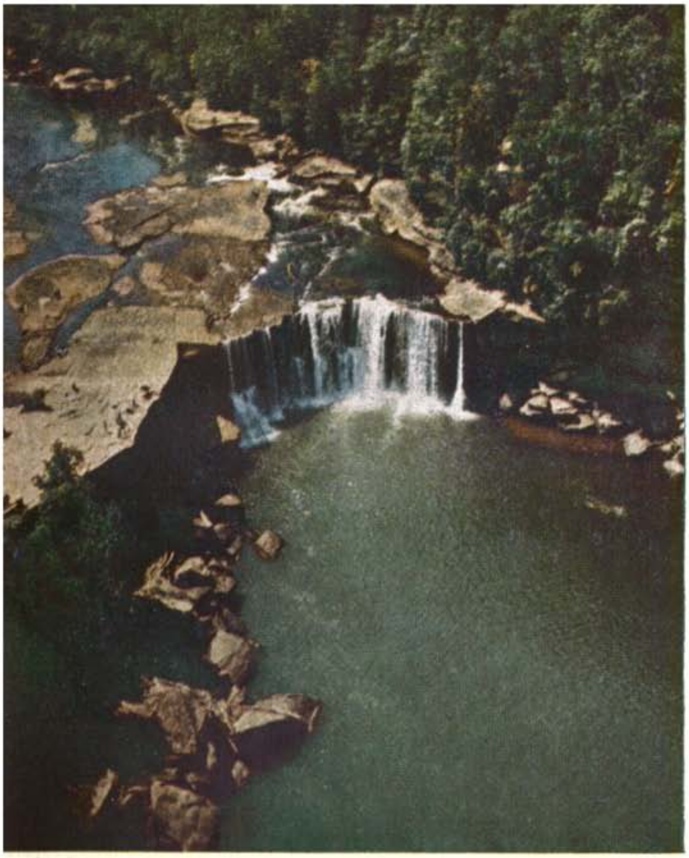

GEOLOGY OF THE CUMBERLAND FALLS STATE PARK AREA

BY PRESTON McGRAIN

KENTUCKY GEOLOGICAL SURVEY 1955
UNIVERSITY OF KENTUCKY, LEXINGTON

COVER PHOTO

Aerial view of Cumberland Falls and Cumberland River gorge. The Falls is maintained by differences in hardness between layers of sandstone. Kentucky Division of Publicity photograph.

University of Kentucky

College of Arts and Sciences

KENTUCKY GEOLOGICAL SURVEY

ARTHUR C. McFARLAN, Director

DANIEL J. JONES, State Geologist

SERIES IX

SPECIAL PUBLICATION — NO. 7

Geology of the Cumberland Falls State Park Area

By

PRESTON McGRAIN

Printed by the Authority of the State of Kentucky

LEXINGTON, KENTUCKY

1955

LETTER OF TRANSMITTAL

March 15, 1955

Dean M. M. White
College of Arts and Sciences
University of Kentucky

Dear Dean White:

The Kentucky Geological Survey is publishing Special Publication No. 7—*Geology of the Cumberland Falls State Park Area*. It is a semi-popular treatment of this scenic attraction, prepared to give the visitor an understanding of the geological conditions responsible for its features. It is a great waterfalls but only what is left of a once much greater one farther downstream. The publication is one of a series being prepared that deals with the natural wonders of the State.

Sincerely yours,

ARTHUR C. MCFARLAN
Director

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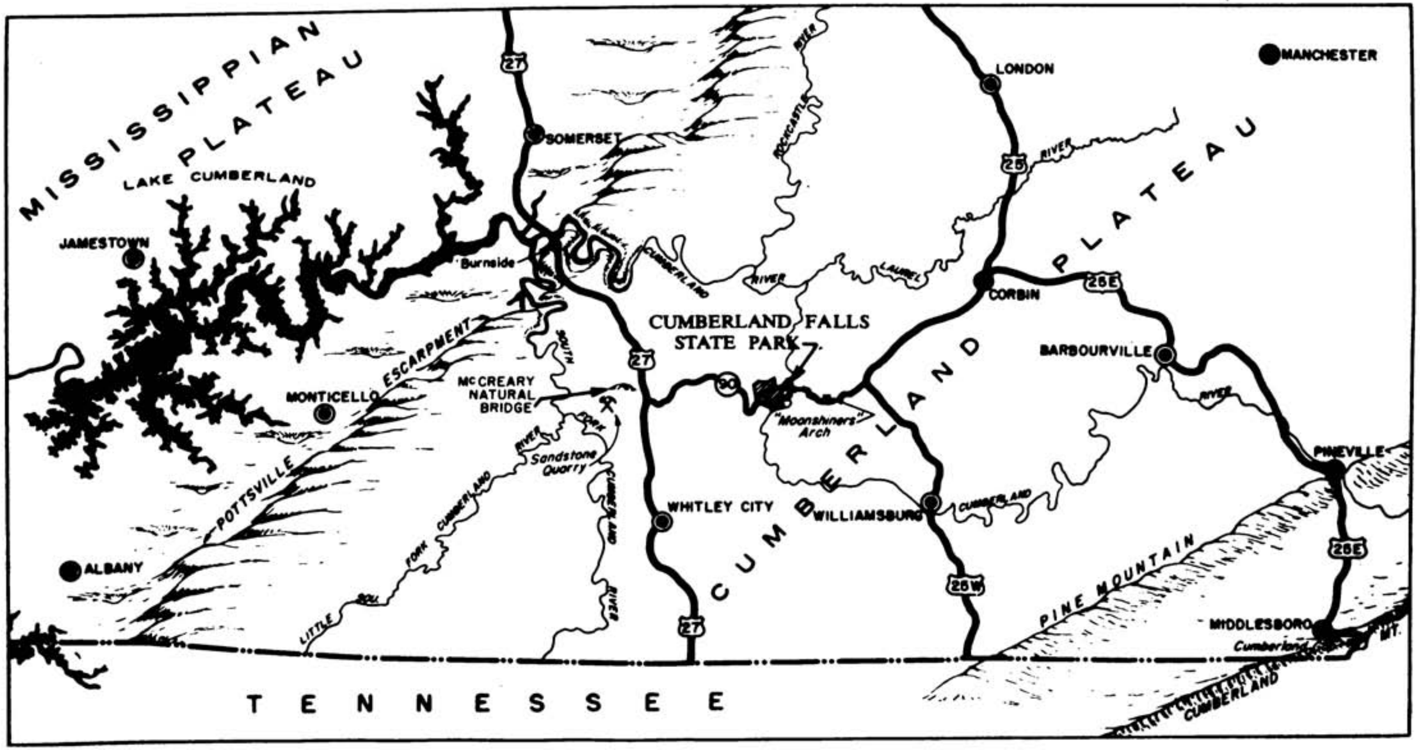


FRONTISPIECE. Index map of the Cumberland Falls State Park area showing location of the outstanding features.

Introduction

Cumberland Falls State Park is situated in one of the most scenic parts of Kentucky. All along the western edge of Kentucky's Eastern Coal Field, massive, cliff-forming basal Pennsylvanian sandstones produce rugged and picturesque landscapes. Waterfalls, precipitous cliffs, rocky gorges, natural bridges, and other interesting and unusual natural features are found here. This narrow, northeasterly-trending belt contains several scenic parks. Reports similar to the present one have already been issued on the Natural Bridge and Carter and Cascade Caves areas.

Millions of gallons of water plunging over the lip of a ledge of massive sandstone has produced one of the really outstanding scenic natural attractions of Kentucky–Cumberland Falls. It is the purpose of this pamphlet to describe the origin and development of the Falls and other outstanding attractions of the area and to present the relationship between them and the rock formations.

The Falls has been a tourist attraction for more than a century. In the 1920's it became part of a state park, which at the present time contains some 1,100 acres of rugged terrain. Surrounding the State Park is the larger area of the Cumberland National Forest, with its million and a quarter acres of woodland, which also contains many scenic spots. In addition to picturesque Cumberland Falls and the rugged Cumberland River gorge other attractions in the immediate area include Eagle Falls, McCreary Natural Bridge, and "Moonshiner's" or Sandgap Arch.

Regional Setting

Cumberland Falls State Park is located in that part of eastern United States called the Cumberland Plateau. The Kentucky portion of this area is also called the Eastern Coal Field of Kentucky. It is a plateau characterized by a nearly level to undulating upper surface dissected by deep, narrow, steep-sided valleys. Streams have cut several hundred feet below the upland, but the region, when viewed from the top of the hills, appears as a series of many narrow, nearly flat-topped ridges, each having the same general elevation. Within the immediate area of the park, elevations range from less than 740 feet above sea level in the gorge below the falls to more than 1,300 feet on the highest hills, knobs, and ridges. Near the western edge of the Cumberland Plateau, elevations of more than 1,400 feet have been recorded.

