The Laurel Creek Basin and Greenville Saltpeter Cave

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Abstract

The Laurel Creek Basin is located in an isolated outcrop of Greenbrier Limestone to the southwest of the main Greenbrier Karst. It is drained by Laurel Creek, a tributary of Indian Creek and thus of the New River. The underground route of Laurel Creek passes through Laurel Creek Cave, Rimstone-Crossroads Cave, and Greenville Saltpeter Cave. The caves are in nearly flat bedding near the crest of the Abbs Valley Anticline.

17.1 Introduction

The Laurel Creek Basin represents the southwest limit of the Greenbrier Karst. It is also the one basin in the Greenbrier Karst that is not part of the Greenbrier River drainage. Laurel Creek flows west and southwest over the Mauch Chunk shales and sandstones onto the limestone and then southwest as karstic drainage to its confluence with Indian Creek, a west-flowing tributary that drains directly into the New River.

Laurel Creek flows from clastic rocks to limestone, to more clastic rocks on its route to the New River. The portion of the route across the limestone is mostly underground through Laurel Creek Cave, Rimstone-Crossroad Cave, and Greenville Saltpeter Cave although a well-defined segment of dry valley marks an old surface route.

Laurel Creek Cave was closed by the owners following a rescue of cavers trapped by flood waters in 1982 (Chap. 5). Greenville Saltpeter Cave has been closed to protect endangered bat species. This chapter, therefore, depends on older published reports and on visits to the caves made many years ago.

Electronic supplementary material
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17.2 Geomorphic and Geologic Framework

17.2.1 Local Geology

The Laurel Creek Karst is an island of limestone brought to the surface by an undulation in the Abbs Valley Anticline (Fig. 17.1). The limestone is surrounded by the shales and sandstones of the Mauch Chunk Formation. Because of their location on the crest of an anticline, local dips are very low. The basin and the caves are formed in the upper members of the Greenbrier Limestone. According to Davies (1949), Laurel Creek, Crossroads, and Greenville Saltpeter Caves are all in the Union Limestone.

17.2.2 The Landscape

The Laurel Creek Karst takes on the rough form of a closed basin (Fig. 17.2) because the limestone surface is lowered faster by dissolution than the surrounding clastics. The resistant sandstones that surround the basin produce a pronounced escarpment on the north and east sides. Laurel Creek has cut a deep narrow valley through the escarpment where it enters the basin from the east. The western boundary is a line of hills at the base of which is the south-flowing Indian Draft, also a tributary of Indian Creek.

The central portion of the basin is a dissected upland with a hilltop elevation near 1800 ft. The upland is pocked with sinkholes, and there is no defined surface drainage although there are several dry valleys. Presumably precipitation in the

