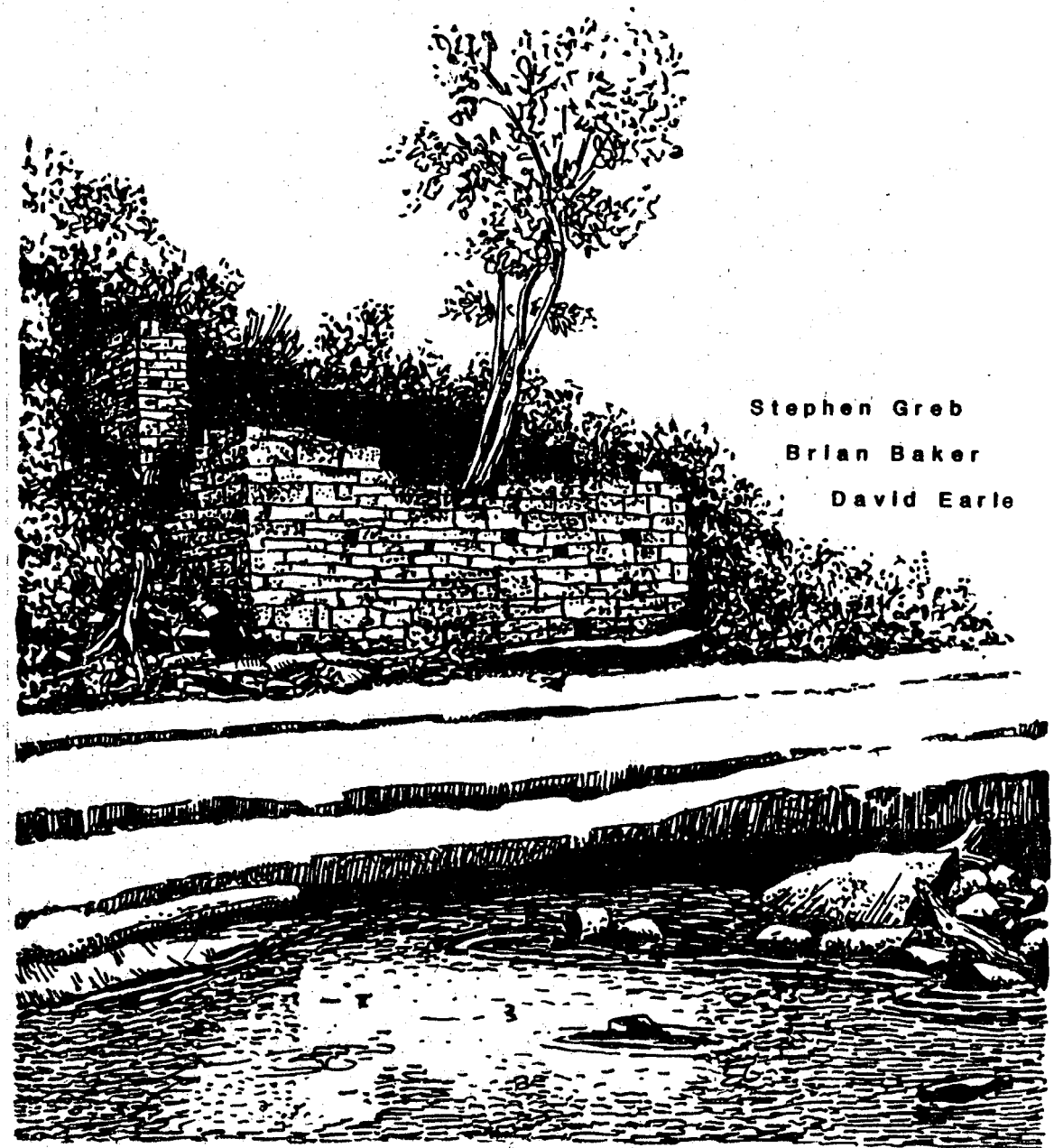
GEOLOGY
OF THE
RAVEN RUN
NATURE SANCTUARY



Stephen Greb

Brian Baker

David Earle

completed March, 1985

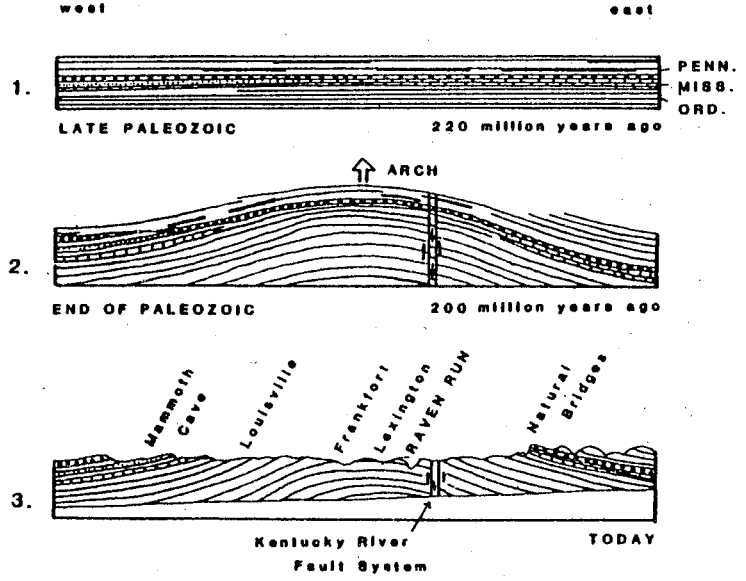
Cover Picture: The stone foundation of Evans' mill.

GEOLOGY OF RAVEN RUN NATURE SANCTUARY

Introduction to the trail guide

Geology is the science of the earth and those who study geology are called geologists. Part of a geologist's job is to determine how the rocks we see today in quarrys, roadcuts, parks, and other areas, were originally formed.

Raven Run Nature Sanctuary is located on the eastern edge of the Bluegrass region in central Kentucky. This region is a broad, oval platform that geologists call the Jessamine Dome. The Jessamine Dome is part of an even larger feature called the Cincinnati Arch. Figure 1 shows how millions of years ago the sediments in central Kentucky were raised relative to eastern and western Kentucky. The area that was relatively uplifted is called an arch. The areas that



REGIONAL EVOLUTION of the CINCINNATI ARCH

CENTRAL KENTUCKY

fig. 1

were relatively downdropped on either side of the arch are called basins. After the arch was formed erosion removed great quantities of rocks and sediments form the arch. This left older rocks exposed on top the arch and younger rocks exposed in the basins. Since Raven Run is located near the top of the arch, some of the oldest exposed rocks in the state are found here.

Most of the rocks you can see in the park are called carbonates. These types of rocks are predominantly made-up of the mineral calcite. Carbonates are formed in warm, shallow seas,often or in part from the remains of small sea creatures. When these remains are preserved they are called fossils.

