The Swago Creek Basin

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Abstract

The Swago Creek Basin is the northernmost drainage in the defined area of the Greenbrier Karst. It is a fluviokarst basin with extensive underground drainage but relatively little expression of surface karst. Swago Creek heads in two large cave-entrance springs: Overholt Blowing Cave and Cave Creek Cave. The Overholt Blowing Cave stream can be explored nearly to the head of the Dry Creek Valley but the upstream segment of the valley is pirated eastward to springs on the opposite side of the mountain. Little of the Cave Creek drainage is accessible to direct exploration but some fragments are represented by Barnes Pit, Tub Cave, and the Carpenters-Swago System. The Carpenter-Swago System has 3.1 miles of surveyed passage, and it is strongly controlled by a N60°E fracture system. Extensive stream tracing in the basin reveals details of drainage pattern which is strongly controlled by the shaly Taggard Formation.

6.1 Introduction

The Swago Creek Basin is the northernmost of the local drainage areas that together make up the Greenbrier Karst. It is a multi-sectioned cove cut into the high Allegheny Plateau to the northwest. The dissected plateau remnants are labeled as mountains on the topographic maps: Rogers Mountain to the west, Swago Mountain to the northwest, Spruce Flats and Day Mountain to the north, and Stony Creek Mountain and Bridger Mountain to the east (Fig. 6.1). Day Mountain at 4255 ft is the highest point of elevation in the basin. Details are shown on the USGS Hillsboro and Marlinton Quadrangles.

Electronic supplementary material
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6.2 History

The very early status of knowledge of the caves of the Swago Creek Basin is given by a single quotation from Price and Reger's (1929) volume on Pocahontas County geology. "Known caverns in Pocahontas County are, Saltpeter Cave at the head of Swago Creek, Overholt Blowing Cave near McClintock's Mill, and Sneadegar Cave west of Droop Mountain near the Greenbrier County Line." Davies (1949) offers a description and map of Overholt Saltpeter Cave that has not been modified, a description of Tub Cave, a description of the first 150 ft of Overholt Blowing Cave, and a description of 1500 ft of Cave Creek Cave. Exploration by cavers from Charleston, West Virginia in 1953 added Swago Pit, Carpenters Pit, and Roadside Pit to the cave list.

The decade from 1956 to 1966 might be termed the "Pittsburgh Period" of exploration. Many trips by cavers from the Pittsburgh Grotto of the National Speleological Society and the Pittsburgh Explorers Club pushed the Swago-Carpenters System to about 2.3 miles and Overholt Blowing Cave to 2.9 miles. Extensive ridge walking revealed many pits and small caves so that by 1963, there were 69 caves listed, most of them very small. Most of these explorations and discoveries were written up in the

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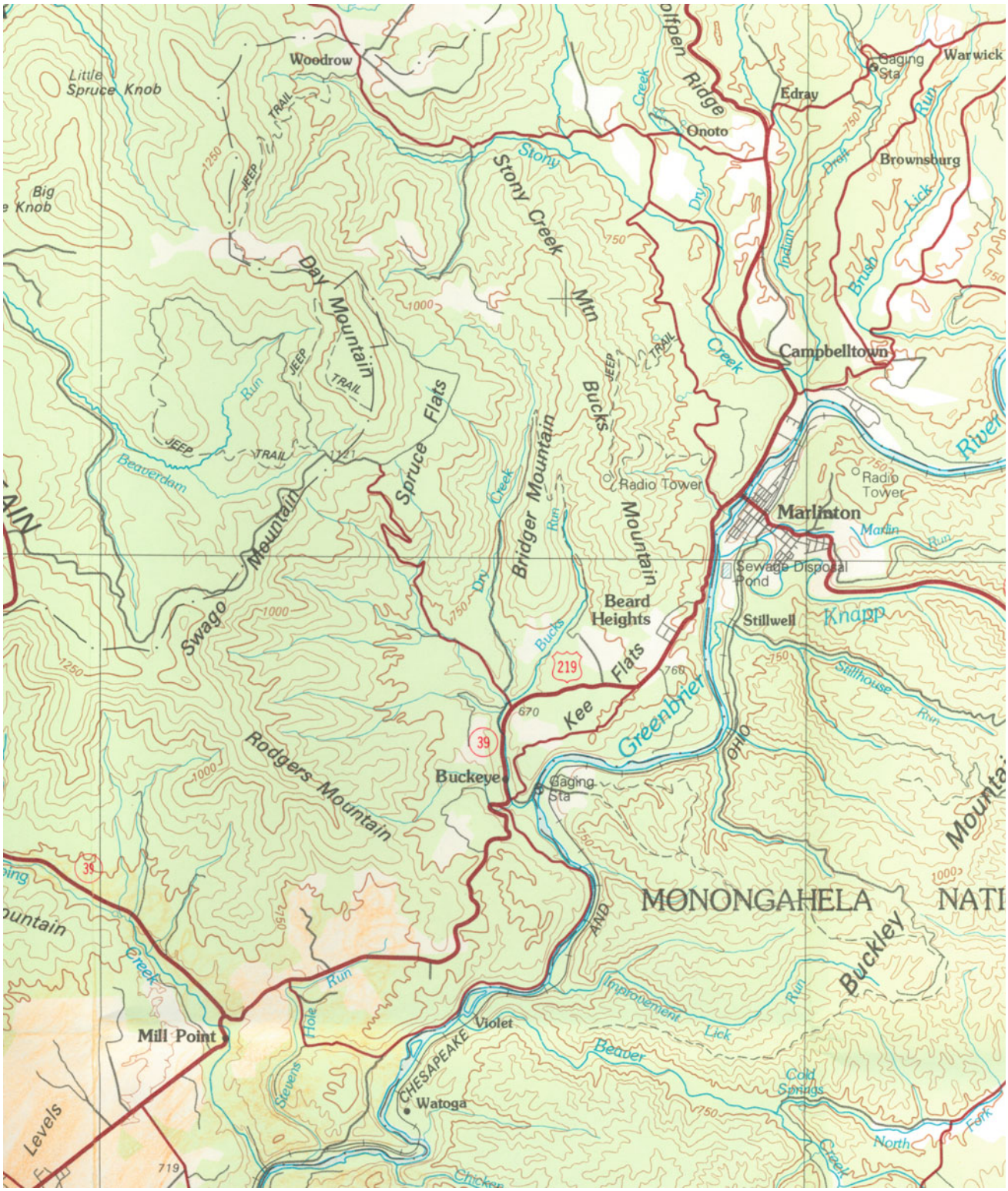

Fig. 6.1 Topographic map of the Swago Creek Basin and surrounding area. Excerpt from U.S. Geological Survey 1:100,000 series Marlinton Sheet. Metric map with 50 m contour interval

newsletters of the two organizations with a later published summary (White 1960, 1964). The Pittsburgh data were made available to W.E. Davies so that the second edition of his book contains many more caves in the Swago Valley (Davies 1958). After 1960, more emphasis was placed on deciphering the drainage system with a series of tracer experiments (Zotter 1963, 1965) which in turn led to the use of the Swago Basin as a demonstration of the importance of conduit flow in karst aquifers (White and Schmidt 1965).

During the 1970s, the Swago Creek Caves came to the attention of cavers from McMaster University in Canada. They extended the exploration of Overholt Blowing Cave and other of the smaller caves in the basin. Most of these explorations appear as field trip reports in the *Canadian Caver*. One of the Canadian cavers, George Tracey, was killed in Barnes Pit on July 1, 1975 when a loose boulder shifted and crushed his chest (Merrin 1975). Much of the Canadian activity shifted south to the rapidly growing Friars Hole System but there were still occasional visits to the Swago Basin, especially Overholt Blowing Cave. A Quebec Group reached the end of the cave in 1978 followed by another group reaching the end in 1991 (Zabrok 1993). There was a final trip to the end by Myrna Diaz-Mundo and Marc Legault in 1995. The Swago Creek Basin was used as a test case for simulation of conduit hydrology (Coward 1975).

