

MIDDLE MISSISSIPPIAN UNCONFORMITIES AND CONGLOMERATES IN NORTHERN OHIO.

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In northern Ohio there are two unconformities with a conglomerate associated with each which occur in rock of about middle Mississippian age. The area in which the unconformities and conglomerates have been observed include portions of five contiguous quadrangles—West Salem, Wooster, Massillon, Medina and Akron.

Two conglomerate beds have long been known in central Ohio and which Herrick recognized as extending northward into this part of the state. His conclusion would appear to be correct, but it is not yet known that these beds at the north lie at exactly the same horizon as those in central Ohio.

In his report on Wayne county (Ohio Geol. Surv. Vol. III, p. 539) Read incidentally mentions a stratum filled with quartz pebbles which he observed in a quarry at Wooster. In the summer of 1912, the writer examined this outcrop and noted the presence of the unconformity. Later study at other points led to the discovery of another unconformity at the base of the lower conglomerate. The presence of these stratigraphic breaks is evidence of crustal movement in this region in middle Mississippian time that may have involved a larger area than is at present known.

The principal facts may be noted briefly: *The lower conglomerate.* The best exposures of the base of this stratum occur on either side of the Killbuck Valley in the western part of the Wooster and eastern part of the West Salem quadrangles. The conglomerate varies in thickness from about two feet to eighteen or twenty feet as found along the Killbuck, but thickens eastward and is thirty to forty-five feet before it passes under cover. The basal one to three feet is virtually a bed of loosely cemented quartz pebbles ranging in size from shot to nearly an inch in diameter. They are usually $\frac{1}{4}$ to $\frac{1}{2}$ inch in diameter, well rounded, and quite even in size at any given place. Cobble stones from hard layers of the underlying shale are frequent and often lenticular in shape, ranging in size from two to six inches. The largest one found measured two and one-half feet long by one and one-half feet wide, and over five inches thick, and completely embedded in quartz pebbles.

At every point where the base was well exposed, the pebble and cobble bed rests upon blue shale with the contact sharp and generally with very conspicuous undulations. The remainder

of the conglomerate stratum is largely a coarse grained sandstone with streaks of fine pebbles. This is followed by shale and fine grained clayey sandstone up to the next unconformity.

The lower conglomerate three miles east of Wooster lies about six hundred and twenty feet above the Berea sandstone and about two hundred feet below the lowest Coal Measure rock in the same locality. These figures would appear to put the time of these movements in the late Mississippian, but this system of rocks is known to have been deeply eroded in this region in Mississippian time. To double or treble the two hundred feet would seem quite permissible, and it may have been much more. For the above reasons, the time of the movements is assigned to middle Mississippian.

At Berea, Ohio, the top of the Berea Sandstone lies at 760 feet above sea, 42 miles due south at Apple Creek Village in the southern part of the Wooster quadrangle, it lies at 300 feet above, dipping 11 feet per mile. The dip of the lower conglomerate in the same direction, is almost exactly the same. This would indicate not merely a local uplift, but an uplift of considerable extent so far as a north-south direction is concerned. There is reason to think it extended much farther southward.

The upper conglomerate. This bed lies, as found so far, from 45 to 85 feet above the base of the lower conglomerate. The lesser measurement applies in the southern part of Wooster quadrangle, and the interval increases northward. The dip of this stratum southward is 13 feet to the mile and lies nearly horizontally from east to west. It is apparent that it departs somewhat from a parallel to the lower conglomerate and the Berea due to differential movement. It is a remarkably uniform stratum in thickness, in composition, and in uniformity of size of pebbles. From east to west it has been observed across nearly its entire belt of outcrop, and about twenty-five miles along the belt. It is only one to three feet in thickness, is always largely and often purely a bed of quartz pebbles ranging in size from shot to pebbles three-fourths of an inch in diameter and notably even in size at any one point. Cobblestones from under rock three to five inches in diameter are found in places. Overlying the pebble bed occurs rather soft, fine grained clayey sandstone and shale, typical of the Logan shale to the southward, and carrying the same fauna.

It was marine laid as shown by brachiopods and crinoid fragments. These occur mingled with the pebbles. The persistency of the bed, the uniformity of its thickness, the assortment of its pebbles, and their well rounded form, the writer ascribes to the work of waves in a sea slowly advancing upon the land. The character of the lower conglomerate indicates that it was laid down in the same way. Both appear to be basal conglomerates.

Where was the land from which these pebbles came? One would be inclined to answer at once, from the west and north where older rocks now occur. But this leaves a structural feature observed in both conglomerates rather hard to explain. At different points south-east of Wooster, the upper conglomerate is found to be cross bedded with bedding planes dipping sharply toward the north. In the northwestern part of the Massillon, the southwestern part of the Akron, and the eastern part of the Medina quadrangles, the lower conglomerate shows conspicuous crossbedding, either toward the west or toward the north. It is hard to see how this structure can occur in any other way than dipping away from a shore, whether produced by stream current or undertow from waves. If one would assign the structure in this case to northward flowing currents along shore, another difficulty is met. In the last named region where twenty to thirty feet of the conglomerate is exposed in one outcrop, various levels of crossbedding occur in different directions varying from west to north. This would seem to be more like a delta deposit of a stream flowing from the southeast. No case of crossbedding has been found which would indicate that the shore was to the west or north, but rather to the south and east. If the interpretation of this structure be correct, it points to the presence of a land mass where we have thought there was open sea.

The existence of these unconformities in middle Mississippian rock would seem to throw light on the time of the very numerous small folds found in the Medina quadrangle and only less numerous in a number of other quadrangles eastward to the Pennsylvania state line. They rarely occur where the Pennsylvanian is exposed above, hence the uncertainty of assigning them to that age or later. Some of them very likely belong to post Mississippian time, but it should be stated that so far as observed they are much less numerous in the Pennsylvanian than in the Mississippian and particularly in the Mississippian below the conglomerate horizons. One very clear case occurs in an outcrop in the north-east corner of the Medina quadrangle in a ravine one-half mile southwest of Hinckley village, where the horizontal beds of the Sharon conglomerate (base of Pennsylvanian) rest upon the upturned edges of the Mississippian. The top of the latter here is about 430 feet above top of the Berea, or more than 150 feet below the horizon of the lower conglomerate. The contact is sharp and the layers of shale are inclined about twenty-five degrees.

If these conglomerates described above are the same beds found in the central part of the state and southward, which would appear to be true, it implies the presence of associated unconformities wherever they occur.