

AMONG THE "CRATERS OF THE MOON"

An Account of the First Expeditions Through the Remarkable Volcanic Lava Beds of Southern Idaho

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With Illustrations from Photographs by the Author

IN THE West the term "Lava Beds of Idaho" has always signified a region to be shunned by even the most venturesome travelers—a land supposedly barren of vegetation, destitute of water, devoid of animal life, and lacking in scenic interest.

In reality the region has slight resemblance to its imagined aspect. Its vegetation is mostly hidden in pockets, but when found consists of pines, cedars, junipers, and sagebrush; its water is hidden deep in tanks or holes at the bottom of large "blow-outs" and is found only by following old Indian or mountain sheep trails or by watching the flight of birds as they drop into these places to quench their thirst. The animal life consists principally of migrant birds, rock rabbits, woodchucks, black and grizzly bears; its scenery is impressive in its grandeur.

A glance at a map of Idaho shows that the southern part of the State, lying between Arco and Carey and north of Minidoka, is a vast region labeled desert or rolling plateau.

Although almost totally unknown at present, this section is destined some day to attract tourists from all America, for its lava flows are as interesting as those of Vesuvius, Mauna Loa, or Kilauea.

The district consists of some 63 volcanic craters, lava, and cinder cones, all at present extinct or dormant. The largest and most conspicuous is 600 feet high, rising in the midst of a belt of craters two or three miles wide and 30 miles long. The craters or cones are close together in the north and west; in the south they are miles apart.

That a region of such size and scenic peculiarity, in the heart of the great Northwest, could have remained practi-

cally unknown and unexplored is extraordinary.

For several years I had listened to stories told by fur trappers of the strange things they had seen while ranging in this region. Some of these accounts seemed beyond belief.

I had made two trips into the northern end, covering practically the same region as that traversed by a Geological Survey party in 1901. My first was a hiking and camping trip with Ad Santel (the wrestler), Dr. Dresser, and Albert Jones; the second was with Wes Watson and Era Martin (ranchers living about four miles from the northern edge). The peculiar features seen on those trips led me to take a third across the region in the hope that even more interesting phenomena might be encountered.

EXPLORING AN UNKNOWN REGION IN THE UNITED STATES

One morning in May W. L. Cole and I, both of Boise, Idaho, left Minidoka, packing on our backs bedding, an aluminum cook outfit, a 5 x 7 camera and tripod, binoculars, and supplies, sufficient for two weeks, making a total pack each of 55 pounds.

We also took with us an Airedale terrier for a camp dog. This was a mistake, for after three days' travel his feet were worn raw and bleeding. In some places it was necessary to carry him or sit and wait while he picked his way across.

North of Minidoka, for about 25 miles, we crossed a rolling lava plateau, after which came comparatively later flows of lava. So far as can be learned by diligent inquiry, we were the first white persons to cross this plateau from south to north (see map, page 306).

For three days our travel was over the



TAKING HORSES TO WATER DOWN A CINDER RIDGE

The cinder cones, or buttes, of southern Idaho are extinct volcanoes of recent date, and of remarkably fresh appearance. They are composed, to a great extent, of dust, volcanic sand, and gravel (called lapilli), thin, cakelike forms of lava, volcanic bombs, and rough, ball-like masses, known as scoria. The prevailing colors are red and brown.

uninteresting, broken-up lava surface known as AA flow (a term derived from the Hawaiian natives, who apply it to a similar surface found in their islands). It was the hardest going imaginable, each rock seeming on a balance and ready to turn the instant it was trod upon.

Our water on this part of the trip was snow and ice which we found in crevices.

WATER FLAVORED WITH WRIGGLERS

The fourth day out we sighted an Indian monument in an open flat, and 20 feet from it we found a hole about two feet in diameter, that opened downward like an immense cistern. This was full of clear water. About 10 feet to the west of this was a lava crack, down which we could see some 15 feet before it angled off.

After drinking our fill, we made the discovery that the water was full of innumerable little bright red wrigglers that looked like small shrimp. Each was about three-sixteenths of an inch long. However, the water was good and one cannot afford to be squeamish in desert country.

We located this water hole by compass bearings on Red Top Butte and Sugar Loaf Butte, noted on the map (see page 306). It is the only water in this vicinity which can be depended upon the year round.

The lower slopes of Sugar Loaf were covered with wild onions, which were crushed as we walked and gave out an odor more pleasant to tell about than to experience.



