TWO SUBTERRANEAN CUT-OFFS IN CENTRAL CRAWFORD COUNTY, INDIANA

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The purpose of this paper is to describe two subterranean cut-offs in central Crawford county, Indiana, which so far as the writer is aware have never been previously described. These cut-offs are herein designated as the *Bottomley Spring* and *Carnes Mill* cut-offs.

Bottomley Spring Cut-off. This designation is here applied to this cut-off because the water which abandons its surface route for a shorter subterranean course rises in a large artesian spring known locally as the Bottomley Spring. (See fig. 1). This spring has long attracted the attention of the people in the locality because of its great volume and supposedly great depth. Its true origin has never been understood. It is simply the "rise" of a subterranean stream which

Fig. 1. View of the Bottomley Spring. This spring marks the rise of the waters which sink along the stream beds of Brushy and Bogard creeks.

has been formed from the sinking of surface waters from Bogard and Brushy creeks. The depth of the spring has usually been greatly exaggerated. According to soundings made by the writer its depth hardly exceeds 15 feet. It is possible that its depth slightly exceeds this amount as considerable debris was present in the bottom of the spring.

In the spring of 1930, the writer in company with Dr. C. A. Malott of the department of geology of Indiana University made a reconnaissance of the region near the Bottomley Spring. It was thought at that time that all of the water which empties out of this spring came from a "sink" in Brushy Creek near the home of Dan King, in the southeast part of the S. W. ¼ of the NE ¼ of Sec. 31, T. 2. S., R. 1 E. (See fig. 2). The water could be heard pouring into a large joint-

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opening in the stream bed but considerable more water was flowing in Brushy Creek at that time than the inlet could accommodate. However, in the latter part of the summer of 1930 when the accompanying map was made no water was passin along the stream bed beyond the "sink" mentioned above.

The "sink" in Brushy Creek occurs at an elevation of 480 feet, according to barometric determinations made by the writer. The elevation of the surface of the Bottomley Spring is approximately 460 feet. There is thus a difference of

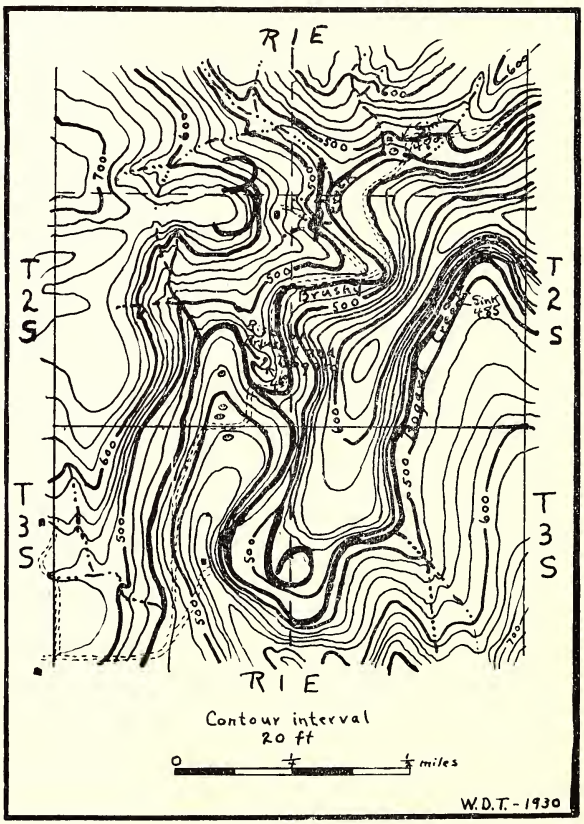

Fig. 2.

Fig. 2—Topographic map of the Bottomley Spring locality.

20 feet in the elevation of the "sink" and the "rise" of the waters of the subterranean cut-off. The straight-line distance between these two points is slightly over one-half mile. This difference in elevation is approximately equal to the regional dip of the underlying Paoli limestone and in line with the direction of dip.

