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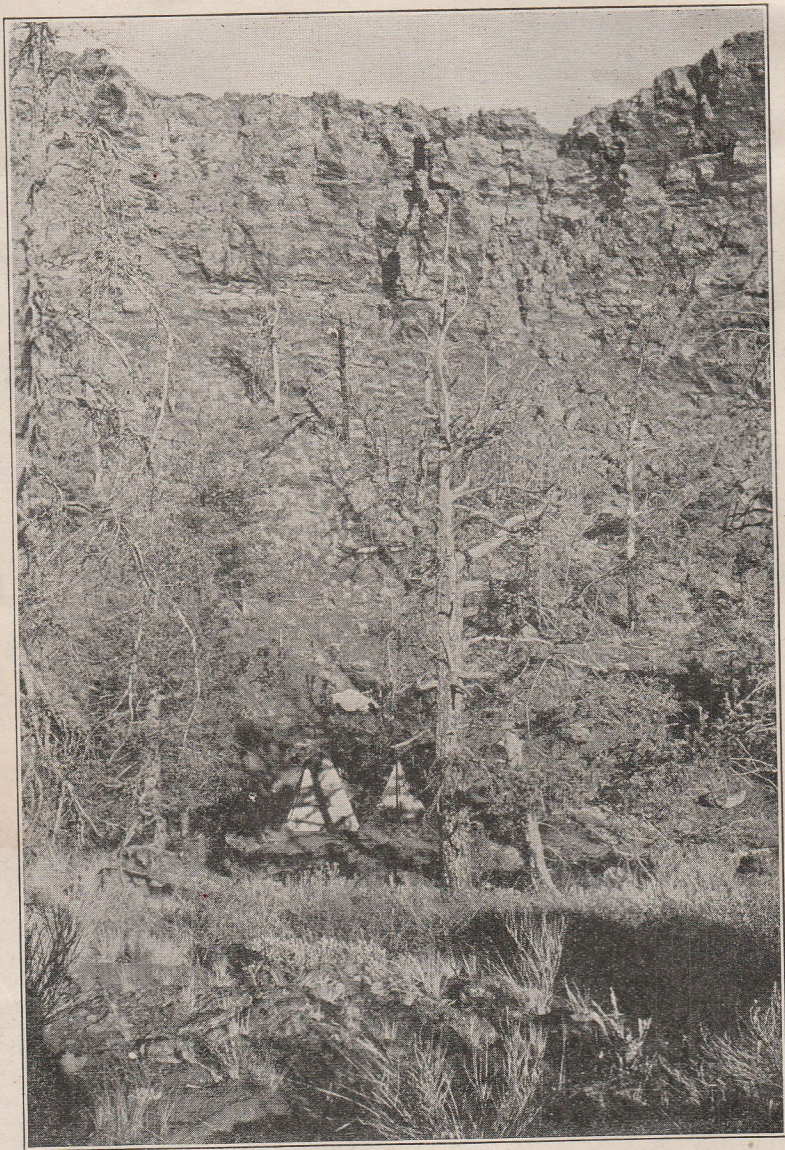


Photo H. T. Stearns

FIG. 1.—The days were short at the camp in the bowl of Echo Crater, the sun rising at ten and setting at four.

EXPLORING THE CRATERS OF THE MOON, IDAHO

NORAH D. STEARNS

In the midst of the dusty sagebrush desert at the foot of the White Knob Mountains in Idaho, lies an area of undreamed of weirdness—a fantasy of barren black cinders and chaotic lava. At first sight the masses of fresh jagged rock and the smooth curves of cones of cinders seem jumbled together without rule or reason. Upon closer view it is seen that the cones all lie in one general zone and stretch out southeast from the White Knob Mountains, disappearing into the haze of the Snake River Desert. Floods of fiery molten lava poured out of a fissure on the south side of the mountains, not so very long ago as geologists count time, and many of the rocks and cinders now look as if they had been erupted only yesterday.

It is perhaps the stillness and lifelessness that strike one in this strange place. I camped there a while, and always I seemed to be gazing out of the door or window in a troubled, puzzled way. Something was strange! Perhaps this area is indeed an "unfinished corner of the universe where the chaos of the primeval world still exists."