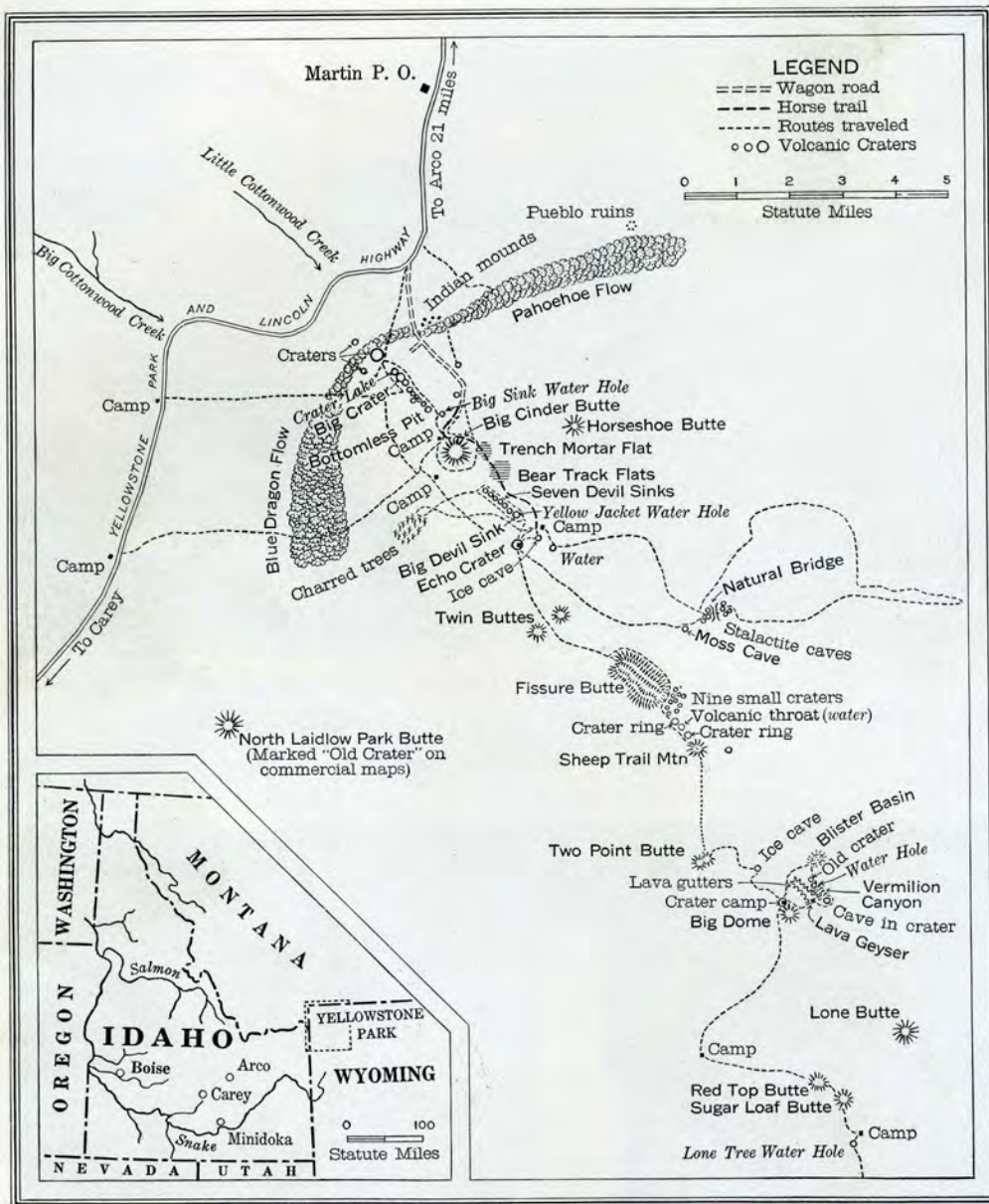
LOOKING SOUTH FROM A RED-RIMMED CRATER

The vegetation of this region includes, besides sagebrush, a few species of pines and junipers, the pear-leaf cactus, and such flowers as larkspurs, wild violets, and daisies. The later lava flows, however, are barren—not even a blade of grass has been able to take root on some of them.



AROUND THE CAMP FIRE

At night, in the weird reflections of a camp fire, the surrounding sides of this crater appeared like a gigantic funnel with flickering colors of red and black. Its floor acted as a sounding board for the notes of birds migrating northward far overhead.



Drawn by A. H. Bumstead

A MAP OF THE "CRATERS OF THE MOON" IN IDAHO

The dotted lines indicate the routes taken by the author on his several expeditions through this unique volcanic region.

Along the slopes there were evidences that bears had been digging for roots and rolling rocks for ants.

From the top of Sugar Loaf we picked up an old Indian trail which resembled a light streak winding through the lava. When the sun was directly overhead it could be seen to advantage, but at other

times was difficult to follow. Think of the years of travel necessary to make that mark on rock!

Some miles to the north was the butte called Big Dome, and a few hundred yards north of it a crater several hundred yards in diameter and about 200 feet deep.

We camped in the bottom of this crater



EXAMINING A SMALL CRATER IN VERMILION CANYON

The lava field of the Snake River plains of Idaho is larger than any other in North America, so far as is known, except that of the Columbia River. One writer, summing up his general impression of the Snake River lava desert, says: "It was as if the great plain had been filled with molten rock which had kept its level and wound in and out along the bays and promontories of the mountain slopes as a sheet of water would have done." The Craters of the Moon district occupies about 300 square miles of the total 27,000 square miles of the Snake River field.

that night, and the experience was well worth the climb up and down. Imagine yourself in some gigantic funnel of bright red and black, weird in its reflections of the camp fire, with the stars above. A peculiar feature of the bottoms of the craters was that they seemed to act as sounding boards for the notes of the birds migrating northward far overhead. Their faint calls were gathered and intensified until the birds seemed only a few feet away. Near here we built a signal fire that was seen by people watching for it 30 miles distant (see page 305).

MAGNETIC CRAGS MAKE COMPASS USELESS

Half a mile east of Big Dome we found an immense crater ring that looked as if the top of a mountain had collapsed and fallen back into the volcanic throat. From the center crags of bright-red lava and burnt cinders jutted up. In some places the lava was black, as if smoked in a fire.