The third major effort on the Swago Valley was in the 1980s and 1990s when groups led by Mark Johnsson extended the Swago Carpenters System and undertook a careful resurvey of the cave along with new surveys of Tub Cave, Roadside Pit and others. Many of these maps were published as part of a guidebook (Medville et al. 1983). These maps form the basis for the present document. Also undertaken in the period 1991–1996 was Gary Storrick's resurvey and extended survey of Overholt Blowing Cave. The survey was truncated in 1996 when the landowners closed the cave to all visitors. Pittsburgh cavers returned to the Swago Valley in the early 2000s to prepare detailed maps of many of the smaller caves (Hamm 2002). Storrick (1992) compiled a volume of cave descriptions for Southern Pocahontas County and a bit of northern Greenbrier County. Portions of the cave descriptions that follow are drawn or paraphrased from this report or from Johnsson's guidebook.

6.3 Basin Geomorphology: Surface Karst

6.3.1 Geologic Setting

The Swago Creek Basin is formed on the west limb of the Browns Mountain Anticline with the limestone dipping very gently to the west. There is a minor anticlinal structure oriented roughly north-south and which parallels the Dry Creek Valley. This structure is plunging to the south.

The Greenbrier Limestone is about 400 ft thick in this area. A detailed stratigraphic column measured a few miles to the north is shown in Chap. 2 (Fig. 2.5). The surface outcrop of the Greenbrier Limestone occupies the middle slopes of the basin. Higher on the mountains are the sandstones, siltstones, and shales of the Mauch Chunk Formation. The lower portion of the valley, below the springs, is floored with the Maccrady Shale and the underlying Pocono Sandstone. The Taggard Formation, a complex sequence of shales and shaly limestones, is an important controlling factor in the development of cave systems in the Swago Creek Basin.

6.3.2 The Drainage Pattern

There are three named tributaries to Swago Creek on Hillsboro 7.5 min quadrangle: Dry Creek, Overholt Run, and McClintock Run. Overholt Run, the central tributary, is again split into three branches, for convenience named on Fig. 6.2 as McKeever Run, Friel Run, and McNiel Run. McClintock Run also has two branches, giving overall six main tributaries that head in the mountains, flowing on the shales and sandstones of the Mauch Chunk Formation and overlying clastics. Without exception, these streams sink into their beds or against rock ledges near or just below the 3000-foot contour. With the exception of a small tributary of McKeever Run that drains into Swago Pit, the other streams disappear into coarse cobble and gravel fills or very minor cave entrances. The Swago Creek Basin has topography of moderate relief. The tributaries of Swago Creek form a radiating pattern where they have cut deep valleys back into the plateau. The tributaries have well-preserved stream channels but these are typically dry except after periods of excessive precipitation. The insurgences have limited capacity, forcing high flows from storms or snow melt onto the surface channels, keeping them well-scoured (Fig. 6.3). Some of the underground flow paths roughly parallel the surface drainage; others do not. The underground flow paths are discussed with the individual cave systems. Representative views of the topography are shown in Figs. 6.4, 6.5 and 6.6.

Swago Creek heads in two large springs: Overholt Blowing Cave and Cave Creek Cave both located near the base of the limestone at 2230 ft elevation. The Overholt Blowing Cave spring is marked as the head of Swago Creek on the USGS Hillsboro 7.5 min quadrangle but Cave Creek Spring is not. Although it is the larger of the two tributaries,

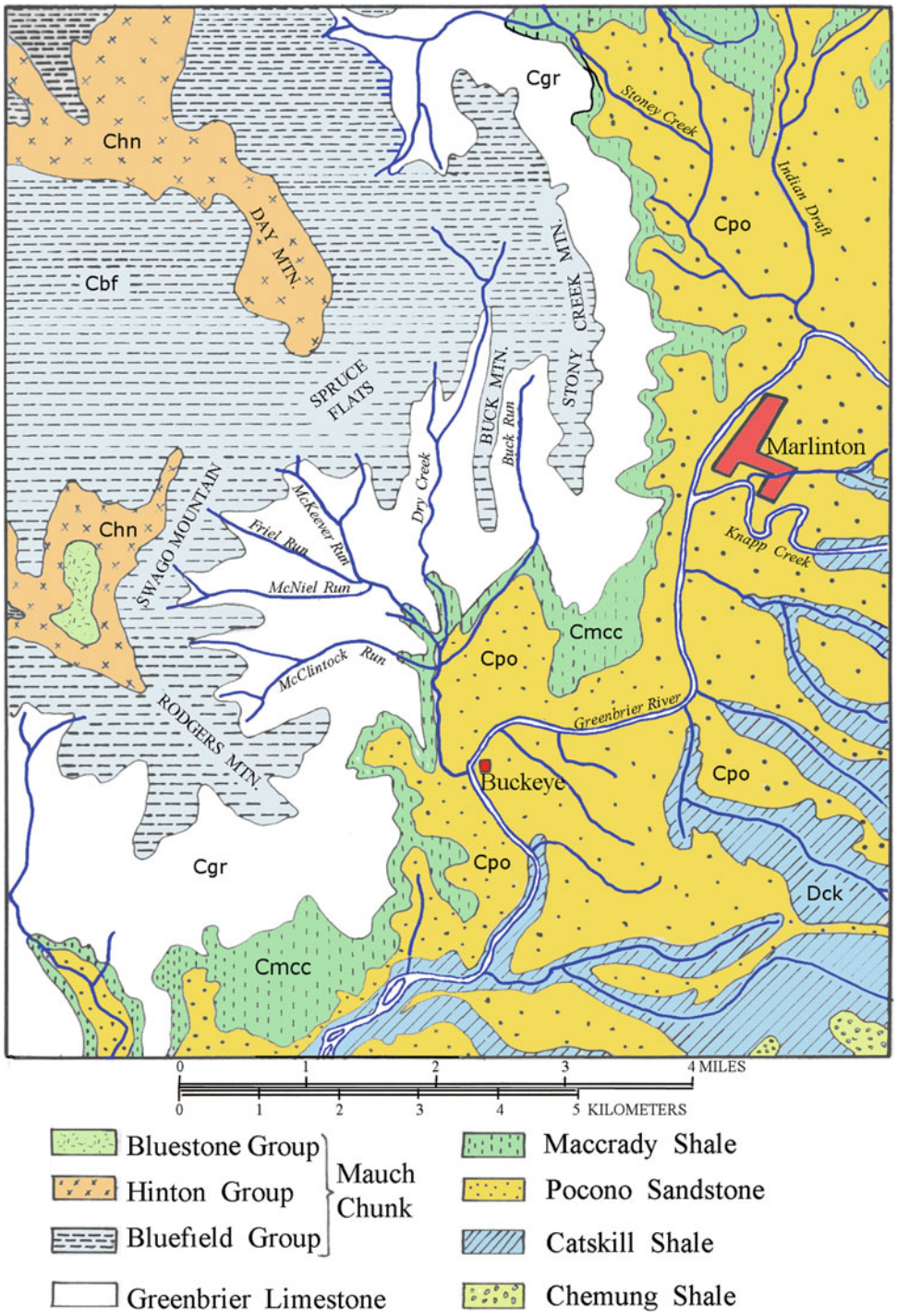

Fig. 6.2 Geologic map of Swago Creek Basin taken from the county geologic map of Price and Reger (1929)

its location at the head of a deep, wooded ravine apparently escaped the attention of the mapmakers. The downstream reach of Swago Creek flows on the clastic rocks of the Maccrady Shale and the Pocono Sandstone and reaches the Greenbrier River at the village of Buckeye at an elevation of 2100 ft.

6.3.3 Lost Waterfalls

The Taggard Formation is a hydrologic confining layer but only a partially effective one. Underground streams perched on the Taggard Formation sometimes breach the confining layer underground but there are examples where the stream

Fig. 6.3 Bed of dry Creek after storm flow has washed out the road. Note cobble and boulder fill in the stream bed. The bedload moves during extreme flood flow. Photo by W.B. White

Fig. 6.4 View to the east with Overholt Blowing Cave quarry in the foreground and Bridger Mountain in the background. Photo by W.B. White

emerges from the hillside as a spring, flows across the confining layer as a short segment of surface stream, and then sinks underground again in the limestone below the confining layer. If the hillside is steep, the segment of surface stream can appear as a waterfall. There are two lost waterfalls on the wall of the Dry Creek Valley, known as the Hause #1 and #2 Waterfalls (Fig. 6.7).

