UNITED STATES DEPARTMENT OF THE INTERIOR

OSCAR L. CHAPMAN, *Secretary*

National Park Service, NEWTON B. DRURY, *Director*

Lassen Volcanic National Park *Self-guiding Nature Trail*

Leaflet No. 2

Bumpass Hell

(TRIP TIME ABOUT 2 HOURS)

LASSEN VOLCANIC NATIONAL PARK is a part of the National Park System, administered by the National Park Service of the Department of the Interior. The System is composed of areas with superlative scenic, scientific, or historic values which are to be preserved inviolate for the enjoyment of present and future generations. Please help us in conserving the natural beauties of the park by refraining from taking or disturbing mineral or plant specimens or throwing objects into mudpots or pools.

This leaflet is designed to aid you in a greater enjoyment and appreciation of the park. The numbers in it correspond to numbers you will find along the trail. The guide to Bumpass Hell proper starts with marker No. 16.

YOU MAY KEEP THIS LEAFLET IF YOU WISH; IF NOT, PLEASE RETURN IT TO THE SUPPLY BOX

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No. 1.—We think of Lassen as a park filled with the evidences of heat (volcanos and hot springs), but here is evidence of the ice of recent mountain glaciers. This fine glacial polish in the lava was caused by rock frozen into moving ice. With the great weight of the ice above and the movement of the whole mass, these rocks became the gouging and polishing tools which smoothed off the lavas.

No. 2.—A Western white pine *(Pinus monticola)* stands to your right about 50 feet down the slope. Like all members of the white pine group, it has five needles in each bundle. Both its needles and its cones are similar to, though smaller than, those of the Sugar Pine. Here the tree is at the upper limit of its 6,000- to 8,000-foot range. Note the unique "checkered" bark pattern.

No. 3.—Whitebark pine *(Pinus albicaulus)* is the timber-line tree (8,000 to 9,000 feet) in the Hudsonian Life Zone. Notice the distinctive smooth white bark—whence the name. The tree is always stunted, often gnarled. It also belongs to the white pine group, as most of its needle bundles are in fives. Look for the dark purple, egg-shaped cones at the ends of the limbs. These cones are thornless, fleshy, and very pitchy. Note how pliable the limbs are. This is an adaptation which enables it to survive severe storms and heavy snowfall.

No. 4.—Lake Helen fills a basin quarried out by glaciers and dammed by their debris during the Ice Age. Its beautiful color gave rise to the now discarded name of "Sapphire Lake." Lake Helen has no surface inlet or outlet. It is unusually deep for a glacial lake—110 feet, with temperatures at depth as low as 39° even in summer.

Behind Lake Helen is Lassen Peak, 10,453 feet high. Those cliffs you see halfway up are the original faces of the huge, once-pasty lava plug that was bodily thrust up through an older pre-Lassen crater to form the present peak. The loose talus slopes are debris from the crumbling of the lava plug as it cooled and from the 1914–17 explosive eruptions from Lassen's summit craters.

On the middle portion of Lassen Peak's east slope see the stunted timber-line trees—the whitebark pine. Timber line here is at about 9,000 feet, but, as you see, it varies with slope exposure. The taller trees lower down and the most numerous about us here are the mountain hemlocks.

No. 5.—View down East Sulphur Creek. The mountain in the middle distance, with the craggy summit, is Diamond Peak, a central remnant of a great ancestral volcano known as Mount Tehama. See the Lassen Peak Highway across its face.

No. 6.—Look to the right (west) across the canyon. Just south of the parking area is a huge isolated boulder known as a "glacial erratic"; it was left perched on the ridge when the glacier melted. Further right and nearby, see the beautifully rounded contour of the hill which our trail crossed and where we saw the glacial polish. The hill was rounded off by the grinding action of the Lake Helen glacier, which proceeded pass us on down Sulphur Creek.

