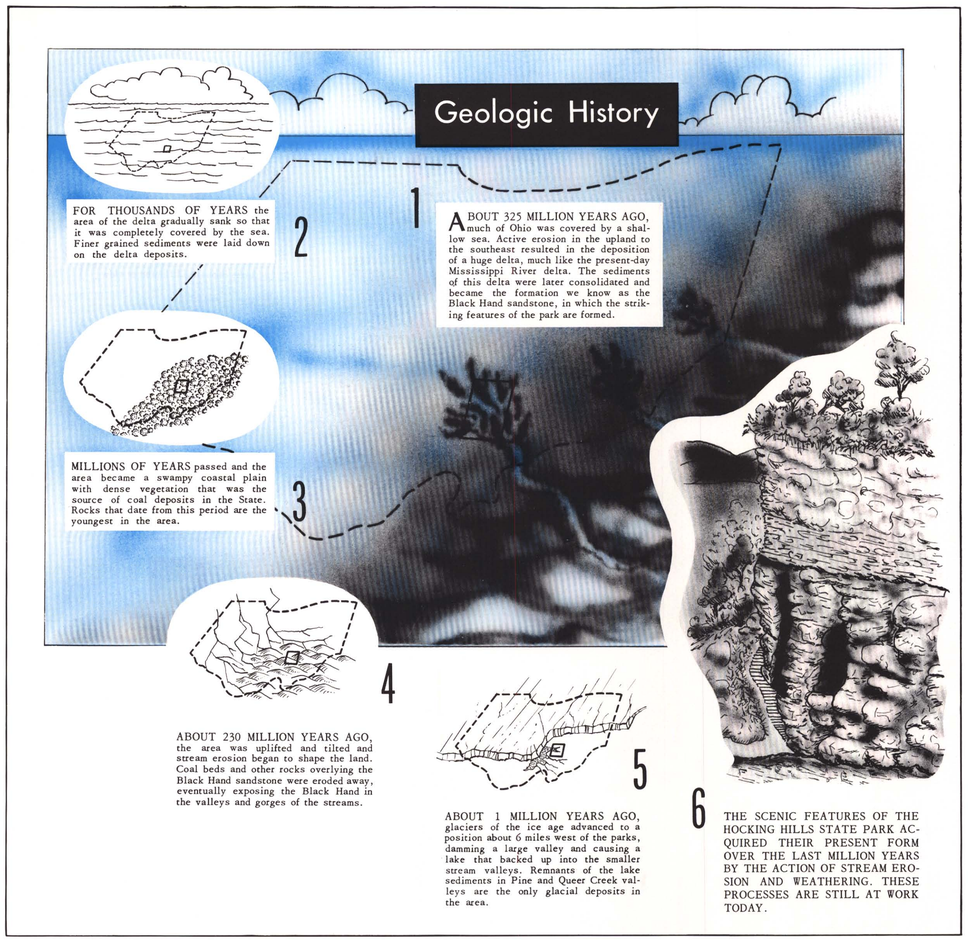
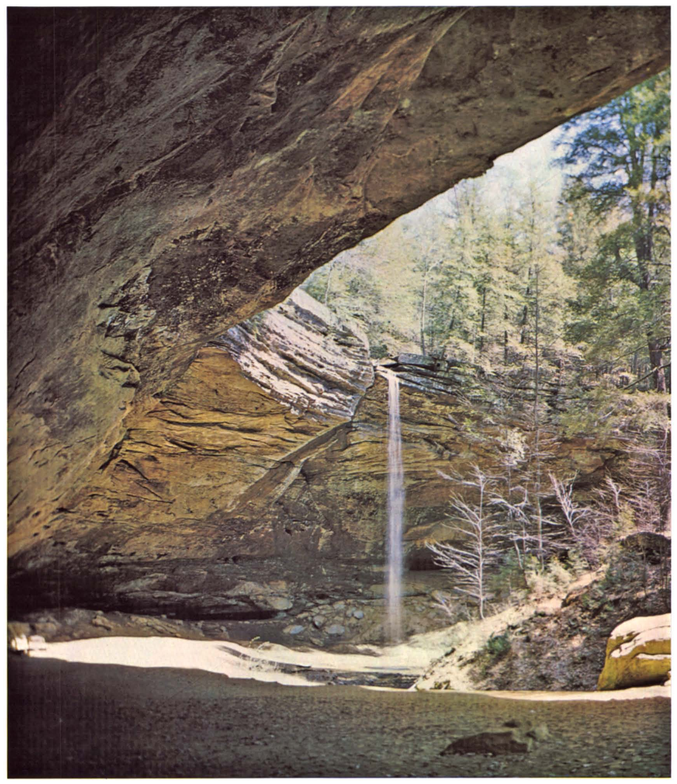
STATE OF OHIO
JAMES A. RHODES, GOVERNOR
DEPARTMENT OF NATURAL RESOURCES
FRED E. MORR, DIRECTOR
DIVISION OF GEOLOGICAL SURVEY
RALPH J. BERNHAGEN, CHIEF