The writer gratefully acknowledges the cooperation of Mr. Henry Ward, Commissioner of Conservation of Kentucky, and members of his staff; Dr. J. W. Huddle, Fuels Branch, U. S. Geological Survey; and fellow staff members of the Kentucky Geological Survey.

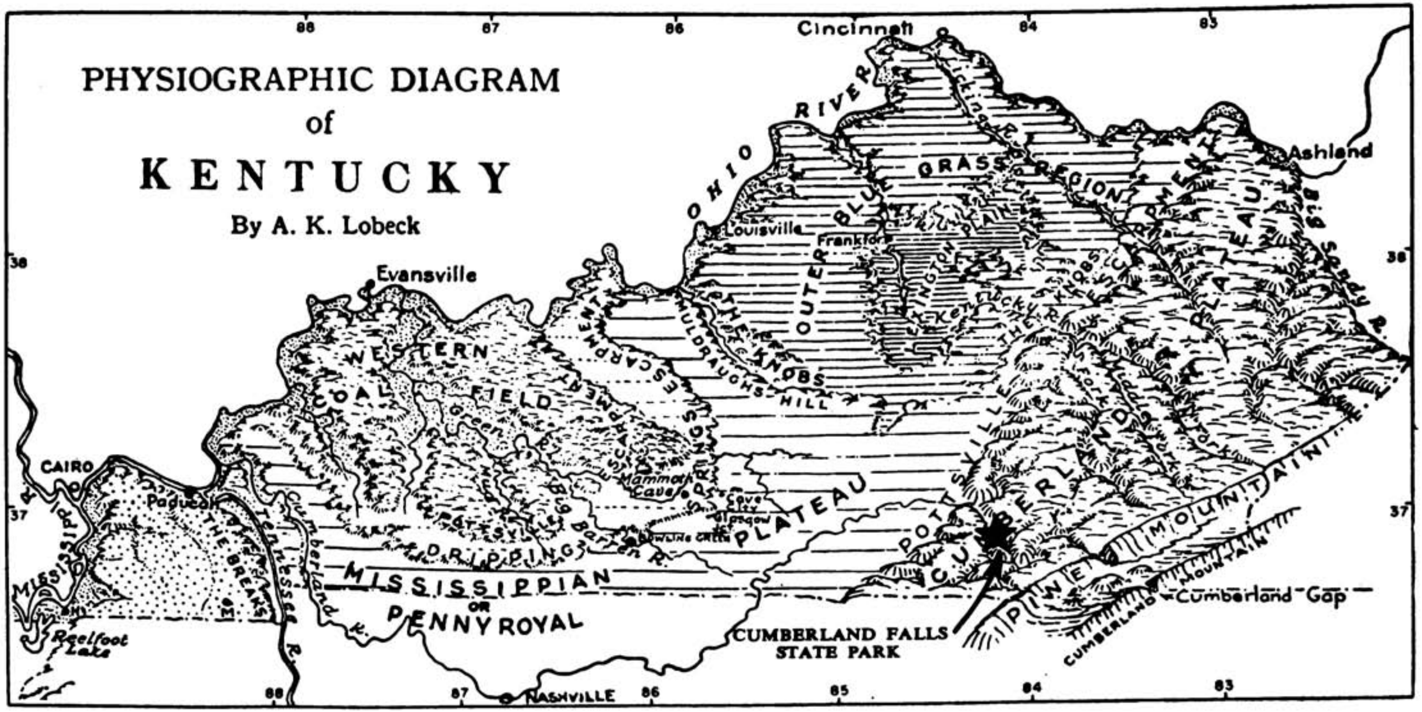


Fig. 1. Physiographic map of Kentucky (adapted from A. K. Lobeck, University of Columbia Press) showing the major geographic and geologic areas of the State. The topographic condition of an area is dependent to a large degree upon the underlying rocks. The vast majority of the rocks which are present in Kentucky are shales, sandstones, and limestones, each of which reacts differently to weathering and erosion and produces different landscapes. Note the similarity in pattern between the physiographic map and the geologic map below.

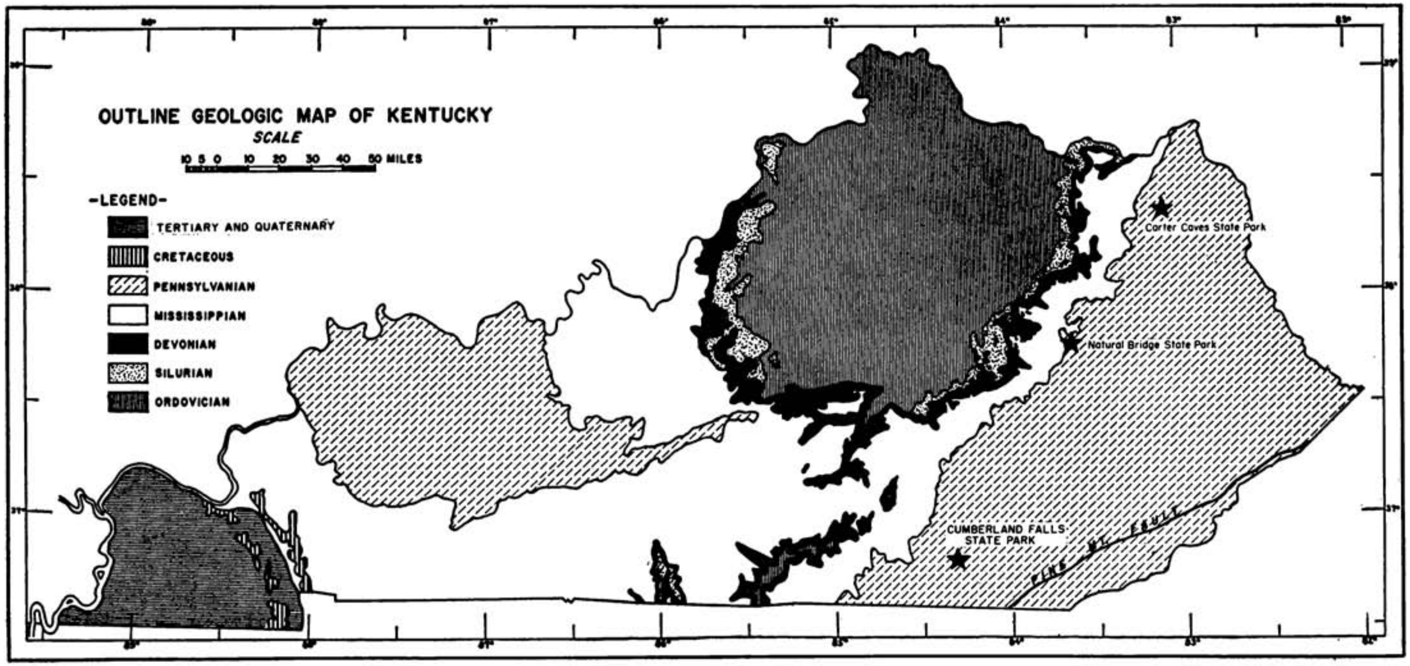


Fig. 2. Outline geologic map of Kentucky showing the distribution of rocks of various ages. The Ordovician rocks, which are exposed in the Bluegrass regions, are the oldest. They dip slightly to the west and southwest from Lexington; successively younger rocks are encountered on the surface as one proceeds in these directions. Thus, at Cumberland Falls one would have to drill a hole several thousand feet deep to reach same rock formations seen on the surface at Lexington.

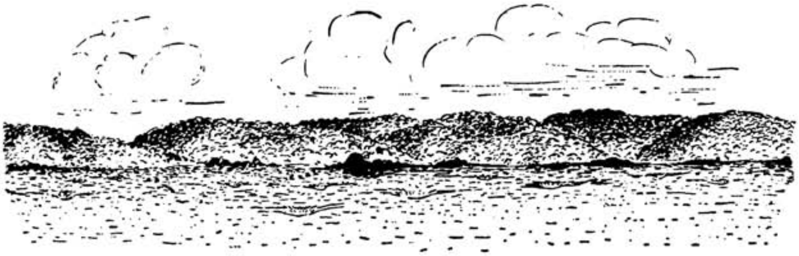


Fig. 3. View of the Pottsville escarpment in southern Pulaski County, Kentucky. The sandstone capped escarpment in the background rises more than 400 feet above the limestone plain (foreground). Also see Fig. 4.

Wolf Creek Dam, constructed by the Corps of Engineers, U. S. Army, on Cumberland River in Russell County, Kentucky, created Lake Cumberland, an extensive reservoir for flood control, development of power, recreation, and other purposes. When the lake is full the water level attains an elevation of 723 feet above sea level, and water backs up to within a short distance of the State Park.

