Stratigraphy and Correlation of Middle Devonian Strata in the Logansport Sag, North-central Indiana

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Abstract

The name Traverse Formation of northern Indiana and the Michigan Basin is extended into the Logansport Sag to include approximately 25 feet of strata previously separated into Miami Bend Formation, Logansport Limsetone, and Little Rock Creek Limestone. Traverse rocks of the Sag and those of the Michigan Basin of equivalent late Middle Devonian age display similar lithologies, have similar depositional histories, and contain nearly identical conodont faunas. The Traverse rocks of the Sag lie within two Middle Devonian conodont zones high in the Givetian Stage and correlate with strata in New York ranging from the Levanna Shale Member of the Skaneateles Shale (Hamilton Group) through the Tully Formation. The lower zone comprises the body of strata containing *Icriodus latericrescens latericrescens* below the lowest position of *Polygnathus varcus;* the upper zone is the *P. varcus* Zone.

Introduction

Upper Silurian and Devonian rocks are exposed in the valley of the Wabash River between Delphi, Carroll County, and Lewisburg, Cass County, Indiana (Fig. 1). The outcrop area is situated near the crest of the northwest extension of the Cincinnati Arch in the structural depression that Cumings and Shrock (10) named the Logansport Sag.

Approximately 25 feet of Middle Devonian carbonate rocks lie between Silurian strata and the New Albany Shale (Upper Devonian). Although the Middle Devonian part of the section is quite thin and exposures are relatively few, several units assigned the rank of formation have been proposed for rocks that crop out in the Sag. These are Miami Bend Formation (6), Logansport Limestone (7), and Little Rock Creek Limestone (5). These three units nowhere are known to be present in a single outcrop, and their lateral and vertical relationships as a result are unclear. With few exceptions, among them the work of Cooper and associates and that of Campbell (3), these names rarely have been used. They have not been adopted for use by the Indiana Geological Survey.

Middle Devonian rocks of the Logansport Sag lithologically more closely resemble equivalent rocks of the Michigan Basin than those of the Illinois Basin. As pointed out by Pinsak and Shaver (15), rocks equivalent to part of the Traverse Group of Michigan are recognized as far south as Carroll, Cass, Howard, and Miami Counties, Indiana. During Middle Devonian time basin type sedimentation was taking place on the northeast side of the Cincinnati Arch and a southward-thinning wedge of sediments was deposited in northern Indiana (15). The Miami Bend, Logansport, and Little Rock Creek represent the southern extension of this wedge into the Logansport Sag.

Field work was conducted during the summer of 1967 when the writer was associated with the Indiana Geological Survey. Charles

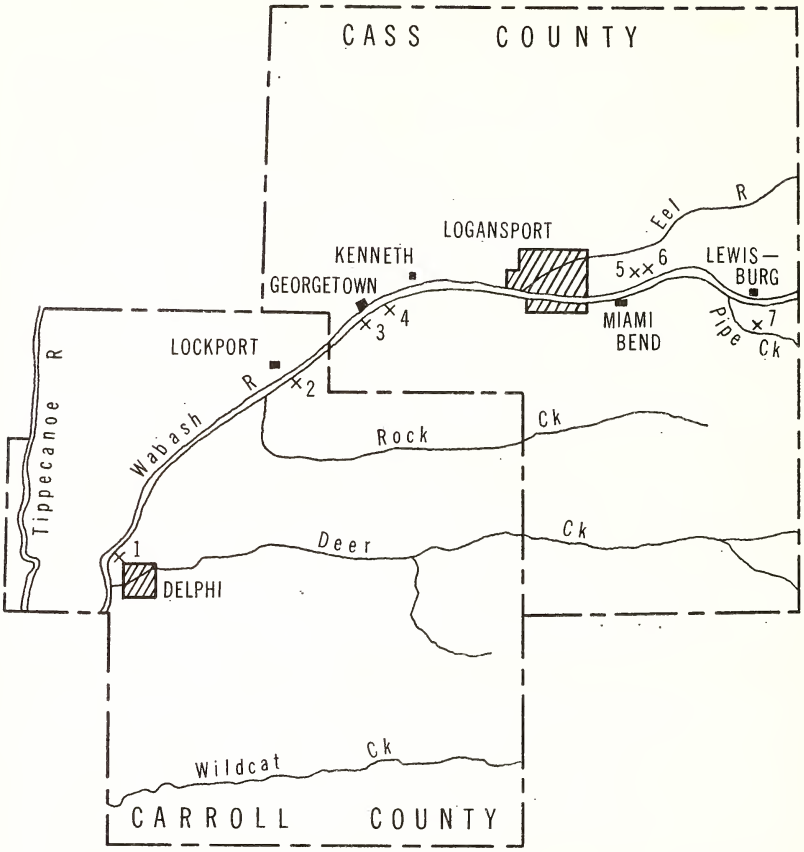

Figure 1. Map of Carroll and Cass Counties showing collecting localities of Middle Devonian limestone units in the Logansport Sag.

