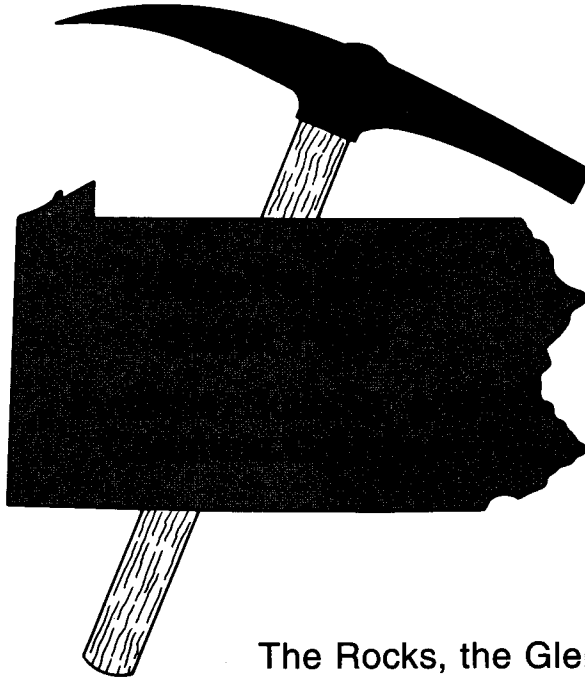


Pennsylvania

TRAIL OF GEOLOGY



The Rocks, the Glens,
and the Falls



Commonwealth of Pennsylvania
Department of Conservation and Natural Resources
Office of Conservation and Engineering Services
Bureau of Topographic and Geologic Survey
and Office of Parks and Forestry
Bureau of State Parks

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Ricketts Glen State Park

by

Duane D. Braun¹ and Jon D. Inners²

Introduction

Ricketts Glen State Park is located on Red Rock and North Mountains. These mountains are part of the Allegheny Front, a steep escarpment that forms the boundary between two geologic regions, the Allegheny Plateau to the north and the Ridge and Valley to the south. The rounded to flat-topped mountains of the Allegheny Plateau are underlain by nearly horizontal layers of sedimentary rock. In contrast, the linear, sharp-crested ridges and intervening valleys of the Ridge and Valley are formed by tilted layers of sedimentary rock. The Allegheny Front itself is capped by hard sandstone that stands above the less resistant shales and sandstones of the Ridge and Valley.

Ricketts Glen is a picturesque gorge carved into the steep face of the Allegheny Front by Kitchen Creek. Drainage changes brought about by glaciation increased the flow of the creek. This heavier flow caused increased erosion, creating the series of scenic waterfalls that are now the centerpiece of the park.

How to Use This Guide

- * Turn to pages 6 and 7. The map on these pages depicts the geology of Ricketts Glen State Park, indicates aspects of the geographic history of the area that relate to the origin of the Glens, and pinpoints five geologic sites of interest within the park boundaries. You will probably want to drive to Sites 1, 2, and 5, but you must hike to Sites 3 and 4. A moderately rigorous, 1.25-mile-long hike along Highland Trail will take you to Midway Crevasse (Site 3) and to the head of Glen Leigh (part of Site 4). The Falls Trail through the Glens (Site 4) is extremely rigorous and can be **dangerous** if care is not taken. A hike around the Falls Trail-Highland Trail loop is about 3.5 miles long and requires a steep descent and a steep ascent, each with about 800 feet of elevation difference.

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Look for this symbol in the guide and at each site to match descriptions and locations.

- * Pages 2 to 5 and 8 to 9 contain descriptions of the geology at the five sites marked on the centerfold map.
- * Turn to pages 9 to 12 to read about the geologic history of the park area, particularly relating to the origin of the Glens.

Outstanding Geologic Sites in the Park



Site 1. Grand View

Grand View (elevation 2,449 feet), the highest point on Red Rock Mountain, is a spectacular scenic overlook. To the east and west stretches the imposing wall of the Allegheny Front, rising as much as 1,200 feet above the rolling hills below. North of Grand View, the wooded undulating surface of the Allegheny Plateau extends as far as the eye can see. In the distance

to the southeast appear the narrow, even-crested ridges of the Ridge and Valley.

