

Volcano Art at Hawaiʻi Volcanoes National Park—A Science Perspective



Open-File Report 2018–1027

Cover.

Painting by Jules Tavernier (title unknown). See figure 6 and discussion in “July 20, 1881” section.



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By Ben Gaddis and Jim Kauahikaua

Open-File Report 2018–1027

**U.S. Department of the Interior
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Abstract

Long before landscape photography became common, artists sketched and painted scenes of faraway places for the masses. Throughout the 19th century, scientific expeditions to Hawaiʻi routinely employed artists to depict images for the people back home who had funded the exploration and for those with an interest in the newly discovered lands.

In Hawaiʻi, artists portrayed the broad variety of people, plant and animal life, and landscapes, but a feature of singular interest was the volcanoes. Painters of early Hawaiian volcano landscapes created art that formed a cohesive body of work known as the “Volcano School” (Forbes, 1992).

Jules Tavernier, Charles Furneaux, and D. Howard Hitchcock were probably the best known artists of this school, and their paintings can be found in galleries around the world. Their dramatic paintings were recognized as fine art but were also strong advertisements for tourists to visit Hawaiʻi.

Many of these masterpieces are preserved in the Museum and Archive Collection of Hawaiʻi Volcanoes National Park, and in this report we have taken the opportunity to match the artwork with the approximate date and volcanological context of the scene.

Introduction

In 2016, we gave a public presentation on the Mauna Loa eruption of 1880–1881, using art by Charles Furneaux and others to illustrate various points and scenes in our talk. Our use of volcano art for this lecture was hardly a first; at the beginning of the 20th century, scientists such as William Brigham and Charles Hitchcock used similar art to illustrate their publications about volcanism in Hawaiʻi.

Only a very limited number of photographs of late-19th-century volcanic activity in Hawaiʻi have survived, and these old photographs lack the detail, scope, and vivid color of the scenes portrayed by artists of the time. Although art does not depict scenes with perfect fidelity, it still moves and informs. For these reasons, volcano art from this period continues to be used in modern U.S. Geological Survey (USGS) publications and is a subject of interest for volcano scientists.

After our presentation, we were approached by the museum staff at Hawai‘i Volcanoes National Park (HVNP), who requested that we provide additional information about the volcano paintings in the park’s archives. The descriptions and comments that follow represent our effort to provide a historical and geological perspective on some of the art in the park’s collection.

November 1880

The painting by Charles Furneaux shown in figure 1 appears to depict Kīlauea Volcano in eruption, with congealed slabs of lava, commonly called “craggs,” tilted skyward by eruptive activity in the foreground. A careful examination of Mauna Loa Volcano in the background shows that it is also erupting and is sending a lava flow down the flank of the mountain towards Ka‘ū. This Mauna Loa eruption, which began on the northeast rift of the volcano on November 5, 1880, spawned three separate lava flows during the month of November. The Ka‘ū branch of the Mauna Loa flow shown in this image was the second of these lava flows, which halted in late November. A third branch, known as the Hilo branch, lasted at least 9 months and sent a lava flow into what is now the city of Hilo. We know that painter Charles Furneaux was on the scene at Kīlauea because he signed the Volcano House Register on November 23, 1880 (Furneaux, 1880).

A newspaper correspondent (J.A.M., 1880) subsequently reported: “Since our last letter there is nothing special about the crater of Mokuaweoweo on Mauna Loa. Mr. Furneaux, the artist, has gone to Kilauea to see if it can be observed better there, and I think, intends to visit the flow. It is now reported to be within three miles of the Government Road to Kau. We have not seen the flow for about four days, as there has been so much haze and smoke.”

The painting by Charles Furneaux shown in figure 2 appears to depict the 1880–81 eruption of Mauna Loa as seen from a ship at the north end of Hilo Bay. The wharf at the end of Wai‘ānuenue Avenue is shown in the foreground on the right, and Hāla‘i hill is on the far left. The Native Church (now Haili Church), the First Foreign Church (now First United Protestant Church), and St. Joseph’s Catholic Church (twin towers), are all outlined as prominent features in Hilo town.