6.3.4 Closed Depressions

There is little surface expression of karst in the Swago Valley except for the sinking streams and dry stream beds. Hillsides are steep and there are few closed depressions. There is a deep depression on the ridge above the entrance to Overholt Blowing Cave, there is the Tub Cave sink, and

Fig. 6.5 View to the west. Overholt Run in the immediate foreground, Barnes Pit in the center of the image, the McClintock run drainage beyond, and Rogers Mountain in the background. Photo by W.B. White

Fig. 6.6 View to the north along the upper end of the Dry Creek Valley. Note dry channel of Dry Creek. The Dry Creek swallet is just around the corner at the beginning of the trees. Photo by W.B. White

there are a few other closed depressions in the uplands but closed depressions are a minor landform in the Swago Valley. What do occur are scattered pits open to the surface. Mostly, they are simple open shafts with no connection to underlying cave passages.

6.4 The Caves of the Swago Valley: Overview

The Swago Valley has been very intensively explored by cavers for more than 50 years, and as a result, there is a very long catalog of caves and pits. The locations are shown in

Fig. 6.7 Hause waterfall #1. **a** Where the stream emerges from the hillside. **b** The waterfall into a closed depression where the water goes back underground. Photos by W.B. White

Fig. 6.8. Most of these are very small. Those that enter the discussion that follows are:

- 2 Barnes Pit
- 15 Carpenters Pit
- 16 Cave Creek Cave
- 25 Dry Creek Swallow Hole
- 43 House Waterfall No. 1
- 44 House Waterfall No. 2
- 45 House Waterfall Cave
- 64 Overholt Blowing Cave
- 71 Roadside Pit
- 84 Swago Pit
- 85 Tub Cave

6.5 Overholt Blowing Cave

6.5.1 Cave Description

Overholt Blowing Cave is a rare example where one can enter at the spring mouth and examine the cave all the way to the headwaters. The main entrance, the spring mouth, is at the head of Swago Creek, in a small abandoned quarry, immediately beside the Spruce Flats Road (Fig. 6.9). A more regional view is shown in Fig. 6.4. There was a second entrance to the cave in the upper corner of the quarry but in the 1990s, it had filled in.

The overall layout of the cave is shown on a stick map (Fig. 6.10). The cave was mapped from the entrance to Disappointment Dome by Pittsburgh Grotto cavers in 1957–

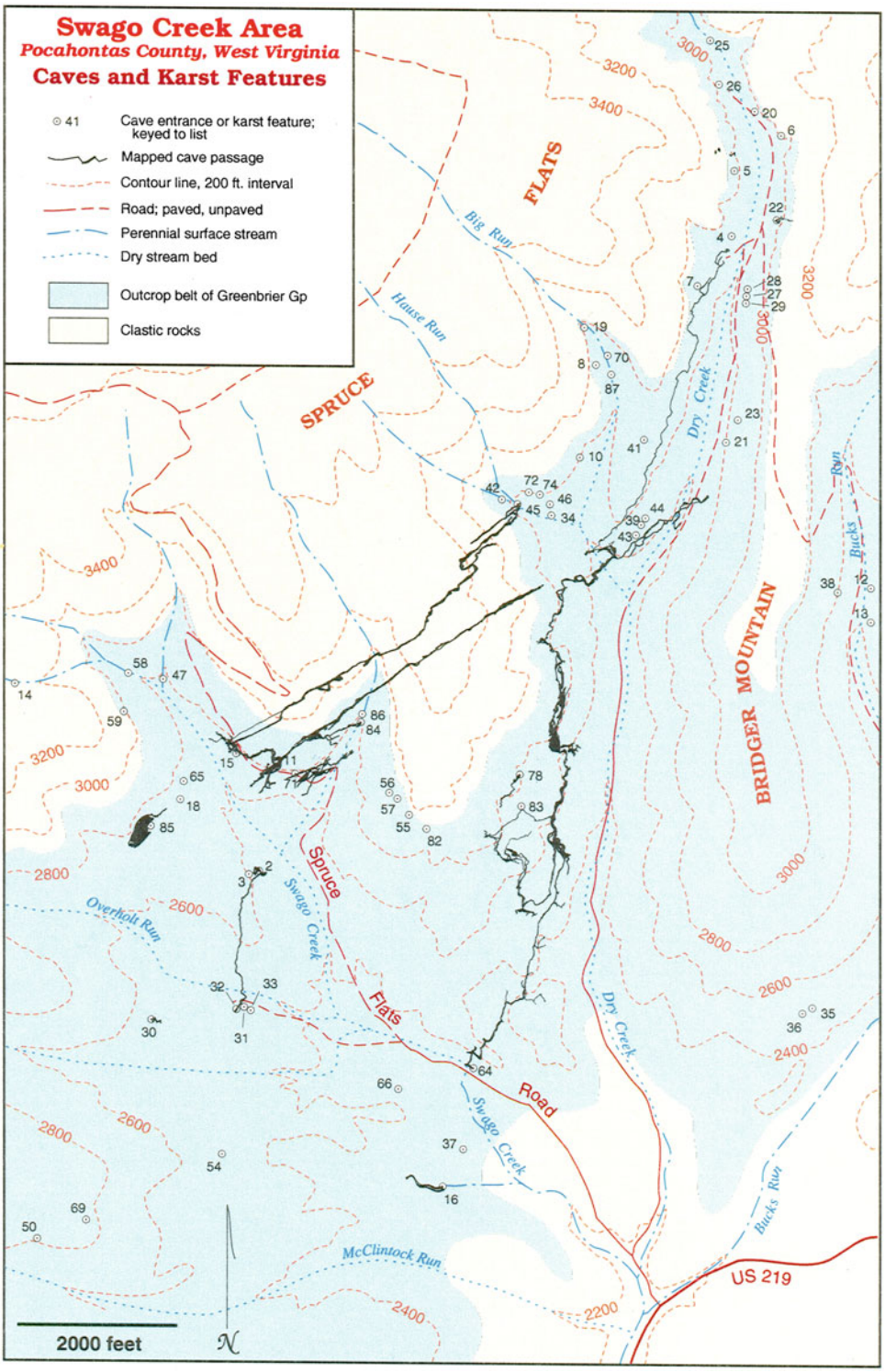

Fig. 6.8 Overview map of the caves and pits in the Swago Valley. Map by Mark J. Johnsson

1959. The extreme back end of the cave was mapped by Canadian cavers in the 1970s. The historical maps are shown on electronic maps M-6.1 to M-6.3. A comprehensive and detailed mapping was undertaken by Gary Storrick and his colleagues in the early 1990s (electronic maps M-6.4 to M-6.13) but the effort was terminated prematurely due to the closing of the cave in 1996. The substantial portion of the cave that was remapped has greater accuracy and far greater detail than the earlier maps.

The spring entrance is an 8–10 foot wide, 4-foot high stream passage which can be traversed for 100 ft to where the passage and stream continue north as a low crawlway.

Fig. 6.9 Entrance to Overholt Blowing Cave. Photo by W.B. White

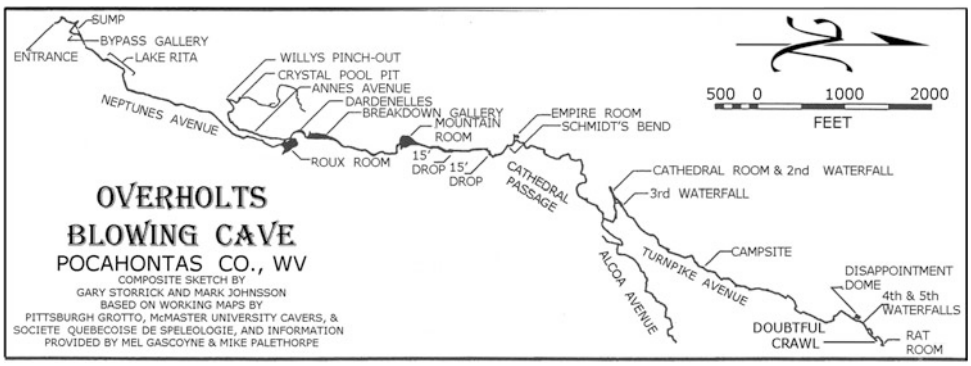

Fig. 6.10 Line map of Overholt Blowing Cave. Map by G.D. Storrick and M.J. Johnsson

A small opening at this point gives access to an upper room floored with rock debris. The second entrance used to connect to a small hole at the top of the slope.

