# Aspects of New Jersey Geology

# 2007

by
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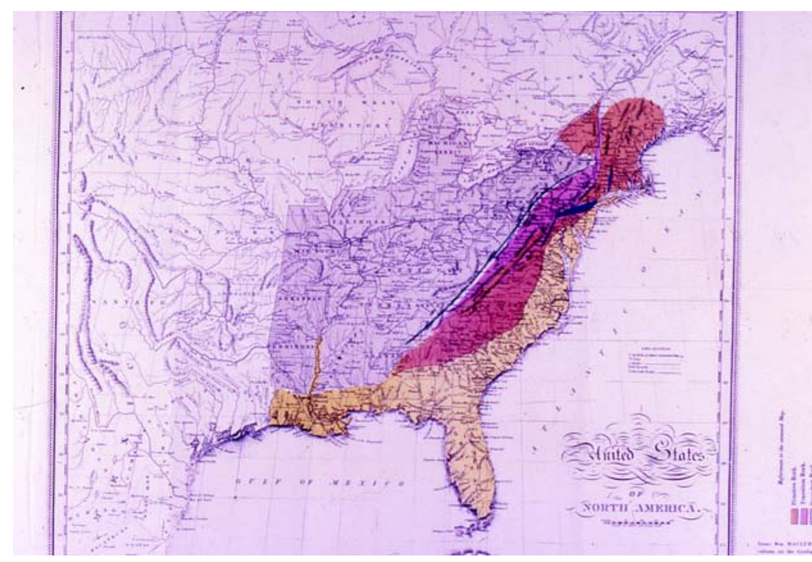
I make no apologies for the narrow range of geologic topics in these photos or for their quality. They are what I have in my slide collection and were converted to digital images using a desktop scanner. I may do another calendar next year if time and energy allow and if people send me enough good pictures. If you have digital images that you are willing to share on a non-copyright basis, e-mail them to me at dvdharper@hotmail.com with your name, the name of the photographer, where the pictures were shot, what they show, and a statement that you and the photographer agree that the images are not copyrighted, are available for free download and use, and may at some time be included in a public collection of images relevant to the geology of New Jersey.

The calendar is formatted for 11 by 17-inch sheets using a portrait format.


**Geologic Map of New Jersey** (Detail from a map (below) included in "Elementary Treatise on Mineralogy and Geology" (Parker Cleveland, 1816). The Elementary Treatise was the first American work of its kind. The New Jersey section of the map was enlarged from the size of a large postage stamp. While it clearly shows the Coastal Plain, Newark Basin, Highlands, and Valley and Ridge, the map does not begin to reflect the detail of understanding of the distribution of rocks even in 1816. The understanding of the origin of the rocks was much less advanced. Geology was in the midst of heated controversy. Neptunists, on one hand, believed that the major rock units of the Earth's crust, including granite and basalt, were deposited by sedimentation or crystallization from water. Plutonists, on the other hand, believed that many of the rock units exposed today, including granites and basalts again, formed as the Earth solidified from a molten mass. The Elementary Treatise on Mineralogy and Geology includes a discussion of basalt and diabase, including those in New Jersey, presenting both sides of the controversy.