One's first impression is that of bareness, desolation, waste—lack of life—yet there are sparse growths of sagebrush, grass, and pine, on some of the cones, and a few birds are seen flying over the edge of the lava. In the daytime is heard the occasional song of a bird, and the long lonesome nights are often disturbed by the wail of the wild prairie wolf. I have wondered whether the contrast of the black, bare lava with the velvety blues and purples of the mountains to the north and the deep blue of the desert sky, does not make one a wee bit lonesome and wistful. I have gazed at the lavas and cones at dawn, at noon, at sunset, in the twilight, and in the moonlight, and they are "never the same, yet always the same through each changing."

Let me tell you more about this unique bit of chaos tucked away in a little corner of Idaho. First, let all be warned of my mistake! When driving into this spell-bound fragment of the universe, let the driver keep his eyes on the road. Too much scenery

brought me woe, and the car had to be towed out of the loose cinders back on the hard road. Too much scenery!—that seems to be the trouble.

Driving to it from Arco, along the dusty roads, through the dusty sagebrush desert, one is suddenly aware of blackness and bareness. Smooth cones of black cinders with dark yawning crater-bowls, sparsely covered with vegetation, are intermingled with masses of bare rock. Some of the lava is smooth and billowy and is rent with cracks. This is the pahoehoe. The *aa* lava looks like fields of sharp, jagged blocks bristling with formidable points, and is in strong contrast to the smooth appearance of the cinders on which it often overlaps. An hour's trip afoot over either lava seems like a long day's hike. You find yourself always picking out the smoother pahoehoe or the loose cinders of the cones for a path. My new heavy boots were literally "chewed up" by a few hours' hike—or better, snail-like progress—over the lava fields.

A birdseye view of this strange, desolate waste is probably best obtained from the top of Big Cinder Butte, the highest cinder cone in the area. To the east stretches barren black lava until it fades into the shimmering haze of the desert. The monotony of it is broken by one group of ancient, yellow, grass-covered cones which were not inundated by the floods of lava, and which now stand together as a yellow island in a sea of black. Farther east, some miles away, rises Big Butte, a landmark in the Snake River Desert. Beyond and to the northeast, are two smaller peaks, the Twin Buttes, floating in the blue haze. These three peaks are outside of the Craters of the Moon and have been silent sentinels on the plain even before the great floods of basalt in southern Idaho.

To the southeast stretches a line of cinder cones, many of them grass-covered and all of them sources of extensive lava flows which unite southward into one great field of lava, lonely and uninhabited. Black Top Butte, the farthest in this march of cones, lies approximately eleven miles southeast of Big Cinder Butte. Still farther away are yellow, grass-covered cones, and against the far horizon are barely discernible the snow-covered peaks of the Portneuf and Bannock mountains.

Four miles to the south lies North Laidlow Butte, a prominent ancient cone, surrounded by a mass of cinder crags and rugged lava. A half-mile beyond this cone is Little Laidlow Park, a grassy

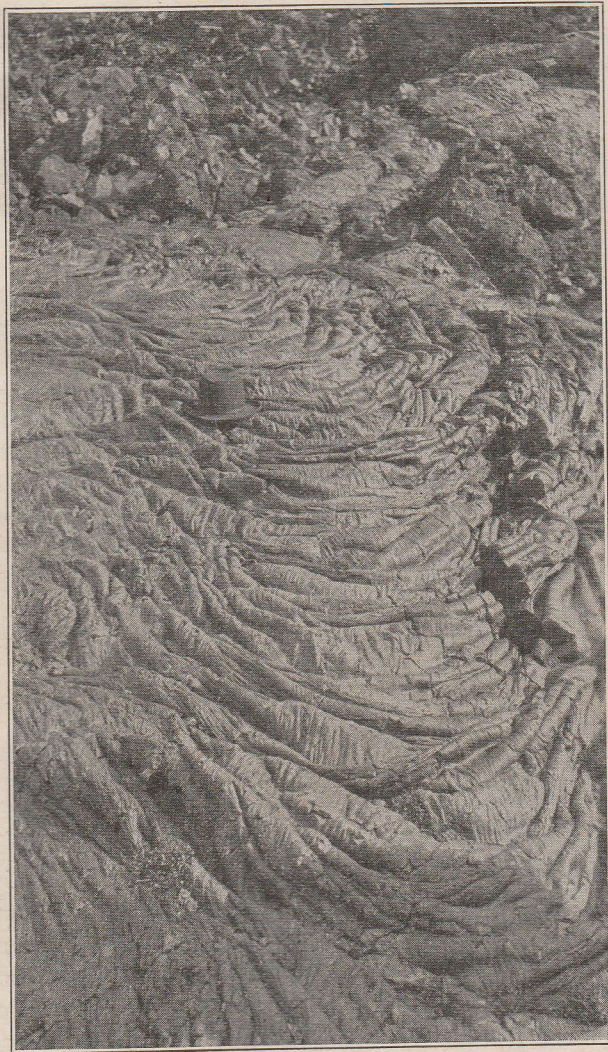


Photo H. T. Stearns

FIG. 2.—Frozen Motion—The hardened lava

field of old lava appearing pale yellow under the bright desert sun. Farther away on the plain beyond are low lava domes with almost imperceptible slopes, and in the far distance, beyond the Snake River, are pale blue mountains which lie along the Idaho-Utah line.

