SWATARA STATE PARK, LEBANON AND SCHUYLKILL COUNTIES

GEOLOGIC FEATURES AND FOSSIL SITES

Swatara State Park is located in Lebanon and Schuylkill Counties between Second and Blue Mountains. Swatara Gap, at the southwest corner of the park, is one of the most outstanding of Pennsylvania's water gaps passing through Blue Mountain. The gap is about a mile across at its widest point and 800 feet in depth (Figure 1). Swatara Creek flows out of the Appalachian Mountains at Swatara Gap and enters the Great Valley; from there it flows southward to join the Susquehanna River at Middletown.

Figure 1. Swatara Gap.

The park's landscape is the result of the gradual wearing away (erosion) of the rocks. As these rocks weather by wind, rain, and frost action, the harder, more resistant rock types—quartzites, sandstones, and conglomerates—erode at a much slower rate than the softer siltstones, shales, and claystones. Today, millions of years later, we see that the resistant rocks that underlie Second and Blue Mountains are about 600 to 1,000 feet higher than the shales and siltstones of Swatara Creek valley.

While the mountains and valleys were developing, Swatara Gap was being formed. The actual "carving" of the gap is a dynamic process, and even today the abrasive action of the small, hard, angular rock fragments carried by the stream is wearing away the streambed. When small streams drained the resistant-rock highlands, the rocks at the gap eroded faster than the rocks along adjacent highland drainageways. Although hard and resistant, the rock beds are thinner at this location and are weakened by a series of fractures. This localized weakness in the rock layers permitted accelerated erosion and the subsequent formation of the gap. At some point in geologic time, Swatara Creek altered its route to flow through this gap in Blue Mountain. Downcutting and erosion of the gap was then continued by Swatara Creek. Another explanation for the origin of the gap is the theory that Swatara Creek once flowed over these resistant rocks before the area was eroded into ridges and valleys, and then, while maintaining its position, downcut the entire gap during the same time period in which the mountains and valleys were forming. Both explanations are possible; the origin of Pennsylvania's water gaps is still speculative.

The Rocks

The high ridges bounding the park are underlain by the hard, dense sandstones and conglomerates of the Pocono and Tuscarora Formations. The Pocono Formation, underlying Second Mountain, is predominantly a hard, gray sandstone and conglomerate. The Tuscarora Formation, underlying Blue Mountain, is a white to gray, medium- to thick-bedded sandstone containing some conglomerate. Both formations are highly resistant to weathering and are exposed at the tops of the ridges. The Tuscarora Formation is also exposed along the park road through the water gap.

The rock units forming the hillslopes and valley bottom of the park are mostly softer rocks, consisting of shales and siltstones with some interbeds of sandstone and minor occurrences of limestone. The Mahantango Formation, underlying the valley bottom, is primarily gray, brown, and olive shale and siltstone that has some geologic characteristics worthy of discussion. The upper member of the Mahantango contains significant marine fossil beds. These fossil beds are exposed in the east section of the park and are discussed later in this guide (see Suedberg Fossil Site). The middle member of the Mahantango is called the Montebello Sandstone. This rock unit forms a low ridge in the southern part of the park, and Swope Mountain to the southeast of Suedberg (see map).

Another interesting characteristic of the Mahantango Formation can be observed at several localities within the park. It is a weathering phenomenon called exfoliation that occurs along the joints (a regular pattern of fractures) in the rock layers.

Exfoliation is a separation of successive "shells" of rock that spall off a block of rock like the skins of an onion (Figure 2). It occurs in these rocks when water flows through the joints, wetting the rock surface and infiltrating to a certain depth. As can be seen in Figure 2, water will infiltrate a block of rock the farthest at the corners, less at the edges, and least at the sides. The water then chemically reacts with the clay-forming minerals of the rock (feldspars). The clay that forms as a result of these reactions has a greater volume, and tensional stress results within the rock mass. This stress causes the clay-bearing "shell" to separate or exfoliate from the rock core. In the later stages of exfoliation, the block becomes spherical or ellipsoidal. Figure 3 shows an example of exfoliation that may be visited in the park.

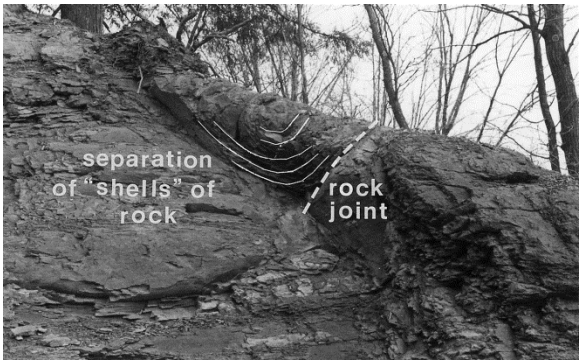


Figure 3. Exfoliation at the Suedberg Fossil Site.