A. Pollock, Department of Geology, Indiana University, accompanied the writer in the field and assisted in the collecting of samples. Charles Pollock, Carl B. Rexroad and William J. Wayne (both of the Indiana Geological Survey), and Robert S. Nicoll, Department of Geology, The University of Iowa, discussed the stratigraphy of the area on several occasions. Carl Rexroad and Robert Nicoll critically read the manuscript.

Development of Stratigraphic Nomenclature

Middle Devonian rocks of the Logansport area have been studied by numerous geologists for nearly 100 years. Collett (4) made a brief survey of Silurian and Devonian rocks in Carroll and Cass Counties among others in 1872. He recognized two divisions of the Devonian part of the section, a lower limestone unit (unnamed by Collett) 20 to 22 feet thick and an upper black shale unit 60 feet thick (Fig. 2). Collett used the name "Louisville-Delphi black slate" for the latter unit in two col-

<table>
<tr><th>COLLETT
1872</th><th>KINDLE
1901</th><th>COOPER
& OTHERS
1942</th><th>GALLOWAY
& ST. JEAN
1955</th><th>COOPER
& PHELAN
1966</th><th>THIS
PAPER</th></tr>
<tr><td>LOUISVILLE-DELPHI
BLACK SLATE</td><td>NEW ALBANY
SHALE</td><td>DELPHI
SHALE</td><td>NOT CONSIDERED</td><td>DELPHI
SHALE</td><td>NEW ALBANY
SHALE</td></tr>
<tr><td rowspan="3">DEVONIAN
LIMESTONE</td><td>SELLERSBURG
BEDS</td><td>LITTLE
ROCK CREEK
LIMESTONE</td><td>LITTLE
ROCK CREEK
LIMESTONE</td><td>LITTLE
ROCK CREEK
LIMESTONE?</td><td rowspan="3">TRAVERSE
FORMATION</td></tr>
<tr><td>JEFFERSONVILLE
LIMESTONE</td><td rowspan="2">LOGANSPORT
LIMESTONE</td><td rowspan="2">LOGANSPORT
LIMESTONE</td><td>LOGANSPORT
LIMESTONE</td></tr>
<tr><td>SILURIAN</td><td>MIAMI BEND
FORMATION</td></tr>
<tr><td>SILURIAN</td><td>SILURIAN</td><td>SILURIAN</td><td>SILURIAN</td><td>SILURIAN</td><td>SILURIAN</td></tr>
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Figure 2. Chart showing development of nomenclature applicable to Middle Devonian rocks in the Logansport Sag.

umnar sections. As pointed out by Wilmarth (23), the "Louisville-Delphi black slate" probably was named for its surface distribution from Louisville, Kentucky, to Delphi, Carroll County, Indiana. Brown (2) used the name "Delphi black slate" to designate the same unit in Marion County, Indiana. Both names have since been replaced in common usage by the older and more widely accepted name New Albany Shale (1).

Kindle (13) distinguished two divisions of Devonian carbonate rocks in the Wabash Valley near Logansport, a lower, gray, crystalline, thin- to thick-bedded limestone and an upper limestone that varies from bluish drab and conchoidally fracturing to dark colored and arenaceous. He correlated the lower unit with the Jeffersonville Limestone (an untenable correlation on the basis of conodont succession) of southern Indiana and applied the southern Indiana term Sellersburg beds (12) to the upper limestone and noted its Hamilton fauna. He provisionally assigned to the Silurian the stromatoporoid-bearing limestone that he observed to be 10 to 13 feet thick below the lower unit (Fig. 2).

Cooper and Warthin (7) proposed the name Logansport Limestone for "light-colored granular limestone" in which "corals and other fossils are abundant particularly in the upper 6 feet" for Middle Devonian limestone that rests on the Silurian at many places in the Logansport area. They designated as type section the exposure at Pipe Creek Falls (Locality 7) where Middle Devonian rocks consist of a lower, gray, fine-grained, stromatoporoid-bearing unit (assigned to the Silurian by Kindle but

more properly Middle Devonian) and an upper, pink, granular, abundantly fossiliferous unit (= the lower of Kindle's two Devonian units).