The passage trends N20°E to N30°E as a crawlway in the stream, 18 in. high and 8-foot wide, for 100 ft to where it opens into a room. Upstream, the stream emerges from a sump and forks, one fork flowing into the crawlway and the other west into a mud choke from which it emerges on the surface as a spring in the base of the quarry. The sump is bypassed by an 8-foot high, 15-foot wide dry passage which rejoins the stream after 400 ft. The main stream passage, Neptune's Avenue, is 5–20 ft high and 6–10 ft wide and 3000 ft long. The water is mostly a shallow stream on the level, gravel-covered, passage floor but reaches a depth of 4 ft at Lake Rita. Small infeeders bring in small streams at multiple locations along the passage. These are short, low, stream crawls that end in vertical shafts and serve as drains for water from the hillside above.

Neptune's Avenue ends where the stream passage becomes a stoopway under breakdown in 1–2 ft of water. Fifteen feet above the stream at this point is a fragment of upper level passage called the Roux Room. The Roux Room passage extends south above the steam passage for 300 ft as a low crawl over sediment infilling. At the north end of the room, a small opening over breakdown connects to another upper level passage, Anne's Avenue which trends south parallel and above Neptune's Avenue for 1500 ft. Another smaller passage below Anne's Avenue is called the Gypsum Crawl. Anne's Avenue has a rectangular cross section 3–15 ft high and 5–6 ft wide which merges into a scalloped elliptical tube with a narrow canyon cut in the floor (Fig. 6.11). The southern trend of the passage is blocked by a gravel and cobble fill (Fig. 6.12) beyond which a low crawl leads to a complex of small passages and shafts. The main passage doubles back at the sediment choke and after 200 ft is cut off by the 25-foot deep Crystal Pool Pit. Traversing the pit and continuing another 200 ft brings one to a large breakdown room. Beyond the breakdown rock, a passage leads to a higher level Attic Room and to an area of clear pools, pits, and a lower level canyon. The lower level

Fig. 6.11 Anne's avenue. Photo by W.B. White

Fig. 6.12 Cobble fill at Willie's Pinchout in downstream end of Anne's Avenue. Photo by W.B. White

canyon connects to a complex of passages at stream level which eventually connect back to the main stream passage in the Breakdown Gallery beyond the Dardanelles.

In the main stream passage at the Roux Room, one can continue upstream by crawling under the breakdown in a very low stream crawl for 500 ft. This crawlway, The Dardanelles, has been known to flood, trapping cavers until the water levels recede. Beyond the stream crawl, the passage opens into the 1500-foot long Breakdown Gallery, a 30-foot high, 25-foot wide trunk with the stream flowing around and under a floor of large jumbled breakdown blocks. Breakdown chokes off the stream passage but a small hole leads up into the Mountain Room, a roughly circular chamber more than 100 ft in diameter floored with breakdown. There is a large stalagmite in the room that has grown up into a shaft in the ceiling. A passage at the southeast corner of the Mountain Room leads to the Ivory Palace, a series of small rooms decorated with pure white speleothems. A second passage continues northward for 1000 ft as the 25-foot wide, 15-foot high Helictite Gallery.

Reconnection with the stream passage is made through a 20-foot deep crevice at the end of the Helictite Gallery or through a hidden passage beneath a high boulder in the middle of the Helictite Gallery. This is followed by 600 ft of stream passage of irregular shape. Five hundred feet along the stream passage is a fork in the passage. The left fork leads to the Empire Room, a 100-foot high cylindrical chamber. The right fork becomes the Cathedral Passage leading 2000 ft to the Cathedral Room. At 1600 ft along the Cathedral Passage, the right fork is Alcoa Avenue which extends 2000 ft ending in a low crawl that passes under the Dry Creek Valley Road.

The 50-foot Second Waterfall enters the Cathedral Room from the ceiling, and a second smaller waterfall enters from a hole in the wall. A 30-foot high pile of breakdown allows explorers to reach the top of the smaller waterfall. The cave continues from the top of the Second Waterfall as a narrow twisting passage leading back sub-parallel to the Cathedral Room and then along a narrow ceiling crack to a wider passage. Third Waterfall is in a shaft adjacent to the ceiling crack. Beyond this is a long stream passage leading to the Turnpike, a walkway with a 300-foot long dry, gypsum sand floor. The passage continues 2000 ft to Disappointment Dome via low steam crawls and narrow walkways. Thirty-foot high Fourth Waterfall drops into 50-foot Disappointment Dome. Almost immediately above Fourth Waterfall is 50-foot Fifth Waterfall. At the top, the passage extends 600 ft to a large canyon with breakdown and ends in a small room. Halfway along this passage, a large passage to the left leads to the high point in the cave. A climb on the right wall leads to a narrow passage ending in domes where green leaves have been found on the floor. Back in the main passage, several short crawls lead from the small room, and a 500-foot crawl connects with the Rat Room, a small room marking the presently known end of the cave.

6.5.2 Geology and Drainage Pattern

The Overholt Blowing Cave spring is in the Sinks Grove Limestone near the contact with the underlying Hillsdale Limestone. The stream maintains this stratigraphic position the entire distance to the Alcoa Avenue Junction with the Mountain Room and the Empire Room developed in the overlying Patton Limestone. The Turnpike and upstream passage are in the Pickaway Limestone so that at the sequence of shafts and waterfalls at the Cathedral Room take the stream through the Taggard Formation and Patton Limestone. At the upstream end of the system, the high passage extending from the top of the Fifth Waterfall to the Rat Room must be very close to the top of the Union Limestone and possibly as high as the Alderson Limestone.

The stream passage roughly parallels the dry surface channel of Dry Creek. It is a few hundred feet west of the surface stream and at relatively shallow depth. The Breakdown Gallery passes beneath a pronounced surface gulley, and the decreased depth and leakage from surface flow in the gully may be responsible for the extensive breakdown in the cave. The Cathedral Room is beneath the side valley that contains Hause Run and Hause Waterfall Cave and appears from the surveys to be very close to the surface.

Hause #2 Waterfall on the hillside is only about 100 ft from the Turnpike inside the cave. A dye trace (Zotter 1963, 1965) showed that water that sinks at Wolfe Swallow Hole (the sink point of Big Run, the northwestern branch of Hause Run) emerges at Hause #2 Waterfall. It remains possible that the water emerging from a bedding plane at the top of #2 waterfall is derived from the cave stream because to get from Wolfe Swallow Hole to the waterfall, the stream would have to pass over (or under) the cave stream if it is not a tributary. The dye ultimately appeared at the Overholt Blowing Cave spring. The emergence of water at the top of Hause #1 Waterfall is 52 ft lower than the emergence of water at #2 Waterfall, and a dye trace shows that the water that sinks at the base of #2 Waterfall re-emerges at the top of #1 Waterfall. An altimeter survey in 1961 gave an elevation of the #1 emergence as 2627 ft, and an overland survey gave an elevation of the #2 emergence of 2679 ft.

The surface stream called Dry Creek heads in a deep valley between Spruce Flats and Stony Creek Mountain. Under low flow conditions, the stream sinks in its bed and at the Dry Creek Swallow Hole (Fig. 6.13). There is a well-developed channel downstream from the swallow hole so that storm flow and snow melt that exceeds the capacity of the swallow hole continues as a surface stream. The furthest point of exploration in Overholt Blowing Cave is only half a mile downstream from the Dry Creek Swallow Hole. It would seem obvious that the Dry Creek Swallow Hole is the source of the stream in the cave but a dye test was conducted in the early 1960s to check it. The dye did not appear at Overholt Blowing Cave. Thinking that insufficient dye had been used, the test was repeated and was found to emerge at the Sharp Farm Spring on the east side of Stony Creek Mountain. Unfortunately, the Sharp Farm Spring is the water supply for the village of Campbelltown and the dye trace turned it green.

