

STRATIGRAPHY OF THE MIDDLE DEVONIAN SHALES OF SOUTHERN ILLINOIS

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ABSTRACT.— Study of fossils from the Middle Devonian shales of southern Illinois has made possible the differentiation of these beds into two units. The first unit, the Misenheimer Shale, is assigned to the Lingle Limestone as its basal member; the second unit, strata below the Misenheimer and above the Grand Tower Limestone in northern Union County, is tentatively referred to the St. Laurent Limestone.

Rocks of Devonian age were reported from southern Illinois as early as 1857 by Norwood, and formation names were applied to these strata by Savage (1920a). General agreement has not been reached on the recognition of these stratigraphic units, especially in the Middle Devonian above the Grand Tower Limestone. In this paper two exclusively Hamilton-age formations are recognized in southern Illinois, the St. Laurent Limestone (a tentative assignment), and the Lingle Limestone. A rock unit that was originally proposed as a formation, the Misenheimer Shale (Savage, 1920a), is reduced to the status of a member — The Misenheimer Shale Member of the Lingle Limestone (FIGURE 1).

The recognition and reclassification of these strata is the result of detailed faunal studies of Middle Devonian shales in southern Illinois started at

Southern Illinois University in 1963 under the direction of Dr. David Nicol, now at the University of Florida. In January, 1965, the study came under the direction of Drs. George H. Fraunfelder and John Utgaard, Southern Illinois University. The author also wishes to acknowledge the aid of Dr. G. Arthur Cooper, U. S. National Museum, Dr. N. Gary Lane, University of California, Los Angeles, and of his fellow students Ira R. Satterfield, John F. Baesemann, and James Norton. Figure 2 was drawn by Mrs. Opal Kurtz.

PALEONTOLOGY AND LITHOLOGY

Paleontology — The Lingle and St. Laurent Limestones consist of alternating limestone and shale beds that reach a maximum thickness of 142 feet in northern Union County (Figures 2 and 3). On the north these beds are truncated by the Rattlesnake Ferry Fault and on the south they are buried by alluvium from the Ohio River. Fossils were collected from the shale beds at nine localities (Table 1), four of which consist of reasonably complete stratigraphic sections and are used as reference sections in this report (Figure 3).

The lowest shale exposed above the *Microcyclus* zone in sections 3 and 5 contains a distinctive but sparse fauna typified by *Chonetes* sp. and *Nuculites triquetor*, and is here tentatively placed in the St. Laurent Limestone. *Chonetes* sp. and *Nuculites triquetor* do occur

rarely in higher shales, all of which are in the Lingle Limestone, but their relative abundance in the lowest shale bed, plus the absence of species typical of the Lingle shales, distinguishes the lower bed from the shales above.

Shale beds A, B, and C in reference section 1, bed B of sections 3 and 5, and the shale in section 7 all contain a second, higher, fauna typified by *Actinopteria muricata*, *Camarotoechia* sp. and *Productella* sp. This assemblage is characteristic of the Misenheimer Shale Member of the Lingle Limestone. Savage (unpublished manuscript, 1920b) listed the following species from the Misenheimer Shale: *Actinopteria muricata*, *Leiorhynchus limitare* (probably=*Camarotoechia* sp. of this study), *Productella* sp., and *Pterinea* cf. *P. flabella*. The latter species was not found during collection for this report, perhaps because Savage applied the name to specimens of *Actinopteria muricata* with strong radial ornament. The three species cited above as typical of the Misenheimer shale beds at the reference sections are also typical at localities 6, 8, and 9. Other fossils characteristic of the Misenheimer Shale Member are *Ambocoelia* sp., *Rhinocaris* cf. *R. columbina*, *Styliolina fissurella*, and an unidentified fistuliporid bryozoan. Abundant megaspores were also found at localities 7 and 8.

Lithology—In contrast to the faunal differences mentioned above, lithologic distinctions between the shale beds referred to the St. Laurent and shales of the Misenheimer Shale Member are not easily made. At all outcrops the shale in the St. Laurent Limestone is medium to dark brown, thin-bedded, and calcareous on fresh surfaces, and light tan and noncalcareous on weathered surfaces.

