Alluviated Cave Springs of South-Central Indiana[1]

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Indiana's largest springs are classified as karst springs (Fig. 1). Karst springs are springs in limestone regions that serve as outlets for underground streams flowing in open cavities created by solution of the limestone bedrock. Most of the karst springs of Indiana, including eight of the 15 largest, are simple gravity-flow tubular or cave springs. Precipitation that enters underground passages through sinkholes and swallowholes at termini of sinking streams flows through solution channels or cavern passages and emerges elsewhere at the surface. Donaldson's Cave in Spring Mill State Park and Boone's Cave in Owen County are examples.

The remaining seven largest karst springs in the State are artesian springs or rises; the water emerging from them is forced upward from underground passages to the surface. These artesian springs are actually alluviated cave springs—cave springs that have been buried by accumulations of alluvial sediment in a previously deeper valley. At some springs the valley fill is shallow, as at the Orangeville Rise and the rise of Lost River; at others, as at Blue Spring on Big Indian Creek in Harrison County, it is thick.

In contrast to cave springs, which flow by gravity, alluviated cave springs are characterized by well-like openings through which subterranean waters from cavern passages ascend under hydrostatic pressure. Harrison Spring, 1 mile north of White Cloud in Harrison County, is the largest alluviated cave spring in Indiana (Fig. 2). It consists of a subcircular pool about 80 feet wide and 110 feet long in the bed of an abandoned meander loop of Blue River. The depth of the pool ranges from a few feet at the base of the steep sides to 35 or 40 feet at the bottom of the well-like opening or rise pit. Skin divers recently descended to this level, where they discovered a horizontal passage in limestone. A low rim or levee, apparently consisting of clays and silts, surrounds the spring on all sides except at the outlet. The outlet stream follows the bed of the abandoned meander to its junction with Blue River half a mile southwest of the spring. Although the stream flows within the flood plain, the alluvial sediments are thin in several places, and limestone bedrock is exposed in the stream bed immediately downstream from the rise—indications of a lateral-planation bench between the bedrock valley and the present valley wall (Fig. 3).

The great flow of Harrison Spring indicates that it is fed by an extensive cavern system. The minimum flow of Harrison Spring in the summer of 1960 was 27.5 cfs, measured at a time when the water was clear, but the spring often gives forth with a violent muddy discharge that partly covers the adjacent flood plain. Much of the water issuing from the spring is derived from a karst plain to the

