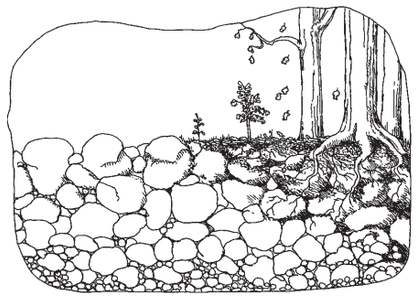
The Glacier Retreats

For unknown reasons, the climate began to warm about 15,000 years ago. The glacier began to melt and retreat farther each year, releasing large amounts of water and debris. When the yearly average temperature rose above freezing, the permafrost thawed, and Boulder Field stopped forming.

As the climate continued to warm, animals and plants returned to their former range. The first people moved in as the landscape slowly reverted. In fact, the forest continues to reclaim the area in a process known as succession. Trees lining the edge of the boulder field drop leaves that settle between the rocks and decompose to form enough soil for new plants to grow. Ever so slowly, the boulder field is shrinking.



As succession takes place, Boulder Field slowly shrinks.

Preserving A Historic Landscape

While the boulder field won't become hidden by a forest any time soon, its future is still uncertain. The crowds of people who visit Boulder Field every year have the ability to negatively affect the site in many ways. Graffiti, souvenir taking, and rock stacking are steadily destroying the natural beauty of this ancient landscape. Every time a rock is moved or stacked, valuable geologic clues that could answer lingering questions about Boulder Field are lost. One example are the "pits" in the boulder field. At one time, they were naturally formed shallow depressions, but they have been changed so much by visitors moving rocks that the geologic evidence explaining their formation is gone.

With advances in technology, geologists are still researching various aspects of Boulder Field which may one day reveal new details of its formation. For instance, there is debate about how far the boulders moved. Some geologists say the boulders traveled about one mile; others say they did not travel at all, but were weathered in place. Some also dispute the lack of sand or other debris between the boulders, saying it washed away or settled under the stones; others wonder if it was ever there at all. Water drains from a bog east of the field, flows through the ground underneath the field, and emerges on the other side officially becoming Hickory Run stream. Did this water flow help form the field or remove the debris from between the rocks? If visitors leave the rocks in place it preserves the field's natural character, which could help a future geologist answer questions just like these.

You can help preserve the boulder field by reporting disrespectful behavior to park staff immediately.

Explore Boulder Field safely and respectfully:

- Boulder Field has been here, mostly unchanged, for over 20,000 years. Enjoy it as you find it.
- Moving or stacking rocks is prohibited. Rock towers are unstable and create hazards for passing visitors and the staff who must dismantle them.
- Be prepared and wear proper footwear. Take your time; some rocks wobble.
- Obey all posted rules and regulations; respect the resources of the park.

Boulder Field Basics

- Boulder Field is 400-foot wide and 1,800-foot long. On average, it is 10 to 12-foot deep.
- The rocks are a mix of red sandstone and quartz conglomerate.
- Snakes may be seen in the wooded rocky edge of boulder field, but not in the open field itself.
- Wolf spiders and a variety of insects live among the rocks.
- Yes! There are other boulder fields; none of them are as large, flat, or as easily accessible as this boulder field.

Learn, Experience, Connect

For a more in depth park experience:

- Attend an educational program at the park; view the program listing at the Visitor Center.
- Contact the Visitor Center to arrange a program for a school or organized group.
- Visit the interactive boulder field exhibit located in the Visitor Center.

Access for People with Disabilities

This publication text is available in alternative formats. If you need an accommodation to participate in park activities due to a disability, please contact the park you plan to visit.

For More Information

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Hickory Run State Park

Boulder Field

Boulder Field is a fossil, a relict, a leftover. However, it is not the remains or impression of an ancient animal or a plant, but a remnant of landscape created by intense climate conditions during the last ice age.

Designated as a National Natural Landmark in 1967, Boulder Field is the best example of a boulder landscape in the eastern United States. It was also declared a State Park Natural Area in 1993, further establishing its significance as a geologic wonder to be preserved for future generations.

While geologists continue to research Boulder Field and offer new theories on its formation, this brochure features the most widely accepted theory to date which was first proposed by Mr. H.T.U. Smith of the US Geological Survey in 1945.

An Ice Age Begins

For unknown reasons, the climate began to cool about 80,000 years ago. More snow fell on the north and south poles than melted each year. The extreme buildup of ice caused the most recent ice advance, also known as the ice age.

As the yearly temperature cooled, animals migrated farther south. Cold-tolerant plant species replaced the dying warm-loving species, changing the forest.

Out of the north crept a giant sheet of ice, a glacier. Several miles thick and as wide as North America, the Laurentide Continental Glacier was a frozen blanket that eventually covered two-thirds of North America.

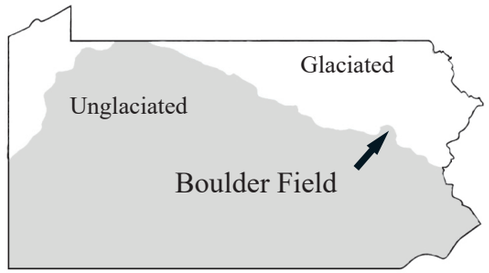
Like a giant bulldozer, the glacier scraped the land, absorbing debris such as rocks, sand, and dirt in its path before encasing them in ice.

