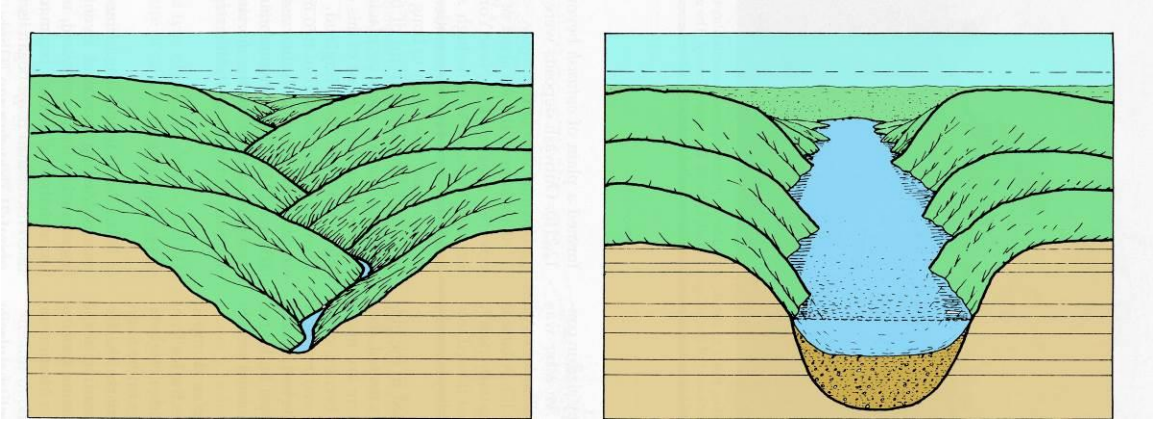
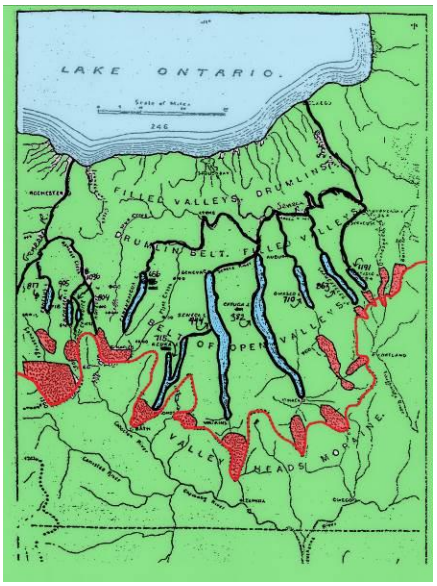
Glaciers

Between approximately 2 million and 12,000 years there ago there were between two and twenty glacial advances into the Finger Lakes. Geologists disagree on actually how many glaciers came into the Finger Lakes, but we know that there were at least two because we have proof at Robert Treman State Park in Ithaca. At Robert Treman, the gorge consists of an older gorge and a newer gorge, which were caused by two different glaciers.

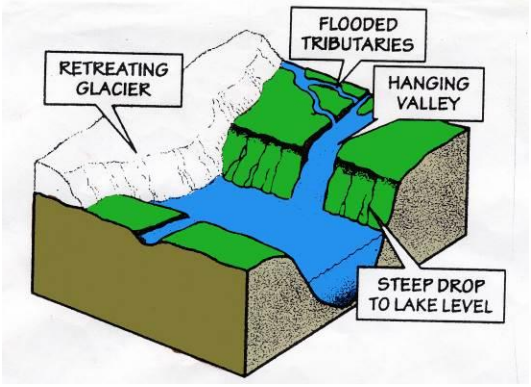
Glaciers are formed when there is a global decrease in temperature and piles of snow eventually get compacted down into a massive chunk of ice that can be a mile high- that's about as high as low clouds! It is difficult to imagine a huge piece of ice moving. A good visual to understand how glaciers move is to imagine making pancakes. When pancake batter is poured onto a pan, it spreads out in all directions. Glaciers work the same way- the ice starts to move in all directions just like pancake batter on a pan. However, landscapes are not all as flat as a pan. If there is a dent in the pan, the pancake batter will naturally flow into it and fill the dent. Although glaciers are ice, they are still a form of water, and will always take the path of least resistance. Glaciers followed river valleys and carved them out, turning them from "v-shaped river valleys" to "u-shaped river valleys".