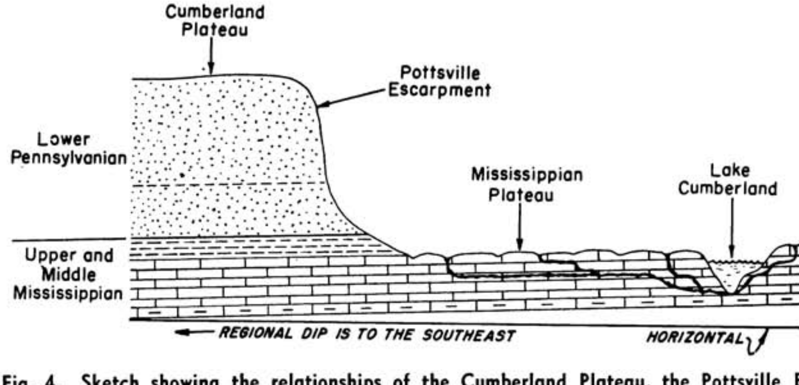
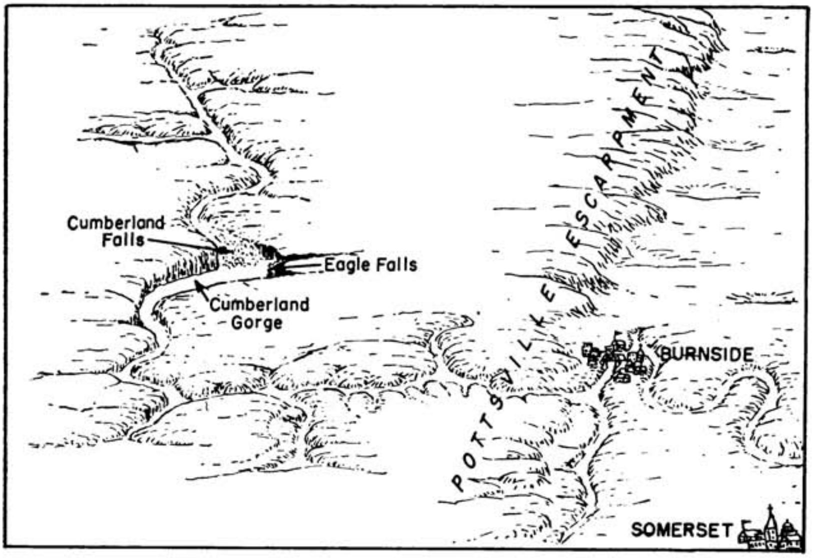
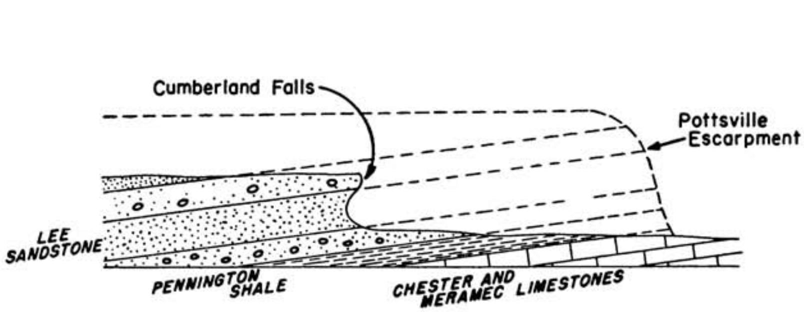


Fig. 4. Sketch showing the relationships of the Cumberland Plateau, the Pottsville Escarpment, and the Mississippian Plateau. Lower Pennsylvanian conglomerates and sandstones form the cliffs and cap the ridges of the Cumberland Plateau. Upper and Middle Mississippian limestones form the Mississippian Plateau here. They are the same geologic age as the limestones in the Mammoth Cave region and contain caverns, sinkholes, sinking creeks, and springs. The rocks dip to the southeast.

Fig. 5. Relationships of position of Cumberland Falls to the Pottsville Escarpment.



a. Cumberland Falls has not always been in its present location nor can it reasonably be expected to remain unchanged in the future. It is thought to have originated on the Pottsville escarpment near Burnside and retreated upstream approximately 45 miles to its present position.



b. The path of recession of Cumberland Falls is marked by the Cumberland River gorge, in which the conglomerate bed which caps the Falls gradually descends from a hilltop position on the escarpment to the level of the Falls. In the Burnside area the undercutting originated in the shales of the Pennington formation (uppermost Mississippian) and the shales and shaly sandstones of basal Pennsylvanian age. The Falls is now maintained by differences in hardness between layers of Pennsylvanian sandstone and is a dozen miles or more upstream from the last exposed Mississippian rocks.

Fig. 6. Cumberland River valley in Cumberland Falls State Park. The river, elevation at this point about 825 feet, has cut its valley some 400 feet below the general plateau level. This view is upstream from the Falls. Kentucky Division of Publicity photograph.

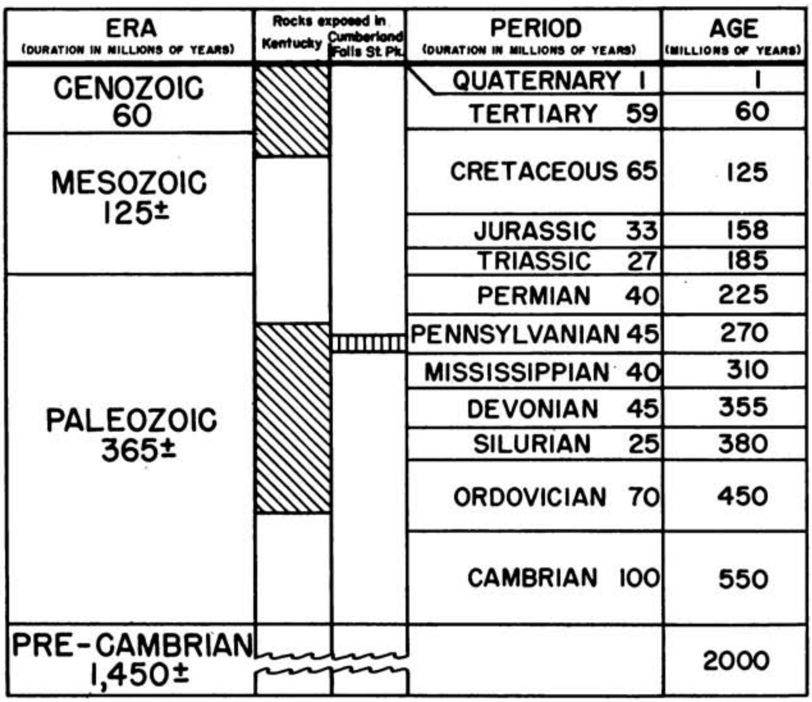


Fig. 7. Geologic calendar showing the relationship of rocks in Cumberland Falls State Park to those in other parts of Kentucky. The scenic attractions of the region have been forming during the last 25 or 30 million years (Tertiary) in rocks which are 260 to 290 million years old (early Pennsylvanian and late Mississippian).

Nature of the Rocks

The rocks in the upper Cumberland River valley belong to the Pennsylvanian period or "Coal Measures." In origin they date back about 250 to 270 million years ago. These rocks are sedimentary; that is, they were formed as sediments washed from land and spread out as great sheets either on the bottoms of the seas or upon lowlands. Owing to their mode of formation they are arranged in layers, or stratified.

