

Geologic Site of the Month
July, 2012

Sugarloaf Mountain near Shin Pond, Maine
A classic geological locality



46° 6' 46.66" N, 68° 36' 36.65" W

Text by
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Introduction

Standing prominently above the surrounding landscape of Township T5 R7 WELS near Shin Pond, Sugarloaf Mountain beckons the hiker with promises of commanding views across the Seboeis River valley towards Katahdin and the Travelers. For those who venture forth, this promise will be kept. A geologist, however, hears another siren - that of ancient fossils which speak of a harsh volcanic landscape and wandering continents.



Photo by Robert G. Marwinney

Figure 1. View to the north from near the top of Sugarloaf Mountain.



The Geologic Context

Sugarloaf and the surrounding landscape are underlain with some of the oldest rocks in Maine, spanning portions of the Cambrian and Ordovician Periods of geologic time (540-470 million years ago) (Figure 2). The oldest formation in this area is the Grand Pitch Formation, which is mostly gray, green, and red slate and siltstone (Neuman, 1967). Trace fossils (markings in the sediment caused by the movement of organisms) set the age of this formation as latest Precambrian to Cambrian. Next upward in the sequence is the Shin Brook Formation, a mixture of volcanic ash, sandstone, and breccia (rock containing large angular fragments). Fossils in this formation set its age as Early to Middle Ordovician (485-470 million years ago).

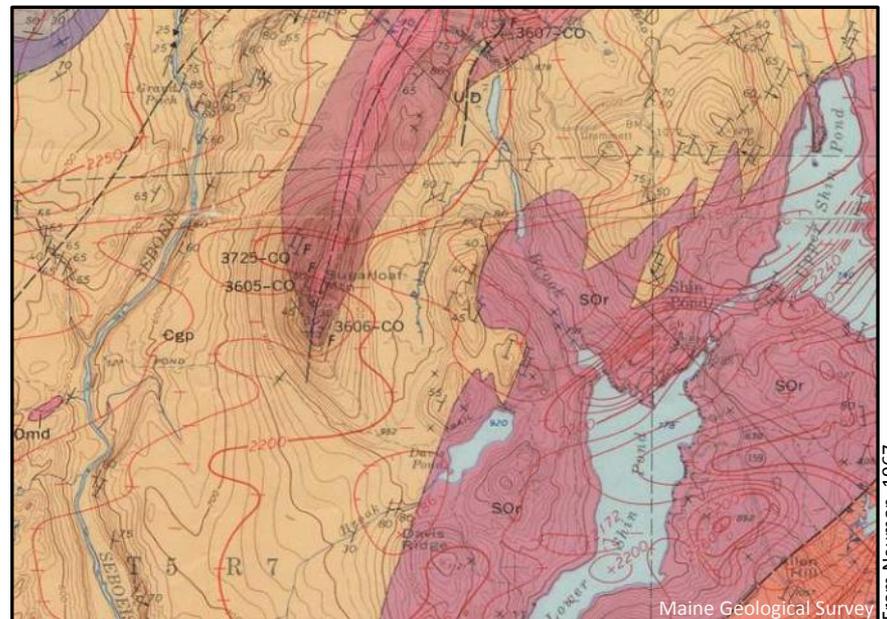


Figure 2. A portion of the geologic map of the Shin Pond quadrangle. Sugarloaf Mountain is left center. Beige areas are the Grand Pitch Formation. The fossiliferous Shin Brook Formation is in dark red and the metadiabase is in brighter red.



The Geologic Context

The capstone on Sugarloaf is dark green metadiabase (Figure 3). Diabase is an igneous rock (formed from cooling of molten magma near the surface, but not at the surface) that is high in iron and magnesium. A metadiabase is a slightly metamorphosed variety, where heat and pressure have changed some of the original minerals. This rock forms the prominent cliffs on the west side of the mountain (Figure 1), and the magma that formed this rock probably intruded parallel to the layering in the Shin Brook Formation, rather than cutting across it.