Disconformity

Beautifully exposed in a roadcut where Interstate 81 passes through Swatara Gap are vertical beds of sedimentary rocks. The darker rocks shown on the left side of Figure 4 are the thin-bedded shales and siltstones of the Martinsburg Formation. They underlie and were deposited (in a horizontal position) before the quartzites and conglomerates of the Tuscarora Formation seen on the right side of Figure 4. Later tectonic forces tilted the rocks to a vertical position.

An important feature at this locality is the disconformable contact between the two rock units. A disconformity is an unconformity (a surface of erosion or nondeposition that separates younger strata from older rocks) in which

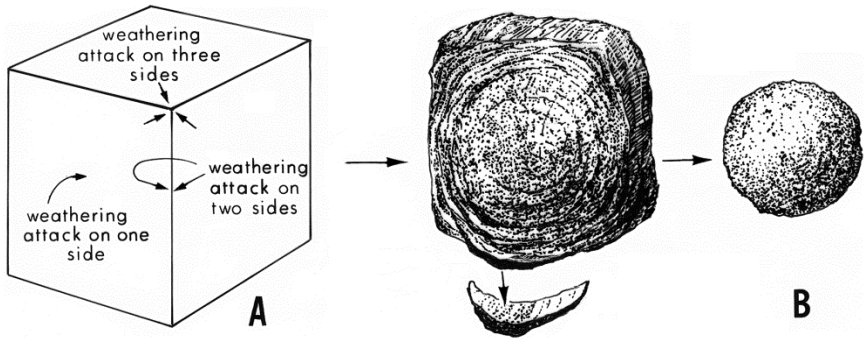
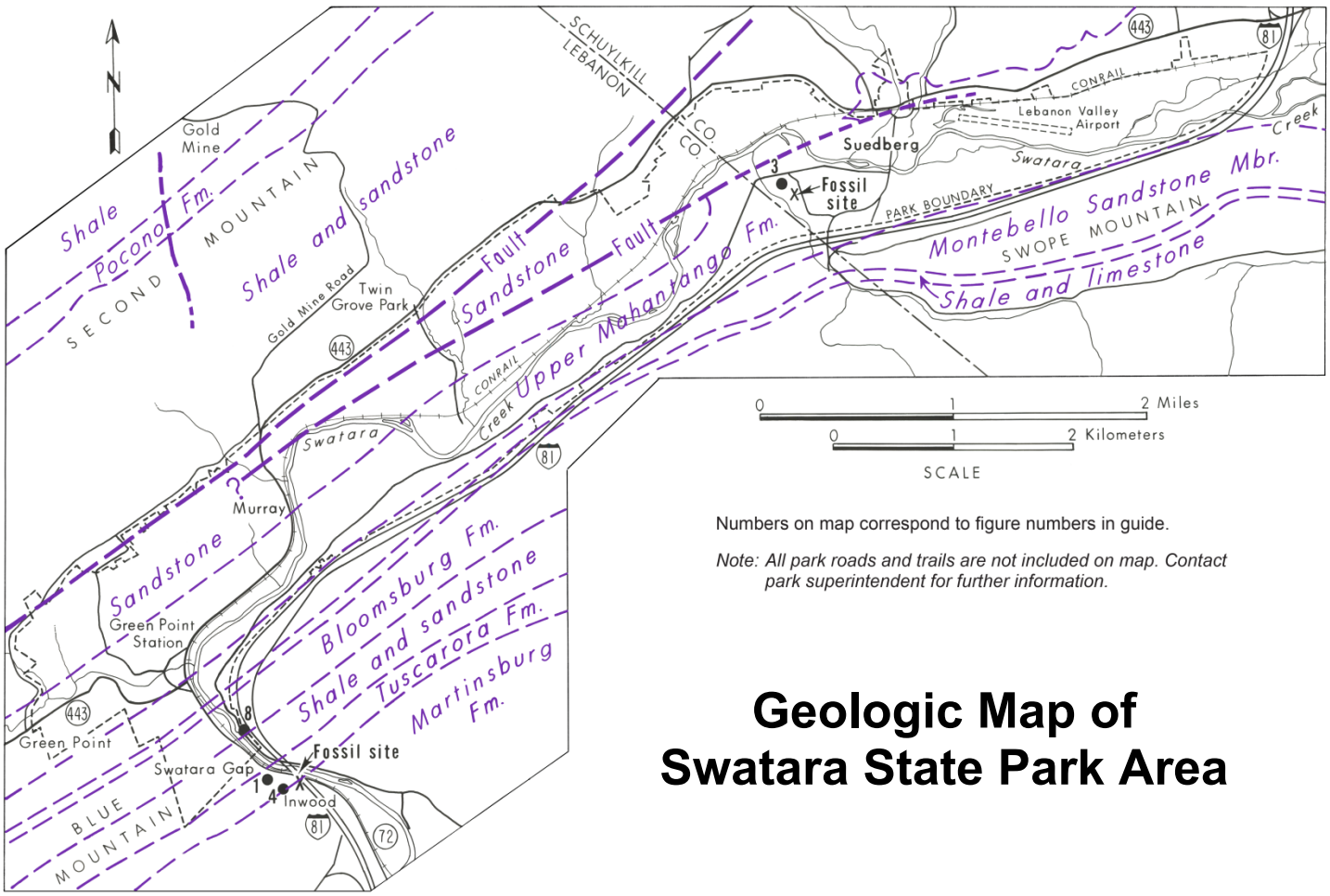