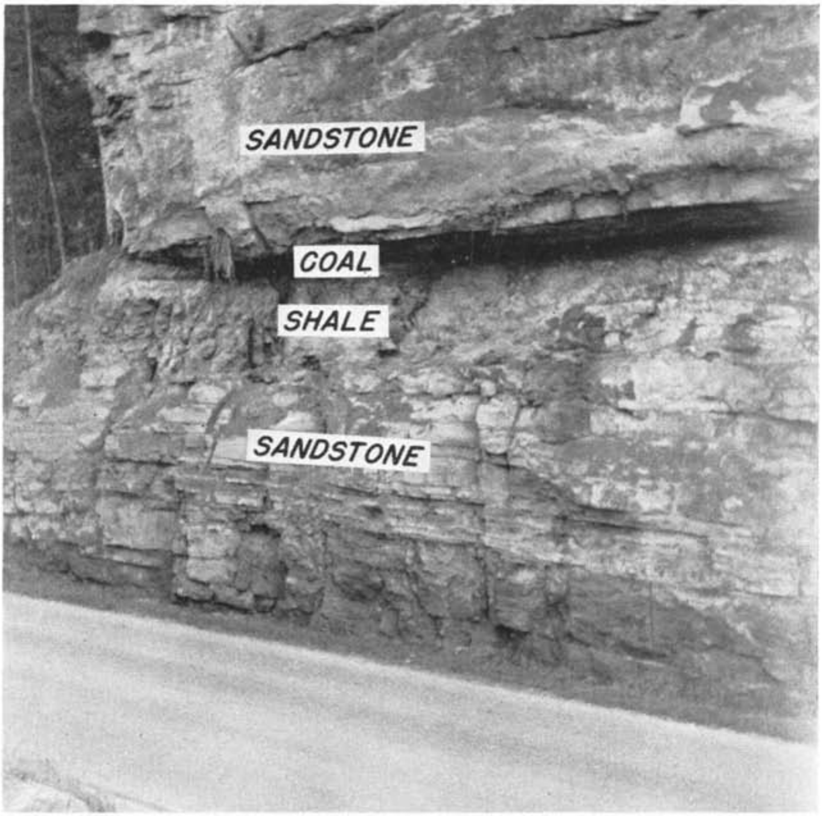


Fig. 8. Roadcut on Kentucky Highway 90 at Cumberland Falls showing the layered character of the rock formations. While the rocks appear to be horizontal, they are actually gently inclined, dipping to the southeast at an average rate of about 35 feet per mile. This, in part, explains why it is a common experience in nearly all mining and well drilling operations that any one bed of coal, limestone, or other rock layer is found at progressively lower levels to the southeast. The rocks that are exposed along Lake Cumberland at Burnside are several hundred feet beneath the surface at Cumberland Falls. Local examples of upward and downward bending of the strata are seen in the area (see fig. 9).

Fig. 9. A small anticline on Kentucky Highway 90 near Cumberland Falls. An anticline is an arch-like fold, with rocks dipping down either side from the center.

The rocks most frequently seen are *sandstones, shales, conglomerates,* and *coals.*

Sandstone: a rock made up of grains of quartz sand.

Shale: a minutely layered rock consisting of very fine clayey material (a mud rock).

Conglomerate: an accumulation of sand and rounded gravel (quartz pebbles) of an ancient delta, beach, or bar deposit now cemented into firm rock.

Coal: accumulation of altered plant remains compacted into firm, brittle rock. Coals occupy only a small percent of the total thickness of the rocks.

The Cumberland Valley coal district is one of the largest coal producing areas in Kentucky.

The conglomerates and sandstones which form the cliffs and cap the ridges in the Cumberland Falls area are a part of the Lee formation. These rocks are the oldest of the Pennsylvanian period. They are particularly conspicuous because they are resistant to erosion and stand up as bold bluffs, craggy pinnacles, and overhanging ledges. Many of the scenic features of Kentucky, including Cumberland Falls and numerous natural bridges, are formed in these sandstones and conglomerates.

Along the Pottsville Escarpment and the Mississippian Plateau immediately adjacent to it to the west, the rocks are predominantly limestones. They belong to the Mississippian period, underlie the cliff-forming conglomerates and sandstones, and are therefore older than these latter rocks. These limestone formations are of the same geologic age as those in the Mammoth Cave region.

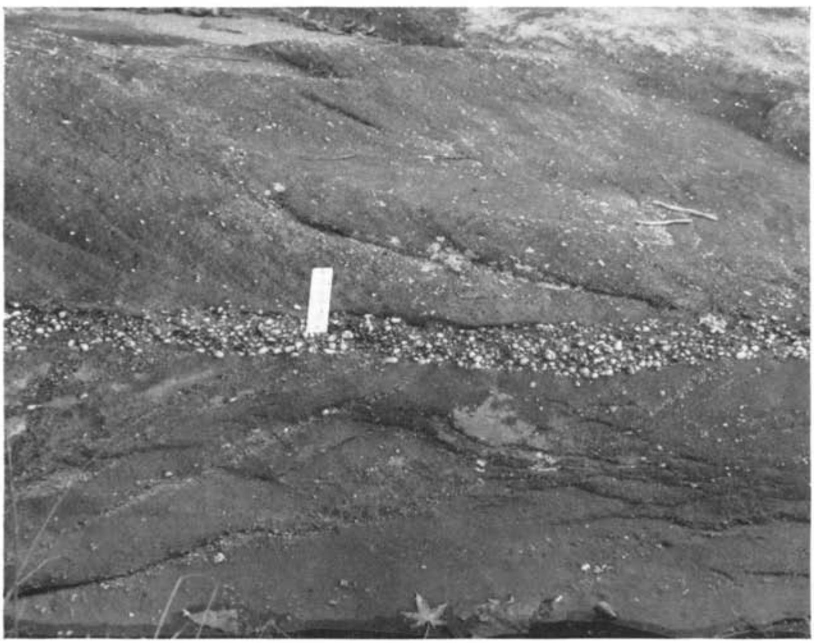


Fig. 10. A nearly flat-lying bed of conglomerate in the sandstone that forms the caprock of Cumberland Falls. This conglomerate consists of cemented sand grains and rounded quartz pebbles. Other quartz pebbles may be observed scattered at random in the sandstone or aligned in narrow parallel bands at angles with the main bed. Rocks such as this were formed as a bar or beach of gravel by strong currents or waves. Pebbles and sand carried by the streams are worn away by their impact against the bedrock and by striking against each other. The result of such wear is the production of rounded stones. In swift moving waters angular fragments are rounded before they have been carried many miles. Photo by J. W. Huddle, U. S. Geological Survey.

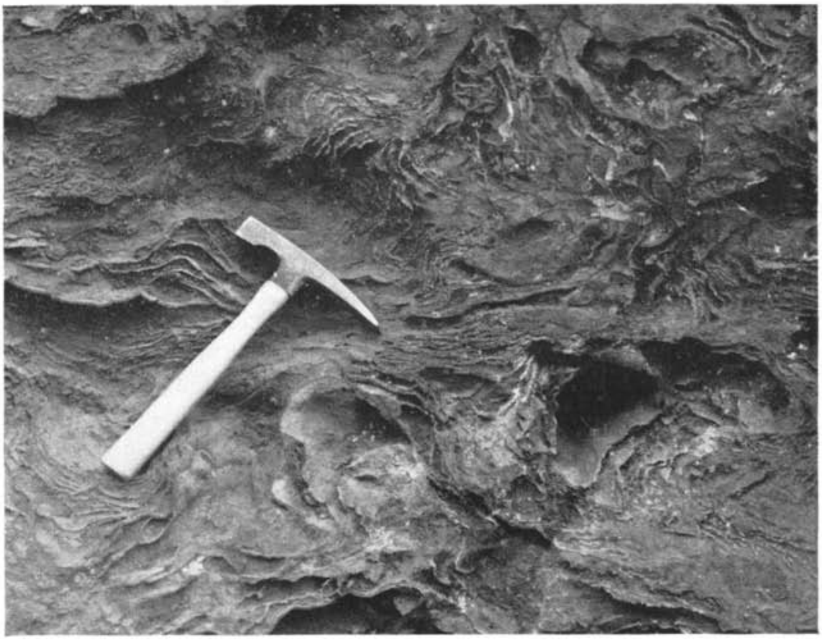


Fig. 11. Bands of limonite (iron oxide) cemented sandstones, as exposed along Kentucky Highway 90 on west side of Cumberland River. Since these bands are more resistant to weathering than the enclosing sandstone, they stand out in relief. The iron was deposited here from solution by percolating ground waters. Photo by J. W. Huddle, U. S. Geological Survey.

Further evidence of the environment under which these rocks were formed is found in the remains of organisms (fossils) preserved in them. Limestones of the Mississippian period contain fossil remains of corals, shells, and other remains of sea animals, indicating marine origin. One of the famous fossil collecting localities of Kentucky is located at the Southern Railroad cut and tunnel, road cuts, and nearby fields at Sloans Valley (Sloans Station), about 4½ miles south of Burnside, Pulaski County. Here Glen Dean limestones and shales (part of the Upper Mississippian) have yielded a great number of species. In contrast, most of the fossils of the Pennsylvanian sandstones and shales are plant remains, suggesting land and swamp environment.

The Development of the Falls

The story of Cumberland Falls is a story of water in action. Running water is the most effective and widespread agent of erosion of the Earth's surface. Waterfall excavation and sapping, lateral quarrying and undermining by streams, and pothole drilling are striking localized phases of stream erosion. Waterfalls are caused by a number of conditions, but those which come into being under conditions similar to those outlined below are common.

Fig. 12. Shale outcrop in roadcut on U. S. Highway 25 about 10 miles east of Cumberland Falls. It is in the lower part of the Breathitt formation. Shales similar to this are used for the manufacture of brick and other heavy clay products.