Figure 1. “Kilauea,” by Charles Furneaux. Image courtesy of the National Park Service, Hawai‘i Volcanoes National Park, catalog number HAVO 311.

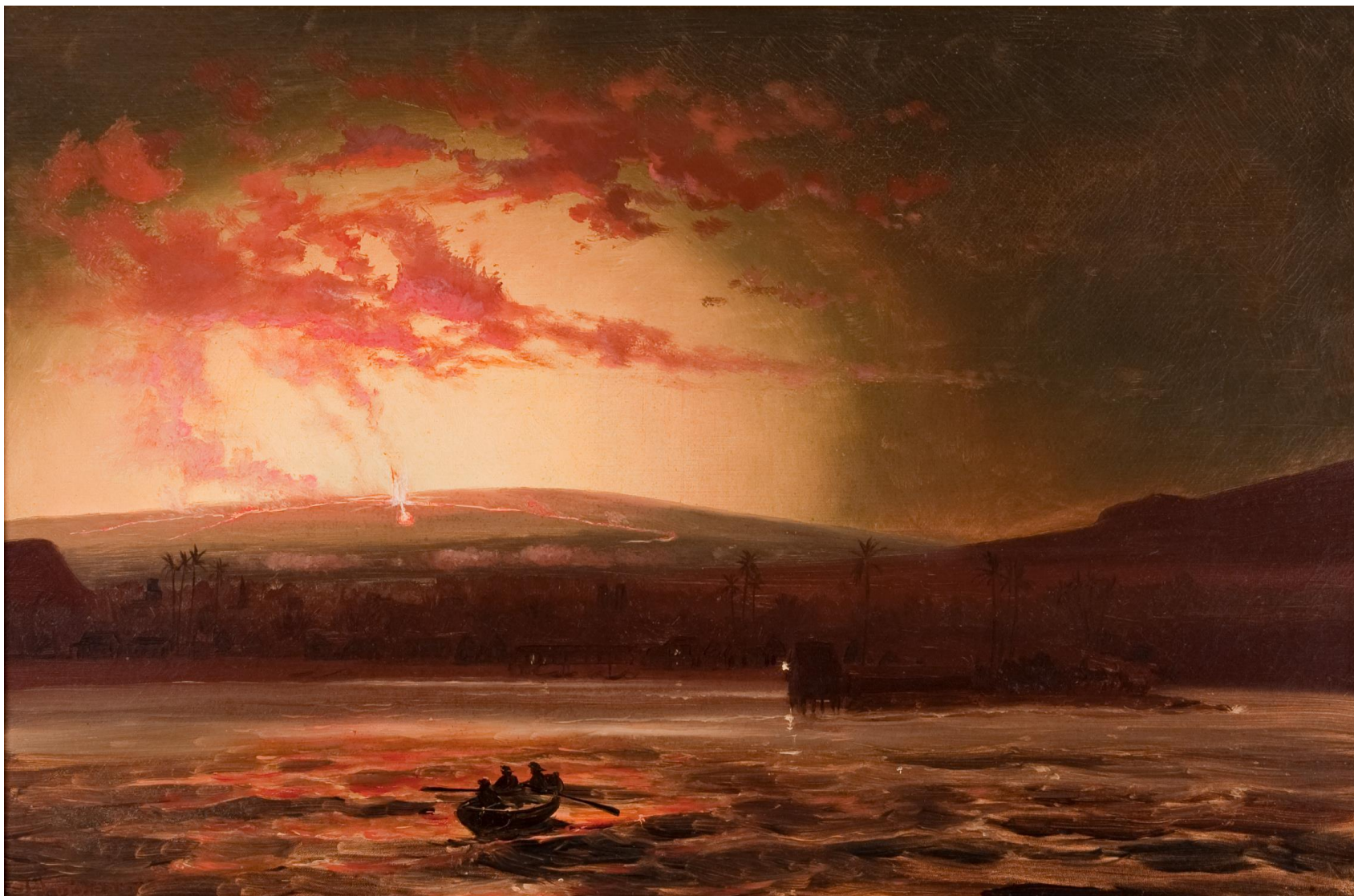


Figure 2. “Night View 1880–1881, Eruption from Hilo Bay,” by Charles Furneaux. Image courtesy of the National Park Service, Hawai‘i Volcanoes National Park, catalog number HAVO 38.

Charles Furneaux was in Hilo on November 11, 1880, and drew a very similar scene in his sketchbook (Furneaux, 1881), fragments of which are preserved at the Hawaiian Historical Society. That sketch probably formed the raw material for this painting (fig. 2).

This eruption produced three major lava flows: one toward Mauna Kea, a second toward Ka‘ū, and a third longer, sustained flow toward Hilo. Furneaux may have intended to depict all three of these flows in this painting (fig. 2). As of November 11, 1880, the leading edge of the Hilo flow had advanced to within 15–20 miles of town.

An anonymous correspondent for the *Hawaiian Gazette* (1880) provided a description of the scene painted by Furneaux.

“On board steamer *Likelike*—November 13, 1880.—The flow of lava from Mauna Loa still continues, and the scene presented from the sea beggars description. On Wednesday night the flow could be seen distinctly from Hilo winding its way towards Puna, with a small branch stream running towards Hilo. The stream running towards Puna is about 30 miles in length, and from 100 to 200 yards in width with a depth of about 20 feet.

On the same night the two streams ran parallel for some distance and presented a very beautiful sight. Columns of smoke and steam ascended from both streams and united in an arch overhead, forming an avenue through which could be seen for miles the molten mass boiling and seething, here and there throwing up immense cones, to be as suddenly burst asunder, and in other places immense columns of lava would be thrown to the height of 200 feet or more.”

