

## Conodonts from a Core of the Black River Limestone, Subsurface of White County, Indiana

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### Introduction

Middle Ordovician rocks are well exposed throughout the eastern Midcontinent of the United States (Fig. 1), and these rocks have been thoroughly studied from the outcrop both stratigraphically and paleontologically. Middle Ordovician rocks are less well studied from the subsurface and are usually correlated on the basis of lithology (6). In Indiana, Middle Ordovician rocks do not outcrop and, their age has been determined by their subjacent position to the Upper Ordovician, well known from outcrops in southeastern Indiana.

### Stratigraphy

The Indiana Geological Survey has defined two carbonate units from the subsurface as Middle Ordovician, the Trenton Limestone below the Upper Ordovician and the Black River limestone beneath the Trenton. These two units are readily distinguished lithologically, however there have been no reports of the fossil content of these two units in the subsurface of Indiana. The Indiana Geological Survey has kindly provided me with samples from a core through the Black River limestone from the John G. Forbes #1 well, drilled by the Indiana Gas and Water Co., in White County, Indiana.

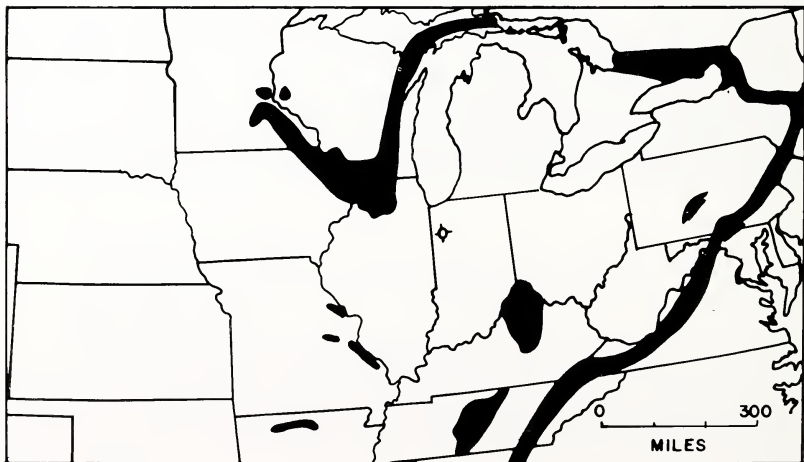


FIGURE 1. Outline map of the eastern Midcontinent of the United States showing the outcrop distribution of Middle Ordovician rocks. The location of the Forbes well, White County, Indiana, is indicated.

The well is located in the SE¼, SW¼, NE¼, Sec. 3, T27N, R6W. The well, located on the southwest flank of the Kankakee Arch, was spudded in Pleistocene till and reached a total depth of 1470 feet. The well bore penetrated the stratigraphic section from the Devonian New Albany shale into the upper 120 feet of the Cambro-Ordovician Knox dolomite. The unit defined as Black River limestone is massively bedded, very fine-grained, tan to light gray, slightly dolomitic limestone with a few vugs and free floating sparry calcite crystals. In some zones, the unit is extensively bioturbated. The top of this interval lies at a depth of 1160 feet immediately beneath the Trenton limestone and the bottom is placed at 1352 feet at the top of a two foot interval of white sandstone cemented by calcite, designated the St. Peter sandstone (Fig. 2). The St. Peter sandstone lies unconformably on the Knox dolomite. Thirty-one samples have been collected from this core from the lower twelve feet of the Trenton limestone to the base of the Black River limestone, as indicated in Figure 2.

TABLE 1

Faunal List	specimens	Faunal List	specimens
acodiform elements	6	<i>Erismodus radicans</i>	69
<i>Acontiodus alveolaris</i>	1	<i>Microcoelodus symmetricus</i>	63
<i>Belodina compressa</i>	122	oistodiform elements	23
<i>Bryantodina? abrupta</i>	9	<i>Panderodus gracilis</i>	254
<i>Chirognathus monodactylus</i>	2	<i>Phragmodus inflexus</i>	5
<i>Curtognathus robustus</i>	7	<i>Phragmodus undatus</i>	1595
<i>Distacodus falcatus</i>	2	<i>Plectodina aculeata</i>	88
<i>Drepanoistodus suberectus</i>	221	<i>Polyplacognathus ramosus</i>	54
		Total	2521

