

NOTES ON SOME NORTHWESTERN INDIANA
ROCK EXPOSURES

ROBERT R. SHROCK, University of Wisconsin
and

CLYDE A. MALOTT, Indiana University*

Introduction. It is the purpose of this brief paper to present some of the results of an investigation of a number of rock exposures in northwestern Indiana. Some of these exposures have been described previously by various investigators, but others have not. The investigation was carried on during the field season of 1929.

The exposures here discussed occur in an area comprising parts of Newton, Jasper and White counties. The area lies in the flat Wisconsin drift plain where rock exposures are rare and surprisingly present. The exposures are usually very small and occur in local quarries or in shallow stream beds widely separated and hemmed in by the mantling drift. Many of the quarry openings have long been abandoned and the exposures are so obscured that they do little more than barely suggest the character of the rock. Some of the quarry and stream exposures, however, are very good, although their limited size and wide separation often make correlations insecure and doubtful. The accompanying map (Figure 1) represents an attempt to depict the general subglacial geology of the area, and is based on the exposures studied, the information indicated by certain well records, and the general relations which the region bears to the larger structural conditions of this part of northern Indiana. It is to be noted that the identification and distribution of the formations depart considerably from the geological maps which have been published in the past.

Kentland Exposures. The three quarries located about three miles east of Kentland in southern Newton County, Section 25, T. 27 N., R. 9 W., reveal parts of the most complicated structure in Indiana. The present active quarry is quite large, occupying several acres, and the rock now being taken from the bottom of the quarry is 60 feet below the surface. The strata are inclined at high angles, in some places closely approaching verticality, and the strike of the upturned layers is far from uniform especially in the south half of the quarry. The other two quarries of the group have been abandoned for a long time. One of them lies about 300 yards southeast of the large active quarry, while the other lies about 600 yards west. These two quarries are rather shallow, but they clearly reveal the upturned strata which are very similar to those of the main quarry. The structure in these quarries has resulted from intense deformation by both folding and faulting. Rocks are exposed here which in nearby localities, in some cases less than three miles, are 1,500 feet beneath the surface. Such structure, occurring as it does in a region of flat-lying rock remote from known areas of intense deformation, is very surprising, and, of course, intensely interesting to the geologist. A paper giving the details of this area is being prepared, and in it will be presented the evidence for conclusions stated below.

*Contributions from the Waterman Foundation, No. 45.

The rocks in the Kentland quarries were first referred to the Niagaran, and the attitude of the strata referred to the same cause as that for the so-called "domes" along the Wabash River.¹ It has been shown, however, that these so-called "domes" are ancient coral reefs of Niagaran age (Cummings and Shrock, 1927, 1928), and that the strata at Kentland are of Ordovician age (Collett, 1883, 58-59; Greene, 1906, 11-17 and Foerste, 1921, 278). The structural situation at Kentland is apparently in no way related to the reefs.

Although Collett (1883, 58-59) was the first to actually assign these rocks to the Ordovician, much of the credit belongs to G. K. Greene, for it was he who collected and identified the fossils which formed the basis for Collett's statement. Greene (1906, 11-17), himself, nearly twenty-five years later revived the idea of the Ordovician age of the rocks. During this interval they had been almost universally referred to the Niagaran. Foerste (1921, 278) recently listed a number of additional species, and stated that they occurred "in a very fine-grained, brownish-gray limestone having a conchoidal fracture, resembling some phases of the Plattin limestone of eastern Missouri." He referred the rocks to the Black River, and thereby corroborated the earlier correlation of Greene, who referred his species to the Lower Silurian (Ordovician).

Mr. Shrock has already identified 14 species, in addition to those listed by Greene and Foerste, from the westernmost of the three quarries, and all are typical forms in the Black River-Trenton series of Minnesota. The strata in the two abandoned quarries have been found to be the same. It is almost certain that they represent rocks of Black River-Trenton age, and it is also very likely that rocks of the same age occur in the larger active quarry.