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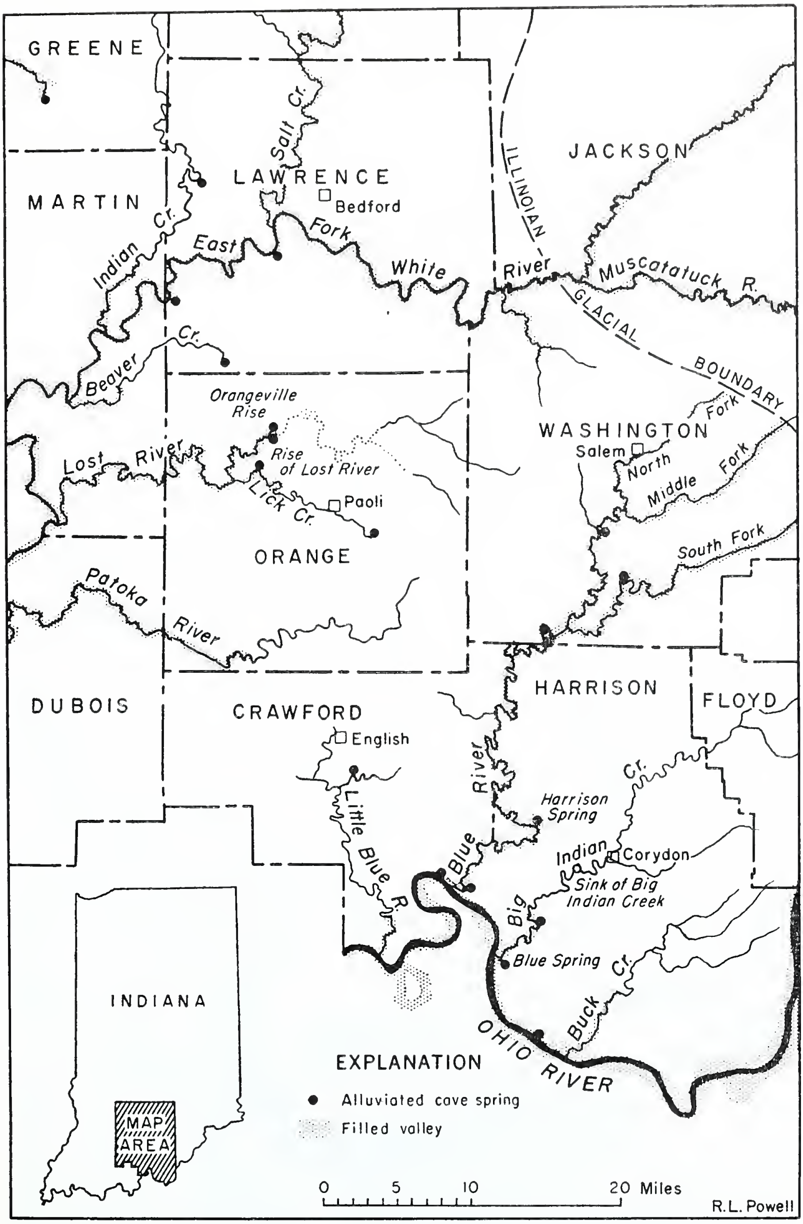

Figure 1. Map of south-central Indiana showing the location of alluviated cave springs.

north, north-east, and east. The exact extent of the underground drainage basin cannot be determined, at least not by examination of the topography. The extent of the drainage basin could be delimited

