A Striking Example of Pre-Pennsylvanian Erosion in Orange County, Indiana[1]

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The most conspicuous erosional unconformity of a regional nature in the bedrock of Indiana is located between the Mississippian and Pennsylvanian systems. The regional aspects of the pre-Pennsylvanian unconformity have been pointed out clearly by Malott (3, p. 239-246) and formed the substance of the Fourth Annual Indiana Geologic Field Conference, which was led by Esarey, Bieberman, and Bieberman (1). Beneath the unconformity progressively older beds are truncated northward from the Ohio River. Consequently, in that part of Perry County near the Ohio River, the Mansfield (Pottsville series, Pennsylvanian) sandstone rests at places on the Kinkaid limestone, which is the youngest formation of the upper Chester (Upper Mississippian) group. Farther northward, the Mansfield rests on progressively older and older Chester rocks until, in the vicinity of Greencastle, Putnam County, the Mansfield generally rests on the Paoli, the oldest limestone of the Chester series, or on the Ste. Genevieve limestone of Meramecian (lower Upper Mississippian) age. Therefore, between the Ohio River and south-central Putnam County, the base of the Mansfield has descended through a stratigraphic interval that approximates 500 feet.

Chester rocks occupy a unique position in the geologic column because they are located stratigraphically between the predominantly calcareous Meramecian strata that may approach 600 feet in maximum thickness and rocks of the Pennsylvanian system which are composed largely of clastic materials. In sharp contrast with these younger and older rocks, the striking feature of the Chester series is the regular alternation of thin, generally fossiliferous, marine limestones and sparsely fossiliferous or typically unfossiliferous clastic formations. Chester limestones characteristically maintain their lithologic individuality over wide areas of outcrop; in contrast, the clastic formations of the series commonly show abrupt lateral and vertical variations in lithology. Because of the lithologic variability of Chester clastic rocks, their field identification is based largely on their stratigraphic position with respect to Chester limestones.

The Mansfield sandstone is also characterized by lateral and vertical lithologic variations and does not differ markedly in its features from Chester clastic rocks. Consequently, where the stratigraphic position of the pre-Pennsylvanian unconformity places the Mansfield on a Chester clastic formation, the stratigrapher is faced with the perplexing problem of differentiating Lower Pennsylvanian and Chester rocks; according to present knowledge, this cannot be done with certainty. A number of criteria, some of which will be mentioned later, will generally suggest either a Mansfield or Chester identification for the rocks in question.

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Although the regional aspects of the pre-Pennsylvanian unconformity are well known, the literature contains few, if any, detailed descriptions of accurately located sections where the unconformity can be measured and studied. The purpose of this paper is to describe a section in which the unconformity can be demonstrated locally rather than regionally. The section under consideration is located in the NW¼ NW¼ sec. 28, T. 2 N., R. 2 W., 1.5 miles west of the village of Prospect and 0.5 mile south of U. S. Highway 150, in western Orange County (Fig. 1).

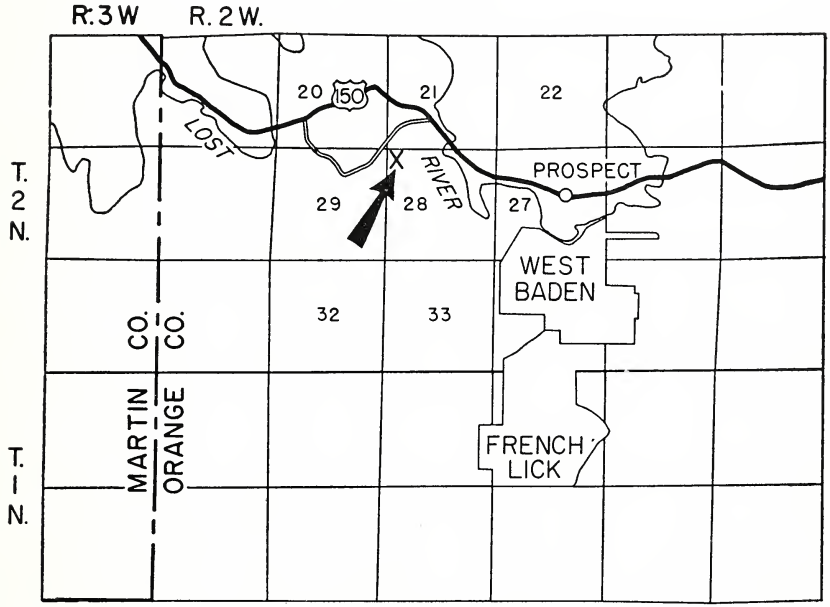

Fig. 1. Map showing location of described section.

In this section, the lowest exposed formation is the Beaver Bend (lower Chester) limestone, which roofs a spring near the north end of the exposure. The Beaver Bend is here a light- to buff-gray, fine- to medium-grained, crystalline limestone that is oolitic in the upper beds and locally stylolitic. The exposed part of the formation measures 17.1 feet in thickness, and individual beds range from 0.1 foot to 2.0 feet thick. *Linoproductus ovatus* (Hall) is the most abundant fossil in this exposure; other identified fossils are *Productus fasiculatus* McChesney, *Spirifer leidyi* Norwood and Pratten, *Orthonychia* sp., compositoid brachiopods, and a few small crinoid stems.