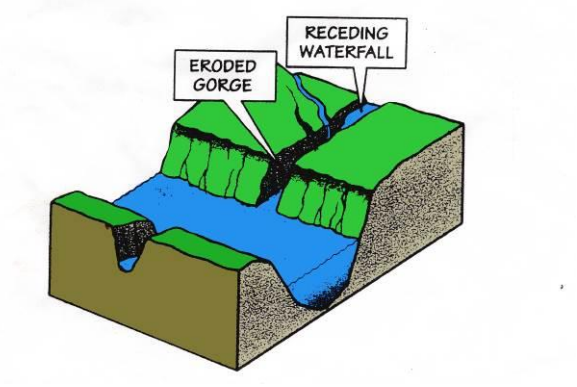


The most recent glacial advance stopped a little south of the Finger Lakes. When the glaciers were advancing they removed the top layers of rock and dirt from the landscape, like a bulldozer. When the glaciers stopped moving and began to melt, all of that sediment and glacial till was left behind. These are called moraines, and show where the most recent glacier stopped. The valleys carved out by the glaciers became the Finger Lakes themselves, and filled in with water from the melting glaciers. There are 11 Finger Lakes that all run roughly in a north-south orientation.



All of the streams that used to flow into these valleys suddenly became waterfalls, since the valley had been carved out. This is called a hanging valley. These waterfalls then began to erode backwards, forming the gorges. Since we know the glacier came through 12, 000 years ago, we know that these gorges are 12,000 years old.

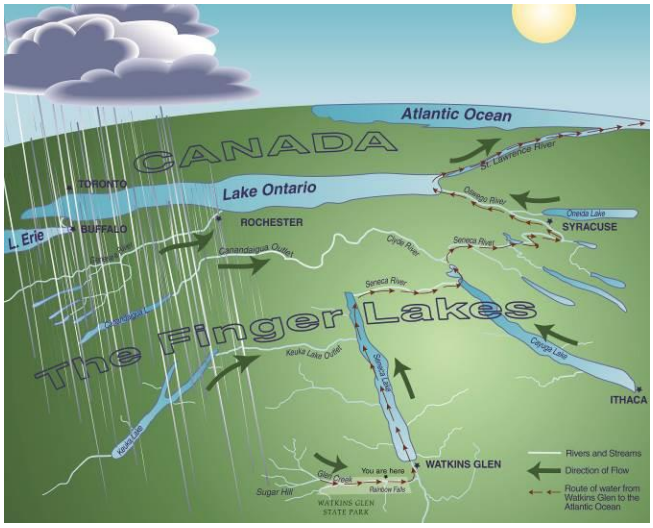




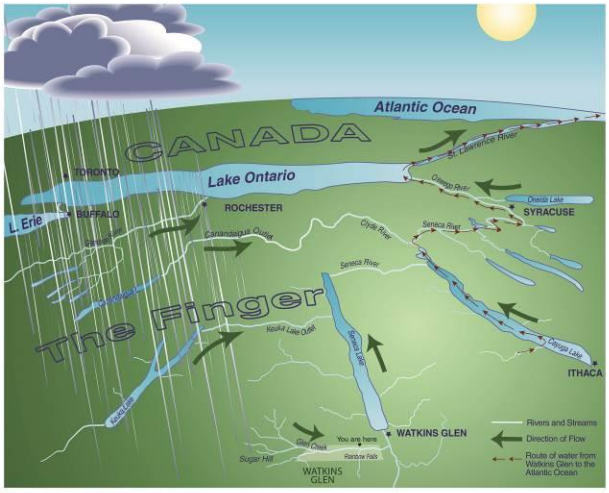
Lakes

Cayuga Lake is the longest of the Finger Lakes, at 38.1 miles long, and about 435 feet deep. Seneca Lake is the second longest lake at about 37 miles long, but is 632 feet deep, at its deepest point- much deeper than Cayuga Lake.

