Maine Geologic Facts and Localities
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The Agassiz Outcrop, Ellsworth, Maine:
A National Historic Landmark

44° 33′ 41.64″ N, 68° 26′ 17.54″ W

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Introduction
Rounded mountains, deep azure lakes, boulder-strewn fields, grooved and striated outcrops. Most school children today will recognize these features of Maine’s landscape as products of the last “Great Ice Age.” However, the concept of continental glaciation in North America was not recognized by the first geologists to explore the state in the 19th century. Most of the features that today are attributed to continental glaciation were then attributed to "The Great Deluge."

Louis Agassiz, the renowned Swiss scientist and "Father of Glaciology," forever changed our interpretation of these features in North America. On a visit to Maine in 1864, Agassiz documented many features that contributed significantly to his thoughts about continental glaciation. The Agassiz Outcrop in Ellsworth (Figure 1), now a National Historic Landmark, was featured prominently in his works on glaciation in North America.
The Agassiz Outcrop, Ellsworth, ME

Directions

The Agassiz Outcrop is located in Ellsworth on the west side of Route 1A at a property that is now a print shop (Figure 1). It is about 1.5 miles north of the intersection of Routes 1A, 1, and 3 in downtown Ellsworth. The intersection of 1A and Route 179 is just north of the outcrop. The property owner supports the designation as a National Historic Landmark. There is parking space for several vehicles on the property, but it would be best to get prior approval from the property owner before bringing large groups to the site.

Figure 1. Location of the Agassiz outcrop (red triangle). Portion of the Ellsworth 1:24,000-scale USGS topographic map.
Louis Agassiz

Born on May 28, 1807 in Montier, Switzerland, Jean Louis Rodolphe Agassiz was educated in the universities of Switzerland and Germany where he received doctorates in philosophy and medicine. In November 1831, Agassiz moved to Paris where he studied under Cuvier, the most famous naturalist in Europe. By this time, Agassiz had proven himself an expert in fossil fish and this so impressed Cuvier that he turned over his own fossil fish research to Agassiz. Agassiz’s prominence within the scientific community expanded with his publication on the fossil record of fish, *Recherches sur les Poissons Fossiles*.

Agassiz turned to the study of glaciers in 1836 after his return to Switzerland where he was a professor at the University. Agassiz noted many of the features we now recognize as being of glacial origin, such as U-shaped valleys, large glacial erratic boulders, grooves and striations on bedrock, and mounds of debris called moraines. He published detailed work on the retreat of valley glaciers. Based on this work and his studies of glacial features all over Europe, Agassiz developed his theory on continental glaciation, the great Ice Age. This theory had the impact on scientists of his time that plate tectonics theory has on scientists of our time.
Louis Agassiz

In 1846 Agassiz accepted a professorship at Harvard and in 1861 became a citizen of the United States. Most important to this account was his visit to Maine in 1864 with the intent to "...examine the drift phenomena on the islands and coast of the state..." (Agassiz, 1867, p. 212). Agassiz published a series of articles in The Atlantic Monthly that extended his theory of continental glaciation to North America. His investigations in Maine were an important part of this work.

Agassiz did many other great things in his lifetime. He founded the Museum of Comparative Zoology at Harvard in 1860. With his colleagues, he helped found the National Academy of Sciences. Agassiz was also appointed a regent of the Smithsonian Institution in 1863.

Most importantly, he inspired generations of students and scientists.
Louis Agassiz in Maine

Agassiz undoubtedly visited a number of outcrops in the Ellsworth area, but he noted in particular the roche moutonées in the Ellsworth Falls area. These are asymmetrical bedrock landforms that have been sculpted by the glacier, with a smooth abraded slope on the side of glacial advance and a steeper, rougher slope on the opposite side. About the Ellsworth area, Agassiz made the following comments:

Between Bangor and Mount Desert the usual evidence of glaciation is very extensive. I would mention as particularly interesting the hills south of Holden and the hills about Dedham. On the route along Union Bay there are also extensive polished surfaces, especially in the vicinity of Bucksport. Near Ellsworth, they are beautifully preserved, and all the eminences are moutonées. At Ellsworth Falls, on both sides of the bridge, there are splendid polished surfaces, with scratches and furrows pointing due north. Between Ellsworth and Trenton, and westward of that meridian, in the direction of Bucksport, there are several longitudinal moraines parallel to one another, running from north to south, composed of large, angular boulders, resting upon ground moraines made up of rounded, scratched pebbles and sand mixed with clay. Such a superposition is utterly incompatible with currents passing over these tracks. Two miles west of Ellsworth a similar longitudinal moraine runs over the top of the hill, and about one mile farther west there is another, chiefly composed of coarse Dedham granite. The bottom deposit, upon which these moraines rest, consists of fine sand and loam with scratched pebbles. Seven or eight miles west of West Ellsworth the hills, consisting of clay slates on edge, trending from east to west, are abraded, and upon the polished surfaces of their leveled edges rest two other longitudinal moraines, with angular boulders of Dedham granite, running from north to south, and resting upon an extensive ground moraine containing many smaller rounded and striated pebbles." (Agassiz, 1867, p. 285)
Glacial Striations

The most prominent glacial features on the Agassiz Outcrop are the abundant glacial grooves and striations. Figure 2 shows prominent grooves on the polished bedrock pavement.

![Glacial Grooves on Bedrock](image)

**Figure 2.** Well formed glacial grooves developed on bedrock oriented northwest-southeast. The rock surface also shows a sheen that geologists refer to as glacial polish. Fine-grained materials trapped in the base of an advancing glacier cause this polishing.
Glacial Striations

The grooves are only a few millimeters deep and are oriented nearly northwest-southeast. Presumably the glacier advanced from the north, gouging the bedrock with rocks carried in its base. Figure 3 shows more detail in the fine striations.

Figure 3. A close-up view showing grooves and striations. The cross-cutting pattern of striations indicates that more than one episode of glacial advance affected this outcrop.
Ellsworth Schist

While not the focus of Agassiz’s work, this locality provides an opportunity to look at some interesting bedrock features. The bedrock is the Cambrian Ellsworth Schist, a feldspar-rich schist of volcanic origin. At this locality, it consists of thinly interbedded buff-colored quartz and feldspar-rich layers, and greenish-gray mica-rich layers. Layers are only a few millimeters thick and are parallel to a strong northeast-southwest trending foliation. The layering is deformed into a contorted series of folds caused by several deformational episodes that affected these rocks (Figure 4-6).

Figure 4. Fine folds developed in the thin layers of the Ellsworth Schist. Most of the hinges of these folds are parallel to one another and are oriented northeast-southwest.
Figure 5. A broad elliptical dome developed in thin layers. The long axis of this dome is parallel to the folds shown in Figure 5. Features like this are evidence that the rocks were affected by more than one deformational episode.
Figure 6. Chaotic folds developed in the Ellsworth Schist.
Offset of Glacial Striations

Another curious feature is the offset of glacial striations along a foliation surface (Figure 7). The south side of the offset is raised several centimeters higher than the north side. The offset occurred more recently than the Ice Age because the grooves that Agassiz so carefully studied are cut by the offset. While it is interesting to speculate about the natural causes of such a feature (earthquakes? frost heaves?), it may be that they were generated by modern road construction.

Figure 7. Bedrock offset of several centimeters along a foliation surface. The south side has been raised up relative to the north. This occurred after the last glacial episode, but may be related to road construction.
National Historic Landmarks

National Historic Landmarks are nationally significant historic places designated by the Secretary of the Interior because they possess exceptional value or quality in illustrating or interpreting the heritage of the United States. Today, fewer than 2,500 historic places bear this national distinction. Interested individuals, organizations, contractors, State Historic Preservation Officers, Federal Preservation Officers, and National Park Service staff, with the participation and assistance of the owner(s) of the property, prepare nominations to the program.

Dr. Harold Borns and Dr. David Smith, University of Maine, nominated the Agassiz Outcrop, in collaboration with Christi Mitchell of the Maine Historic Preservation Commission. The National Park System Advisory Board accepted the nomination in February 2003.
References and Additional Information

