A BIOSTRATIGRAPHIC STUDY OF THE LOWER MEMBER
OF THE COLUMBUS LIMESTONE IN CENTRAL OHIO

A Thesis
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for the Degree Bachelor of Science

by
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Plate 1. Ventral and dorsal views of *Icriodus huddlei huddlei* Klapper & Ziegler, and ventral and dorsal views of *Icriodus latericrescens robustus* Orr .................. folder
ABSTRACT. Fourteen samples from three surface sections of the lowermost Columbus Limestone in central Ohio yielded small collections of stratigraphically diagnostic conodonts. The sequence of the conodonts in the strata studied is similar to that previously reported from the eastern United States. The presence of *Icriodus huddleii* Klapper & Ziegler confirms the stratigraphic placement of the basal sandstone of the Madison Quarry section as Devonian and correlative to the Lower Columbus Limestone.

INTRODUCTION

Since Mather (1859) first described the Columbus Limestone until the present, no biostratigraphic study has ever been done on the lowermost part of the Columbus Limestone and its associated basal conglomerate. Summerson (1959) described the stratigraphic sequence in one of the sections dealt with herein (Madison Quarry Section), but his age determination was based on pure conjecture and he gave no supporting faunal evidence. Consequently, a more extensive study of the basal Devonian sequence in central Ohio is appropriate. Further, little is known about the age of the
Figure 1. Generalized map of Ohio showing major cities and locations of measured and sampled sections.
dolomitic strata immediately below the Columbus Limestone, and in the present investigation it was also attempted to get diagnostic fossils from these strata. The study includes three relatively well-known sections (Marble Cliff, Mill Creek, and Madison Stone Quarry) and one section (Hal-Mar Quarry) that apparently has not been described before (Fig. 4).

METHODS OF STUDY

Samples were collected from sections at three localities where the basal contact of the Columbus Limestone is exposed. Samples averaging between six and ten kilograms were collected, with the exception of a 360g. sample of shale collected at locality three (Hal-Mar Quarry). The collecting interval varied due to the varying thickness of the basal most unit of the Columbus Limestone, and precise collection levels may be located in figures 2,3, and 4.

In the laboratory, sample preparation procedures were similar to those outlined by Collinson (1963). The samples were in 10% acetic acid for three days, at which time the solution was replenished. Three days later the acetic acid solution was replaced by a 10% formic acid solution, which was replenished after two days. Heavy liquid separation completed the laboratory phase.
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LITHOSTRATIGRAPHY

Introduction

The Lower and Middle Devonian strata of central Ohio consist of the Columbus Limestone, the Delaware Limestone, and the lower part of the Olentangy Shale. The lower part of the Columbus Limestone is uppermost Lower Devonian (Em- sian), the upper part of the Columbus Limestone and the Delaware Limestone are Lower Middle Devonian (Eifelian), and the lower part of the Olentangy shale is Middle Devonian (Givetian) in age (Ramsey, 1969).
The name Columbus Limestone was introduced by Mather (1859) in a description of well samples from Columbus, Ohio. Mather apparently included the overlying Delaware Limestone in his "Columbus Limestone". On the basis of lithologic and paleontologic differences Newberry (1873) first differentiated the Columbus Limestone from the overlying strata, which he named the Sandusky Limestone.

Winchell (1874) first used the name "Delaware stone" for the lower part of the strata overlying the Columbus Limestone in Delaware County, Ohio. Orton (1878) first used the name Delaware Limestone to include the entire interval that is presently recognized as the Delaware Limestone in central Ohio. Winchell (1874) correlated the Delaware Limestone with the Sandusky Limestone of Newberry. Swartz (1907) concluded that the Delaware and Sandusky Limestones were not correlative and that the Sandusky was correlative with the Columbus Limestone. Prosser (1905) suggested that the name Sandusky Limestone be dropped and that Delaware Limestone be adopted. This practice has been followed by subsequent authors.

Lithologic Sequence

The Columbus Limestone is divisible into a lower and an upper part on the basis of the lithology and fossil content (Janssens, 1969). The lower part of the Columbus Limestone is a 30- to 35- foot thick, massive, sparsely fossiliferous, dolomitic limestone. The upper part of the
Figure 2. Columnar section of the lithologic succession of locality 1, the Madison Stone Quarry section. Black bars on the right side indicate location of samples. For lithologic details, see Appendix II.
Columbus Limestone is approximately 60 feet thick, less massive, less dolomitic, and more fossiliferous than the lower portion. Janssens (1969) placed Stauffer's (1909) coral "zone" at the base of the upper portion of the Columbus Limestone (Fig. 5).