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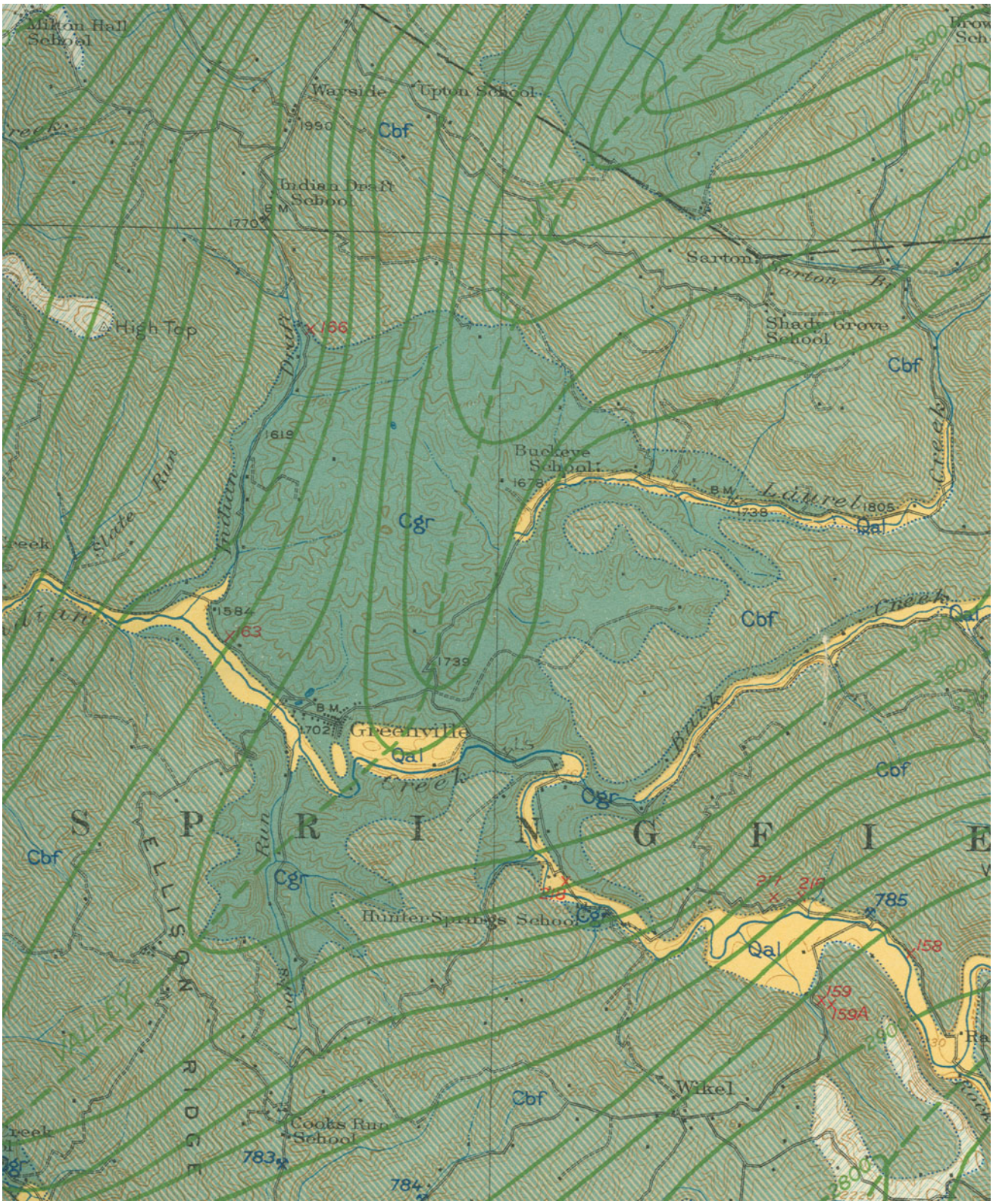

Fig. 17.1 Geologic map of the Laurel Creek karst taken from Reger and Price (1926). The *darker*, *blue-green* (Cgr) is the Greenbrier Limestone. The hatched *lighter green* is the Bluefield member of the Mauch Chunk group. *Green lines* are structure contours. The *dashed green line* marks the location of the axis of the Abbs Valley Anticline