Figure 2 shows how geologists subdivide the carbonate rocks in the park. The lower and therefore older carbonates are called the High Bridge Group. The group is divided into three formations. Formations are used to classify rocks that are similar and can be mapped over large areas. At Raven Run, the High Bridge Group consists of the Camp Nelson Limeston Formation, the Oregon Formation and the Tyrone Limestone Formation. The upper and therefore younger carbonates are part of the Lexington Limestone Formation. The Lexington Limestone Formation can be further subdivided into specific members. Members are simply a more detailed classification. Three of the lower members of the Lexington Limestone are present in the park. These are the Curdsville Member, the Grier Member and the Tanglewood Member. The members of the Lexington Limestone Formation are generally buried beneath the soil on the upper slopes and ridgetops of the park. However, the formations of the High Bridge Group are spectacularly exposed in the gorges and along the trails of Raven Run..

The carbonate rocks that make up these formations were formed in a shallow sea that covered much of the eastern United States over 460 million years ago. This time was part of what geologists call the Ordovician period. During the Ordovician period the Raven Run area probably looked like the tidal flats and shallow seas of the Bahama Islands today. However, many of the creatures that lived in this Ordovician sea were very different

GEOLOGIC TIME CHART

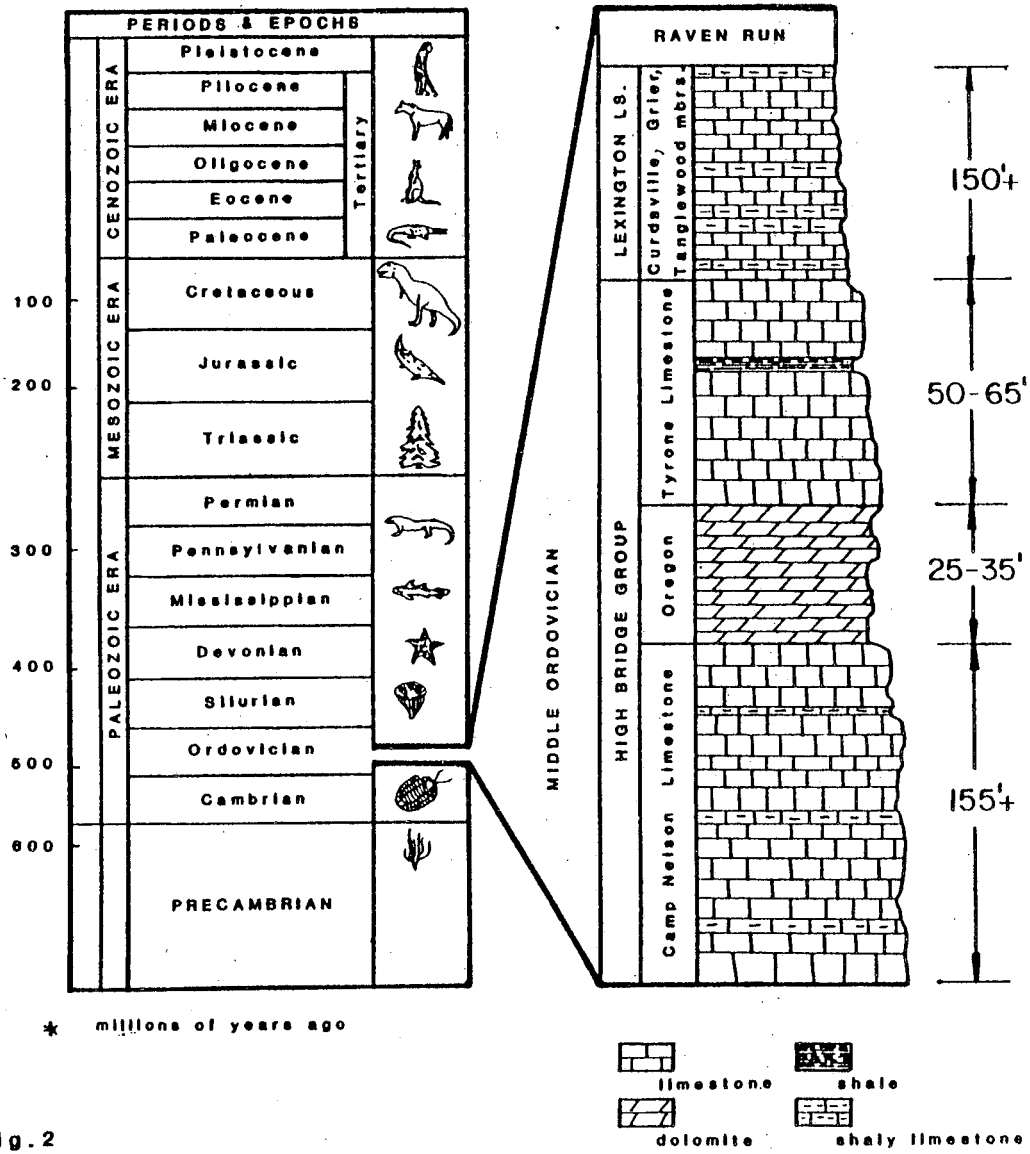


fig. 2

from the creatures we see today. Figure 3 is a illustration of what the Ordovician seas of the Raven Run area might have looked like 460 million years ago. In those seas were squid-like creatures with shells called cephalopods, strange cousins of the horseshoe crab called trilobites, creatures that resembled underwater flowers called crinoids, primitive snails called gastropods, primitive clam-like organisms called brachiopods, small coral-like creatures called bryozoans, as well as many relatives of the modern corals and marine worms.

Figure 4 is a geological map of the park. It is on page 6 of this pamphlet. Geological maps are used to show the rock formations occuring at the earth's surface. When you start out at the barn, the map indicates that the rocks right below your feet are part of the Lexington Limestone Formation. When you get down to the waterfalls at stop 4 the map indicates that you are standing on rocks which are part of the Camp Nelson Formation.

This pamphlet is a trail guide to the Raven Run Nature Sanctuary. Points of geological interest along the Red Trail are marked on the map (page 6). Brief descriptions of the points are listed in the following pages as geological stops. These stops can be seen from the designated trails as shown on the map. Walking off the trail can be very dangerous and is discouraged. Please do not remove or vandalize the rocks or fossils in the park. This park is meant to be enjoyed by everyone. Leave only footprints, take only memories.