### Paleontology

Thirty-one samples from the Black River limestone were treated for conodonts by standard acetic acid techniques. More than 2500 identifiable conodont elements have been extracted from these samples. These elements have been assigned to fourteen species of thirteen genera of conodonts (Table 1). The stratigraphic intervals from which each species has been collected is indicated in Figure 2 by a solid vertical bar. Samples 1-4 contain elements of *Phragmodus undatus* (Pl. 1, Figs. 4-6), a key species to Fauna 8 of Sweet, Ethington, and Barnes (5). *Bryantodina? abrupta* (Pl. 1, Figs. 21-22) is present in samples 3 and 4 and is a common component of Fauna 8 elsewhere (1,5). Elements of *Polyplacognathus ramosus* (Pl. 1, Figs. 19-20) are restricted to samples 1-3 of this collection but are known to range lower in the section elsewhere (2,7,8). Fauna 8 characterizes the type Trenton Group of New York (3) and its lateral equivalents throughout the eastern Midcontinent (5).

Elements assigned to Fauna 7 of Sweet, Ethington, and Barnes are present below sample 4. *Phragmodus inflexus* (Pl. 1, Figs. 1-3) is present in samples 28-30 near the base of the Black River limestone. This species is known to range up into the middle of Black Riveran rocks throughout the eastern Midcontinent (Fig. 3) (7). *Erismodus radicans* (Pl. 1, Figs. 7-9), a fibrous conodont, is present

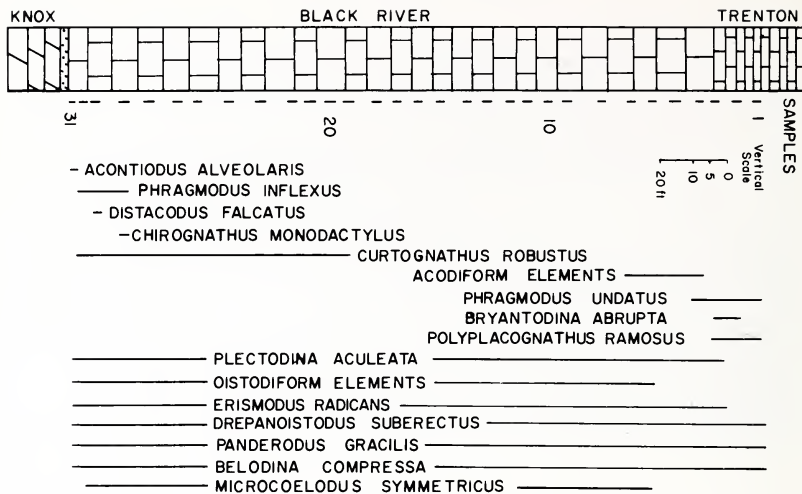
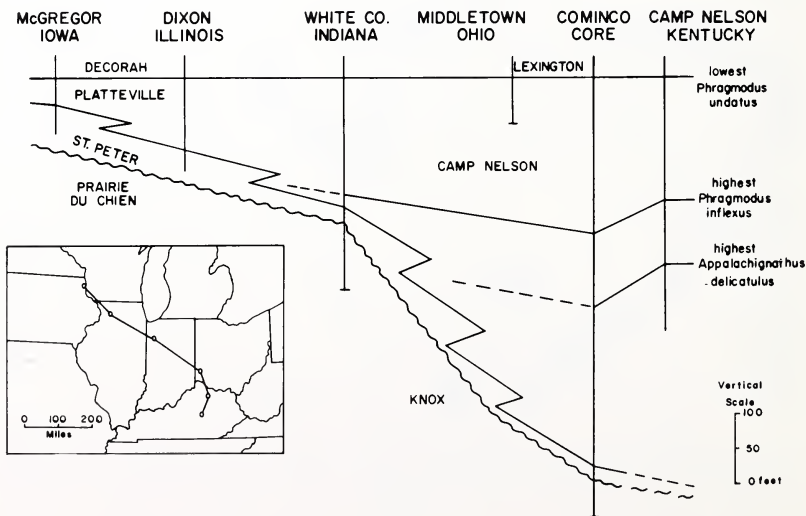


FIGURE 2. Generalized lithology, intervals sampled and stratigraphic ranges of the conodont species from the Forbes well, White County, Indiana.

from sample 4 through 31, and elsewhere is restricted to Fauna 7 (7). Other elements of fibrous conodonts *Curtognathus robustus*, *Microcoelodus symmetricus*, and *Chirognathus monodactylus* are found throughout the interval of samples 4-31 and are common constituents of Black Riveran conodont collections elsewhere (7). Several ubiquitous Middle and Upper Ordovician species, *Drepanoistodus suberectus*, *Belodina compressa*, and *Panderodus gracilis* are found throughout the sampled interval in the Forbes well.



