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PRELIMINARY REPORT ON MACRO-PALEONTOLOGY OF STRATA ABOVE AND BELOW THE UPPER BOUNDARY OF THE TYPE MISSISSIPPIAN

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ABSTRACT

We have examined the macropaleontology of the beds above and below the Mississippian/Pennsylvanian boundary in the type region of the Mississippian. The area of study is in the south-central part of the Illinois Basin. The macrofossils above the boundary are generally regarded as Pennsylvanian forms, and are significantly different from those below which are generally regarded as Mississippian forms. The differences between these biotas indicate the presence of a major hiatus at the Mississippian/Pennsylvanian boundary in this area. Intercontinental comparisons indicate that macro-invertebrates are not presently diagnostic biostratigraphically, but the plant fossils strongly indicate chronostratigraphic equivalence of the latest type Mississippian with a position near the Viséan/Namurian bounday of Europe. This correlation, however, is at odds with other correlations, which are based upon invertebrate paleontological evidence, especially micropaleontological evidence.

TEXT

For any world-wide correlations, a knowledge of the type area of a stratigraphic unit is necessary. Accordingly, we have investigated the macropaleontology of strata near the upper boundary of the type Mississippian System. The type Mississippian System lies in the upper Mississippi River Valley (Winchell, 1869) on the western margin of the Illinois Basin, although a specific outcrop (or series of outcrops) has never been designated. Standard procedure (Atherton et al., 1960; Willman et al.,

1975) in the Illinois Basin positions the upper boundary of the Mississippian by lithology at the top of the uppermost limestone or marine shale and below conglomeratic sandstone, sandy shale, or coal which are termed Pennsylvanian (except where pre-Pennsylvanian erosion has caused similar coarse, coal-bearing clastic units of the Mississippian and Pennsylvanian to be directly superposed). With the upper boundary of Mississippian System defined in this manner, the youngest Mississippian strata occur (Figure 1) at the southern margin of the Illinois Basin and are designated the Grove Church Formation (Swann, 1963), which is best exposed at its type section (Figure 2a, b). Basal Pennsylvanian strata are also exposed here (Figure 2a-d) and are referred to the Wayside Member of the Caseyville Formation (Lamar, 1925; Kosanke, et. al., 1960).

We have discovered significant floral and faunal remains in both the uppermost Mississippian and basal Pennsylvanian strata in the Cedar Grove Church area. Fossil plants of the Grove Church Formation occur throughout the unit in the exposure along the road past the church, but are most common in silty shale at the base of the unit (Figure 2b). Lycopods, although rare, occur in the Grove Church Formation along with more numerous sphenophytes and abundant seed fern remains (Table 1). The fossil plants in the Wayside Member of the Caseyville Formation occur in sandstone and are mostly not as well-preserved as those of the Grove Church Formation. A number of distinctive forms of lycopods, sphenophytes, seed ferns, and cordaiteans are present, however (Table 1).

The uppermost megafauna in the Grove Church Formation occurs in a six-inch (15 cm) interval of bluish-gray shale three feet (1 m) below the top of the Grove Church Formation at the type section (Figure 2b). It consists of corals, brachiopods, pelecypods, gastropods, cephalopods, blastoids, crinoids, trilobites, conularids, and trace fossils in the form of "worm" trails and filled burrows (Table 2).

The boundary between the Mississippian and Pennsylvanian in the Illinois Basin has historically been considered to be a basin-wide unconformity. Despite physical evidence of a hiatus, this view has recently been challenged by Rexroad and Merrill (1985), who examined microfossils and interpreted the boundary strata in the area of Cedar Grove Church and the type Wayside as a continuous depositional sequence. Examination of Rexroad and Merrill's (1985) published data, however, suggests that the morphological similarities between the Grove Church and the Wayside conodonts may not be as great as they suggest. Furthermore, the possibility of reworking cannot be ruled out.