At Grand View, the rim of the Allegheny Front is capped by a thick sequence of sandstone layers in the Huntley Mountain Formation (refer to the rock column and cross section on the facing page). The first set of knobs on the plateau surface to the north are underlain by the particularly hard and re-

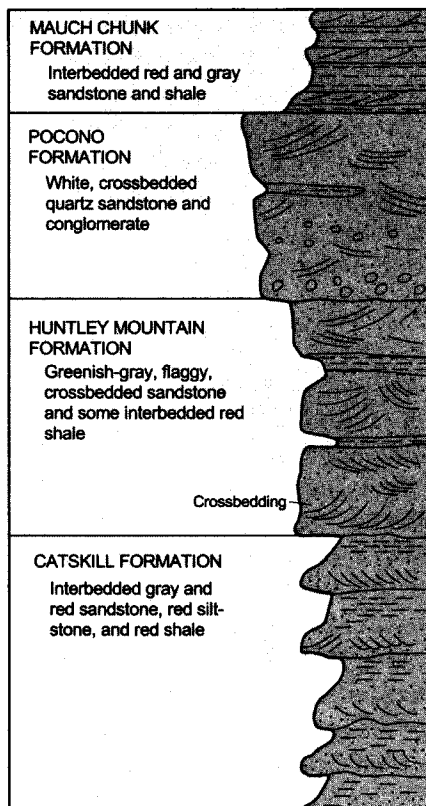


Scene from Grand View (looking east)

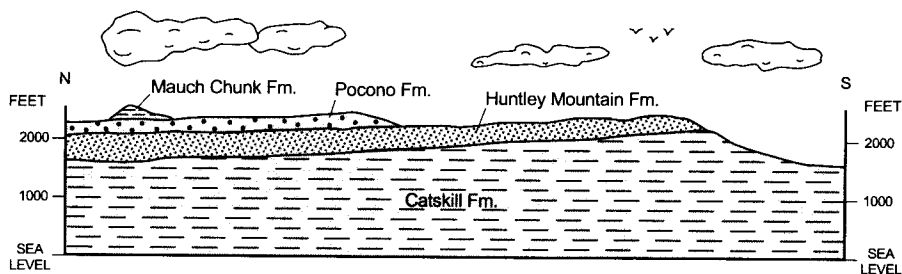
Columnar section showing sequence of rock formations

sistant sandstones of the Pocono Formation. The highest knobs on the plateau surface to the north are capped by the mudstones and sandstones of the Mauch Chunk Formation. The low, rolling hills visible to the southeast of Grand View are underlain by less resistant interbedded shales, siltstones, and sandstones of the Catskill Formation. The great relief (difference in elevation) along the Allegheny Front is the result of the marked difference in erosional resistance between the harder rocks that form the top of the Allegheny Plateau and the softer rocks that form the adjacent Ridge and Valley lowlands.

East and west along the Allegheny Front are what appear to be shallow notches in the escarpment. Actually, these are only the upper portions of deep, V-shaped stream valleys or glens that are cut back into the Front. Ricketts Glen is the second notch to the east.



During the last Ice Age, the continental glacier extended from Canada to Pennsylvania and covered the entire landscape surrounding Grand View (see edge of former glacier shown on the centerfold map). Because Grand

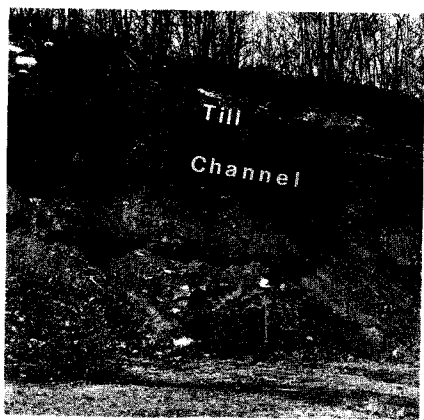


View was an especially high point at the thinning edge of the glacier, it projected above the glacier. The glacier flowed across the Allegheny Front to either side of the Grand View knob and extended southwestward across the low terrain below the escarpment.

Site 2. "The Red Rock"

Red shale and sandstone exposed in a quarry pit along Pa. Route 487 (the old Berwick-Elmira Turnpike) occur in the upper part of the Huntley Mountain Formation. It was from this distinctive horizon that Red Rock Mountain got its name. Because these rock layers made a conspicuous band of red across the old turnpike at this point, nineteenth-century travelers called the locality "The Red Rock." Today, stone from the quarry pit is used for road surfacing and campsite construction in the park.

