RAYMOND B. WINTER STATE PARK, UNION COUNTY

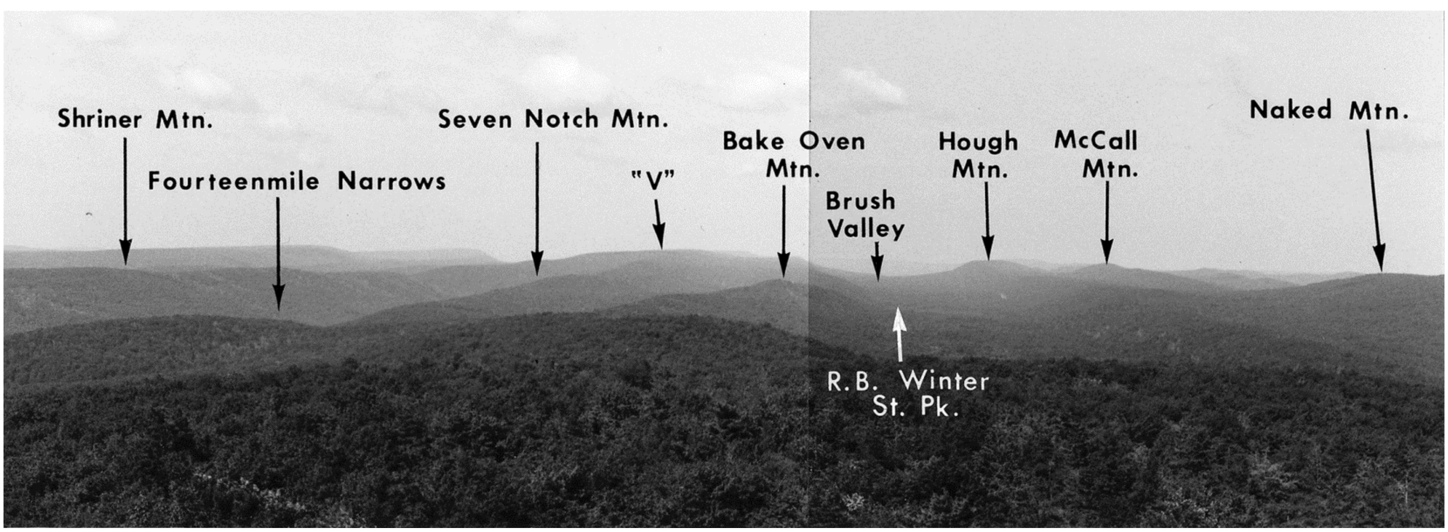
SCENERY, ROCKS, AND SPRINGS IN EASTERN BRUSH VALLEY

Raymond B. Winter State Park encompasses approximately 700 acres of forested "valley and ridge" terrain at the east end of Brush Valley in the folded Appalachian Mountains of western Union County. The centerpiece of the park is Halfway Lake, a 7-acre stream- and spring-fed lake impounded behind a "native" sandstone dam on Rapid Run. The dam is situated just upstream of a deep water gap through which Rapid Run exits from Brush Valley. Along the boundaries of the park to the north and south are narrow mountain ridges that rise 300 feet or more above the valley floor.

Although at times we tend to take our scenic resources for granted, it is important to remember that the development of a landscape takes place over a time scale of millions of years. Changes that profoundly affect the landscape may occur within a few tens of years (an example being the rapid destruction of the great virgin timber stands that covered this part of central Pennsylvania before the turn of the century) to hundreds of millions of years (the amount of time it took for stream erosion to carve the distinctive topography of the park area). There is probably no better way to gain an understanding of the development of the park landscape and its minor elements (such as rock outcrops and springs) than to visit several spots in the park area where the natural features are well developed or can be best seen.

(1) Sand Mountain Fire Tower

The fire tower on Sand Mountain affords a magnificent panorama of the geologic setting of Raymond B. Winter State Park. Although much could be said about the views to the south, east, and north, let us concentrate our attention to the west, in the direction of the park itself, and ponder several questions. What causes the striking topography of



Sand Mountain fire tower (view west)

narrow, northeast-southwest-trending, parallel valleys and ridges? And why do some of the mountains double back on themselves, as can clearly be seen where Seven Notch and Shriner Mountains come together to form a distinct "V"? What is the origin of the numerous short, but deep, transverse gaps, such as those in Seven Notch Mountain south and southwest of the fire tower? Why do all of the higher mountain summits seem to rise to nearly the same elevation, so as to approximate a level plain if the intervening valleys were filled in?