Figure 2. Geometry of exfoliation weathering. A. Block of rock before weathering. B. Rock in advanced stage of weathering.



Numbers on map correspond to figure numbers in guide.

Note: All park roads and trails are not included on map. Contact park superintendent for further information.

Geologic Map of Swatara State Park Area

Figure 4. Disconformity at Swatara Gap.

the beds on either side are parallel. Millions of years passed between the deposition of the Martinsburg Formation and the subsequent deposition of the Tuscarora Formation on top of it. Thus, the top of the Martinsburg Formation, seen at the contact between the two rock units, represents an ancient erosional surface.

The following sequence of events may have occurred. The sediments forming the rocks of the Martinsburg Formation were deposited in a shallow sea. Other sediments, coarser and finer, were deposited on top of the Martinsburg. The sea receded and the sediments deposited on the former sea bottom were exposed to the sun and air. Over many years, they were eroded by the natural elements (i.e., rain, wind) and transported elsewhere, eventually exposing the Martinsburg Formation again. The sea level then rose and the exposure of the Martinsburg shales and siltstones was submerged, bringing

the erosional cycle to an end. The quartz pebbles and sands of the Tuscarora Formation were then deposited in the sea over the Martinsburg Formation.

Unconformities are not merely academic curiosities. They are sometimes significant sites of mineral deposition and are usually mapped in extreme detail. Some of the world's largest petroleum occurrences are associated with unconformities. Gold and platinum placer deposits and other metallic deposits have also been found along unconformities.

Swatara Gap Fossil Site

A popular fossil collecting site can be found along Pa. Route 72 where the northbound lane of Interstate 81 crosses Swatara Creek. Fossils can be collected from approximately 100 feet of exposed Martinsburg Formation, which at this site consists of fine-grained, dark-gray shales interbedded laterally with thin layers of coarse-grained, brown and gray siltstones. Fossils may easily be spotted in the gray shales by the bright-colored iron oxide that coats their molded surfaces.

In Late Ordovician time, about 440 million years ago, this location had the special environmental conditions required to support abundant animal life and preserve a record of that life in the rock materials that were deposited there. In that time period, this site was the sunlit floor of a quiet, shallow sea. Food was plentiful and a diverse and abundant animal population flourished. Occasionally, turbulence would cause an influx of silty sediments, but the sea floor remained mostly quiet and undisturbed.

The sedimentation rate of fine clays was fast enough to cover the corpses of the dead organisms before they could decay by other natural processes. Once covered, water circulating in the sediments dissolved the original shells or skeletal materials, leaving only an impression or mold(fossil) of the animals in the sediment. Later, some of these molds were filled with sediment to form a cast (Figure 5). Molds, however, are the primary fossil type found at Swatara Gap.

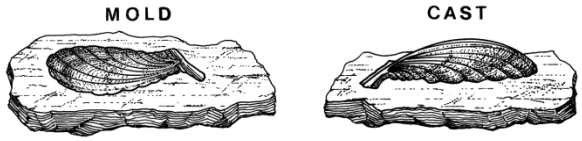


Figure 5. Illustrations of fossil mold and cast.