The macro-biota of the Grove Church Formation is quite different from the biota of the Wayside Member of the Caseyville Formation (Tables 1, 2). Biostratigraphically diagnostic forms among both the plants and the invertebrates in the Grove Church Formation exhibit close affinities with biotas of other Chesterian formations. For example, *Asterophyllites grandis*, *Rhodea* spp., *Teleangiopsis sp.*, *Rhynchogonium* sp., *Diaphragmus cestriensis*, *Composita subquadrata*, and *Pentremites* sp. are widespread in the Chesterian generally (e.g. Jennings, 1984; Weller et al., 1948). The Wayside biota, on the other hand, includes such forms as *Lepidodendron aculeatum*, *Calamites cistii*, *Hexagonocarpus crassus*, *Artisia transversa*, *Desmoinsia* sp., and *Syngastrioceras (= Eoasianites) oblatus* regarded as typically Pennsylvanian in the midcontinent and elsewhere (e.g. Gordon, 1964; Jennings, 1974).

The paleontological dissimilarity between the Grove Church and the Wayside

indicates that a major hiatus is indeed present. The differences cannot be attributed to facies change, because there are similar marine and non-marine facies present both above and below the boundary. The lowermost floras described from the type Pennsylvanian (and other Pennsylvanian outcrops) are slightly older than the flora of the Wayside. A chronological gap nevertheless remains between the top of the type Mississippian and base of the type Pennsylvanian. Transitional strata present in other regions lack any objective basis for assignment to either the Pennsylvanian or Mississippian.

The Visean/Namurian boundary of Europe is typically correlated with the Middle Chesterian (e.g. Weller et al., 1948; Collinson et al., 1971; Saunders, 1973; Ramsbottom and Saunders, 1984), although Baxter and Brenckle (1982) have put it considerably higher. There are problems with the definition of the Namurian (Salvador, 1985), and the type Namurian in Belgium has an unconformity at its base (Stockmans and Willière, 1955; Boukaert and Higgins, 1970). The very large flora present in the strata above the unconformity at the base of the type Namurian (Stockmans and Williere, 1952-53, 1955) shares only two or three long-ranging species with the Grove Church flora and appears to be significantly younger. In contrast, most of the plant species in the Grove Church Formation have been reported from the Oil Shale Group of Scotland (Lindley and Hutton, 1831-37; Hibbert, 1836; Kidston, 1923), a unit regarded as Viséan (Craig, 1983).

Indeed, many of the Grove Church fossil plant forms have been reported only from European strata identified as Viséan. A lesser number are known only from beds regarded as Namurian. To reconcile these differences requires a correlation of the Grove Church with a position very near the Viséan/Namurian boundary. Invertebrate macrofossils are poorly known in Scottish Lower Carboniferous strata and there are no species in common between the Scottish faunas (e.g. Wilson, 1966) and the Grove Church fauna, although the faunas share a few genera. These cannot be considered diagnostic, but are not inconsistent with the fossil plant data. There thus remains a significant discrepancy between current correlations based on invertebrate microfossils and evidence from the plant megafossils.