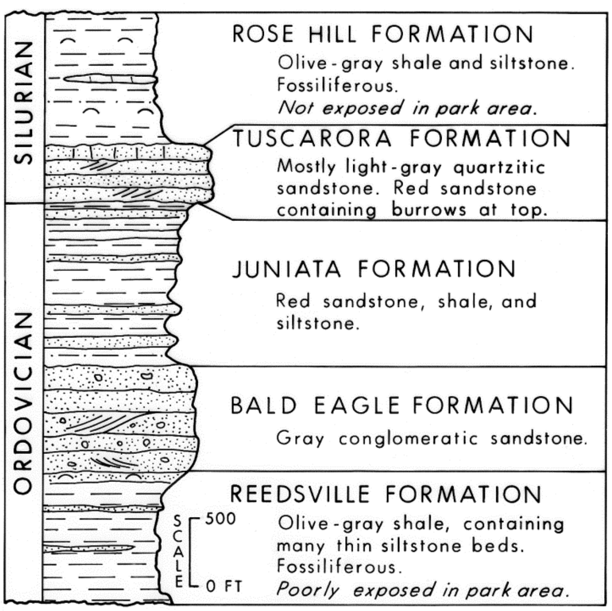
The distinctive "valley and ridge" topography of the Appalachian Mountains in the park area results from the erosion of folded sedimentary rock layers that vary in hardness and resistance to weathering. The upturned edges of hard, quartzitic sandstone and conglomerate beds form the mountain ridges, whereas softer, more easily eroded shales and limestones floor the valleys. The folds, which formed during a great mountain-building episode about 250 million years ago, extend for many miles in a northeast-southwest direction. They commonly have wavelengths of 1 to 2 miles and fold heights of several thousand feet. Where the rocks are folded up, an "anticline" is formed. Where they are folded down, a "syncline" results. Brush Valley is a large, eroded anticline, and Fourteenmile Narrows is a syncline. Because the "crests" and "troughs" of these great eroded, wavelike folds are not horizontal and tend to plunge into the earth, the mountain ridges converge into "V's" and form zig-zag patterns that are clearly visible from a high altitude.

The major streams in the area, such as Rapid Run and White Deer Creek, flow mainly northeastward down the centers of the anticlinal and synclinal valleys which they have excavated during millions of years of downcutting. The deep, transverse gaps in the mountain ridges have been eroded by tributaries (or short reaches of the major streams) flowing at right angles to the northeast-southwest topographic grain. Stream erosion in areas of folded rock strata typically forms such a "trellis" drainage pattern. The short, right-angle segments mark places where spring-fed streams have eroded headward into the steep mountain slopes. Perhaps the regular pattern of notches that gives Seven Notch Mountain its name arises from the spacing of narrow, intensely fractured zones that locally make the sandstone more susceptible to erosion.

The origin of the relatively level, imaginary "surface" formed by the mountain crests has been a matter of controversy for many years. All agree that streams and rivers have eroded many thousands of feet of rock to create the present landscape. Some geologists, however, believe that the summit "level" is a natural result of millions of years of stream erosion acting on rocks of varying resistance to erosion. Other geologists speculate that the flat ridge summits represent an old erosion surface that formed 10 to 15 million years ago when the entire Appalachian Mountain chain was reduced to a nearly level plain sloping southeastward toward the Atlantic Ocean. Later this great "plain" was uplifted in a series of intermittent uplifts to its present height of about 2,000 feet. The downcutting of streams into this surface during and after its uplift has etched out the present topography. So take your pick! As with many geological controversies, there is probably some truth in both views.

(2) Rock Strata Exposed in Rapid Run Gap

Several of the sedimentary rock formations that form the landscape of Raymond B. Winter State Park and the surrounding area are exposed along Pa. Route 192 in the water gap south of Halfway Lake. As shown in the columnar section on the next page, these rocks are predominantly shales, sandstones, and conglomeratic sandstones of Ordovician and Silurian age (about 450 to 425 million years old). The Reedsville Formation at the bottom and the Rose Hill Formation at the top were deposited in relatively deep water, marine environments. The Bald Eagle, Juniata, and Tuscarora Formations represent mainly river bar and channel, floodplain, and shallow marine deposits, respectively, that spread northwestward across the region during an episode of mountain building affecting southeastern Pennsylvania and nearby regions in late Ordovician time. Long after cementation, recrystallization, and pressure had changed the original unconsolidated sands, gravels, and muds to solid rock, the strata were folded and uplifted (about 250 million years ago). As a result of the folding, all of the rock strata in Rapid Run gap are inclined to the southeast.