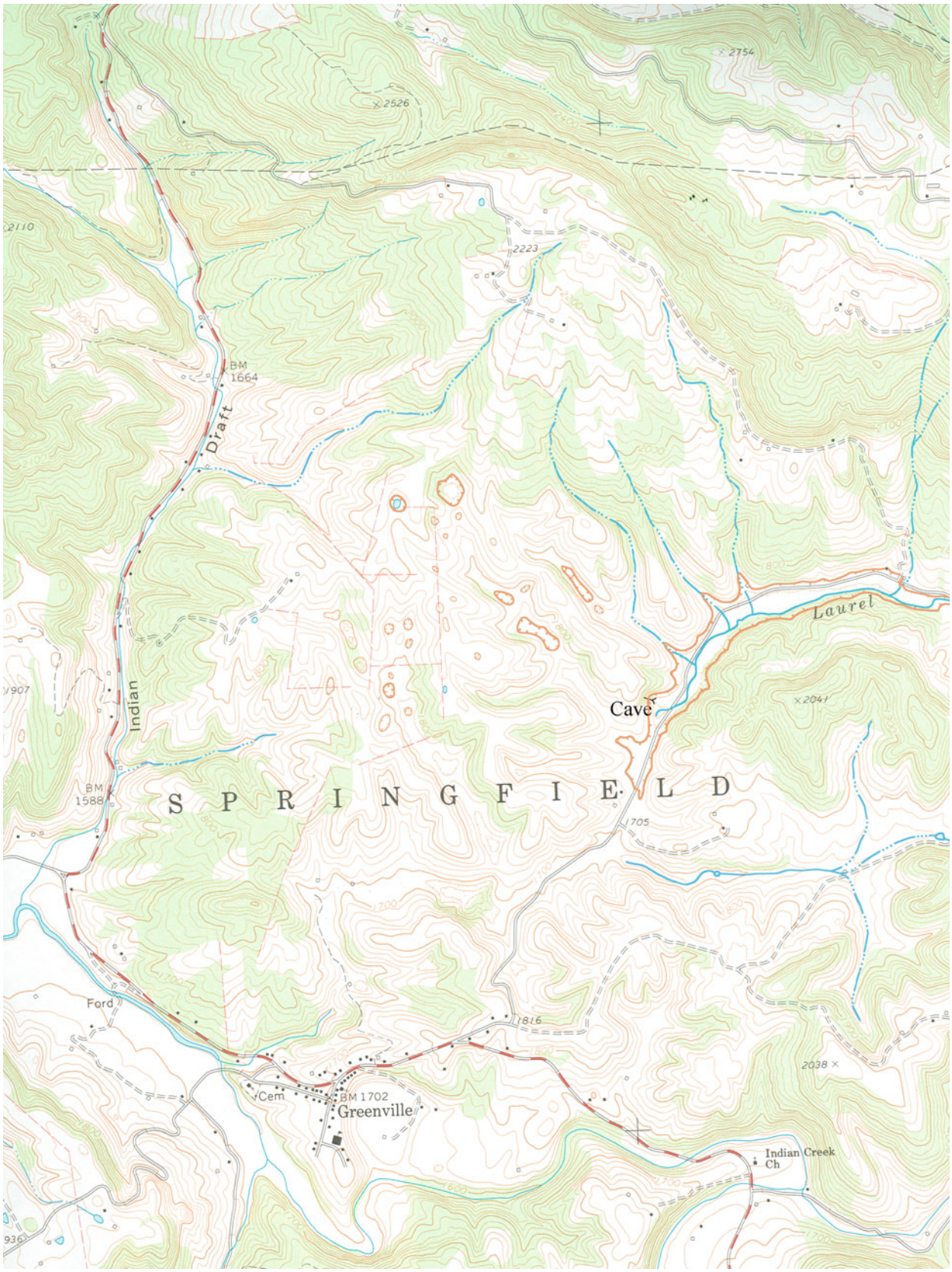

Fig. 17.2 Section of the U.S. Geological Survey Greenville 7.5 min quadrangle

central portion of the basin drains through sinkholes and eventually reaches Laurel Creek by underground routes.

17.2.3 The Laurel Creek Drainage

Laurel Creek has a large surface catchment east and north of the karst region. A profile of Laurel Creek through the karst was constructed from the topographic map (Fig. 17.3). The stream enters the basin through a valley cut in the escarpment on the east side of the basin. The stream contact with carbonate rock is near the edge of Fig. 17.2 where the slope of the stream channel abruptly flattens to the floor of a blind valley at an elevation of 1670 ft. At the southwestern end of the blind valley is the entrance to Laurel Creek Cave and the sink point of Laurel Creek (Fig. 17.4). Under low flow conditions, the stream channel is dry above the cave entrance (Fig. 17.5) but contains flowing water a few hundred yards upstream.

Downstream from the cave entrance, the floor of the dry valley rises over a low saddle to an elevation of 1705 ft and then descends to a flat floor at an elevation of 1690 ft. This flat sequence of valley floor is interrupted by the karst window that exposes a short surface exposure of Laurel Creek between the spring and the Water Entrance to Greenville Saltpeter Cave. Downstream from the karst window, the dry valley floor drops rapidly to the spring at the Mill Pond Entrance. The end of the profile is the confluence between Laurel Creek and Indian Creek at an elevation of 1580 ft.