# January 2007

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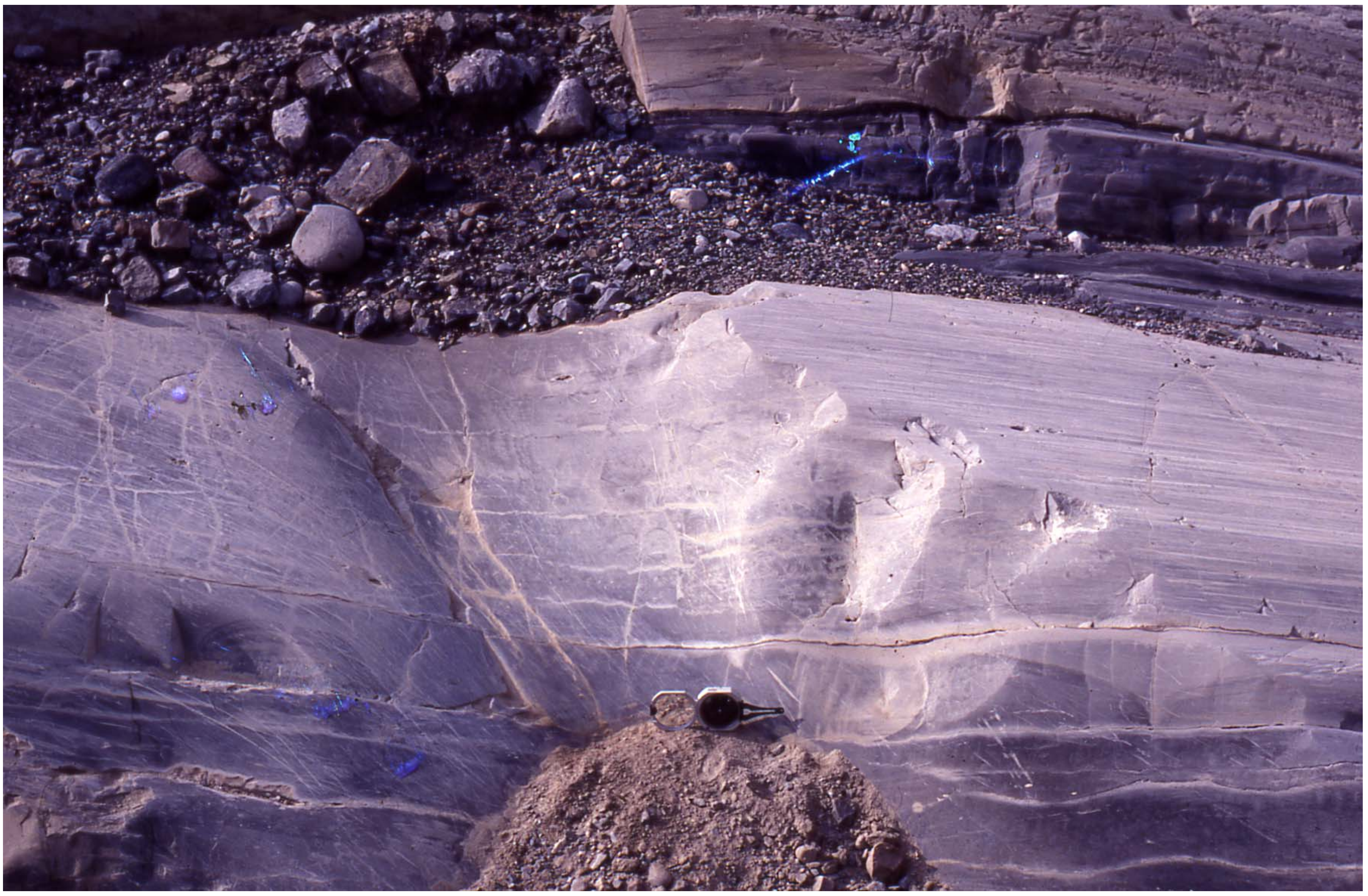

**Glacially scoured dolomite, Hamburg Borough, Sussex County** (Brunton compass for scale). The northern counties of New Jersey were at the southern limit of continental glaciation at least three times in the past two and a half million years. Most recently, the Late Wisconsinan glaciers entered New Jersey something over 20,000 years ago and were retreating northward by about 18,000 years ago. At this location, the ice was moving from right to left. Sand and stones embedded in the base of the ice scoured and flattened the side of the outcrop facing into the flow. The side away from flow was not subject to the full erosive scour of the sediment carried at the base of the glacier. Instead, pieces of the outcrop froze hard to the moving ice and were plucked from the outcrop and carried southward. This photo is from a worked out gravel pit. The scoured and plucked surfaces are well preserved here because they were shielded from weathering for 18,000 years by 20 or 30 feet of gravel.

