Bumpass Hell Nature Trail

Lassen Volcanic National Park

You will be entering an area of thermal activity.

Stay on boardwalks.

Several people are severely burned each year when they ignore this caution.

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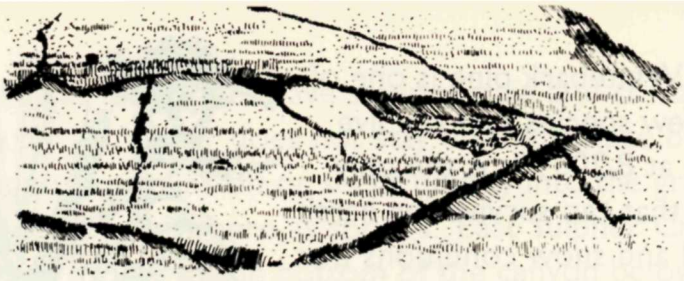
Passing along the edge of the Ancient Tehama Volcano, learn about all the forces that have shaped this area--volcanoes, glaciers, and thermal activities. Discover the ways that these forces shape and are shaped by the dynamic interactions of living things and the landscape.

Lassen Peak

The round trip is a little less than 3 miles and takes about 3 hours for a leisurely walk. Stakes along the trail correspond to the numbered paragraphs in this folder which point out features of special interest. There is no water along the trail so take your own. During the early summer and late fall, there are no toilets beyond this point.

1. Geologists think Lassen Peak is between 15,000 and 25,000 years old. It erupted into the remnants of a small caldera on the northern flank of Tehama Volcano (also known as Mount Tehama or Brokeoff Volcano). Possibly the world's largest volcanic dome, Lassen Peak probably grew in a single event that may have taken several decades.

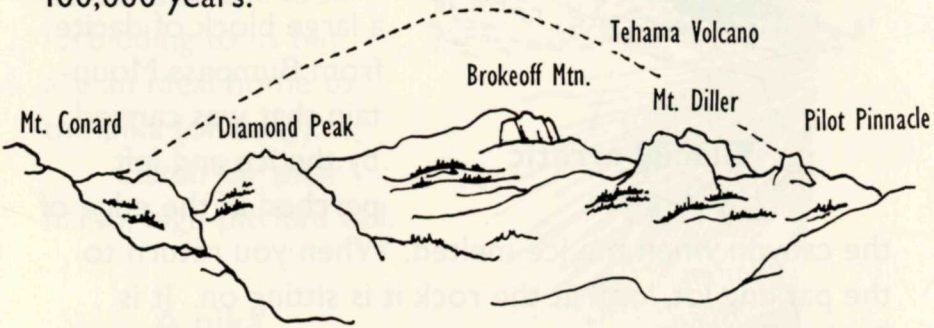


Glacial striations

2. Glaciers are flowing bodies of ice that can be hundreds of feet thick. Glacial striations are produced by the tremendous weight of the ice, which contains loose rock debris that gouges and polishes the solid rock beneath the glacier. Feel the glacial polish. Can you tell the direction of the glacier's flow from the striations?

3. Mt. Conard, Brokeoff Mountain, Mt. Diller, Pilot Pinnacle and the ground you are standing on are remains of the once mighty Tehama Volcano, a composite volcano similar to but smaller than Mt. Shasta.

The Tehama Volcano was built by intermittent activity between 650,000 and 400,000 years ago, but is now largely eroded. Hydrothermal activity, similar to what you will see at Bumpass Hell, weakened the volcanic rock layers, and allowed glaciers and streams to carve the deep valleys and steep cliffs in the Tehama Volcano in only 400,000 years.

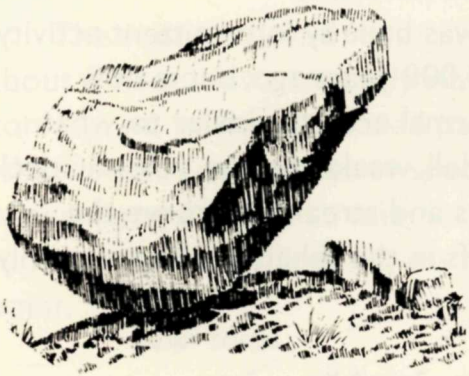


Tehama Volcano and the present topography

4. Whitebark pine is one of the few species that can live here at 8,200'. It is the only tree that can survive the harsh wind and snow conditions that prevail on the upper parts of Lassen Peak. These high elevation habitats are produced by volcanic mountain building.