To the west for about six miles the lava has flowed against the southern spur of the White Knob Mountains, filling the valleys as if they were bays and leaving the ridges like projecting headlands in a sea of black. Only small cinder crags break these forbidding fields of lava.

To the northwest there are gaping crater pits, symmetrical spatter cones, rounded cinder cones, and dark lava flows, massed along a fissured zone called the Great Rift. Many of the cinder cones are brilliant red at noon, but slowly change to purple with sundown. On the tops of many of them are discernible yawning crater pits which are especially beautiful under the lengthened purple shadows of evening. On one there is visible only a single tree—a solitary reminder of the struggle for existence. Beyond this generous display of volcanic features rise the White Knob Mountains covered with rich yellow grass and grey-green sagebrush, and streaked with small groves of quaking aspen, golden with fall foliage and snuggled away in twisted ravines and canyons. Farther northward are the snow-clad Sawtooth Mountains, with serrate outlines against a blue sky. These mountains to the north give one a sense of security as belonging to one's own world, yet the lavas, black and barren as they are, have a weird charm. The mountains seem to be a symphony, the lavas a rhapsody!

The details of the queer volcanic forms are fascinating, and a trip of exploration in the cones and lavas reveals strange and unexpected things. The most conspicuous features of the area are the cones of cinders and the fields of lava surrounding them. The lava was poured out after the cones were formed and lap up on their lower slopes. The cones have smooth, gentle slopes, and the white wild buckwheat clusters, the only vegetation on some of the slopes, give the cones a polka-dot pattern. Some are surmounted by rounded summits and some are indented by bowl-like craters. While a few are symmetrical, many others are bunched together, their lower slopes merging into one another. These cones were

once the sites of great lava fountains, and many gave vent to lava flows. Usually the earliest phase of an eruption consists of ejections of cinders, and the later phases comprise lava clots and spatter, and then the quiet welling out of the lava flows.

Let us examine some of these cinders more closely—on Big Cinder Butte, for example. The cinders on which we are standing are loose, and our feet slide along leaving indistinct dusty holes as footprints. The pieces of cinder are about the size of a walnut,



Photo S. A. Paisley

FIG. 3.—Owl Cavern. Scaring to flight the wise-eyed tenant

and are light in weight and cellular like pumice. They are frozen lava froth. At the surface they are mostly red, black, or dusty brown, and crush under our feet, giving a crunching sound and a puff of dust. A detailed examination of some of the pieces, especially those a few inches below the surface, reveals a remarkable and very beautiful iridescence. I have often scraped away the top layers and found below wonderful fresh-looking fragments with soft, iridescent gleams of deep blue, purple and gold. This color-

ing is said to be due to the sudden oxidation of certain iron compounds contained in them. The cinders probably had these beautiful colors when they were first erupted. Geologists say that when the volcanic action is explosive and violent, accompanied by much gas, the molten rock is thrown out with terrific force and disrupted into small cinders. The cellular structure is due to the escape of bubbles of steam. The fall of these cinders around the fire-fountains of Hawaii give a continual din like the pounding of heavy surf on a rock-bound coast.

One of the striking features of this unique area is the little spatter cone. It seems as if chains of spatter cones are strung along cracks like beads on a string. These are small cone-heaps of lava made by the sputtering of a small lava fountain. Many of them are found in a row along the Great Rift, ranging in height from 10 to 50 feet. They look like great blast furnaces ready for action. One can scramble up these rough heaps and peer down their red, vitreous throats. Most of the openings have been nearly filled by débris. One of the heaps, called the Ice Cave, has a narrow throat twenty feet deep, and on the bottom of the hole is a heap of ice and snow, mocking the slumbering fires. Crystal Pit nearby has a narrow throat that opens downward like an inverted funnel, eighty feet deep. It is lined with delicate spines of lava coated with white crystal gypsum, the exhalation of the former fires.