The crags had magnetic properties, and the compass needle could not be depended upon when near them. About a quarter mile to the northwest was a large fissure, which we called Vermilion Canyon. The floor, a hundred or more feet in width, was composed mostly of cinders; the walls of lava were a bright, almost a vermilion, red in the sunlight. Near the center were several extinct lava spouts, one of which was 25 feet in diameter and built up so that it resembled the geyser formations of Yellowstone Park. In the center of it was the throat, about 5 feet wide and 18 feet deep. The sides had fallen in and choked it up.

Fifteen feet south of this was a hollow cone, built up 4 or 5 feet. One side had fallen in, exposing the throat, which went down 25 feet and then angled off, we could not tell how far. Fifty feet to the north was another cone, about 4 feet high and $2\frac{1}{2}$ feet in diameter at the base. This had a 6-inch hole in one side, which



INVESTIGATING A LAVA SPOUT IN VERMILION CANYON

The bird and animal life of this fantastic region includes sparrow hawks, mourning doves, rock conies, rabbits, chipmunks, mice, kangaroo rats, and other species. Rattlesnakes, however, are absent, although they abound on the edges of the flows. It is probable that the snakes were killed off at the time of the eruption, and that they have as yet been unable to cross the immense lava barrier.

opened up as it went down—how deep we could not gauge, as it had drifted full of snow.

Near here we saw a pile of rocks with a piece of charred sagebrush in it pointing to another water hole that probably contains water during the summer. Working our way through the fissure for a quarter of a mile, we found it opened upon a flat, and about 600 yards to the north was another crater similar to the one just passed. As we sat on the east side of its rim, we saw below us a hundred or more large lava blisters or bubbles. In many instances the tops had

fallen in, disclosing rooms from 8 to 10 feet across and as high as 6 or 7 feet. The shells of these lava bubbles were from 6 to 8 inches thick. Their color was a grayish brown.

DISTANCES WERE DECEPTIVE

At all places of interest I set up the compass and triangulated on the more prominent buttes shown on the accompanying map (see page 306). Sometimes it was necessary to move the location several hundred feet, as the needle was attracted to the rocky points. In one spot the north end of the needle swung



COMING OUT OF A LAVA SPOUT, VERMILION CANYON

This canyon has a cinder floor over 100 feet in width and lava walls of a vermillion color in the sunlight. Near the center the expedition found extinct lava spouts, one of which resembled the famous geyser formations in Yellowstone Park.

completely around and pointed within 7 degrees of due south.

Estimating distance was also very difficult, owing to the lack of any object of known size to use as a scale. We usually found that distances between specific points were about half again as far in an air line as we estimated.

West of the crater beside Bubble Basin we saw channels winding through the lava flat just as meandering brooks might cross a level meadow. Examination showed these to be lava gutters. Here the plastic lava had flowed down grade, assuming all the shapes of a mountain stream. It was in waves, rolls, twists, and levels.

As we stood on the edge and looked down, we tried to imagine the wonderful sight when the whole lava bed was glowing red.

A CAVE COVERED WITH CRYSTAL ICE

Traveling northwest for a mile, we came to another Indian marker—a pile of rocks. It had a smaller pile at the base and, in a line with it, about 20 feet distant, at the base of a cliff, was the entrance to a cave that opened up into a room 18 feet wide by 12 feet high. From the ceiling hung clusters of immense ice stalactites, sometimes touching a few stalagmites of the same material below. The floor was covered with ice so clear



LOOKING ACROSS ECHO CRATER

This vividly colored crater is 700 feet deep and about one-fourth of a mile wide. The eastern side has breached away until it is only 100 feet high. Viewed from the center, the crater shows the effects of two explosions, the first of which formed the crater, the second blowing a hole in the bottom. A ridge on the southern end is pitted with 14 smaller craters, 9 of which are of the blow-out, or explosive, type. Echo Crater is one of the few in the district having trees on the inside (see text, page 312).

that when I first reached it I dipped down for a drink.

Lighting our single candle, we worked our way for about 50 yards, until the passage narrowed down to about 2 feet in width and 1½ feet in height. After about 10 feet of this, it opened again into a drop-off that blocked our farther progress.

When leaving we restored the old Indian marker, which had partly fallen down.

CRATERS BANDED WITH GREEN AND YELLOW

North of this point we found a high cinder cone whose sides were terraced with old mountain sheep trails. They stood out so prominently from a distance that we called it Sheep Trail Mount. In climbing to its top to triangulate our position, we found it had a double crater, or rather a crater within a crater, evidently caused by two heavy explosions at different times.

The sides of the crater were banded with rings of green and yellow. This was the only sulphur deposit found on the trip.

On the very top of the cone we noticed fresh bear signs, where a grizzly had sat for some time looking at the land below.

About 200 yards to the north was another large crater, 300 yards wide and 150 or 200 feet deep. For three-fourths of its circumference the sides were perpendicular, the balance being a cinder and ash slope.

About 100 yards northwest of the north rim of this crater we found a blow-out cone, with a throat about 10 feet wide and 15 feet long, that went down 30 feet and branched off.