Cooper (5) introduced the name Little Rock Creek Limestone (= the upper of Kindle's two Devonian units) for 7 feet of "gray, brittle, conchoidally fracturing limestone above the Logansport" that is exposed along the bed and banks of Little Rock Creek upstream from the bridge located 1 mile southeast of Lockport, Carroll County (Locality *2*).

Cooper and Phelan (6) proposed the name Miami Bend Formation for the gray, stromatoporoid-bearing limestone that formerly was included as the lower part of the Logansport Limestone (7). They designated the west side of the France Stone Company quarry (Locality *5*) as type section. Here the unit is a biostrome about 15 feet thick and consists of gray, fine-grained, indistinctly bedded, stromatoporoid- and coral-bearing limestone that disconformably overlies the Kokomo Limestone Member of the Salina Formation (Silurian).

All three Middle Devonian limestone units may be observed resting disconformably on Silurian strata along the Wabash River. The Kenneth Limestone Member (probably Silurian in age) of the Salina Formation is not present at any of the studied localities.

Conodont Faunas

The Miami Bend, Logansport, and Little Rock Creek units all contain characteristic upper Middle Devonian (Givetian) conodont species. The Miami Bend (sampled at Localities *5* to *7*) is a stromatoporoid-coral biostrome that yields small numbers of conodonts. Platform species include only *Icriodus latericrescens latericrescens* Branson and Mehl and *I. expansus* Branson and Mehl. At these three localities the Miami Bend is overlain along a sharp contact by the granular Logansport Limestone, the lower part of which contains a conodont fauna identical to that of the Miami Bend. At Locality *6*, the upper part of the Logansport contains *Polygnathus varcus* Stauffer in addition to the above two taxa. At Localities *2* to *4*, *I. latericrescens latericrescens*, *I. expansus*, *I. cymbiformis* Branson and Mehl, *P. varcus*, and *P. linguiformis linguiformis* Hinde are irregularly distributed throughout the Logansport. The conodont fauna of the Little Rock Creek (sampled at Localities *1* and *2*) is identical to that of the Logansport at Localities *2* to *4* listed above.

Correlation

The above faunas show that two conodont zones are present in Middle Devonian strata of the Logansport Sag. The lower is characterized by the presence of *Icriodus latericrescens latericrescens* below the lowest position of *Polygnathus varcus*. The upper is the *P. varcus* Zone (25) that is characterized by the association of these two taxa.

In Germany, *Icriodus latericrescens latericrescens* is confined to the *Polygnathus varcus* Zone high in the Givetian Stage (24). In North America, *I. latericrescens latericrescens* is widely distributed below the

P. varcus Zone and in New York ranges from the Levanna Shale Member of the Skaneateles Shale (Hamilton Group) into the Tully Formation. *Polygnathus varcus* ranges from the Centerfield Limestone Member of the Ludlowville Shale (Hamilton Group) also into the Tully (14). See Orr and Klapper (18) for a discussion of the correlation of this interval.

In the Logansport Sag, the Miami Bend and the lower part of the Logansport lie within the zone of *Icriodus latericrescens latericrescens* below the lowest position of *Polygnathus varcus*. In the Michigan Basin, the lower part of the Traverse Formation (20) of northern Indiana and that part of the Traverse Group of Michigan below and including the lower part of the Alpena Limestone lie within this conodont zone (17). The highest part of the Silver Creek Member of the North Vernon Limestone of southern Indiana also lies within this zone (19).

The upper part of the Logansport and the Little Rock Creek lie within the *Polygnathus varcus* Zone. In the Michigan Basin, the upper part of the Traverse Formation of northern Indiana and that part of the Traverse Group of Michigan above and including the middle part of the Alpena Limestone to the base of the Squaw Bay Limestone lie within this conodont zone (17). In southern Indiana, the Beechwood Member of the North Vernon Limestone lies within the *P. varcus* Zone (16).

Cooper and others (8) correlated the Logansport with the Beechwood Member of southern Indiana and with the Four Mile Dam Limestone of Michigan. They considered the Little Rock Creek to be younger than the Beechwood and correlated it with the Potter Farm Formation and Thunder Bay Limestone (both of the Traverse Group) of Michigan. Campbell (3) also correlated the Devonian rocks exposed at Pipe Creek Falls with the Beechwood on the basis of megafaunal similarities.

Galloway and St. Jean (11) studied the stromatoporoid faunas of both the Logansport and Little Rock Creek units. They indicated the Hamilton age of the Logansport fauna and pointed out the correlation with Frasnian and Faminian faunas from the Dinant Basin, Belgium. They considered the Little Rock Creek to be of Tully age and correlated its stromatoporoid fauna with that of the Potter Farm Formation of Michigan.