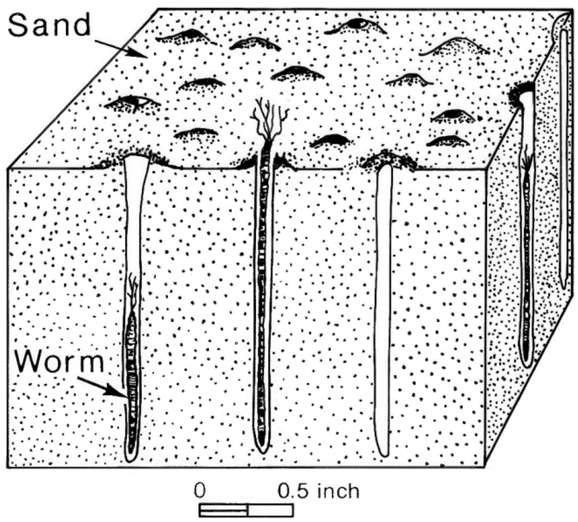
Columnar section

Only the moderately to highly resistant sandstone-bearing formations can be examined in Rapid Run gap. The relatively nonresistant shales of the Reedsville and Rose Hill Formations are concealed beneath stream deposits and bouldery overburden on the valley bottoms and lower mountain slopes.

Directly opposite the parking area at Halfway Lake (site A on the geologic map) the sandstones and conglomeratic sandstones of the Bald Eagle Formation crop out. Because these rocks are composed predominantly of quartz (a hard and chemically resistant mineral), they tend to form fairly high mountains, the exposures here being at the east end of Brush Mountain. South of Boyer Gap Road, the red sandstones, siltstones, and shales of the overlying Juniata Formation can be seen on the east side of Pa. Route 192 (site B). The Juniata red beds are not nearly as hard as the Bald Eagle sandstones; hence, they generally underlie lower topography. At the south end of the gap through Seven Notch Mountain (site C) are interbedded olive-gray and purplish-red quartzitic sandstones that occur in the upper part of the Tuscarora Formation. Because these rocks are not only composed dominantly of quartz grains but also have a tough, quartz cement binding the grains together, the Tuscarora sandstones are the hardest and most resistant rocks in the region. Therefore, as you might guess, the highest mountains bounding the park—including Seven Notch Mountain—are ribbed by this rock formation. In the reddish sandstones of the Tuscarora outcrop are conspicuous sediment-filled tubes 0.2 inch in diameter and perpendicular to the bedding planes. These tubes (called *Skolithos*) are

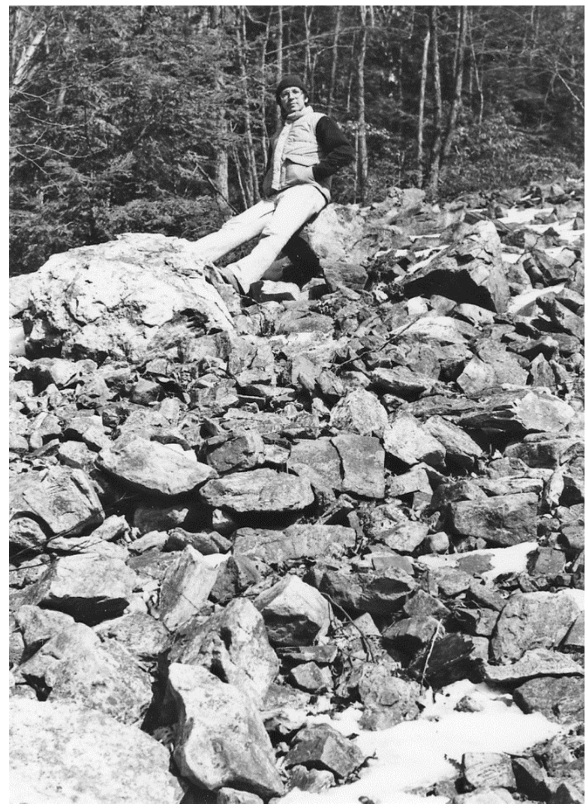
Tuscarora sandstone on Pa. Route 192
(Quartzitic sandstone strata arc inclined 35 degrees to the southeast.)

believed to be the burrows of soft-bodied worms that inhabited the intertidal sands of an ancient beach about 425 million years ago.



