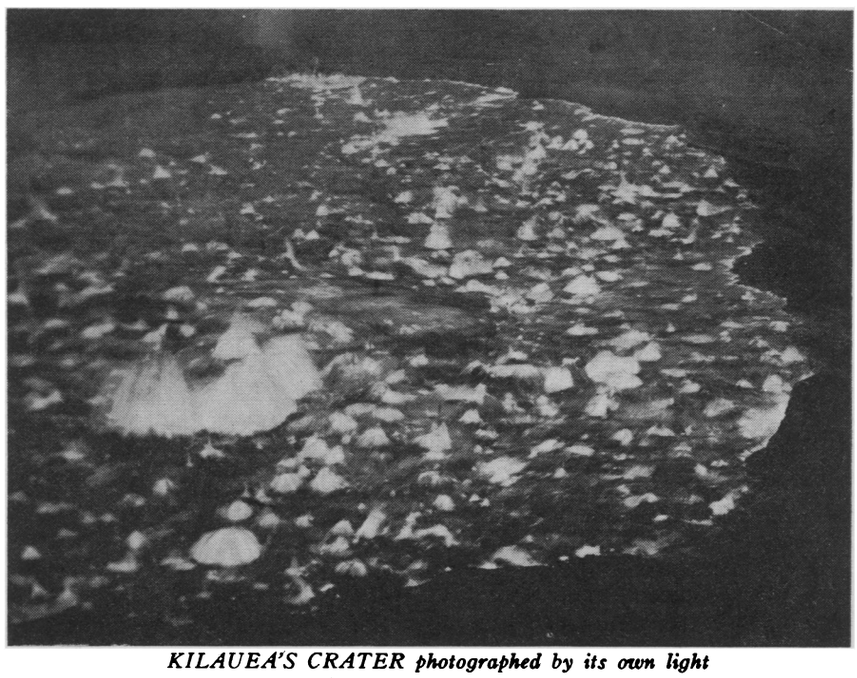
CLASSICS OF SCIENCE:

Dana Describes Kilauea

Geology

Kilauea is traditionally the volcano which, instead of spreading tragedy and terror, provides nearby residents with a good show which they turn out to watch. But though usually quiet and well-behaved, it is by no means harmless.

CHARACTERISTICS OF VOLCANOES, with contributions of facts and principles from the Hawaiian Islands, including a historical review of Hawaiian volcanic action for the past sixty-seven years, a discussion of the relations of volcanic islands to deep-sea topography, and a chapter on volcanic-island denudation. By James D. Dana. New York, 1890.



KILAUEA'S CRATER photographed by its own light

Eruption about the Year 1789

The account of the eruption of 1789, or about that time, was gathered from the natives by the Rev. I. Dibble and published in his "History of the Sandwich Islands," at Lahainaluna (Island of Maui), in 1843. It was taken by the author from the lips of those who were part of the company and present in the scene, and is as follows: The army of Keoua, a Hawaiian chief, being pursued by Kamehameha, were at the time near Kilauea. For two preceding nights there had been eruptions, with ejections of stones and cinders. "The army of Keoua set out on their way in three different companies. The company in advance had not proceeded far before the ground began to shake and rock beneath their feet, and it became quite impossible to stand. Soon a dense cloud of darkness was seen to rise out of the crater, and, almost at the same instant, the thunder began to roar in the heavens and the lightning to flash. It continued to ascend and spread around until the whole region was enveloped, and the light of day was entirely excluded. The darkness was the more terriffic, being made visible by an awful glare from streams of red and blue light, variously combined through the action of the fires of the pit and the flashes of lightning above. Soon followed an immense volume of sand and cinders, which were thrown to a great height, and came down in a destructive shower for many miles around. A few of the forward company were burned to death by the sand, and all of them experienced a suffocating sensation. The rear company, which was nearest the volcano at the time, suffered little injury; and after the earthquake and shower of sand had passed over, hastened on to greet their comrades ahead on their escape from so imminent peril. But what was their surprise and consternation to find the center company a collection of corpses! Some were lying down, and others were sitting upright, clasping with dying grasp their wives and children, and joining noses (the mode of expressing affection) as in the act of taking leave. So much like life they looked that at first they supposed them merely at rest, and it was not until they had come up to them and handled them that they could detect their mistake." Mr. Dibble adds: "A blast of sulphurous gas, a shower of heated embers, or a volume of heated steam would sufficiently account for this sudden death. Some of the narrators. who saw the corpses, affirm that though in no place deeply burnt, yet they were thoroughly scorched."