Hocking Hills State Park

DIVISION OF GEOLOGICAL SURVEY
REPORT OF INVESTIGATIONS NO. 63
GEOLOGY OF THE
SOUTH BLOOMINGVILLE QUADRANGLE, OHIO
(HOCKING HILLS STATE PARK)

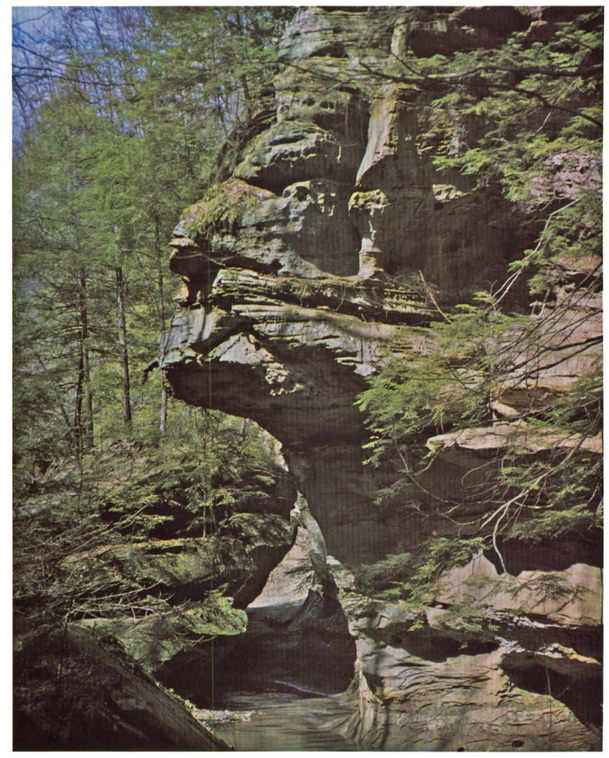




Ash Cave

Ash Cave is the outstanding shelter cave in the park area. This huge horseshoe-shaped re-entrant measures approximately 100 feet from the rim to the back wall; the rim is 90 feet above the plunge pool of the falls, and the distance around the rim of the cave is 700 feet. It has remarkable acoustics and two spots have the qualities of a whispering gallery. This park is among the most popular for winter scenery.

The name was derived from ash piles found under the rock shelter by the earliest settlers. A test excavation in 1877 revealed sticks, arrows, stalks of coarse grasses, food bones in great variety, bits of pottery, flints, and corn cobs. Recent excavations show that animal bones are predominantly of deer; other animals represented are black bear, elk, skunk, wildcat, squirrel, rabbit, duck, wild turkey, passenger pigeon, and box turtle.



THE SPHINX HEAD - OLD MAN'S CAVE

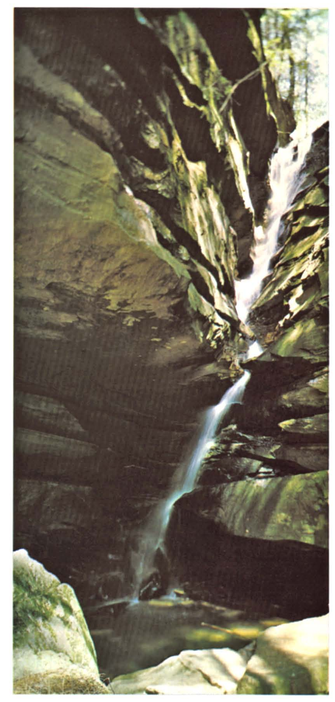
Old Man's Cave

At Old Man's Cave a visitor may see all of the erosional features to be found in the Hocking parks—shelter caves, narrow vertical-walled gorges, and waterfalls—plus natural rock sculptures. The park is named for a fugitive from West Virginia, a man named Rowe, who lived in the cave in the upper gorge for many years after the Civil War.

The largest and perhaps the wildest, this park is the most popular. It comprises four principal sections, all continuous with one another along the valley of Old Man's Creek. These are the upper falls, upper gorge, lower falls, and lower gorge. The upper gorge, about a quarter of a mile long, is a primitive area that contains many of the major attractions of the park: the cave that the old man lived in, the rock profile, the "middle" falls, and outstanding examples of stream abrasion, such as potholes. The potholes, which are round pits or holes in the rock floor of the stream, were cut by the grinding action of rocks swirled by turbulent water.

The sphinx head profile (shown in the picture above) displays some of the small-scale effects of weathering and erosion on the Black Hand sandstone. The slight parallel recesses from the chin to the mouth and in the brow are caused by weathering along bedding planes (surfaces between rock layers); the pitting at the forehead and honeycomb weathering along the cheek are the results of removal of individual sand grains by water as it dissolves the cementing material. The jutting chin was formed by the stream undercutting the rock, permitting blocks of rock to break along bedding planes and fall into the stream.