Skolithos, interpreted as a worm burrow

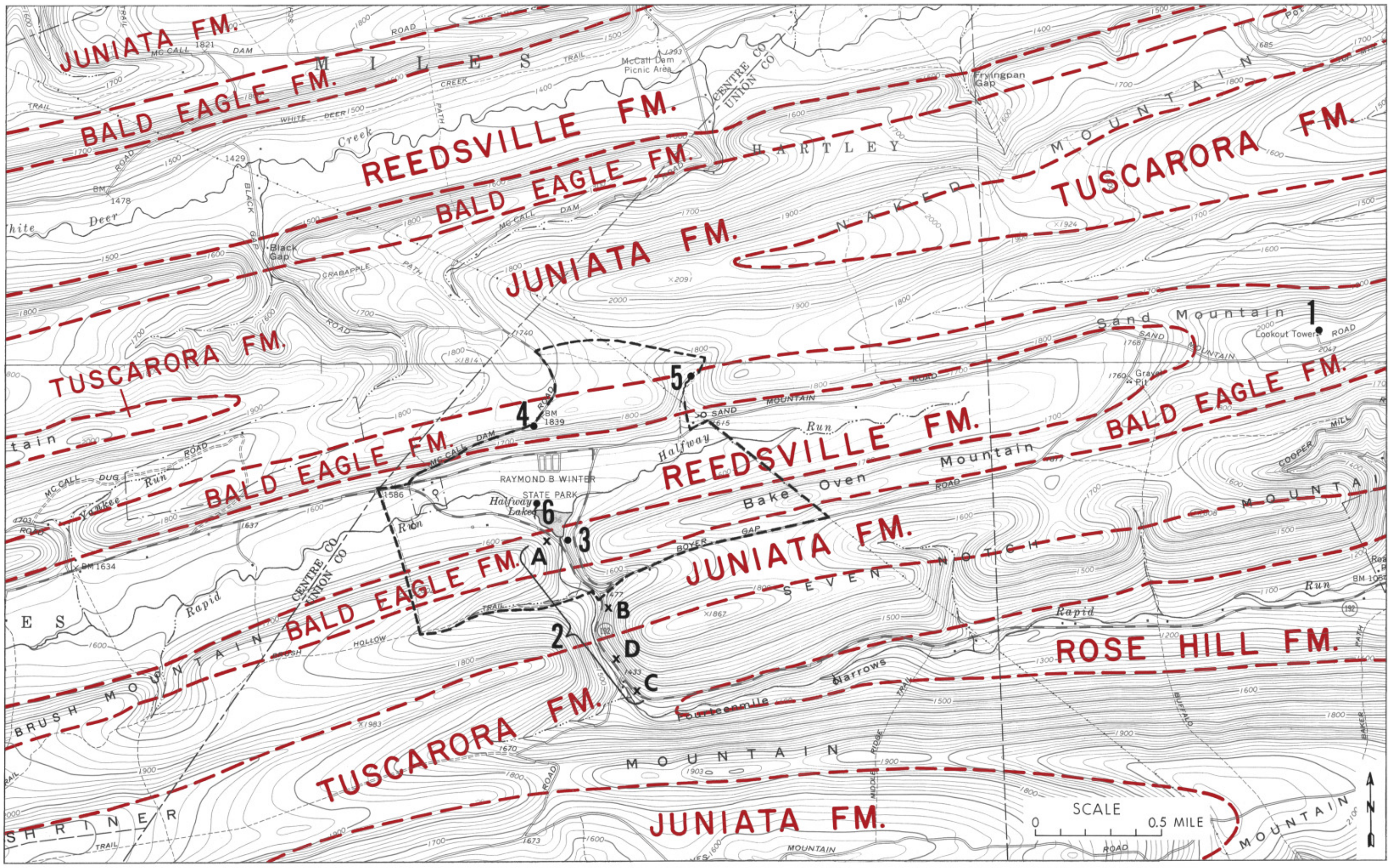
One other feature of interest in Rapid Run gap is the boulder-strewn slope about 1,000 feet north of the south end (site D). Angular white quartzite boulders, some of which are more than 6 feet in diameter, cover a broad area that extends upslope from road level into the sparsely forested area above. Such "scree slopes" or "boulder fields" are relicts of the Ice Age. They formed some 10,000 to 15,000 years ago when arctic cold associated with the most recent continental glacier held much of northeastern United States in its grip. Although the glacier did not reach this part of Pennsylvania (stopping some 30 miles to the northeast near Williamsport), the extreme cold that existed for several thousand years promoted intense frost action (the freezing of water and growth of ice crystals) in natural fractures within the sandstones that form the mountains. At this particular spot, the thick quartzitic Tuscarora sandstone beds were split into loose angular boulders that gradually moved down the mountainside under the influence of gravity. At the end of this last glacial episode, virtually all of the mountain slopes of central Pennsylvania were covered by this natural blanket of broken stone. As the climate warmed, vegetation and shallow soil reclaimed the barren mountainsides, leaving only patches of bouldery terrain here and there to resist renewed forest growth.