Between the weight of the glacier, the direction of the retreating glacier, and the moraines, the water flow was re-routed. The water flowed south prior to glaciers coming through this area, but now it flows north.



Watkins Glen: Glen Creek flows North into Seneca Lake, reaches the Seneca River and flows into Cayuga Lake, continues on the Seneca River and meets up with the Oswego River. The Oswego River runs into Lake Ontario and eventually the St. Lawrence River takes it the rest of the way to the Atlantic Ocean. A single drop of water spends about 18 years in Seneca Lake, and it takes about 25 years for a drop of water to travel from Glen Creek into the Atlantic Ocean.



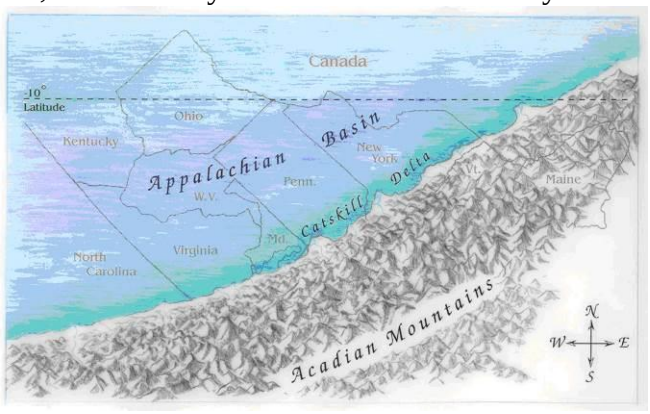
Robert H. Treman & Buttermilk Falls & Taughannock Falls: [Enfield Creek/ Buttermilk Creek/ Taughannock Creek] flows through this gorge into Cayuga Lake, then flows north into the Seneca River, where it flows east into the Oswego River. The Oswego River runs into Lake Ontario and eventually the St. Lawrence River takes it the rest of the way to the Atlantic Ocean. A single drop of water spends about 18 years in Cayuga Lake, and it takes about 25 years for a drop of water to travel from Enfield Creek into the Atlantic Ocean.

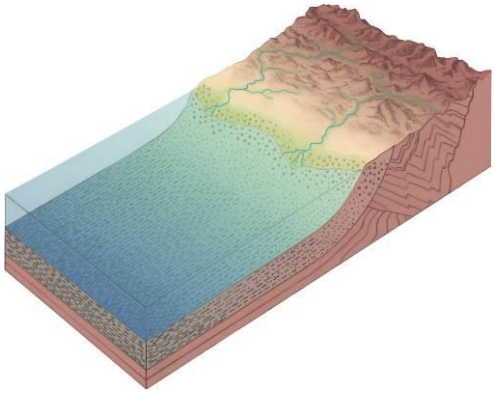
South Facing vs North Facing Sides of Gorge

We have a north-south running lake, so therefore we have an east-west running gorge. So, we have a south facing side that is warm and sunny, and a north facing side, which is cool and shady. This creates different ecosystems on each side, with visible differences in plants and amount of vegetation. On the south facing side there are sun loving plants, such as golden rod, Queen Anne's lace, white ash trees, staghorn sumac, white oaks, and even poison ivy. Alternatively, if the South side of the gorge gets too much sun even for these plants, it may be a very dry and almost desert-like area. On the north facing side we have shade loving plants, such as eastern hemlock, yellow birch, and ferns and mosses.