# February 2007

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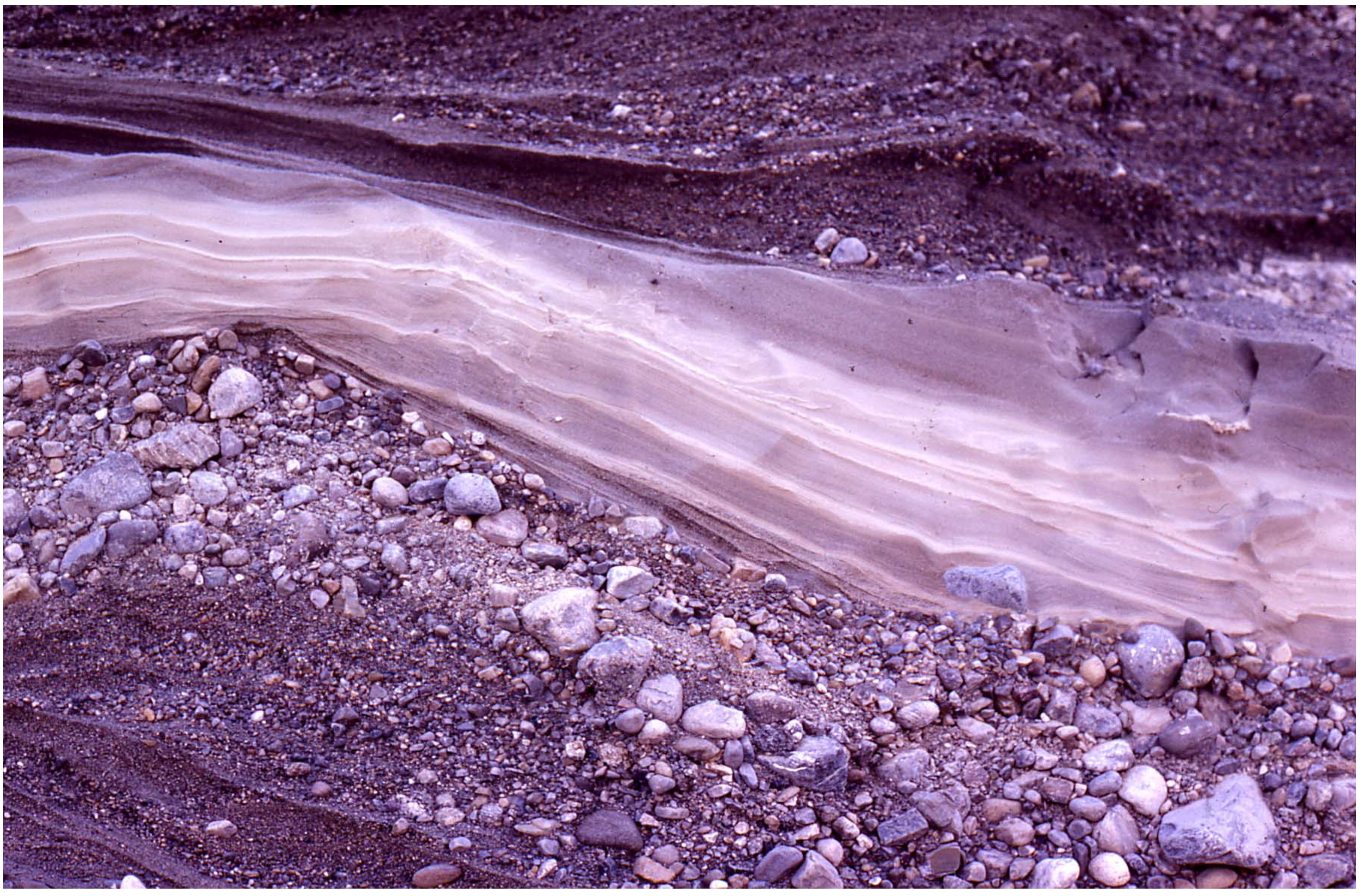

**Sand and gravel deposited by glacial meltwater, Allamuchy Township, Warren County.** While glaciers are the basic fact of ice ages, meltwater may be at least as important, or more important, in eroding sediment, moving it from place to place, and depositing it. This sand and gravel was deposited by meltwater in an ice marginal delta, one of the most dynamic, constantly changing environments on Earth. In wintertime, little water may be discharging. In summertime, torrents pour from the ice. River courses change constantly as meltwater cuts new channels through and under the ice and as sediment-choked rivers find new outlets. In this deposit from glacial Lake Pequest, sediment changed from coarse gravel to clean sand, then to fine gravel. The entire thickness may have accumulated within a few hours.