Analysis of this conodont assemblage indicates a change from Fauna 7 to Fauna 8 between samples 5 and 4, six feet below the top of the Black River lithology. Consequently the lower 186 feet of the Black River limestone and the two feet of St. Peter sandstone are assigned to the Black Riveran Stage of the Champlainian Series, and the upper six feet of the Black River and the sampled portion of the lower Trenton limestone are assigned to the Rocklandian Stage.

### Correlation

The Black River limestone of the Forbes well can be correlated with Middle Ordovician limestones in the outcrop at Dixon, Illinois, McGregor, Iowa, and along the Kentucky River south of Lexington, and in cores from wells near Middletown, Ohio, and in northern Kentucky (Fig. 3). The lowest stratigraphic occurrence of *Phragmodus undatus* marks the base of the Rocklandian Stage and the top of the Black Riveran. In each case cited here the top of the Black Riveran Stage falls within ten feet above or below the lithologic change at the contact of the Trenton limestone with the Black River limestone.

Limestones of the Black Riveran Stage thin dramatically from 550 feet in the Cominco core of northern Kentucky (Fig. 3) to only forty feet in a complete exposure in northeastern Iowa. The stratigraphically highest occurrence of *Phragmodus inflexus* and *Appalachignatus delicatulus* document the Champlainian transgression of the eastern Midcontinent from southeast to northwest.

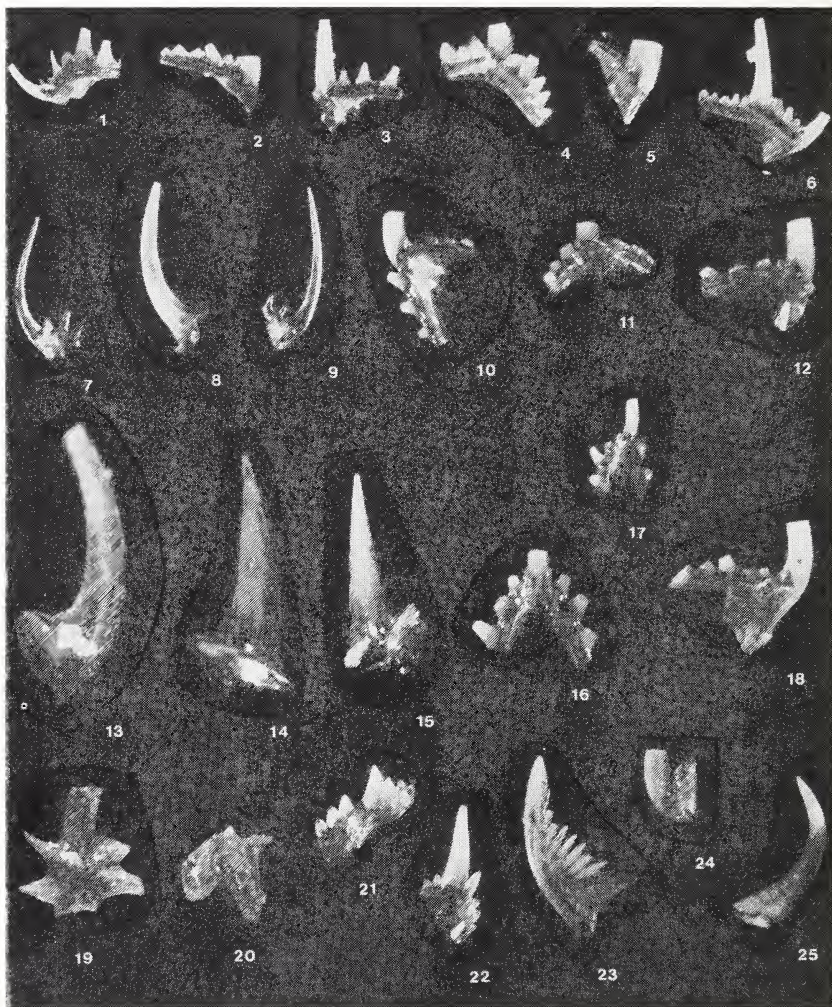
The assemblage of conodont elements obtained from this core belongs to Faunas 7 and 8 of Sweet, Ethington, and Barnes, and is diagnostic of the Black Riveran and Rocklandian Stages respectively. Thus all of the lithologic unit in the subsurface of Indiana described by the Indiana Geological Survey as Black River limestone is, with the exception of the upper six feet, Black Riveran in age and correlative with the Watertown, Gull River, and Pamela of New York, the Lebanon, Ridley, Pierce, and Murfreesboro of Tennessee, the Joachim of