LIFE IN THE ORDOVICIAN SEAS

460,000,000 years ago

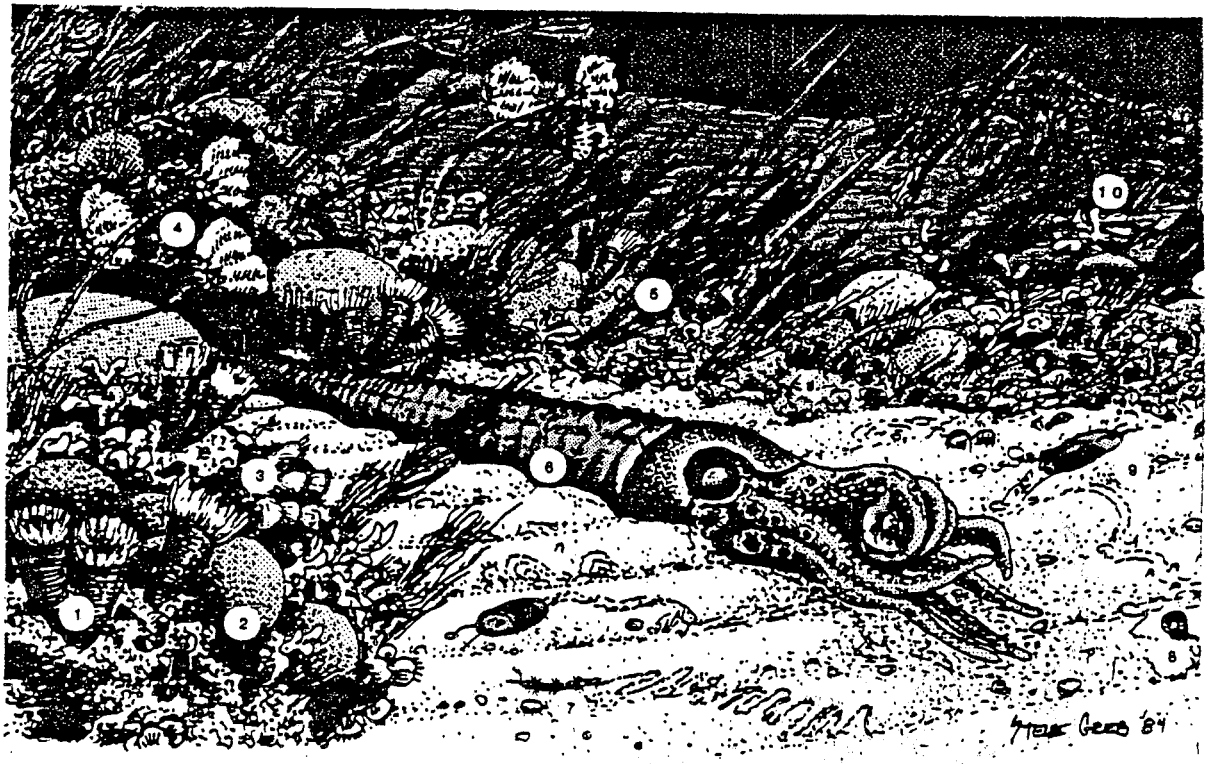


fig.3

1) horn coral
2) colonial coral
3) brachiopods
4) crinoids
5) algae
6) cephalopod
7) marine worm
8) gastropod
9) trilobite
10) bryozoan

GEOLOGIC MAP of the RAVEN RUN NATURE SANCTUARY

COLETOWN TOPO

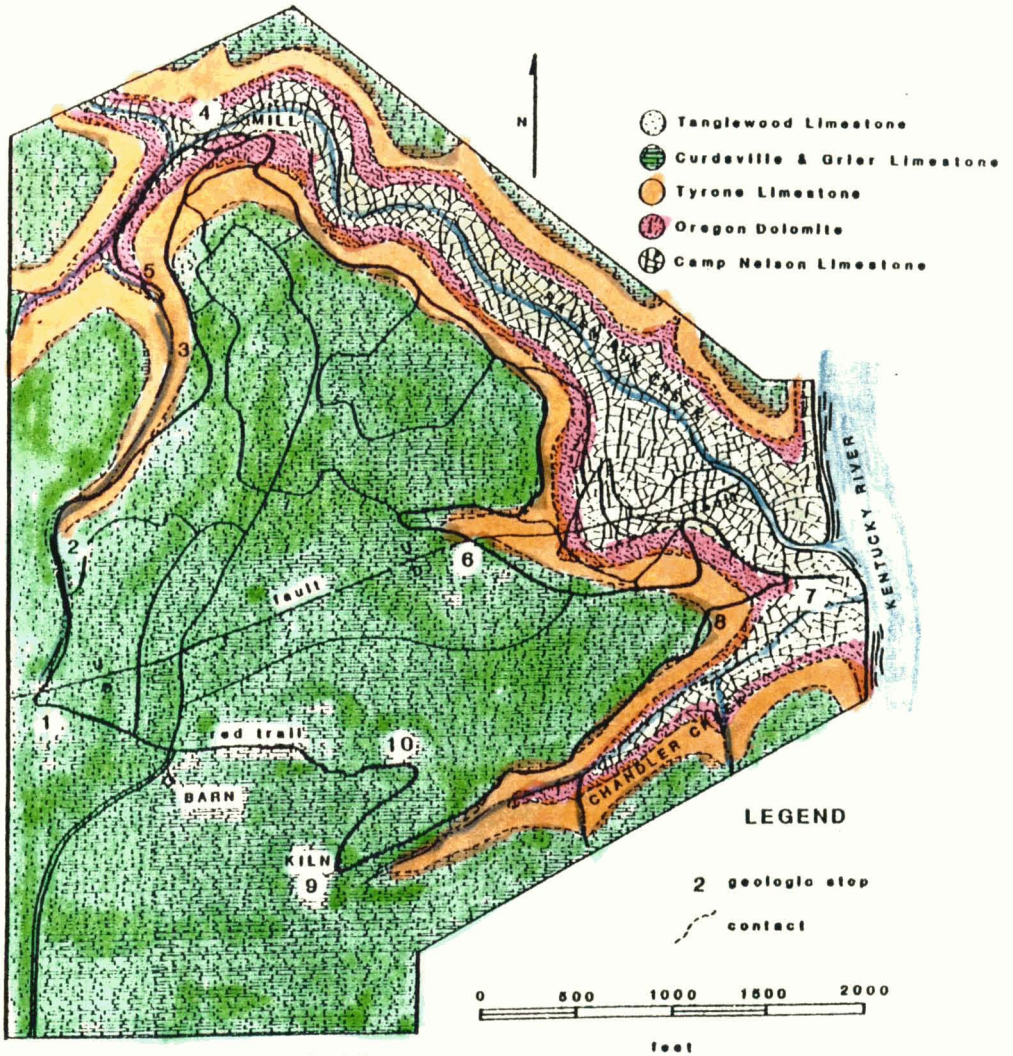


fig. 4 after Black (1967)

TRAIL GUIDE

STOP 1

As you came down the hillside on the Red Trail you were walking over the Lexington Limestone Formation. These rocks are called limestones, because they are predominantly made up of calcium carbonate or "lime". Figure 5 is a sketch of the creek at stop 1. When you look into the creek bed you can see that there are many parallel cracks in the limestone. Geologists call these straight cracks in the rocks, joints. At this stop the joints are all alligned in the same direction. At other points along the trail you may see an additional set of joints alligned approximately 80° from this set. Joints can make the rock very weak, so that it is easily broken apart. As you walk along the creek you can see how water falls have formed where rocks have broken along the joints.