"The Red Rock" formed about 360 million years ago from chan-



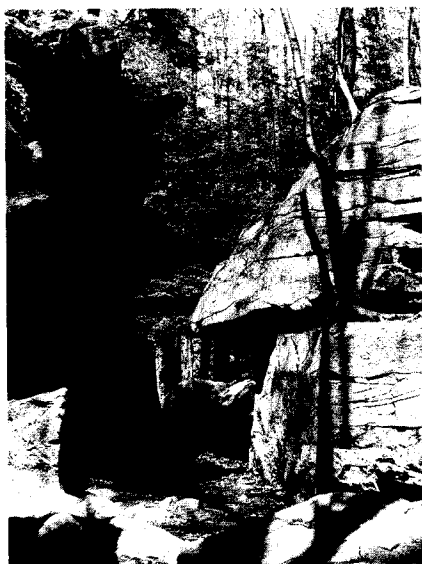
Shale pit ("The Red Rock")

nel and overbank floodplain deposits of ancient streams. A broad and shallow channel (200 feet wide and less than 10 feet deep) is clearly evident in the wall of the pit. Other noteworthy features of the pit include the gentle northward inclination of rock layering (a characteristic of rocks throughout the park) and the occurrence above the bedrock of reddish-brown stony debris (glacial till) deposited during the last glaciation.

Site 3. Midway Crevasse

Midway Crevasse is a narrow passageway between large blocks of Pocono sandstone and conglomerate that have been split apart along natural fractures that cut across the layering of the bedrock. The fractures were formed by the tremendous stresses that were placed on these rocks when they were deeply buried under other sedimentary layers. Smaller blocks, partly covered by leaf litter, cover the ground surface from the crevasse to a bedrock ledge about 100 feet upslope to the north. It is clearly apparent that the blocks have split off this ledge and have moved down the gentle slope to their present position, but the undisturbed trees and lichens growing on the blocks indicate that the blocks are not moving today.

The blocks are actually leftovers from the intensely cold climate conditions that existed here for



Midway Crevasse

several thousand years after the last glacier retreated from the area. As the glacier passed over the site, it plucked away exposed loose blocks and left behind an intact sandstone ledge. The freezing and thawing of water infiltrating along fractures and rock-layer partings resulted in the splitting off of a series of blocks from the parent ledge. These blocks then slid down the slope to the present position of Midway Crevasse in the following way: During the brief summers of the early post-glacial period, the ground thawed out to a shallow depth under the blocks. This thawed material had a high water content, and it slowly flowed down the gentle slope, carrying the sandstone blocks with it. Continued frost wedging during the movement phase broke the

blocks into numerous smaller blocks. The trail at Midway Crevasse follows one of the more prominent spaces between the transported blocks.