Whitebark pine

5. The 110-foot deep Lake Helen fills a depression created by eruption and growth of the volcanic domes of Bumpass Mountain, Mt. Helen and Ski Heil Peak, all between 200,000 and 250,000 years old. Thus, although its basin was modified by later glacial activity, Lake Helen predates Lassen Peak by at least 175,000 years.



Glacial erratic

6. The boulder sitting across the canyon just to the left of the parking area demonstrates the power of a glacier. This "glacial erratic" is a large block of dacite from Bumpass Mountain that was carried by the ice and left perched at the edge of the canyon when the ice melted. When you return to the parking lot, look at the rock it is sitting on. It is Brokeoff andesite.

7. Volcanic landscapes have steep terrain and contain porous rocks. Water does not stay on the surface because it either drains off or seeps quickly into the ground and reappears elsewhere as springs. East Sulphur Creek rises from springs at the bottom of the canyon below. These springs originate from seepage from Lake Helen and surrounding areas.

8. As hot lava cools it contracts, forming a system of parallel cracks called joints. Water seeps into these joints, expands when it freezes, and wedges loose blocks of rock that fall away from the cliffs created by the glaciers.

The accumulation of these rocks at the base of the cliff are called talus and look forbidding to us but are an ideal home to the pika (or cony).

Listen for their harsh, high-pitched call.

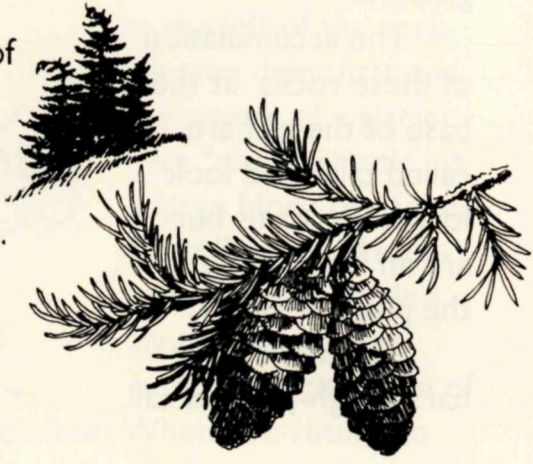
A pika with its "haystack"

9. On the slopes below you can see the silverleaf lupine. How has it adjusted to this harsh mountain environment with bright sunlight, short growing season, and well-drained soil? Silvery hairs on the leaves reflect the intense ultraviolet radiation of this thin atmosphere. They also trap a layer of air, helping to maintain stable temperature and moisture conditions around the leaf.

Pikas collect lupines and dry them in "haystacks" before storing them deep in the loose rocks for winter food.

Silverleaf lupine

10. Mountain hemlock is the predominant tree of this area. Short waxy needles and a spreading root system help it to grow on these dry slopes. Mountain hemlocks tend to grow in clumps. How would that help them to survive? Do you see two different ages of trees? What would cause the difference?