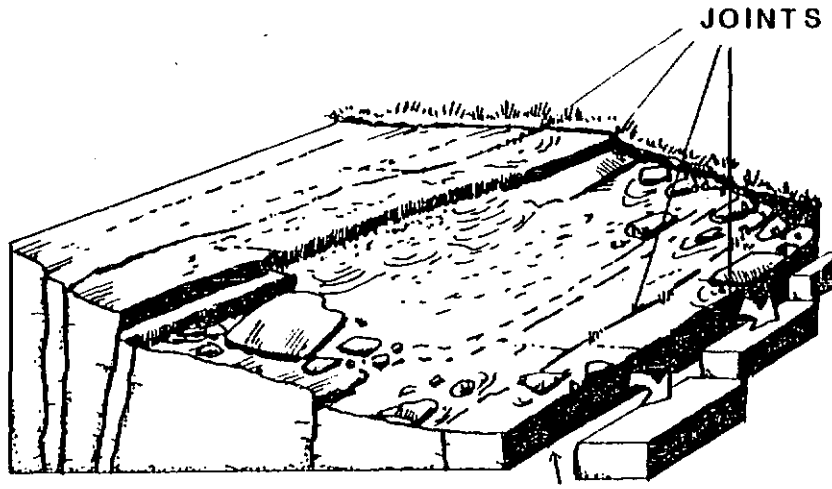
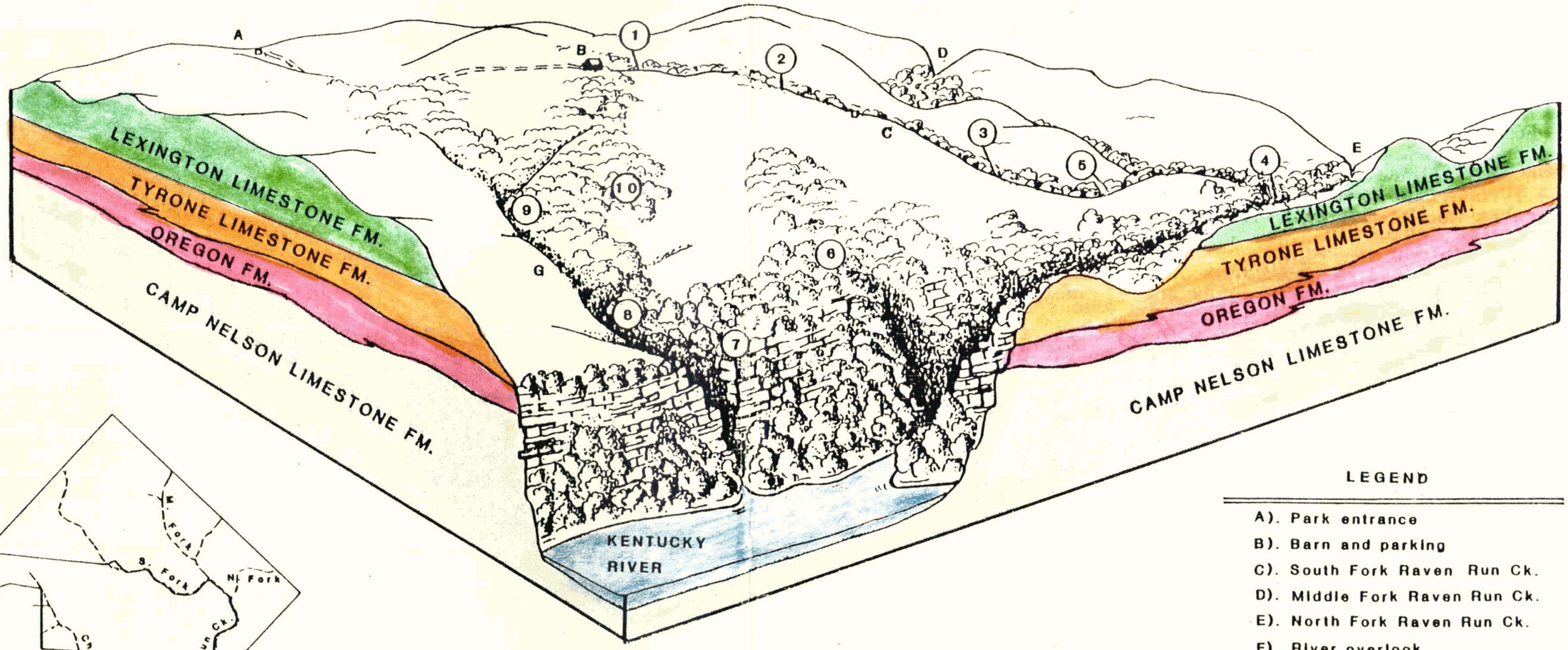
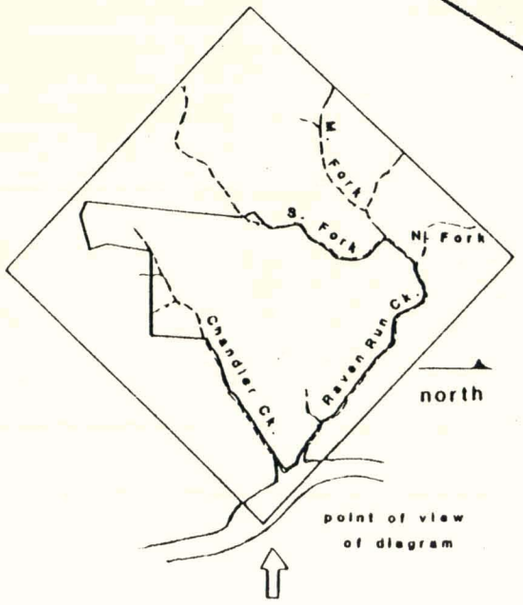


fig. 5

BLOCK DIAGRAM of the RAVEN RUN AREA





VIEW FROM ACROSS THE RIVER (east)

LEGEND

A). Park entrance
B). Barn and parking
C). South Fork Raven Run Ck.
D). Middle Fork Raven Run Ck.
E). North Fork Raven Run Ck.
F). River overlook
G). Chandler Ck.