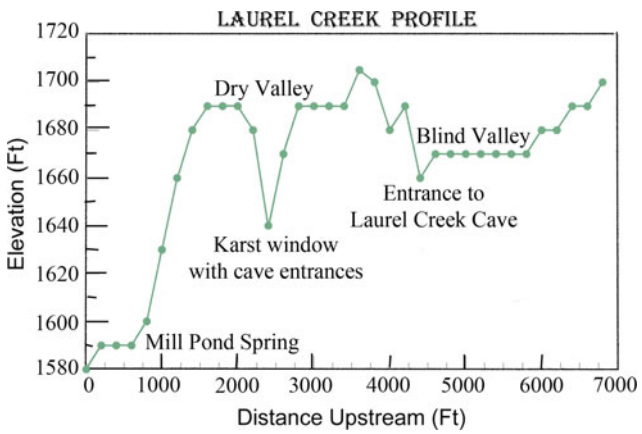

Fig. 17.3 Profile of the Laurel Creek dry valley measured upstream from the confluence with Indian Creek. Data taken from U.S. Geological Survey Greenville 7.5 min quadrangle

17.3 Caves

17.3.1 Laurel Creek Cave

The main entrance to Laurel Creek Cave is along the Laurel Creek Road 1.5 miles northeast of Greenville. It is a prominent opening at creek level 110 ft wide and 30 ft high. In recent years, the property owners have planted evergreens across the entrance (Fig. 17.6). Under low flow conditions, Laurel Creek either sinks in its bed or continues past the cave entrance to drain into a sinkhole in the streambed a short distance downstream.

Laurel Creek Cave, or at least its prominent entrance, was known to the earliest settlers in Monroe County. It was extensively described by Davies (1949). The Davies description was repeated by Hempel (1975). Following a caver entrapment by flood waters in 1982 (see Chap. 5), the owners have denied access to the cave (Fig. 17.7) and little new information has been gathered in recent decades. A map prepared in the 1940s shows the main passages in good detail and was reproduced by Davies (1949). A second survey by the VPI Grotto produced a map with more passage shown but with less passage detail that was published by Hempel (1975). The third and last survey by George Dasher and the Greenbrier Grotto in the late 1970s produced the map included in this chapter which shows more passage, more passage detail, and two more entrances (electronic map M-17.1).

Much of the description that follows is paraphrased from Davies (1949) and Hempel (1975). From the main entrance, a broad passage curves to the south and for more than 300 ft maintains the cross section of the entrance (Fig. 17.8). At this point, the passage is divided by a partition with the west section strewn with breakdown while the east section is an open passage 20 ft wide and 15 ft high. On the northwest edge of the breakdown is a small exit to the top of the hill. At the end of the divided section, the passage resembles the entrance section except that the width is about 50 ft. One thousand feet from the entrance is the theater room, 160 ft long with a ceiling height of 50 ft. From this room, the cave consists of two roughly parallel passages.

The upper level leads off from the southwest edge of the upper part of the room and is 10 ft above the lower passage. Three hundred feet from the theater room, the passages are connected by a broad corridor. After another 350 ft, the upper level is full of breakdown for 225 ft after which it changes direction to the south and crosses the lower level, continuing for 900 ft to where further advance is blocked by

Fig. 17.4 View of the blind valley looking upstream from the entrance to Laurel Creek Cave. Photo by the author

Fig. 17.5 A dry bed of Laurel Creek. The cave entrance is in the wood in the backgound. Photo by the author

silt and flowstone that reaches the ceiling. Throughout its entire length, the upper level is rather uniform in size averaging 20–3 ft wide and 6–15 ft high.

The lower level is less uniform. From the theater room, the passage is 25 ft wide and 15 ft high for 100 ft where a passage develops to the southeast. The passage turns abruptly to the west and for 420 ft is 20 ft wide and 4–7 ft high. Here the lower passage passes beneath the upper level and is connected to it by a pathway along the south wall. The passage is traversable for 250 ft where a lake is encountered

Fig. 17.6 Main entrance to Laurel Creek Cave. Laurel Creek flows past the entrance in the foreground. Photo by the author

Fig. 17.7 Warning sign along Laurel Creek Road at the cave entrance. Note wide marshy area that forms the alluviated floor of the blind valley. Photo by the author

which continues for 100 ft more at which point it narrows to a thin crevice. The lake can be reached from the upper level, 250 ft from the end. The lower level is floored with breakdown.