# March 2007

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**Sediment disruption by cryoturbation, Groveville, Mercer County**. Ice age conditions in New Jersey are best known from the glaciated northern part of the state, but relics of the severe climate are common to the south as well. In today's climate, rain soaks into the ground, percolates downward to the water table, then flows underground to streams or lakes. Under permafrost conditions, water freezing in the cold soil fills the pore spaces between grains with ice and creates an impermeable barrier. The sediment in this photo is well drained today. In the ice age, it was above an impermeable permafrost layer and could not drain. Summertime melting of the top few feet turned the soil into water soaked mud. Mud flows even on gentle slopes. If heavier sediment is on top of lighter sediment, mud can flow where there is no slope at all.

# April 2007

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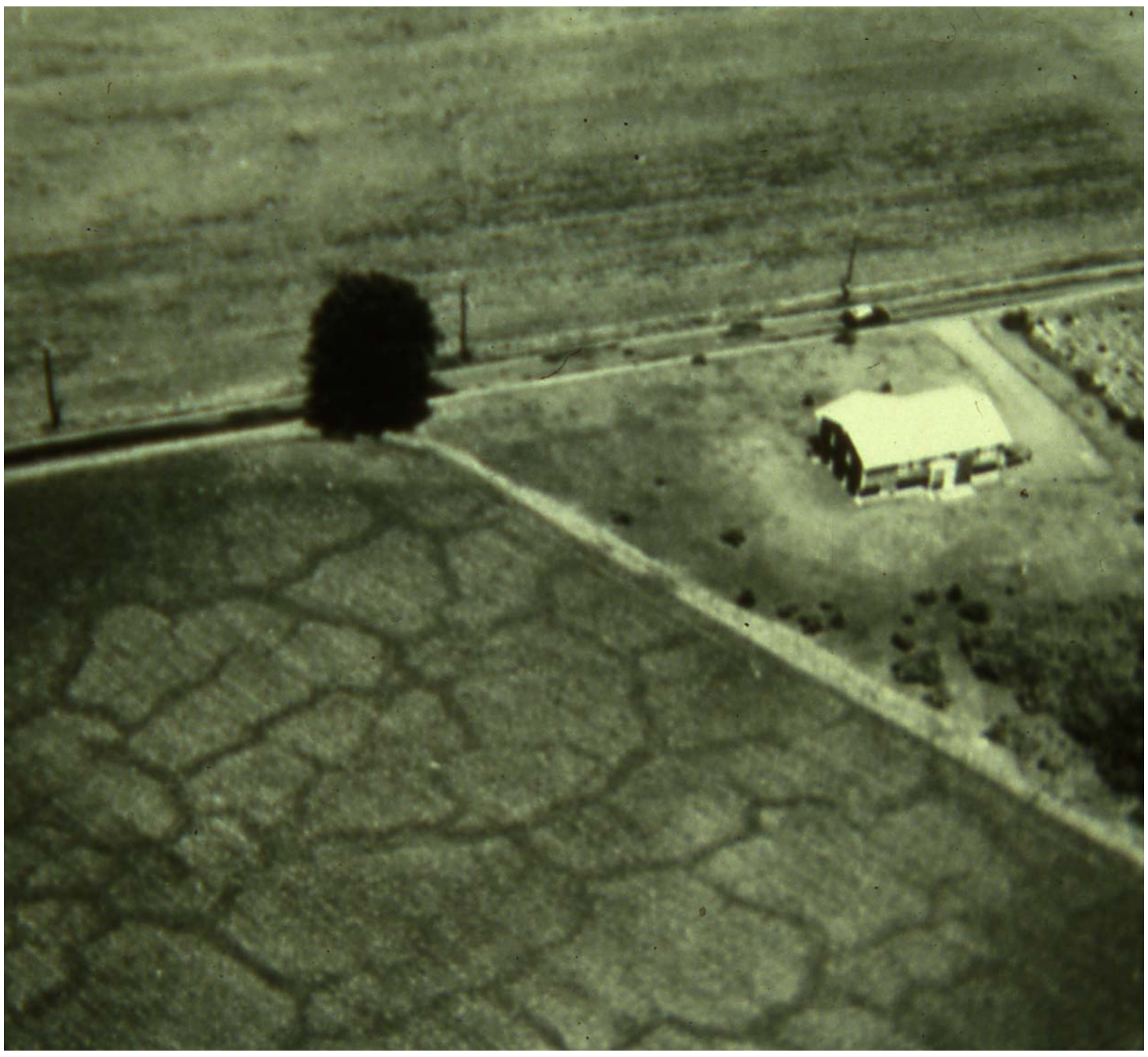 