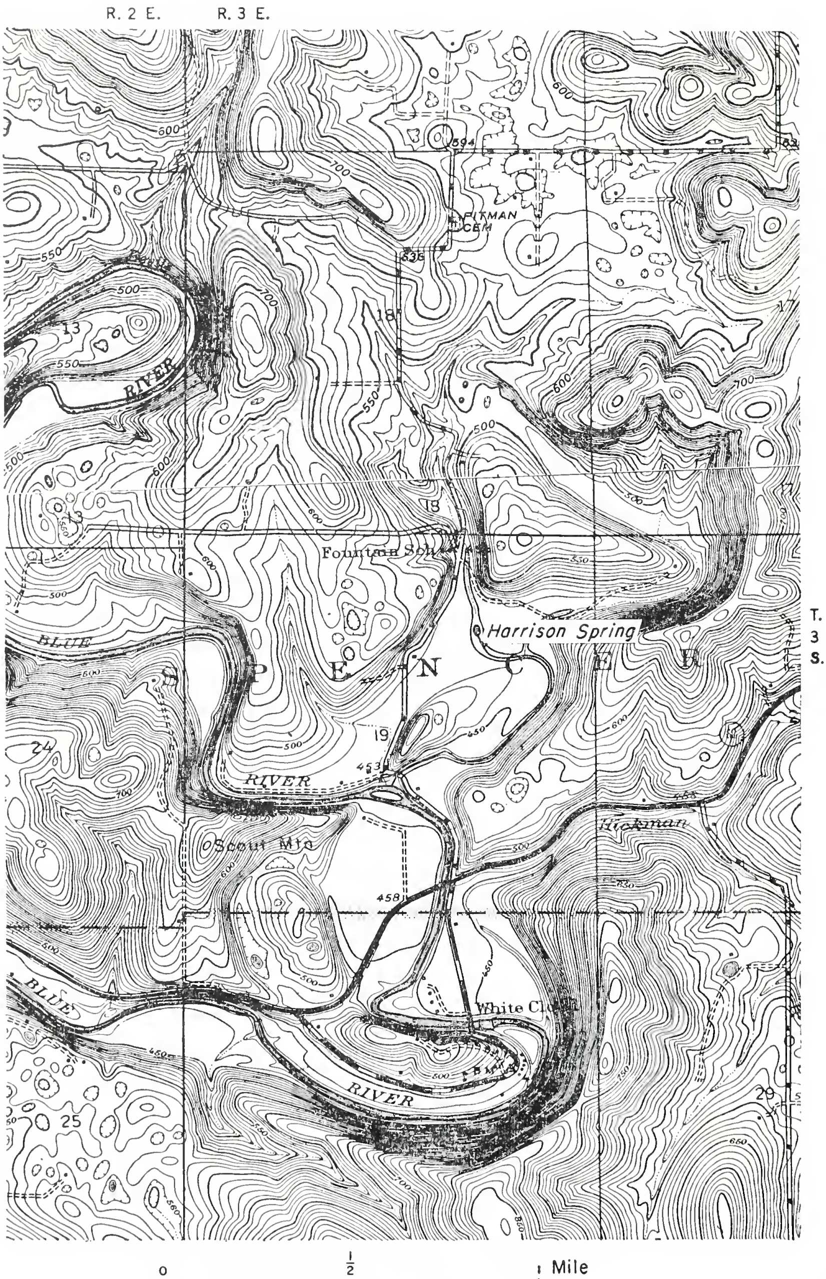

Figure 2. Topographic map of Harrison Spring and vicinity, Harrison County (parts of Corydon West and Depauw Quadrangles).

by the use of dyes or radioactive tracers, but this method would be expensive. The discharge at the spring may be augmented by water diverted from Big Indian Creek (Fig. 1), which sinks at a higher elevation and updip from Harrison Spring.

Harrison Spring, as well as perhaps most other alluviated cave springs, was formed at the place where a former meander of the stream swings in an updip direction and most deeply dissects the strata. Pohl (7) observed that resurgences of subterranean drainage "are found where the meanders of a surface stream are convex in an updip direction." Harrison Spring occupies a meander that crosses the axis of a

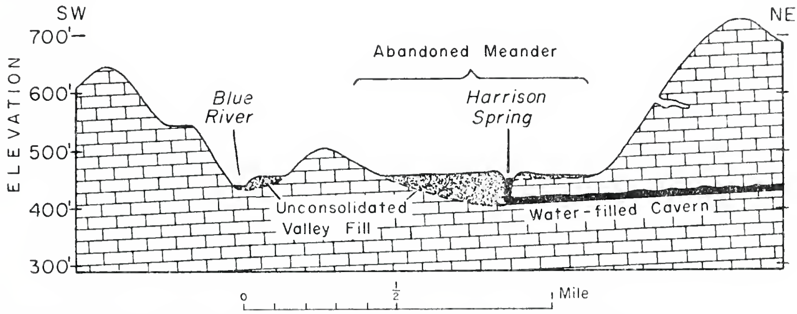

Figure 3. Idealized cross section through Harrison Spring and Blue River.

broad shallow syncline, which covers an area of more than 25 square miles between the spring and Big Indian Creek (5). The sink of Big Indian Creek (NW¼NE¼ sec.3, T.4S., R.3E.), mentioned by Ashley and Kindle (1), lies updip from Harrison Spring. The hypothetical gradient between this sink and Harrison Spring would be approximately 21 feet per mile, or adequate to permit subsurface drainage from the sink to Harrison Spring. The spring described by Ashley and Kindle as the rise of Indian Creek (Stoner Spring, SE¼SE¼ sec.19, T.4S., R.3E.) was not flowing at a time when the low flow of Big Indian Creek was entering the sink. If Big Indian Creek upstream from the sink is tributary to Harrison Spring, part of the waters of more than 200 square miles could be added to the drainage area of Harrison Spring (Fig. 4).

