

# Observations in the Swiss Alps and Elsewhere

All quotations in this file are from Louis Agassiz, 1838,  
*Upon Glaciers, Moraines, and Erratic Blocks*: Presidential  
Address to the Helvetic Society, published in the  
*Edinburgh New Philosophical Journal*, vol. XXIV, pp.  
364-383.

<https://www.biodiversitylibrary.org/>

“Everyone in Switzerland is familiar with the glaciers, and knows that their margins are bounded by piles of roundish blocks which are called moraines, and which are continually pushed forwards, or abandoned, by the glaciers, as these advance or retire...”



**Figure A.** A terminal moraine forms at the leading edge of Mendenhall Glacier in Alaska.  
<http://www.earthscienceworld.org/images/index.html>, Photo ID: hflscf

Dirt and rock accumulate on the ice in summer and are covered by fresh snow in winter. Each dark + light layer represents one year of glacial accumulation. Here, the layers are bent as the ice flows. When the ice melts, the debris in the dark layers piles up to form a moraine, while meltwater flows out from under the glacier.



**Figure B.** Closeup of a terminal moraine at the edge of Alaska's Columbia Glacier.  
<http://www.earthscienceworld.org/images/index.html>, Photo ID: hfz3nk



Rocks embedded in the bottom of the glacier served as "tools" that scratched the bedrock over which the glacier moved. The resulting features are useful indicators both of the former presence of glaciers and of the direction in which the glacier moved.



**Figure C.** Glacial polish on bedrock.

<http://www.earthscienceworld.org/images/index.html>, Photo ID: ih07hx

Long parallel scratches in bedrock or in boulders are called **striations**. Larger versions (big enough to walk in) are known as glacial grooves. Note that striations and grooves may also form in rocks carried by the glacier.