From the entrance to the theater room, the floor is covered with coarse gravels made up of cobbles from 4 to 10 in. in size in a matrix of finer sand and gravel. Banks of stratified clay reaching to the ceiling occur in this section in niches along the wall. The floor of the remainder of the cave is underlain by deep, fine-grained, olive-drab silt. On the upper level, it is dry but compact. On the lower level it is damp, and in some places the high clay content makes it sticky. Near the end of the upper level a slump pit exposes 15 ft of silt resting on rock, a thickness that is average for this level. On the west side of the theater room, the thickness reaches 40 ft, but in the remainder of the lower level the thickness ranges from a thin veneer to 6 or 7 ft (Fig. 17.9).

The underground route of Laurel Creek lies somewhere below the main cave passages although it is likely that the lakes in the rear of the cave connect with the active stream level. The surface stream does not enter the cave during periods of low flow, but during flood runoff, the stream overflows its banks and

Fig. 17.8 Entrance passage with gravel floor. Photo by George Dasher. Used with permission

Fig. 17.9 Stream channel cut into silt fill on floor of passage. Photo by Ed McCarthy. Used with permission

fills the cave passage, backing up water to form a lake in the blind valley above the entrance (Fig. 17.10).

17.3.2 Rimstone-Crossroad Cave

The Crossroad Entrance is in a low escarpment 25 ft east of the Laurel Creek Road (Fig. 17.11). The entrance is at the top of a breakdown slope that immediately drops down 15 ft to a main stream passage. The Rimstone Entrance is at the base of a 60-foot cliff, 400 ft north of the Water Entrance to Greenville Saltpeter Cave.

The Crossroad Entrance was reported by Davies (1949), but only a short segment of the stream passage was known. Members of the Pittsburgh Grotto explored the cave, pushing low air spaces and connected Crossroad Cave with Rimstone Cave. The map given here was surveyed in 1973 (Fig. 17.12).

Fig. 17.10 Laurel Creek Cave. Main entrance in flood. Photo by Debbie Kyle

Fig. 17.11 Crossroad Cave Entrance to the Rimstone-Crossroad Cave. Photo by the author

Rimstone-Crossroad Cave (spelled Cross Road by Davies 1949 but Crossroad on the map in Hempel 1975) is essentially a half-mile segment of stream passage. The stream rises from a sump at the eastern end, 75 ft upstream from the Crossroads Entrance. This segment of passage is keyhole-shaped with the stream flowing in a deep-cut trench. Downstream, the passage varies in width and height but except for a short segment just downstream from the Crossroads Entrance, contains a stream with depths ranging from 2 to 7 ft. The stream emerges from the Rimstone Entrance.

17.3.3 Greenville Saltpeter Cave

Greenville Saltpeter Cave (also called Head of the Mill Pond Cave) lies beneath a remnant of dissected upland immediately north of Greenville. The cave has four entrances. The southern or Mill Pond Entrance is near the resurgence of Laurel Creek. The three northern entrances are in a karst window 2000 ft to the north. From east to west, these are the Water Entrance, the Hilltop Entrance, and the Saltpeter Entrance. The cave is described by Davies (1949) but