(1) geology trail stops

STOP 2

The second stop is located 200 feet past the trail junction. If you look to your right about 20 feet up from the trail you can see a protuding ledge of rock. The ledge is made up of limestone from the Curdsville Member of the Lexington Limestone Formation. The limestone beneath the ledge is from the Tyrone Limestone Formation. When two formations meet like this, it is called a stratigraphic contact.

Note the differences between the two types of limestone. The Curdsville Limestone is very rough to the touch. and contains many fossils. The fossils are more easily seen on the underside of the ledge. On the other hand, the Tyrone Limestone is much smoother to the touch, and contains much fewer fossils.

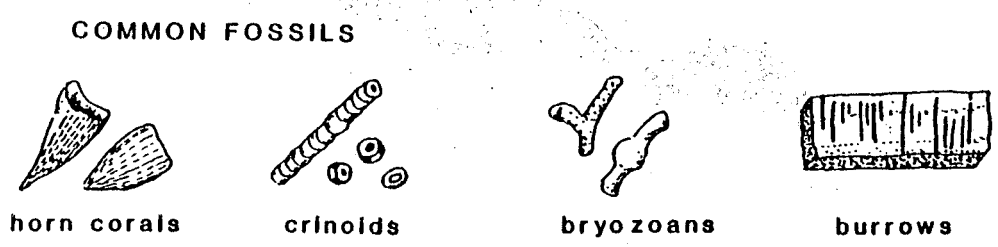
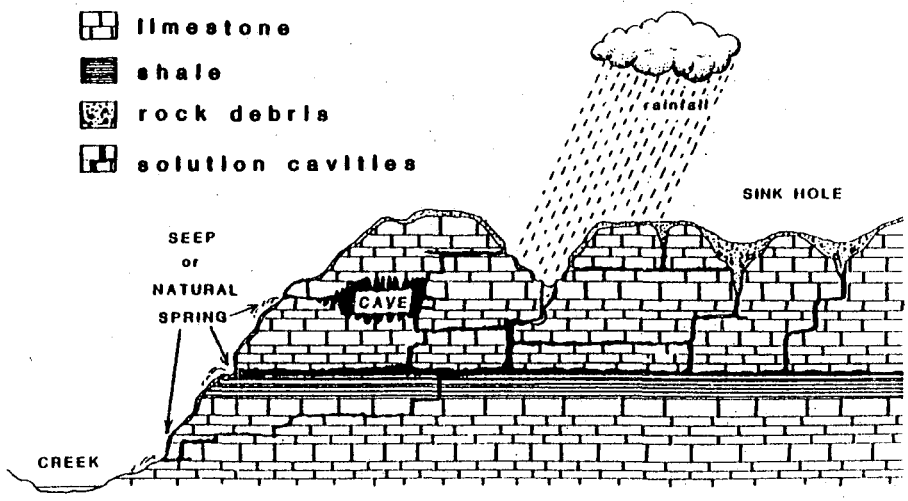


fig.6

Figure 6 shows some of the fossils you can see in the ledge rock. These fossils are the remains of creatures that lived here over 460 million years ago. Figure 6 also shows the curious straight lines that you can see in the Tyrone Limestone, beneath the ledge. They represent a different kind of fossil. While the fossils in the ledge represent the actual remains of an organism, these lines represent the tracks organisms leave behind. They were once the burrows of small worms and clams. When burrows are straight-up like these, geologists call them 'vertical burrows'. They are evidence that creatures were living in the mud on the ancient tidal flats. Apparently when the tides came in, the creatures came out of their burrows to feed. Then when the tides withdrew, they retreated back into their moist burrows so that they would not dry-out in the hot sun.

STOP 3

Water seeps out of the limestone rocks at sevral places throughout the park. When these seeps are large enough they are called natural springs. Figure 7 shows how a spring may form. Rain falling on the earth's surface seeps into the ground. As the 'groundwater' travels through the soil it becomes mildly acidic. Carbonate rocks, such as limestone can be dissolved underground by these acidic waters. Often the groundwater works it's way down joints like you saw at stop 1. As the acidic water moves underground it enlarges the joints, forming solutional cavities. Over a long period of time, large amounts of the limestone may be dissolved away, forming a cave. Another feature that may form in this situation are bowl-shaped depressions called sinkholes. All of these features; the seeps, springs, sinkholes, solution cavities, and caves are called 'karst' by geologists. They are common throughout Kentucky. In fact, Kentucky is one of the most famous karst areas in the world.



KARST FEATURES

fig.7

STOP 4

There are many things to see in this area. The rocks at the waterfalls are part of the Camp Nelson Formation. This is the oldest formation in the park. It is also the oldest exposed formation in Kentucky.

If you look at the rocks around the falls or the large boulder near the old mill you can see all sorts of twisting features that stand out on their surfaces. Geologists believe these are another kind of fossil burrow. Figure 8 shows the difference between these burrows and the burrows that can be seen in the Tyrone Formation. These fossil tracks were formed by worm-like organisms moving over or through the muds. They are known as horizontal or lateral burrows.

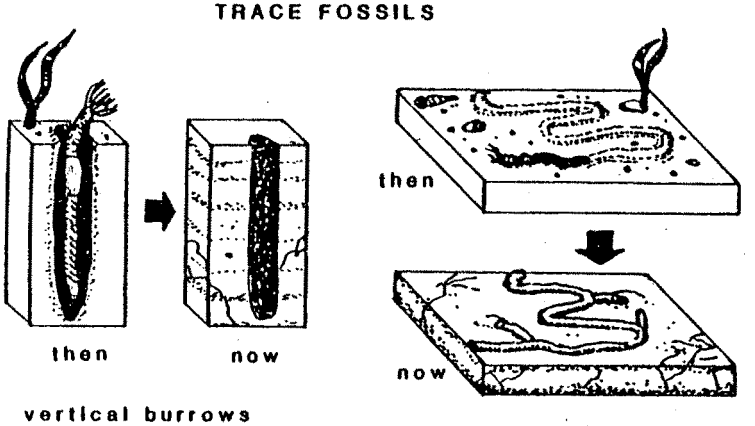
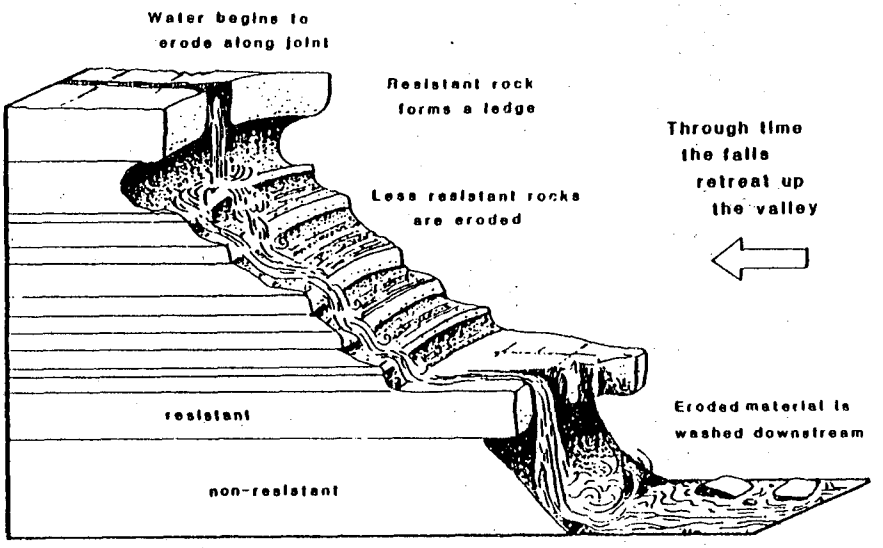