The upper Dry Creek Valley was mainly sheep pasture at the time of these observations. The sheep found the limestone overhang at the swallow hole to be a cool resting place, so the sink of Dry Creek is through a thick mixture of stream cobbles and sheep dung, not the best source for a water supply. The elevation difference between the swallow hole just below the 3000-foot contour and the Sharp Farm Spring at 2450 ft means a roughly 500-foot drop in elevation with deep flow beneath Stony Creek Mountain. The flow line is across the dip from near the top of the limestone at the swallow hole to near the bottom at the spring. Several attempts have been made to dig open the hypothetical cave at the swallow hole but to date with no success.

Fig. 6.13 The Dry Creek swallow hole. Photo by W.B. White

6.6 The Carpenter-Swago System

6.6.1 Description of the Cave System

The Carpenter-Swago System has two entrances, both pits. Swago Pit is 500 ft north of a sharp bend in the Spruce Flats Road in the bottom of a steep, narrow gully. The gully carries a tributary of McKeever Run which flows off the clastics, across the Alderson Limestone and the Greenville Shale, through a small cave in the upper portions of the Union Limestone, and finally plunges into Swago Pit (Fig. 6.14) at an elevation of 2760 ft. Carpenters Pit is an open shaft on the hillside below the Spruce Flats Road also at an elevation 2760 ft. (Fig. 6.15).

The overall pattern of the cave (Fig. 6.16) displays two long, straight, parallel passages connected at the southwest end by cross passages. The vertical development is complex in the southwest section with multiple overlapping passages. The cave contains 3.1 miles of mapped passage with an estimated 1.5 miles un-surveyed. The total vertical extent is

Fig. 6.14 The Swago Pit entrance with waterfall. Photo by W.B. White

Fig. 6.15 The Carpenters Pit entrance. Photo by W.B. White

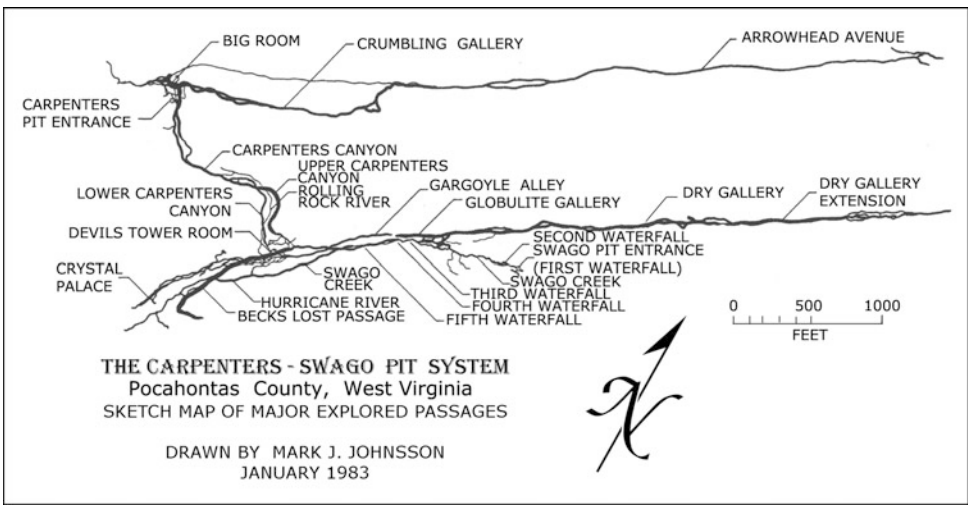

Fig. 6.16 Line map of the Carpenter-Swago System. Map by M.J. Johnsson

239 ft. The survey is presented in the electronic map file as a series of sectional maps with a master map showing the relationships (M-6.14 to M-6.20).

A low stream passage at the base of Swago Pit takes the stream 120 ft to the Second Waterfall where it plunges 25 ft into a deep pool. A fissure passage crosses the stream passage and can be followed to several shafts which allow access to the second level of the stream passage downstream from the Second Waterfall (Fig. 6.17). The stream passage continues southwest for 180 ft with a 5-foot by 5-foot cross section typically with several feet of water (Fig. 6.18), then opens into a 4–7-foot high, 10–30-foot wide passage which continues 320 ft to the Third Waterfall. Beyond the 33 foot drop is 50 ft of additional passage to the Fourth Waterfall. The base of this 24-foot drop in considered the connection with Carpenters Pit.

From the wide section of the second level, a number of small crawlways on the northwest side of the passage lead, via a complex breakdown area, to the eastern of the two long straight passages. To the southwest, the passage is called the Globulite Gallery, 20–30 ft high and wide, that extends 300 ft to a blockage by a massive flowstone slope. To the northeast, it is called the Dry Gallery that extends 1900 ft to an apparent end in breakdown. At the end of the Dry Gallery, one can crawl beneath the breakdown at a number of points and enter a low stream passage that parallels the Dry Gallery beneath the breakdown. After 300 ft, the passage opens into an extension of the Dry Gallery which continues

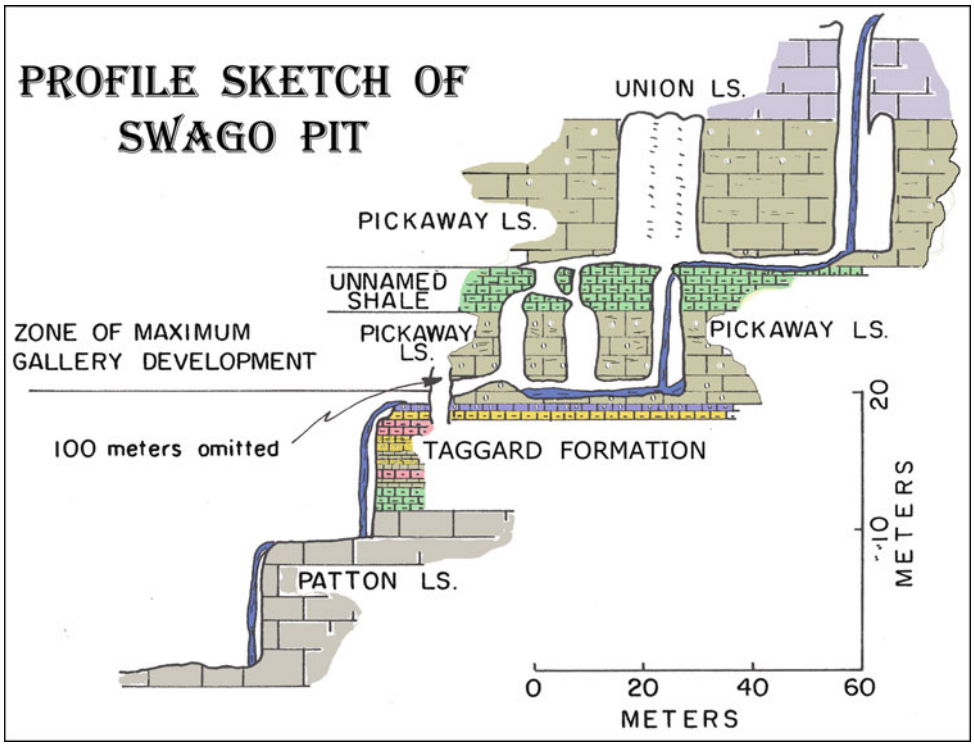

Fig. 6.17 Profile of the Swago Pit entrance area

for and additional 1600 ft. The passage ends in a 124-foot high shaft nearly 4000 ft from Swago Pit and only a few hundred feet from passages in Overholt Blowing Cave. The shaft was scaled in 1979 but no passage was found at the top.

Carpenters Pit is 4–6 ft wide and 40 ft long at the top and 76 ft deep. An additional 16-foot offset pit opens into a room with a canyon cut in the floor. This room or ledge is Upper Carpenter's Canyon. An additional 29-foot drop takes one to the floor of Carpenter's Canyon.