The underlying rock formation is the Paoli limestone (upper part of the so-called Mitchell formation) of Mississippian age. A knowledge of the characteristics of this limestone formation is essential to a proper understanding of the features developed. Two outstanding characteristic features of the Paoli limestone

are its thin-bedding and numerous joints. These features have favored the development of an underground conduit down the dip of the rock. The subterranean course is only about one-half as long as the surface route. The "sink" in the bed of Brushy Creek occurs about 35 feet below the top of the Paoli limestone. A number of joints, greatly enlarged by solution, show conspicuously along the rocky stream bed. One, more prominent than the others, opens deeply and receives most of the water entering the underground channel. (See fig. 3).

Fig. 3.

Fig. 3—View of one of the enlarged joint-openings into which the water in Brushy Creek sinks. The opening is the result of solution along one of the many vertical joints in the Paoli limestone.

Until the mapping of the area was begun it was supposed that all of the water of the Bottomley Spring came from the "sink" in the bed of Brushy Creek. In the course of the mapping a similar "sink" was discovered along the channel of Bogard Creek. This "sink" is located about one-half mile southeast of the "sink" in Brushy Creek and occurs at an elevation of 485 feet. The water which sinks here passes beneath the spur which lies between the valleys of Bogard and Brushy creeks also rises in the Bottomley Spring. The geological conditions are similar to those described above. The difference between the inlet and the outlet is 25 feet or approximately the same as in the case of the cut-off developed by Brushy Creek. The straight-line distance between the "sink" in Bogard Creek and the Bottomley Spring is approximately three-eights of a mile, whereas the distance around the surface channel is one and one-half miles. The underground course is thus about one-fourth as long as the surface route.

Carnes Mill Cut-off. The second cut-off to be described may well be designated as the Carnes Mill cut-off since it occurs at the site of an old abandoned mill of that name. It is located about a mile and one-fourth southeast of state road 37 in the NE ¼ of Sec. 13 T. 3 S., R. 1 W. The mill was no different from many others that used to do custom grinding but it was unique in that it utilized a subterranean cut-off that had developed at this point in Little Blue River.

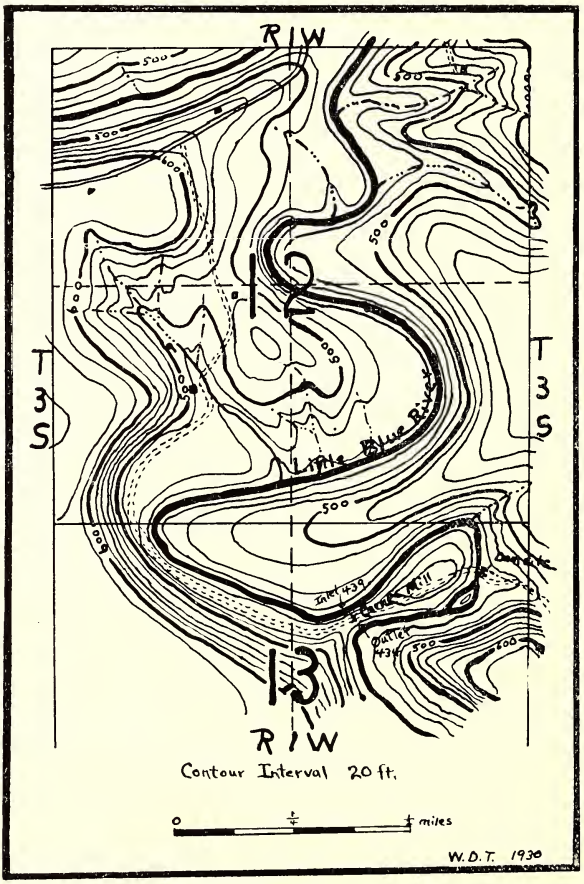

Fig. 4.

Fig. 4. Topographic map of the Carnes Mill locality.

(See fig. 4). Little Blue River follows a deeply-set meandering valley and in the Carnes Mill meander the neck of the spur has been practically severed. A subterranean channel has been dissolved out of the limestone through the neck of the meander, permitting the water to flow beneath the spur. The length of the subterranean route is only 200 feet, whereas the distance around the surface channel is approximately three-fourths of a mile. The underground distance is thus only about one-eighteenth that of the surface course.