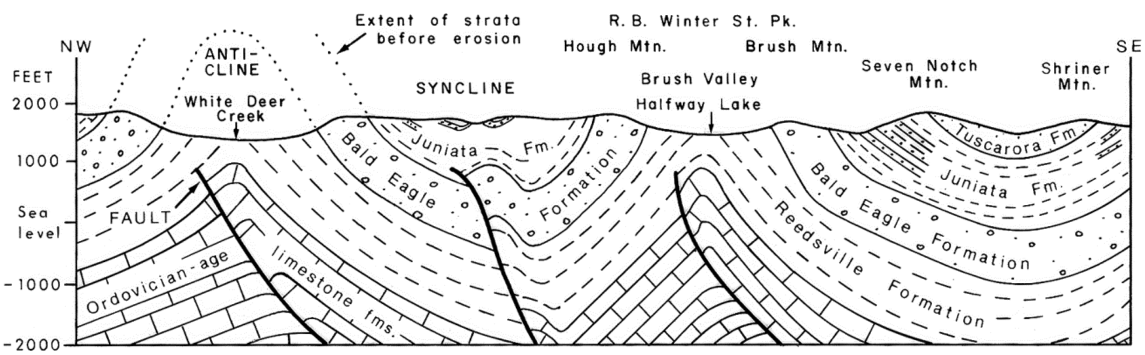
Scree in Rapid Run gap
(Angular boulders are hard, quartzitic sandstone of Tuscarora Formation.)

(3) Bald Eagle Sandstone at Left Abutment of Halfway Dam

One of the best exposures of the Bald Eagle Formation in the park area is at the end of Bake Oven Mountain near the left abutment of Halfway Dam. Exposed here is a prominent ledge formed of 1- to 2-foot beds of gray conglomeratic quartz sandstone containing many rounded, 1/2-inch, white quartz pebbles. Bedding in the sandstone is inclined 80 degrees to the southeast on the south side of a major anticlinal fold, whose center line (or



Geologic Map



Schematic Geologic Cross Section

axis) runs the length of Brush Valley. Just as conspicuous as the bedding planes in this outcrop are the closely spaced fractures, or joints, that are inclined 10 to 20 degrees to the northwest. These joints formed at about the same time that the folding took place and reflect the hard and brittle nature of the sandstone.

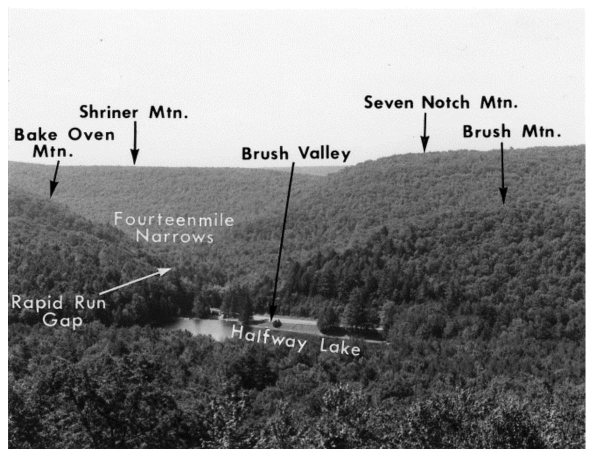
Note that the sandstone ledge tends to break up along the intersecting bedding planes and joints. Two processes are especially active in splitting up the rock. The first is frost action within the bedding and joint cracks, the same process that formed the scree slope in Rapid Run gap. Much more important under present climatic conditions, however, is the