Mountain hemlock

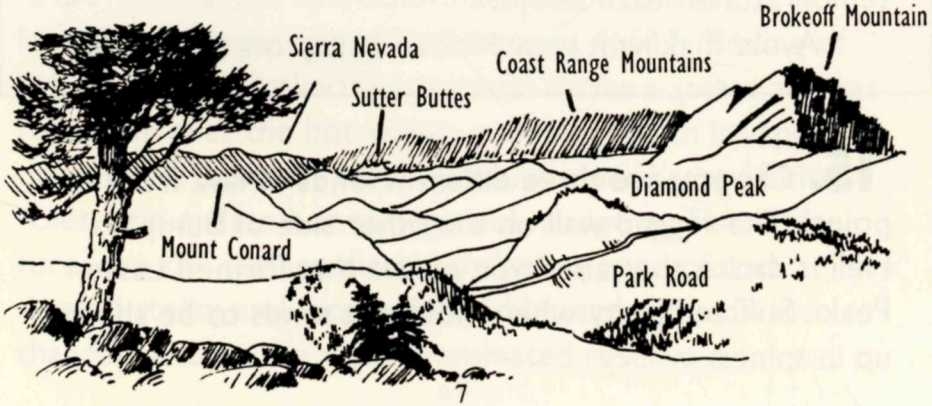
11. Pinemat manzanita, like other plants that grow in this fierce environment, hugs the ground. Its vertical waxy leaves help conserve water. Its berries and seeds provide important food for birds and mammals who live here.

Pinemat manzanita

12. Lightning storms are frequent near timberline, but because vegetation is sparse, fires do not normally spread to any extent.

13. The mountains of the Cascade Range, including Lassen Peak and the eroded Tehama Volcano, are volcanic in origin, but the Sierra Nevada and the Coastal Ranges visible in the distance were formed by different processes. Starting 10 miles south of here, the Sierra Nevada is primarily masses of granite that have been uplifted and tilted. The coastal mountains were formed by a squeezing process that folded, buckled and uplifted them.

Panoramic view from stake 13



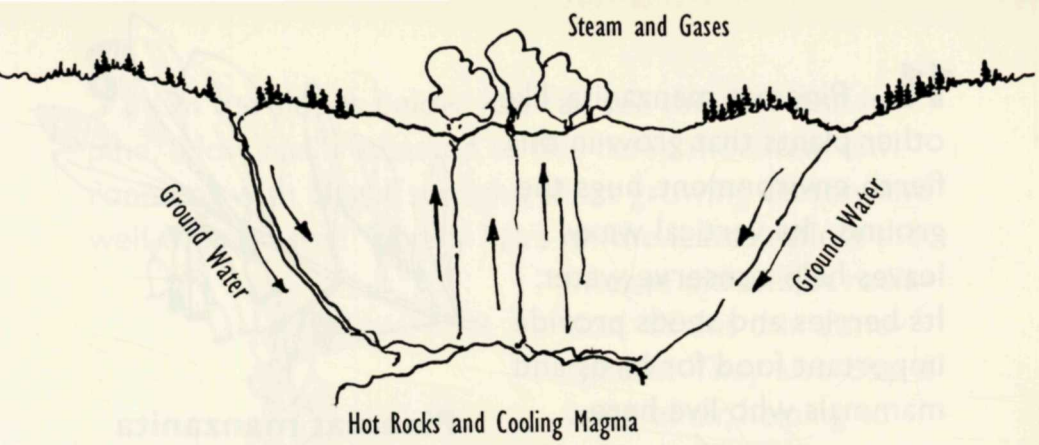


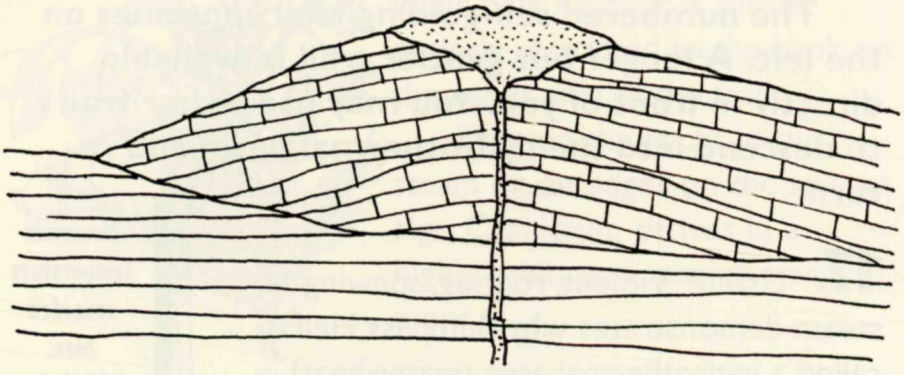
Diagram of Lassen's hydrothermal system

14. The fumaroles and boiling pools of Bumpass Hell testify to the recent volcanic origin of Lassen's landscape. Rain and melted snow percolate deep into the earth where the water is heated by a mass of hot rocks or cooling magma 6 to 12 miles below the surface. The site of Bumpass Hell occupies the vent area of the 240,000 year old dacite dome of Bumpass Mountain, whose conduit serves as the main upflow zone for the Lassen hydrothermal system.