Shales in the Misenheimer are variable in their constitution. Generally the Misenheimer is brown to gray shale when unweathered, tan on weathered surfaces, thin-bedded and calcareous in the north, and very thin-bedded to thickly laminated and noncalcareous in the south. The upper shale beds in the Misenheimer in the north more closely resemble the typical Misenheimer of the south than do the lower beds. In the southern part of the area the Misenheimer has been subjected to rather extreme weathering, and its composition is noticeably complicated at locality 6 by mineralization and alteration due to faulting. A few thin limestone beds are present in the Misenheimer to the north

(reference sections 1 and 2); these limestones are fossiliferous, but their paleontology and petrology has not been studied.

DISCUSSION OF THE STRATIGRAPHY

Historical—Savage (1920a, 1920b) believed that in northern Union County and at Grand Tower, Illinois, the Misenheimer Shale was absent, and that the Lingle Limestone, with *Microcyclus*-bearing rocks at its base, rested directly on the Grand Tower Limestone. This interpretation has been reiterated to varying degrees in publications of the Illinois State Geological Survey by J. M. Weller (1940, 1944a, 1944b), Orr (1964), and Meents & Swann (1965), although none of these later authors recognizes the Misenheimer Shale as a valid rock unit. G. A. Cooper *et al.* (1942) and G. A. Cooper (1944) tentatively assigned the *Microcyclus*-bearing rocks in northern Union County and at Grand Tower, Illinois to the St. Laurent Limestone, which

DEVONIAN	Upper	Grassy Creek Shale
		Alto Limestone
	Middle	Lingle Limestone
		Misenheimer Shale Member
		St. Laurent Limestone
		Grand Tower Limestone
	Lower	Clear Creek Limestone
		Backbone Limestone
		Grassy Knob Chert
		Bailey Limestone

FIGURE 1. The Devonian formations of southern Illinois.