Bald Eagle sandstone near left abutment of Halfway Dam

second process—root wedging. The effectiveness of growing roots in the opening up of rock fractures can be clearly seen at several places along the length of the ledge. One result of the breaking up of the rock along these inclined, natural fractures has been the formation of a shallow "joint cave" 5 feet high, 2.5 feet wide, and 4 feet deep, sizable enough to give at least one fisherman shelter from a summer thunderstorm!

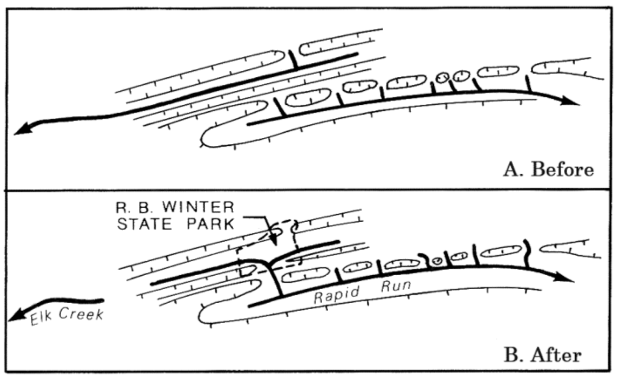
(4) Park Overlook

From the overlook off McCall Dam Road, an observer can gain a clear appreciation of the topographic effects brought about by differences in the erosional resistance of rock units. Brush Valley—in which Halfway Lake is nestled at an elevation of 1,506 feet—is developed along the outcrop belt of relatively soft shales in the Reedsville Formation. Bake Oven and Brush Mountains—the two terrace ridges on either side of Rapid Run gap—are each 1,800 to 1,900 feet in elevation and are formed by the upturned edges of hard, conglomeratic sandstone beds in the Bald Eagle Formation. The swale between these terrace ridges and Seven Notch Mountain directly to the south is underlain by less resistant, red sandstones and shales of the Juniata Formation. Seven Notch and Shriner Mountains attain elevations of more than 2,000 feet and are developed on highly resistant, quartzitic sandstones of the Tuscarora Formation. Fourteenmile Narrows between Seven Notch and Shriner Mountains is underlain by easily eroded shales of the Rose Hill Formation.



Park Overlook
(view south)

Rapid Run gap itself is evidence of an interesting example of stream capture, one of the many minor adjustments in the trellis drainage pattern that has resulted from at least tens of millions of years of stream erosion in the folded mountains of central Pennsylvania. Halfway Run and the reach of Rapid Run west of Halfway Lake once were the headwaters of Elk Creek, a stream that now rises about 3 miles west of the park and drains the entire western part of Brush Valley. At some time in the distant past, one of the right-angle tributaries of Rapid Run (then restricted to Fourteenmile Narrows) cut back headward from the westernmost of the seven “notches” in Seven Notch Mountain and “beheaded” Elk Creek. This diverted the drainage at the east end of Brush Valley from the Penns Creek basin to the West Branch Susquehanna River basin. Although it is not known exactly when Rapid Run captured the headwaters of Elk Creek, this blatant act of “stream piracy” probably took place about one million years ago.

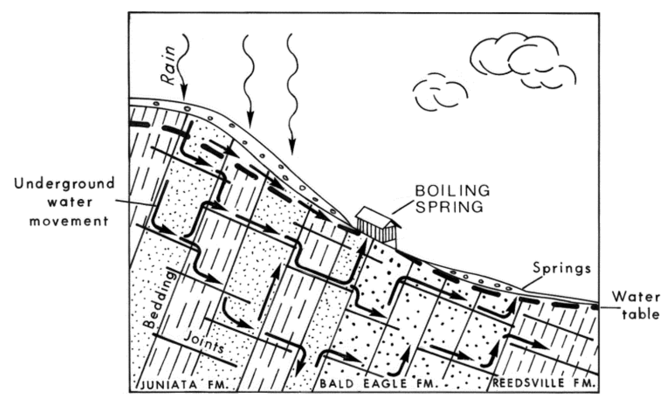


Stream capture at Rapid Run gap

(5) Boiling Spring and (6) the “Little Bubbler”