The “stream running towards Puna” described by the *Gazette* observer was probably the Ka‘ū branch of the Mauna Loa flow; the observer’s estimate of the length of this flow is greatly exaggerated.

July 20, 1881

The next three paintings (figs. 3, 4, and 6) show the 1880–81 lava flow from Mauna Loa as it enters a stream in Kukuau Gulch near Hilo on July 20, 1881.

Painter Charles Furneaux was present and sketched these scenes. Menzies Dickson also photographed the lava as it cascaded over a cliff into a pool of water below. At this point, the 1881 flow was about 2.5 miles from Hilo.

A writer identified only as W.W.H. (1881) described the scene in a letter to the *Hawaiian Gazette*:

During the afternoon some of my friends had seen the molten lava run over a fall of perhaps fifteen feet into the water below, six feet deep, and the sight was grand beyond description. There was quite a large basin to be filled with lava and it took an hour and forty-two minutes to fill it up even, before it could continue on its course. Mr. Furneaux the artist has taken some very fine sketches of the flow on the spot, both by day and by night. Did any artist ever have such an opportunity to paint flowing lava? Mr. Dickson too, has got some good views of the flow which will soon be on exhibition.

The paintings by Charles Furneaux shown in figures 3 and 4 depict lava as it cascaded over a cliff into a pool of water during the Mauna Loa eruption of 1881. We know the date of the incident because the lava fall was photographed and was described by many observers in letters to newspapers [see comments for HAVO 39, figure 3].



Figure 3. Title unknown, attributed to Charles Furneaux. Image courtesy of the National Park Service, Hawai'i Volcanoes National Park, catalog number HAVO 39.



Figure 4. “Man Watching Volcano: No. 3 Lava Fall, 2 Miles Mauka of Hilo, Hawai’i,” by Charles Furneaux. Image courtesy of the National Park Service, Hawai’i Volcanoes National Park, catalog number HAVO 808.