There are very few other fossil collecting sites in the Martinsburg Formation, even though it underlies large portions of several counties (Franklin to Northampton). Other locations were not suitable for the formation of fossils due to adverse environmental conditions such as excessive mud, turbulence, and shortage of food. The seawater itself may have selectively dissolved the shells and skeletal remains of the animals before they could be buried.

Illustrations and names of the most common fossils collected at this borrow pit are included in Figure 6. This exposure is especially popular as a site for the collection of the trilobite genus *Cryptolithus.* Trilobite specimens may easily be found in fragments and are often found nearly intact. Swatara Gap is also one of the few places where the starfish genus *Hallaster* can be collected. Complete specimens of the starfish are prized by collectors. All specimens collected are fragile and for preservation should be wrapped in paper and placed in a sample bag.

Suedberg Fossil Site

A very accessible and interesting collecting site for Middle Devonian (about 375 million years ago) fossils can be found in the eastern section of the park. The borrow pit exposes a sequence of olive-gray siltstones and claystones called the upper Mahantango Formation. The fossils are concentrated primarily at the west end of the pit in deeply weathered bands 2 to 3 inches thick.

These ancient rocks are a record of a past environment. They show that this site was a shallow sunlit seafloor where mostly filter-feeding organisms thrived in the gentle sea currents. Following the death of these organisms, wave action concentrated their hard parts into lens-shaped deposits. Today we find these concentrations of shell and skeletal matter exposed as rock.

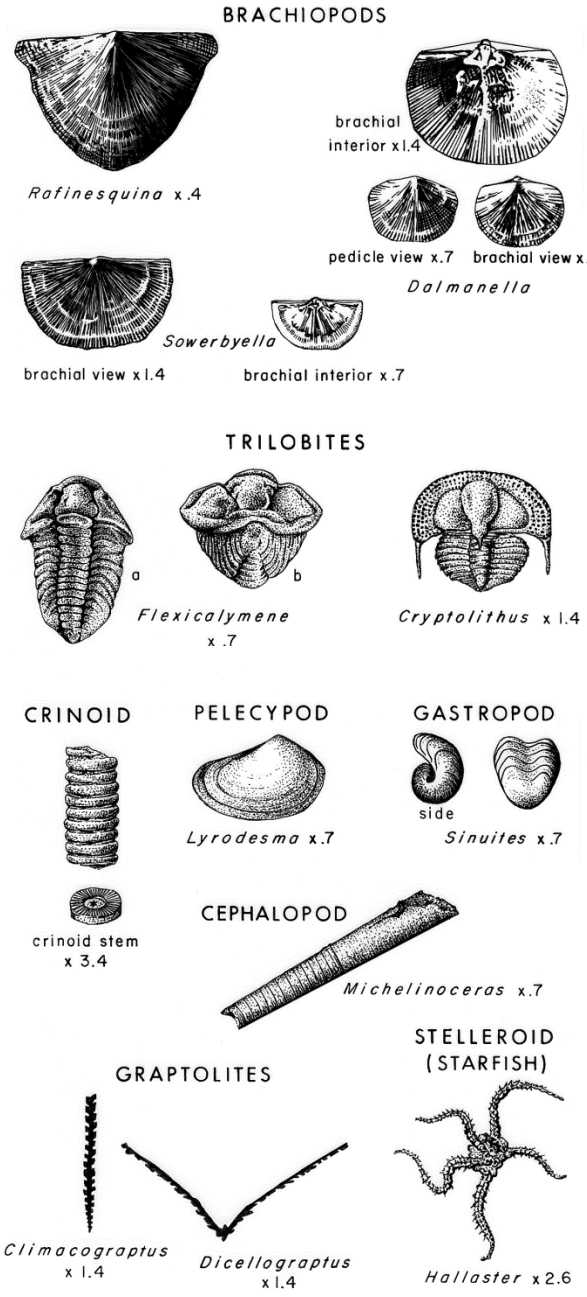


Figure 6. Common fossils at Swatara Gap.

Although the environmental conditions were similar to those described for Swatara Gap, the fossil zones at Suedberg are representative of organisms that lived 65 million years later than the ones at the gap. Figure 7 illustrates and names the fossils most commonly collected here. The fossils found in the concentrated zones are mostly internal and external molds of brachiopods and bryozoans. Pelecypods can be found as delicate white casts in the claystones on the east side of the pit.