While Mr. Cole was adjusting the straps of his pack, I noticed a narrow crack in the side of the throat and climbed down. The snow had drifted into the passage 15 or 20 feet. The north wall had a sort of lava oven about 10 feet high and hollow, which resembled an inverted wasp nest, the sides being about 8 inches thick.

Fifteen feet north of the oven was the rim of another crater blow-out, 100 feet across and 150 feet deep. Fifty yards from the edge of this were nine small blow-out craters.

Were I gifted with the art of word painting, I might in some small way suggest the wonderful coloring of these craters. Picture yourself standing in some vast amphitheater whose towering walls are a riot of yellow, green, orange, brown, and black, with brick red and vermillion predominating. Imagine, too, an awesome, enveloping silence. I noticed that at places like these we had almost nothing to say. It was little wonder the Indians feared and shunned the region.

After leaving this scene, our trail lay along a series of cinder cones for about seven miles, each with a depression in its top. Examination from a distance with the binoculars showed no unusual features worth the climb, and when one is carrying a pack weighing 55 pounds over this kind of country one does not climb for the mere pleasure of it. As our food supply decreased, we increased our load with oddly formed pieces of lava rock, and the last day found our pack nearly as heavy as when we started.

A PRISONER IN A CRATER

The night we reached the point marked Echo Crater on the map, Cole's feet had become so badly blistered that the pain of walking was almost unendurable. The dog was in terrible shape also; it was pitiful to watch him, as he hobbled after us.

We planned to camp for several days, while I worked out alone. When morning came the tendons in one of Cole's feet had swollen and were so stiff he could not bend it. It was then decided that he should stay in camp and bathe his foot while I tried to reach Era Martin and Wes Watson, who were waiting to come back with us from the north end. That day I made the round trip of 28 miles, getting back at dark. I carried only a gun, camera, and canteen.

It was on this trip that I had rather an odd experience. In passing through a pahoehoe flow (a word also borrowed from the Hawaiians and used to distinguish a smooth, ropy flow from the rough, broken-up, ice-jam formation of the AA flow), I noticed a hole, 15 feet wide and 10 feet deep, evidently caused by the cave-in of the roof of some underground passage.

Happening to look down, I saw a mountain sheep's skeleton with the horns



FILLING CANTEENS AT BIG SINK WATER HOLE

The water supply of this region is hidden in tanks or holes at the bottom of blow-outs and can be found only by following old Indian trails and mountain sheep paths, or by watching birds as they make sudden drops into these hiding places. The water is usually cold and free from algæ.

in a good state of preservation. Carelessly I laid aside my gun, camera, and canteen and jumped down, alighting on some wind-blown cinders which happened to be at one end. After looking the horns over, I started to climb out, and found that the farthest I could reach lacked about four feet of the top. To be frank, I had some very queer thoughts, chief of which was, Will anybody ever find me or shall I, like the sheep, lie here for years?

Sitting on one of the rocks that littered the floor, I rested and thought. After a time, by rolling and lifting some of these rocks into a pile at one end, I had a mound from which I could easily reach the rim and draw myself up.

Echo Crater, as we called it, is one of the most beautiful in this region. It is 700 feet deep and is one of the few craters having a growth of timber on its sides and bottom. The dark green of the pines and cedars emphasized the vivid coloring common to all these craters. It was an ideal camping place, our camp being in the shade of the west wall after 2.30 p. m.

The acoustic properties of the site were most unusual. One morning, just at daylight, I was awakened by the loud calls of a bird. I lay trying to place it, and finally got up to locate the source, and found a robin singing in one of the pines at the foot of the west wall. We afterward took turns in singing and yodeling from that side to hear the echoes break the voices up and fade away. The east side produced no echo.

AN ICE CAVE OF UNUSUAL BEAUTY

About a quarter of a mile east of Echo Crater is the ice cave discovered on the trip of the year before. Happening to look down in one of the numerous sinks with which this region abounds, I saw a black opening which had the appearance of a cave. Climbing down one side of the pit, which was 100 feet long and 30 feet deep, we were surprised at the rush of cold air from the entrance.

The cause was immediately apparent. It was an ice cave and one of the finest examples, I believe, in existence. The floor was a conglomerate mass of huge



"THE BRIDGE OF TEARS"

This natural bridge of solid lava doubtless covered an underground cavern at one time. It has a 50-foot span, and the height from floor to roof of arch is more than 15 feet. West of this bridge is a cave, where the author discovered fresh bear tracks, but no live animals were seen.



EXAMINING VOLCANIC BOMBS

Most of the lava bombs on Big Cinder Butte resemble footballs, with projections, or "ears," at each end. Some are compact throughout; others have an outer crust, sometimes an inch thick, of black basalt. The shape assumed by the liquid lava before cooling depended upon the length of time it was in the air and on the manner in which it rotated.



A SPATTER CONE ON TRENCH MORTAR FLAT

Many of these blowholes, or fumaroles, have perpendicular throats from four to twenty inches wide, and are twisted or rifled like gun barrels. Most of the hundred or more cones on this flat have been plugged with small stones, probably by Indians.

lava blocks. These and the walls were incrustated with about two inches of ice as clear as glass, through which the structure of the rock could easily be seen.

We struck matches and were surprised to see hanging from the ceiling many ice stalactites, some 4 to 8 inches in diameter at the base and from 3 to 8 feet long. In places, especially where there was a ridge in the ceiling, they were in closely packed clusters. In spots I noticed ice stalagmites building up to meet the stalactites from above.