Quarry 5 Miles South of Wolcott. In the extreme southwestern corner of section 19, T. 26 N., R. 5 W., the White County Stone Company is operating a small quarry in a limestone of Devonian age. The following section was measured in the quarry:

6. Light pink to gray, thin-bedded, coarsely crystalline limestone.....	6'
5. Blue to gray sandy shale.....	1½'
4. Thin-bedded gray limestone.....	1'
3. Blue to gray sandy shale.....	1½'
2. Thin-bedded, gray crystalline limestone with occasional chert nodules..	5'
1. Light gray crystalline limestone with some chert.....	1½'
Total.....	16½'

Several feet of soil overlie the limestone. The slabby, coarsely-crystalline character of the rock, along with the presence of a large brachiopod, *Spirifer cf. divaricatus* and several corals, indicate that it is of Devonian age. It very probably correlates with the Onondaga (Jeffersonville) of the Wabash valley. On the geological map of Indiana published by Blatchley in 1904 the New Albany shale is mapped as the subglacial formation where the quarry is located. This exposure of Devonian limestone occurs nearly 15 miles west of the main mass of limestone to which it belongs.

The occurrence of Devonian limestone here is rather unexpected, and its presence indicates an interesting structural irregularity of probable anticlinal

¹For a discussion of the literature see Cummings and Shrock, Proc. Ind. Acad. Sci. 1928: 137-139.

character on the southwestern homoclinal flank of the anticlinal fold extending between the Cincinnati and Wisconsin domes. The altitude of the limestone in the quarry south of Wolcott is about 750 feet. The same formation along the Tippecanoe River in the vicinity of Monticello, 15 miles east, is about 600 feet. At Monon, 15 miles northeast, the same limestone, apparently, occurs at an altitude of 675 feet and at Remington, 10 miles northwest, it is about 650 feet—based upon outcrops of the New Albany shale which overlies the Devonian limestone. Thus it is seen that the quarry outcrop 5 miles south of Wolcott is about 150 feet higher than outcrops 15 miles east; about 75 feet higher than outcrops 15 miles northeast; and about 100 feet higher than the same formation 10 miles northwest. The extent of this limestone as shown on the geologic map accompanying this report is only suggestive. The authors were informed that limestone similar to that in the quarry south of Wolcott lies just beneath the level drift surface about one mile southeast of the same village. This statement could not be verified, but it is quite likely that it may be found there, whereupon the extent of the Devonian limestone within the overlying New Albany shale area would be extended considerably.

Monon Exposures. The Devonian is represented at Monon by a crystalline limestone which contains a number of typical Devonian fossils, and which overlaps the Niagaran disconformably (Cummings and Shrock, 1928, 112). This limestone may be seen outcropping along a small stream in the tourist camp. On the accompanying map (Figure 1) it is considered to be of the same age as the Devonian limestone at Reusselaer and very likely the same as that south of Wolcott.

Alter's Quarry, ¼ Miles Northeast of Remington. At the present time Mr. L. S. Alter is operating a small quarry along Alter's Branch in the N. W. ¼ of Section 21, T. 27 N., R. 7 W. The following section was measured at and near the quarry:

5. Badly weathered, buff-colored, impure flaggy limestone.....	2'
4. Greenish-gray calcareous shale.....	1½'
3. Gray shale with thin impure limestone layers.....	1½'
2. Hard, bluish-gray limestone with green mottling. Goniatite (?) and Orthoceratite cephalopods were procured from this bed.....	4½'
1. Gray blue fissile shale with thin layers of black carbonaceous shale....	5'
<hr/>	
Total.....	14½'

The limestone which is quarried is No. 2 of the section. It is persistently 42 inches thick throughout the rather extensive shallow quarry. No dip is perceptible. A system of east-west joints is conspicuous. The lithic characteristics and the several specimens of cephalopods which have been taken from this bed at once strongly suggest the Rockford limestone of southern Indiana.

Mr. Alter stated that he encountered 80 feet of stone similar to No. 1 of the above section in a well drilled near his dwelling. This is very likely the same stone as the 85 feet of shale, beginning 5 feet below the surface, which was found in a well at Remington (Logan, 1926, 280).

The limestone in this section is mapped as Harrodsburg on Blatchley's map and the shale as Borden (Knobstone),² but from the faunal and lithic

²Collett (1883a, 69-70) gives a section at Alter's quarry, but it differs considerably from that given above. He also lists a number of fossils from the same locality

characteristics of the limestone, and the stratigraphic relations of the formations to nearby exposures, it seems to be more nearly correlative with the thin Rockford limestone of southern Indiana.³ The underlying shale would then be New Albany. Such a correlation seems reasonable, since the New Albany shale, overlaid by Mansfield sandstone, is exposed three miles due east along Carpenter's Creek at about the same altitude. (Figure 1.)