Immediately above the Beaver Bend is light-gray, rust-spotted, fine- to medium-grained sandstone that has irregular beds averaging 0.3 foot thick, except in the basal 1.0 foot where all beds are less than 1.0 inch in thickness. Some beds in this interval are orange-brown and highly ferruginous. This 8.6-foot nonfossiliferous unit is assigned to the Mansfield but, on the basis of its thin-beddedness, the clastic rocks in this unit may be the lower part of the Sample sandstone of lower Chester age.

The next overlying unit, 37.7 feet in thickness, is assigned to the Mansfield sandstone of Lower Pennsylvanian age. This unit consists of light-gray and rust-colored, fine- to medium-grained, ferruginous nonfossiliferous sandstone that is conspicuously cross-bedded and has a pitted weather surface (Fig. 2); this sandstone is essentially massive and forms

Fig. 2. Crossbedding in Mansfield sandstone in Orange County.

an impressive cliff that is several hundred feet in length. The prominent crossbeds in the photograph strike N. 45 degrees W. and dip 23 degrees SW. Elsewhere on the outcrop, the crossbedding is randomly oriented, but the high-angled dips are dominantly south and southwest. The high angle of the crossbeds and their irregular orientation strongly suggest that this sandstone was deposited in a fluviatile environment.

A 44.5-foot covered interval overlies the prominent cliff of the underlying unit. The terrane of this covered interval, however, is strewn with many large sandstone blocks that have the same lithology as the sandstone in the underlying, cliff-forming unit. This covered interval is followed by a 17-foot section of medium-gray, fine- to medium-grained, crystalline Beech Creek limestone that is readily identified by the large (somewhat over 0.5 inch in diameter) crinoid stems that it contains. The exposure of Beech Creek is located about 300 feet southeast of the massive sandstone cliff.

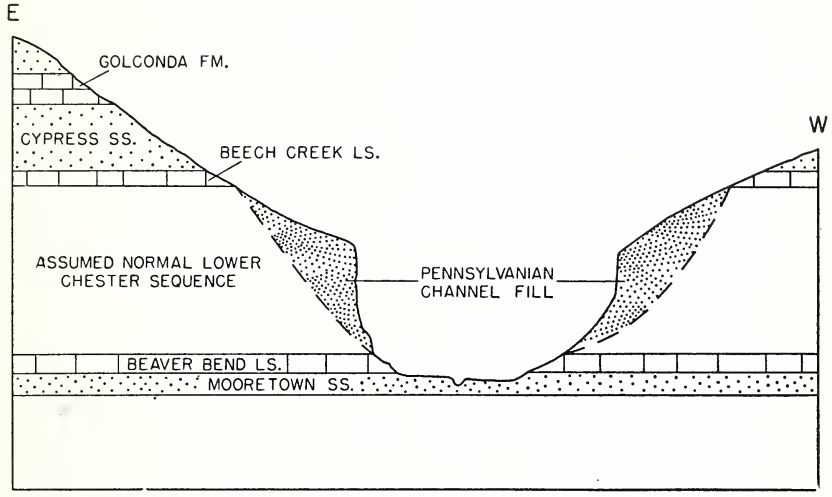

Fig. 3. Diagrammatic interpretation of a Pennsylvanian channel fill in Orange County.

The remainder of the hill is largely covered. A few poor exposures of the Cypress sandstone may be observed, however, and these are overlain by poorly exposed, cherty limestone of the Golconda formation. The terrane above the Golconda is covered by blocks of sandstone float but whether these blocks have come from the Hardinsburg sandstone of middle Chester age or from the Mansfield cannot be determined.

The normal stratigraphic sequence, in ascending order, between Beaver Bend and Beech Creek limestones is as follows: 16 to 35 feet of thin- to massive-bedded Sample sandstone; a 3- to 6-foot thickness of gray, massive, crystalline Reelsville limestone that typically weathers to a distinctive rust color; and about 40 feet of Elwren sandstone that normally contains, in part, red and green, thin-bedded shale.

In this section, however, a 91-foot stratigraphic interval that is composed entirely of clastic rocks, mainly sandstone, intervenes between the Beaver Bend and Beech Creek limestones. The most prominent unit in this interval is the 37.7-foot cliff of massive sandstone whose base is 8.6 feet above the upper surface of the Beaver Bend limestone. Thus, the normal, expectable horizon of the Reelsville limestone, as indicated by the thickness of the underlying Sample sandstone, here falls within the upper

and lower boundaries of the cliff. Furthermore, the massive appearance of this cliff-forming sandstone and particularly the prominent, high-angled crossbedding is more suggestive of the Mansfield than a Chester sandstone.

For the above reasons, the authors interpret the sandstone between the Beaver Bend and Beech Creek limestones in this section as a Lower Pennsylvanian channel fill that was deposited in a steep-sided pre-Pennsylvanian valley which was carved into a Mississippian terrane (Fig. 3). In making this interpretation, the authors realize that the Reelsville limestone may be locally absent (2, p. 14, 48); the authors have observed this limestone, however, in the NW¼ sec. 18, T. 2 N., R. 2 W., about 2 miles northwest of the section under consideration. This interpretation is logical and is in accord with present knowledge of the irregular topography that the pre-Pennsylvanian erosional surface displays. Future studies of the Mansfield sandstone and Chester clastic rocks may reveal criteria by which they can be indisputably differentiated in the field. If such criteria should prove that the interpretation of the authors is incorrect, then the Reelsville limestone is most assuredly missing in the immediate vicinity of this section. If the interpretation herein placed on this section is correct, a drill hole located on or slightly above the Beech Creek limestone should pass through a normal lower Chester sequence in which the Reelsville limestone would be encountered.

Literature Cited

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