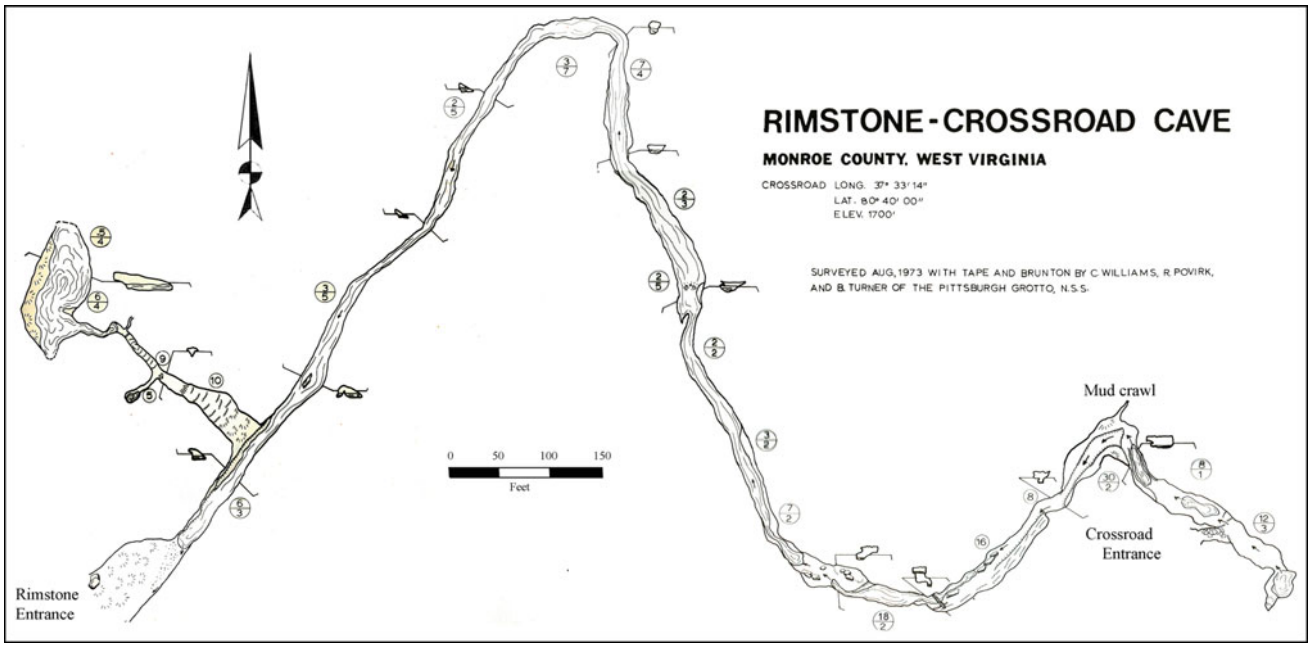

Fig. 17.12 Map of Rimstone-Crossroad Cave. Adapted from Hempel (1975)

without a map. The cave was first mapped by Charleston Grotto in 1948, and this map (Fig. 17.13) was published by Davies (1958). The most recent map was surveyed by Pittsburgh Grotto cavers in 1973 and was included in Hempel's (1975) report.

The spring run from the cave entrance was dammed just upstream from its confluence with Indian Creek to serve a grist mill which still survives as a historic monument. The Mill Pond is backed up to the cave entrance (Fig. 17.14). The Mill Pond Entrance is 5 ft high and 20 ft wide. It opens into a broad, sloping room on the north side of which is a low passage with a floor composed of large Rimstone pools. The main passage trends east for 1200 ft and then north, where it splits into multiple passages in the central portion of the cave.

The Water Entrance, 25 ft high and wide, carries the stream south along the east side of the cave through a passage that leads to a large breakdown room. It carries the main flow of Laurel Creek which rises from a spring on the north side of the karst window, flows across the floor of the window, and into the Water Entrance. The stream follows the passage and flows beneath the breakdown to a smaller breakdown passage for an additional 200 ft. The stream passages ends in a sump at the end of the passage. The remaining link between the sump and the Mill Pond Spring is through a deeper and probably water-filled passage. Passages from the breakdown room connect with a complex tangle of passages to the south which connect with the Mill Pond passage.

The Hilltop Entrance opens onto a talus slope that leads to a large chamber. To the south is a major passage which extends to a three-way junction between the Mill Pond passage and the complex passage from the Water Entrance.

The Saltpeter Entrance opens into an east–west trending passage that was the main locus of Saltpeter mining operations. A side passage to the south connects to a larger east–west trending passage which also contains the remnants of the Saltpeter mining. Cart ruts, burro tracks, mattock marks, and other relics are found in these passages. It appears that the Saltpeter mining was extensive, because artifacts are also found in most of the side passages in this area. The larger Saltpeter passage connects with the large chamber inside the Hilltop entrance.

Overall, the passage pattern of Greenville Saltpeter Cave is that of an anastomotic maze in the sense of Palmer (1975). Passage development is mainly along bedding plane partings so that passages curve and wander and interconnect at random points as would be expected from the initiation routes along bedding planes. Passage cross sections (where not modified by breakdown are irregular but smoothly sculptured. The hydrologic implications are that passages developed slowly along multiple pathways, by slowly moving water under completely phreatic conditions. This is consistent with the clastic sediments found in the cave. These are fine-grained clays and silts (except where the floors are covered with breakdown) as expected from material settled out of slowly moving water.