At locality one, the Madison Stone Quarry of West Jefferson, Ohio (Fig. 2), samples were collected from a five foot interval from the Bass Island Group dolomite six inches into the upper Columbus Limestone. At this locality the contact between the Columbus Limestone and the Bass Island Group dolomite is marked by an abrupt change from a buff, finely laminated, unfossiliferous dolomite to a two-foot interval of limy sandstone/sandstone/limy sandstone. This unit includes a distinctive carbonate cemented, well-sorted quartz sand. Immediately above this unit is a thin clay layer, and then a clastic, styolitic limestone belonging to the upper Columbus Limestone. The coral "zone" is missing from the upper Columbus Limestone in this section. The Bass Island Group dolomite has a brecciated upper surface, and Summerson (1959) states that there is evidence of weathering and irregular polygonal cracking on the upper surface.

At locality two, a bluff on the south bank of Mill Creek in Delaware County, Ohio (Fig. 3), samples were collected from a four-foot interval from the underlying
Figure 3. Columnar section of the lithologic succession in locality 2, the Mill Creek section. Black bars on the right side of the column indicate the location of samples. For lithologic details, see Appendix II.
dolomite and two feet into the lower Columbus Limestone. At this locality the Columbus Limestone unconformably overlies rocks that are of lower Devonian age. The contact is a one foot thick sandy and conglomeratic dolomite containing well rounded pebbles from the underlying strata. The lower part of the Columbus Limestone is a massively bedded, fine-grained, sparsely fossiliferous dolomitic limestone. The section is capped by a four to six foot section of the upper Columbus Limestone containing the coral "zone" of Janssens (1969) and Stauffer (1909).

At locality three, the Hal-Mar Stone Quarry in Pickaway County, Ohio (Fig. 4), five samples were collected from a six foot interval from the underlying Bass Island Group dolomite four feet into the overlying upper Columbus Limestone. At this locality the contact between these units is very irregular. A direct contact between the Bass Island dolomite and the coral "zone" of the upper Columbus Limestone can be observed. In the southeast corner of the quarry section a conglomerate containing well rounded dolomite pebbles of a lithology different from that of the underlying Bass Island Group dolomite can be seen as lenses along the contact. Also, in the same lithologic horizon, a thin, black shale was found. Although the shale yielded some conodont fragments, it cannot be more precisely dated than as Devonian (see Fig. 6). For further information about the
Figure 4. Columnar section of the lithologic succession in locality 3, the Hal-Mar Quarry. Black bars on the right side of the column indicate the location of samples. For lithologic details, see Appendix II.
lithology of the sections, see Appendix II.

CONODONT BIOSTRATIGRAPHY

Previous work

Stewart & Sweet (1956) first studied the conodonts from the bone beds in the Columbus and Delaware Limestones of central, north-central, and west central Ohio, but at that time little was known about Lower and Middle Devonian conodonts and their stratigraphic value. Stewart & Sweet (op. cit.) made no attempt to establish a zonation since samples were collected from the bone beds only and did not yield adequate material for detailed study of the stratigraphic distribution of conodonts throughout the two formations.

Klapper & Ziegler (1967) recognized eight Lower and Middle Devonian faunas in the standard North American Devonian sequence in New York. Klapper (1969) has discussed a sequence of five conodont faunas from the Lower Devonian of Royal Creek, Yukon Territory, and one Lower Devonian conodont fauna from Devon Island, Canada, which he compared with the Eureka County sequence of central Nevada.

Ramsey (1969) studied the conodont faunas of the Columbus and Delaware Limestones and the lower Olentangy Shale in central Ohio. She determined the upper limit of distribution of Icriodus huddlei huddlei Klapper & Ziegler, a stratigraphically important species, to be the top of the
lower Columbus Limestone (Bellepoint member). However, her study did not include detailed work on the lowermost Columbus Limestone.