fig.8

STOP 5

A trail leads up the creek to a very large waterfall. It is much safer to stay along the creek and not climb the hillside. Figure 9 gives some idea how the waterfall was formed. The top of the waterfall is a stratigraphic contact between rocks of the Tyrone and Oregon Formations. Joints, like those you saw at stop 1, created lines of weakness in the rocks. Since, at this location, the Oregon rocks were weaker than the overlying Tyrone rocks, the Tyrone was left as a resistant ledge for the water to fall over. But even the Tyrone rocks are gradually



WHY ARE THERE WATERFALLS?

fig.9

eroded. Through time the water has eroded the canyon further back into the hillside, to the point where you see it today. Someday, thousands of years from now, the falls will retreat even further up the valley.

STOP 6

If you look at the map you can notice that the trail winds around a small valley that breaks away from the main gorge. This valley follows a large break in the surface of the earth, known as a fault. Faults differ from joints because rocks along a fault move. This type of movement is what causes an earthquake. Don't worry the fault you are walking along has not moved for millions of years. Because of all the vegetation and soil cover, the fault is difficult to see. However, many faults can be seen in the roadcuts in the Raven Run area. After leaving the park if you drive over the Kentucky River by Clays Ferry on Old Richmond Road (Route 25), or at the bridge near Camp Nelson, on Nicholasville Road (Route 27) you can see good examples of faults in the roadcuts.

STOP 7

The rock at the top of the overlook belongs to the Camp Nelson Formation. This is the same formation you saw back at stop 4. Notice that you can still see the trace fossils in the limestone rocks at your feet. Figure 10 shows a pitcure of these burrows and the other common fossils at the overlook.

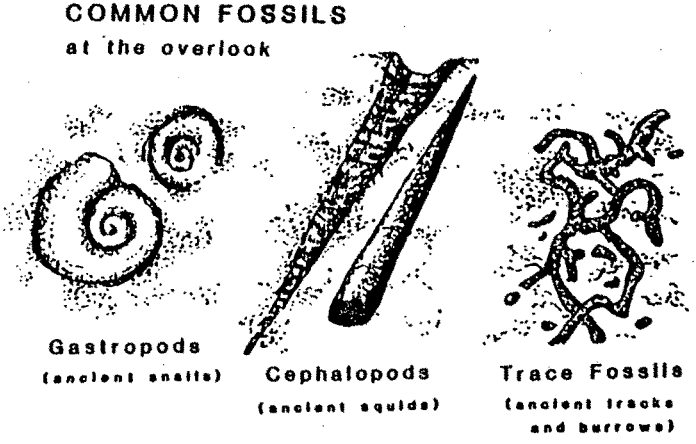


fig.10

Walk out to the overlook. The center of this pamphlet has a block diagram that shows Raven Run park as it would be seen from across the river. It also shows the rock units that are found in the park.

In many areas of the Bluegrass, the Kentucky River winds through a gentle valley. But here the river has been forced to cut through the resistant carbonates of the High Bridge Group. Because they are hard to erode the Kentucky River has had to cut a steep-sided gorge into the rocks, known as the Palisades.

Sometimes if you look at the river right below the look-out you can see a sand bar. Sand bars commonly form in river bends and at locations where another creek or river join. This sand bar is a result of sediment that has been washed out of the Raven Run gorge. Utimately these sediments, which have been formed by erosion of the rocks in the area, may end up in the Ohio River. From there it may be washed into the Mississippi River and as far as the Gulf of Mexico, over 1500 miles away!

STOP 8

As you head up the hill from the overlook you will walk through a moss-covered pass. When the trail levels out on the other side of the pass, you are back into the Tyrone Formation. The Tyrone Formation is easily recognized because of it's white color. Most of the other formations in the park are dark grey, tan or buff color.

Look for the circular mound shapes in the light colored rocks along this part of the trail. These are yet another kind of fossil. Figure 11 shows a sketch of these mounds. They represent the remains of a colonial coral called Tetradium. These corals flourished in parts of the ancient tidal flat, when the Tyrone Formation was deposited.

You can also see patterns of cracks in the limestone. These are called mudcracks. A sketch of these is also shown in figure 11. The mudcracks were formed just as they are today. In some areas when the tide withdrew, the beach area was left to dry in the sun and the muds cracked.

COLONIAL CORAL FOSSIL

ANCIENT MUDCRACKS

fig.11

STOP 9

The ruins of the structure in front of you is a limestone kiln. A kiln is like a large furnace. Years ago the settlers in this area baked the limestone rocks in this kiln to produce 'lime'. The lime was used in making mortar and plaster for construction purposes. These types of kilns are no longer important since there are now more modern methods for obtaining lime.

STOP 10

The last part of the trail follows the old stone fence. Early settlers commonly used the carbonate rocks of the area for building. They made good building material because they broke along joints and bedding planes into block-like shapes. They also were abundant and easily accessible. The kiln at stop 9 was made out of limestone from the Lexington Limestone Formation. The mill at stop 4 was made out of dolomitic limestone from the Oregon Formation. In fact, even many of the more modern buildings in the towns around the park were made from the carbonate rocks like you saw in the park today.

This trail quide was meant to give the visitor to Raven Run a brief introduction to the geology of the Bluegrass area. If you are interested in learning more about the geology of Kentucky many local libraries will be able to help you. Information may also be obtained from the state universities and the Kentucky Geological Survey.

References

The following references discuss in more detail the geology of the Raven Run area.

Black, D.F.B., Cressman, E.R., and MacQuown, W.C. Jr., (1965), "The Lexington Limestone (Middle Ordovician) of Central Kentucky"; U.S. Geol. Surv., Bulletin 1224-C, 29pp.

Black, D.F.B., 1967, "Geologic map of the Coletown Quadrangle, east-central Kentucky"; U.S. Geol. Surv., GQ-644.