The second and third largest springs in Indiana are the Orangeville Rise and the rise of Lost River (Fig. 1). These two karst springs are the resurgences of subsurface drainage in Lawrence, Orange, and Washington Counties, which has been described by Malott (4) (Fig. 4). The Orangeville Rise, which is fed by some 30 square miles of drainage north and northeast of Orangeville, is on the south side of Orangeville at the head of perennial Lost River (Fig. 5). It is the more picturesque of the two rises and has long been mistakenly considered by many local people to be the rise of Lost River.

Malott (4) stated:

> The Orangeville rise issues from a semicircular rock-walled pit 110 feet across, and the waters rising from it flow southward in a

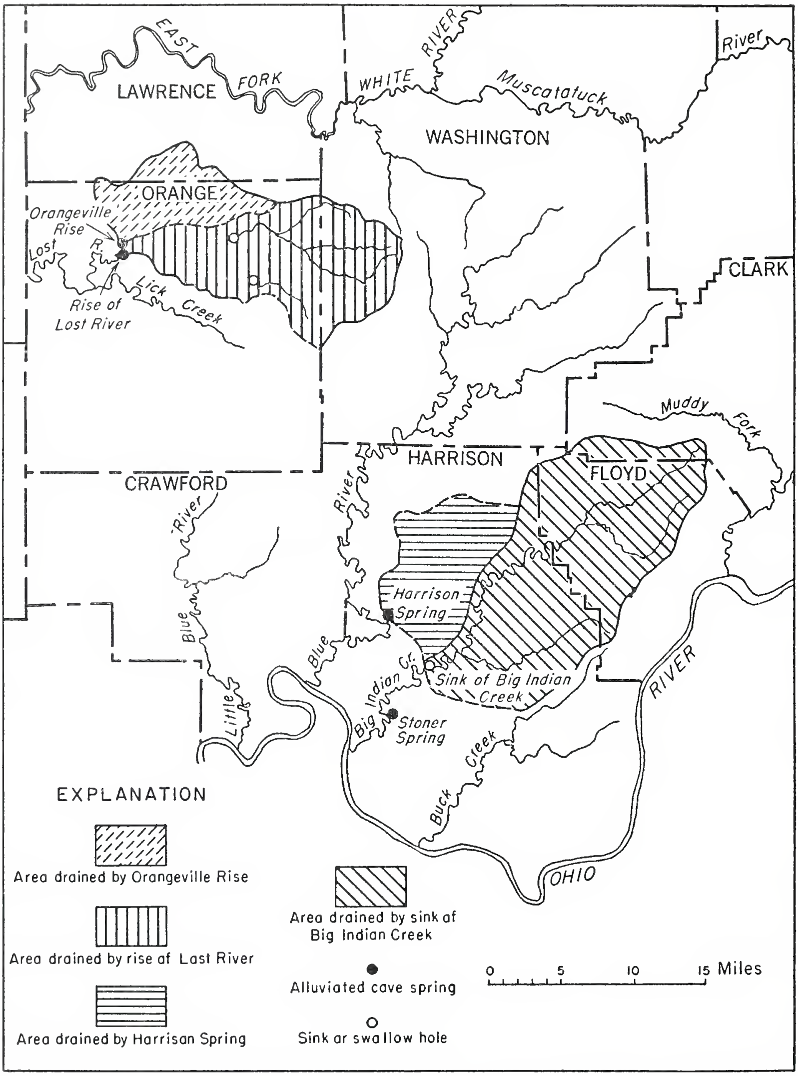

Figure 4. Map showing the areas drained by Harrison Spring, sink of Big Indian Creek, Orangeville Rise, and rise of Lost River.

mud-banked channel 15 feet deep and 40 to 50 feet in width for about 150 yards before entering Lost River. The waters rise some 15 or 20 feet as a great artesian spring from a water filled cavern the mouth of which is apparently 70 feet in width. The rock wall above the waters . . . form an overhanging, lunar-shaped cliff about 15 feet above the waters in the rise pit. . . . After heavy rains its flow is estimated to reach or exceed 2,000 cubic feet per second, and its lunar shaped, low cliff is submerged and the channel leading to Lost River is filled to overflowing.