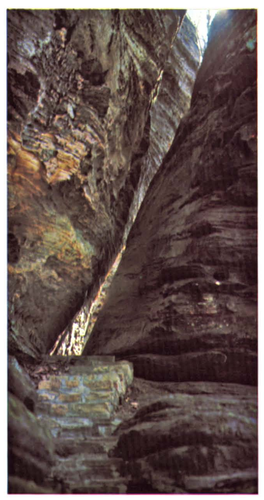
This is the only park in which the full thickness of the Black Hand sandstone may be seen. Old Man's Creek flows on the surface of the Black Hand at the head of the gorge, and at the lower falls the contact between the Black Hand sandstone and the underlying shale can be seen readily in the back wall of the shelter cave.



Cantwell Cliffs

Cantwell Cliffs is located in the Rockbridge quadrangle area, 3 miles north of the South Bloomingville quadrangle. The park is 7 miles by road from Rock House.

The high cliffs and shelter caves display the usual erosional features of the Black Hand sandstone, but several clefts which form narrow passageways through the rock distinguish this park from the others. These clefts are the result of weathering along joints, a process that weakens the rock so that large blocks are separated from the rock mass by slumping (movement downhill and away from the face of the cliff). The magnitude of slumping ranges from a few inches to tens of feet and is indicated by tilting of the slumped blocks and downward offsetting from the main rock mass. However, there is no evidence of movement of either block shown in the photograph to the right; apparently this cleft is a result solely of weathering along a joint or some similar zone of weakness.



Geologic Processes

The scenic features of the Hocking parks have resulted from the great contrasts in weathering between "hard" or resistant zones and "soft" or nonresistant zones in the Black Hand sandstone. These zones are of varying thickness from one locality to another. A most significant zone is the top 15 feet of the Black Hand which forms the overhangs, the lips of the falls, and the rims bounding the valleys. The sand grains and pebbles of this upper zone are extremely well cemented by iron and silica, making the rock very resistant to erosion; it is the resistance of this caprock that is the key to formation of the unique topography of the parks area.

In contrast, the sand and pebbles of the soft zones are so weakly cemented that particles may be freed from one another by rubbing the rock between one's fingers. Soft zones thus erode more easily, causing the hard zones to stand out in relief. All of the erosional features, small and large, such as honeycomb weathering (rock surfaces pitted to resemble the honeycomb of bees), grottos, recesses, and shelter caves, owe their origin to the more rapid erosion of the soft zones.

Water is the erosional agent responsible for all of these forms. Rain wets the surface of the exposed rock and dissolves cementing material, freeing individual sand grains. Rain soaks into the soil and percolates downward to saturate the rock. This ground water moves downward most readily along cracks in the rock, and horizontally along the surfaces between rock layers. Dissolving of the cement along these cracks and bedding planes causes them to become zones of weakness and large and small blocks spall off the cliffs along these zones. Some of the ground water emerges in the form of springs and may erode recesses into the rock. Water in the form of ice acts as a wedge to split and disintegrate the rock. Continuous wetting of the rock surface by spray from the waterfalls causes further erosion of the deep re-entrants or shelter caves. However, springs may be as important a factor as spray in formation of some of the caves.

Every stream is continuously at work deepening its valley from mouth to source. If the rock traversed by the stream is of uniform resistance, the gradient of the stream is a smooth downhill slope with a gradual steepening toward the source. However, interruptions of this gradient are caused by layers of comparatively hard rock which cannot be cut into as readily as the softer layers. Where alternating hard and soft layers are thin, riffles or rapids form. Where strong resistant caprock overlies thick nonresistant rock, as in the case of the Black Hand sandstone, waterfalls form. The character of the Black Hand is particularly amenable to the transformation of cliffs into re-entrants or shelter caves, and characteristically an amphitheater shape is assumed at the point of a falls. As the caprock is undermined by enlargement of the re-entrant to the extent that its own weight becomes too great for its physical strength, blocks of the caprock fall; this in turn exposes the re-entrant to further weathering. By repetition of this process a waterfall retreats slowly upstream, resulting in the gorge that is always present downstream from the falls.

Conkle's Hollow

Conkle's Hollow is in some respects the most spectacular of the Hocking parks. It is a narrow half-mile-long ravine with vertical walls that stand 200 feet above the mouth of the gorge; these cliffs are the highest in the area and provide some of the most outstanding scenery.