Bumpass Hell was named after Kendall Vanhook Bumpass who discovered it and lost a leg as a result of burns suffered when he stepped in a thermal pool. Some temperatures reach 240° F.

Avoid making it your Hell and **stay on the trail!**

15. Can you see three different kinds of lava from this point? The rugged wall on the other side of Bumpass Hell is dacite, the same type of lava that formed Lassen Peak. Stiff and pasty when molten, it tends to be shoved up in spines.



Mt. Harkness, a shield volcano and cinder cone

Look to the east to see Mt. Harkness, a shield volcano with a small cinder cone on top. Formed by the highly fluid basalt lavas, they assume the shape of a Roman shield.

Tehama Volcano, including Bumpass Hell, is andesite which is between basalt and dacite in characteristics. The sequence of flows from magma chambers over vast periods of time is commonly from Basalt to Andesite and then Dacite. Think of B-A-D -- most fluid to least fluid.

16. The Lassen hydrothermal system consists of a lens-shaped reservoir of hot water at 465^0 F. Boiling of the hot water at elevated pressure forms a steam and gas reservoir over the hot water--a system which is vapor-dominated. Bumpass Hell has many super-heated fumaroles, acid-sulfate hot springs and mudpots. These features are the surface discharge from a zone of condensed steam and locally derived heated groundwater that forms over the vapor-dominated reservoir.

The numbered self-guiding trail continues on the left. A longer but gentler trail is available directly in front of you. You may use either trail to descend into the hydrothermal basin and return.

17. Listen! Violent, roaring, spewing hot steam demonstrates why Bumpass Hell is called a hydrothermal area (water-heat). Water boils at 198° F at this elevation compared to 212° F at sea level. Because the steam was heated under pressure, it can be heated above the boiling point making it super-heated. Maximum recorded temperature in this basin is 284° F.

Bog Kalmia

18. Bumpass Hell is a barren but colorful place. High temperatures, acidic soils and waters and high concentrations of sulfur compounds and other materials have created an environment where only the specialized survive. Look at how different plants tolerate these conditions. Bog Kalmia and the grass-like rushes creep down this slope,

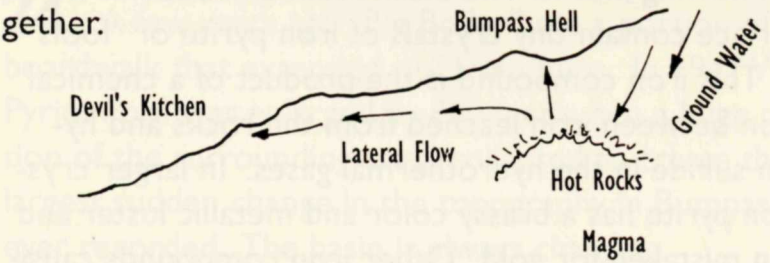
Pink heather

while pink heather is almost entirely restricted to the bank on the other side of the trail.

Even on the rocks in the steam or on edges on the soil, an alga, Cyanidium thrives in a highly acidic and searing environment.