Shallow Inland Sea/ Layers in Rock

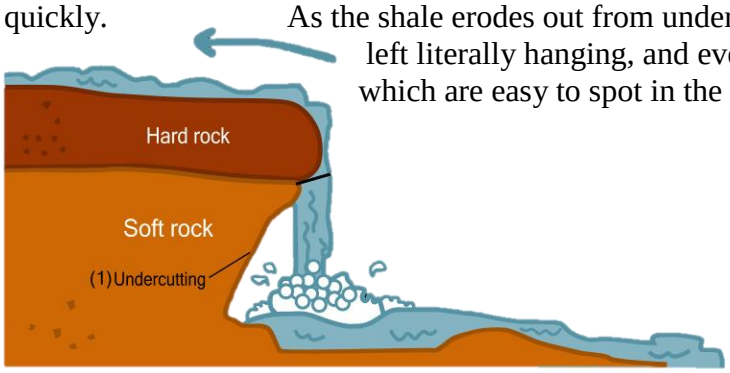
The super continent Pangea is fairly well known as the most recent time that all the tectonic plates were connected. Around 390 million years ago, about 90 million years *before* Pangea occurred, New York State was covered by a shallow inland sea. New York was located much closer to the equator at the time, so it was a tropical sea. At this time, North America (Laurentia) and Europe (Baltica) were colliding. North America subducted, or went underneath, Europe, which pushed Europe up and formed the Acadian Mountain range. When continents collide and form mountains it is called an orogeny. Some geologists say the Acadian Mountains were as tall as the Himalayas are today! That is around 29,000 feet tall. The Acadian Mountains came and went fairly quickly geologically speaking. By about 360 million years the Acadian Mountains had eroded away. The sediment eroding off of the mountains was deposited in layers in the inland sea, and these layers of rock are still clearly visible.





Types of Rock

We have primarily three types of rock in our gorges. Two types of sedimentary rock were formed in this area when the Acadian Mountain range was eroding into the sea. These rocks are sandstone and shale. The crumbly, darker rock is called shale, and that is made from mud. The thicker blocks of rock are sandstone, made from sand, and they are a bit tougher than shale. Because the shale is weaker than sandstone, it erodes more quickly. As the shale erodes out from under the sandstone, the sandstone is left literally hanging, and eventually falls in large slabs, which are easy to spot in the gorge steams.



The third type of sedimentary rock that we find is limestone, but this is less common. We find limestone in Taughannock Falls State Park, as it is the rock that makes up the riverbed. Limestone is primarily composed of the mineral calcite, which is what shells and bones are made of. As the aquatic organisms living in the inland sea were covered by sediment from the eroding Acadian Mountains, their shells and bones formed limestone. Limestone is usually white or light grey.

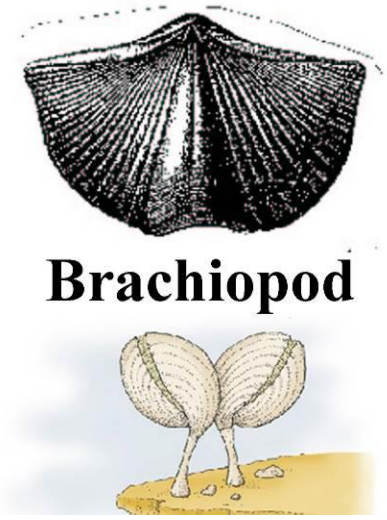
Granite can occasionally be found in our gorges too. Granite is an igneous rock made formed by volcanoes. When we find granite in this area, we know it was brought here by glaciers. Rocks carried and deposited by glaciers are called "glacial erratics".

Fossils

All this sediment being carried into the inland sea and trapping organisms in the rock caused fossils. Three kinds of fossils are relatively common.

Horn Coral were solitary marine animals that were attached to the sea floor at their narrow end. As horn corals grew, they would form rings, like a tree, and counting the rings gives us an idea of the age of the coral.

Brachiopods look a lot like a clam and were abundant as clams are today. The word "brachiopod" means "arm-foot", which references a major difference between brachiopods and clams- brachiopods have a pedicle which they use to attach themselves to the bottom of the ocean floor. Brachiopods are also completely symmetrical if you were to cut them in half vertically, clams are symmetrical if you cut them in half horizontally. Brachiopods are actually still living today, off the coast of Washington, in the Gulf of Mexico, and around Australia and New Zealand.



Trilobites were bottom dwellers and lots of tiny legs along the bottoms of their shells. Their mouths were also on the bottoms of their shells. Trilobites were the first identified invertebrate with an exoskeleton. When they were in danger, they could roll up and be protected by their exoskeletons, like a pill bug. Their closest living relative is the horse shoe crab.