**Frost wedges (left: aerial photo, Branchburg, Somerset County; right: cross section, Rutgers - Busch Campus, Middlesex County).** Photos courtesy of Jim Walters. Frost wedging can disrupt rock or frozen soil. In much of central New Jersey, fractured bedrock is near the land surface and repeated freezing and thawing in the ice ages allowed ice to penetrate into fractures in the rock and pry it upward in polygonal patterns similar to, but larger than, the polygonal cracks that form when mud dries. Most of the time, ice age frost wedges are not visible today. The aerial photo to the left was shot under drought conditions. The polygons are visible because soil filling the wedges held enough moisture to keep grasses healthy. The grasses on bedrock closer to the centers of the polygons dried out and went dormant. The photo on the right shows soil filling a frost wedge in shale bedrock. The bedrock layers were pried upward while the frost wedge was growing. The soil may have washed in while the wedge was growing or later.

# May 2007

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| 27 AGU, Mineralogical Society of America, Geochemical Society; Baltimore | 28 | 29 | 30 | 31 | | |

**The Haddonfield Dinosaur, *Hadrosaurus foulkii*.** Excavated in 1858, this was the most complete dinosaur skeleton to be found anywhere up to then. The fossil changed the understanding of dinosaurs when Joseph Leidy recognized that the creature could stand on two feet, not four. It was also the first dinosaur ever mounted for museum display (in 1868 in Philadelphia). After anatomists noted similarities between the New Jersey skeleton and those of birds, Thomas Huxley became the first to argue that birds evolved from dinosaurs. Because of the efforts of Joyce Berry and her Haddon Township fourth grade classes through many years, *Hadrosaurus foulkii* was designated the New Jersey State Dinosaur in 1991. A stained glass window in Trenton's State House Annex and numerous Hadrosaur recreations, like this one in the Watchung Reservation's Trailside Museum reflect the fossil's status as an official New Jersey symbol.

# June 2007

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**Cross bedding in sand, Sand Hills, South Brunswick, Middlesex County.** Sand Hill is the highest point along Route 1 in central New Jersey. Instead of being underlain by rock, it is underlain by sand. An ironstone cap may have been important in keeping the hill from eroding. The hill is to the southeast of the Rocky Hill diabase ridge, and was interpreted by George Cook in his 1868 "Geology of New Jersey" as an eddy deposit in the lee of the ridge, one of numerous remnants of a catastrophic flood which swept northwest to southeast across New Jersey. Flooding was scarcely mentioned in subsequent reports, and within 10 years, many of the deposits previously attributed to flooding were clearly demonstrated by Cook and John Smock to be glacial. By contrast, he sand at Sand Hill has long been accepted as a Cretaceous marginal marine deposit. The blobs above the lens cap are red clayey silt which appears to be derived from the Passaic Formation. They may have been shale pebbles or mud lumps when they were deposited. In either case, they suggest that the Passaic was exposed to erosion fairly close to where the sand was being deposited.

# July 2007

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**Palisades Diabase, Bergen County, from the Hudson River.** The Palisades cliff is made of diabase, an igneous rock. Two hundred million years ago, the Atlantic Ocean did not exist and New Jersey was contiguous with North Africa. North America, Africa, and Europe were splitting apart. Molten rock moved upward into rock fractured by the splitting, and spread horizontally between layers of sedimentary rock to form a flat layer, known as a sill. As the melt cooled, it contracted. The stress from the contraction split the sill into the vertical columns seen in this photo.