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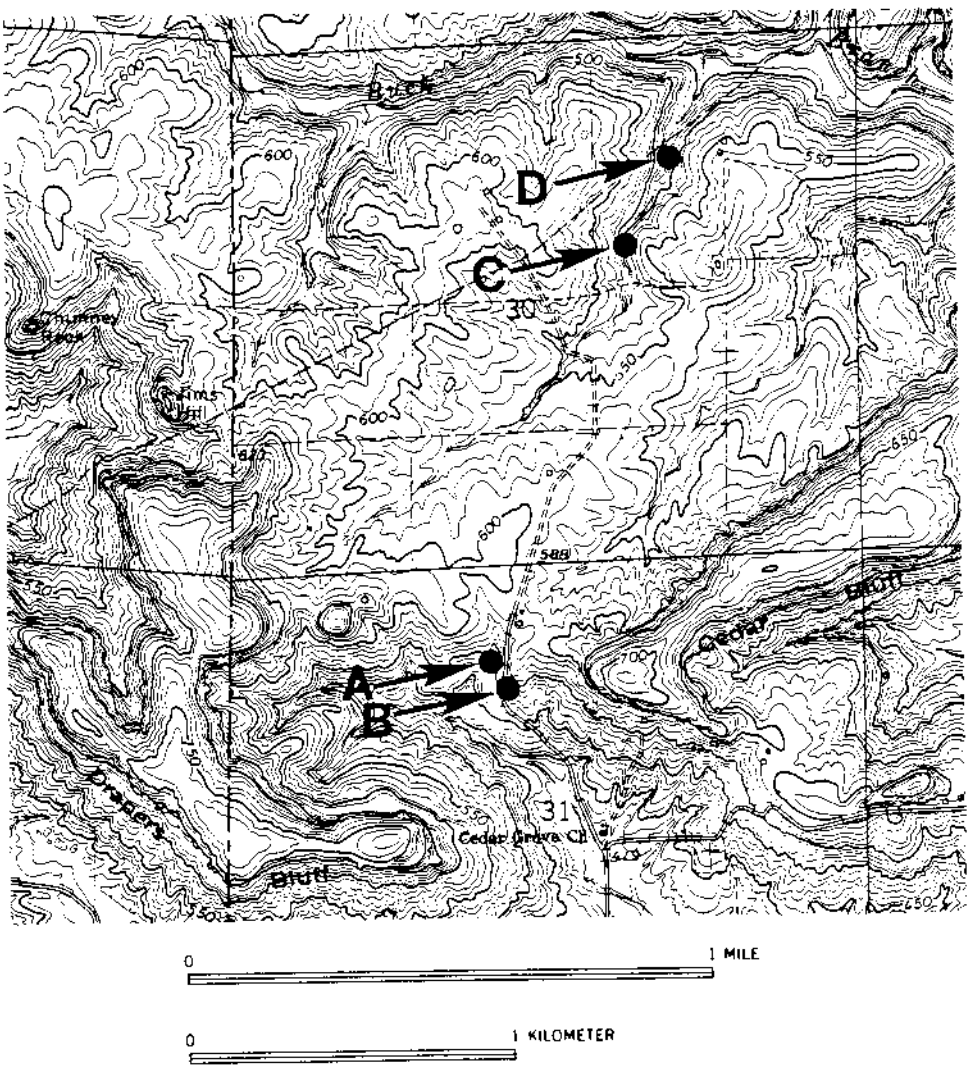

Fig. 1. Location map (part of the Lick Creek Quadrangle) of the area in southern Illinois where the uppermost strata of the type Mississippian are exposed. Locations A and B show the position of the type Grove Church along a small creek and along a secondary road. Locations C and D are fossil collecting sites in the type Wayside.