Forty-five feet from the entrance the tunnel narrowed and inclined downward at an angle of 15 degrees. Breaking off the tips of some of the icicles, I threw them down and could hear them skidding and sliding on the ice for some distance. It was not advisable to venture out on this ice incline, for a slip might have projected us we knew not where.

During the month of August, on a subsequent trip into this region, I visited the cave and found it full of ice on the bottom, but without the icicles or incrus-

tations on the wall. At the south end of the pit we noted another cave, which had about three feet of water over the stratum of ice. This went off into still another cave of unguessed dimensions.

At this point my curiosity was aroused by the number of mourning doves flying about. Knowing their habits, I wondered at their appearance in a region lacking water. I followed their course with the binoculars, just as a bee hunter would line bees to a bee tree, and was surprised to see them drop down into a blow-out. Following them, we came upon a pool of water five feet in diameter.

It was an extremely hot afternoon, in the middle of August, and the heat on the sides of the blow-out was terrific. The rocky slopes burned the hand. We were wet with perspiration as we reached the bottom. Dipping up a cupful of water, we were astonished to find it icy cold—so cold, in fact, that it hurt our teeth, and we put the cup down on the hot rocks to warm. This phenomenon can only be accounted for by the supposition that it was seepage water from an ice cave.

By lining flights of doves, four other water holes were located, all as cold as the first. One was covered with an inch coat of drowned hornets that had been chilled and had fallen in. The water underneath was pure and sweet. We named this Yellow Jacket Water Hole.

On the north rim of the big sink or cave-in containing Yellow Jacket and



A VOLCANIC CRATER SHOWING ITS COATING OF LAVA PAINT

The deep-blue film on the surface of some of the lava flows is a "desert varnish," which is due to the evaporation of water drawn from within the lava. This process has brought about a chemical precipitation of some of the material leached out of the lava.

about 50 feet from the edge are the remains of a perfect lava geyser built up 5 feet, with a spiral hole in the top which forks at a depth of 15 feet.

The sink itself is about 400 yards wide and 150 feet deep. We named it the Big Devil. Just to the north of it is a series of six smaller sinks or blow-outs. We called the row the Seven Devils. One of these also has a water hole.

LOST IN A FOG

The morning after we had explored this section there was a fog so thick that a person could see but 150 feet in any



THE INTERIOR OF AMPHITHEATER CAVE

This is one of a series of eight caves found near the Bridge of Tears. It is an almost perfect model of a miniature theater, with a circular, sloping auditorium, a miniature bridge of lava for the stage, an orchestra pit, back drop, and domed ceiling. It is lighted by a 6-inch hole in the roof. The coloring of this group of caves is red, brown, and black, with splotches of white.

direction. We started out hoping that it would lift, but after an hour of aimless travel we decided to go back to camp.

Watson happened to be in the lead and we naturally followed him. I finally asked him where he was going, and when he said "camp," Cole and I undertook to show him where he was wrong. The fog by this time was so dense that 75 feet was about as far as we could see. The sun was invisible.

Watson in turn laughed at us. We referred to our compass, and the needle pointed in the direction we thought south. I suspected this to be another case of magnetic attraction, so tried a different direction finder.

No matter how dull the day, if you lay your knife-blade on edge on the back of your watch or on a piece of paper, there will be a faint shadow; turn slowly around until you lose the shadow, and in



FOLDED FORMATIONS OF THE PAHOEHOE FLOW

This lava formation is about 20 miles wide, and consists of ridges, folds, crevices, and cracks. Some of the shapes resemble crumpled blankets, knots, and ship's hawsers neatly piled. *Pahoehoe* a Hawaiian term for a smooth, ropy, lava flow (see page 311), means "having a satinlike finish."* Indians had marked the trail across this flow by laying rocks on pieces of sagebrush pointing to caves or water holes. Occasionally old trails, marked by gray streaks across the bare rock, worn by ages of travel, can still be followed for short distances.

that direction is the sun; point the hour hand of your watch there, and half way between that point and the mark 12, for the noon hour, is due south, or near enough for practical purposes. This checked our compass; we had to admit we were wrong. It was the first time in my life that I had been lost.

Watson now got his bearings from some rocks he had passed.

About a half mile northwest of the

* See "The Hawaiian Islands," by Gilbert Grosvenor, in the NATIONAL GEOGRAPHIC MAGAZINE for February, 1924.

northern end of the Seven Devils we came upon a large cinder flat a mile long and a half mile wide. Here we encountered another strange feature of this land. In general, these flats were barren and packed so hard that an automobile might have been driven across at any place, but at this point we noticed a series of light-brown dots extending in lines crisscrossing the flats.

When we came to them we were surprised to find old bear tracks, into which the wind had carried a species of plant seed that had taken root and exactly filled



BIG CINDER BUTTE AND THE PAHOEHOE FLOW

This volcanic cone of reddish and black lapilli, the highest in this region, rises 600 feet from the plain, but was twice as large before its top and southwest side were blown off. Its slopes are covered with large pancakes of lava and with curious globular formations which resulted from the whirling motion of the lava as it was thrown high into the air. They range in size from a finger's length to 12 feet and are termed "volcanic bombs" (see illustration, page 313). The north and east sides of this butte are timbered with pines and quaking aspens.

the tracks. It was a small grayish-colored plant about one and a half inches high—hardly enough in some cases to show above the level of the tracks. Specimens I brought back have been identified as *Eriogonum acaule*, a pigmy variety of the buckwheat family.