Stratified (layered) rocks characteristically present alterations in hardness between different beds. Softer or weaker layers of rock erode more rapidly than harder layers, and the hard layer tends to stand up above the softer one. Where the vertical interval between resistant rock layers is large a cap-rock waterfall, or merely waterfall, may form. Cumberland Falls and Niagara Falls are of this type but differ in the kind of rocks present and other details. If the interval is small, the stream will descend in a low cascades or rapids. Almost every gradation between them may be seen in the Cumberland Falls area. The following diagrams show the stages in the origin and development of Cumberland Falls.

At an early stage, the Cumberland River was a smoothly flowing stream (fig. 13a). As active down-cutting took place Cumberland River valley was formed and differences in the resistance (relative hardness) of the various rock layers became conspicuous.

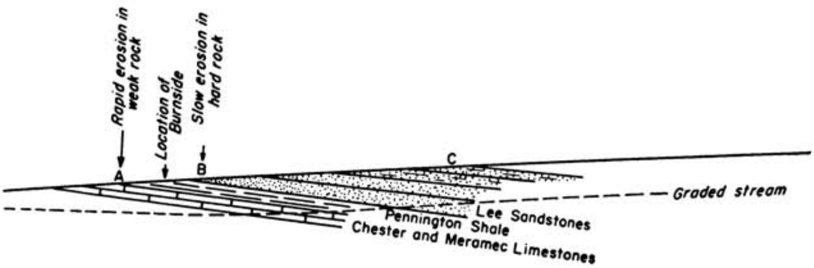


Fig. 13a. Cumberland River at an early stage.

In the upper course of the stream (C) the Pennsylvanian sandstones and shales were not unduly difficult to erode. Farther downstream (B) the Lee sandstones (lower Pennsylvanian) are harder and more massive, and eroded with difficulty. The Mississippian shales and limestones, particularly the Pennington shale of the Upper Chester (A), were easily eroded, and valley deepening proceeded rapidly.

There is a lower limit to valley deepening, a low level at which the current is slow and active downward erosion ceases. When the rocks in the stream bed have been cut down to this level the river is again a smooth flowing (graded) stream.

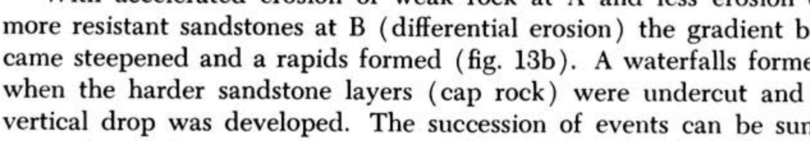


Fig. 13b. Recession of a waterfall formed by a resistant bed that dips upstream.

With accelerated erosion of weak rock at A and less erosion of more resistant sandstones at B (differential erosion) the gradient became steepened and a rapids formed (fig. 13b). A waterfalls formed when the harder sandstone layers (cap rock) were undercut and a vertical drop was developed. The succession of events can be summarized as follows:

a. A rapids developed as a result of differential erosion of rocks of varying resistances.

b. Erosion cut deeply into the less resistant Mississippian shales and limestones but not very effectively into the Lee sandstones. A falls was formed. Cumberland Falls probably attained its maximum height at this downstream location, because more of the weaker rocks were exposed and the cap rock stood higher than farther upstream.

c. Undercutting by plunging water produced an overhang. Large blocks of sandstone at the lip of the Falls, weakened by joint fractures, were undermined and broke away. In this manner the Falls receded upstream, leaving a gorge behind. There is no record of the rate of recession, but the distance involved up to the present time is about 45 miles. The rate of recession was probably greater in the early history of the Falls than it is now, because shales are more susceptible to erosive work than sandstone, the Falls was higher, and much more water poured over the Falls at the downstream locations. (Laurel and Rockcastle Rivers, two important tributaries, enter the Cumberland River between the Falls and Burnside.)

d. Since the rocks dip downward in the upstream direction of Cumberland River, the height of the Falls became less with continued recession. In this stage (d) the weaker beds are below the level of the stream bed, and as the river slowly eroded the projecting hard ledges, the Falls began to fade into a rapids again (e, f, and g).

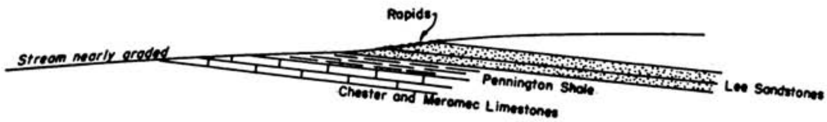


Fig. 13c. Resistant bed is eroded, leaving a rapids instead of a falls.

Falls and rapids undergo constant change, although this change is usually very slow. Cumberland River reverted to a rapids as recession of the Falls passed upstream from the outcrop of the weaker Pennington shales. Gradually the sandstones will be eroded to give again the relatively smooth, uninterrupted flow of a graded stream.

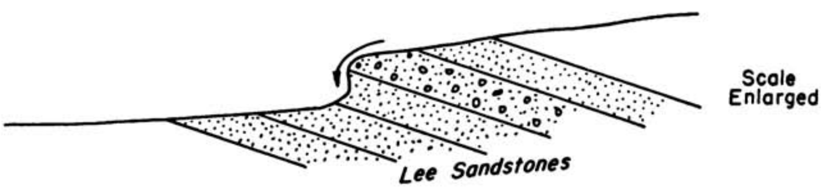


Fig. 13d. Cumberland Falls as it appears today. Vertical scale greatly exaggerated.

However, within the Lee sandstones some beds are more resistant (more massive and/or better cemented) to erosion than others. Differential erosion also occurs here; weaker beds are cut away and undermined, and a lower or smaller falls than was present downstream is maintained. This is Cumberland Falls today. The Falls will become lower and lower in the course of time until the resistant beds form mere ledges in the stream and Cumberland Falls will cease to exist. Geological changes are slow, but ultimate disappearance is the fate of waterfalls formed by a resistant bed that dips up the stream.

Fig. 14. A joint crack in sandstone of the bed of Cumberland River just above the Falls. Nearly all consolidated rocks are intersected by crevices which are essentially perpendicular to the surface. Intersecting joint systems, each of roughly parallel joints, divide rocks into rough blocks. Undermined ledges break along these lines of fractures causing some of the rockfalls. Collapse of these blocks is important in the recession of the Falls and formation of the gorge. At the Falls the most conspicuous joints are aligned roughly parallel with the valley sides. At the present time water is entering these fractures and emerges in the face of the Falls. Joints are often enlarged into open clefts in the rock. Where the rock on one side has fallen away a smooth rock wall is shown.

Cumberland Falls State Park

It has been said that waterfall sites, more than any other geologic feature, attract and hold the interest of the general public. Cumberland Falls State Park bears the name of the most striking geologic feature of the Cumberland Valley area. The principal area of the park was purchased by T. Coleman duPont, a native Kentuckian, and donated to the State. This generous gift came as a result of a long struggle by many public-spirited people to prevent industrialization of this beautiful spot.

The 1,098-acre area comprising Cumberland Falls State Park is divided almost equally between McCreary and Whitley Counties. The highest point is Pinnacle Knob, with an elevation of slightly more than 1,340 feet above sea level. The Lodge is situated on a ridge at an elevation of some 1,090 feet, more than 250 feet directly above Cumberland River.

Cumberland Falls.—Cumberland Falls is reported to be the largest falls south of Niagara Falls and east of the Rocky Mountains.

It has already been pointed out that waterfalls are most common where rocks in a stream channel are appreciably harder than those downstream. Such is the case at Cumberland Falls. The rocks here are all sandstones and conglomerates, but the unequal hardness of the various layers is responsible for the cap-rock type of falls. Cumberland River passes from resistant, well-cemented sandstone and

Fig. 15. Stream-gaging station on Cumberland River above Cumberland Falls. Records of the stream's behavior and characteristics are automatically gathered here. Knowledge of the variations in streamflow is desirable and important for practically any use of water or any water project. Published records for this point indicate variations in streamflow from a minimum of 8.5 cubic feet per second to a maximum of 59,600 cubic feet per second. This stream-gaging station is the oldest station now in operation in Kentucky.