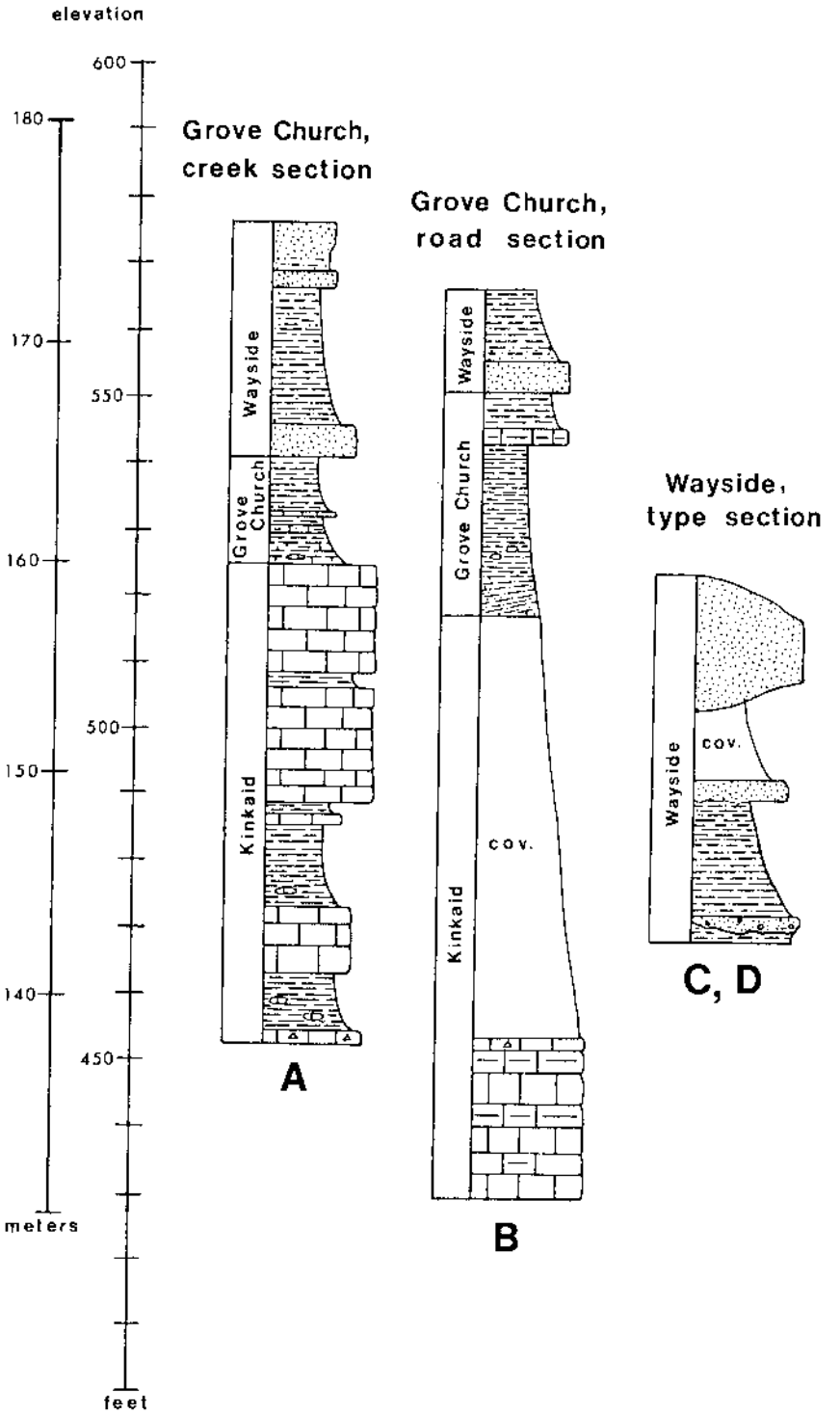

Fig. 2. Columnar sections of uppermost Mississippian strata and strata of the immediately overlying Pennsylvanian. Arrowheads indicate horizons from which fossil collections have been made (in = invertebrate fossils, pl = plant fossils).

Table 1. List of fossil plants from the Grove Church Formation and Wayside Member of the Caseyville Formation in the vicinity of Cedar Grove Church, Johnson County, Illinois.