Cressman, E.R., and Noger, M.C., 1976, "Tidal-flat environments in the High Bridge Group (Middle Ordovician) of Central Kentucky"; U.S. Geol. Surv., Series 10, Report of Investigations 18, 15pp.

Cressman, E.R., 1973, "Lithostratigraphy and depositional environments of the Lexington Limestone (Ordovician) of central Kentucky; U.S. Geol. Surv., Proffessional Paper 768, 61pp.

McFarlan, Arthur C., 1943, Geology of Kentucky; University of Kentucky, Lexington, KY, 531pp.

Topographic Map of the Raven Run Nature Sanctuary, Fayette County, Kentucky; scale 1"=400'.

1,958,000 E

1,962,000 E.

146,000 N.

146,000 N.

LEGEND

- PRIMARY TRAIL
- SECONDARY TRAIL
- PAVED ROAD
- DIRT OR GRAVEL ROAD
- 10 POINT OF INTEREST (see back of map)
- FORESTED AREA
- PROPERTY LINE
- B BENCH
- BUILDING

North

North Fork

South Fork

Raven Run

Chandler Creek

POWER LINES

RED LOOP TRAIL

MADISON CO.
FAYETTE CO.

KENTUCKY RIVER

Parking Area

Picnic Area

Rest Rooms

Entrance

Water

JACKS CREEK ROAD

VICINITY MAP

RAVEN RUN SANCTUARY

TATES CREEK ROAD

I-75

Jacks Creek Rd.

RAVEN RUN NATURE SANCTUARY

FAYETTE COUNTY, KENTUCKY

SCALE: 1 INCH EQUALS 400 FEET

CONTOUR INTERVAL 10 FEET

Note: The Sanctuary's property lines follow the center of South Fork, Raven Run, and Chandler Creek, unless shown otherwise.

Cartography by Terry Hounshell

Prepared by Lexington-Fayette Urban County Government, Division of Planning, in cooperation with the Division of Parks and Recreation; Department of Community Development.

140,000 N

1,958,000 E.

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THE SANCTUARY

The Raven Run Nature Sanctuary is dedicated to the preservation of the Kentucky River Palisade's natural beauty. It exists to acquaint present and future generations with the natural beauty of early Kentucky, to provide a meaningful fulfillment for leisure hours and to enhance appreciation of our natural heritage.

Within its 274 acres, one may discover more than 400 species of plants and wildflowers. Many of these may not be found anywhere else in the Southeastern United States.

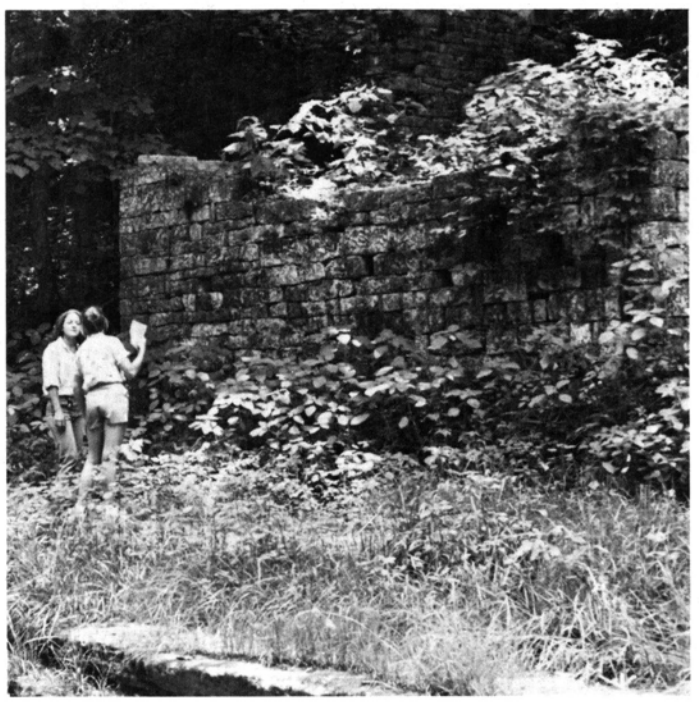
GENERAL INFORMATION

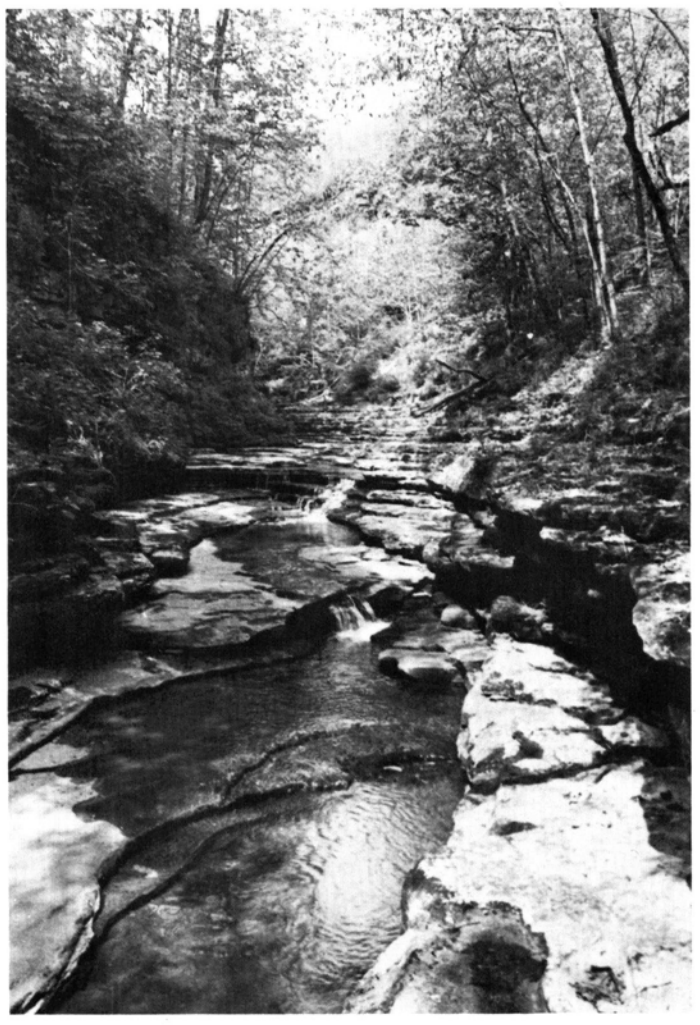
Group visits to the sanctuary are by permit only and under the supervision of the Division of Parks and Recreation. Information about group permits and seasonal park hours (they vary), may be obtained by calling the Division of Parks and Recreation at 255-0835. Guided nature tours of the sanctuary take place from time to time and are announced in the local newspapers.

SANCTUARY REGULATIONS

The following guidelines and regulations have been set up for your safety, as well as the protection of the natural and historical features of the sanctuary.

