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## Measuring the Mountain: The United States Exploring Expedition on Mauna Loa, 1840–1841

LIEUTENANT CHARLES WILKES and his team from the United States Exploring Expedition made the first official scientific measurement of the heights of Mauna Loa and Mauna Kea. A determined group of officers, men, and scientists from the squadron sustained an observation site on the inhospitable summit of Mauna Loa for nearly three weeks during December 1840 and January 1841. They calculated the latitude, longitude, and height of both peaks as accurately as the technology of the time allowed. Transporting a remarkable array of scientific instruments to the summit, they also recorded daily changes in the temperature and humidity of the air, the velocity of the wind, the variations in the earth's gravitational pull and magnetic field, and the speed of sound through the rarified air.

The following, taken from Wilkes's *Narrative of the United States Exploring Expedition* and the accounts of others who participated in the adventure, relates the extraordinary exertion and unyielding perseverance the undertaking required. Two recent works on the expedition refer to the summit trek. The Smithsonian Institution's publication, *MAGNIFICENT VOYAGERS*, calls it "one of the most dramatic episodes of the entire voyage." William Stanton's book, *The Great United States Exploring Expedition*, describes the trip

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to the peak as “the most spectacular of the excursions” the explorers made in Hawai‘i. Neither describes how the feat was accomplished.<sup>1</sup>

#### EARLY ASCENTS

In the years following western arrival in the Hawaiian Islands, several explorers had attempted exploration of the two peaks. (See “Earliest Ascents of Mauna Loa Volcano, Hawai‘i, by Walther M. Barnard, in this issue.) Some did not reach the top; others did not have the scientific equipment needed to make a determination which was much more than an estimate. The first recorded effort was made by John Ledyard, an American with Captain James Cook’s third expedition, who proposed the ascent of Mauna Loa in January 1779. Cook enthusiastically approved the project to obtain more information “about that part of the island, particularly the peak, the tip of which is generally covered with snow, and had excited great curiosity.” Ledyard, three shipmates, and “some attendants among the natives to assist us in carrying our baggage and directing us through the woods,” struggled upward from Kealakekua for four days. They turned back 11 miles from the mountain top, by Ledyard’s estimate, having traveled 24 miles. The party’s quadrant measurements placed the peak at 35 miles distant from the sea with an elevation of approximately two miles. Another of Cook’s men, Lieutenant James King, did not attempt to climb the mountain but recorded his guess at the height of the summits. Basing his estimate on the known height of the snow line on other mountains in the tropics, he thought both peaks “cannot be less than 18,400 feet, but probably . . . may be considerably higher.”<sup>2</sup>

Fifteen years later, in February 1794, naturalist Archibald Menzies, in Hawai‘i with Captain George Vancouver’s expedition, spent one day at the summit of Mauna Loa. Menzies, directed by Kamehameha I to approach the mountain from the south, journeyed by foot and canoe to Ka‘u to start his climb. At an altitude of 6,500 feet, his Hawaiian guide and porters pleaded with him to turn back, saying the cold would kill them all. Menzies persisted, however, and reached the summit. He took his measurements

and left, since he had brought no equipment to remain overnight. By comparing his summit barometer and temperature readings with those made simultaneously on his ship in Kealakekua bay, he estimated the summit of Mauna Loa to be 13,634 feet and “regretted much not having a spirit level or some other instrument to ascertain whether this mountain or Mauna Kea is the highest.”<sup>3</sup> Although his methods were not as reliable as later techniques, Menzies’ estimation was the most accurate of the early summit adventurers.