GROVE CHURCH	WAYSIDE
lycopods	lycopods
Lepidodendron cf. *L. veltheimii*	*Lepidodendron aculeatum*
Lepidostrobophyllum lanceolatum	*Lepidophloios* sp.
	Syringodendron sp.
	Lepidophylloides sp.
	Lepidostrobophyllum sp.
sphenophytes	sphenophytes
Calamites cistiiformis	*Calamites cistii*
C. roemeri	*C. suckowii*
Asterophyllites grandis	*?Sphenophyllum* sp.
ferns	ferns
none	*Alloiopteris* sp.
	Pecopteris plumosa
	Sphenopteris cf. *S. amoena*
seed fern vegetative material	seed fern vegetative material
Dictyoxylon sp.	*Alethopteris decurrens*
Plumatopteris elegans	*A.* cf. *A. lonchitica*
Sphenopteris affinis	cf. *Eremopteris* sp.
S. crassa	cf. *Lesleya* sp.
S. dubia	*Linopteris (Reticulopteris)* sp.
S. fragilis	*Mariopteris* cf. *M. nervosa*
S. gigantea	*Neuropteris* cf. *N. gigantea*
S. hibberti	*N.* cf. *N. heterophylla*
S. macconochii	*N.* cf. *N. tenuifolia*
	cf. *Palaeopteridium* sp.
	Sphenopteris (Palmatopteris) furcata
	S. pygmaea
	S. cf. *S. schatzlarensis*
seed fern pollen organs	seed fern pollen organs
Boulaya cf. *B. hallii*	none
Potoniea sp.	
Scheutzia sp.	
Telangiopsis sp.	
cordaitean vegetative material	cordaitean vegetative material
none	*Artisia transversa*
	Cordaites principalis
seeds and ovules	seeds and ovules
Carpolithes granularis	*Cordaicarpon annulatum*
C. sp.	*C. cornutum*
cf. *Cornucarpus* sp.	*C. major*
"Hexagonospermum" rugosum	*Hexagonocarpus crassus*
Rhabdocarpus turbinatus	*Trigonocarpus massarti*
Rhynchogonium sulcatum	*T. noeggerathii*
Trigonocarpus kevretianus	*T. parkinsoni*
T. cf. *T. noeggerathii*	*T. schultzianus*
T. cf. *T. parkinsoni*	

Table 2. List of invertebrate fossils from the Grove Church Formation and Wayside Member of the Caseyville Formation in the vicinity of Cedar Grove Church, Johnson County, Illinois.

GROVE CHURCH	WAYSIDE
coelenterates	coelenterates
Amplexizaphrentis palmatus	*?Amplexizaphrentis* sp.
	Michelinia sp.
brachiopods	brachiopods
Quadratia sp..	*Composita wasatchensis*
Composita subquadrata	*Desmoinesia* sp.
Diaphragmus cestriensis	*Hustedia gibbosa*
Productus sp.	*Lingula carbonaria*
	Linoproductus sp.
	?Sandia sp.
	Spirifer cf. *S. goreii*
	S. cf. *S. opimus*
	Spiriferellina campestris
	Tesuquia morrowensis
bryozoans	bryozoans
Fenestella sp.	none
Polypora multispinosa	
pelecypods	pelecypods
?Aviculopecten sp.	*Aviculopecten arkansanus*
Conocardium sp.	*Cardiomorpha* cf. *C. missouriensis*
?Euchondria sp.	*C.* sp.
Nuculana sp.	*Edmondia* cf. *E. maccoyi*
?N. sp.	*E.* sp.
?Nuculopsis sp.	*Leda* cf. *L. bellistriata*
?Palaeoneilo sp.	*Nucula* cf. *N. beyrichi*
Parallelodon sp.	*N. lunulata*
?P. sp.	*N.* cf. *N. rotundata*
Solemya sp.	*Nuculopsis croneisi*
cf. *Posidonia* sp.	*N. girtyi*
Schizodus subcircularis	*N.* cf. *N. ventricosa*
S. sp.	*Parallelodon* cf. *P. obsoletus*
gastropods	gastropds
cf. *Bellerophon* sp.	*Bellerophon* sp.
	?Hemizyga sp.
	?Ianthiniopsis sp.
	?Leptotygma sp.
	Meekospira sp.
	Naticopsis (Jedria) sp.
	Palaeostylus (Pseudozygopleura) sp.
	Pharkinodontus sp.
	Straparollus cf. *S. reedsi*
	Trepospira sp.
	Worthenia sp.

cephalopods
?Michelinoceras sp.
Spyroceras sp.

echinoderms
Pentrimites sp.
columnals

conularids
Paraconularia sp.

arthropods
Paladin sp.

cephalopods
Gastrioceras cf. *G. oblatus*
Mooreoceras cf. *M. normale*
M. sp.

echinoderms
columnals

conularids
none

arthropods
Ameura (of authors) cf. *A. trinucleata*