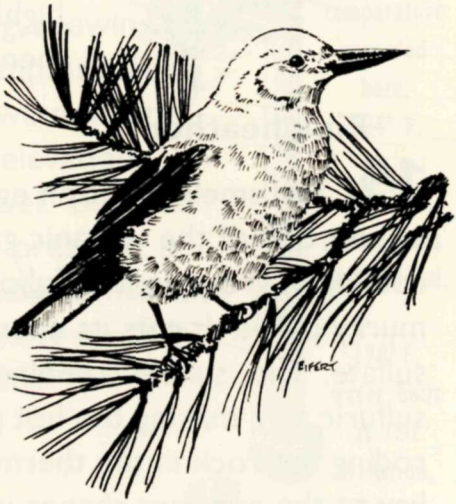
19. The smell of rotten eggs? It is really hydrogen sulfide, one of the volcanic gases released by magma cooling at great depth. Sulfolobus bacteria lives in hot, murky pools. It gets its energy by converting sulfur to sulfate. The sulfate combines with hydrogen to produce sulfuric acid making the hot pools very acidic and corroding the rock in the thermal area. So the bacteria are key to the constant change in the thermal area.

20. All hydrothermal areas in Lassen Volcanic National Park are connected underground and are fed by the same hydrothermal reservoir. Thus Bumpass Hell, Little Hot Springs Valley, Sulphur Works, Devils Kitchen, Boiling Springs Lake and Terminal Geyser within the park and Morgan Springs in Mill Creek Canyon are all linked together.



The hydrothermal areas in Lassen are connected

21. Sulfuric acid produced by the sulfur bacteria attacks the rock making up the basin. Decomposition of the rock is a complex process in which elements are leached from the rock and some of the sulfuric acid is neutralized. When sufficient acid is present, complete decomposition of the rock produces a whitish powdery material that is a mixture of amorphous (without form) silica and kaolinite, an aluminum and silica-rich clay mineral.

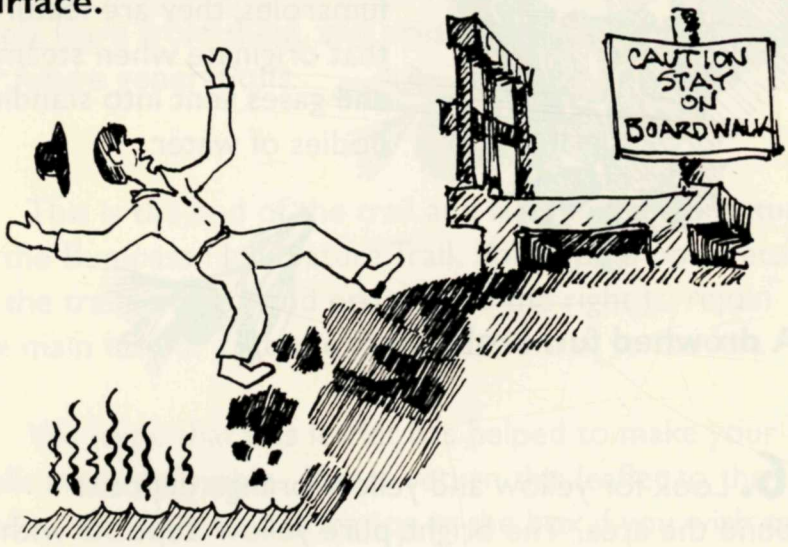


Clark's nutcracker

22. When the sulfuric acid is diluted by rain or snowmelt, decomposition of the lava is slowed down, and a variety of intermediate products are present. These include colored iron and magnesium-bearing clay minerals and orange-brown iron hydroxides, as well as some of the more resistant minerals in the original rock.

23. East Pyrite Pool boils violently in spite of the cool stream flowing into it. The black scum and bubbles on the surface contain tiny crystals of iron pyrite or "fools gold". This iron compound is the product of a chemical reaction between iron leached from the rocks and hydrogen sulfide in the hydrothermal gases. In larger crystals iron pyrite has a brassy color and metallic luster and is often mistaken for gold. Other iron compounds cause many of the red, yellow and tan stains.