To the northwest from the floor of Carpenter's Canyon, the canyon opens into a large passage 50–100 ft high and 34–40 ft wide that extends north, then west for 300 ft, the Big Room. A stream enters the corner of the Big Room as a 20-foot waterfall emerging from a narrow fissure passage. A steep breakdown slope, the Foggy Breakdown Mountain, descends to the floor of the Big Room. To the north from the entrance pit along Upper Carpenter Canyon, one can cross the canyon and enter the Crumbling Gallery, the southwestern end of the western long straight passage. About 300 ft along Crumbling Gallery, openings in the breakdown floor connect with a narrow canyon below which doubles back and connects with the Big Room. Crumbling Galley continues with occasional pits in the floor for 1500 ft when it reaches a flowing stream. The stream passage is incised below the level of Crumbling Gallery and apparently crosses under it multiple times. This is the stream that emerges from the fissure passage to form the waterfall in the Big Room but has not been surveyed. Upstream 200 ft, the stream emerges from a breakdown that blocks the main passage. A small passage, Paul's Crawl, bypasses the breakdown and connects with the continuation of the main passage, now called Arrowhead Avenue, with the stream flowing on its floor. Arrowhead Avenue is the western of the two long straight passages and extends as an 8–10 foot high, 4–6 foot wide roughly rectangular stream passage for 2000 ft to the northeast, crossing under Spruce Flats, and ending at the base of several shafts on the side of Dry Creek Valley.

Southwest from Carpenters Pit, Carpenter's Canyon averages 30–50 ft high and 10–20 ft wide and continues 350 ft to an obscure climb on the western wall. This climb leads upward 15 ft to the Upper carpenter's Canyon. Lower Carpenter's Canyon continues southeast for 300 ft to end in a series of breakdown rooms beneath the Devil's Tower Room. Rolling Rock River is encountered by descending a 10-foot pit in Lower Carpenter's Canyon. This stream passage may be followed 350 ft and ranges from 1 to 10 ft high and 4 to 10 ft wide. Rolling Rock River is the downstream continuation of the stream in Arrowhead Avenue and from the waterfall in the Big Room.

At the top of the obscure 15-foot climb, Upper Carpenter's Canyon can be followed as a high ledge back to the bottom of the entrance pit. To the southeast, the upper canyon extends 300 ft to the Devil's Tower Room (named for a

Fig. 6.18 Stream passage below Second Waterfall in Swago pit. Photo by W.B. White

similar-shaped stalagmite in the center of the room). This room is one of the major junctions in the cave. A series of passages extending 500 ft southwest comprise the Crystal Palace Section. Gargoyle Alley extends northwest for 200 ft as a 6–10 foot high and wide passage. A steep flowstone slope on the northeast side of the Devil's Tower Room gives access to a lower level. To the southwest is Beck's Lost Passage, a 30–50-foot high, 20–30-foot wide elliptical trunk passage that extends 1000 ft to the southwest. The passage is choked with fill at the end, and it has no obvious hydrologic link to other passages in the system. To the northeast of the Devil's Tower Room is a 20–50-foot high, 4–8-foot wide canyon leading 400 ft to the base of the Fourth Waterfall and the connection to Swago Pit.

Midway along Beck's Lost Passage is the Hurricane River, a low, wet stream passage that continues upstream and downstream. Upstream 100 ft is the confluence of the Rolling Rock River and the Swago Pit stream. Downstream 300 ft is the final sump of the Carpenters-Swago drainage at an elevation of 185 ft below the entrance.

6.6.2 Hause Waterfall Cave

The entrance to Hause Waterfall Cave is at the base of a waterfall on a tributary of Dry Creek. A stream, informally called Hause Run, rises on Spruce Flats and flows down into the Dry Creek Valley where it sinks into Hause Waterfall Cave. A complex entrance series (Fig. 6.19) leads to 500 ft of nearly linear passage that begins as a small phreatic tube and later develops as a deep canyon in the floor. Hause Waterfall Cave is the source of the stream in Arrowhead Avenue but, although the passages line up properly, no physical connection was found during the early exploration. Sometime later, a collapse opened a connection and Hause Waterfall Cave is now a back entrance to the Swago-Carpenter System.

6.6.3 Roadside Pit

Roadside Pit may be considered a satellite cave to the Swago-Carpenter System but has no known connection to it. The entrance is a small hole in the ditch of the Spruce Flats Road about halfway between Swago Pit and Carpenters Pit at an elevation of 2800 ft (Fig. 6.20). The entrance is a 55-foot shaft. The entrance pit is barely large enough at the top to admit an explorer but which bells out 15 ft below and descends through the ceiling of a room.

The main passage is 300 ft long with an irregular breakdown floor. At the end of the main channel, a 6-foot waterfall drains though the breakdown. Beyond is a series of shafts elongated along the guiding fracture. To the right of the main channel about 100 ft from the waterfall, a crawlway leads to the 12-foot high, 70-foot wide, 180-foot long Big Room. Prior to the 1970s, this was the known extent of the cave. A 10-foot pit in the southeast corner of the Big Room gave access to a crawlway which opened into a set of northeast-southwest trending passages on several levels as shown on the electronic map. The present length of the cave is 4457 ft and the vertical extent is 166 ft (electronic map M-6.21).

Water enters the cave through shafts and drips and multiple points. These aggregate into two streams, the Corkscrew River and the Rimstone River, which meet at the Junction Room and then flow through a low stream passage to the southwest. The stream passage can be followed for 500 ft to where the stream is lost in breakdown 166 ft below the entrance.

6.6.4 Geologic and Hydrologic Relationships

The tops of both Swago Pit and Carpenters Pit are in the upper part of the Union Limestone. The Swago Pit stream crosses the

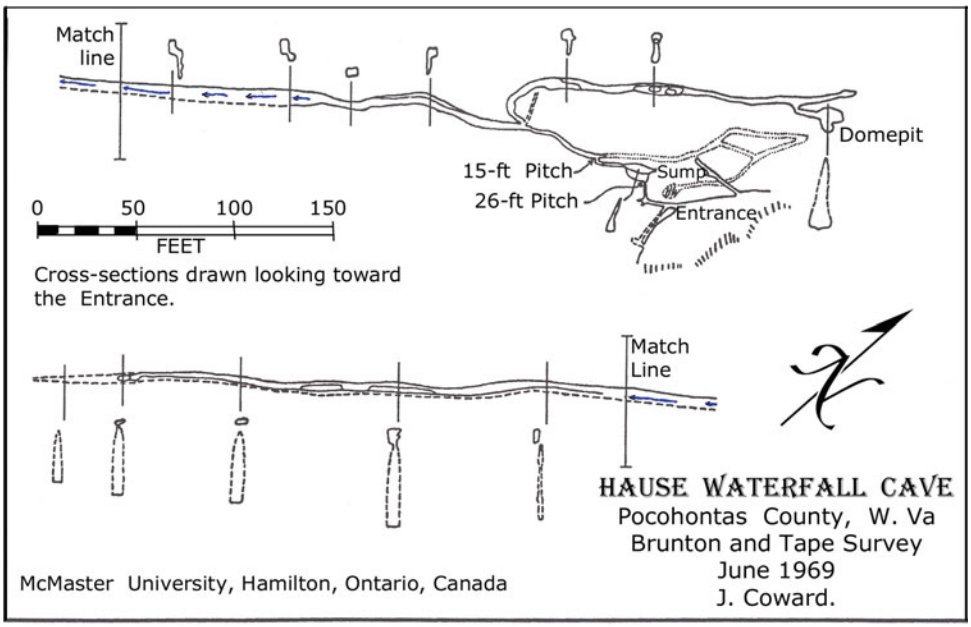

Fig. 6.19 Map of Hause Waterfall Cave. Adapted from Coward (1975)

Fig. 6.20 Entrance to Roadside Pit. Photo by W.B. White

lower units of the Greenbrier Limestone as a sequence of step-like waterfalls (Fig. 6.17). Carpenters Pit passes through the Union and Pickaway Limestones and reaches the first cave passages at the contact between the Pickaway and the Taggard Formation. The Taggard Formation as a confining layer is a dominant control in the Swago-Carpenter System. Both the Dry Gallery and Arrowhead Avenue, the two long straight parallel passages, appear to have developed as perched drainage on top of the Taggard Shale. The floor of the Dry Gallery is somewhat above the Taggard and is now abandoned except for a small stream in the extension. Arrowhead Avenue carries an active stream that derives its flow from the sink of Hause Run at Hause Waterfall Cave. Only at the southwest end, in Crumbling Galley and Carpenter's Canyon, has the stream cut its way through the Taggard into the underlying Patton Limestone.