The most active erosion of valley walls in the parks is taking place at Conkle's Hollow. The rock face of the valley walls is casehardened almost everywhere. Casehardening results from a coating of cementing material that is generally deposited at the surface of porous rock by evaporation of mineral-saturated water. Sand grains of exposed rock are tightly cemented and erosion is greatly retarded. At two places in Conkle's Hollow the casehardened rock has been broken and soft or weakly cemented sandstone is exposed; the rapid erosion of the rock at these places is indicated by the large quantities of loose sand that have accumulated on the slope at the base of the cliffs. These actively eroding areas are much lighter in color than the casehardened dull-gray rock. This freshly exposed rock will in time become casehardened again.

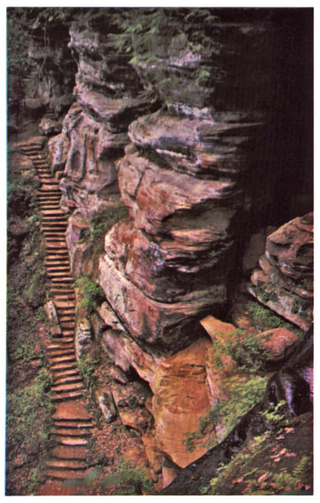
This hollow was named for W. J. Conkle, who left his name and the date 1797 carved into the sandstone on the west wall of the ravine.

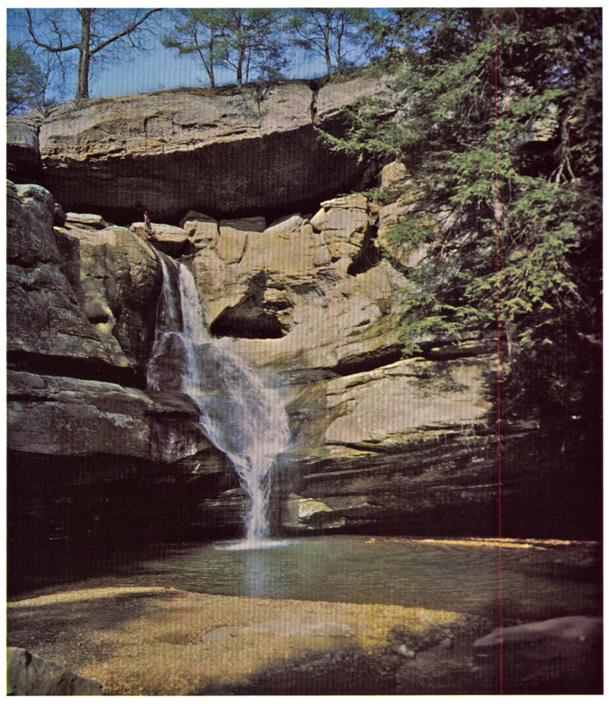
Rock House

Rock House is a straight natural tunnel or corridor, 200 feet long and 20-30 feet wide, situated midway up a vertical cliff 115 feet high. The five "windows" in the corridor wall overlook Laurel Run and give this locality the aspect of a building, hence the name Rock House.

Rock House is an outstanding example of erosion controlled by joints. Joints are vertical fractures or cracks in the rock; they break the continuity of the rock and are planes of weakness. At Rock House the joint pattern consists of a set of joints parallel to each other in a roughly north-south direction and a second set in a general east-west direction. Blocks of rock, in breaking away from the cliff along this joint pattern, have created right-angle offsets. One of these offsets has left the rock mass which encloses Rock House jutting out from the face of the cliff. Erosion along the north-south set of joints has formed the windows and erosion along a single east-west joint has created the main corridor.

The interior of Rock House well illustrates weathering along these joints. The east-west joint at the peak of the arched ceiling acts as a watercourse during rainy periods; rainwater which percolates down through the soil finds an outlet much like a springline along this joint. During prolonged heavy rains much of the water from this joint drips onto the floor but some spreads across the ceiling, wetting its surface. The concentration of water is greatest at the joint and erosion is most rapid there; hence the rough Gothic-arch shape of the ceiling. A springline at floor level brings additional water into Rock House and has created a recess of several feet in the base of the wall. All of the water entering Rock House flows in rivulets out the windows, removing sand loosened by the percolating water.





Cedar Falls

The massive thick-bedded character of the middle and upper parts of the Black Hand sandstone is shown in the above photograph of Cedar Falls. The resistant "caprock" so prominent throughout much of the park area is the uppermost rock layer and here is approximately 15 feet thick. Two joints or vertical fractures in the caprock are readily visible, one to the left of the large bare tree, the other in the midst of the evergreens in the center of the picture. Abrasion by rock fragments has worn the watercourse smooth in contrast to the indented and pitted surface of the rest of the cliff.

The trail down the gorge below Cedar Falls to the lower gorge of Old Man's Cave and from there to the park area of Old Man's Cave passes through the most austere area in the Hocking parks. This remote primitive chasm, bounded by rock walls and their accompanying grottos and waterfalls, is a wild and lonely but spectacularly beautiful place.