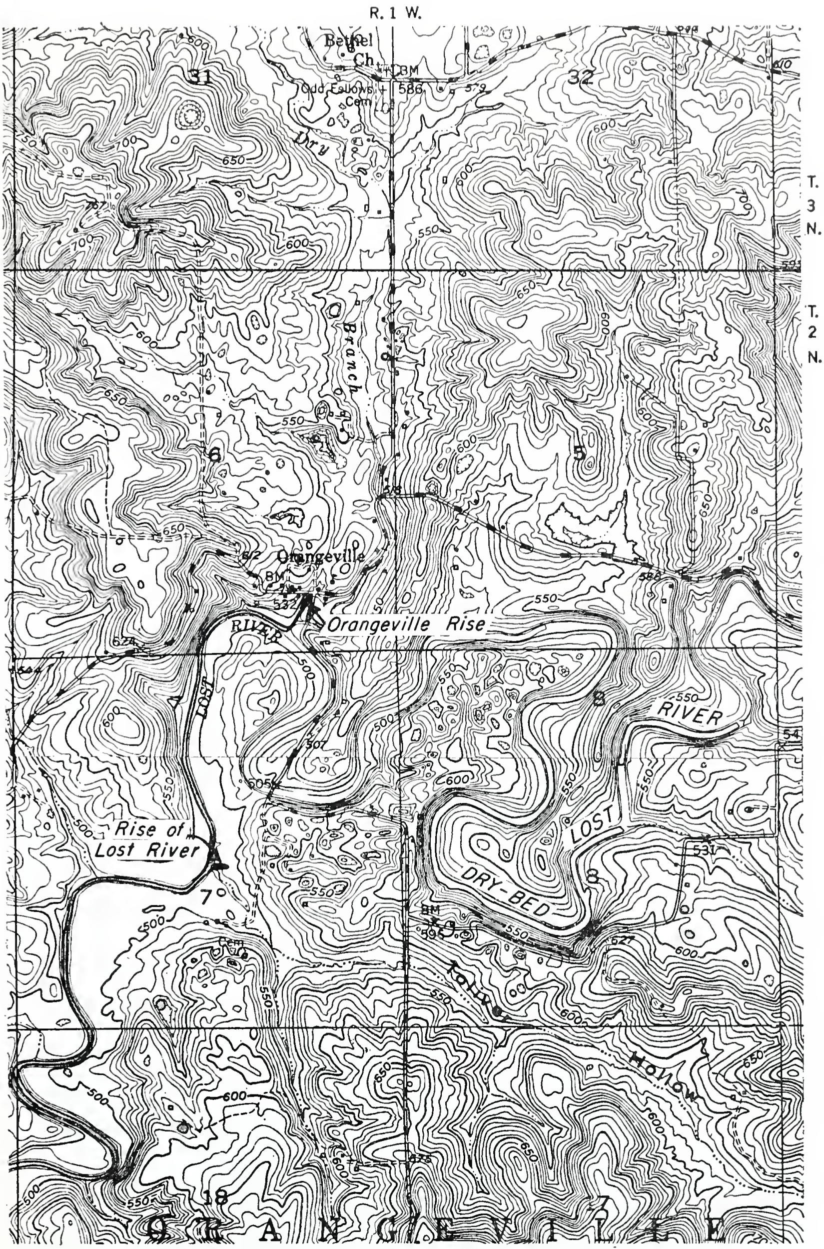

Figure 5. Topographic map of the Orangeville Rise and the rise of Lost River and vicinity, Orange County (parts of the French Lick and Georgia Quadrangles).

If the alluvial fill were removed, the buried cave spring at Orangeville would resemble the entrance to Boone's Cave in Owen County.

The rise of Lost River, which marks the resurgence of more than 80 square miles of surface drainage that has been diverted underground, lies about three quarters of a mile southwest of Orangeville (Fig. 4). It consists of several openings of small diameter that are aligned in the floor of a steep-banked channel, which is about 25 feet deep, and which is filled with water to a maximum depth of 11 feet at low-water stage. A sounding in one of the rise pits indicated that the cavernous route which feeds the resurgence is at least 17 feet below the floor of the channel. The channel enters Lost River within 50 feet of a rise pit. The stream from the Orangeville Rise is only a few feet deep, but downstream from the rise of Lost River the water reaches depths several times greater than those upstream from the junction.

