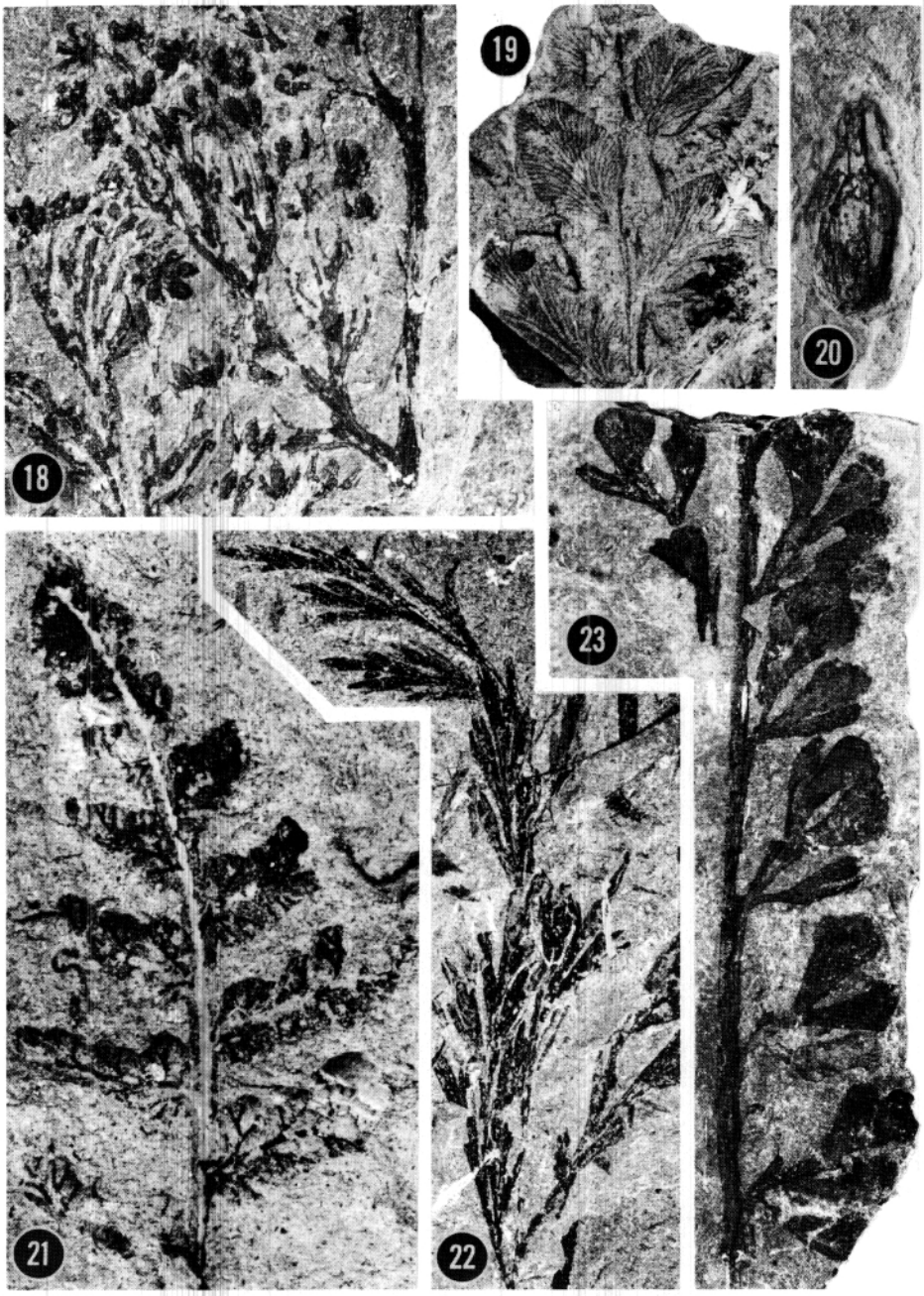


FIGURE 18. Synangiate pollen organ of the type usually referred to *Telangium*. X 5. FIGURE 19. Attached pinnules probably representing the distal portion of a *Fryopsis* frond. X 2. FIGURE 20. Seed referable to the genus *Rhynchogonium*. X 1. FIGURE 21. *Sphenopteris* resembling *S. mississippiana*. X 5. FIGURE 22. *Sphenopteridium*-like foliage. X 2. FIGURE 23. *Adiantites* showing characteristic lobed pinnules. X 2.

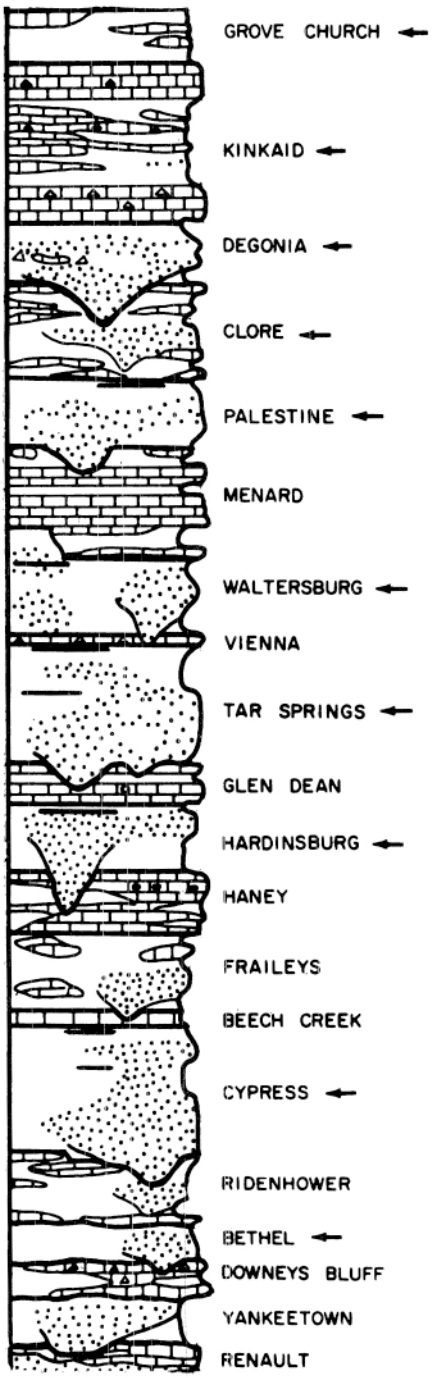


FIGURE 24. Generalized stratigraphic column of the Chester Series of Illinois. Formations from which fossil plants have been collected are indicated by arrows. Standard symbols are used to indicate the various lithologies with the exception of shale which is indicated by areas of solid white. (Modified from Swann, 1963).

been assigned to specific genera.

The Chester Series flora of southern Illinois is outstanding among floras of a comparable age from North America for several reasons. The different modes of preservation should make possible the determination of a variety of types of information including external features, internal anatomy, the nature of pollen and spores, and features of the cuticle. This diversity of preservation is especially noteworthy because of the relatively large number of taxa present in the flora. Unlike most Late Mississippian floras from North America, the southern Illinois flora contains numerous types of foliage. A much better comparison will, therefore, be possible between the Illinois flora and many of the European Lower Carboniferous floras in which similar foliage constitutes the

FIGURE 25. Outline map of the southern portion of Illinois. The outcrop area of the Chester Series is indicated by stippling. Large dots represent fossil plant localities.

major part of the flora. A knowledge of the plants present in the type region of the Chester Series will be of obvious usefulness for comparison with the floras of other Chesterian age rocks from North America, and may provide valuable information for determining the stratigraphic position that the Chester Series occupies in relation to the major divisions of the European Carboniferous.

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