

## THE OCCURRENCE OF CONGLOMERATE AND SANDSTONE OF POST-GLACIAL ORIGIN IN JEFFERSON COUNTY, INDIANA.

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The city of Madison, Jefferson County, Indiana, has been built on a great sand and gravel bar. This bar is approximately three miles long, from a quarter to a half mile wide, and of varying depth up to sixty or eighty feet. It is composed quite largely of sand, gravel and pebbles of glacial origin, water worn and deposited by the Ohio river. The bar deposit was very probably formed contemporaneously with the "second bottoms" or the first terrace of the Ohio river, and during the time of flooded waters as the later glaciers were melting.

Crooked creek, a stream some eight or ten miles long, which in glacial or preglacial times emptied into the Ohio near what is now the upper part of the city was deflected by these deposits, and now flows approximately parallel to the Ohio river for some three miles, emptying into the larger stream at a distance below the pumping station of the Southeastern Hospital for the Insane.

It is along the banks and on the slope to the south of Crooked creek

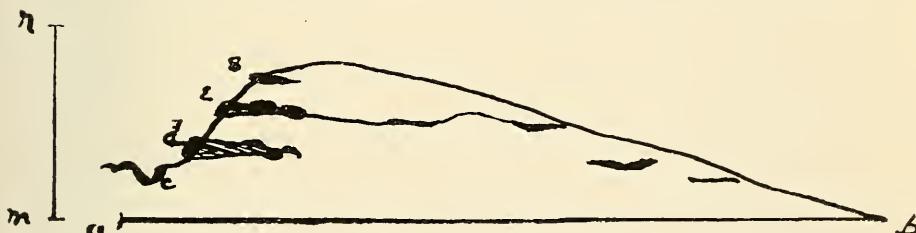


Fig. 1.

Ideal cross section of gravel bars and conglomerate deposits. Width of bar  $a\ b$  equals one-fourth mile; height  $m\ n$  equals 60 feet.

(c) Bed of Crooked creek.

(d) Position of thickest conglomerate and sandstone deposits, irregularly placed.

(e) and (s) Other irregularly placed deposits of indurated rocks.

(a b) Low water mark Ohio river,

that the more important sandstone, gritstone and conglomerate formations may be seen. Their outcroppings are especially noticeable along the slope south of Crooked creek, and between the large fill of the Pennsylvania railroad and the bridge over Crooked creek on the Hanover road.

So far as determined from sections seen in a few short valleys, on the creek banks, and in a large gravel pit, the consolidated sands and gravel are more abundant on the side of the bar farthest from the river, and on the slope near the creek. Here the conglomerates and sandstones are in several irregularly placed layers which vary in thickness from a few inches up to six or more feet. The formations are not of uniform thickness, and grow thinner the farther they are from the creek and the exposed slope. The accompanying ideal cross section of the portion of the bar from Crooked creek on the north to the Ohio river on the south in the locality above mentioned shows the relative position and general character of the formations.

The cementing material, so far as tested, was found to be calcareous. Much of the stone is quite compact and firm, but a part of it is more or less friable. In general the upper portion of any layer is the more indurated. In a few limited areas the upper surface of the conglomerate appears to be cemented by material of stalagmitic character. By far the greater part of the formations, however, gives no evidence of the existence of cementing material of that nature or origin.

The formation is peculiar from the fact that the cementation and consolidation took place above the water and in the absence of any considerable pressure. In the opinion of the writer the cementation of the sands and gravels was the result of capillary action. The waters of Crooked creek, which flow throughout their course over limestone and calcareous shales become at times strongly impregnated with calcium carbonate. This was preëminently the case when the stream was low at the time of a drouth. On the arrival of the waters at the place of the present conglomerate formations, the slope of the stream and the character of the bed were such that the movement of the water was very slow. Hence much of the water with its content of calcareous material passed into the sandy and gravelly banks, and then was drawn up by means of capillary action through the firmer close-textured beds. On approaching the surface of the beds the water evaporated and left a residue of calcium carbonate. This

residue, on being deposited between the grains of sand, the particles of gravel and the pebbles cemented them together into the solid rock.

The character of the beds of material underlying the consolidated portions is such that capillary action was not only possible but highly probable. The greater abundance and the greater thickness of the indurated beds on the side of the gravel bar nearest the creek indicates that its waters were largely responsible for the presence of the cementing materials.

In explanation of the formation in places of material resembling stalagmite, it is probable that surface waters flowing over or through the more or less consolidated rock redissolved a part of the cementing material, and when such waters reached the surface of the soil or rock at a lower level they were evaporated and the calcium carbonate was again deposited in the form mentioned.