Although many of the Greenbrier Limestone caves develop along bedding plane in response to various

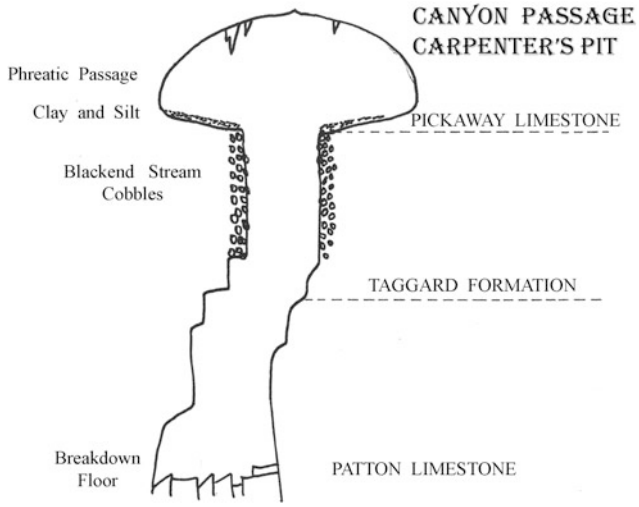

Fig. 6.21 Cross section of Carpenter's Canyon

lithologic controls and the hydraulic gradient, the Carpenter-Swago System displays very strong structural control. The Arrowhead Avenue and Dry Gallery passages are nearly linear, ignore surface topography and drainage, and are clearly guided by N60°E master fractures.

Carpenters Pit made an interesting demonstration of the quite different characteristics of karst aquifers (White and Schmidt 1965). In classical porous media aquifers, the water table is a subdued image of the overlying topography—high beneath the hills and low under the valleys. Hause Run continues serenely down Arrowhead Avenue as a low gradient, free-surface stream in an air-filled cave passage. Where it passes beneath a spur of Spruce Flats, the cave passage is 700 ft below the land surface. What water table?

The time sequence for passage development is unknown. The cross section of Carpenter's Canyon is instructive (Fig. 6.21). After the upper passage had formed at the Pickaway–Taggard contact, there was a massive flux of clastic sediments that deposited a thick layer of stream cobbles in the passage. When renewed downcutting resumed, the stream that formed Carpenter's Canyon cut through the sediment layer but left a thick sequence of cobbles on the walls of the canyon. These deposits must be very old, predating the sections of cave below the Taggard.

There are many great vertical shafts, some in the caves and others as isolated shafts with openings on the hillsides. These form near the edge of the caprock—either the Mauch Chunk Formation or the Greenville Shale—where water flowing off the caprock reaches the limestone and developed open pathways to the subsurface. They are not usually found in cave passages below the caprock. The large, roughly circular, shafts are formed in the vadose zone by fast-moving films of unsaturated water. The mechanism is similar to that developed for the large vertical shafts of the Mammoth Cave area (Brucker et al. 1972).

There remain some interesting inconsistencies. Zotter (1963, 1965) reported a Canadian dye trace that showed the combined Carpenters streams—Hurricane River—resurged at the top of the Barnes Pit Waterfall. The final observation of Hurricane River in the lowest stream passage is 185 ft below the entrance, an elevation of 2575 ft. The Barnes Pit Spring is at 2520 so the elevation difference of 55 ft would be reasonable. However, for the stream to get from the lowest level of Carpenters Pit to the Barnes Pit Spring would require a channel under the valley fill in McKeever Run. The flow path would have to go deep and then come up again.

There is a further inconsistency. The final disappearance of Hurricane River is 50–60 ft below the shaly beds of the Taggard Formation. The Barnes Pit Spring is on top of the Taggard Formation. The Taggard/Pickaway contact at the base of Carpenters Pit is at an elevation of 2660 ft. The top of the Taggard at Barnes Pit Spring is at 2520 ft, resulting in a 140-foot discrepancy in the position of the Taggard/Pickaway contact. Either there is a massive error in the elevation data, a massive error in the identification of the strata, or there is an unknown structural feature along the valley of McKeever Run.

6.7 The Infeeders to the Cave Creek Spring

Cave Creek Spring drains roughly two-thirds of the Swago Basin including the tributaries of McClintock Run and Overholt Run. These tributaries sink at the upper limestone contact but few accessible cave entrances have been discovered. Based on discharge characteristics, Cave Creek Spring should be the outlet for a large and complex cave system but only a few fragments have been discovered.

6.7.1 Cave Creek Cave

The entrance to Cave Creek Cave is at the head of a ravine, a rectangular opening 70 ft wide and 10 ft high. The cave entrance is also the spring mouth with the stream flowing over a picturesque 6-foot waterfall, where the Hillsdale Limestone contacts the underlying Maccrady Shale. The passage divides just inside the entrance. The dry branch is 15 ft wide and 2–4 ft high developed along a bedding plane in the cherty limestone. The other branch is of similar dimensions and carries the stream. The branches rejoin after 350 ft to form a 3-foot high stream crawl that ends 125 ft upstream

where massive slabs of breakdown block the passage (Fig. 6.22).

There is anecdotal evidence that the breakdown blockage occurred between 1948 and 1956. Davies (1949) reported 1500 ft of passage beyond the passage junction. According to a personal communication, a local resident traversed a long distance in the cave mostly along a dry passage of walking height. The slabs blocking the passage hinged downward from the ceiling and are likely to now be supported in in-washed stream gravel. An attempt in the 1960s to blast open the blockage was aborted because of lack of any obvious place to plant the charge. Modern techniques of microblasting might be successful.

6.7.2 Tub Cave

The entrance to Tub Cave is in a large collapse sink on the crest of a spur of ridge that extends southward from Swago Mountain (Fig. 6.23). The entrance, a 15-foot by 4-foot slot, is against the wall of a slump area at the bottom of the sink. It descends to the top of a breakdown slope at the ceiling of the main chamber of the cave.

Tub Cave consists mainly of a single chamber, 420 ft long, 200 ft wide and 40 ft high (electronic map M-6.22). The floor of the chamber is a mud flat that appears to be the bed of an intermittent lake. The western wall of the chamber is bedrock but the eastern side is a massive breakdown slope

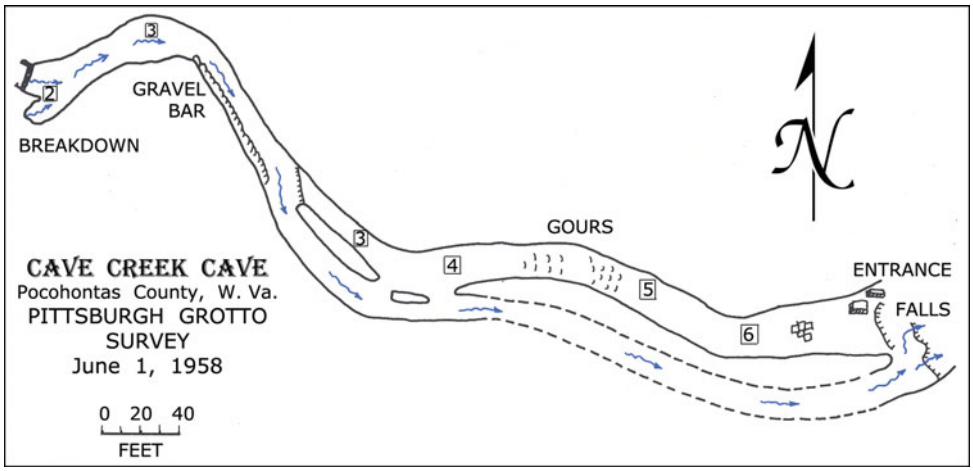

Fig. 6.22 Map of Cave Creek Cave

Fig. 6.23 Sinkhole that contains the Tub Cave entrance. Photo by W.B. White

that extends up to the ceiling. A small waterfall enters the chamber through a shaft in the ceiling and has built up a flowstone mound over the breakdown. The southwestern end of the chamber appears to be blocked by breakdown but it can be circumvented to give access to an additional smaller room that marks the southwestern limit of the cave.

A moderate-size stream enters the chamber from a passage at the northeastern end. It is joined by several other small streams, in addition to the waterfall, that enter the chamber. The combined streams flow in complicated patterns across the mud floor and exit through a small hole beneath the breakdown. The passage carrying the main stream can be followed upstream for some hundreds of feet —the exact distance varying between reports. The stream passage has a left wall (looking upstream) mostly of solid rock but a right wall of breakdown with many small openings extending upward through the breakdown. The passage is clearly formed around the edge of a massive collapse, possibly the entrance sink.