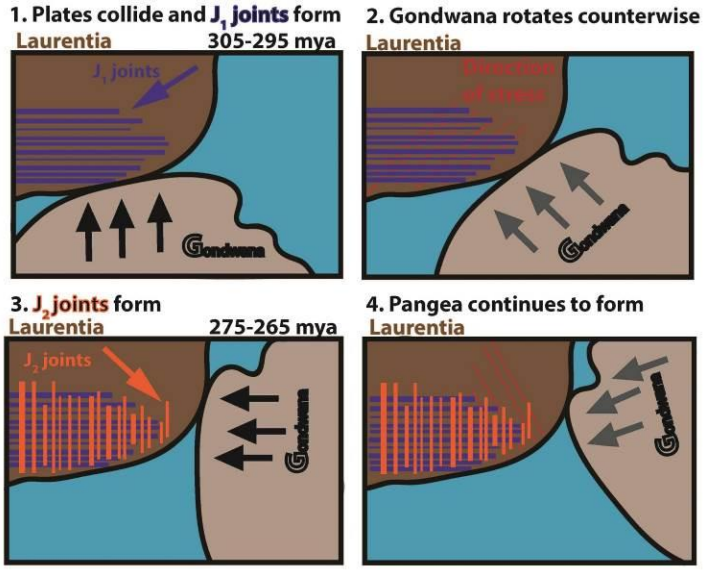
Plunge Pool

This perfect circle in the middle of the stream is a plunge pool where a waterfall was for years and years. Eventually, the waterfall eroded back and left almost a perfect circle present. The longer the waterfall was in one spot, the larger the plunge pool will be.

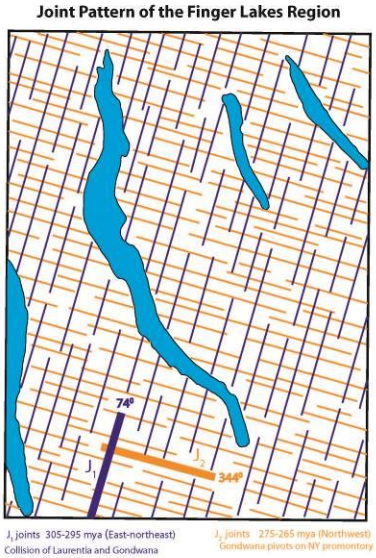
Jointing

Around 300 million years ago, an increase in temperature, pressure, and depth caused organic matter buried in the ground to reach the oil window. This organic matter was trapped during the erosion of the Acadian Mountains. The oil and gas were generated by a chemical reaction that would normally require an increase in pore space, but because there was no room for expansion, the pressure was relieved through cracking of rock. The cracking started with micro-cracks around flakes of organic matter. The cracks eventually opened into full scale joints – the large cracks we see today- as more hydrocarbon was generated.

As the gas escaped from the rock, it broke through the weakest spots in the rock. 305-295 million years ago, Africa (Gondwana) collided with North America (Laurentia) and began to slide down the east coast. This caused fault lines that ran from north to south, and so when the gas needed to expand 300 million years ago, it followed these north-south fault lines and cracked the rock.



Around 275-265 million years ago, Africa got hung up around New York City and began to pivot in a clockwise motion for the next 15 million years. During that time, another batch of natural gas reached its thermal maturity and again broke through the rock, following the fault lines. In this region, the fault lines were now running east-west, making them almost perpendicular to the first set of fault lines. This means that the joints now visible intersect at close to a perfect 90 degree angle.



These perfect angles allow erosion of the gorges to happen much faster than they normally would, because of the large rectangles of sandstone that fall out rather than needing to be eroded away. Farther north and south, however, the joints do not intersect at a 90 degree angle, and in many areas, there was not gas underground that was released and cracked the rocks. Without this combination of characteristics, waterfalls left behind by hanging valleys do not erode enough in 12,000 years to form gorges. This is what makes the Finger Lakes Region so unique.