# August 2007

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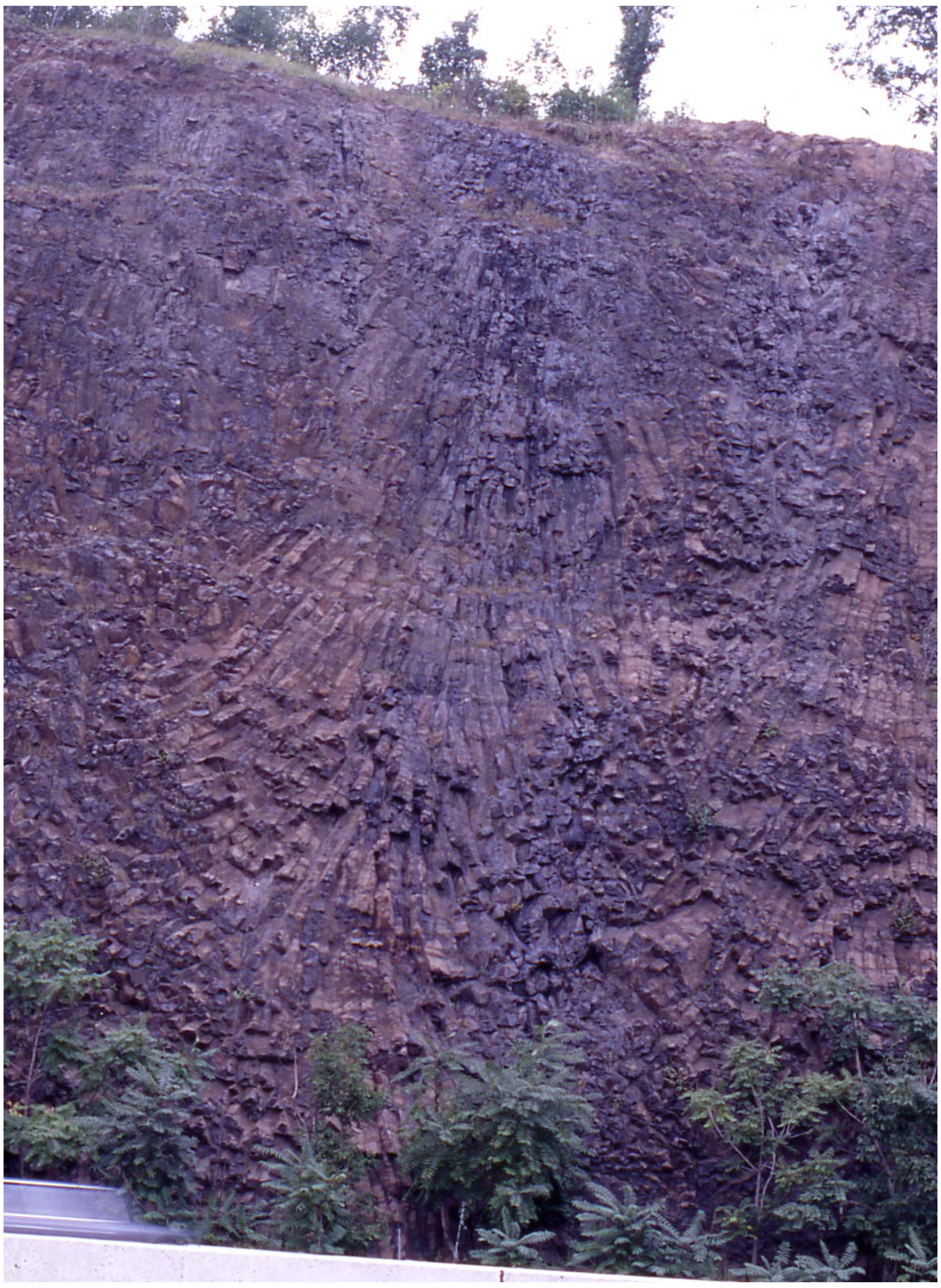