Reverend William Ellis, at Kilauea on a trip around Hawai‘i in 1823, examined both Mauna Loa and Mauna Kea through a telescope. He estimated the altitudes of both mountains to be “perhaps 15,000 to 16,000 feet above the level of the sea.” Missionary Joseph Goodrich climbed to the summit of Mauna Kea in 1826. In an article he wrote for the *American Journal of Science*, he estimated it to be “upwards of 18,000 feet high and Mouna Roa . . . probably near the same height.” Later in the article, he remarked in a footnote, “Admitting that snow is permanent on a mountain in the torrid zone at the height of 14,600 feet it was supposed that this might be the height of Mouna Roa and Mouna Kea, as the tops of these mountains are covered with perpetual snow.”<sup>4</sup> In 1834, Scottish naturalist David Douglas ascended both Mauna Kea and Mauna Loa. By simultaneous temperature and barometer readings coordinated with Goodrich (whose first name he mistook as James) in Hilo, Douglas determined the height of Mauna Kea as 13,645 feet (Baily’s tables) or 13,587 feet (Daniell’s tables).<sup>5</sup> With his Hawaiian guide, Douglas spent one night at the summit of Mauna Loa. He reported its height at either 13,230 feet (Baily) or 13,175 feet (Daniell).

#### THE WILKES EXPEDITION IN HAWAI‘I

Investigation of natural phenomena, geographical and meteorological, was one of the principal tasks of the Wilkes expedition. Since sailing from Norfolk, Virginia, in August 1838, the squadron had charted both coasts of South America, explored and charted numerous Pacific island groups, and established the existence of the continent of Antarctica in the frigid southern lati-

tudes. It reached Honolulu harbor in September 1840, sorely in need of rest, repair, and refreshment. Carpenters, caulkers, and sailmakers set to work on the vessels. The men of the expedition welcomed the respite from their rigorous voyage. "Honolulu exhibits . . . many dwellings built in the European style," Wilkes noted, adding, ". . . to look upon it was a source of pleasure. Many of us expected to meet friends . . . while letters for us had certainly been accumulating, in which news from home was to be found." Wilkes, the officers, and the scientists moved to dwellings on shore. Crewmen were given a week's leave and \$8 spending money. The sick and injured were moved to a makeshift hospital on land. Three days later, thanks to the solicitude of their able-bodied friends, all the invalids were roaring drunk. Their doctors promptly returned them to the ships to recuperate in sobriety.<sup>6</sup>

Wilkes's orders directed him to proceed from Honolulu to the northwest American coast to continue his explorations. Repairing and reprovisioning the ships took longer than expected, preventing the expedition from departing before winter storms in that region would make exploration unduly hazardous. Faced with a few unexpected months in the Hawaiian islands, Wilkes decided to undertake a scientific expedition to the island of Hawai'i, with the determination of the altitude of its two highest peaks as his primary objective. Two of his Honolulu acquaintances elected to make the journey with him. Doctor Gerrit Judd "was desirous to share our trouble and fatigues, and undertook to act as our physician, interpreter, adviser and manager of the natives," Wilkes wrote. American commercial agent Peter Brinsmade "hoped to improve his health, which had suffered from long confinement in the warm zone of the islands, by the invigorating mountain air. . . ."<sup>7</sup> Judd recruited several graduates of Lahainaluna School to assist in directing the Hawaiian porters whom Wilkes would hire to carry equipment to the top of the mountain.

Leaving Honolulu harbor proved to be the first obstacle of the trip. Wilkes reported:

. . . we were all ready at an early hour on the 3d of December, excepting the pilot [Alexander Adams] who was not to be found. He finally came on board, when, from his actions, I concluded

that he was intoxicated, and told him so; this it seems he took in high dudgeon. . . . Finding that he was not to be depended upon, I determined to take the ship to sea myself, and for this purpose stationed boats to act as buoys on the narrowest part of the bar. Shortly after this was done, a fresh breeze sprung up, we cast off, and in a few minutes were safely outside.<sup>8</sup>

After stopping briefly to pick up its small boats, the *Vincennes*, Wilkes' flagship, filled its sails and was away for Hawai'i.