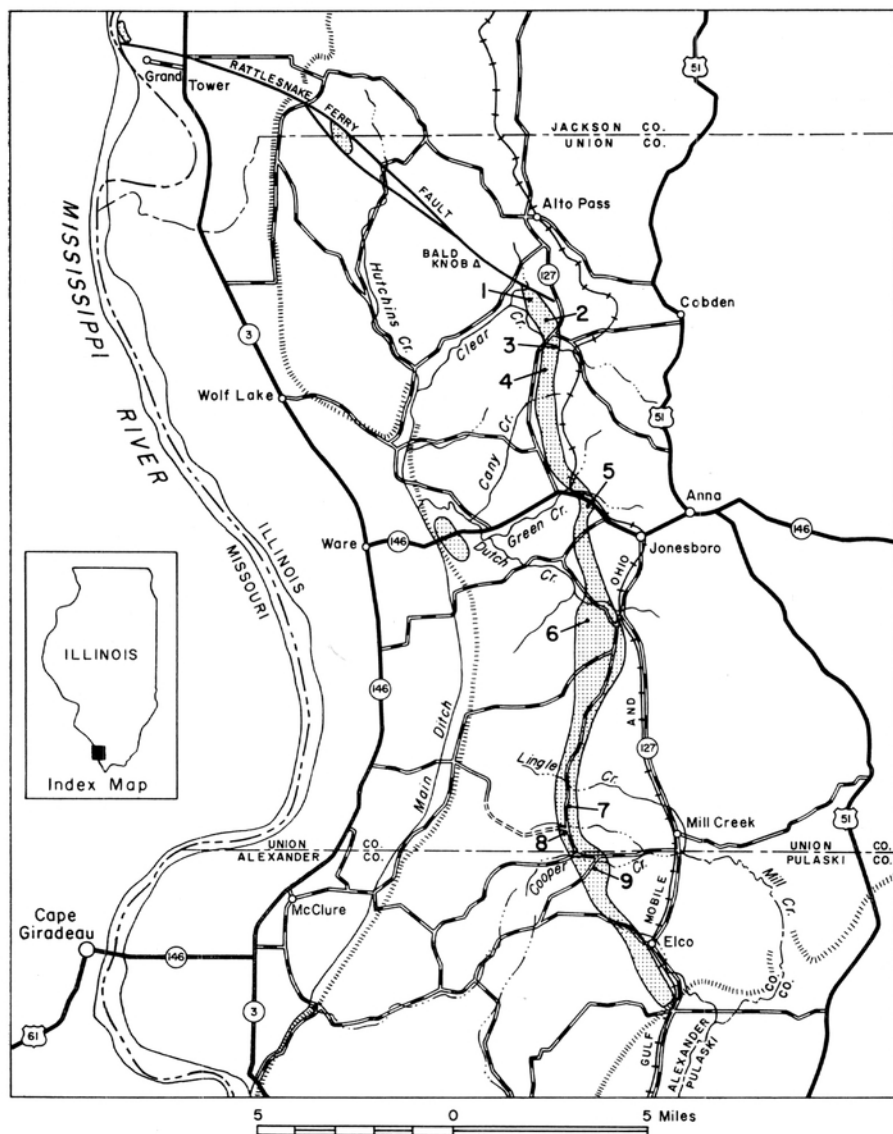


FIGURE 2.—Stipled area indicates outcrop pattern of the combined St. Laurent, Lingle, and Alto Limestones (modified from Weller and Ekblaw, 1940). Large numbers indicate collecting localities. See Appendix for more precise locality data.

had formerly been recognized only in southeastern Missouri. A graphic summary of the various stratigraphic

interpretations of the Middle Devonian of southern Illinois is shown in Figure 4.

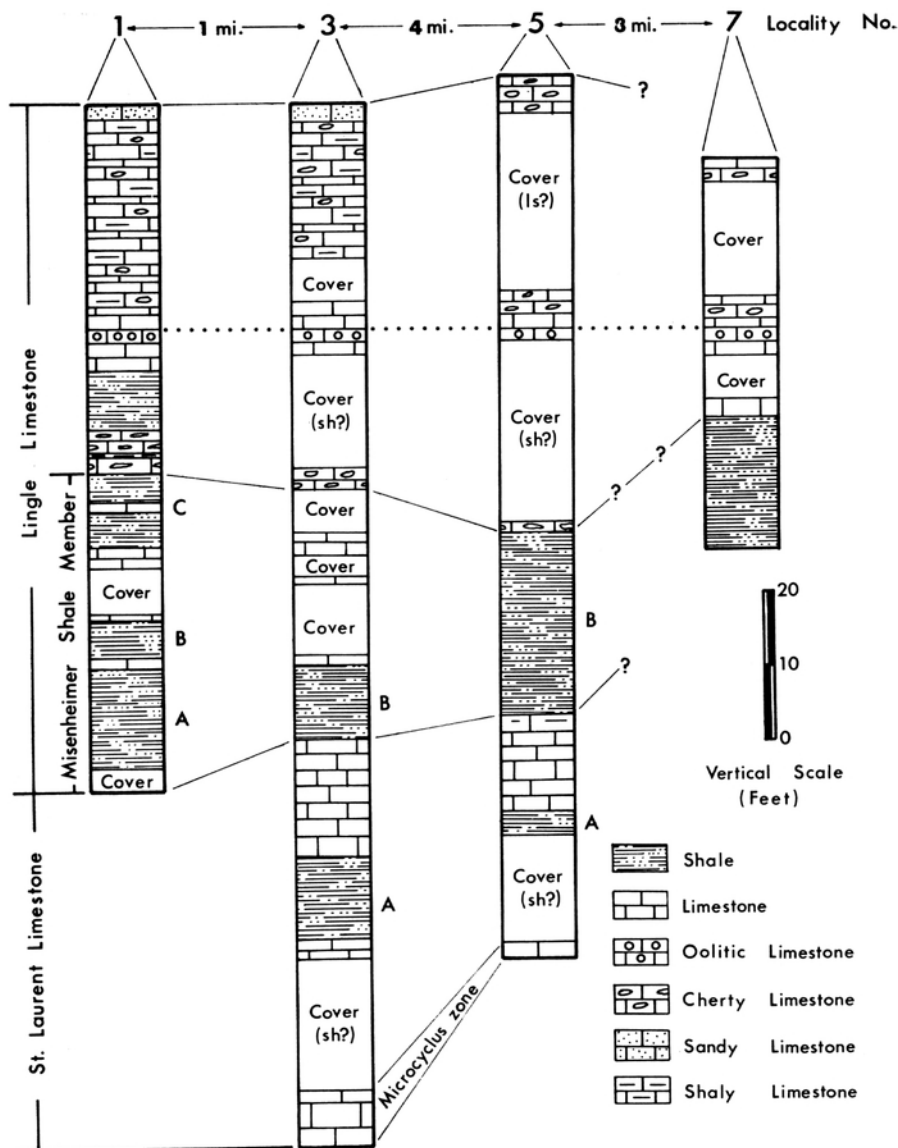


FIGURE 3.—Columnar sections of the Lingle and St. Laurent Limestones. The principal reference section for the Misenheimer Shale Member is at locality 5.