Site 4. The Glens

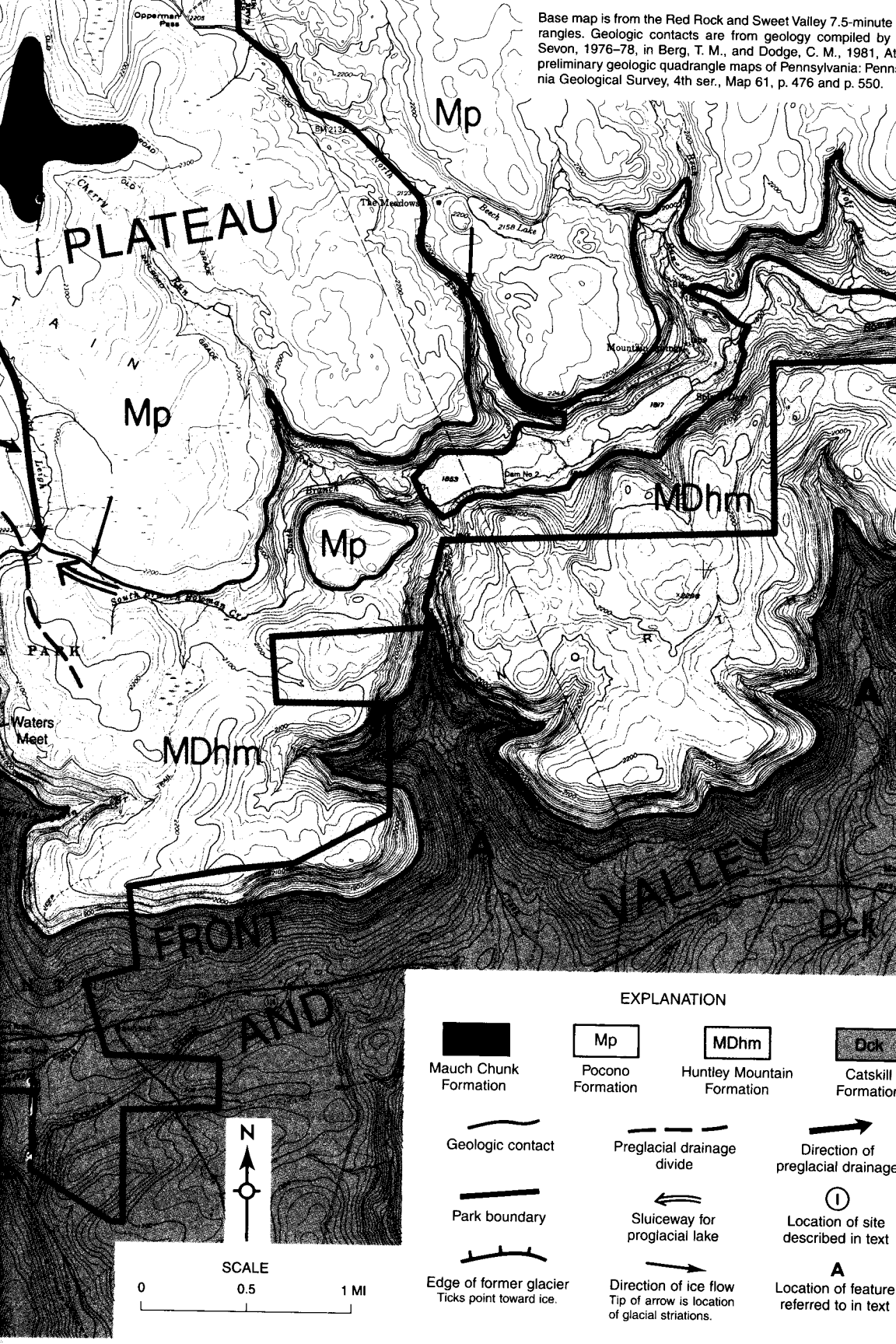
The Glens is a precipitous Y-shaped gorge cut back into the resistant rocks of North Mountain by Kitchen Creek. The elevation drop within the Glens area is approximately 1,000 feet in a distance of 2.25 miles. Most of this drop takes place in Ganoga Glen and Glen Leigh above their junction at Waters Meet. The Glens contain at least 25 distinct waterfalls, 22 of them named. These falls range in size from low single cascades, such as Oneida Falls (13 feet), to the many-tiered Ganoga Falls (94 feet), highest falls in the park.

While each falls in the Glens has its own unique beauty, two general types can be recognized. Where the creek descends in a series of small steps over thin-bedded sandstones in the Huntley Mountain Formation, distinctive "wedding-cake" falls result, as exemplified by F. L. Ricketts Falls. Along Ganoga Glen, all but one falls upstream of Tuscarora Falls are of the wedding-cake type. On Glen Leigh, wedding-cake falls include all those that are upstream of R. B. Ricketts Falls. The other type of falls is the "bridal veil," and falls of














RICKETTS GLEN STATE PARK



Base map is from the Red Rock and Sweet Valley 7.5-minute ranges. Geologic contacts are from geology compiled by Sevon, 1976-78, in Berg, T. M., and Dodge, C. M., 1981, At preliminary geologic quadrangle maps of Pennsylvania: Pennsylvania Geological Survey, 4th ser., Map 61, p. 476 and p. 550.



EXPLANATION

- | | | | |
|---|---|---|---|
|  |  |  |  |
| Mauch Chunk Formation | Pocono Formation | Huntley Mountain Formation | Catskill Formation |
|  |  |  |  |
| Geologic contact | Preglacial drainage divide | Direction of preglacial drainage | Location of site described in text |
|  |  |  |  |
| Park boundary | Sluiceway for proglacial lake | Direction of ice flow
Tip of arrow is location of glacial striations. | Location of feature referred to in text |
|  | | | |
| Edge of former glacier
Ticks point toward ice. | | | |