The "sand and cinders" of this eruption (the latter usually called on the island *pumice* on account of its extreme lightness, and first mentioned by Ellis, who says "light as a sponge"), are well known to cover an area of "many miles" to the southwest of the crater. . . .

The author was over the region here referred to in 1887. In accordance with Mr. Dibble's words "many miles around," the deposits exist through the whole circuit of Kilauea, even the vicinity of the Volcano House; and the projection of stones preceded that of the light scoria ("pumice"), yet it was itself preceded by a great shower of volcanic ashes or sand. . . .

This sponge-like scoria contains the least possible amount of solid matter, being about ninety-eight and one-third per cent. air, the rest glass; for the small round cells have no walls except a few slender threads, and it is as light as a dry sponge. On account of its lightness it is easily carried off by the winds as well as by the sleepiest of waters, and hence the bed is often left in patches. . . .

The greatness and violence of the eruption cannot be doubted. The distribution of the ejected stones, ashes, and scoria all around Kilauea seems to show that the whole bottom of the pit was in action; yet the southern, as usual, most intensely so. The heavy compact rock of the stones and the size of many of them indicate that the more deep-seated rocks along the conduit of the volcano were torn off by the violent projectile action. It was an *explosive* eruption of Kilauea such as has not been known in more recent times. . . .

Condition of the Crater at the Time of the Author's Visit in November, 1840

Although the crater had been discharged but six months before, the Great South Lake, Halema'uma'u, was again in full (*Turn to next page*)

Dana on Kilauea—*Continued*

ebullition over its surface, an area of one thousand by fifteen hundred feet, according to measurements by Captain Wilkes. Besides, there were two small boiling lava lakes.

Still, to the spectator on the northern brink of the pit, all was marvellously quiet. The lofty walls were horizontally stratified, much like those of limestone along some river-gorges, and, in the view, were as free as the latter from scoria and all else of volcanic aspect. The interior of the crater, an area two and a half miles long, covering nearly four square miles, was a desolate scene of bare rock. Instead of a sea of molten lava "rolling to and fro its fiery surge and flaming billows," the only signs of action were in three spots of a blood-red color which were in feeble but constant agitation, like that of a caldron in ebullition. Fiery jets were playing over the surface of the three lakes; but it was merely quiet boiling, for not a whisper was heard from the depths. And in harmony with the stillness of the scene, white vapors rose in fleecy wreaths from the pools and numerous fissures, and collected over the large lava-lake into a broad canopy of clouds not unlike the snowy heaps that lie near the horizon on a clear day, though changing rapidly in shape through constant accessions of cloud material from below.

When on the verge of the lower pit, a half-smothered, gurgling sound was all that could be heard. Occasionally a report like musketry came from the depths; then all was still again, except the stifled mutterings of the boiling lakes.

In a night scene from the summit the large caldron, in place of a bloody glare, now glowed with intense brilliancy, and the surface sparkled all over with shifting points of dazzling light like "a network of lightning"[1] occasioned by the jets in constant play; at the start of each the white light of the depths breaking through to the surface.