Some of the ambiguities and conflicting interpretations of Middle Devonian stratigraphy of southern Illinois are probably the result of an un-

fortunate choice of type localities by Savage (1920a) for his Lingle and Misenheimer formations. These localities are in the southern part of the

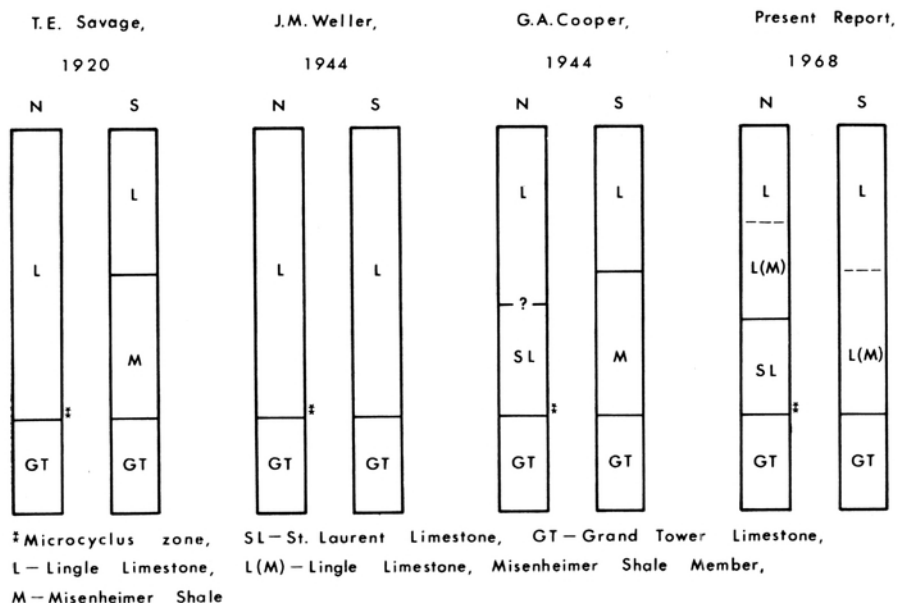


FIGURE 4.—Summary of interpretations of Middle Devonian stratigraphy in southern Illinois. Each author's interpretation of the stratigraphy in the northern (N) and southern (S) parts of the outcrop area is represented. Not to scale.

outcrop belt and although the sequence is thicker and the exposure is better in the north, Savage apparently felt compelled to designate the type areas where he did because of the close relationship between his two formations and the supposed absence of the Misenheimer in the north.

The Misenheimer Shale Member—J. M. Weller (1944a) recommended suppression of the name Misenheimer on the basis that the unit could not be recognized consistently, and included all strata from the top of the Grand Tower Limestone to the base of the Alto Limestone in the Lingle. G. A. Cooper (1944) disagreed with Weller's definition of the Lingle, but in his short discussion of the Misenheimer did not define the stratigraphic or geographic boundaries of the unit.

The present reappraisal of the status of the Misenheimer stems from recognition of the Misenheimer fauna in northern Union County in shales 56 and 34 feet above the Grand Tower at localities 3 and 5 respectively, and the evidence for lateral continuity of these beds with Savage's type Misenheimer furnished by fossil collections from nine localities and extensive field mapping (especially by Ira R. Satterfield). This evidence indicates that a more refined stratigraphic interpretation can now be made and that such an interpretation must include the Misenheimer.

There are two reasons for assigning these shales to the status of the Misenheimer Shale Member of the Lingle Limestone. The Middle Devonian beds above the St. Laurent

Limestone form a coherent sequence. The close relationship of the Misenheimer to the Lingle is especially apparent in the northern part of Union County where there are several thin limestone beds that interfinger with the shales (FIGURE 3). This close stratigraphic relationship is the principal reason for the inclusion of the Misenheimer in the Lingle Limestone. Also, considering the typically poor exposure it is not generally practicable to map such a thin shale unit. Although this last point is subjective, the author feels that it lends considerable weight to the argument for the inclusion of the Misenheimer in the Lingle.