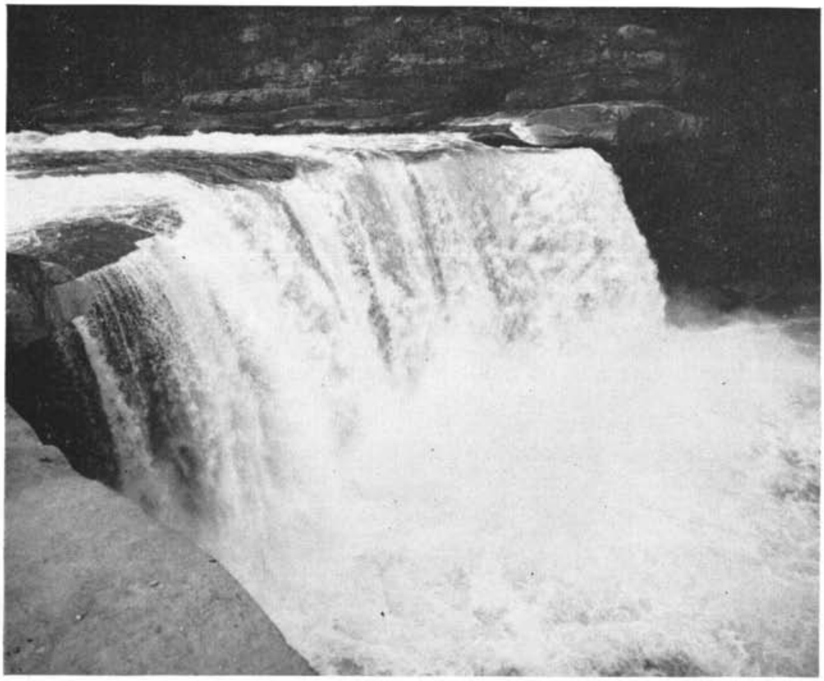


Fig. 16. Cumberland Falls. Millions of gallons of water pouring over a ledge of resistant sandstone has produced one of the outstanding scenic attractions in Kentucky. The foaming cataract produces the mist which is a requisite for the picturesque rainbow seen during the morning hours and the famed moonbow which is frequently visible on bright moonlight nights.

conglomerate beds to soft sandstone layers below, eroding the softer strata and leaving the harder ledge in its present position.

The drop from the lowest lip of the Falls to the river below is 55 feet. The top ledge of the Falls, from which water plunges when the river is at a high stage, is 10 feet or more higher, making a total drop, during certain seasons, of more than 65 feet.

A great amount of erosion also takes place at the foot of a falls. The impact of the plunging water, together with its sediment and rock load, has a great erosive force which has carved out a large depression in the stream bed called a *plunge basin* or a *plunge pool.* The swirling water, using rock fragments as tools of erosion, both enlarges the basin and undercuts the face of a falls.

Probably the most publicized feature associated with Cumberland Falls is the "moonbow." Visible only on bright moonlight nights, the phenomenon is reported to be quite rare. As water plunges over the Falls a mist rises from the basin below and slowly floats down the gorge. Bright moonlight falling on the mist produces an effect similar to a rainbow. The colors, however, are not as vivid. At low stages of the flow the stream may not yield sufficient mist to produce a "bow." When a breeze is blowing upstream at the Falls, it lifts the mist, giving the moisture a better opportunity to be intersected by light rays.

Relatively unpublicized and unappreciated is the rainbow which is frequently visible at the foot of Cumberland Falls during the morning. Here again, the amount of light and water and direction of the wind affect the size, shape, and brilliance of the rainbow. On a bright, sunny morning the rainbow arched against the foaming cataract produces a very colorful scene, indeed.

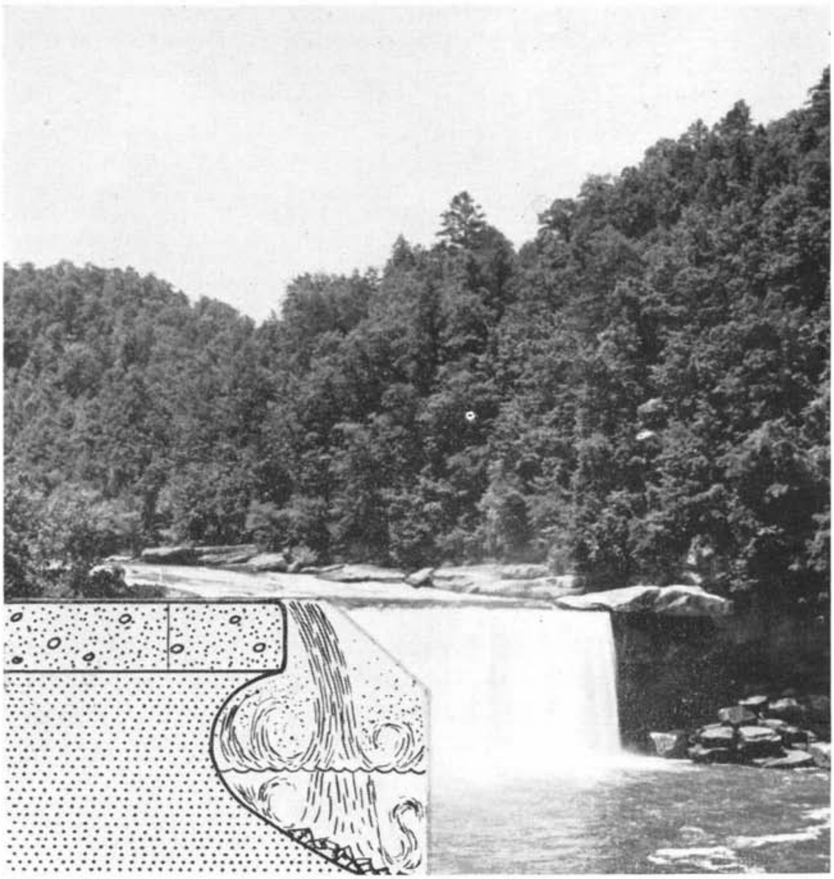


Fig. 17. Relation of Cumberland River to bedrock at the Falls. Cumberland River passes from resistant, well-cemented sandstone and conglomerate beds to soft sandstone layers under the hard cap rock. With more rapid erosion of the softer layers the hard upper layer or cap rock will be undermined. If such undermining proceeds to a joint plane or other zones of weakness that intersect the hard layer, a block of the cap rock, deprived of its support, will break out and fall into the gorge below. Thus the valley is widened or the Falls retreats upstream. The over-deepened part of the stream bed immediately below the Falls is the plunge basin.

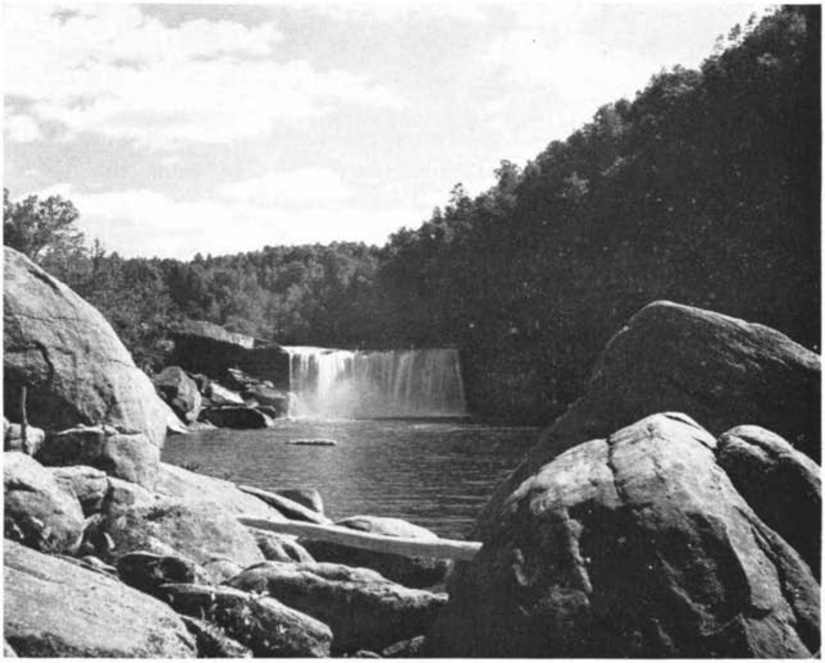


Fig. 18. Cumberland Falls and Cumberland River gorge. The large, pebble-studded sandstone boulders mark the upstream retreat of the Falls. They are the broken off parts of the resistant ledge which caps the Falls and borders the edge of the gorge. It is thought that the Falls originated on the Pottsville escarpment some 45 miles downstream. Kentucky Division of Publicity photograph.

Cumberland River Gorge.—Gorges are formed where the downcutting of a stream greatly exceeds the weathering back of the side walls. Conditions favoring the formation of such valleys include rock capable of maintaining a steep face, and also a rapidly cutting stream. These conditions exist in the Cumberland Valley as the rock forming the Falls outcrops in the valley walls, and the gorge below the Falls is one of the scenic and spectacular features of the region. Tributary valleys entering the gorge form small waterfalls as they encounter this same resistant ledge.