WHITE COUNTY	OKLAHOMA	MISSOURI	IOWA	CINCINNATI	TENNESSEE	NEW YORK	STAGE
TRENTON	CORBIN RANCH	PLATTIN	DECORAH	TYRONE OREGON	CARTERS	SELBY	ROCKLAND
BLACK RIVER	UPPER BROMIDE	JOACHIM	PLATTEVILLE	CAMP NELSON	LEBANON RIDLEY PIERCE	TYPE BLACK RIVER	BLACK RIVER
ABSENT	LOWER BROMIDE	DUTCHTOWN	ABSENT	ABSENT	ABSENT	ABSENT	CHAZY

FIGURE 4. Correlation of the Black River limestone in White County, Indiana, with equivalent units in the eastern United States (After Sweet and Bergstrom, 1976).



Missouri, and the upper Bromide of Oklahoma (Fig. 4) according to the recent conodont-based correlation chart of Middle and Upper Ordovician of the United States Midcontinent (4).



#### Explanation of PLATE I

All figures are X40. Sample number for each specimen is in parentheses.

FIGURES 1-3—*Phragmodus inflexus* Stauffer. Lateral views of phragmodiform (29), cyrtioniodiform (29), and dichognathiform (28) elements.

FIGURES 4-6—*Phragmodus undatus* Branson and Mehl. Lateral views of dichognathiform (3), oistodiform (3), and phragmodiform (3) elements.

FIGURES 7-9—*Erismodus radicans* Hinde. Lateral views of microcoelodiform (29), ptiloconiform (29), and erismodiform (29) elements.

FIGURES 10-12, 16-18—*Plectodina aculeata* Stauffer. Lateral views of prioniodiniiform (16), ozarkodiniiform (27), and dichognathiform (16) elements; posterior views of trichonodelliform (29) and zygognathiform (27) elements; lateral view of corydodiform element (29).

FIGURES 13-15—*Drepanoistodus suberectus* Branson and Mehl. Lateral views of drepanoistodiform (3), suberectiform (3), and oistodiform (3) elements.

FIGURES 19-20—*Polyplacognthus ramosus* Stauffer. Views of upper surface of polyplacognathiform (1) and bilobatiform (2) elements.

FIGURES 21-22—*Bryantodina? abrupta* Branson and Mehl. Lateral views of bryantodiniform (3) and prioniodiniform (3) elements.

FIGURES 23-24—*Belodina compressa* Branson and Mehl. Lateral views of belodiniform (3) and oistodiform (3) elements.

FIGURES 25—*Panderodus gracilis* Branson and Mehl. Lateral view of panderodiform element (3).

### Literature Cited

1. BERGSTROM, S. M., and SWEET, W. C. 1966. Conodonts from the Lexington Limestone (Middle Ordovician) of Kentucky, and its lateral equivalents in Ohio and Indiana. *Bull. Am. Paleont.* **50(229)**:271-441.
2. ETHINGTON, R. L., and SCHUMACHER, D. 1969. Conodonts of the Copenhagen Formation (Middle Ordovician) in central Nevada. *Jour. Paleont.* **43**:440-483.
3. SCHOPF, T. J. M. 1966. Conodonts of the Trenton Group (Ordovician) in New York, southern Ontario, and Quebec. *Bull. N.Y. St. Mus.* **405**:1-105.
4. SWEET, W. C., and BERGSTROM, S. M. 1976. Conodont Biostratigraphy of the Middle and Upper Ordovician of the United States Midcontinent. 121-151 in Bassett, M.G. (ed.). *The Ordovician System: proceedings of a Paleontological Assoc. symposium.* Univ. of Wales Press and National Museum of Wales, Cardif. 696.
5. SWEET, W. E., ETHINGTON, R. L., and BARNES, C. R. 1971. North American Middle and Upper Ordovician conodont faunas. *Mem. Geol. Soc. Am.* **127**:163-193.
6. TEMPLETON, J. S., and WILLMAN, H. B. 1963. Champlainian Series (Middle Ordovician) in Illinois. *Ill. Geol. Surv. Bull.* **89**:1-260.
7. VOTAW, R. B. 1971. Conodont biostratigraphy of the Black River Group (Middle Ordovician) and equivalent rocks of the eastern Midcontinent, North America; Ph.D. diss. (unpubl) The Ohio State Univ. :1-170.
8. WEBERS, G. F. 1966. The Middle and Upper Ordovician conodont faunas of Minnesota. *Spec. Publ. Minn. Geol. Surv.* **SP-4**:1-123.