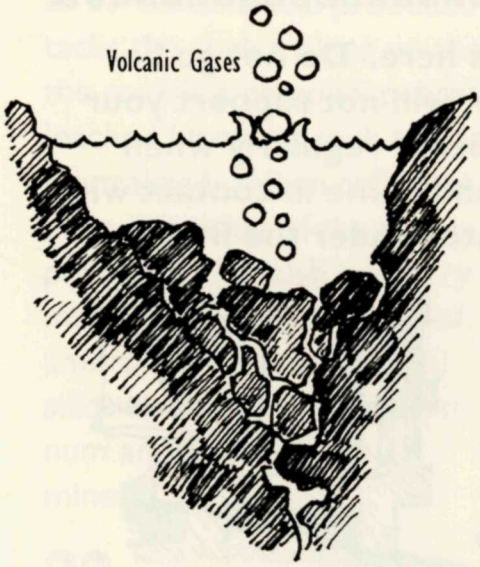
NOTE: The trail ends here. Do not go beyond this point. The crust will not support your weight. Serious injuries occur regularly when visitors venture beyond and come in contact with the steam and boiling water under the fragile surface.



To see additional thermal features, retrace your steps and take the path to your right. This will take you through the central portion of the Bumpass Hell Thermal Area marked by numbered stakes 24-27.

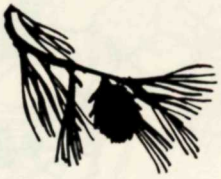
24. A few years ago "Big Boiler" ate a portion of the boardwalk that extended out from here. In 1947 West Pyrite Pool was enlarged by 800 feet when a huge portion of the surrounding crust collapsed to create the largest sudden change in the topography in Bumpass Hell ever recorded. The basin is always changing.

25.

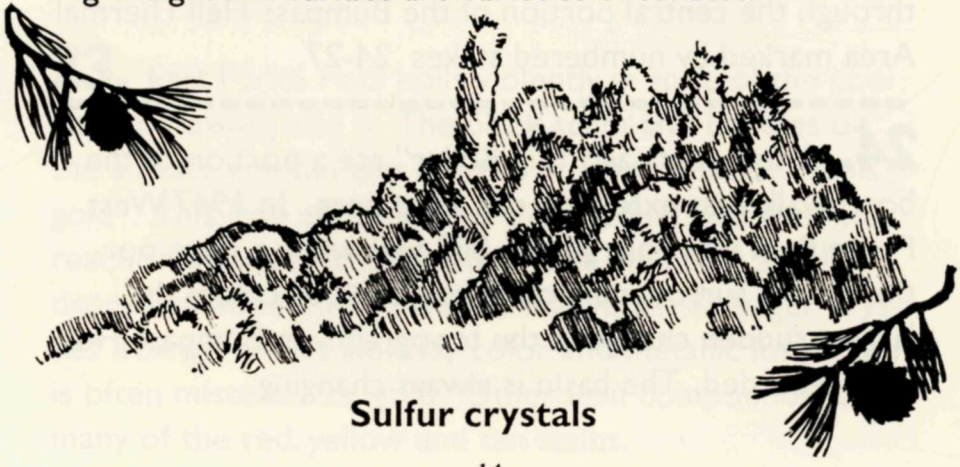


A drowned fumarole

Fumaroles, small vents that let out volcanic gases, are the most common hydrothermal feature in Lassen. Most of them at Bumpass Hell are drowned fumaroles; they are features that originate when steam and gases vent into standing bodies of water.



26. Look for yellow and yellow-orange deposits around the area. The bright, pure yellow deposits with bunches of prominent crystals lining the active fumarole vents are pure sulfur. The yellow-orange material coating the ground surface are varieties of sulfates.



Sulfur crystals

27. Bumpass Hell provides a window into the inner geology of our planet. These hydrothermal features are surface clues to the forces operating at great depth that will reshape this land for millions of years. On this trail you have seen many of the forces that have shaped this area of the Cascades--a variety of volcanoes, glaciers, running water and hydrothermal features. Enjoy them safely, learn from them, and preserve and protect them for future generations.

This is the end of the trail and last numbered feature of the Bumpass Hell Nature Trail. You should now return to the trail junction and proceed to the right to rejoin the main trail or take the more gentle trail to the left.

We hope that this leaflet has helped to make your walk more enjoyable. Please return this leaflet to the leaflet box or leave a donation in the box if you wish to keep the pamphlet.

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