SCALE

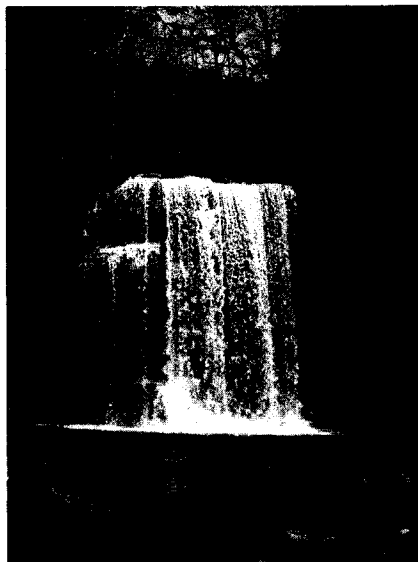
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F. L. Ricketts Falls

this type form mainly where the creek flows over the Catskill Formation or over the “Red Rock” in the Huntley Mountain Formation. Bridal-veil falls consist of a relatively hard caprock (usually gray sandstone) that overhangs an underlying softer layer of red shale. Commonly, a plunge pool is scoured out at the base of such falls. A well-developed example of a bridal-veil falls is Harrison Wright Falls.

Kitchen Creek, which flows through Ricketts Glen, is unique compared to all other nearby streams that flow down the Allegheny Front (e.g., streams labeled “A” on the centerfold map). It is the only stream that contains an almost continuous series of waterfalls. The form and location of individ-



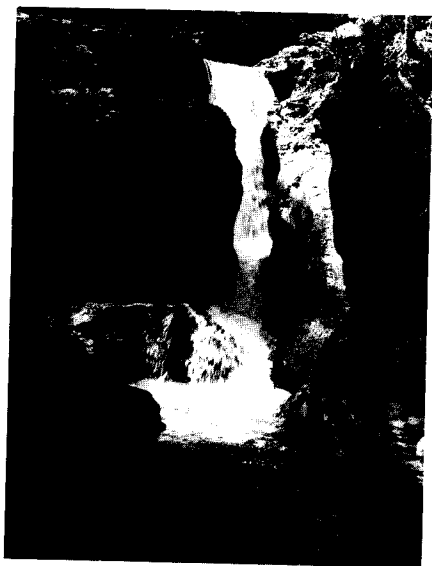
Harrison Wright Falls

ual falls are clearly controlled by the sequence of rock layers the stream crosses. But why are there so many falls in Ricketts Glen and hardly any in streams flowing over the same rock layers in adjacent valleys? This question is answered in the section on the geologic history of the park.



Site 5. Adams Falls

Adams (or Kitchen Creek) Falls is the most accessible and the most beautiful falls in the park. At the bridge on Pa. Route 118, Kitchen Creek plunges over three picturesque cascades (18, 25, and 10 feet high) developed in gray sandstone and red shale of the Catskill Formation. Between the individual falls, the stream rushes through

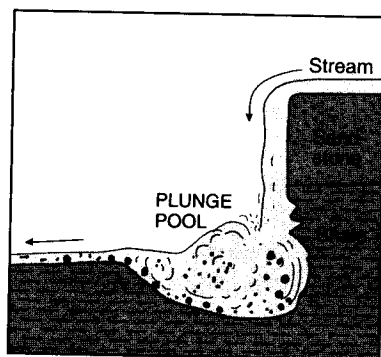


Adams Falls

deep, narrow gorges that are fluted with numerous potholes. Below the middle and lower falls are large plunge pools eroded by the turbulent water that descends the falls. The lower plunge pool (Leaven-

worth Pool) is about 30 feet in diameter and 8 to 10 feet deep.

The potholes at Adams Falls are formed by the grinding action of gravelly sediment swirled in tight circular patterns by strong eddies in the stream current. Gradually, a smooth circular depression is created where there once was only a minor irregularity on the bedrock floor of the stream.



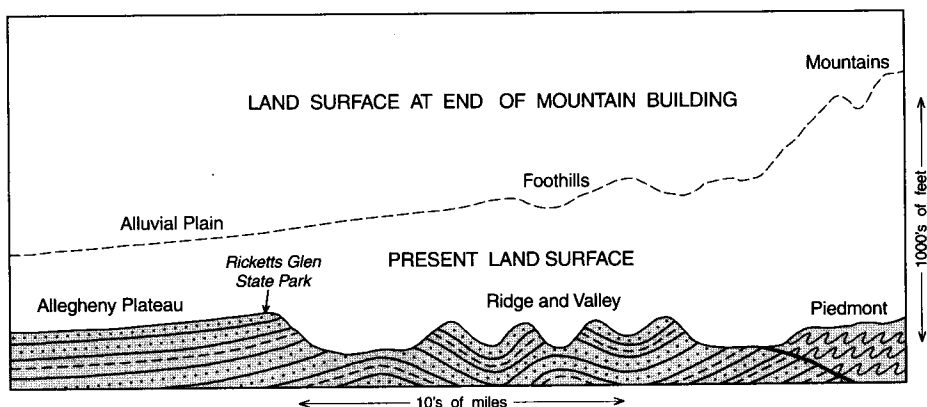
Scouring of a plunge pool by sand and pebbles in turbulent water