Under the code established by the American Commission on Stratigraphic Nomenclature (1961, Article 13, Remark (h)) type sections cannot be moved; however, Article 13, Remarks (a) and (i) permit the establishment of reference sections and a principal reference section when for various reasons the type section is inadequate. The type locality established for the Misenheimer by Savage (1920a, 1920b) is locality 8 of this report. At this locality neither the upper nor lower contact is well exposed, although the Misenheimer does appear to be resting on the Dutch Creek Sandstone which is the basal member of the Grand Tower

TABLE 1.—Distribution and abundance of fossils in the Middle Devonian shales of southern Illinois.

Fossils	Locality												
	1A	1B	1C	2*	3A*	3B	4*	5A*	5B	6	7	8	9
<i>Rhinocaris</i> cf. <i>R. columbina</i>		R				C			R	R			
<i>Lingula</i> sp.					R								
<i>Orbiculoidea</i> sp.						C			R				
<i>Ambocoelia</i> sp.	C	A				A			R	C			
<i>Camarotoechia</i> sp.		C		R?		R	C?		A	A	A	A	C?
<i>Chonetes</i> sp.					R		A	C			C?	R?	
<i>Cupulorostrum?</i> sp.		R				A							
<i>Productella</i> sp.			R			A			A	C	R	R	R
<i>Michelinoceras</i> sp.						R			C				
<i>Spyroceras</i> sp. A.	R?		R?		R?		C						
<i>Spyroceras</i> sp. B.						R							
<i>Spyroceras</i> sp. C.							R						
<i>Tornoceras</i> (<i>Tornoceras</i>) cf. <i>T. (T.) uniaugulare</i>							R						
<i>Actinopteria muricata</i>	R	C	R			A			A	A	C	C	
<i>Cornellites</i> sp.						R			R				
<i>Leiopteria</i> cf. <i>L. leavis</i>									R	R			
<i>Leptodesma</i> sp.											R		
<i>Modiella?</i> sp.							R						
<i>Modiomorpha</i> sp.					R	R	C						
<i>Nuculites triquetor</i>			R	R	R	R	A	C					
<i>Phthonia</i> cf. <i>P. cylindrica</i>					R		C		R				
Fistuliporid Bryozoan.	R	C	R			A			A	R			

*=St. Laurent horizon, all other locality numbers refer to shales in the Lingle.
?=Identity in question

R = Rare (1 - 3 specimens)
C = Common (4 - 12 ")
A = Abundant (Over 12 ")

formation. Because of the inadequacy of the type locality it is proposed that the sections at localities 1, 3, 5, and 7 illustrated in Figure 3 be recognized as reference sections, and that of these locality 5 be recognized as the principal reference section.

Where exposed the upper contact of the Misenheimer is sharply defined, but the lateral persistence of thin black cherty limestone above, and of other thin limestone beds in the Lingle suggests that the entire sequence is conformable. At locality 5 the lower contact of the Misenheimer is gradational; the upper few inches of the massive limestone bed at the top of the St. Laurent become argillaceous and thin-bedded. Farther south the Misenheimer rests on the basal Dutch Creek Sandstone Member of the Grand Tower Limestone with what is probably a local unconformity.

There is a general decrease in the proportion of carbonates as one goes south along the Devonian outcrop in southern Illinois and it is not entirely clear whether this is the result of a facies change, or carbonate solution by weathering, or both. J. M. Weller (1944a) discussed the case for weathering and concluded that for the most part the decrease in carbonates was due to that cause. Later, Meents and Swann (1965) tried to resolve some of the stratigraphic problems encountered in the Grand Tower by proposing a structural feature they named the Wittenburg Trough, which was active in the Devonian and extended from southern Illinois northwest into Missouri following the boundary between the Ozarks and the Illinois Basin.

Strata of the St. Laurent and upper Grand Tower formations were not seen south of Jonesboro, Illinois, and the Misenheimer appears to rest on the Dutch Creek Sandstone in southern Union County. Some limestone blocks from the Lingle are slumped over the Misenheimer at locality 8, but Lingle carbonates are not seen farther south. It is this author's opinion that thinning of the Middle Devonian section and gradual disappearance of carbonates to the south indicates that the rocks to the south were deposited shoreward relative to the rocks farther north, probably near the edge of the Wittenburg Trough.