No. 7.—The parallel system of straight cracks along the trail here is known as "jointing." It was caused by contraction stresses as this once hot dacite lava cooled after solidifying. When water seeps into joints and then expands on freezing, it wedges out blocks of rock such as that indicated by the numbered stake. This is an effective aid in the mechanical distintegration of rocks. Compare this process with the chemical decomposition across the canyon. There in the distance you see the brown, yellow, and red coloration of lavas which have been attacked by steam and sulphur fumes. You will see this process close at hand in Bumpass Hell.

No. 8.—Far below, on the right, are the headwaters of East Sulphur Creek. The large springs from which it starts are clearly visible from this point. They are fed by seepage through the rock pores and joint systems from Lake Helen and the other surrounding areas.

No. 9.—Watch and listen carefully, as you cross this barren rock talus slope, for the cony, which makes its home among these boulders. Conies look like small rabbits (to which they are related), but have small ears. Their call is harsh, high-pitched. They also are known as picas or haymakers, the latter because of their habit of cutting leafy materials during the summer for food for the many months when they will be snow-bound.

No. 10.—As you look right (west) the first and largest peak you see on the skyline is Brokeoff Mountain (A), so-called because the south tipping lava-and-ash layers of which it is made are abruptly cut or broken off, forming the steep north cliff. Mount Diller (B) is the large ragged peak further right with lava beds tilting away from us (west). Pilot Pinnacle (C) is the sharp knob next in line; just below it lava layers dip northwest. These are the remnants of a great composite or stratovolcano called Mount Tehama. It had the same origin and shape as Mount Shasta and towered more than a thousand feet higher than Lassen Peak. Mount Tehama was destroyed by cracks in the earth's crust along which movement took place. This is known as "faulting." Subsequent sinking of these great blocks created the basin spreading before us. In this shattered or faulted zone we find most of our hot-springs areas. (See sketch above.)

No. 11.—This tree was struck by lightning which ripped off a wide strip of its bark. The tree still lives. Lightning may shatter trees to bits or start fires.

No. 12.—Just off the trail to the left are chunks of lava which show banding due to the separating of growing crystals as the lava flow moved along.

Mountain hemlock *(Tsuga mertensiana)* is the dominant tree here in the Hudsonian type of climate or "life zone." The tree's graceful, nodding top and limbs have the Japanese look suggested by their scientific name, Tsuga. The short single needles grow in rosettelike patterns. The delicate and regularly formed cones are 1½ to 3 inches long and without thorns on the scales. In July and August the small, new, bright purple cones hang gracefully from the limbs in great numbers.

No. 13.—This lightning burn occurred long ago. It did not spread far because of the sparseness of the vegetation up here.

No. 14.—The Cascade Range, of which Lassen is a part, ends about 10 miles air line south of us. State Highway No. 36, which follows a series of low passes from Red Bluff through Mineral and on to Susanville, marks the boundary between the Sierra Nevada on the south and the Cascade Range on the north.

Notice the stiff symmetrical California red fir *(Abies magnifica)* trees with branches in neat whorls in the right foreground. They are out of their normal (Canadian) life zone. Their cones are borne erect on the branches and fall apart upon maturing. Red fir needles generally curl upward to produce a brushlike effect. (See sketch on back of folder.)

No. 15.—Examine the very narrow tree rings in this cut trunk. High in the mountains, spring comes late and winter comes early. As the growing season is short, the annual tree rings are small. This tree is about 400 years old!

No. 16.—Bumpass Hell, discovered by Kendall Vanhook Bumpass in 1864, is the most spectacular hot-spring area of the park. It is similar to the Norris Basin of Yellowstone National Park, but there are no true geysers in Lassen. Bumpass Hell is about 500 by 1,400 feet in area. Your elevation here is 8,380 feet above sea level; the lowest point of the basin is 8,135 feet. This natural bowl before us has literally been eaten out of hard lava rock by hot acids. The "rotten egg" odor you get here is due to hydrogen sulphide gas. We are situated on a geologic fault or line of weakness in the earth's crust along which heat and sulphurous fumes from a great subterranean mass of hot magma (the source of Lassen lavas) are able to come to the surface.