Eagle Falls.—A little-known feature of the State Park is picturesque Eagle Falls. Situated on Eagle Creek near its junction with Cumberland River, some 600 yards downstream from Cumberland Falls, it is virtually hidden in a narrow, wooded ravine. Waters from Eagle Creek and its tributaries descend the sharp valley over a series of low falls and cascades and plunge over a hard, sandstone ledge, studded with quartz pebbles, to a plunge basin 44 feet below. From here Eagle Creek flows down a boulder-filled channel to join Cumberland River 150 feet beyond. Conspicuous joint cracks are developed in the cap rock parallel to the face of the little falls and will be points of weakness as the softer beds beneath are eroded and the cap rock is undermined. A small pothole has developed in the overhanging lip of the falls and has penetrated the entire thickness of this ledge. Eagle Falls developed as a result of the rapid deepening of the Cumberland Valley. As Cumberland Falls retreated past the mouth of the tributary stream, the latter was left as a hanging valley with a falls at the stream junction. Thus, although the rocks forming Eagle Falls are the same ledges which are found at Cumberland Falls, Eagle Falls is, geologically, a younger feature. It is receding in the same manner as the larger falls, but the rate of recession will probably be slow because of the small amount of water involved.

Trails.—The many miles of bridle and foot trails lead to other interesting and scenic natural features. Magnificent views of the falls and gorge are common. For rugged beauty, Trails 1, 2, and 9 are outstanding. Bluffs, cliffs, and ledges of sandstone abound on all sides. Differences in hardness of rock produce overhanging ledges and rock shelters. The term "rockhouse" is applied locally to any

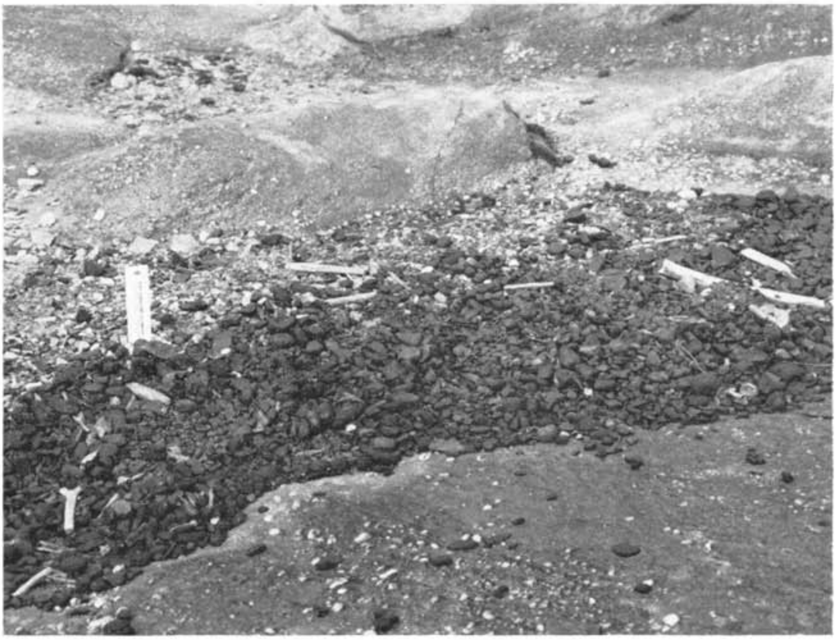


Fig. 19. A small and peculiar gravel bar in the channel of Cumberland River a short distance upstream from the Falls. It is unique in that the gravels consist of coal pebbles instead of the quartz, chert, and other hard rocks usually associated with such stream deposits. Since coal is rather soft and brittle, the distance of travel probably has been short. Photo by J. W. Huddle, U. S. Geological Survey.

Fig. 20. Potholes in the sandstone capping Cumberland Falls. These depressions are the result of differential erosion, originating at a point of localized weakness in the stream bed. As they grew larger, pebbles too large for the current to move out of the low spots became trapped here. Running water swirls around and keeps such pebbles in action, and as such they are grinding tools that enlarge and deepen the potholes. Photo by J. W. Huddle, U. S. Geological Survey.

such conspicuously hanging body of rock, sufficiently extensive to provide shelter for man or beast.

Large, angular blocks of sandstone are also common features along the hillsides. They represent masses of stone which have been weakened by undermining, thus leading to their eventual collapse. From the size and shape of the blocks it is often possible to locate the place on the cliff from which they fell.

Along the base of the bluffs near the river there are occasional small springs. Ground water percolating downward through the porous sandstone is concentrated along joint fractures and emerges as a seep or small spring. They vary in flow, depending upon the season and the amount of rainfall.

Some of the trails lead to lookouts in the uplands. From these points one can see for miles in almost any direction. Ridge after ridge, each capped with the same massive sandstones, may be seen on a clear day. However, when viewed from this perspective, it is noted that all ridge tops are about the same elevation, thus giving a plateau or tableland effect. From the fire tower on Pinnacle Knob one can see a smokestack at Stearns, some 14 miles southwest of this point.

Some of the sandstones that have been sculptured by geologic processes to produce the scenic attractions have been quarried for construction purposes. Foundations, walls, steps, and some trim of duPont Lodge are built of native sandstone. The new bridge across the Cumberland River, just above the Falls, is faced with the same type of rock.

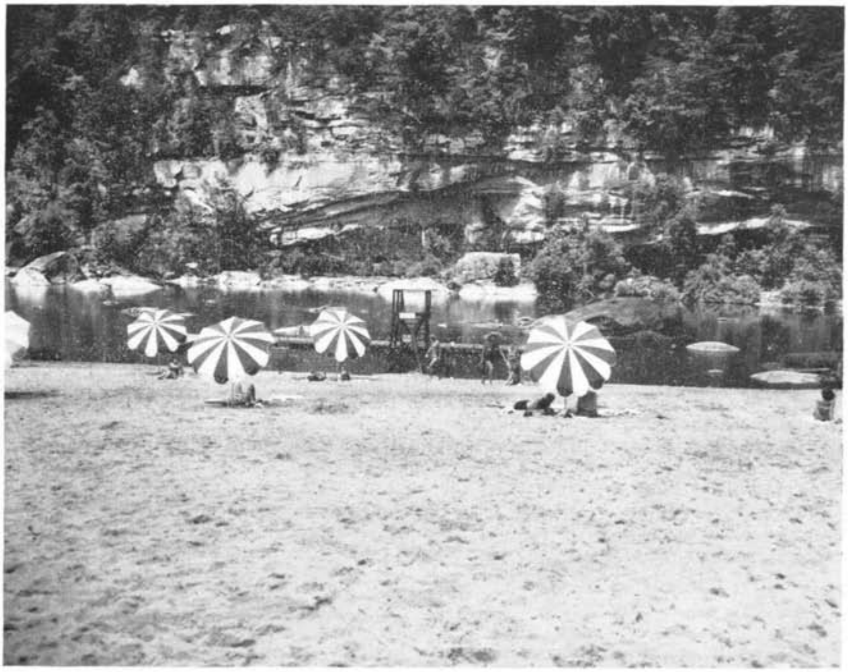


Fig. 21. The Cumberland River, in flowing down the narrow gorge, has dropped some of its load. One conspicuous example is the natural sand beach below the Falls, which has been developed as a recreation facility. This deposit of sand has been built on the inside of a curve in the stream where the rate of flow is less, and, consequently, the carrying power of the stream is also less. The source of the beach sand is the disintegrated sandstone ledges upstream. There are other alluvial deposits farther downstream, but most of the material is hidden by a cover of soil and vegetation. The rock shelter at the foot of the bluff on the opposite side of the river is the result of differential weathering and undercutting by the more swiftly moving water on the outside of the curve. Kentucky Division of Publicity photograph.

Outstanding Features in the Adjacent Area

The Cumberland National Forest area in the vicinity of Cumberland Falls State Park contains other scenic features of geologic in-

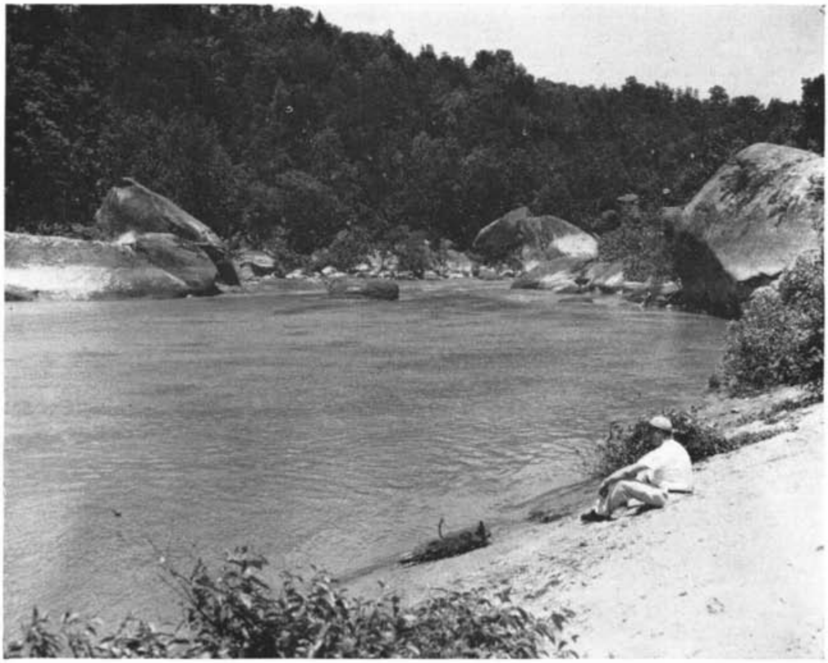


Fig. 22. Downstream view of Cumberland River gorge, a short distance below the Falls. Great fallen blocks of pebbly sandstone mark the upstream path of the retreating Falls. In places the channel of the river appears to be almost choked by these masses of fallen rock, some weighing hundreds of tons. They are elephantine in size and shape, appearing from a distance to be the backs of great animals partly submerged in the water. These boulders are too large to be moved by the force of the stream itself, but the rock debris carried by the water is an effective agent in knocking off rough edges, smoothing corners of angular blocks, and "streamlining" the rocks with which it comes in contact. Kentucky Division of Publicity photograph.

terest. Some are easily accessible but not very well-known because little has been written about them.