Geologic History of the Park

The rocks exposed in Ricketts Glen State Park comprise a 1,500-foot sequence of sedimentary rock layers. They were originally deposited as unconsolidated gravels, sands, and muds by ancient rivers that flowed across the region from about 370 to 340 million years ago. (During this time period, the continental area later to be called Pennsylvania was located south of the equator.) The sediments accumulated on flood-

plains near sea level as the region continually subsided. These flood-plain sediments became deeply buried by other sediments. They were consolidated into solid rock by the high temperatures and pressures existing several thousands of feet deep in the earth's crust, and by the precipitation of minerals from underground water.

Approximately 250 million years ago, forces within the earth's crust

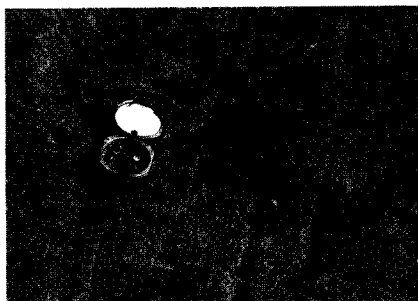


Regional landscape—past and present

that were caused by the collision of the North American continental plate with Africa deformed the rocks into large, tight folds in the Ridge and Valley and into much gentler folds in the Allegheny Plateau. At this time, the rock layers in the park were tilted down at a low angle to the north and elevated in the first of a series of intermittent uplifts that raised them to their present position far above sea level. Erosion of the rocks began with the initial uplift and has continued with varying intensity. Streams have eroded as much as 5,000 feet of overlying rock.

At least three times in the last one million years, continental glaciers buried northeastern Pennsylvania under hundreds to thousands of feet of ice. The last glacial event, about 20,000 years ago, left an extensive record as the glacier advanced in a south-southwesterly direction across the Plateau and over the Allegheny Front. This

glacier scoured up loose soil and rock, plucked large blocks of sandstone from outcropping ledges, and cut striations into the underlying bedrock. (Glacial striations are formed by the dragging of hard stones embedded in the base of the ice sheet across the bedrock surface. See the black arrows on the centerfold map.) When the ice front retreated to the north-east, a layer of bouldery glacial till was left behind, partly filling in old valleys and creating lakes and swamps on the flat plateau upland. The last glaciation probably

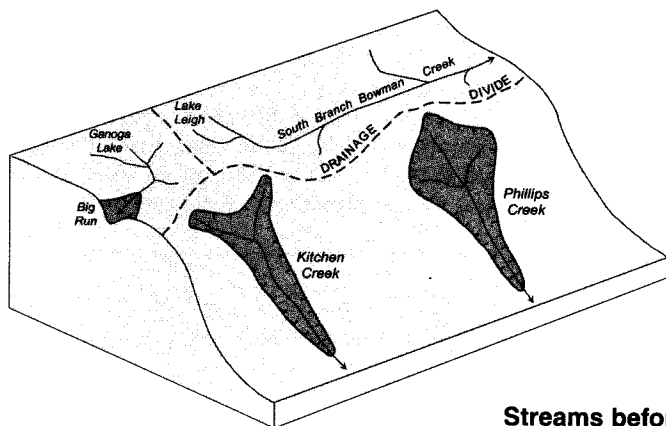


Glacial striations

finished changes in the stream drainage pattern that were started by earlier glaciations.