Conodont Fauna

The conodont fauna studied included principally two species: *Icriodus huddiei* Klapper & Ziegler, and *Icriodus latericrescens* robustus Orr. Ramsey (1969) examined a series of samples from this author's locality two, the Mill Creek Section (Fig. 3) sampled at two foot intervals above the basal conglomerate (see Fig. 3, 68RB-001 thru 68RB-033). One additional sample was taken from the dolomite below the conglomerate. That sample yielded a specifically unidentifiable anterior process of a species of *Icriodus*. This specimen is either as *Icriodus huddiei* Klapper & Ziegler or *Icriodus latericrescens* robustus Orr; the distinction between these species is the point of juncture of the outer lateral process and the anterior process and unfortunately this specimen misses the lateral process and the point of juncture. The specimen, however, is distinct from the only pre-Devonian *Icriodus* species known from the Silurian, accordingly the dolomitic strata must be of Devonian age. This age assignment is different from that generally accepted for these dolomitic strata - Silurian -, but it should be noted that the previous dating has never been supported by fossil evidence.
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Figure 5. Columnar section of the lithologic succession in the Marble Cliff Quarry section.
Ramsey (1969) records *Icriodus huddlei huddlei* Klapper & Ziegler only from the lower Columbus, where it is associated with *Icriodus latericrescens robustus* Orr. This assemblage is similar to the *I. huddlei huddlei-* *I. latericrescens* n. subsp. A Orr assemblage described by Klapper & Ziegler (1967), which is characterized by the above association and the absence of other platform conodonts. Klapper & Ziegler (1967) have reported this assemblage from the Schoharie Formation in eastern New York and the Bios Blanc Formation in western New York. Orr (in Klapper & others, 1970) has reported this assemblage from the Clear Creek Limestone of Illinois.

The association of *Icriodus huddlei huddlei* and *Icriodus latericrescens robustus* appears to be characteristic of faunas of Emsian age in the eastern United States. Direct correlation of Emsian faunas of the eastern United States with those of the Nevada-Royal Creek sequence is difficult because *Icriodus huddlei huddlei* is a long-ranging species in Nevada and *Icriodus latericrescens robustus* has not yet been reported from Nevada (Klapper & others, 1970) (see Plate 1 for illustrations).

Klapper & Ziegler (1967) placed the Schoharie and the Bios Blanc Formations in the Emsian on the basis of megafossil evidence (Boucot & Johnson, 1967) since the
Figure 6. Correlation of the investigated basal Columbus Limestone successions in central Ohio. Note that the coral "zone" is missing in the Madison section where only strata of the upper Columbus Limestone is present.
association of Icriodus huddlei huddlei and Icriodus latericrescens robustus has not yet been found in Europe. Klapper & others (1970) noted that the highest range of Icriodus huddlei huddlei is the Schönauer Kalk (Upper Emsian) in Germany and the upper Eureka spirifer pinyonensis zone (Emsian) in Nevada. This supports Klapper & Ziegler's (1967) dating of the conodont faunas from the Schoharie and Bois Blanc Formations in New York.

The lower portion of the Columbus Limestone in central Ohio was correlated by Oliver & others (1968,1969) with the lower part of the Onondaga Limestone of New York. However, on the basis of the conodont fauna it appears that the lower portion of the Columbus Limestone is correlative with the Schoharie and Bois Blanc Formations in New York rather than with the lower part of the Onondaga Limestone. Presently this correlation is based entirely on conodonts, but it should be noted that no megafaunal study has been made of the lower part of the Columbus Limestone in central Ohio due to the apparent absence of such a fauna.

Below I will discuss the conodont biostratigraphy of each section separately.

Locality one, the Madison Stone Quarry, Madison Co., Ohio (Fig. 2), had four samples collected. Sample 73DB1-2 yielded a specifically unidentifiable fragment of an Icrio-
 dus. Sample 73DB1-3 yielded one specimen, an *Icriodus huddllei huddllei* Klapper & Ziegler. Immediately above the limestone there is a 1/8" clay layer and then a massive limestone characteristic of the upper Columbus Limestone (Summerson, 1959). The presence of *Icriodus huddllei huddllei* Klapper & Ziegler places this limestone/sandstone/limestone sequence as a correlative of the lower Columbus Limestone. This unit is conformably overlain by the upper Columbus Limestone.

Locality two, the Mill Creek Section (Fig 3), had five samples collected. No specimens were recovered from the samples. Ramsey (1969) collected samples from the succession at this locality and recovered some forty specimens and demonstrated the presence of an *Icriodus huddllei huddllei- Icriodus latericrescens robustus* faunal assemblage as has been discussed earlier.

Locality three, the Hal-Mar Quarry in Pickaway County (Fig. 4), had five samples collected and yielded twenty-two fragments of *Icriodus sp?* and one *Icriodus latericrescens robustus*. Sample 73DB3-11 yielded three fragmentary anterior processes of *Icriodus*. Sample 73DB3-13 yielded five fragmentary anterior processes of *Icriodus* and one complete specimen of *Icriodus latericrescens robustus* Orr. Sample 73DB3-14 yielded fourteen fragmentary anterior pro-
cesses of *Icriodus* sp?.