On the morning of December 8, the masses of Mauna Kea and Mauna Loa appeared off the starboard bow. Naturalist Charles Pickering thought Mauna Kea looked like a mountain, but noted:

. . . the more distant gentle arc-like Mauna Roa, also in sight, could not with all the aid of the imagination be conjured into a mountain; in the absence of steepness, the very vastness of these mountain-masses deprived them of an imposing presence.<sup>9</sup>

On December 9, the ship anchored off Waiiaka (fig. 1). The following day the small boats were hoisted out, and the instruments, tents, and a portable house which Wilkes intended to transport to the top of the mountain were unloaded. A small observatory was set up on shore for determining the variations of temperature, humidity, barometric pressure, tides, positions of the sun, moon, and stars, magnetic attraction, and all the other myriad readings it was the task of the expedition to record.

#### THE ASCENT

Wilkes spent the next several days buying provisions and hiring porters for the trip. His plan was to stop at Kilauea on the first night. He expected to reach the summit of Mauna Loa the following day. The company set out on the morning of December 14. The official party consisted of Wilkes, Judd, Brinsmade, expedition "scientifics" Pickering and William Brackenridge, illustrator Joseph Drayton, ships' officers Thomas A. Budd, Henry Eld, and Samuel Elliot, ten sailors, and Wilkes' Newfoundland dog Sydney.<sup>10</sup> The support group, which Wilkes likened to "a May-day morning in New York," was made up of

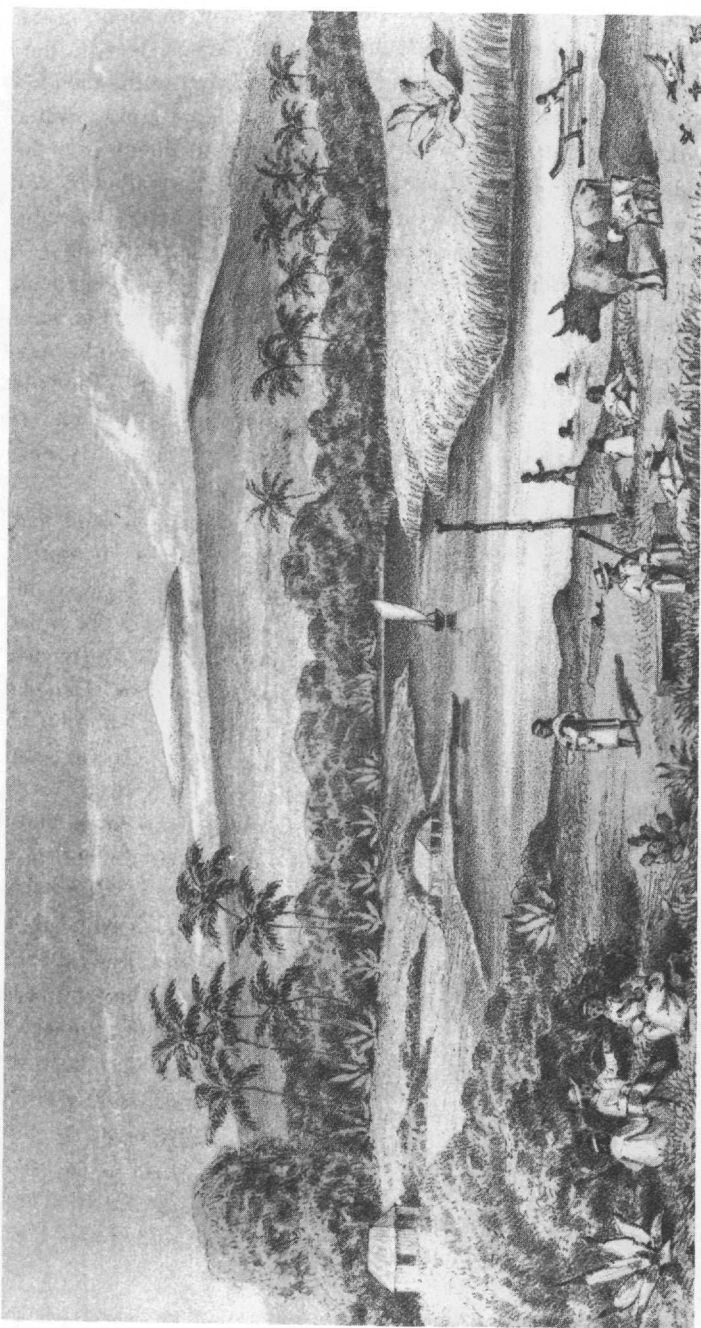


FIG. 1. Mauna Loa, as viewed from Waiākea in Hilo, by author and illustrator Edward T. Perkins, in *Na Moto: or, Reef-Rovings in the South Seas* (New York, 1854). (HHS photo collection.)