Think of tracking a grizzly bear that had crossed here possibly hundreds of years before! In a few places wild rye grass had taken root and was crowding the smaller plant out.

We called this place Bear Track Flat.

Adjoining Bear Track Flat on the north was a similar one having features all its own, which consisted of more than 100 blowholes or fumaroles. These had at some time spewed out lava through from 4- to 20-inch throats. In many instances they looked like old tree stumps, 3 to 7 feet high. All had holes in the top and these openings were spiraled or twisted like the riflings in a gun barrel. We saw one with two openings about 5 inches

apart and 4 inches in diameter. Another was found that had forked about half way from its base. These branches had broken off and lay on the cinders, in appearance like pieces of twisted spiral pipe.

All the openings except three were plugged with bits of rock dropped in probably by Indians, as the old trail passed along the cinder flat 100 yards distant. Several were examined in which the opening angled off at a 45-degree slope and to unknown depths. They reminded us of a number of trench mortars, so we gave this the name of Trench Mortar Flat.

STRANGE FORMS OF THE LAVA FLOW

From our camp in Echo Crater we made an excursion for 9 miles out into a lava flow some 20 miles wide extending to the east. Most of the flow has a pahoehoe surface (see text, page 311). In places there are ridge after ridge and fold upon fold, with crevasses and cracks;



EXAMINING PROBABLE SIGNS OF THE LATEST ERUPTION

The sagebrush is charred and the lava pancakes are half an inch thick, with a high gloss on the upper surface. It is possible that the most recent lava flow in this region took place only 150 years ago. Six large streams flowed from the Cinder Buttes district at a late date, and three of them are as fresh as if they had congealed and come to rest but yesterday. The lava looks black, as one walks over it, but at a short distance and in certain lights it has a light-gray appearance, as if covered with dust. This surface "bloom" indicates youth and is absent from flows known to be older.

again, there are huge folds and waves, as if some one had crumpled a heavy blanket.

One place suggested a number of great ships' hawsers neatly piled; another had a long, sinewy twist of lava tied in as neat a knot as any sailor could make. How the ends could have twisted around and come through the loop is a mystery. I found a small specimen of this kind and carried it out with me. One flow had spread until it looked like an automobile speedway, except that it was broken by narrow cracks caused by cooling.

One day we crossed a stretch that tinkled with a hollow sound. Happening to notice that the surface was cracked and loosened in large sheets, we turned several pieces over and found the bottoms covered with jagged masses of nail-like projections all pointing in the direction of the flow. Many of the points were needle-sharp.

In one place the plastic lava had taken a circular, flowing motion while harden-

ing, just as if it had been a large whirlpool several hundred yards across. Watson built a row of monuments from this lava formation back to the caves, described further on.

About four miles from Echo Crater we came to a large black hole. Climbing down, we entered a lava stalactite cave, each stalactite from 2 to 7 inches long and covered with green moss. We went in about 75 feet.

A short distance from this we reached a second moss cave, extending to the east. Farther on we found another cave, where, in the dust around the entrance, we discovered fresh bear tracks. As we started in, I asked Cole if there were any word he wanted sent to his folks. What he answered is not printable. About 20 feet in, the cave forked, one branch going west and the other northwest. We entered each of these about 100 feet, until they narrowed down, making it necessary to crawl.



BOTTOMLESS PIT WHEN VIEWED THROUGH A MIST

Northwest of Big Cinder Butte the expedition found a row of seven lava sputter cones, one of which went down 40 feet and then opened up like an hourglass. Large rocks when rolled into it were never heard to strike bottom (see text, page 327).



THE STARTING POINT OF THE BLUE DRAGON LAVA FLOW

Perhaps the strangest features of this flow are its color and texture. Its tint is a deep cobalt blue, with a glossy finish, resembling varnish or enamel. The coating averages one-fourth of an inch in thickness. The play of light and shadow at sunset turns this formation into a twisted, wavy sea of grays, purples, blues, and blacks (see also illustration, page 322).



THE BLUE DRAGON LAVA FLOW

This remarkable flow is well named. Its surface is netted and veined with small cracks like scales of a prehistoric monster, while ropy twists of blue and gray lava, bursting through an older flow, have spread out in branches resembling the claws and legs of a dragon. This fantastic region of folds 30 feet wide, of whirlpools, gigantic snakes, and frozen waves, extends 11 miles to the southwest of Tycho Crater (see map, page 306, and text, page 327).

About 100 yards from the entrance to this cave, at the base of a cliff facing south, Watson discovered the entrance to a cave leading northwest. It also contained bear tracks.

East of the bear caves we came upon a natural bridge of lava arching a point where two cliffs of lava narrowed down. It had a 50-foot span, and from the floor to the roof of the arch was 15 or 18 feet. Its width was 75 feet. There was a pine tree growing under the east entrance. One of the party bumped his head on the roof near the edge, so we laughingly called this the Bridge of Tears (see illustration, page 313).

A CAVE FORMED LIKE A MODERN THEATER

East of the Bridge of Tears we came to the entrance of what we afterwards decided to call Amphitheater Cave. Climbing down, we found ourselves on the east side of a room some 40 feet wide and 60 feet long, with a domed ceiling 20 feet high.