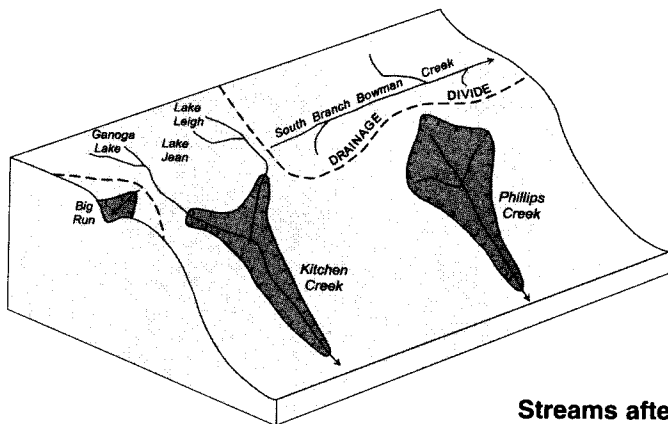
The most significant drainage change caused by the glacier was

the diversion of the headwaters of South Branch Bowman Creek and Big Run to Kitchen Creek. This change is illustrated and explained below. (See also the centerfold map.)



Streams before capture

A. In preglacial times, the areas of what are now Lake Leigh and the eastern part of Lake Jean drained eastward down South Branch Bowman Creek. Ganoga Lake and the area that would become the western part of Lake Jean drained westward down Big Run. The preglacial drainage divide between these areas and Kitchen Creek ran in an arc around the head of what is today the Glens.



Streams after capture

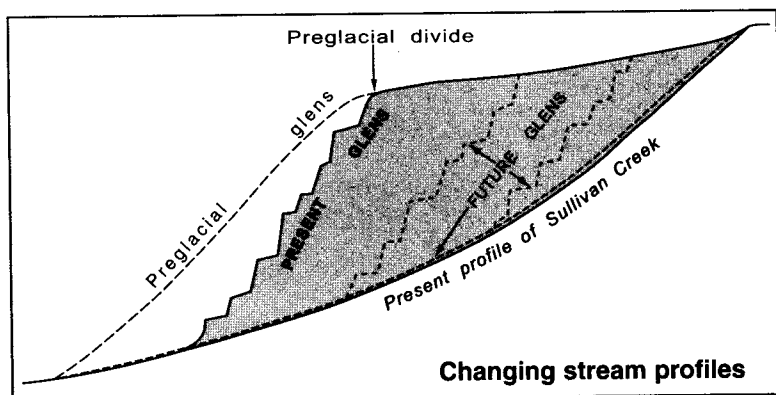
B. Glaciation altered the drainage pattern so that the stream in Glen Leigh captured the former headwaters of South Branch Bowman Creek and the stream in Ganoga Glen captured the headwaters of Big Run. Glacial meltwater assisted the Glen Leigh branch of Kitchen Creek in capturing the "Lake Leigh" drainage. In each

glaciation, the ice retreated northeastwardly and temporarily impounded a lake in the eastwardly draining South Branch Bowman Creek valley. The drainage from that proglacial lake cut a channel, or sluiceway, across the divide into the Glen Leigh valley. It probably took all three glaciations to finally cut the sluiceway deep enough so that the Lake Leigh area could continue to drain down through Glen Leigh after glaciation. Today, the divide between South Branch Bowman Creek and the stream in Glen Leigh is a broad valley occupied by a swamp, the abandoned sluiceway for the former glacial lake in South Branch Bowman Creek valley.

Glacial deposition was instrumental to the capture of the Ganoga Lake-western Lake Jean drainage by the Ganoga Glen branch of Kitchen Creek. The last glacier deposited 20 to 30 feet of debris in the area of what is today the intersection of Pa. Route 487 with Ganoga Lake and Big Run Roads ("B" on the centerfold map). This material blocked the Big Run valley and forced the drainage to follow its present path through Ganoga Glen. Today, seepage from Lake Jean flows through the glacial debris blockage and appears at the head of Big Run as a spring, which has a steady discharge of 25 gallons per minute regardless of the season.

These drainage diversions added about 7 square miles to the Kitchen Creek drainage basin. The increased water flow from this added drainage area is what has been cutting the falls in the Glens since the last glacier retreated. The slope, or gradient, of the Glens is too steep for the present amount of water flow. As shown in the profile diagram below, the gradient of a stream with a drainage equal to that of Kitchen Creek, such as Sul-

livan Branch of Fishing Creek ("C" on the centerfold map), is much gentler than the gradient of the Glens. The falls are gradually eroding upstream and will continue to do so until the gradient is reduced to the appropriate angle for the size of the present drainage basin of the Glens. Before the falls retreat all the way headward, however, another glaciation will probably occur, and the drainage pattern may be changed yet again!



For More Information, Contact:

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