The Tenure of Man

The Hocking parks area is now, as in prehistoric times, some of the wildest and most rugged country in Ohio. Then as now the permanent population was low but visitors numerous. However, the motivation for visiting the parks has changed: we visit this area today for its scenic values and for recreation; Indian visits were in the form of hunting parties. This wild country was a superb hunting grounds and the rock shelters provided temporary housing while game was dressed and packed for transport to permanent settlements. The hunting parties left their records in the form of refuse on the floors of the caves: bits of food, bones, charcoal from the campfires, and artifacts such as arrow and spear points. The layers of debris that have accumulated indicate that this continuous but temporary occupancy goes back from historic time to about 6000 B.C. Deer was the main game animal killed by these primitive hunters; bear, bison, elk, and wild turkey were taken in smaller numbers.

As the Indians were forced northwest away from this hunting grounds, they were rapidly replaced by hunters and settlers who cleared many areas of this vast wilderness and rapidly depleted the large game animals. The last bison of this area was reported killed along Queer Creek in 1799; bear lasted but little longer despite the ideal habitat that the cave region provided, and by the middle of the 19th century deer and wild turkey were almost nonexistent. Today, however, under careful game management, both deer and wild turkey have made a remarkable recovery; in fact, the present deer population is probably greater than it was before the advent of the settlers. The resurgence of these traditional game animals provides both hunting opportunities and an atmosphere of primitiveness for park visitors.

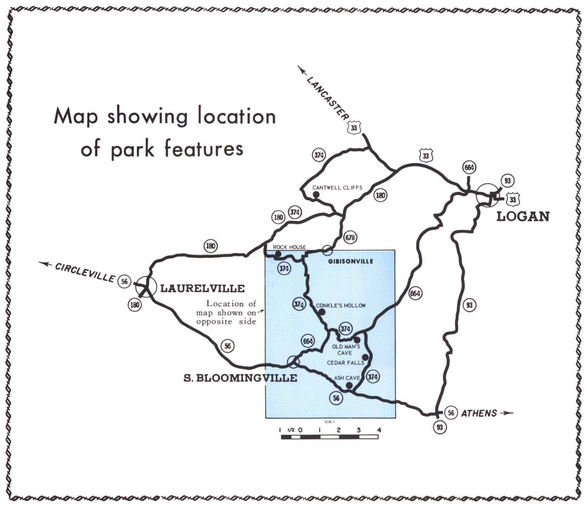
Early hunters and Indian scouts from Kentucky settlements undoubtedly visited this area at an early date. However, the first written record is an anonymous carving on a beech tree that stood near South Bloomingville: "This is the road to hell, 1782." Speculation has it that the author was an escaped prisoner of the Indians. Undoubtedly other itinerants knew this area, but it was not until the 1790's that permanent settlers arrived.

Hocking County was organized in 1818 and by 1820 had a population of more than two thousand. In 1835 a powder mill was built at Gibisonville, east of Rock House, to make gunpowder from saltpeter that was found in nearby caves and gorges. In 1840 the canal along the Hocking River was completed, connecting Logan with points north and south, and encouraging rapid settlement. The first attempts to develop the county's mineral resources came in 1865 when shafts were sunk to mine coal and iron ore and wells were drilled for oil and gas. By the close of the 19th century the hilltops and flat stream valleys of western Hocking County had been cleared of their large stands of timber and lumbermen slowly encroached upon the area now enclosed by the parks.

In 1915, the State Forest law was passed, allowing purchase of land deemed necessary for preservation of scenic areas, and in 1924 the State purchased 146 acres at Old Man's Cave to preserve that place for the public. Other purchases followed rapidly and the Hocking parks were established. These additions are shown below.

Park	Acreage	Date of initial purchase
Cantwell Cliffs	50	1929
Rock House	50	1925
Conkle's Hollow	100	1925
Old Man's Cave	250	1924
Cedar Falls	50	1929
Ash Cave	50	1925

Thousands of acres surrounding the park area have since been incorporated as part of the Hocking State Forest under the management of the Ohio Division of Forestry and Reclamation.



For additional information

For information concerning hiking, camping, and park facilities please write the Department of Natural Resources, Division of Parks and Recreation, 913 Ohio Departments Building, Columbus, Ohio 43215.

Information on which this publication is based is on file with the Ohio Division of Geological Survey, 1207 Grandview Avenue, Columbus, Ohio 43212.