Figure 3. Close-up of uniformly fine-grained metadiabase at the top of Sugarloaf Mountain. Note the lack of layering.

The Fossils

USGS and Smithsonian Institution geologist Robert B. Neuman spent many summers during the 1950s and 1960s meticulously mapping the geology of the Shin Pond area, paying particular attention to fossils. In the Shin Brook Formation, Neuman identified fossils at eight localities, with the largest number and greatest variety coming from localities on Sugarloaf. These include six species of brachiopods (similar to modern clams) and several trilobite species. Figure 4 is a reprint of his photograph of one of the most prominent fossil localities.



Photo by Neuman, 1964

Figure 4. One of the most prominent fossil localities on Sugarloaf Mountain. Reprint from Neuman (1964).



The Fossils

Figure 5 is a modern photo of that same location.

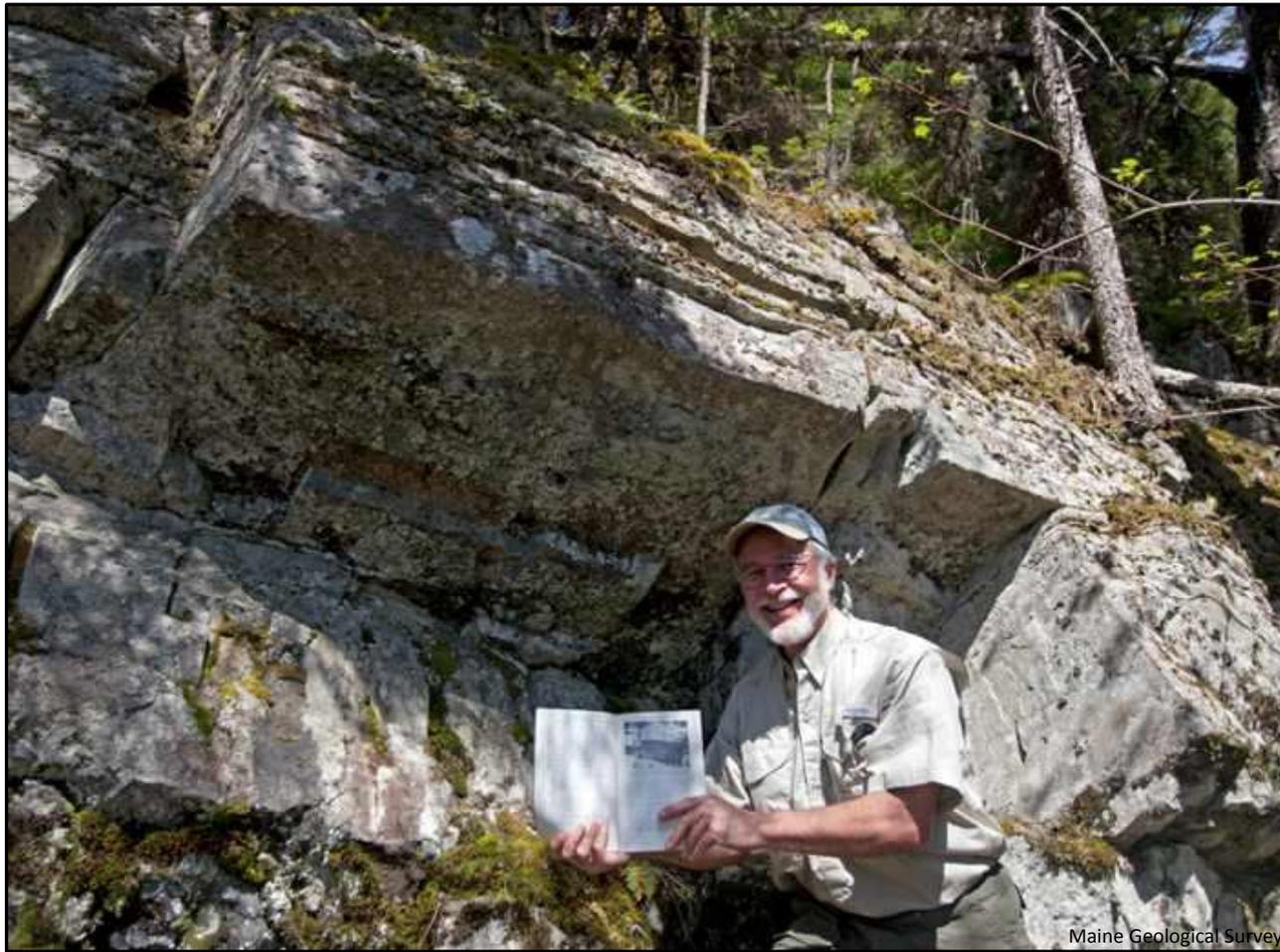


Figure 5. The author at Neuman's locality shown in Figure 4. Note the prominent layering in the ledge.

The Fossils