Natural bridges.–Several well-developed natural arches or bridges are known. The geologic setting and conditions under which they developed are quite similar to those in the Natural Bridge State Park area, less than 100 miles to the northeast. (For an excellent discussion of the origin and development of natural bridges in Kentucky the reader's attention is invited to the report of Dr. A. C. McFarlan, 1954, entitled "Geology of the Natural Bridge State Park Area.")

McCreary Natural Bridge, also called "McCreary County Bridge" and "Natural Arch," is one of the most striking and spectacular of Kentucky's many natural bridges and is an outstanding example of this type of natural feature. It is located southwest of Parkers Lake, 1.7 miles west of U. S. Highway 27 on Kentucky Highway 927. Ample parking space is available. A well-marked trail leads from the parking area. After walking a few hundred feet, the visitor pauses at a lookout for his first view of the arch about a quarter of a mile away. Deeply cut valleys, precipitous sandstone cliffs, and craggy pinnacles add to the picturesque vista. From here the trail leads down a flume-like pathway with steps hewn out of sandstone, past bluffs of crossbedded and honeycombed sandstone and conglomerate, to the arch itself. The span, 65 feet across at the base and 45 feet to the base of the arch, is in massive, crossbedded, honeycombed, jointed conglomerate and sandstone, and is the Natural Bridge of Kentucky type. The major joint fractures are parallel to the length of the span and played an important part in its development.

"Moonshiner's" or Sandgap Arch, a receding-waterfall type of natural bridge, is located just north of Kentucky Highway 90, about 3 miles east of duPont Lodge. The span, 10 to 12 feet high and 36 feet wide, is split in the middle by a joint opening, producing a double arch effect. Honeycombed weathering and iron-cemented sandstone standing out in relief give an intricate pattern to the surface of the rock.

Fig. 23. McCreary Natural Bridge, as seen from the south. The bridge is in a massive sandstone and is similar in character and origin to many of the arches in the Natural Bridge State Park area. The rock is probably the same stratum which forms Cumberland Falls.

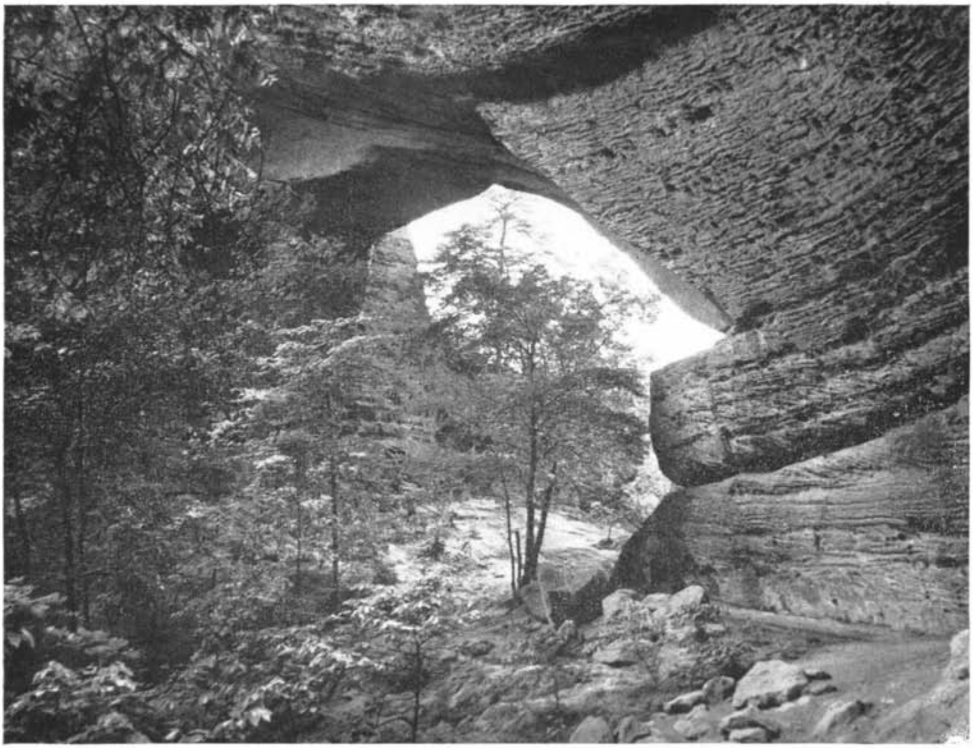


Fig. 24. Closeup of McCreary Natural Bridge, from the north side. The arch is 65 feet wide and 45 feet high. Weathering has etched out delicate features in the rock surface, emphasizing the crossbedded character of the rock and producing a honeycombed appearance. Crossbedded strata, as seen on this arch, were produced wherever sediment was moved by currents in such a way that it spilled over the front edge of a growing deposit as at the forward or foreset edge of a delta. Since the foreset beds invariably slope downstream, the direction of the currents that formed the crossbedded deposits can be determined. Kentucky Division of Publicity photograph.

Caves, springs, and associated features.—In front of the Pottsville escarpment, and reaching a short distance up the main forks of the Cumberland River from Burnside, is a limestone plain 150 to 250 feet above the river itself. (Elevations are computed on the river level prior to the formation of Lake Cumberland.) Geologic conditions similar to those found along Green River in the Mammoth Cave region exist here. The limestones are the same; they differ only in that they are thinner. This is a sinkhole plain in which the main drainage is through underground routes. There are sinking creeks, streamless valleys, springs, caverns, and other features usually associated with such limestone terrains.

Fig. 25. "Moonshiner's" or Sandgap Arch in Cumberland National Forest near Cumberland Falls State Park. It is a receding-waterfall type of natural bridge. The span is split in the middle by a joint opening, producing a double arch effect. Photo by J. W. Huddle, U. S. Geological Survey.

Fig. 26. DuPont Lodge in Cumberland Falls State Park. Steps, walls, and trim are constructed from Pennsylvanian sandstones quarried in McCreary County, nearly 18 miles west of the Park. Stone from the same quarry was used as facing on the new bridge which spans Cumberland River in the Park. Kentucky Division of Publicity photograph.

Fig. 27. Sandstone quarry located on Kentucky Highway 927, about 3 miles southwest of Parkers Lake, McCreary County. The stone is removed in slabs ranging in thickness from 3 to 8 inches. Minute shale partings between the layers of sandstone facilitates quarrying. Stone from this quarry has been used for construction at duPont Lodge. Cumberland River bridge, and schoolhouses at Monticello, Whitley City, Parkers Lake, Pine Knot, and other communities. It is thought to be lower Breathitt in age, and thus lies above the layers forming the Falls.

Mill Springs, about half way between Burnside and Monticello, is a large spring which is thought to collect drainage from miles away. It once furnished power for grinding grain. Within 2 miles upstream from this spring are several other large, high-level springs.

Cumberland Cavern (also referred to as Crystal Cave) was once a commercial cave located near Sloans Valley. It is the downstream portion of the more extensive Sloans Valley cavern system which is developed under a streamless, sinkhole valley. Impounded waters of Lake Cumberland have inundated the lower passages of this cavern system, and it is no longer operated as a tourist attraction. Other caves of various sizes and descriptions have also been reported in this limestone belt.

Fig. 28. Stalactites, stalagmites, and other decorative cave deposits in a high-level room of the extensive Sloans Valley cavern system in southern Pulaski County, Kentucky. This room is not a part of the formerly commercialized section known as Cumberland Cavern. Many of the passages have been flooded by Lake Cumberland and are not accessible. The cavern is developed in Mississippian limestones at the edge of the Pottsville escarpment. They are the same geologic age as the limestones in the Mammoth Cave region. The stalactites and draperies are concentrated along bedding planes. Photo by C. A. Malott.

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