The shale and the impure yellow limestone overlying the hard quarry ledge at the Alter quarry are regarded as basal Borden (Knobstone) and are probably equivalent to the New Providence in southern Indiana. This correlation is based simply on stratigraphic succession. Small sections of crinoid stems, sparingly present in the impure limestone, were the only fossils noted above the Rockford limestone.

The Alter quarry is unusually interesting because of the three formations exposed in it. One of them, the Rockford limestone, is entirely exposed. This formation has not hitherto been recognized or identified in exposures in northern Indiana.

Limestone very similar to that of the upper part exposed in the Alter quarry has been taken from a number of shallow quarries in the vicinity. All of the openings are now abandoned, however, as the stone is of poor quality and unfitted for the construction of rock roads. One of these old quarries was in the S. E. $\frac{1}{4}$ of Sec. 18, T. 27 N., R. 7 W., about $1\frac{1}{2}$ miles west and north of the Alter quarry. Another quarry was located about one mile southwest of the Alter quarry in the N. $\frac{1}{2}$ of Sec. 29, T. 27 N., R. 7 W. Several crinoid fragments were found in the impure yellow limestone here. The opening is now filled with water and debris. The limestone is reported to have been quarried to a depth of 14 feet.

Exposures Near Goodland. Several exposures occur in the shallow bed of Cherry Creek south of U. S. Highway 24, about one mile east of Goodland, in Sec. 25, T. 27 N., R. 8 W. These exposures of impure limestone and bluish shale, with the limestone containing numerous small geodes, represent some part of the Borden (Knobstone) somewhat above the exposures in the Alter locality.⁴ Under the abutments of the bridge across Cherry Creek on U. S. Highway 24 hard, bluish impure limestone was encountered in excavating. The limestone here thrown out bears a slight resemblance to the Rockford limestone in the Alter quarry, but it more likely represents some part of the calcareous lower part of the Borden in the region. The area of the outcrops on Cherry Creek is indicated as Borden (Knobstone) on the Blatchley geological map of 1904.

About $1\frac{1}{2}$ miles west of Goodland, north of U. S. Highway 24, in the S. W. $\frac{1}{4}$ of Sec. 22, T. 27 N., R. 8 W., is an old quarry pit about which were found fragments of a soft, yellow, impure limestone. In the crumbling foundations, which mark the sites of two old buildings nearby, are slabs which are reported to have come from this quarry. The stone very closely resembles the impure yellow limestone above the Rockford limestone of the Alter locality. Crinoid stems were the only fossils observed. The authors regard the rock as lower

³Kindle (1901, 561) in speaking of the Devonian of the Wabash area states, "It appears from well sections, however, that the Rockford limestone is absent in this area." Logan (1926, 281), however, interprets 10 feet of limestone in a well in northeastern Jasper County as Rockford limestone.

⁴Collett (1883, 59-60) gives sections at two localities along Cherry Creek, and refers the strata to the Keokuk and Knobstone shales.

Borden and consider it correlative with that in the Alter exposures. Kindle (1904, 413-414) considered this rock as Niagaran, and it is so mapped on Blatchley's 1904 map.

Exposures near Remington. In the center of the N. $\frac{1}{2}$ of Sec. 34, T. 27 N., R. 7 W. a small quarry, now filled with water, has been opened in a very argillaceous limestone of buff color. Thin layers of gray sandy shale are intercalated with the layers of impure limestone. About seven feet of the stone, thin-bedded and badly weathered, may be seen about the edges of the quarry. Small geodes are common, and several erinoid plates, corals, and a small neotremate brachiopod were found.

About three-fourths of a mile southwest of the above quarry, in the southwest quarter of the same section, a gray argillaceous limestone with intercalated layers of gray sandy shale has been quarried. The stone seems to be the same as that in the quarry to the north.

The rock in these two quarries is mapped as Harrodsburg on Blatchley's map, but the lithologic character of the thin impure limestone beds, as well as their stratigraphic relations, points towards the conclusion that they are lentils in the Borden (Knobstone) rather than representatives of the Harrodsburg limestone. They are shown as such on the sketch map. (Figure 1.)