Fossils are commonly concentrated in shell beds a few inches thick along which the rock often parts, leaving broad surfaces festooned with fossils, as in the overhanging ledge (Figure 6 and Figure 7).



Photo by Robert G. Marvinney

Maine Geological Survey

Figure 6. The underside of the prominent overhang shown in Figure 5. This surface is entirely covered with impressions of brachiopods, both fragments and complete shells, the original shell material having weathered away eons ago.



The Fossils



Photo by Bill Duffy, Northern Geomatics

Maine Geological Survey

Figure 7. Close-up of broken and complete brachiopod impressions from the ledge in Figure 5.



The Fossils

Notably, this locality marked the discovery of the new genus and species, *Platytoechia boucoti*, a thin brachiopod with a finely striated shell (Figure 8 and Figure 9).

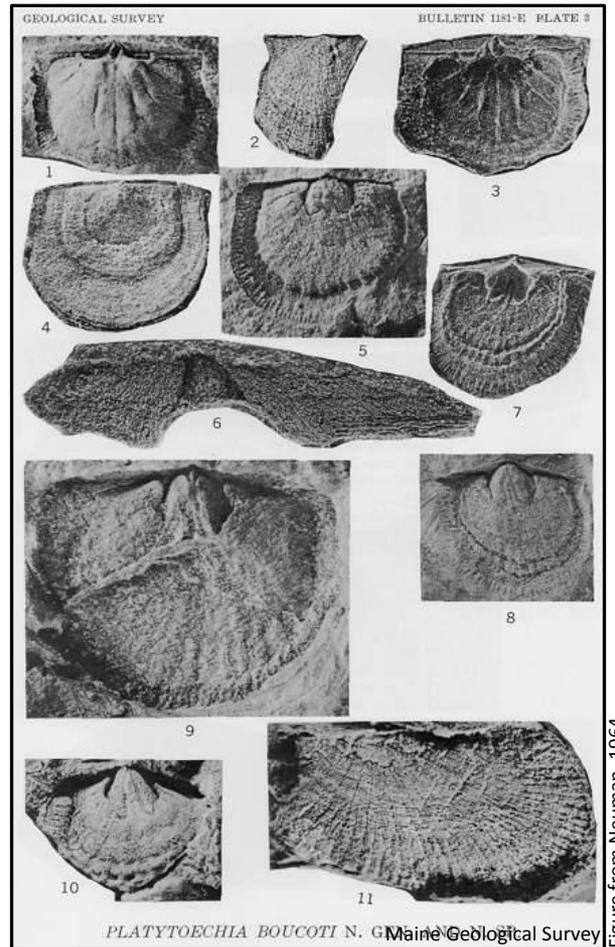


Figure from Neuman, 1964

Figure 8. Examples of the brachiopod *Platytoechia boucoti*.

The Fossils



Photo by Robert G. Marvinney

Maine Geological Survey

Figure 9. Impressions of the brachiopod *Platytoechia boucoti* in a hand sample. The well-preserved fossil at left center is about 1/2" across.