Springs are points of groundwater discharge at the earth’s surface. They can be of many different origins and sizes, ranging from great limestone springs that yield many thousands of gallons per minute to tiny overburden springs from which water trickles at a pint per minute only after heavy rainfalls. The chief springs of Raymond B. Winter State Park and the immediately surrounding area (shown on the geologic map) fall between these two extremes, but are decidedly on the small side. Because most of these springs are permanent and maintain a fairly constant year-round temperature that approximates the average annual air temperature, they are probably supplied mainly from bedrock fractures that extend below the level affected by seasonal drought and variation in ground temperature.

The largest spring in the park area is Boiling Spring, which is in the “notch” on Hough Mountain 1,200 feet north of Sand Mountain Road. This spring is presently the sole water supply for the park. It has a dry-season flow of at least 25 gallons per minute and a nearly constant water temperature of 47°F (winter) to 49°F (summer). Boiling Spring apparently issues from fractures in sandstone beds of the uppermost Bald Eagle Formation and/or the lowermost Juniata Formation. (An excellent outcrop of fractured Bald Eagle conglomeratic sandstone can be examined beneath the power line 500 feet south of the spring.) In its natural state, Boiling Spring was “artesian”; that is, water flowed out of the fractures under pressure, probably forming sand boils similar to those in the “Little Bubbler” described below. When the spring was developed in the 1930’s, a small amount of rock and overburden was blasted out of the way to make a foundation for the springhouse. This blasting apparently destroyed or greatly reduced the artesian head pushing up from the fractures in the sandstone below. Consequently, the spring no longer “boils.”



Water movement at Boiling Spring

The “Little Bubbler” is a small boiling-pool spring just west of the bathing beach on Halfway Lake. This spring is a fine example of an artesian spring, complete with a floor of coarse white sand that bubbles and “dances” as the water currents ascend into the pool.

The temperature of the water as it issues out of the ground is 45ºF in the winter and 51ºF in the summer. Although the cause of the artesian pressure in the "Little Bubbler" is not known for certain, the spring is presumably fed by water flowing through bedrock fractures. The water originated as rainfall on the summit and slopes of Hough Mountain to the north and has moved toward the valley of Rapid Run. The "Little Bubbler" apparently marks a point where the unconsolidated overburden on the valley floor is somewhat thinner or more porous than elsewhere, allowing the artesian groundwater to force its way to the surface. Other springs are known to occur beneath Halfway Lake and to contribute a significant amount of water to the lake. The flow of cold spring water directly into the lake largely accounts for its frigid summertime temperature.

The "Little Bubbler"
(Note the sand boils. Air bubbles bursting at the surface cause the concentric ripples.)

—Jon D. Inners, Geologist
Pennsylvania Geological Survey
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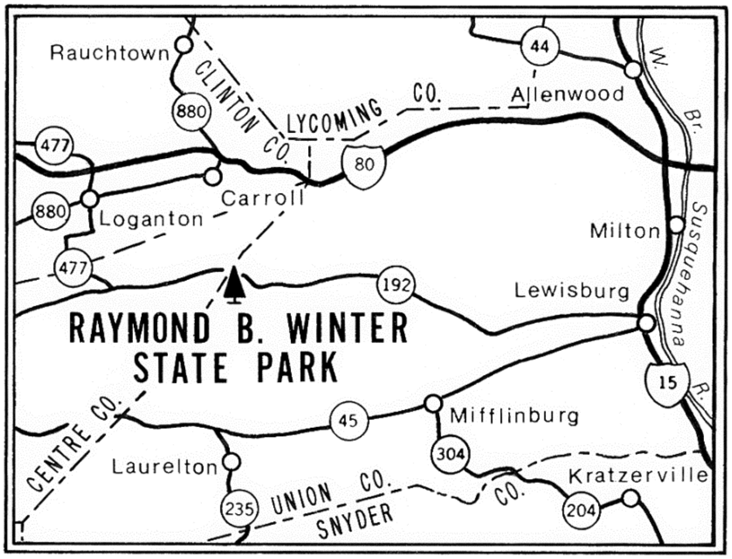

LOCATION MAP

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