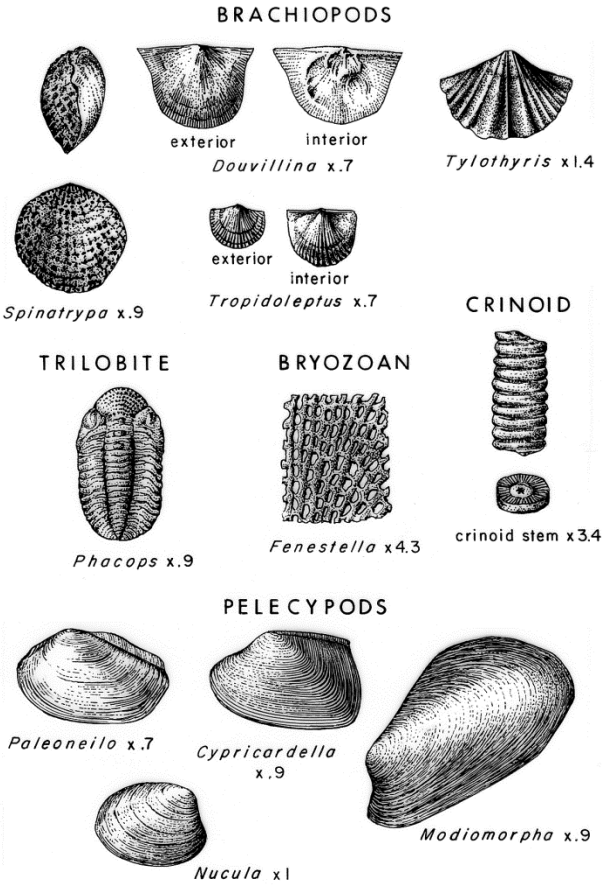


Figure 7. Common fossils at the Suedberg site.

Mineral Prospecting

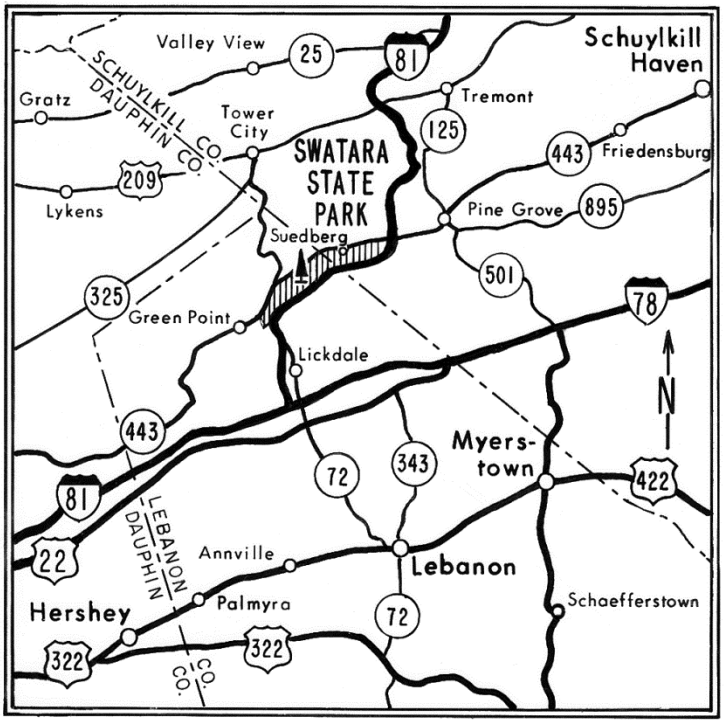
There has been mineral prospecting in the park area and local vicinity. A copper prospect hole (adit) can be seen in the siltstones and sandstones of the Bloomsburg Formation along Old State Road (Figure 8). The adit is a nearly horizontal excavation, 3 feet by

Figure 8. Copper adit along Old State Road.

5 feet at its opening and extending about 20 feet in length. A copper deposit was suspected here because the olive coloration in the sandstone suggested copper-bearing mineralization. Elsewhere in the state, copper has been found in the Bloomsburg Formation, but apparently none was found here.

There may have been some prospecting for gold north of the park area. Gold Mine Road leaves the park and extends to Gold Mine and Gold Mine Run. Although these names are strong indications that gold was indeed discovered and mined, it was probably never found in a form worth the cost of recovery.

—Denise W. Royer, Geologist
Pennsylvania Geological Survey
1982



LOCATION MAP

Swatara State Park
1450 Suedburg Road
Pine Grove, PA 17963
Phone: 717–865–6470

Modified to page-size format in 2012.
Series and address information updated in 2016.

PREPARED BY

Department of Conservation and Natural Resources
Bureau of Topographic and Geologic Survey

pennsylvania
DEPARTMENT OF CONSERVATION
AND NATURAL RESOURCES