

Effect of Geologic Processes on Economic Resources of Late Paleozoic Rocks of Indiana

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Geologists and geographers are interested in different aspects of our natural resources. Geologists are concerned primarily in locating natural resources and in studying the geologic conditions under which they were formed. Geographers, in contrast, probably are most interested in their conservation, their location with respect to manufacturing areas, and economic conditions which permit their exploitation and development. It is desirable that my retiring address should appeal to both factions of this Division, geologists and geographers; presumably comments on natural resources, a common meeting ground of geologists and geographers, will interest both groups. I plan, therefore, to discuss one aspect of our natural resources, namely the manner in which some geologic processes have adversely affected our natural resources in local areas of Indiana.

Geologic processes include all operations or forces which modify or contribute to the material forming the crust of the earth. Such processes would include metamorphism by which pre-existing rocks are highly altered as a result of heat and pressure as well as chemical action; erosion by which pre-existing topography is changed due to the activity of running water, glacial ice, wind, and other erosional agents; weathering by which rocks are decomposed slowly under the attack of atmospheric agents; and sedimentation, the process involving the deposition and accumulation of such sedimentary rocks as limestone, shale, and sandstone.

I now wish to focus attention on rocks of late Mississippian age which crop out in a northwesterly trending area from the Ohio River to the vicinity of Greencastle, Indiana. These rocks (Fig. 1) form the Chester series and consist of alternating limestone and sandstone or shale formations. Several Chester limestones are sufficiently thick to quarry, notably the Beech Creek, Golconda, and Glen Dean. Quarries in Chester limestones are strategically located geographically because Pennsylvanian rocks, which lie immediately west of the Chester outcrop belt, do not contain limestones of sufficient thickness for commercial quarrying. Hence, the area west of a quarry located in a Chester limestone generally affords a ready market for the quarry's products.

The shallow seas in which Chester rocks were deposited in late Mississippian time withdrew southward at the close of this period. Destructive erosional forces instantly began their attack on a terrane underlain by recently deposited late Mississippian rocks. As a result, a topography reminiscent of that now found in Crawford and western Orange Counties, Indiana, was developed on this post-Mississippian land surface. Therefore, erosion destroyed the lateral continuity of Chester limestones which are quarried today for crushed stone and agricultural

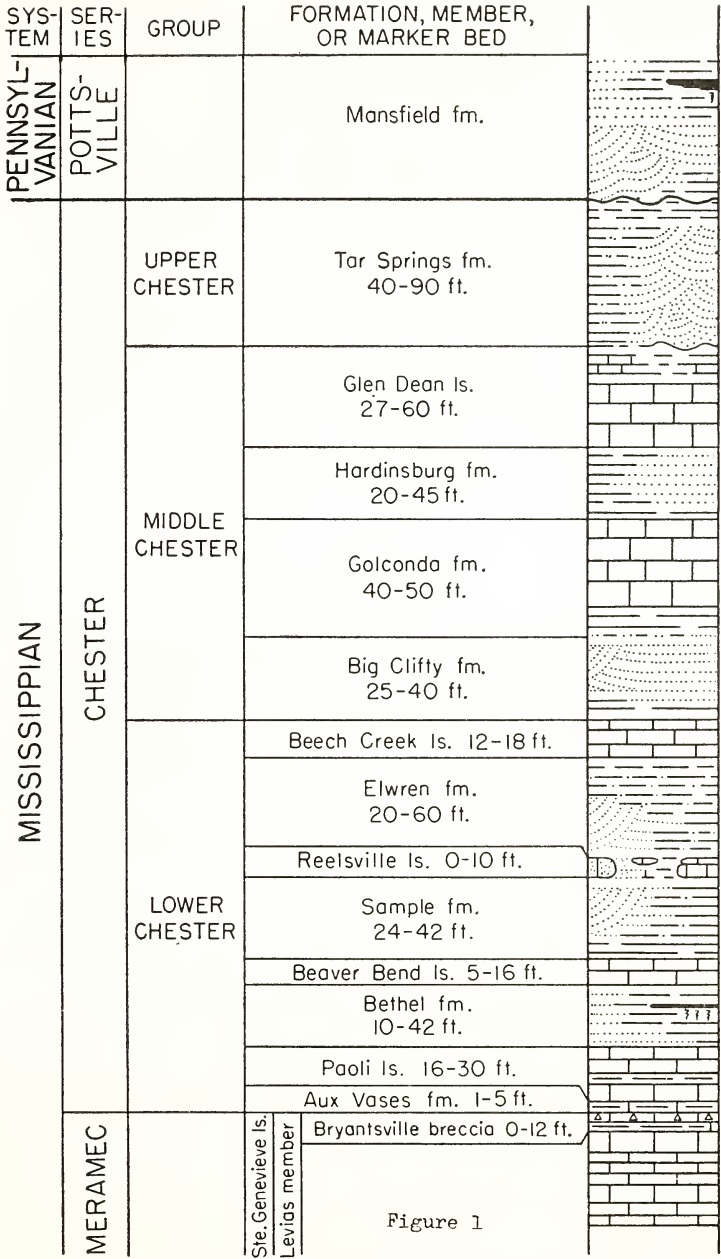


Figure 1. Columnar section showing part of Chester series (late Mississippian) and basal portion of Pottsville series (early Pennsylvanian).