The cut-off has been developed in the very top of the Paoli limestone. The contact between the Paoli and the overlying Mooretown sandstone is only six feet above the surface of Little Blue River. The elevation of the inlet is approximately 439 and that of the outlet is 434 feet. There is accordingly a fall of five feet in a horizontal distance of 200 feet. Additional fall was obtained for the mill by the construction of a dam about three-eights of a mile below the site of the cut-off. It is not known what the exact height of the dam was but the ruins of the dam would indicate that between eight and ten feet additional fall was obtained by this method.

Only a small part of the water of Little Blue River follows the underground conduit but a large enough stream of water passes through this channel to turn a fair-sized wheel. Figure 5 is a view of the outlet of this cut-off. At present there is no large opening on the up-stream side of the cut-off. Since abandonment of the mill, considerable debris and silt have obscured this opening and the water now filters through the gravel and silt along the stream bed.

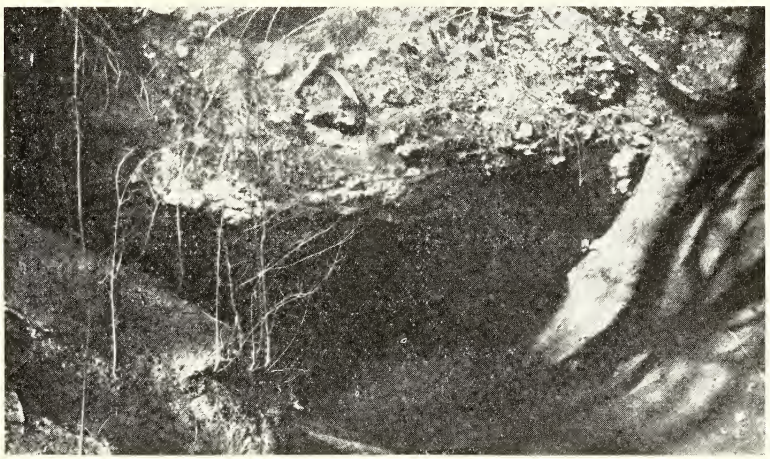

Fig. 5.

Fig. 5. View of the outlet of the waters of Little Blue River which follow the subterranean cut-off at the site of Carnes Mill.

It is probably only a matter of time until Little Blue River will abandon the route around the meander bend for the shorter course which is developing beneath the narrow spur. This will likely come about through the cutting into of the spur by lateral erosion rather than by further enlargement by solution of the underground conduit. The slight difference in elevation between the two sides of the cut-off will not permit the development of an underground channel large enough to carry all of the water in Little Blue. The cut-off which has occurred here as the result of the solution of a subterranean passageway simply marks the initial stage in the development of a permanent surface cut-off. Little Blue would soon have cut the neck into by lateral erosion but the geologic conditions were such as to permit the waters to flow through underground along the joint-openings in the Paoli limestone.

It is improbable that the cut-offs along Brushy and Bogard creeks will ever develop to sufficient size to accommodate all of the waters of these two streams, although it is probable that there may be some further increase in the volume of water sinking along these two streams. The difference in elevation between the "sinks" and "rise" is hardly large enough to permit the development of a subterranean channelway large enough to carry all the waters of these two streams. However, even under present conditions most of the water in these two streams during the summer months flow through the subsurface route. During the summer of 1930, no water at all passed beyond the "sink" in Brushy and there were only a few pools of standing water below the "sink" in Bogard. This summer was an abnormally dry one, so it is probable that the diversion is not as complete as this year would indicate.

The two topographic features described above are particularly interesting because they occur at the very western edge of the area where the Paoli limestone outcrops. Only a mile or two west of the areas described the Paoli limestone is below the level of the streams. They attract one's attention because they occur in an area where the topography is on the whole lacking in features resulting from solution. The rocks in this part of Crawford county are the Chester sandstones, shales, and limestones. A few sinkholes occur in places where some of the thicker limestones immediately underlie the surface, but in no place are these features developed in anything like the abundance that they occur where the Paoli limestone is the subsurface formation. Here is further evidence of the important influence which this formation has upon the topography of any region where it outcrops or forms the immediate bedrock. Wherever one finds this limestone forming the immediate bedrock of a region there he may expect a development of karst topogrpahy.