. . . two hundred bearers of burdens, forty hogs, a bullock and bullock-hunter, fifty bearers of poe (native food), twenty five with calabashes . . . lame horses, which, instead of carrying their riders, were led by them . . . besides a large number of hangers-on, in the shape of mothers, wives and children, equalling in number the bearers.<sup>11</sup>

They made their way through dripping forests of fern, *koa*, *ohia*, and sandalwood. At nightfall, they rested until the moon rose, then continued their trek, arriving at Ola‘a about 4:30 A.M. They stopped there until eight that morning, then pressed on during the warm day. “At 3 P.M., we reached Kapuauhi,” Wilkes wrote, “which consists of a few houses and is about fifteen miles from Olaa.” Not finding enough level ground for their tent, and with rain threatening, Wilkes and his party occupied one of the houses which had been offered. “This,” he declared, “taught us a lesson we remembered for some time, for all our blankets and clothes became infested with fleas, and those of the most voracious kind.”<sup>12</sup>

After an uncomfortable night at “Flea Hall,” the explorers continued toward Kilauea. Emerging from the woods, Wilkes was astounded at his first close view of the mountain:

Mauna Loa burst upon us in all its grandeur. . . . this immense dome rose before us from a plain some twenty miles in breadth. I had not, until then, formed any adequate idea of its magnitude and height. The whole dome appeared of a bronze color, and its uninterrupted smooth outline was relieved against the deep blue of a tropical sky. . . . I now for the first time, felt the magnitude of the task I had undertaken.<sup>13</sup>

The party camped that night close to the western edge of Kilauea crater (fig. 2), which Wilkes called “a huge pit, black, ill-looking and totally different from what I had anticipated.” All, Americans and Hawaiians alike, watched in entranced silence as nightfall made the volcano panorama spectacular. Later in the evening, some of the Americans descended into the crater along the Black Ledge. They stumbled and fell frequently, Wilkes reported, but at length they arrived,



FIG. 2. The western edge of Kilauea crater, site of the Wilkes party camp. (Patrick McCoy contemporary photo.)

. . . directly over the pool, or lake of fire, at the distance of about five hundred feet above it, and the light was so strong it enabled me to read the smallest print. . . . The whole party was perfectly silent, and the countenance of each individual expressed the feeling of awe and wonder which I felt in so great a degree myself.

At midnight, they returned to their tents, but Wilkes reported they had difficulty falling asleep after their exhilarating encounter with the force and brilliance of the molten lava.<sup>14</sup>

The next morning a rebellion was brewing among the porters.



Its ringleaders, Judd discovered, were advising the throng that Wilkes would be obliged to pay whatever they demanded now that they had come this far. Judd turned the troublemakers out of camp, and the rest agreed to continue if they could rest their sore shoulders for a day. Wilkes concurred, but suspecting further difficulties ahead, dispatched an order to the ship for a contingent of 50 men and an extra supply of provisions. Brinsmade urged Wilkes to give up the trip, saying it would kill his sailors. Wilkes retorted that if he wished the *Vincennes* brought to the summit he had men who would do it.<sup>15</sup>

All men on board volunteered when Wilkes's order reached the ship two days later. Fifty sailors and marines left that night, under the command of Lieutenant James Alden and Passed Midshipman Joseph Sandford. Some were concerned that their captain had undertaken too difficult a task, but most were confident that "if it is possible for it to be accomplished by any man, Captain Wilkes is the one who will succeed for a more persevering man never lived."<sup>16</sup>