Both Charles Furneaux and Menzies Dickson were present when the lava cascade event occurred. Dickson took a photograph of the lava fall (fig. 5), which may have been used as a basis for Furneaux's painting (fig. 4). The same coffin-shaped rock angles to the left in the foreground in both the photograph and the painting.



Figure 5. “No. 651 Lava Flow of 1881,” by Menzies Dickson. Image courtesy of the National Park Service, Hawai‘i Volcanoes National Park, catalog number HAVO 1167.

This Dickson photograph can be found in most works on Hawai‘i volcanoes from this period (see, for example, Dana, 1891, plate XI, p. 207; Hitchcock, 1909, plate 24B, p. 148).

The painting by Jules Tavernier shown in figure 6 depicts the 1880–81 lava flow from Mauna Loa as it enters a stream near Hilo on July 20, 1881. Tavernier, who arrived in Hawai‘i about 3 years after this eruption occurred, probably used the photograph by Menzies Dickson (fig 5) as the basis for his painting. Both images show a coffin-shaped rock in the foreground, slanting to the left in front of the lava fall.



Figure 6. Title unknown, by Jules Tavernier. Image courtesy of the National Park Service, Hawai‘i Volcanoes National Park, catalog number HAVO 806.

1885

On January 12, 1885, artist Jules Tavernier signed the guest register at the Volcano House (Tavernier, 1885). The next morning, a strong earthquake shook the hotel. The seismic event, described as the largest since 1868, caused a tsunami at Laupāhoehoe and was felt as far away as O‘ahu (Pacific Commercial Advertiser, 1885a).

At that time, Kīlauea caldera featured two active lava lakes, one at Halema‘uma‘u and a second, smaller lava pond to the east called “New Lake.” The day before the earthquake, Tavernier had sketched an active spatter cone called “Little Beggar,” which was located near New Lake. The earthquake caused Little Beggar to collapse. On the evening of January 13, while Tavernier and his friend Joseph Strong watched, “New Lake broke up, causing a remarkably grand effect” (Pacific Commercial Advertiser, 1885b).

Many of the Kilauea paintings by Tavernier show ragged slabs of tilted lava crust, but the features of the painting shown in figure 7 seem particularly violent. Was the artist trying to convey the effects of the earthquake the day before? Is this a painting of New Lake, and is the active cone in the lower right Little Beggar?



Figure 7. “Volcano—Kilauea, Island of Hawai‘i,” by Jules Tavernier. Image courtesy of the National Park Service, Hawai‘i Volcanoes National Park, catalog number HAVO 798.

1893–94

The painting by D. Howard Hitchcock shown in figure 8 depicts a lava pond perched on the floor of Halema‘uma‘u crater (dark brown walls just behind the lava lake) within Kīlauea caldera (lighter walls behind the Halema‘uma‘u crater walls) and snow-covered Mauna Loa in the background. Such symmetrical elevated ponds commonly form when a rising lava lake overflows repeatedly, building steep levee walls that allow the lava level to rise above the surrounding terrain. When the levee fails, active flows such as the one depicted in the painting (fig. 8) spill out onto the surrounding crater floor.



Figure 8. Title unknown, by D. Howard Hitchcock. Image courtesy of the National Park Service, Hawai‘i Volcanoes National Park, catalog number HAVO 452.

This active lava lake at Halema'uma'u rose slowly between 1892 and 1894. The feature was a popular visitor attraction, and numerous photographs of the circular lake at various stages have survived. This D. Howard Hitchcock landscape depicts the lava pond with remarkable detail.