The lavas are the most widespread forms in the area. From afar they look relatively smooth, though undulating and uneven, but upon closer inspection are found to be astonishingly rough and acicular. The pahoehoe lava has smooth and billowy surfaces, and contains innumerable caves and tunnels. This kind of lava wells out in an extremely fluid condition and the lava rivers flow beneath their own hardened crust through ramifying tubes to the margin. On the steeper slopes near the sources the lava drained out and left long caverns and tunnels hidden in the lava flows. In many places portions of the roofs of these tunnels have broken in, leaving picturesque skylights and natural bridges and openings which facilitate their exploration.

The *aa* lava issues at a slightly lower temperature or with a lower gas content, and often the pahoehoe streams suddenly change by the loss of these two properties into *aa* which resembles slush

ice in the rivers in spring. A peculiar type of granulation by motion occurs in the formation of *aa*, developing great clinkery masses which are pushed and carried forward by the still molten and moving mass below, or are shoved over the surface and finally left as fields of jumbled and chaotic rocks. The margins of *aa* lava flows are often steep, forming walls of broken blocks of rock piled up at a perilous angle. It seems inconceivable that the mass ever moved or ever was in a molten condition. These *aa* lavas, at first enticing, soon become monotonous and relatively uninteresting, and being hazardous to both foot and hand are to be shunned rather than sought.

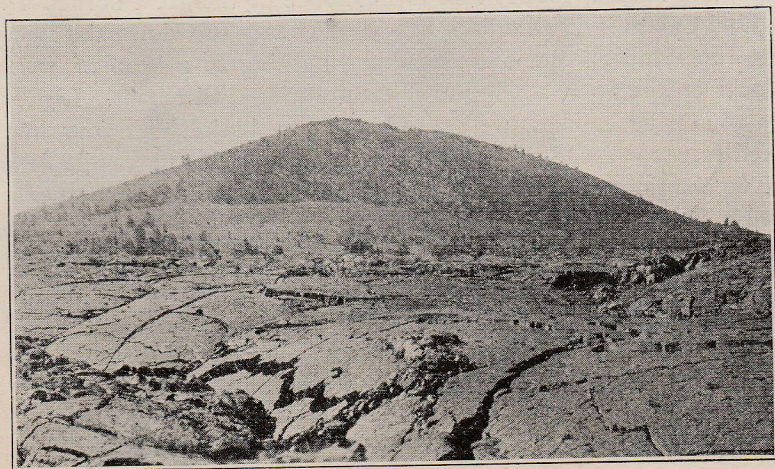


Photo H. T. Stearns

FIG. 4.—Some of the lava is smooth and billowy and rent with cracks

Extensive areas of the pahoehoe lava have beautiful crusts about a quarter of an inch in thickness which shine and glisten with a marvelous iridescent blue. This tiffany blue effect is particularly noticeable in the Blue Dragon Flows, southwest of Big Cinder Butte. These crusts are said to be pure glass and to indicate sudden freezing. As this bloom is gradually lost with age its presence suggests the newness of the lava.

The striking frozen forms of the lava defy description. One can almost imagine the writhing contortions of the moving plastic stream. Patches of braided ropes of lava—frozen motion of a

lava river—are frequently found. Huge protruding toes of lava that seem to creep stealthily away from a twisted and tortured surface, a frozen cascade caught as it tumbled over a steep cliff, a smooth river turned to stone—these break upon you suddenly as you pick your way slowly across the lava flows. At times I have caught myself looking quickly back out of the corner of my eye, half believing I could see the mass of rock slowly creep forward. So weird are the surroundings that one can easily believe in “hobgoblins, satyrs, and dragons of the pit.” I am sure I can readily believe anything under the spell of this haDES of frozen fire!

I was particularly fascinated by the tunnels and caverns in the lava, and made a special visit to the abode of the great horned owl—Owl Cavern. With others I climbed twenty feet down the swaying rope ladder from the top of the opening to a heap of fallen blocks on the floor, scaring to flight the wise-eyed tenant. Lighted by sputtering candles, we groped our way back about four hundred feet to one end of this dark place. The flickering candle flame lit up the floor undulating with frozen ripples of the lava stream, and revealed large and small lava pendants or stalactites hanging from the vaulted roof.