On December 18, Wilkes's party was ready to move on. Judd decided to rid the caravan of wives, mothers, and children, "who were not only much in the way of those to whom they belonged, but were great consumers of the food the natives had supplied themselves with for the journey." This was accomplished to the great displeasure of those detached. In spite of the somewhat reduced numbers, it was noted that some porters were short of food. All the party was short of water, having taken a route where no replenishing source existed. Apparently no record remains of the exact route the party followed to the summit, but the Hawaiian guide and bird hunter Keaweehu told Wilkes that if they had "come by way of Palapala he would have been able to conduct us by a route we should have found water every few miles." There were still nearly 300 in the company. Everyone began to feel some distress from the altitude, Wilkes observed:

Mr. Brackenridge had a violent attack of the mountain-sickness, although one the stoutest of the party; many of the natives felt unwell; and we all began to experience great soreness about the eyes, and a dryness of the skin. . . . Dr. Judd had his hands full

administering to the wants of all; but his spirits, always buoyant and cheerful, made every one comfortable and happy around him.<sup>17</sup>

They toiled up the mountain for two days, stopping on the third, Sunday, for a day of rest. "In the morning," Wilkes recorded, "Dr. Judd had religious service with the natives, and the day was passed without work." Realizing he needed to arrange a continuing flow of supplies to maintain his summit camp, Wilkes established a forwarding base at this site, naming it "Sunday Station." That evening the party was "gratified at receiving fifteen gallons of water, which the natives had brought ten miles . . . over the rough mountain roads."<sup>18</sup>

On Monday, December 21, the company made an early start, but the steep terrain slowed their progress. The sun on the lava warmed the day uncomfortably, reminding the climbers they had little water nor even any *ohelo* berries which had served at lower altitudes as a substitute source of moisture. Judd volunteered to go ahead to determine if there was enough snow higher on the mountain to slake their thirst. The rest of the climbers took a break, feeling the altitude as did Wilkes:

Most of the party were now lying about on the rocks, with the noonday sun pouring on them; a disposition to sleep, and a sensation and listlessness similar to that induced by sea-sickness, seemed to prevail. I felt the former strongly myself, and enjoyed as sound an hour's sleep on the hard lava as I have ever had.<sup>19</sup>

After an hour's rest, they struggled two more miles upward, but Wilkes estimated that everyone's strength had decreased by at least half. All complained of being unable to carry their burdens.

Concern mounted as night fell and Judd had not returned. The encamped party lit signal fires and was relieved when he appeared, even more so to see he carried a small snowball. Snow was plentiful on top of the mountain, he reported, but it was melting fast. If they expected to use it for their water supply they must reach the summit by the following day. Fearing that water, as well as food and fuel, would be severely limited at the summit station,

Wilkes sent Brackenridge, Drayton, and Elliot, who were not needed for the scientific observations, on a quick trip to the top to satisfy their curiosity, after which they left the mountain. Brackenridge was later joined by Pickering, who left Mauna Loa before the rest of the Wilkes party, in an exploration to the summit of Mauna Kea.

At this 9,000-foot camp, Wilkes established a second supply station, placing Budd in charge. He called it "Recruiting Station," since a large cave nearby served as a hospital ward for the recovery, or "recruitment," of those suffering from altitude sickness. Wilkes delegated some of his men to remain at this camp to organize the carrying of heavy articles up the trail. Taking a few of the lighter instruments, he set off for the summit to choose a site for the encampment. His group included a guide, 12 porters, and seven sailors. Early in the afternoon, gale force winds compelled them to halt. At 3 P.M., the thermometer registered 25° F, and Wilkes realized the Hawaiians could not continue:

For some time previous, I had been obliged to keep the Kanakas [Hawaiian men] before me, to prevent them from throwing their loads down and deserting; but I found them unable to go any further; being nearly naked they were suffering much. . . . I allowed them to deposit their loads, and gave them permission to return, upon which they seemed actually to vanish; I never saw such agility displayed by them before.