The Significance

The Grand Pitch Formation has suffered through several episodes of folding, while the younger Shin Pond Formation has been subjected to only one period of folding. Thus, the contact between these formations represents a period of time during which the older rocks were folded and eroded, and younger rocks subsequently deposited in flat-lying fashion above - the classic occurrence of an unconformity. Geologists call the event that folded the older rocks the Penobscottian orogeny, and it represents the collision of islands within the ancestral Atlantic Ocean during the Late Cambrian period. These were violent times, as volcanoes formed on the assembled islands, spewing forth huge clouds of volcanic ash into the shallow sea. Tenaciously clinging to the edges of these volcanic islands was a rich assemblage of marine life.



The Significance

The really fascinating thing to geologists is that the assemblage of fossils (the fauna) in the Shin Brook Formation, as Neuman discovered, are unlike the North American fauna of that time period, and more like the fauna of Ireland (the Celtic fauna) (Figure 10). Somehow the tectonic forces at play in the ancestral Atlantic Ocean rafted islands with Celtic fauna to the shores of North America! While the hiker might walk right across this significant locality, a geologist can read this complex story in the rocks.

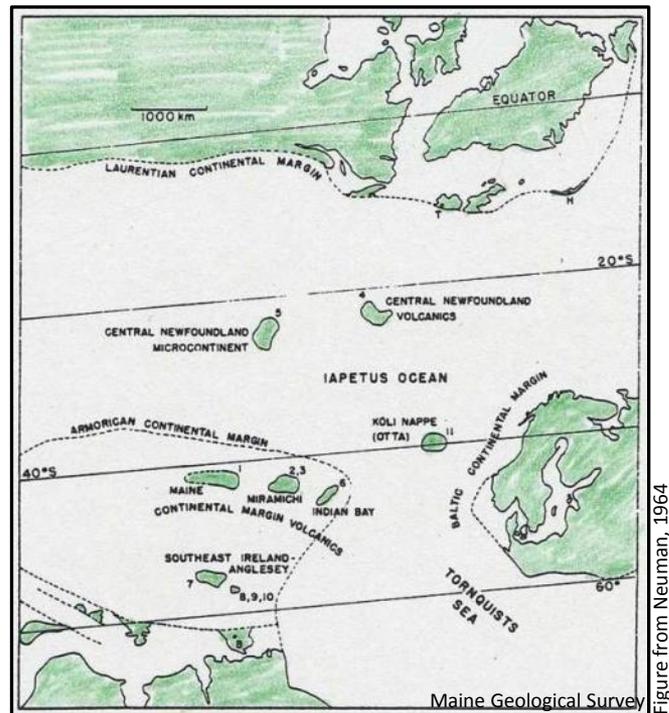


figure from Neuman, 1964

Figure 10. Neuman's reconstruction of the distribution of islands with Celtic fauna in the ancestral Atlantic Ocean (labeled Iapetus Ocean) during the early Ordovician period. North America is at the top, and Europe is at the bottom. Islands with Celtic fauna are labeled with numbers.



Getting There

Sugarloaf is not terribly remote, but hiking there and back will take the better part of a day. Drive from wherever you are to Patten, and then take Route 159 toward Shin Pond. After passing over the north end of Lower Shin Pond, turn left on Wapiti Road. Follow this across the outlet to Lower Shin Pond, then up the steep hill toward Wapiti Camps. Park near the gate for the camps. Here you will find an overgrown road on the northwest side of Wapiti Road. Begin your hike here (Figure 11), following the best road approximately parallel to the shore of Davis Pond for about 1.4 miles (Figure 12).