The glacier's southern advance slowed and eventually stopped about a mile north of Boulder Field's location. Being so close to the glacier, the area at the boulder field was subjected to intense cycles of freezing and thawing, referred to by geologists as a periglacial environment.

Characteristics Of A Periglacial Environment

CLOSE PROXIMITY TO A GLACIER

The entire area encompassing the boulder field is a highland. The map below shows the extent of the last glacier in Pennsylvania. The glacier formed around, but did not cover or reach Boulder Field. Nearly surrounded by glacial ice, the periglacial conditions at the boulder field were extreme.



The furthest expansion of the last glacier into Pa.

On the park map, the topography is better seen. The edge of the glacier, called a moraine, is denoted by white triangles, and contour lines show the nearby ridges. These high points to the north and east of Boulder Field probably influenced the glacier's path.

PERMAFROST

During the last ice age, the climate in the area of Boulder Field was vastly different than it is today.

The average temperature was well below freezing. It was cold enough to create permafrost, or permanently frozen ground.

Few plants can grow on permafrost soil. Without vegetation, soil erodes and exposes the underlying rock, which is called bedrock.

The upper layer of permafrost is called the active zone. It thaws as temperatures change seasonally, but deeper down the ground remains frozen year round. This waterlogged mixture of soil, rocks, and sand rests on top of the frozen layer. It is able to shift and creep downslope in a process called gelifluction.

FREEZE-THAW & FROST-HEAVE

Water has a unique property that helped create Boulder Field. Most substances shrink as they cool, but water expands as it freezes due to the molecular bonds.

Water

Water seeps into a very small crack in rock. When the temperature drops below freezing, the liquid water expands as it turns to ice, widening the crack. If the temperature rises, the ice thaws allowing the water to sink deeper into the crack. This process is called freeze-thaw.

Ice

A similar process is frost-heave, which takes place in wet soil or sand. As water freezes it expands, lifting objects up. Freezing water attracts more water and the molecules stack themselves. Objects such as rocks can be lifted up almost two inches.

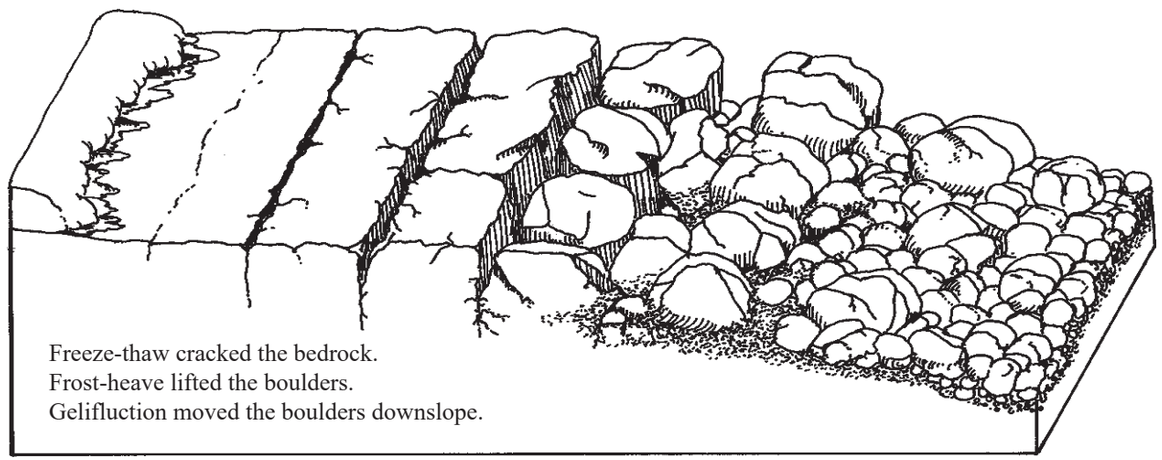
The combination of freeze-thaw and frost-heave is how potholes in roads are formed.

Periglacial Processes Combine To Create A Unique Landscape

Like puzzle pieces falling into place, the story of Boulder Field reveals itself. The location was close enough to the glacier to experience intense periglacial conditions. The climate was cold enough to expose bedrock and create permafrost, yet warm enough for the temperature to go above and below freezing. The temperature fluctuations caused freeze-thaw and frost-heave that eroded (broke-up) bedrock, while gelifluction moved the rock downslope on the permafrost in a slurry of ice, mud, sand, water, and rocks. It is not known how fast this movement occurred, but it is assumed that it was extremely slow.

As the large boulders moved, they slowly rolled, exposing more cracks that were widened by freeze-thaw. The boulders broke into smaller and smaller pieces as they crept downslope, grinding against each other and rounding the edges. Streams of rock can be traced the length of the field to their origin in the bedrock at the head of the field to the east. The boulders also moved vertically. Constant ice formation at the bottom of the field heaved upward lifting the boulders. As frost-heave took place, slowly the smaller rocks, sand, and dirt worked their way to the bottom of Boulder Field as the larger boulders were heaved to the top.

Over the course of 15,000 to 20,000 years, these processes repeated multiple times to create the landscape known today as Boulder Field.



Freeze-thaw cracked the bedrock.
Frost-heave lifted the boulders.
Gelifluction moved the boulders downslope.