**Basalt along Interstate 280, West Orange, Essex County.** The columns in this basalt, like the columns in the Palisades diabase (August) are the result of contraction during cooling from a melt. They are smaller because the basalt erupted to the surface and lost its heat quickly to the atmosphere. Several explanations have been offered as to why the columns fan outward from the top instead of running vertically like those in the Palisades. In the most straightforward explanation, but not necessarily the right one, the curving is the result of differences in heat loss from place to place across the surface of the lava flow. The top of the flow was not flat and uniform. At some places thick, floating rafts of lava frothed up by escaping gas insulated the melt and reduced heat loss. At other places fissures cut through the cold crust, exposed the red-hot interior, and let heat escape straight to the air. Because the lava was colder where heat was going out fastest, the cooling did not progress uniformly from top to bottom. The cooling also progressed laterally from colder places where the heat was escaping fastest towards hotter places where thick crust slowed heat loss. The contraction and fracturing followed the cooling, fanning outward from colder places towards hotter places.

# September 2007

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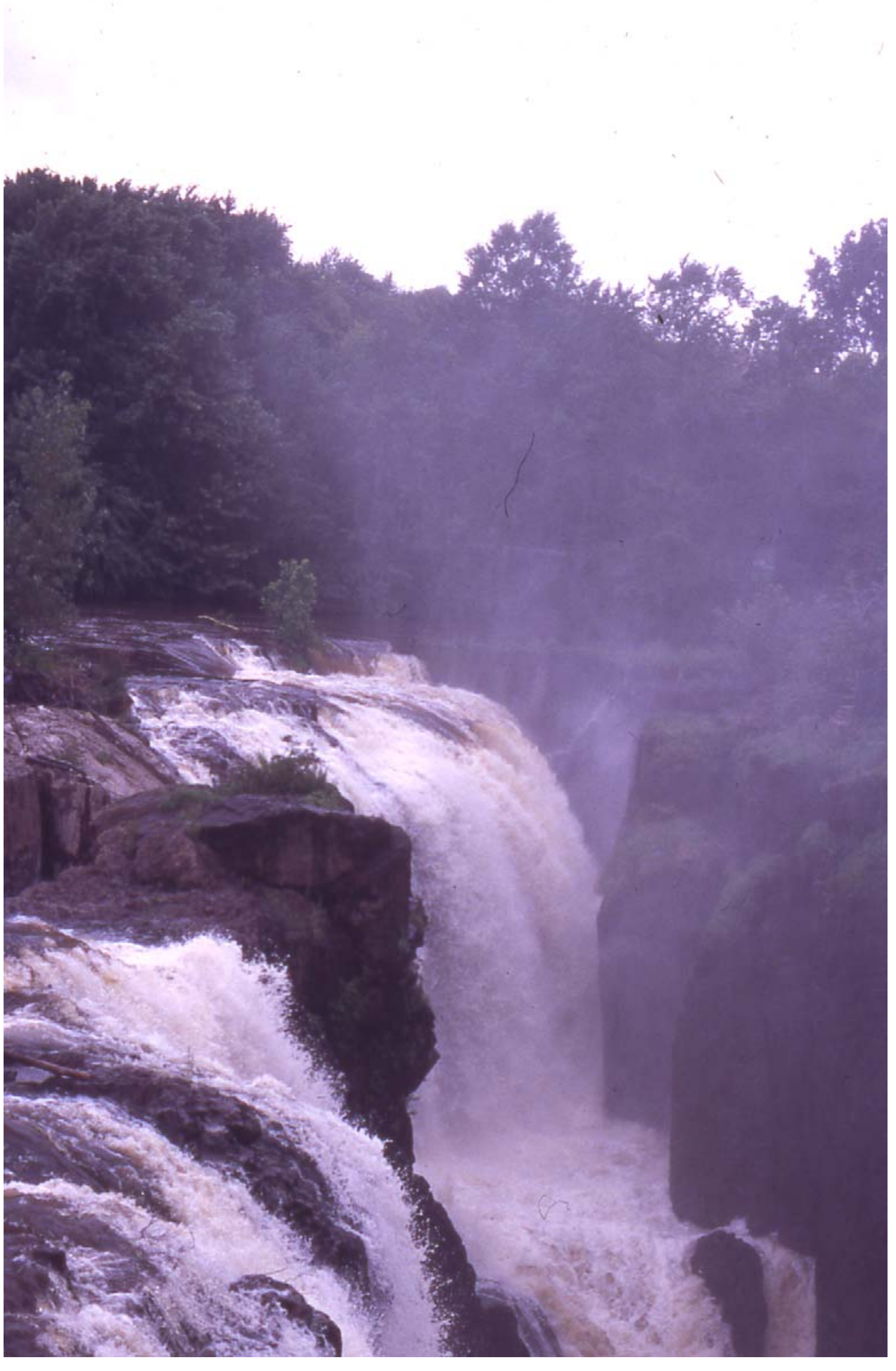