The Orangeville Rise and the rise of Lost River are alluviated cave springs. The present channel immediately downstream from the Orangeville Rise does not reach bedrock, but farther downstream the channel crosses a buried bedrock bench. The rise of Lost River lies in a flat part of the valley, and no bedrock is exposed either at the rise or in close proximity to it. The cavernous routes and their exits into the buried bedrock valley lies 30 to 50 feet below the top of the present valley fill.

Indiana's alluviated cave springs are found along major streams that are tributary to the Ohio River and the East Fork White River. The valleys of both of these streams are known to contain deep bedrock channels. The U. S. Corps of Engineers discovered bedrock approximately 270 feet above sea level or 114 feet below the normal pool elevation of the Ohio River about 1 mile upstream from Blue River.

The headwaters of Blue River lie in northeastern Washington County at a general elevation of 800 feet above sea level. The gradient of the buried bedrock valley between the headwaters and Harrison Spring is about 5½ feet per mile. The Illinoian ice sheet overrode the Knobstone Escarpment in northeastern Washington County, and meltwater streams deposited as much as 50 feet of outwash, silts, clays, sands, and gravels in the three forks of Blue River (Fig. 1). These deposits are preserved as terraces and valley fill (9). The lower part of Blue River, probably as far upstream as Harrison Spring, was the site of a Wisconsin-age lake. The lacustrine materials filled the valley to an elevation of 435 feet near the mouth of Blue River (9), and at Harrison Spring stream-borne silts and clays stand at an elevation of 455 feet.

The cavern outlet of Harrison Spring lies at least 35 or 40 feet below the surface of the spring or about 405 feet above sea level. The gradient of the buried bedrock valley between Harrison Spring and the Ohio River has been calculated at just more than 7 feet per mile, but that of the Ohio bedrock valley is less than a foot per mile. It is likely that the bedrock valley of Blue River in its lower reaches is at grade with the Ohio and that the waters of Harrison Spring may rise from a passage that is at a depth greater than 40 feet.

Various karst hydrographers such as Swinnerton (8), Piper (6), Gardner (2), and Malott (3 and 4) have indicated that caverns are formed at or near the water table or base level by the diversion of surface water or by the sapping of ground water from carbonate uplands adjacent to deeply dissected valleys through subterranean routes. Because most artesian karst springs are found along deeply filled bedrock valleys of pre-Kansan age, it logically follows that they are buried cave springs that predate the filling of the valleys, which took place during Kansan, Illinoian, and Wisconsin time.

Thus the cavern that feeds Harrison Spring was formed at grade with base level of a deep stage during early Pleistocene time. The large volume of water emerging at this level may account for the steepened bedrock profile of Blue River below the spring, but the spring may rise from a slightly lower elevation, which would also decrease the gradient. Tucker (10) estimated that 25 percent of the discharge of Blue River at White Cloud originates at Harrison Spring. The cavern system that is tributary to the spring must have been formed prior to Illinoian time when the headwaters of Blue River were encroaching into northeastern Washington County. Later, Blue River was partly filled with Illinoian outwash, and later yet the spring may have received a cover of backwater lacustrine deposits of Wisconsin age.

The rise may have originated suddenly as hydrostatic pressure forced trapped subterranean waters to ascend through the sediments that impounded the former cave spring. A more logical, although less dramatic, explanation is that the water welling up from the cavern prevented deposition within the area above the cave spring while alluvial or lacustrine deposits were filling the rest of the valley. Sediment settling within the mouth of the submerged cave spring was carried upward by the ascending water and was deposited at the margin of the opening where current slackened, in somewhat the same way as a natural levee is formed. Natural levees are formed around some rise pits, especially those situated well within flood plains.

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