In Buffalo Cave the walls are scored with horizontal parallel ledges, the ancient shore-lines of the subsiding river of lava. Wonderful, fragile, white crystals of gypsum are found coating the roof of Crystal Pit. In Last Chance Cave there is a refreshing pool of cold water on a mass of ice. Water from the melting snows in spring has percolated through the crevices in the roof of the cave, forming huge blue icicles and a heap of ice on the floor beneath. During the summer the icicles melt and form a pool of water.

Bones of animals have been found in a few of the caves. Buffalo Cave is so named because of a buffalo horn found there. Indian Tunnel suggests the occupation of the cave by Indians. That the area was occupied by Indians is evidenced by the arrow-heads, scrapers, pottery, and other artifacts found near some of the caves. Indian Tunnel was probably a refuge for them in time of war. Crescentic piles of rocks which formerly weighted down their tepees are numerous near this tunnel. Further indications are found in the faint trails still discernible across the lavas. Doubtless the Indians witnessed eruptions in the areas and had many a story and legend to pass on to posterity. Major Jim, a Bannock

Indian scout, was asked in 1879 whether any traditions existed regarding eruptions in this area. He replied that his great, great, great, great, father saw fire in the region. With usual Indian reticence he would say no more.

In some of the caves in the more inaccessible parts of the lava beds one often finds rounded shallow depressions hidden away in the dark corners in the volcanic dust that has sifted into the caves. These are the winter beds of bear that occasionally wander down from the adjacent mountains to hibernate. Not many years ago much game wintered in the southern part of the Monument, and

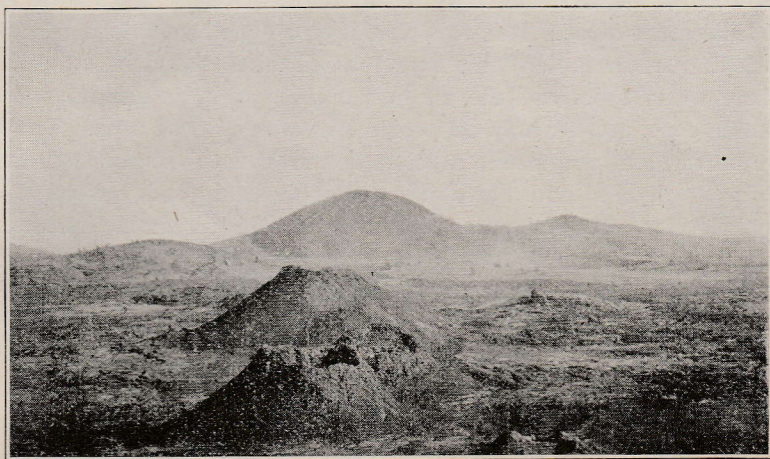


Photo H. T. Stearns

FIG. 5.—Chains of spatter cones are strung along cracks like beads on a string.

skulls of antelope, big horn sheep, and deer, are seen in places on the black lavas bleaching in the sun.

In many places the roofs of the tunnels or caves have fallen in, and the remaining portions form narrow natural bridges. The open places are enticing skylights to dim spaces below. An immense pile of huge rocks obscures the graceful arch of the Bridge of the Moon, one of these roof remnants. It is rumored that if one looks carefully one is sure to see sitting on one of the bridges no other than the Man in the Moon himself, who is the faithful custodian of these "Craters of the Moon."

After a long hike over the hot, shadeless lavas, one may come unexpectedly upon a pool of the coldest water lying in a depression in broken blocks of *aa* lava. The absurdity of ice-cold water lying in the sun on a hot day, and of water resting in the most broken sieve-like rock, is quite overshadowed by one's joy in the satisfying of thirst. Most of the large water holes in the area occur in such places. In winter considerable snow collects in the depressions, some sifting down into the crevices between the rocks. Here it accumulates and freezes. In the crevices it is sheltered from the heat of the long, hot summer days, and only a little ice melts to form a pool of water in an ice basin. In favored localities it never entirely melts away. It is said that if you dig down into the loose rock in a water hole of this type you will always find ice beneath. These water holes and the ice in the caves and the throat of the spatter cone, are the only occurrences of water in the area. There are no streams, and all the precipitation sinks into the porous lavas to great depths, and flows underground southward toward the Snake River where it appears in the form of innumerable immense springs.