W.R. Castle (1893) described the lava lake as it appeared in July 1893:

Today there is a lake of fire of over nine hundred feet in diameter surrounded with a broad flat plain forming a rim perhaps five hundred feet wide, the whole enclosed by precipitous walls hard by over a hundred feet high. That is, the bottom of Halemaumau has risen certainly four hundred feet in two years. How much of this is from the inflowing of lava and how much from an upward thrust is impossible to say. But the present development is at least beautifully simple. A nearly round pit, a flat rim at the bottom surrounding a circular lake which is enclosed with a wall tilted from the edge of the rim at angle of say 40°. In short, the lake is in a truncated cone. The surface is about thirty feet higher than the surrounding rim, or "black ledge," as Mr. Lee has named it. That is, it fills up to about that level, when the walls are unable to longer stand the pressure and a break occurs at some point and the whole glowing contents rushes out and floods the ledge until a general level is attained, when the walls of the cone build up again and the process is repeated.

The Pacific Commercial Advertiser of March 30, 1894 describes one of D. Howard Hitchcock's paintings that depicts the lava lake within Halema'uma'u crater in early March 1894:

Mr. Hitchcock's painting of the crater . . . may be seen in the window of the Pacific Hardware Company. It presents a fine view of the molten lake as it appeared a month ago, from which a stream of lava is flowing down the slope in front. At the back of the lake is an irregular wall of lava, which may be fifty or more feet high, and the daily overflows are so rapidly raising the level of the lake and decreasing the height of this wall that the wall is reported at latest date to have nearly disappeared. The crater mound has assumed the form of an overturned saucer the lava lake occupying the central bottom of the overturned saucer. And this lake is estimated to be 1000 or 1200 feet across, it being in shape nearly circular, and from its rim the lava overflows at times on each side (Pacific Commercial Advertiser, 1894).

The article describes well the painting shown in figure 8, but it may represent the date incorrectly. Various observers reported that Halema'uma'u was filled as early as mid-February 1894. F.S. Dodge (1894) surveyed Halema'uma'u on March 20, 1894, and reported that, not only was Halema'uma'u filled, but also that the lava lake had built upward another 200 feet. The scene shown in figure 7 was most likely observed in December 1893.



Figure 9. “Dana Lake,” by D. Howard Hitchcock. Image courtesy of the National Park Service, Hawai‘i Volcanoes National Park, catalog number HAVO 804.

The painting by D. Howard Hitchcock shown in figure 9 depicts a lava pond perched on the floor of Kīlauea caldera after filling Halema‘uma‘u crater.

During the 1880s, several separate lava lakes formed around Halema‘uma‘u, including “South Lake,” “New Lake,” and “Dana Lake,” the last of which was named after the famous geologist James Dana, who visited the lava lakes in 1887. H.M. Whitney (1891) located these intermittent lakes within what was known as the “Halema‘uma‘u cluster,” and he suggested that these lakes were simply different vents of the same subterranean volcanic chimney of Halema‘uma‘u.

In 1891, lava had drained entirely from the summit of Kīlauea, leaving a gaping pit at the site of the lava lakes. Between 1892 and 1894, a new lake rose slowly from within the pit and the name “Halema‘uma‘u” was applied to the feature once again. There are no references to Dana Lake in the literature after the 1891 collapse.

W.R. Castle (1894) contrasted the appearance of the perched lava pond in 1893 (see fig. 8), with the appearance of the pond on March 20, 1894 (see fig. 9):

Halemaumau does not look like what it did nine months ago. Then, at the bottom of a deep pit half a mile across, a round lake, perhaps a thousand feet in diameter, contained the sole activity of the volcano. It was then most interesting and unique, for none of the recoveries after collapse have resembled this. The round lake has continued to push up and to enlarge its circumference, till it is now over twelve hundred feet across and is now on top of a nearly circular cone, which is four hundred and fifty feet above its position in August, 1892. The surface of the lake is now only about seventy feet below the Volcano House! But that need not scare the timid, for it is over two miles away and an enormous gulf intervenes. Activity has increased the past few months, till a day does not pass without one or more flows over the rim down the sides of the cone and out on the floor of the main crater. The pit of Halemaumau no longer exists. During the past week there have been several flows each day.