WARNING: You should know that there is always some danger attendant upon visiting any hot-spring area. Keep away from danger by following the well-defined trail. **STAY ON THE TRAIL AT ALL TIMES.** If first aid is needed, a cabinet containing first-aid equipment is located on the knoll just beyond the foot of this trail.

No. 17.—Look to the east across the south (right) edge of Bumpass Hell. There you see Lake Almanor just above the trees. Lake Almanor, which is outside of the park, is a man-made lake, a part of the Caribou hydroelectric power development. The Red Bluff-Susanville Highway No. 36 passes the near end of the lake where the town of Chester is located. The large mountain on Lake Almanor's left is Dyer Peak; beyond to the left you see the basin range mountains of Nevada. On the horizon to the right, the Sierra Nevada, with the highest peaks in the Lake Tahoe region, is visible.

No. 18.—You may take this short spur trail, but **stay on it.** Because of decreased air pressure at this elevation water boils at 196° instead of the 212° Fahrenheit at sea level. Most of the steaming areas you see are at least 196°. At the left are tepid springs trickling first into small pools of mild activity then farther on into more interesting boiling muddy pools. In dry seasons this surface flow disappears.

No. 19.—The violent, roaring superheated hot spring is called Steam Engine. Its temperature is several degrees above 196° because the steam comes out under pressure.

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No. 20.—Bog Kalmia *(Kalmia polifolia)* is the name of this dwarf shrub. It blooms in June or July. Note how the edges of the leaves are rolled under. It is poisonous to stock; cattle and sheep in the Rocky Mountain area have died from eating it.

Across the trail to the right there is Brewer mountainheath *(Phyllodoce breweri)*. Like Kalmia and the hemlock trees we see all around us, it is characteristic of the Hudsonian Life Zone of this elevation. Notice that the leaves are much narrower than Kalmia's and that the flowers are a stronger pink. It blooms in July or August.

No. 21.—There is much water available on this cool north slope, hence the abundance of hollow stemmed rushes (not grass) and green algal growth in the seepages.

No. 22.—This water is good to drink; it is melted snow water.

No. 23.—The trail crossing the stream here goes on to Cold Boiling Lake, 1.7 miles; Crumbaugh Lake, 2.7 miles; and Kings Creek Meadows, 2.7 miles. Bear to the left for the Bumpass Basin Trail.

No. 24.—This miniature "River Styx," is more properly known as the headwaters of Bumpass Creek. The water originally fell as snow, drained into the basin, and has been heated and mineralized in Bumpass Hell. The water contains soluble soda, potash, lime, and alumina salts. It is turbid with clay. Look at the black material carefully—see the golden reflections. These are tiny fool's gold or iron pyrite crystals. Cross this "River Styx," then **TURN RIGHT** 30 feet ahead.

No. 25.—The dark green scumlike plant growing in the warm streamlet is an alga. It is a primitive plant related to seaweeds and the green "whiskers" often seen in stagnant ponds. The hissing on the left (north) is steam from water which has seeped down to the point where the rocks are hot. It was there vaporized, returning to the surface as steam. Steam vents such as this are known as fumaroles.

No. 26.—With the steam comes about 2 percent of sulphurous gases which form sulphurous acid. This attacks the rocks and breaks them down chemically, making the whole area unsound or "rotten."

Where you see those delicate and beautiful sulphur needles about steam vents you can be sure that these are very hot. They are known as "solfataras."

DANGER—STAY ON THE PATH!

No. 27.—The large pool is really a flooded fumarole. The turbulance of the escaping steam beneath keeps the clay (kaolin) mud stirred up, hence the grayish color. The gurgling mudpot is high in heat and clay, but low in water, therefore the "gooey" consistency. This one could be called a "mud volcano" because the splash from it is slowly building up a mud cone about itself. The blue-gray color probably is caused by fine iron pyrite crystal grains. The bright yellowish "frying pool" just beyond, also on the left (north) side of the trail, is colored by an excess of free sulphur.