In 1966 Cooper and Phelan (6) reported for the first time the brachiopod *Stringocephalus* in Indiana. They obtained their specimens from the Miami Bend unit at several localities just east of Logansport including the upper 18 inches of the unit in the west wall of the France Stone Company quarry (Locality 5). On the basis of brachiopod faunas, Cooper and Phelan correlated the Miami Bend with the Rogers City Limestone of the Michigan Basin and with an interval in New York between the Marcellus and Skaneateles Shales. In terms of conodont zones, the Miami Bend lies within the same zone as the Skaneateles Shale of New York.

Cooper and Phelan's (6) correlation of the Miami Bend with the Beauvais Sandstone of Ste. Genevieve County, Missouri, is herein rejected as untenable because of the presence in the Beauvais of *Icriodus angus-*

tus Stewart and Sweet. This important species is found also in the Dundee Limestone of northwest Ohio (14), Delaware Limestone of central Ohio (21), and lower part of the intertonguing Speed and Silver Creek Members of the North Vernon Limestone of southern Indiana (16). The correlation of these units with the Marcellus Shale of New York is well established.

Nomenclatural Proposal

Thornbury and Deane (22) and Pinsak and Shaver (15) previously have pointed out the lithologic affinities of the Middle Devonian rocks of the Logansport Sag to Traverse rocks of the Michigan Basin. The Miami Bend, Logansport, and Little Rock Creek units represent a southern extension of southward-thinning Traverse strata into the Sag. The Four Mile Dam Limestone of Michigan and the Miami Bend unit represent similar biostromal developments of similar Late Givetian age. The conodont faunas of the Middle Devonian rocks of the Sag are essentially identical to those of Traverse strata of the Michigan Basin.

Because of lithologic similarities, similar depositional histories, and equivalent conodont faunas, it is here proposed that the name Traverse Formation (20) be used for those rocks in the Sag that previously have been designated as Miami Bend Formation, Logansport Limestone, and Little Rock Creek Limestone. The extension of the name Traverse into the Logansport Sag is consistent with Middle Devonian paleogeographic interpretations of Pinsak and Shaver (15) and eliminates needless nomenclature applicable to outcrops in a few-county area. In contrast to the Miami Bend, Logansport, and Little Rock Creek, the Traverse is a mappable unit that can be traced in the subsurface of northern Indiana and the Michigan Basin.

Because the Miami Bend, Logansport, and Little Rock Creek units are quite thin, have unclear lateral relationships, and have been recognized only in outcrop in a few-county area, but do possess identifying lithologic characteristics, it is here suggested that when these names are used they be assigned the rank of lithofacies rather than formation.

Collecting Localities

All cited topographic maps are from the U. S. Geological Survey 7.5 minute series (1:24000).

Locality *1:* Delphi Limestone Company quarry on north side of U. S. Highway 421 northwest of Delphi, SW¼ SW¼ sec. 19, T. 25 N., R. 2 W., Carroll County, Indiana (Delphi quadrangle). Location cited by Cumings and Shrock (9).

Fauna from Little Rock Creek Lithofacies (7 feet 9 inches to 9 feet 2 inches below top) contains *Icriodus latericrescens latericrescens*, *Polygnathus varcus*, and *P. linguiformis linguiformis*. Fauna from Little Rock Creek (4 feet 6 inches to 6 feet 6 inches below top) contains the same fauna but without *I. latericrescens latericrescens*. Fauna from Little Rock Creek (3 feet 2 inches to 4 feet 6 inches below top) contains

only *P. linguiformis linguiformis.* Total thickness of Little Rock Creek is 9 feet 2 inches. The limestone rests on the Huntington Lithofacies of the Wabash Formation (Silurian) and is unconformably overlain by the New Albany Shale (Upper Devonian). A conodont fauna recovered from a limestone band low in the shale contains *Palmatolepis gigas* Miller and Youngquist and *P. subrecta* Miller and Youngquist.

Locality *2*: Little Rock Creek, bed and banks of stream from the bridge near its mouth to about 300 yards upstream, SE¼ SW¼ sec. 17, T. 26 N., R. 1 W., Carroll County, Indiana (Burrows quadrangle). This is the type locality of the Little Rock Creek Lithofacies as designated by Cooper (5); location cited by Cooper and others (8).