A large boulder on the edge of the road across from the McKeever farmhouse was taken as the benchmark for a number of altimeter and overland surveys conducted in the early 1960s. The best estimate from the topographic map gave an elevation of 2445 ft for the benchmark. One of these surveys was an altimeter traverse to establish elevations of Barnes Pit and Tub Cave with the following result. Elevations are calculated with respect to the benchmark.

Benchmark (P-13)	2445 ft
Lip of Barnes Pit	2493
Top of Barnes Pit waterfall	2520
Saddle at the edge of Tub Cave sink	2703
Tub Cave entrance	2590
Floor of Tub Cave	2534

The mud floor of Tub Cave is only 14 ft above the elevation of the Barnes Pit Spring. It seems likely that the floor of Tub Cave is perched on the Taggard Formation. This would place the cave in the Pickaway Limestone. In spite of the short horizontal distance and the small elevation difference, a dye trace from Tub Cave to the Barnes Pit Spring was negative. The test was positive to Cave Creek Spring.

Tub Cave is a somewhat enigmatic feature. The large cross-sectional chamber has the appearance of being a fragment of very large master trunk conduit blocked by collapse at both ends. Its elevation and stratigraphic position are close to those in the Carpenters-Swago Cave System on the opposite site of the valley but there is no comparable passage in the Carpenters-Swago System. Tub Cave is a hint of a previous large and complex cave system that has been destroyed by erosion except for a few fragments.

6.7.3 Barnes Pit

The entrance to Barnes Pit is a 20-foot pit at the edge of the McKeever Branch of the Overholt Run valley. The very dangerous descent is through the loose boulders that make up the valley fill material. The Barnes Pit stream rises from a broad platform of red shale that marks the top of the Taggard Formation, crosses the shale as a waterfall, and flows into the pit (Fig. 6.24). Continuous stream action contributes to the unstable entrance. Few explorers have felt any urge to push Barnes Pit, but Pittsburgh and McMaster explorers have provided a short description and a map (electronic map M-6.23). The cave is in the Patton Limestone.

The entrance pit leads to 50 ft of passage followed by a low wet crawlway opening into a small room with an 8-foot waterfall and two small wet leads. The right passage continues to a sharp 140-degree bend, then walking-height passage leading to a 22-foot pit. At the base of the pit is an extremely unstable breakdown room. This feature is marked on the McMaster map as a 60-foot high boulder choke. Its location would place it under the valley, and it may represent the site of a previous entrance. From the bottom of the breakdown room, a stream passage continues downstream as a 6- to 8-foot high, 2–3-foot wide passage which continues uniformly for 1800 ft to an 18-foot climbable drop.

Beyond the top of the 18-foot drop, a passage continues for 200 ft to an overhanging drop into a room with no passage leading off. At the base of the 18-foot drop, the passage is nearly blocked by a large rock after which is a 12-foot drop to a place where the stream disappears into a 6-foot wide, 3-in. high crack which marks the point of furthest exploration in Barnes Pit. The stream has been traced to Cave Creek Spring but Barnes Pit does not appear to be an access to the system.

6.8 Mineralogy

The caves of the Swago Creek Basin offer little in the way of exotic mineralogy. Calcite speleothems are found in modest quantities in those portions of the caves that are not protected by a shale or sandstone caprock. Caves beneath the caprock do not receive seepage water from overlying soils and thus tend to be devoid of speleothems. Special attention can be called to a few places. Roadside Pit is one of the better decorated caves. There is the flowstone mound

Fig. 6.24 Entrance to Barnes Pit. The stream emerges from a spring at the top of the Taggard Formation, flows across the shale and into the pit entrance. Photo by W.B. White

beneath the waterfall in Tub Cave. There is the Mountain Room and the Ivory Palace in Overholt Blowing Cave. And, there is the Globulite Gallery in the Carpenters-Swago System.

The Globulite Gallery contains a profusion of the botryoidal or nodular speleothems variously known as globulites, cave coral, cave popcorn, and cave grape (Fig. 6.25). Globulites are layered structures built up slowly as the calcite is deposited. The point of origin for the growth is a point of the cave wall or ceiling. The exact mechanism of their growth is not completely understood but when conditions are right, they usually appear in great numbers.

Gypsum appears as wall crusts and as sand on the passage floor in a few exceptionally dry passages, specifically Anne's Avenue, the Gypsum Crawl, and the Turnpike Passage in Overholt Blowing Cave, and in the Dry Gallery in the Carpenter-Swago System. The origin of the gypsum has not been established. Cave gypsum is commonly derived from the oxidation of pyrite in the limestone. There is an alternate source in the Swago Creek Caves. Nodules of anhydrite occur in some of the shaly limestones and the hydration of anhydrite, $CaSO_4$, to gypsum could be the source. Measurement of the sulfur isotope ratios in the gypsum could determine the source.

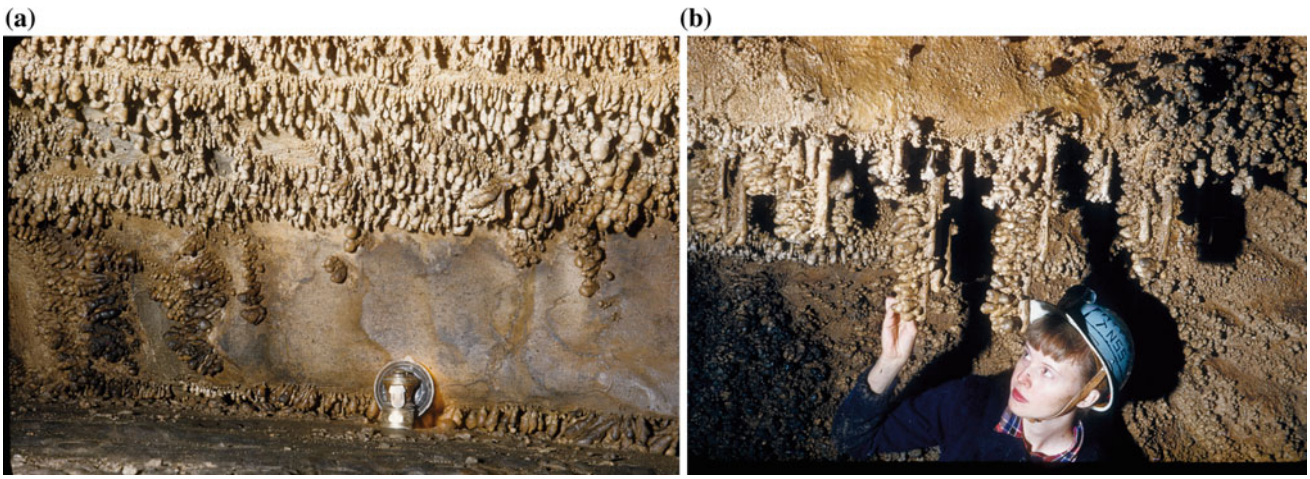

Fig. 6.25 Globulites in the Globulite Gallery, Carpenter-Swago System. **a** On walls. **b** On stalactites. Photos by W.B. White

6.9 Concluding Comments on the Swago Creek Basin

Swago Creek, as the northernmost basin selected as part of the Greenbrier karst, is primarily fluviokarst. Runoff from much of the roughly 7 mi^2 drainage basin is by way of surface streams on clastic rocks. These feed a large and complex underground drainage system the empties into two large springs that provide the headwaters for Swago Creek. Inputs to the underground system are not efficient so that high flows from storms and snow melt override the insurgences and cross the karst in surface channels. As a result, the karst erosion surface is represented only by a few remaining fragments of upland. Surface flow has produced a dendritic pattern of stream channels in deep valleys which have removed large parts of the original erosion surface and also fragmented the cave system.

Acknowledgements This chapter is dedicated to the memory of G. Dallas McKeever, farmer and beekeeper, who owned important cave entrances and whose welcome to the cave explorers who arrived in the 1950s and 1960s allowed the explorations to get underway. Thanks are extended to all landowners in the Swago Valley who have tolerated cavers tramping across their property for more than half a century. A document such as this can only be written because of the exploration and mapping conducted by dozens of individual cavers. Only a few names appear on the maps and documents, but thanks to them all.

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