CONCLUSION

Conodonts show that the basal conglomerate of the Columbus Limestone at Mill Creek, Marble Cliff Quarry, and Hal-Mar Quarry is of Lower Devonian (Emsian) age. The sandstone/limestone unit found in the Madison Quarry is in all probability equivalent to the conglomerate. The upper part of the dolomite unit immediately below the Columbus Limestone at Mill Creek is apparently not Silurian, but Lower Devonian in age. This suggests that additional studies should be carried out of the dolomites immediately below the Columbus Limestone to establish their precise age elsewhere in central Ohio.
COLLECTING LOCALITIES

Locality 1. Bass Island Group dolomite, Lower Columbus Limestone, and Upper Columbus Limestone exposed in the Madison Stone Quarry, 1.6 miles S of West Jefferson, Ohio, Jefferson Township, Madison County, Ohio (West Jefferson, Ohio 7.5 min quad).

Locality 2. Basal Columbus Limestone as exposed in a bliff on the south side of Mill Creek, immediately below a gaging station, NW corner, Concord Township, Delaware County, Ohio (Shawnee Hills, Ohio 7.5 min quad).

Locality 3. Bass Island Group dolomite with unconformal upper Columbus Limestone, between which is found lenses of conglomerate and shale, as exposed in the Hal-Mar Quarry, SW corner, Deer Creek Township, Pickaway County, Ohio (Clarksburg, Ohio 7.5 min quad).
APPENDIX II

LITHOLOGIC DESCRIPTION OF SECTIONS

Locality 1. The Madison Quarry section (Fig. 2).

Upper Columbus Limestone.

A zero to fourteen foot remnant of the Upper Columbus Limestone is present at the quarry. It is a medium-bedded, clastic limestone with occasional stromatolites and a pronounced sty-olite layer 15" above its base. The base is marked by a thin clay and is conformable to the underlying strata.

Lower Columbus Limestone.

A two foot sequence of dolomitic sandstone/sandstone/ sandy limestone. The base is conformable to the underlying strata and is a reddish, limonitic stained sandy limestone about 6½-7" thick. There is a sharp contact with the medial white, fine-grained, well-rounded, well-sorted, carbonate cemented sandstone which is about 5½-8" thick. Above this is a grey, sandy, dolomitic limestone with much sand in the lower portion and little sand in the upper portion. The upper contact of the lower Cloumbus Limestone is very sharp and marked by a 1/8" clay layer.

Bass Island Group Dolomite.

More than thirty feet of grey-green, finely-
laminated dolomite, which is locally cherty and brecciated. The upper contact is a brecciated, limonitic, sparry calcite horizon 2-3" thick. Summerson (1959) states that irregular polygonal cracking is also present.

Locality 2. The Mill Creek section (Fig. 3).

Upper Columbus Limestone.

A 4½-6 foot section of the upper Columbus Limestone is present. A coral biostrome marks the base of the upper Columbus Limestone (Janssens, 1969). The grey limestone is clastic, medium-bedded, and contains many corals and bryozoans.

Lower Columbus Limestone.

The lower Columbus Limestone may be subdivided into two zones; a basal zone containing a grey-green-brown, medium bedded, sparsely fossiliferous dolomite and a one foot thick conglomerate containing well-rounded, poorly sorted pebbles derived from the underlying dolomite; and an upper zone containing a massive, fine-grained, brown, sparsely fossiliferous dolomite between 30 and 33 feet thick.

Locality 3. The Hal-Mar Quarry section (Fig.4).

Olentangy Shale.

The unit is a thinly bedded blue shale with
thin interbedded limestone with a total thickness of about 20 feet. The contact between the Olentangy Shale and the Columbus Limestone is covered by excavation debris.

Upper Columbus Limestone.

The upper Columbus Limestone is a 14-16 foot thick, very clastic, grey limestone which unconformably overlies the Bass Island Group Dolomite. The lower portion of the limestone contains a thick coral "zone" similar to the basal coral "zone" of Stauffer (1909) and Janssens (1969). The limestone contains many corals, bryozoans, crinoidal fragments, and some brachiopods.

Lower Columbus Limestone.

The lower Columbus Limestone here is represented by a thin, 1 foot thick conglomerate. The basis for this determination is the similarity of the lithology of the pebbles to the basal conglomerate and dolomite of the Mill Creek section. The pebbles do not appear to be derived from the underlying Bass Island Group dolomite. Also, in this same interval, a thin (¼ inch) black shale was found. Fragmentary conodonts of definite Devonian age were found in this shale. Determination of the precise age of the unit requires further study.
Bass Island Group Dolomite.

A 16 foot section of Bass Island Group dolomite is present. It is a grey-green, finely-laminated dolomite with locally cherty horizons and is locally brecciated.

Tymochtee Dolomite.

An 8 foot section of Tymochtee dolomite is represented here as a thinly bedded, platy, grey-green, finely-laminated dolomite.
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