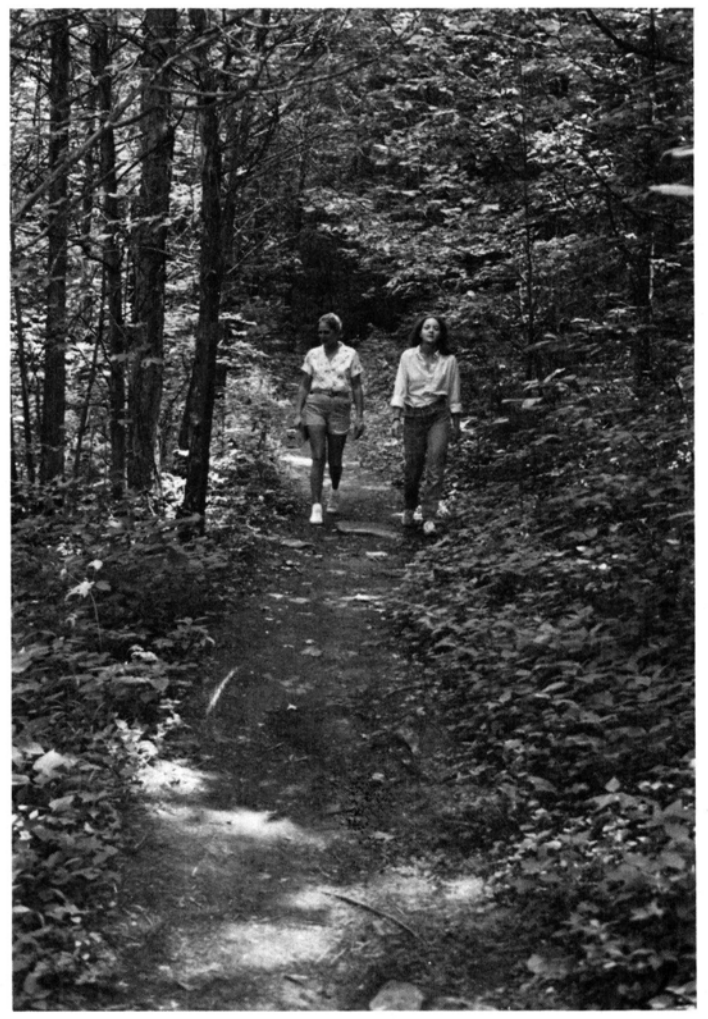
1. The following are prohibited within the sanctuary:
   - (a) Fires of any sort - no cooking, barbecuing, etc.
   - (b) Camping - day or overnight
   - (c) Firearms or weapons of any sort
   - (d) Alcoholic beverages
   - (e) Pets - leashed or unleashed
   - (f) Collection, destruction, defacement of plant parts, wildlife, rocks, or anything else within the sanctuary
   - (g) Rock or tree climbing
   - (h) Horses
   - (i) Motorcycles or bicycles
2. Guidelines:
   - (a) Don't hike alone. Let someone know of your hiking plans.
   - (b) For your own safety and to protect the beauty of the park, stay on the marked trails.
   - (c) Avoid clifftops, wild animals, and unknown vegetation.
   - (d) Trash and litter not only detracts from the natural beauty of the park, it can represent a health hazard. Please carry out your trash.
   - (e) If you become disoriented, don't cross any major flowing stream-these are the park's boundaries. Stay on the trail and walk in an uphill direction to the unforested area on the ridgetop.





Photography by James R. Rebmann

PLEASE HELP PRESERVE THIS SANCTUARY



PATHS OF PIONEER KENTUCKY SETTLERS

More than seven miles of trail make up the trail network within the sanctuary. Much of this system follows along the paths once used by early settlers. Their way of life is evidenced by the artifacts that remain. Along the Red Trail, many artifacts and areas of interest may be observed.

1. **Archibald Moore Grave**
   Archibald Moore, born November 25, 1810, was buried in the front yard of his log cabin homestead on February 9, 1871. His homestead consisted of 12 acres bordering the South Fork of Raven Run Creek.
2. **Archibald Spring**
   Natural springs often dictated where the pioneers built their homesteads. Moore's cabin was located above and less than 200 feet from this spring.
3. **Farm Lane**
   This farm lane gave access to Evans' Mill Road and thus to roads permitting travel to Lexington and other nearby towns.
4. **Water Gate**
   Spring flood waters often destroyed fences built across creekbeds. To remedy this problem, the pioneers constructed water gates. Pressure exerted by the flood waters would force the gates to open thus permitting the water to flow underneath. Gates would remain shut during the dry seasons. The gate, upstream to the left, was hinged to a log that rested upon two stone pillars.
5. **Evans Mill Road**
   In 1830, pioneer Evans secured the approval of the County Commissioners to build a road between the old Richmond and Jack's Creek roads. This road came down the North Fork at Raven Run Creek, passed by the Mill and then crossed the South Fork at this marker.
6. **Property Line Markers**
   Property line markers were important to the first homesteaders because physical features of the land surface were often difficult to describe. The center of a stream bed often acted as a property line.
7. **Wayside Spring**
   Since most traveling was by horseback, wayside springs were essential.
8. **Pioneer Evans Homestead**
   The Evans log cabin was located above the Red Trail near an excellent spring. Evans operated a mill on the forks of Raven Run Creek.
9. **The Mill Path**
   Evans traveled this path from his home to the mill. Other pioneers also used this path to transport grain to Evans' Mill.
10. **Evans' Mill**
    Built in 1820, Evans' Mill was typical of those located along creeks cutting through the Kentucky River Palisades. Until the advent of steam power, creeks provided the energy needed to operate mills. Today the stone foundation is all that remains at this mill.
11. **The Mill Pond**
    Because creek flow was unpredictable, the pioneers would dam up an area adjacent to their mills. The pond that was created ensured a constant supply of water to turn the mill wheel.
12. **Pioneer Road to the River**
    Creeks cutting through the Palisade wall gave upland farmers access to the Kentucky River. Farm goods such as tobacco, corn, and hams were moved down trails and streambeds to waiting rafts on the Kentucky River. Some goods were shipped to ports as far away as New Orleans.
13. **Kentucky River Overlook**
    The Kentucky River bed is more than 100 feet below this point. This cliff and those to the south (at left) are excellent examples of the Kentucky river Palisades.
14. **Lime Kiln**
    Lime kilns used intense heat from wood fires to break limestone down into lime.
15. **Rock Fence**
    The pioneer farmers used field rock to build property line markers of fences. Fence construction also provided farmers with an opportunity to clear the fields for cultivation.
16. **Cedar Grove**
    Cedar trees are indicative of poor soil which often results from poor farming practices. The rich topsoil has been washed away and nature has taken over.