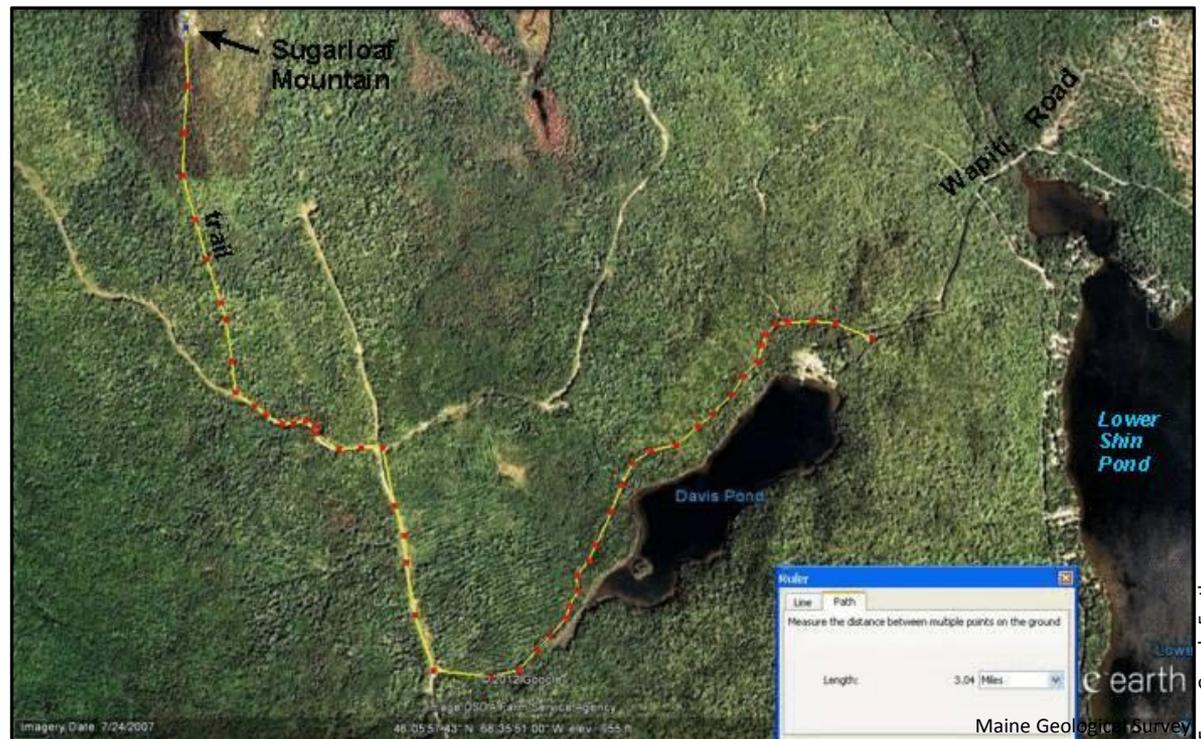


Figure 11. Location map.



Getting There



Photo by Robert G. Marvinney

Figure 12. A dry part of the trail near Davis Pond.



Getting There

At the intersection, turn right (north) on a newer dirt road and continue for another half mile. Turn left (northwest) at this intersection, and follow the road for about 0.4 miles, until you see the sign at the Sugarloaf Mountain trailhead. It's about another half mile to the top. When the trail steepens significantly at about the 1600 foot level, you should see a large rock in the trail (Figure 13). Leave the trail and walk along contour to the east until you see the prominent ledges shown in Figure 5.



Photo by Bill Duffy, Northern Geomatics

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Figure 13. This large boulder in the trail marks where the hiker should leave the trail and walk to the east to find the large outcrop shown in Figures 4-6.



Please Note:

Important! This is a unique natural exposure that has been used for detailed geologic study and for teaching students. While photographs are encouraged, there is no reason or excuse for breaking or damaging these rocks. There are plenty of broken rocks below the ledge from which you may sample. Please take care of this special place.



References and Additional Information

- Neuman, R. B., 1964, Fossils in Ordovician tuffs, northeastern Maine: U.S. Geological Survey, Bulletin 1181-E, 38 p., 7 plates.
- Neuman, R. B., 1967, Bedrock geology of the Shin Pond and Stacyville quadrangles, Penobscot County, Maine: U.S. Geological Survey, Professional Paper 524-I, 37 p., 3 plates.
- Neuman, R. B., 1984, Geology and paleobiology of islands in the Ordovician Iapetus Ocean: Review and implications: Geological Society of America, Bulletin, v. 95, p. 1188-1201.