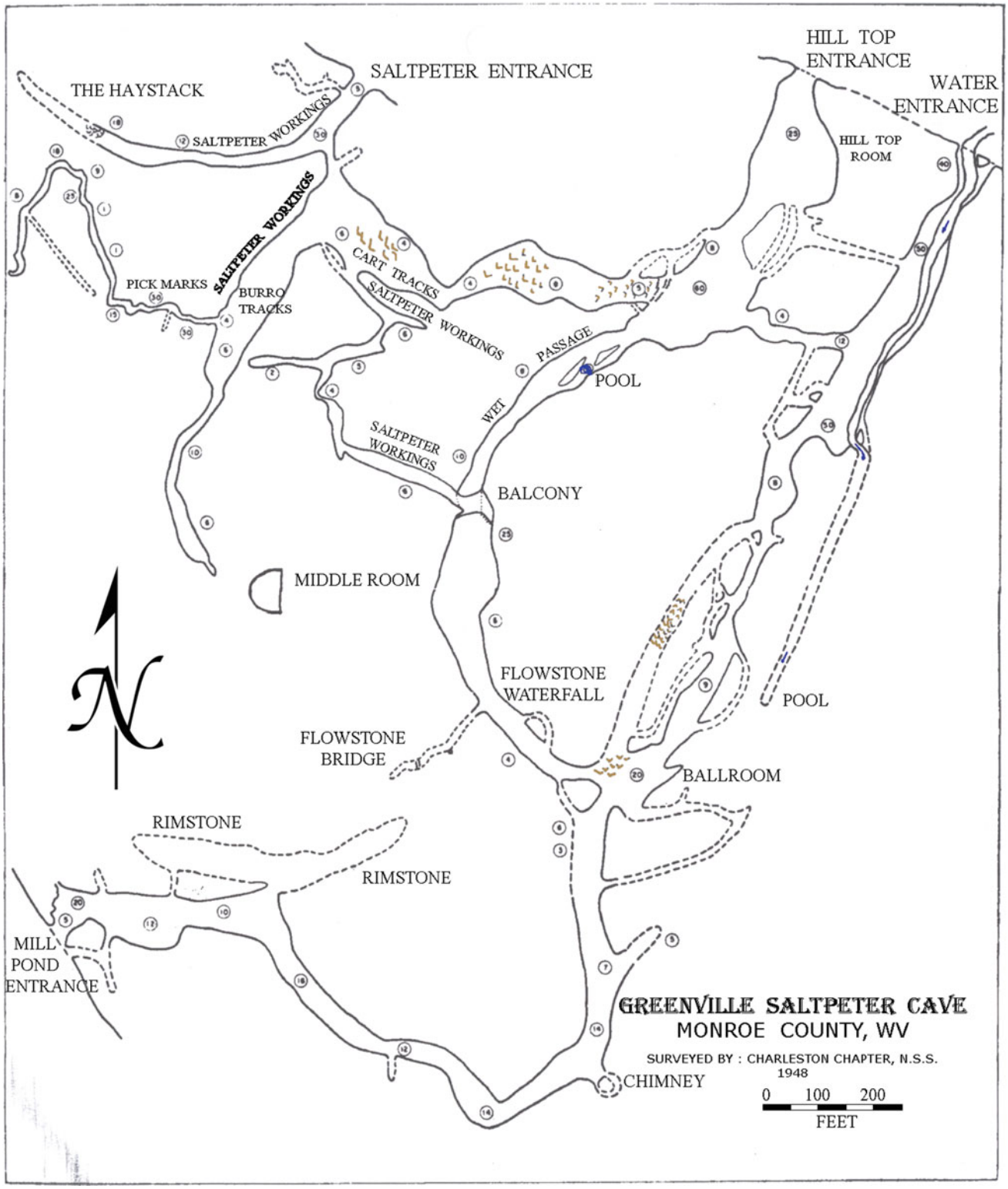

Fig. 17.13 Map of Greenville Saltpeter Cave taken from Davies (1958)

Fig. 17.14 Mill Pond at Greenville. The Mill Pond Entrance to Greenville Saltpeter Cave is in the woods at the head of the pond. Photo by the author

17.4 Water Chemistry

There is a single set of measurements of water chemistry along the Laurel Creek drainage (Groves 1992). Samples were collected on April 11 and 12, 1987, analyzed for the common aqueous species, and the saturation state of the water with respect to calcite was calculated. Groves' data were recalculated and are displayed in Fig. 17.15. The concentrations of Ca^{2+} and Mg^{2+} ions were combined and recalculated as Ca + Mg hardness, a useful measure of concentration of dissolved carbonate. Saturation indices were taken directly from the original paper.