The sketch for this painting (fig. 9), which may have been made from Uēkahuna Bluff on the west rim of Kīlauea caldera, depicts the lava lake near its peak height, having already filled Halema‘uma‘u, and just before its collapse on July 11, 1894 (Thurston, 1894).

April 1896

The painting by D. Howard Hitchcock shown in figure 10 depicts the 1896 summit eruption of Mauna Loa, which lasted for 16 days. The artist, D. Howard Hitchcock, was a member of a large party that ascended the mountain, arriving at Moku‘āweoweo on April 29, 1896. Hitchcock made sketches in color of both day and night displays of the eruptive activity (fig. 11).

Daniel Logan (1896a) described the first view of the eruption by the party:

As if to introduce us by degrees to a spectacle too stupendous for surprising mortal eyes in one instant, the swirling tempest from the skies gradually abates within the crater. For a few minutes even the candle already mentioned becomes hidden. It suddenly flares up again and as we strain our gaze it is transformed into a sputtering fountain of exploding rockets, whose fiery trail is seen all at once. Then another flame appears away to the left, not rising high but burning fiercely like the fire excited in a forge by the bellows. At the same time the screen parts two or three hundred feet to the right, disclosing another fountain of only less magnitude than the first. Continuing to dissipate the shimmering white veil is at last totally vanished, leaving the entire crater of Mokuaweoweo exposed to view in a clear atmosphere. If there is a word better than sublime to describe awful grandeur and gorgeous beauty in combination, the reader must be left to supply it for the scene that is opened before us like a vision from the ‘undiscovered continent.’



Figure 10. “Mokuaweoweo,” by D. Howard Hitchcock. Image courtesy of the National Park Service, Hawai‘i Volcanoes National Park, catalog number HAVO 451.

The finished oil painting shown in figure 10 was exhibited shortly after the return of the expedition (Pacific Commercial Advertiser, 1896): “Among the contributions are quite a number of D. Howard Hitchcock. The oil painting of the crater of Moku‘āweoweo as it appeared on the occasion of the recent visit of that artist to the summit of Mauna Loa is especially good. The two fountains of fire and the surrounding lava banks are very effectively shown.”