**Great Falls of the Passaic, Paterson, Passaic County**. Drainage disruption is a common effect of glaciation. Before the Late Wisconsinan glaciation, the Passaic River crossed the First Watchung through a gap cut to about present sea level at Short Hills. The terminal moraine now fills this gap to over 350 feet, and the Passaic crosses the First Watchung through the Paterson Gap, at an elevation of about 120 feet. The Paterson Gap is one of a series of gaps across the Watchungs and the New Jersey Highlands which may have carried a river flowing southeastward across New Jersey long before the Passaic came into existence. In 1778, early in the history of the United States, Alexander Hamilton visited the falls and recognized its industrial potential. As Secretary of the Treasury, he helped found the Society for the Establishment of Useful Manufactures, which leased property to mills using water power to drive their machinery. Later, the falls were used to generate electricity.

## October 2007

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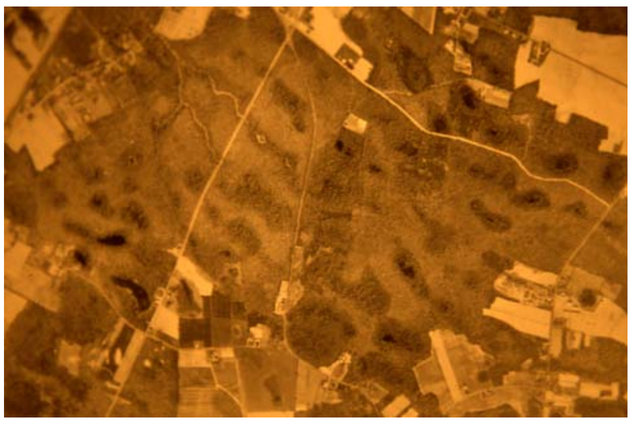
**Ventifact, New Brunswick, Middlesex County.** The faceting of this rock is hard to explain by stream wear but easy to explain by "sandblasting" by sand and silt blown from the predominant wind directions. Rocks like this, called "ventifacts," are common where soil is not stabilized by vegetation. They do not form in heavily vegetated places like New Jersey, but they are common here. The Cape May County air photo to the right, which may show dunes in an inland area now stabilized by forest, is more evidence that New Jersey was once less vegetated, and its soils more subject to wind erosion.



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**36-inch diameter rock core, Tocks Island Dam Site, Warren County.** The Tocks Island Dam was a large multi-purpose dam authorized in 1962 just upstream from the Delaware Water Gap. Geologic conditions at the site were not ideal for a dam, but construction was feasible. One problem was pervasive west-dipping jointing. The jointing is visible in outcrops along Old Mine Road (below). In order to determine whether the joints were continuous, 36-inch diameter holes were drilled to depths up to 300 feet. Field notes were made by a geologist lowered down the hole, and stress measurements were made across fractures. It was found that the joints were continuous, and that a proposed 300-foot-high cut would destabilize rock above the joints. The entire hillside above the cut might move downslope along joints towards the dam. Engineering solutions were available to deal with the fractured rock, but the dam was not built because of many other controversial issues. The project was not formally de-authorized until 1992.

# December 2007

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