A row of small basins on the southeast side of the lake were also jetting out their glowing lavas. The two smaller lakes tossed up their molten rock much like the larger, and occasionally there were sudden bursts to a height of forty or fifty feet. The broad canopy of clouds above the pit, and the amphitheatre of rocks around the lower depths were brightly illumined from the boiling lavas, while a lurid red tinged the more distant walls, and threw into varying depths of blackness the many cavernous recesses.

The next night streams of lava boiled over from the lake, and formed several glowing lines diverging over the bottom of the crater. Toward morning there was a dense mist, and the whole atmosphere seemed on fire. The lakes were barely distinguished through the haze, by the spangles on the surface that were brightening and disappearing with incessant change.

Reaching the black ledge we came upon the scene of the recent fires and lava-flows, although the boiling pools were still three hundred and forty feet below. Streams of hardened lava with their tortuous windings covered its surface, some spreading far and wide and ending in a rolled margin against the base of the outside walls of the crater, and some twisted into ropes or ropy lines, or reaching out in rounded knobs. Others, of less extent, surrounded an oddly shaped cone, a few yards in height, which small worming streams and smaller driblets of lava had raised. These features were testimony to the great lava-floods that spread over the whole crater, even the black ledge, before the eruption of the preceding June. Other reminders were the many dark chasms along the margin of the black ledge, some opening to depths of hundreds of feet, and letting up torrents of hot air or suffocating fumes of sulphur. In several places acres of the ledge were tottering ready to fall; and twice, while among the chasms, long-continued rumbling sounds broke the silence of the pit, showing that the engulfing or down-plunging of the walls, that began with the discharge of June, was still in progress.

General Cycle of Movement in Kilauea

The history of Kilauea, through all its course since 1823, illustrates the fact that the cycle of movement of the volcano is simply: (1) a rising in level of the liquid lavas and of the bottom of the crater; (2) a discharge of the accumulated lavas down to some level in the conduit determined by the outbreak; (3) a down-plunge of more or less of the floor of the region undermined by the discharge. Then follows another cycle: a rising again, commencing at the level of the lavas left in the conduit—that is, the lavas of the lava-column—which rising continues until the augmenting forces, from one source or another, are sufficient for another outbreak.

In 1832 the conditions were ready for a discharge when the lavas had risen until they were within seven or eight hundred feet of the top; in 1840, when within six hundred and fifty feet; in 1868, when within five or six hundred; in 1886, when within three hundred and fifty feet. The greater height of recent time may seem to show that the mountain has become stronger, or better able to resist the augmenting forces. But it also may show a less amount of force at work. In 1823, 1832, and 1840 the down-plunge affected a large part of the whole floor of the crater, which proves not only the vastness of the discharges, but also indicates active lava through as large a part of the whole area preceding the discharge, while in 1886 the down-plunge and the active fires in view were confined to Halema'uma'u and its vicinity. It was not in earlier time, therefore, the greater weakness of the mountain, but probably the greater power of the volcanic forces.

The broad low-angled cone which the volcano tends to make, has a great breadth of stratified lavas to withstand rupturing forces. How great may easily be calculated by comparing a cone of 5° to 8° with one of 30°, the latter the average angle of the greater volcanic mountains of western America; and this suggests important differences in the results of volcanic action independent of those consequent on the possible prevalence of cinder-ejections in the latter. Somehow or other Mount Loa breaks easily—very easily, its quiet methods say—and it seems to be because such rocks, however thick, can offer but feeble resistance to rupturing volcanic agencies.

James Dwight Dana (1813-1895) became interested in science at an early age, and at 17 entered Yale to study under Benjamin Silliman. Their association continued, Dana becoming Silliman's assistant, later marrying his daughter. After four years as mineralogist and geologist on a U. S. exploring expedition in the Pacific, during which he made a special study of volcanoes, he returned to Yale. He succeeded Silliman upon the older Professor's retirement, holding the position for 42 years. He also succeeded Silliman as editor of Silliman's American Journal of Science and Arts.

[1] A comparison made by my friend Dr. Charles Pickering, a man of very exact observation and measured words.