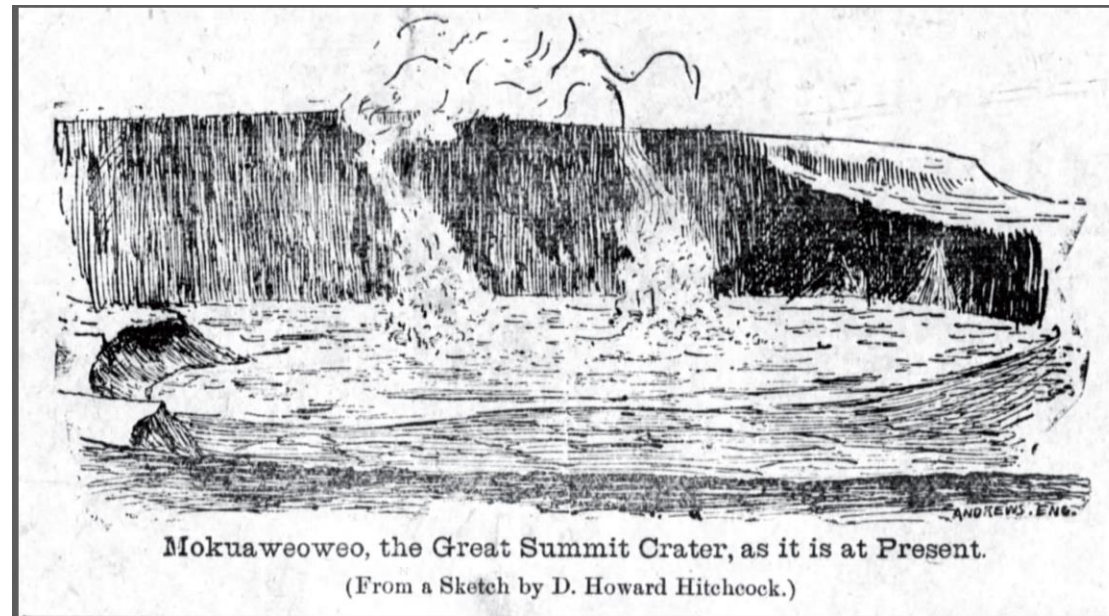


Figure 11. During the 1896 eruption of Mauna Loa, the Evening Bulletin published occasional letters from Daniel Logan, who was among an expedition that visited the summit crater. One of his published letters included this sketch of the scene by artist D. Howard Hitchcock (Logan, 1896b).

1917

The tinted photographic panorama in figure 12 shows a block of congealed lava rising above a molten lake in the crater of Halema'uma'u. Thomas A. Jaggar, Jr., called these large blocks of solidified lava “crag.” The image can be dated using the unique profile of the crag itself. Other nearly identical photographs of the same feature were taken by Jaggar in January 1917. Typically, crags were transitory features that changed rapidly over time as the lava blocks were tilted and broken up by forces within the circulating active lava lake. A copy of a similar photograph of this crag, dated January 5, 1917, appeared in the Hawaiian Volcano Observatory Weekly Bulletin for January 1917 (p. 8). The caption reads: “Jan. 5, 1917 – Crag mass and lava lake from N.E. rampart, standing on edge of lake.” Jaggar (1947, p. 8) surveyed Halema'uma'u on January 12, 1917, and found the crag mass to be 65 feet high.



Figure 12. Title and photographer unknown. Image courtesy of the National Park Service, Hawai'i Volcanoes National Park, catalog number HAVO 684.

When he visited Kīlauea in January 1917, William Twigg-Smith painted the scene shown in figure 12, which features the same distinctive twin-spired lava crag shown in figure 13.

In January of 1917, the lava lake in Halema'ūmau was about 100 feet below the rim. Thomas Jaggar and others repeatedly climbed down onto the floor of the crater to take photographs and perform experiments in the lava lake. During his visit, Twigg-Smith (1917) drew a delightful sketch (fig. 14) of the volcanologist in the Volcano House guest register. The artist provided this caption: "On or about January 1917 Proff TA Jaggar Jr and his able henchman Alex made a successful trip across Halemaumau. The Boat was made of Asbestos re-inforced by armor plate, and had many lava proof compartments. The Hero is seen standing confidently in the middle of the Boat, attired in a fire resisting suit of his own design with one arm resting lightly on his Lava Pick, while with the other hand he gracefully indicates the passages to his henchman in the rear." "Seeger Cones," or more properly Seger cones, were used by Jaggar to measure temperatures in the lava lake.



Figure 13. Title unknown, by William Twigg-Smith. Image courtesy of the National Park Service, Hawai'i Volcanoes National Park, catalog number HAVO 807.



Figure 14. Sketch by William Twigg-Smith (1917) from the Volcano House guest book. Image courtesy of the National Park Service, Hawai'i Volcanoes National Park, catalog number HAVO 401.

The painting by Lionel Walden shown in figure 15 depicts a block of congealed lava rising above a lake of molten lava in the crater of Halema'uma'u crater. Craggs such as this were common features in Halema'uma'u between 1916 and 1922, and the artist probably depicted the view during this period. Snow-clad Mauna Loa can be seen behind and to the right of the lava lake.



Figure 15. Title unknown, by Lionel Walden. Image courtesy of the National Park Service, Hawai'i Volcanoes National Park, catalog number HAVO 447.