**Figure D.** Glacially rounded and striated bedrock.

<http://www.swisseduc.ch/glaciers/glossary/roche-moutonnee-en.html>

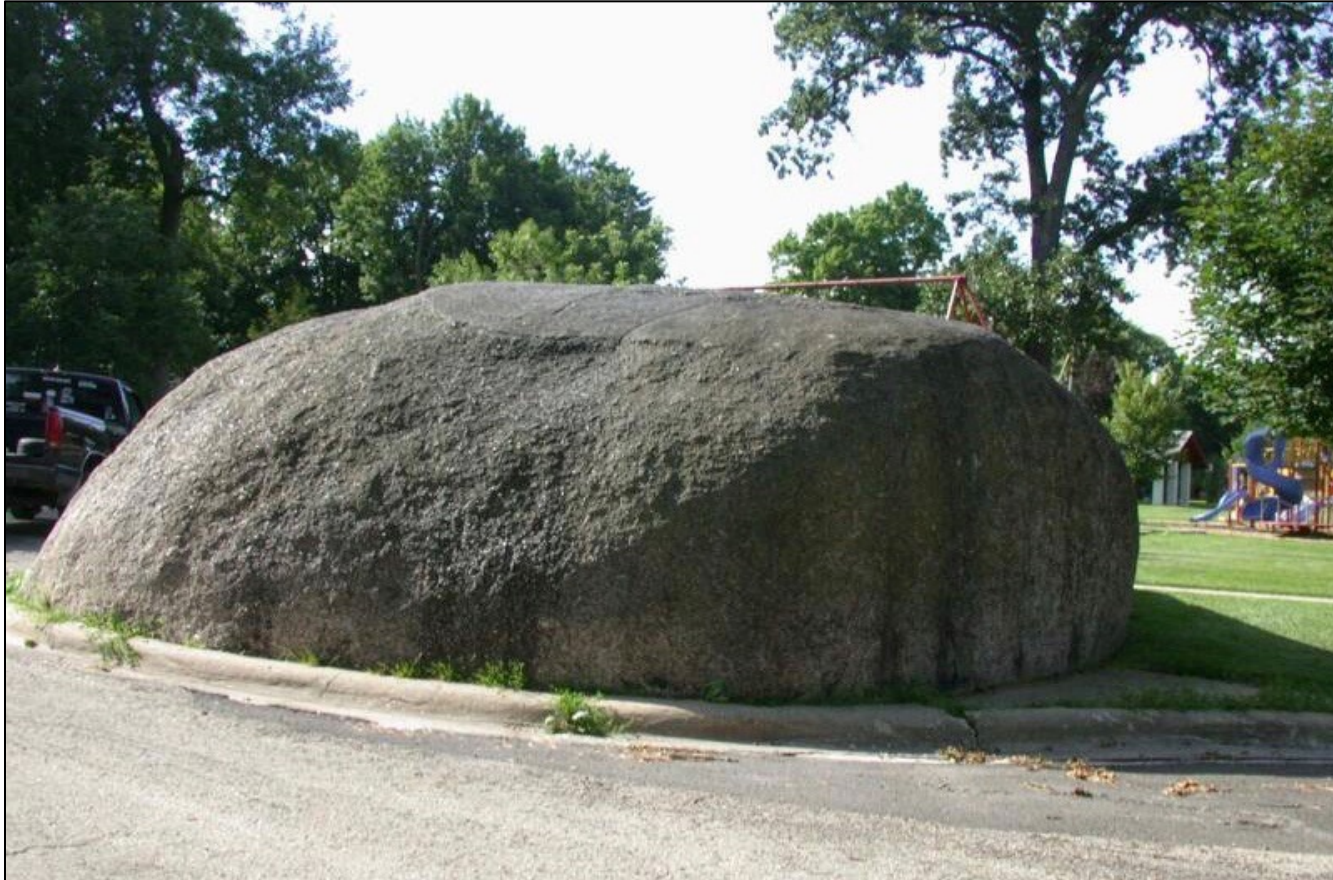


“[Some of the Swiss people] are acquainted with another phenomenon which is striking among our mountains - I mean that of erratic blocks, or those masses of granite and other [igneous] rocks, which are found chiefly on the southern slopes...”



**Figure E.** A glacial erratic looks out of place on the shore of Lake Ontario.  
<http://www.earthscienceworld.org/images/index.html>, Photo ID: iparq3

Glacial erratics are scattered across northern lands. Their scratches and shapes and their rock types that do not match the local bedrock indicate their glacial origin.



**Figure F.** This huge erratic is still half-buried in Nora, Iowa.  
Photograph by E. Herrstrom



“[These appearances] may be observed not less distinctly in all the valleys whose flanks are crowned with ancient moraines, at whatsoever distance they may now be from the existing glaciers...”



**Figure G.** Lateral moraines (along the sides of a glacier, not in front) extend beyond the ice, indicating that the glacier used to be longer.

<http://www.earthscienceworld.org/images/index.html>, Photo ID: hdeep6



**Glacial till** is a jumbled mixture of boulders, cobbles, gravel, pebbles, sand, mud, and dust without any internal layering. The sediment is poorly sorted. The grains themselves may be pieces of whatever rock the glacier moved across as the ice advanced.



**Figure H.** A person gives the scale of material in glacial till in the Sierra Nevada Mountains in California.

<http://www.earthscienceworld.org/images/index.html>, Photo ID: hdeeee

**Outwash** consists mainly of sand and gravel (medium to coarse rounded grains) carried by flowing water and deposited in layers. Because outwash material was once frozen in ice, it is considered a glacial sediment, even though it is actually deposited from water.

**Figure 1.** Layered outwash overlies unlayered till.





When outwash dries, wind picks up the finest grains and carries them away. Eventually, the dust settles to the ground. This type of wind-blown deposit contains material that was carried by water, but before then it had been frozen in ice, and so it too is considered to be a glacial sediment.



**Figure J.** Wind-blown dust near a glacier in New Zealand

<http://soilweb.landfood.ubc.ca/landscape/eolian-environment>

**Loess** (German for "loose and crumbly") is the term for these accumulations of wind-blown dust that usually produce unbedded deposits. The thickness of a layer of loess may range from a few centimeters to many meters.



**Figure K.** Loess can form near-vertical cuts and cliff faces.

[https://commons.wikimedia.org/wiki/File:VIEW\\_OF\\_A\\_SMALL\\_LOESS\\_BLUFF,\\_A\\_GLACIAL-FORMED\\_SOLID\\_EARTH\\_BLUFF\\_IN\\_DONIPHAN\\_COUNTY\\_KANSAS,\\_NEAR\\_TROY\\_IN\\_THE\\_EXTREME...\\_-\\_NARA\\_-\\_557100.jpg](https://commons.wikimedia.org/wiki/File:VIEW_OF_A_SMALL_LOESS_BLUFF,_A_GLACIAL-FORMED_SOLID_EARTH_BLUFF_IN_DONIPHAN_COUNTY_KANSAS,_NEAR_TROY_IN_THE_EXTREME..._-_NARA_-_557100.jpg)



**Sample A**





Sample B





# Sample C





# Sample D