As we sat on the north side, we beheld to the south a perfect stage. The floor was double, the lower section being about 8 feet lower than the top of the floor above, which was 15 feet wide. It was almost an exact model of a modern theater. To the right of the stage a large rock jutted up; imagination might call it one of the wings.

At the top of the dome the roof had caved in, leaving a circular skylight 6 inches in diameter. Back of the stage and starting on a level with the lower floor, the tunnel led away to the southeast.

We walked and crawled between a quarter and a half mile; but judging distance when part of the way must be made on all-fours and by candle light is difficult. Finally, the passage closed down until the roof was only $1\frac{1}{2}$ to 3 feet high. Leaving Watson and Cole here, Martin and I crawled on about 200 yards, until we came to a place we christened Fat Man's Misery. Martin weighs about 125



"PUEBLO RUINS" OF VOLCANIC TUFA

These peculiar masses were formed when molten lava undermined the sides of a crater, large pieces of which broke off and fell on top of the flow. The fragments are usually black or various shades of red, and when viewed from a distance resemble pueblo ruins of the Southwest. They are from 10 to 80 feet in height and of many curious shapes.

pounds and made it easily; I made it, too, but in all pictures taken after that I faced the camera!

About 50 feet farther on, the passage opened up again, and then closed down, owing to a cave-in of the roof. We could see through, but could go no farther.

The roof throughout was covered with stalactites and the floor with jagged drip-pings from above. Crawling was a painful operation.

The coloring in these caves was red, brown, and black, with splashes of white.

While proceeding east, Martin and I happened to leave the others to climb to a low mound in the flow. From this vantage point we sighted a lake a half mile long and, to the south of it, what appeared to be a grove of willows and cottonwoods. Turning the binoculars on the scene heightened the effect, and we decided to walk to another elevation, a mile and a half farther along, where we could look down into the basin. When we got there we sat for a few moments examining it, still apparently three miles off,



DEAD AND BURNED TREES WEST OF THE BUTTES (SEE TEXT, PAGE 328)

There is no positive evidence as yet to prove that the dead trees found on the borders of the lava flows in certain instances were killed by heat.



"THE BRIDGE OF THE MOON"

This gigantic stone arch has a span of 125 feet and a height of from 80 to 110 feet. Its golden-brown color contrasts sharply with the dark green of the pines below. As one looks through the arch from point to point in the landscape, the view changes from canyon walls and rocks to a series of green, yellow, and brown rolling hills, set off here and there, in the purple haze of the skyline, by the higher volcanic cones of Moon Valley.



ARCO TOWNSMEN WELCOMING THE EXPEDITION'S RETURN

The peculiar scenic beauties of the "Craters of the Moon" are unique in the United States. In due time this wonder-region will doubtless be opened up to tourists by a road which could be built from the northern end along its eastern side, following the open places that run back through the lava flows in narrow strips.

when suddenly lake, trees, and all floated away and disappeared in the distance. We had been the victims of a mirage.

AN AWESOME PANORAMA

A short distance northwest of Trench Mortar Flat lies the highest of the cinder cones in this region. As it stands today, it is about half its size before the explosion blew off its top and southwest side. The ascent to this point, known as Big Cinder Butte, was through a conglomerate of lava bombs and pancakes, where still plastic lava had fallen and flattened out. Near the top the cinders are broken by a number of jagged crags of red lava; the north and east sides of the butte are timbered with pines and quaking aspens.

From the summit we looked south over the country we had traversed, tracing our course through the maze of lava and cinder cones. On all sides were crater rings, showing we had examined but few of the many. We took turns in focusing the binoculars on the different features spread below. Very little was said except when one of us wished to call attention to something he did not want the others to overlook. We yielded to the influence of silence. Below us we counted six distinct lava flows, each comparatively fresh.

LOOKING DOWN INTO "BOTTOMLESS PIT"

To the north were many sputter cones and the shadowy outlines of craters deeper and larger than any we had passed. A route to some of these was planned, so as to avoid a large part of the rough, broken-up flow lying between.

Two miles northwest of Big

Cinder Butte we came to a row of seven lava sputter cones caused by molten lava which had been thrown out of a vent, piling up to a height of 60 feet. The southern one was the first climbed. Imagine finding a hole 15 feet in diameter and bottomless, so far as we could judge. It went down for 40 feet; then narrowed slightly, after which it opened up, giving the crater the shape of an hourglass. Large rocks rolled in were never heard to strike bottom. We called it the Bottomless Pit.

Near by a volcanic throat about 30 feet in diameter and 60 feet deep was found, full of snow and ice. From the sides hung large clots of lava. The outside slopes were covered with numerous volcanic bombs resembling double-ended pears. In many the ends had curved upward as they had fallen, giving the appearance of buffalo horns. A short way from this was the entrance to the narrow tunnel of another cave.

In this vicinity there were seven lava cones in a row, three of them in a state of perfect preservation. In climbing a high ridge to the north, in order to get a photograph, I descried three of the largest craters in the belt, one of which was a quarter of a mile across and several hundred feet deep. Its northern and eastern sides were perpendicular cliffs of a bright red lava, the balance being a steep cinder slope. The rim was almost a perfect circle.