PLEASE DO NOT TAKE SPECIMENS

No. 28.—This bank is made largely of opal. This is the common, nonprecious type which is a hard white, cream, or dark gray mineral with a waxy luster. The white dust is almost pure clay. The yellow crusts are sulphur deposits. Notice also the partly altered gray lava and some so changed by chemical action that it is chalky white—you can still make out the original lava texture.

No. 29.—Peasoup Pool shows horizontal lines on its shore representing recently higher levels of the water. The stirred water is laden with clay and sulphur.

No. 30.—This fumarole in the wettest seasons is a "mud volcano," as is apparent from the visible evidence.

No. 31.—The East Pyrite Pool is boiling violently in spite of the large supply of chilled water flowing into it. Here sulphur combines with free iron to make millions of small pyrite or fool's gold crystals. These are so small that they appear black; they make up the dark scum and bubbles on the water surface. Where did the iron come from? When the sulphurous acid attacks the lava the minerals become chemically decomposed. Clay (hydrous aluminum silicate) opal (hydrous silica), and iron oxides (tan limonite and red hematite) are relatively insoluble and remain behind while the water dissolves the magnesia, soda, potassia, lime, etc., carrying these away in solution.

No. 32.—Look at the hard fresh lavas (dacite) of Bumpass Mountain on the sky line ahead on the right. See how they are cracked. The mountain is disintegrating as the result of frost action, jointing, and the great daily temperature changes typical of high altitudes. When hot sulphurous steam attacks such rock masses, the cracks are enlarged; edges and corners are decomposed and eaten away, eventually leaving an accumulation of rounded boulders such as we see along the path ahead of us.

No. 33.—This "5th Column" hot spring, having bored from within, caused a collapse here by eating away the rock underneath. See the fine coating of sulphur needles generally present on the walls.

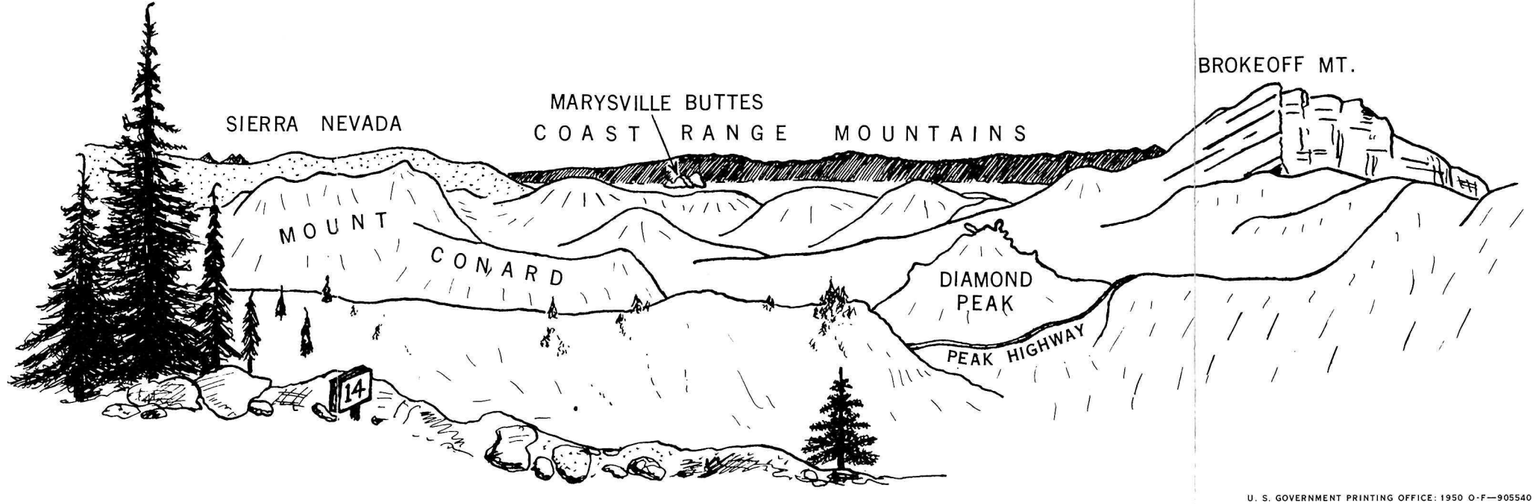
No. 34.—Does it not seem remarkable that trees should dare to grow in Bumpass Hell? The red fir (with single needles growing brushlike), the whitebark pine up ahead, and the mountain hemlock (with short straight single needles in starlike clusters) are striving to survive here. Seeds are supplied from the edge of the forest and take root wherever they can. Plants and animals thrive in certain areas, but they are forever trying to pioneer, striving to get a foothold in marginal areas not yet occupied by their kind, in the continual process of expanding the range of the particular species. In this spreading attempt, pioneering is successful only when conditions become favorable to the requirements of the species involved. It is of interest to contemplate biologic conflict when we include man as a part of it.