Fauna from Logansport Lithofacies includes *Icriodus latericrescens latericrescens, I. expansus, Polygnathus varcus,* and *P. linguiformis linguiformis.* Fauna from Little Rock Creek Lithofacies includes *I. latericrescens latericrescens, I. expansus, I. cymbiformis,* and *P. varcus.* Approximately 12 to 15 feet of strata are poorly exposed at intervals in the bed and along the banks of the stream. Silurian rocks crop out in the creek bed below the bridge, but the contact with Devonian strata is not exposed.

Locality *3:* Low bluff with small natural bridge on north side of South River Road along south side of Wabash River across from Georgetown, SW¼ SW¼ sec. 35, T. 27 N., R. 1 W., Cass County, Indiana (Burrows quadrangle).

Fauna from Logansport Lithofacies (0 to 1 foot 7 inches above base) contains *Icriodus latericrescens latericrescens.* Fauna from Logansport (4 feet 3 inches to 6 feet 6 inches above base) includes *I. latericrescens latericrescens, Polygnathus varcus,* and *P. linguiformis linguiformis.* Exposed thickness of Logansport is 6 feet 6 inches of granular fossiliferous limestone that overlies the Kokomo Limestone Member of the Salina Formation (Silurian).

Locality *4*: West bluff of Grant's Run on east side of South River Road 1 mile east of Georgetown, NE¼ SE¼ sec. 35, T. 27 N., R. 1 W., Cass County, Indiana (Burrows quadrangle).

Fauna from Logansport Lithofacies (4 feet 9 inches to 11 feet 3 inches below top) includes *Icriodus latericrescens latericrescens, I. expansus,* and *Polygnathus linguiformis linguiformis.* Fauna from Logansport (0 to 4 feet 9 inches below top) includes these species but in addition *P. varcus* and *I. cymbiformis.* Exposed thickness of Logansport is 11 feet 3 inches. A covered interval of approximately 20 feet separates the Logansport from the highest exposure of Silurian strata situated in the stream bed at the base of the bluff.

Locality *5*: West wall of France Stone Company quarry on north side of U. S. Highway 24, 2 miles east of Logansport city limits, SW¼ NE¼ sec. 27, T. 27 N., R. 2 E., Cass County, Indiana (Logansport quadrangle). This is the type section of the Miami Bend Lithofacies as designated by Cooper and Phelan (6). Cooper and Phelan recovered

specimens of *Stringocephalus* from the upper 18 inches of the Miami Bend exposed in the abandoned west wall of the quarry (U. S. National Museum Locality 391a).

Fauna from Miami Bend Lithofacies (0 to 1 foot 4 inches, 1 foot 4 inches to 3 feet, 3 feet to 5 feet above base) contains *Icriodus expansus*. Fauna from Miami Bend (5 feet to 7 feet 6 inches above base, 12 feet 8 inches to 14 feet 8 inches above base) contains *I. latericrescens latericrescens*. Fauna from Miami Bend (7 feet 6 inches to 10 feet 2 inches, 10 feet 2 inches to 12 feet 8 inches above base) contains both of these species. Total thickness of Miami Bend is 14 feet 8 inches. It rests on the Kokomo Limestone Member of the Salina Formation (Silurian) and is overlain by isolated patches of the Logansport Lithofacies.

Locality *6:* South wall of France Stone Company quarry near gravel pile, SW¼ NW¼ sec. 26, T. 27 N., R. 2 E., Cass County, Indiana (Logansport quadrangle). Location given by Cooper and Phelan (6).

Fauna from Logansport Lithofacies (0 to 1 foot 10 inches above base) includes *Icriodus latericrescens latericrescens* and *I. expansus*. Fauna from Logansport (12 feet 7 inches to 14 feet 3 inches above base) contains same association but in addition *Polygnathus varcus*. Exposed thickness of Logansport is 14 feet 3 inches. The underlying Miami Bend Lithofacies is 6 feet 2 inches thick and rests on the Kokomo Limestone Member of the Salina Formation (Silurian).

Locality *7:* Pipe Creek Falls, east bluff of Pipe Creek below the dam, 4000 feet north and 1200 feet east of southwest corner of grant 1, T. 26 N., R. 3 E., Cass County, Indiana (Onward quadrangle). This is the type section of the Logansport Lithofacies as designated by Cooper and Warthin (7); section described by Cumings and Shrock (9); location cited by Cooper and Warthin (7), Campbell (3), and Cooper and Phelan (6).

Fauna from Miami Bend (0 to 2 feet 6 inches below base of overlying Logansport) contains *Icriodus expansus*. Fauna from Logansport (0 to 3 feet above base) contains *I. expansus*. The Miami Bend is 6 feet 6 inches thick and rests on the Kokomo Limestone Member of the Salina Formation (Silurian). Exposed thickness of Logansport is 7 feet 10 inches.

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