As expected, the hardness is low where the stream is flowing on clastic rocks (BR) and increases rapidly when Laurel Creek flows onto the Greenbrier Limestone and continues to increase downstream. Groves assigned the increase in hardness to the kinetics of limestone dissolution as the water in the stream was exposed to more and more carbonate rock. However, an unknown factor is the amount of water from fractures and bedding plane partings leaking into the master conduit. These waters are derived from the epikarst and from runoff into sinkholes and are expected to have a higher content of dissolved carbonate.

All samples are highly undersaturated with respect to calcite and although the degree of saturation increases downstream. The final sample taken at the spring outlet of Crossroad Cave is only 10% of saturation. This is consistent with other observations that conduits fed by sinking streams usually traverse the conduit without coming into chemical equilibrium with the bedrock.

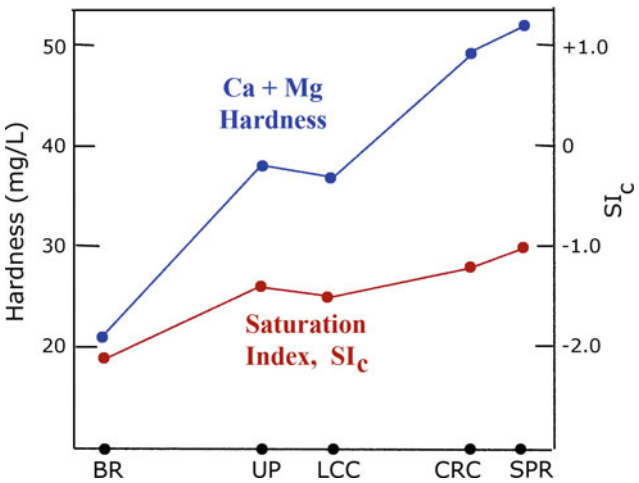

Fig. 17.15 Geochemical profile along Laurel Creek calculated from data of Groves (1992). The distance scale is approximate and based on estimated distances between sampling sites. Code for the sampling sites: *BR* Bridge across Laurel Creek Road at the eastern edge of the basin where the stream is flowing on shales and sandstones. *UP* Upstream from Laurel Creek Cave where the stream is flowing in an alluviated blind valley. *LCC* Entrance to Laurel Creek Cave. *CRF* Stream in Cross Road Cave. *SPR* Spring where Laurel Creek emerges into the karst window

17.5 Summary

The underground drainage of Laurel Creek is essentially a linear system now fragmented into three caves: Laurel Creek Cave, Rimstone-Crossroad Cave, and Greenville Saltpeter Cave. The system is low gradient and was formed before the dissection of the topography by Indian Creek and its tributaries. The surface tributaries of Laurel Creek provide most of the allogenic input; however, infiltration through the karst surface of the closed basin must also drain through the system. Also unknown is the contribution from Indian Draft, a loosing stream that flows south along the west side of the basin.

References

Davies, W.E. 1949. *Caverns of West Virginia*, vol. 19, 353pp. Morgantown, WV: West Virginia Geological Survey.

Davies, W.E. 1958. *Caverns of West Virginia*, vol. 19(A), 330pp. Morgantown, WV: West Virginia Geological Survey.

Groves, C.G. 1992. Geochemical and kinetic evolution of a karst flow system: Laurel Creek, West Virginia. *Ground Water* 30: 186–191.

Hempel, J.C. 1975. *Caves of Monroe County*, vol. 4, 149pp. Barrackville, WV: West Virginia Speleological Survey Bulletin.

Palmer, A.N. 1975. The origin of maze caves. *National Speleological Society Bulletin* 37 (3): 57–76.

Reger, D.B., and P.H. Price. 1926. *Mercer, Monroe, and Summers Counties*, 963. Morgantown, WV: West Virginia Geological Survey.