No. 35.—This clear turquoise pool owes its lovely color to the white clay bottom and to the small amounts of very finely suspended material. It is just tepid and is ill-tasting. Note the lush growth of algae and mosses in and near the outlet stream.

No. 36.—This small turquoise pool is turbid because of greater stirring by very active vents, which action suspends more clay in the water. This must be a particularly potent chemical laboratory. See the great pit it has eaten out and the large number of solid rock cores, rounded and being further decomposed by the attacking fumes and fluids. **DO NOT THROW OBJECTS INTO THE POOLS!**

No. 37.—Here is a series of beautiful, deep "Morning Glory"-type pools, probably originally mudpots which have been flooded by the little snow-fed stream. They bubble only gently now. Listen carefully—one can usually hear rumblings of a subterranean mudpot just across the creek, a little further along the trail. In late summer the stream and even these pools sometimes dry up completely.

No. 38.—This interesting mud-crack pattern is about an old dried up mudpot which now naturally has become a fumarole.



No. 39.—Just think of the tremendous amount of energy being released here day and night, year in year out, by "Big Boiler." Its steam is superheated; **BE CAREFUL** not to get burned.

No. 40.—See how the hillside back to the left is being eaten away, especially at its base, by the violence of the chemical attack. The slumping is a sort of landslide action. The colorful clays—yellow, brown, and red—are tinted by various iron oxides and perhaps some sulphides. Look around for whitish crust on the ground; taste it cautiously. This is a complex alumlike mineral which is washed away by each rain and is reformed by the evaporation of the waters carrying the salt products of decomposition in solution.

No. 41.—The action of this miniature waterfall contributes to the wearing away of the area by starting much of the soft insoluble chemical debris (clay, opal, and iron oxides) on its way out of the Bumpass Hell basin.

No. 42.—This odd-looking rock has been shaped by the attack of hot waters which at one time probably flowed around it.

DANGER—STAY ON THE TRAIL! Turn right here.

No. 43.—Note the interesting small simmering areas of various shades.

No. 44.—The West Pyrite Pool (see No. 31) was enlarged by an area of 800 square feet in 1947 when the northeast (right) portion submerged. The posts visible in the pool once formed a guard railing.

No. 45.—This is the best mudpot in the area. Its mud gets less fluid as the season progresses and the percentage of water decreases. See the mud rim it has built about itself by splashing. Please do not mutilate it.

No. 46.—This is one of our newest mudpool the area was formerly one of "frying" activity.

RETURN TO THE TRAIL JUNCTION

and continue down the slope to the right to the main trail. You may retrace your route to the Bumpass Hell Parking Area, or turn left at marker No. 23. The latter will bring you out at Kings Creek Meadow, where there is a campground. It is a beautiful walk with excellent flower displays in midsummer.

We hope that this leaflet has been helpful to you. It has been provided for your enjoyment by the National Park Service, United States Department of the Interior. Maps and booklets are for sale at the museum. Comments and criticisms are welcomed.

So that we may keep this, one of your own national parks, beautiful for you and you children, please help us keep it clean and protect our flowers and wildlife.

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