CONCLUSIONS

1. The status of the Misenheimer Shale is reevaluated and it is designated here the Misenheimer Shale Member of the Lingle Limestone.
2. The Misenheimer Shale Member is traced the full length of the Middle Devonian outcrop in Union and Alexander Counties, southern Illinois.
3. Strata below the Misenheimer Shale Members of the Lingle Limestone and above the Grand Tower Limestone are tentatively referred to the St. Laurent Limestone as suggested by Cooper (1944).
4. A much larger fauna is reported from the Middle Devonian shales of southern Illinois than was previously known.

APPENDIX OF LOCALITIES

All collecting localities are listed below. The sequence of numbering agrees with that used on all figures and tables. When the locality number is followed by a letter e.g. 3B, the letter denotes a particular shale unit as illustrated in figure 3.

1. SE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 27, T. 11 S., R. 2 W., 3 Principal Meridian, 3 $\frac{1}{2}$ miles west of the Village of Cobden and 2 miles south of the Village of Alto Pass, Union County, Illinois. This is the most northerly good exposure of the Lingle Limestone. It is $\frac{1}{4}$ mile north of the sharp bend in the county road in the NW $\frac{1}{4}$ sec. 27, same township. See figure 3 for a columnar section of the Lingle Limestone at this locality.

2. NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 27, T. 11 S., R. 2 E., 3 P.M.; 3 $\frac{1}{4}$ miles west of the Village of Cobden, and 2 $\frac{1}{2}$ miles south of the Village of Alto Pass, Union County, Illinois. This is a small exposure of the lowest shale unit. It is on the east hillside of a field adjacent to the gravel road in sec. 27, same township.

3. NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 34, T. 11 S., R. 2 W., 3 P.M.; 3 $\frac{1}{4}$ miles west of the Village of Cobden, and 3 $\frac{1}{4}$ miles south of the Village of Alto Pass, Union County, Illinois. *Microcyclus*-bearing rocks crop out in the south bank of Clear Creek 200 feet east of the bridge on Illinois State Highway 127. It is extremely difficult to accurately measure the stratigraphic section at this locality. See figure 3 for a columnar section.

4. NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 34, T. 11 S., R. 2 W., 3 P.M.; 3 $\frac{1}{4}$ miles west of the Village of Cobden, and 3 $\frac{1}{4}$ miles south of the Village of Alto Pass, Union County, Illinois. This is a very small exposure in the base of the main drainage from Iron Mountain. The shale here is very calcareous and contains a distinctive assemblage of fossils.

5. NE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 23, T. 12 S., R. 2 W., 3 P.M.; 1 $\frac{3}{4}$ miles NW of the Town of Jonesboro, Union County, Illinois. *Microcyclus*-bearing rocks crop out in the south bank of Green Creek 300 feet SW of the bridge across Illinois State Highway 146. There has been much slumping in the upper part of the section at this locality. See figure 3 for a columnar section.

6. SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 2, T. 13 S., R. 2 W., 3 P.M.; 3 miles SW of the Town of Jonesboro, Union County, Illinois. Access to this locality is best gained by using the trail which goes south from the main road just west of the center of sec. 35, T. 12 S., R. 2 E., 3 P.M. Approximately 20 feet of shale is exposed in the east bank of the main drainage. The shale here closely resembles the "calico rock" found in the Springville Shale. The colors vary from white to tan with maroon patches and streaks. A fault is

exposed at the north edge of the outcrop.

7. SW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 26, T. 13 S., R. 2 W., 3 P.M.; 3 miles WNW of the Village of Mill Creek, Union County, Illinois. The outcrop is immediately adjacent to the main county road in the SW $\frac{1}{4}$ sec. 26, at the concrete ford on Lingle Creek. This exposure is the type section of the Lingle Limestone. See figure 3 for a columnar section.

8. SW $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 35, T. 13 S., R. 2 W., 3 P.M.; 3 miles west of the Village of Mill Creek, Union County, Illinois. The exposure is in the south bank of a branch of Cooper Creek about 400 feet west of the main county road in sec. 35; and is the type section of the Misenheimer Shale.

9. NE $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 2, T. 13 S., R. 2 W., 3 P.M.; 2 $\frac{1}{2}$ miles WSW of the Village of Mill Creek, Alexander County, Illinois. The exposure is in the creek bed 150 feet south of the farmhouse at the above location. This is the southern-most exposure of Lingle Limestone and the only exposure observed in Alexander County.

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