The Museum and Archive Collection of Hawai'i Volcanoes National Park

The paintings that are the subject of this report are contained in the museum and archive collection of Hawai'i Volcanoes National Park. The collection consists of more than 31,000 objects under the general classifications of archeology, art, ethnology, history, biology, paleontology, and geology. The holdings also include 1,350 linear feet of shelf space that include documents and audio-visual material. The public may conduct research at the park by appointment; contact havo_archive_museum@nps.gov.

References Cited

- Castle, W.R., 1893, Madam Pele's realm; The Volcano of Kilauea as it now is: Honolulu, Hawaiian Gazette, July 25, 1893, p. 2.
- Castle, W.R., 1894, The volcano of Kilauea: Honolulu, Hawaiian Gazette, March 30, 1894, p. 2.
- Dana, J.D. 1891, Characteristics of volcanoes: New York, Dodd, Mead, and Company, 399 p.
- Dodge, F.S., 1894, Halemaumau Mar. 20th '94: National Park Service, Hawai'i Volcanoes National Park, Volcano House Register, v. 4, p. 111.
- Forbes, D.W., 1992, Encounters with paradise—Views of Hawaii and its people, 1778-1941: Honolulu Academy of Arts.
- Furneaux, C., 1880, Nov 23/80: National Park Service, Hawai'i Volcanoes National Park, Volcano House Register, v. 2, p. 338.
- Furneaux, C., 1881, Narrative of the lava flow of 1880-1 [pencil sketches]: Hawaiian Historical Society Accession No. MS 919.69 F98.
- Hawaiian Gazette, 1880, On board the steamer *Likelike*: Honolulu, Hawaiian Gazette, November 17, 1880, p. 3.
- Hitchcock, C.H., 1909, Hawaii and its volcanoes: Honolulu, The Hawaiian Gazette Company, Ltd., 314 p.
- Jaggard, T.A., 1947, Origin and development of craters: Geological Society of America Memoir 21, 508 p.
- J.A.M., 1880, Mauna Loa: Honolulu, Hawaii, The Saturday Press, November 27, 1880, p. 2.
- Logan, D., 1896a, Tuesday, April 28, 1896: National Park Service, Hawai'i Volcanoes National Park, Volcano House Register, v. 4, p. 161–168.
- Logan, D., 1896b, Daniel Logan's letters: Honolulu, Hawaii, The Evening Bulletin, May 6, 1896, p. 1.
- Tavernier, J., 1885, Jan 12: National Park Service, Hawai'i Volcanoes National Park, Volcano House Register, v. 2, p. 600.
- The Pacific Commercial Advertiser, 1885a, An earthquake wave: Honolulu, Hawaii, The Pacific Commercial Advertiser, Jan. 19, 1885, p. 3.
- The Pacific Commercial Advertiser, 1885b, Art notes: Honolulu, Hawaii, The Pacific Commercial Advertiser January 28, 1885, p.2.
- The Pacific Commercial Advertiser, 1894, A splendid painting. Howard Hitchcock's New Picture of Kilauea: Honolulu, Hawaii, The Pacific Commercial Advertiser, March 30, 1894, p. 8.
- The Pacific Commercial Advertiser, 1895, Art center in Hawaii: Honolulu, Hawaii, The Pacific Commercial Advertiser, December 12, 1895, p. 1.
- The Pacific Commercial Advertiser, 1896, First view to-night: Honolulu, Hawaii, The Pacific Commercial Advertiser, May 19, 1896, p. 6.
- Thurston, L.A., 1894, Changes at the volcano: Honolulu, Hawaiian Gazette, July 24, 1894, p. 1, 5.

Twigg-Smith, W., 1917, Episode No. 1., The Jaggar expedition across Halemaumau January 1917: Hawai'i Volcanoes National Park, Volcano House Register, v. 7, p. 110–111.
W.W.H., 1881, The latest from the great lava flow: Honolulu, Hawaiian Gazette, July 27, 1881, p. 3.
Whitney, H.M., 1891, Notes on the volcano: Honolulu, Hawaii, The Pacific Commercial Advertiser, December 5, 1891, p. 5.

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