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Price $1.00

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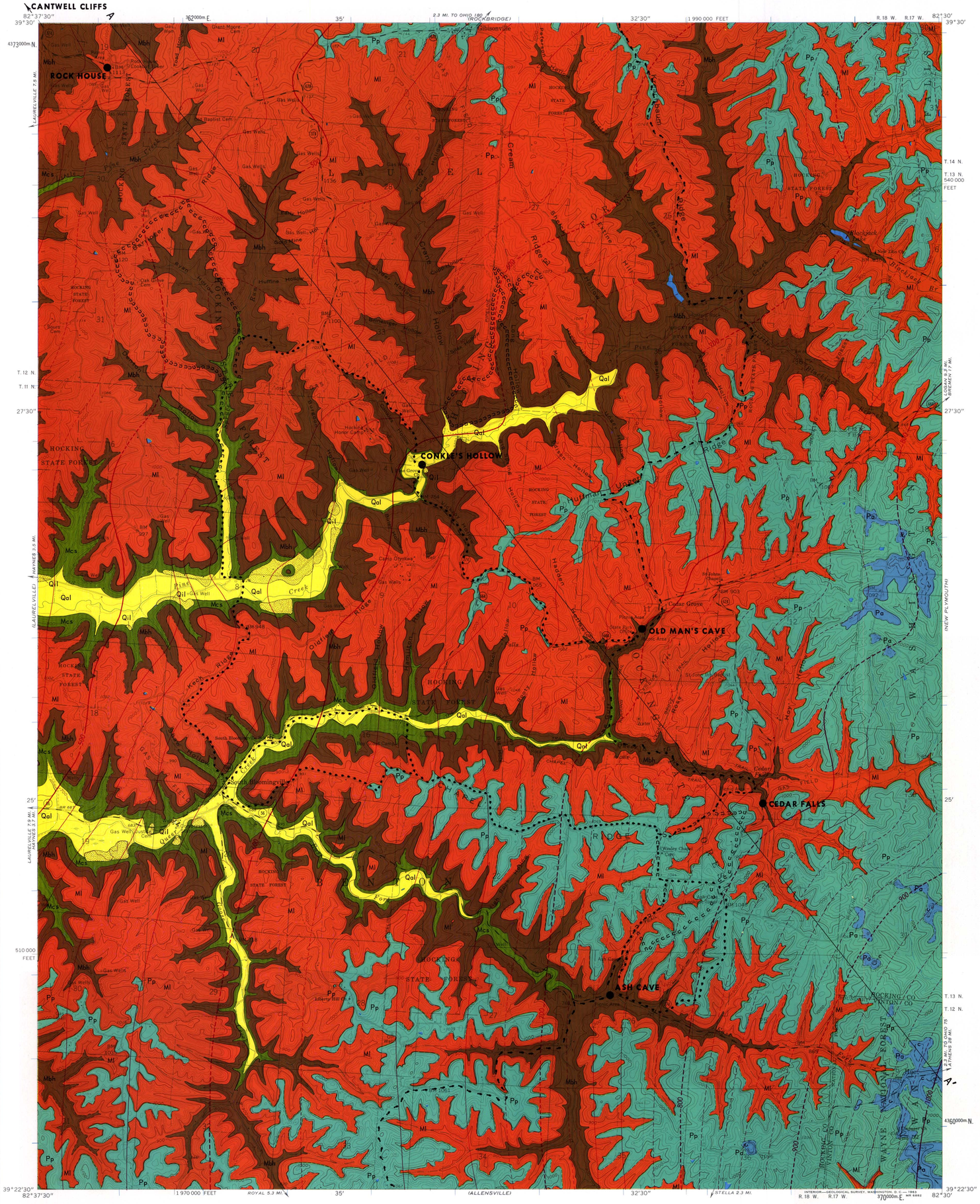
GEOLOGY OF THE
SOUTH BLOOMINGVILLE QUADRANGLE, OHIO