North and northwest of Remington along Carpenter's Creek the New Albany shale is well exposed in the creek bed and in the sides of the valley. Perhaps as much as 20 feet of the dark, fissile shale, locally charged with pyrite, is exposed. Between two prominent outcrops of the shale just northwest of Remington is a narrow area, along the banks of the creek, of a coarse, gritty sandstone of a rather friable character. This sandstone is no doubt a deposit of Mansfield sandstone of Pottsville age in an old channel area in the New Albany shale. It has been well described by Kindle (1904, 416), and it is shown on the Blatchley geological map. It is of more than local interest for it well illustrates the overlapping basal Pennsylvanian resting on a formation far below it stratigraphically. It is an outlier far from the main mass to which it belongs. Again it is another of the many formations which is barely glimpsed in a small exposure in this region of geological surprises, where a mantle of drift barely fails to cover the entire area.

The Geological Map. The small geological map (Figure 1) accompanying this paper was constructed on the basis of the above conclusions, and differs considerably from the same section shown on the map published by Blatchley in 1904.

The rock exposed east of Kentland is mapped as Ordovician instead of Silurian; Devonian limestone is mapped at two new localities, and its area increased; the area of the New Albany shale is shown extending to the State line (so shown because of well data); a small area of the Rockford limestone is outlined; the area of the Borden (Knobstone) is reduced in size; and no Harrodsburg (Warsaw) limestone is shown. Attention should be called to the fact that a blank area is left between the Ordovician area east of Kentland and the surrounding formations. This has been deemed advisable since nothing is known about the relations at the contact between the Ordovician and the overlying rock.

It may be stated that this area lies on the south flank of the geanticlinal axis between the Michigan and Illinois basins, hence the beds show a more or less gentle dip in a direction slightly west of south, except east of Kentland where structural complications are present, and perhaps also in the area of the struc-

tural high indicated by the Devonian limestone 5 miles south of Wolcott.

Summary. This paper may be summarized in the following statements:

1. The rocks exposed in the three quarries east of Kentland are of Black River-Trenton age (Middle Ordovician), and represent the oldest rock exposed in Indiana.

2. The exposures of limestone and shale occurring along Alter's Branch, and in the immediate vicinity, between Goodland and Remington are thought to belong to three different geological formations: The New Albany shale, the Rockford limestone and the Borden (Knobstone) shales; rather than Borden (Knobstone) and Harrodsburg as they have been mapped heretofore. The Rockford limestone is recognized for the first time in the exposures in northern Indiana.

3. The exposures in the two small quarries in section 34, two and one-half miles southwest of Remington are thought to be limestone lentils in the Borden rather than Harrodsburg as they have been mapped.

4. Exposures of undoubted Devonian limestone, probably Onondaga, at Monon and in a quarry five miles south of Wolcott give further information on the extent of the Devonian limestones, and indicate a probable anticlinal structure of some considerable size.

BIBLIOGRAPHY

1. Blatchley, W. S., 1904. Geological Map of Indiana. Indianapolis, 1901-1903 (On a scale of 4 miles to 1 inch).

2. Collett, J., 1883. Geological Survey of Newton County. Indiana Dept. Geol. and Nat. Hist., 12th Ann. Rept., pp. 48-64.

1883a. Geological Survey of Jasper County. Indiana Dept. Geol. and Nat. Hist., 12th Ann. Rept., pp. 65-76.

3. Cumings, E. R. and Shrock, R. R., 1927. The Silurian Coral Reefs of Northern Indiana and Their Associated Strata. Ind. Acad. Sci., Proc. 36c 71-85. 1926.

1928. The Geology of the Silurian Rocks of Northern Indiana. Conservation Comm. Div. of Geology, Publication No. 75, 226 pp.

4. Foerste, A. F., 1921. Notes on Artic Ordovician and Silurian Cephalopods. Denison Univ. Bull., 19c 247-306, (plates).

5. Greene, G. K., 1906. Contribution to Indiana Paleontology. Part I, Vol. II, 17 pp., plates. Ewing and Zeller, New Albany, Indiana: Published privately.

6. Kindle, E. M., 1901. The Devonian Fossils and Stratigraphy of Indiana. Indiana Dept. Geol. and Nat. Res., 25th Ann. Rept., pp. 529-758, plates.

1904. The Stratigraphy and Paleontology of the Niagara of Northern Indiana. Indiana Dept. Geol. and Nat. Res., 28th Ann. Rept. pp. 397-427.

7. Logan, W. N., 1926. The Geology of the Deep Wells of Indiana. Conservation Comm., Div. of Geology, Publication No. 55, 54 pp.