lime. As a result, quarry sites in Chester limestones which are near the Mississippian-Pennsylvanian boundary should be proved by drilling or critically examined by a geologist before quarrying operations are initiated. As an example of this statement, several years ago I investigated a potential quarry site about one mile north of the village of Atkinsonville in northern Owen County, Indiana. Here the Beech Creek limestone attained the impressive thickness of nearly 25 feet and was well exposed near the top of a broad, flat-topped knoll of considerable extent so that removal of overburden would not be a formidable or expensive task. On cursory examination, the site appeared ideal. A more detailed examination, however, showed that, less than 200 yards from the Beech Creek exposure, the topographic level of the Beech Creek was occupied by sandstone of Pennsylvanian age. Thus, vagaries of pre-Pennsylvanian erosion permitted local preservation of this remnant of the Beech Creek limestone. Had quarrying operations begun at this site, the operator would have soon been confronted with the embarrassing situation of rapidly exhausting the available limestone. Thus, erosion, a widespread geologic process, here has adversely but locally affected this formation as a source of crushed stone and agricultural lime.

A controversial geologic section (1) is exposed in the abandoned quarry of the French Lick Sandstone Company in the NW $\frac{1}{4}$ NW $\frac{1}{4}$ 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, Indiana. Here a geologic section consisting entirely of sandstone intervenes between the top of the Beaver Bend limestone and the base of the Beech Creek limestone. The Reelsville limestone is not represented in this section. The absence of the Reelsville may be attributed to pre-Pennsylvanian erosion; under this interpretation, the massive, cliff-forming sandstone would represent a channel fill deposit, as is suggested particularly by the prominence and direction of the cross-bedding in this exposure, formed in a stream that carved its valley in a late Mississippian terrane. In contrast, sedimentation conditions may have militated against deposition of Reelsville limestone in this locality; elsewhere, particularly in east-central Owen County, conditions of sedimentation did not permit deposition of Reelsville limestone (4). Further, either because of post-Reelsville erosion or abrupt facies changes (3), the Reelsville limestone shows abrupt lateral discontinuity (Fig. 2) as is shown in an exposure in the NE $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 5, T. 3 N., R. 2 W., along the Baltimore and Ohio Railroad 0.5 mile east of the village of Huron in Lawrence County, Indiana.

Regardless of what geologic process brought about the absence of the Reelsville limestone in the French Lick Sandstone Company section, the immediate area of this prospective quarry site should be carefully scrutinized by drilling prior to its further development as a dimension stone quarry. As quarrying operations would proceed southeastward, the operator may conceivably encounter the Reelsville limestone in a short distance, which circumstance would probably militate against continued exploitation of this site for dimension stone. Here again, one of two



Figure 2. Reelsville limestone in railroad cut near Huron, Indiana. Limestone, 8 feet thick, in west (left) side of photograph is laterally continuous westward for more than 100 yards; eastward (right) limestone abruptly gives way laterally to olive-gray silty shale. Scale card is 1 foot wide.

common geologic processes, erosion or vagaries of sedimentation conditions, has affected one of Indiana's natural resources, dimension stone.

Now let us finally turn our attention to the youngest Paleozoic rocks of Indiana which were deposited during the Pennsylvanian period when flourishing vegetation in extensive swamps supplied the basic materials for the formation of a very vital natural resource, coal. Only those nations which have an abundant supply of coal within their boundaries or ready access to coal in neighboring countries have risen to industrial prominence.

Pennsylvanian rocks in Indiana contain several distinct mineable coal beds, which are generally indicated by numerical designation. One of these is Coal V which is found in Vigo County and elsewhere in Indiana. Geologic processes have rendered this coal, normally about 5 feet thick, unmineable in the area of the Dresser mine in Vigo County.

Friedman (2) described in detail the geologic processes which have rendered this coal locally unmineable in the vicinity of the Dresser mine. In Pennsylvanian time in this area a stream coursed through the initial phases of peat formation in the swamp whose lush vegetation contributed to Coal V and ultimately became entrenched in shale and clay underlying this peat bog. In addition to depositing sand in its channel, the stream meandered, cut laterally, and laid down mud and fine sand

in its flood plain as do modern rivers. Peat formed locally where swamp conditions advanced on the flood plain of this ancient stream. Mud, sand, and peat were deposited synchronously as is indicated by the intertonguing (interleaving) of these materials. The channel of the stream was then temporarily abandoned and was overgrown by vegetation which ultimately formed peat. Renewed stream activity on this site caused local erosion of the somewhat more recently formed peat. At the conclusion of this sedimentation cycle, the channel site contained about 40 feet of sand, and the peat adjoining this stream was probably of the same order of thickness. Compaction of the peat resulted in the formation of Coal V and the inferred geologic conditions now maintaining. Friedman (2) depicts the lateral extent of the area that has been rendered unmineable by two widespread geologic processes, sedimentation and erosion, shows a stratigraphic cross section through the unmineable area of Coal V, and indicates the position of closely spaced drill holes on which this geologic interpretation was based.

In conclusion, I trust that geographers now have a better realization that the potential value of many natural resources in the crust of the earth may be governed by geologic processes which were in operation scores of millions of years before man began their exploitation.

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