BEDROCK GEOLOGY OF THE SOUTH BLOOMINGVILLE QUADRANGLE, HOCKING AND VINTON COUNTIES, OHIO

By Richard M. DeLong

1967

SYSTEM	GROUP	FORMATION	MEMBER OR BED	LITHOLOGY	THICKNESS IN FEET	DESCRIPTION
QUATERNARY			Alluvium Lake deposits		0-15	Alluvium; restricted to floodplains of largest streams. Clay, gray to yellow-brown, silty to sandy; scattered rock fragments; occurs in valleys as terraces and erosional remnants.
PENNSYLVANIAN	ALLEGHENY		Kittanning shale and sandstone		50	Shale, yellow to reddish-brown, thin-bedded. Sandstone, brown, massive, crossbedded; restricted to the vicinity of Hue. Limonite nodules embedded in clay at base of unit.
			Clarion coal		2	Coal; varies to coaly shale.
			Clarion clay		2	Clay, light-gray, plastic.
					30	Shale, yellow-brown to light-gray, thin-bedded. Sandstone, very fine-grained, laminated.
			Putnam Hill limestone			Limestone, light- to medium-gray, crystalline; grades into gray silty shale.
			Brookville coal		0-1	Coal; restricted to secs. 18, 19, Washington Township, Hocking County.
			Brookville clay		0-2	Clay, light-gray, plastic.
			Tionesta coal and clay		0-4½ 10	Shale, gray to dark-gray. Sandstone, brown, laminated.
					0-3	Coal, shaly; 0-2 ft. Clay, light-gray; 0-3 ft.
			Upper Mercer limestone		7	Shale, sandy. Sandstone, light-gray, shaly.
			Bedford coal and clay		0-3½ 0-2	Limonite, nodular to bedded; locally marine limestone and flint. Coal to coaly shale, 0-1 ft. Clay, light-gray, 0-2 ft.
			Upper Mercer coal and clay		20	Shale, gray, carbonaceous to sandy. Sandstone, shaly. Coal and clay, thin; irregular in occurrence.
		POTTSVILLE	Lower Mercer bed Middle Mercer coal and clay			Limonite, nodular to bedded; varies to marine shale.
					0-½	Coal, shaly, 0-½ ft. Clay, light-gray, 0-4 ft.
					0-4	Shale and shaly sandstone, gray.
			Flint Ridge coal and clay		3-10 0-3	Coal and shale, 0-½ ft. Clay, light-gray, 0-3 ft.
					15	Shale, light- to medium-gray.
			Lower Mercer coal and clay		0-1½	Coal; varies to shale; 0-1½ ft. Clay, light-gray, 0-1 ft.
			Undifferentiated		30-50	Sandstone, brown to gray; locally massive, well-sorted, coarse-grained, crossbedded, up to 15 feet thick; varies to thin- to medium-bedded, poorly sorted, fine- to medium-grained. Shale, gray to brown, argillaceous to sandy; dominant at many places and interbedded with sandstone. Thin unidentified coal and clay beds also present. Brown to gray sandy shale or thin-bedded sandstone in contact with Mississippian beds.
		LOGAN	Vinton member		73-117	Shale, buff to light- or dark-gray, pinkish-orange to orange-brown, clayey to silty; weathers readily; discontinuous interbeds of laminated siltstone and fine-grained buff and pale-olive-drab to brown sandstone, generally thin- to medium-bedded but locally massive, cumulative thickness as much as 10 feet, distinctive zone of nonresistant red shale about 10 feet thick present in the upper part.
			Allensville member		2-35	Sandstone, buff to yellowish-orange; weathers brown; thin- to medium-bedded; entire unit locally composed of pebbles ¼ inch in diameter in sand matrix; at most localities consists of lenses or thin beds of coarse sandstone interbedded with very fine-grained sandstone and bluish-gray silty shale similar in character to beds in the Byer member; marine fossils present but sparse.
			Byer member		17-50	Sandstone, greenish-gray to brown and orange-brown, limonite-staining, thin- to medium-bedded, very fine- to fine-grained; subangular to rounded grains; interbedded with thin gray siltstone beds and bluish-gray silty shale; worm trails and borings common; locally contains brachiopods and crinoids.
			Berne conglomerate member		0-3	Conglomerate, brown; with rounded quartz pebbles up to ¼ inch in diameter in matrix of rounded coarse-grained sand.
MISSISSIPPIAN		CUYAHOGA	Black Hand member		80-250	Conglomerate and sandstone, light-gray to buff; weathers medium-gray; typically well-sorted medium- to coarse-grained sandstone with conglomerate lenses and scattered pebbles; medium- to massive-bedded with conspicuous crossbedding and erosional planes that dip generally north; massive beds up to 20 feet thick in the lower and middle portions, structureless to crossbedded with some scour and fill features. Maximum thickness in the northwestern part of the quadrangle, thinning to 80 feet in the southwestern part as a result of lateral gradation of sandstone to shale. Upper 15-30 feet uniform in character throughout the area, consisting of coarse-grained conglomeratic medium- to massive-bedded sandstone, very resistant due to heavy cementing, forms prominent rims along the valley walls; middle and lower parts of typical coarse-grained rock irregularly but generally weakly cemented resulting in formation of recesses or shelter caves; basal portion, as much as 100 feet thick in the northwest, commonly fine- to medium-grained sandstone with sparse pebbles ¼ inch in diameter in massive beds that grade into thin- to medium-bedded sandstone with sandy shale and clay interbeds; sandstone similar to but better sorted than sandstone beds in the Cuyahoga shale member.
			Cuyahoga shale member		70	Shale, gray to bluish-gray, silty to sandy, micaceous; plant remains; interbedded with sandstone, gray to brown, generally very fine- to fine-grained with regular thin to medium bedding, but locally fine- to medium-grained, micaceous, in beds 10 feet thick. Lateral gradation from southwest to northeast into Black Hand sandstone.