On my first trip to this place, Albert Jones volunteered to climb to the bottom, to serve as a scale. To my surprise, he was invisible on the ground glass of the camera and could be found in the finished print only with the aid of a magnifying glass. In pictures of a place like this, the camera does not lie, but it does not tell all of the truth, for in its results the colors and gigantic scale of things are missing.

The north rim of this crater is a knife-edge, the other slope being the side of another crater, almost as wide and deep, formed by two explosions, which caused a double depression in the bottom. One contains a small lake. In the spring of 1919 it was about 100 feet in diameter; the following year it had shrunk to 40 feet. We called it Crater Lake and the crater, Tycho, after the large crater on the moon.

As we climbed around the crater walls we amused ourselves by rolling rocks down, watching them bounce and bound, sometimes 100 feet in the air. As they reached the talus slopes below, they reminded us of rabbits on the run, and I could not resist shooting at them. Once we united our strength and pushed a huge rock over the cliff, watching it fall until it reached the slope below, where it rolled, gradually getting smaller and leaving a cloud of dust in its wake.

A LAVA FLOW OF COBALT BLUE

Stretching to the southwest for a distance of about 11 miles, we saw perhaps one of the most remarkable lava flows in the world. Its color is a deep cobalt blue, with generally a high gloss, as if the flow had been given a coat of blue varnish. The surface is netted and veined with small cracks, having the appearance of the scales of some prehistoric reptile. Mr. Israel C. Russell, at one time of the United States Geological Survey, called it the Blue Dragon Flow. It merits the name, as in many places it has burst through the crevasse of an older flow, and the ropy twists of blue lava, spreading out in branches, together with its scaled surface, need but a little stretch of imagination to suggest the claws and legs of a dragon.

It is the play of light at sunset across this lava that charms the spectator. It becomes a twisted, wavy sea. In the moonlight its glazed surface has a silvery sheen. With changing conditions of light and air, it varies also, even while one stands and watches. It is a place of color and silence, the latter broken only by the wail of the coyote and chirp of the rock cony.

About a mile to the north of Crater Lake is an immense cinder cone, the west side of which has breached away, leaving the floor of the crater exactly as it must have appeared when the eruption of lava ceased. Here are bubbles, rolls, folds, and twists, as if a giant's frying pan of thick gravy furiously boiling had been frozen instantaneously.

We sat on the southern edge of the rim for perhaps half an hour before we climbed down. This flow had broken out and traveled northwest for several hundred yards, and then, having been dammed up, had broken through a low

place in the cinder ridge and gone east. Here the channel was about 300 yards wide, and the flowing lava had assumed strange shapes and twists, as if a rapid in a mountain stream had suddenly congealed.

When the eruption occurred the molten lava undermined the volcanic sides, which fell in and floated off on top of the flow, like sticks and sawdust on the surface of running water.

Around the bases of the larger floating pieces of volcanic tufa there are depressions in the lava where the masses had pressed down, as occurs when a greased stick is floated in water. Some of these moats are from 4 to 10 feet deep and 10 to 30 feet across.

TEAPOTS, CHIMNEYS, AND SILOS MOLDED BY LAVA

A mile and a half out on the flow we saw hundreds of these crater-wall fragments, some as high as 80 feet. Viewed from a distance, they resemble the pueblo ruins of southwestern United States. One was about 60 feet high and not more than 20 feet in diameter at its base. From a distance it resembled a silo. How it remained upright as it drifted along is a mystery. Many more were observed that resembled chimneys 10 to 20 feet high, and one was an almost perfect teapot in shape.

About two miles southwest of Big Cinder Butte is a flow with similar formations. Along the north side of the Ruined Pueblo flow are 14 mounds composed of rock and sagebrush, which the Indians have built. They are from 4 to 10 feet long and about 4 feet wide. We had no means of digging into them.

Three well-worn Indian trails come into this belt from the north. The plainest is one that goes in about six miles west of Martin, near the sinks of a lost stream

known as Little Cottonwood. It is distinct for about 11 miles, and then fades; yet we found traces of it all the way across. It is sparingly marked with small rock piles and pieces of sagebrush, with rocks to weight them. A few flint or obsidian arrow-points can be picked up along it. Where these trails go and why, no one knows.

Northward, a mile from the Ruined Pueblo flow, are a few more low cinder cones similar to those we had passed. Puzzling features along the west side of this volcanic belt are the many dead charred trees growing in a cinder flat absolutely barren of vegetation of any kind which could carry fire from one to the other. I found charred sagebrush around a lava blowhole near the Seven Devils. A piece of brush was picked up near this spot that had a clot of lava "frozen" around it.

In appearance the flows seem as if they had happened only yesterday, but in reality the latest probably occurred about 150 or possibly 200 years ago. Perhaps the eruptions of spattered lava around some of the small sputter cones occurred about the time of the eruption of Buffalo Hump, in Idaho County, Idaho, in 1866.

The total area of the six young lava flows of this region is about 300 square miles, while that extending above and below this point, along the Snake River plains, reaches the astounding total of approximately 27,000 square miles.

A report has been prepared by Mr. H. T. Stearns, of the U. S. Geological Survey, suggesting to the National Park Service that an area of 39 square miles be set aside as the "Craters of the Moon National Monument." In this area there occurred a fissure eruption displaying surface phenomena which are paralleled only by those in Iceland.

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