To me one of the most fascinating experiences was to pick up lava bombs on the slopes of the cinder cones. These bombs range in size from tiny fragments less than an inch long to huge pieces up to thirteen feet long and eight inches wide. They are lava projectiles thrown out during an eruption in a plastic condition. The motion during their flight through the air gave them various queer shapes. Many of them have ear-like projections on a football-shaped body, many have spiral and spindle forms, many are mere strips of twisted lava ribbon. Besides these, there are scattered over the cinder slopes many splashes and clots of lava, some of them fragile and extremely thin. These were so plastic when they fell on the cinders that the impression of cinders was molded on the under surface. Most of the fragile forms have been protected by a cover of cinders, and have only recently been uncovered by winds.

One of the queer volcanic forms that always attracts attention is the tree mold. Evidently the lava flows in places entered into stands of trees and laid them low. Some of the trees escaped complete obliteration, probably because the lava at those places was partly cooled. The lava surrounded the tree forming a lava shell which solidified before the tree entirely burned. With the burning

of the tree and the disappearance of the charcoal, there was left in the lava a vertical hole or well where the tree had stood. Often the tops of the trees, burned off at the base, fell upon the plastic lava, forming a log mold. In some of these molds even the shrinkage cracks in the charcoal were delicately molded as well as the grain of the wood.

More spectacular, however, are the lava trees, notably on Trench Mortar Flat. In the case of lava trees the lava, after making a shell around the tree, drained away leaving an upright column of lava with a hole inside. Or, the trees were covered by spatter from a nearby fissure and coated with clots of lava. Parts of these lava trees now stand as vertical shells one to six feet high. In some of them one can see the places where the branches forked. One curious tourist tried to examine the bottom of the hole for charcoal, but found only cramped quarters.

After seeing all these queer things and exploring caves and flows, one can rest again on Big Cinder Butte sheltered from the strong southwest wind, and ponder the why of it all. How did it happen, when did it happen, and will it happen again?

Geologists tell us that over 200,000 square miles of northwestern United States are covered by huge lava flows, but most of these flows were erupted long, long ago. The lava and cinder cones of the Craters of the Moon are remarkable because of their freshness and recency. This is the story of the lavas of the Craters of the Moon:

Long ago, after the glaciers of the Ice Age had disappeared from the mountains on the north, a fissure or rent opened on the south side of the White Knob Mountains. Along this fissure at various times and at various intervals southeastward, there were volcanic eruptions. Cinders were thrown out and cinder cones were built around the vents. Lava flowed from the craters of these cones, from vents on their sides, or from cracks along the great fissure zone called the Great Rift. Later lavas buried earlier lavas and cones, and later cinder cones were built along cracks in the earlier flows. Periods of quiet and rest probably occurred and a sparse vegetation must have taken root in the cinders and lava during the quiet times. It is believed that the fissures of the Great Rift opened again and again, ejecting cinders and lava. The fresh-looking black lavas and cones near the northern end of the area are the

most recent. Because the lavas are so similar, geologists have difficulty in assigning them definite ages. They can say this one is more recent than that one because it lies on top, but can only estimate from various facts the actual number of years ago that the eruptions took place. For instance, a tree was felled and the annular rings counted. The tree proved to be 461 years old and was estimated to have been dead about two years. This tree grew on one of the most recent lavas, hence the lava is older than the tree, or, older than 463 years. Comparison of the lavas with those in other areas, such as Italy or Hawaii where the actual dates of eruptions are known, gives another clue to the age. It is stated by a geologist who investigated the area that all the evidence points to the last eruption being not less than 250 years, and perhaps not over 1000 years ago.

Of more interest to many than the date of the last eruptions is the question whether another eruption will occur in the Craters of the Moon. Who knows? Lassen Peak, in California, was listed as an example of extinct volcano, yet in 1914 and 1915 it violently erupted! Only the fact that the surrounding area was uninhabited and isolated made this eruption appear minor to the public. In reality it was comparable to many that have caused huge loss of life and property in Japan and Java.

Viewed in the light of the immense amounts of lava erupted in the Northeast and of the recurrent eruptions since earliest time, the possibility of another eruption in the Craters of the Moon is regarded as very likely by a geologist who has studied this area in detail and volcanism in general. However, the area is isolated and uninhabited, and little if any damage would be done if such an eruption occurred. As this geologist points out, the eruptions in the area have all been of the quiet, non-violent type, similar to the eruptions of Kilauea and Mauna Loa volcanoes in Hawaii. If a similar eruption should occur in the Craters of the Moon today, you and I could stand with safety one-half mile away on the windward side of a cinder cone in action, or a few feet from a lava flow in motion.

Considering the periodic recurrence of volcanic activity throughout the world, is it for us to say we will not live to see an eruption in the Craters of the Moon?