EXPLANATION

- Recent / Pleistocene — QUATERNARY
  - Qal — Alluvium
  - Qil — Lake deposits, Illinoian or older
- Lower and middle Pennsylvanian — PENNSYLVANIAN
  - Pa, c — Allegheny Group, c, *Clarion coal*
  - Pp — Pottsville Group
- Upper Mississippian — MISSISSIPPIAN
  - Ml — Logan Formation
  - Mbh, Mcs — Cuyahoga Formation, Mbh, *Black Hand member*, Mcs, *Cuyahoga shale member*

Contact
Dashed where approximate; short dashed where concealed

Coal outcrop
Dashed where approximate

Structure contours
Drawn on top of Delaware Limestone of Devonian age. Contour interval 20 feet. Dashed where approximate.

Park entrance

Buckeye Trail

Chief Leatherlips Trail

Bridle trail

BASE BY U.S. GEOLOGICAL SURVEY, 1961

10,000-foot grid based on Ohio coordinate system, south zone
1000-meter Universal Transverse Mercator grid ticks,
zone 17, shown in blue

2½° MAGNETIC NORTH — TRUE NORTH
APPROXIMATE MEAN DECLINATION, 1961

SCALE 1:24000
1 0 1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 0 1 KILOMETER

CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL

Quadrangle Location

MINERAL RESOURCES

Oil and gas.–Gas has been the principal mineral resource since its discovery in the early 1900's. Most of the production is from the Silurian age Albion ("Clinton") Sandstone, from a number of pools that lie entirely or partially within the South Bloomingville quadrangle area. The "Clinton," from 5 to 30 feet in thickness, generally consists of a single unit; in some areas, however, well records show that it is broken by one or two shale partings 2-13 feet thick. Initial production from individual wells was a few thousand to 7,790,000 cubic feet of gas per day. From west to east, drilling depth to the "Clinton" ranges from about 2,100 to 2,650 feet below the surface.

Minor amounts of oil and gas have been produced from the Berea Sandstone (Mississippian), which is 25-50 feet thick. Its drilling depth ranges from about 500 to 800 feet from west to east.

The Benton gas storage area (Calvert, 1964) occupies much of the western half of this quadrangle area and adjacent areas to the west and north. This storage area was converted from depleted "Clinton" gas fields in 1926. The only drilling since 1964 has been for storage development wells.

Coal.–The Clarion coal bed is 1-2 feet thick in the vicinity of Hue, where it has been mined. However, in sec. 18, Washington Township, Hocking County, this bed is represented by 2 feet of carbonaceous shale and sandstone. Because of its limited areal extent, the Clarion coal does not constitute a major resource.

The Brookville coal bed, 2 feet thick, was stripped in sec. 18, Washington Township, where it is apparently limited to the area within a radius of about ½ mile from the mining site. The Brookville coal and clay and the Putnam Hill limestone are missing from the Pennsylvanian sequence in the southern Washington Township and Vinton County portions of the map area.

Clay.–During the last half of the nineteenth century the Middle Mercer and Flint Ridge clays were mined near Hue for the manufacture of stoneware, and in neighboring areas of Vinton County these clays have been mixed with shale for the manufacture of brick. In the vicinity of Hue, the Flint Ridge clay is 2 feet thick and the Middle Mercer clay ranges from 2 to 4 feet in thickness.

Sandstone.–Sandstone, despite large reserves, has not been developed except for local use. The Black Hand sandstone was formerly quarried for glass sand north of this area, near Rockbridge. The silica content of unwashed samples from this quarry was 98.63 percent and of washed samples 98.73 percent (Bownocker, 1921, 1923, 1926).

Other resources.–Upper Mercer iron ore was mined in the vicinity of Hue and, in the last century, small amounts of saltpeter were extracted from several shelter caves in the north-central part of the quadrangle area.

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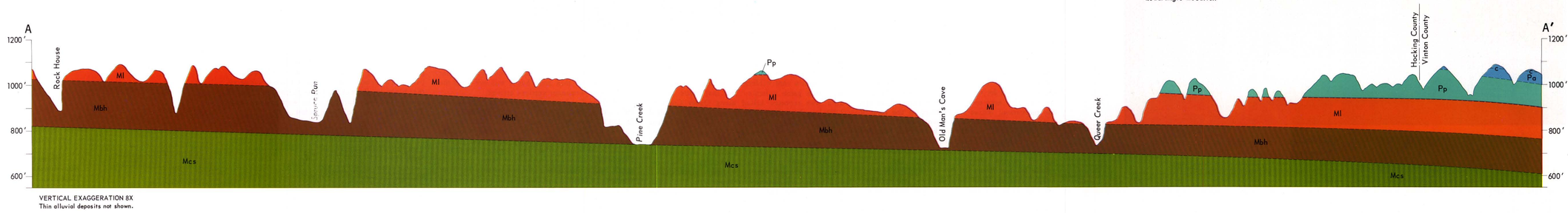
Cartographic drafting by
Philip Celnar



VERTICAL EXAGGERATION 8X
Thin alluvial deposits not shown.

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Price $1.00