Nothing could persuade the porters downslope to carry on as they saw their compatriots headed for warmer country. They threw down their loads and joined the downward rush. Wilkes watched with dismay as "the mountain became a scene of confusion; being strewn with instruments, boxes, pieces of the portable house, tents, calabashes &c., which the natives had dropped."<sup>20</sup>

The thermometer dropped to 18° F, and a snowstorm threatened. Snow would relieve the water shortage, but the storm confronted the exposed climbers with a survival problem. Wilkes and the remnants of his party built a circular wall of lava clinkers, covered it with their only piece of canvas, and crawled inside. They passed an uncomfortable night, not improved when the weight of

the snow pulled the canvas loose, filling the enclosure with snow and rocks. Repairing it, Wilkes observed, "was the work of nearly an hour of unpleasant labour; but it was much more easily accomplished than getting ourselves warm again."<sup>21</sup>

#### THE SUMMIT ENCAMPMENT

In the morning, after planting a flag and naming this encampment "Flag Station," the small party trudged upwards in snow squalls for two hours before reaching the summit. The group searched most of the day for a good campsite, finally picking one about 60 feet from the eastern edge of the crater, close to the spot now occupied by the National Park Service summit cabin. The sailors pitched Wilkes's tent, holding it down with large blocks of lava. He sent all the party, except two sailors, back to "Flag Station."

The wind at the summit increased during the night. It blew out candles, scattered the fire and pummelled the tent viciously, until Wilkes feared it would fly away:

I now felt that what we had passed through on the previous night was comfort in comparison to this. The wind had a fair sweep over us, and as each blast reached the opposite side of the crater, the sound which preceded its coming was at times awful. . . .

The morning's calm, clear sunrise was a welcome sight. Wilkes was intrigued by the refractive effects of the high altitude atmosphere which made the sun

. . . a long horizontal ellipse of two and a half diameters, first enlarging on one side and then on the other. After it had reached the height of two diameters above the horizon, the ellipse gradually inclined on the right, and in a few moments afterwards its long axis became vertical, and it then enlarged at the bottom, somewhat in the form of an egg.

With no wood to make a fire and little rest the night before, Wilkes and the sailors wrapped up in their blankets and slept. The arrival of Judd, Pickering, and the rest of the summit party

awakened them at 11 A.M. Judd reported that Alden and a portion of the detachment from the ship had arrived at "Recruiting Station" but had no provisions with them, so "instead of supplying our wants rather increased them," Wilkes noted.<sup>22</sup>

The temperature at the summit was 29° F at 6 P.M. on Christmas eve. It fell that night to 22° F. The next day was worse, Wilkes recorded:

Christmas-day set in quite stormy, with snow and a gale from the southwest; it was very cold, and the only way we had of keeping warm was to wrap ourselves in blankets and furs. We had just wood enough to heat a little chocolate.

Wilkes set his crew to work building a high rock enclosure which would hold the portable house and the tents once these things arrived at the summit (fig 3). Each tent would also be inside its own rock wall, which reached to the eaves. It was an experiment, which they found "to succeed admirably, protecting us very much from the south west wind."<sup>23</sup>

But Eld noted the holiday bleakly:

This is the most uncomfortable Christmas-day I have ever experienced. The only way we had of keeping warm was to wrap ourselves in pea-coats and blankets. We had not enough wood to cook our food, and I had to content myself with some sea-biscuit and a piece of raw pork.<sup>24</sup>

The wind came up again on Christmas night, "causing an incessant slamming, banging and flapping of the tents, as though hundreds of persons were beating them with clubs. These noises, added to the howling of the wind over the crater, rendered the hours of darkness truly awful," Wilkes reported.<sup>25</sup>

Eld felt the situation had not improved much by December 27:

The cold this day to our feeling was intense, although the thermometer did not stand lower than 26 degrees. All our exertions in carrying stone for the wall which is to surround our tents . . . and other exercises, such as running and jumping, could scarcely keep us from freezing. We also found it very difficult to breathe, on

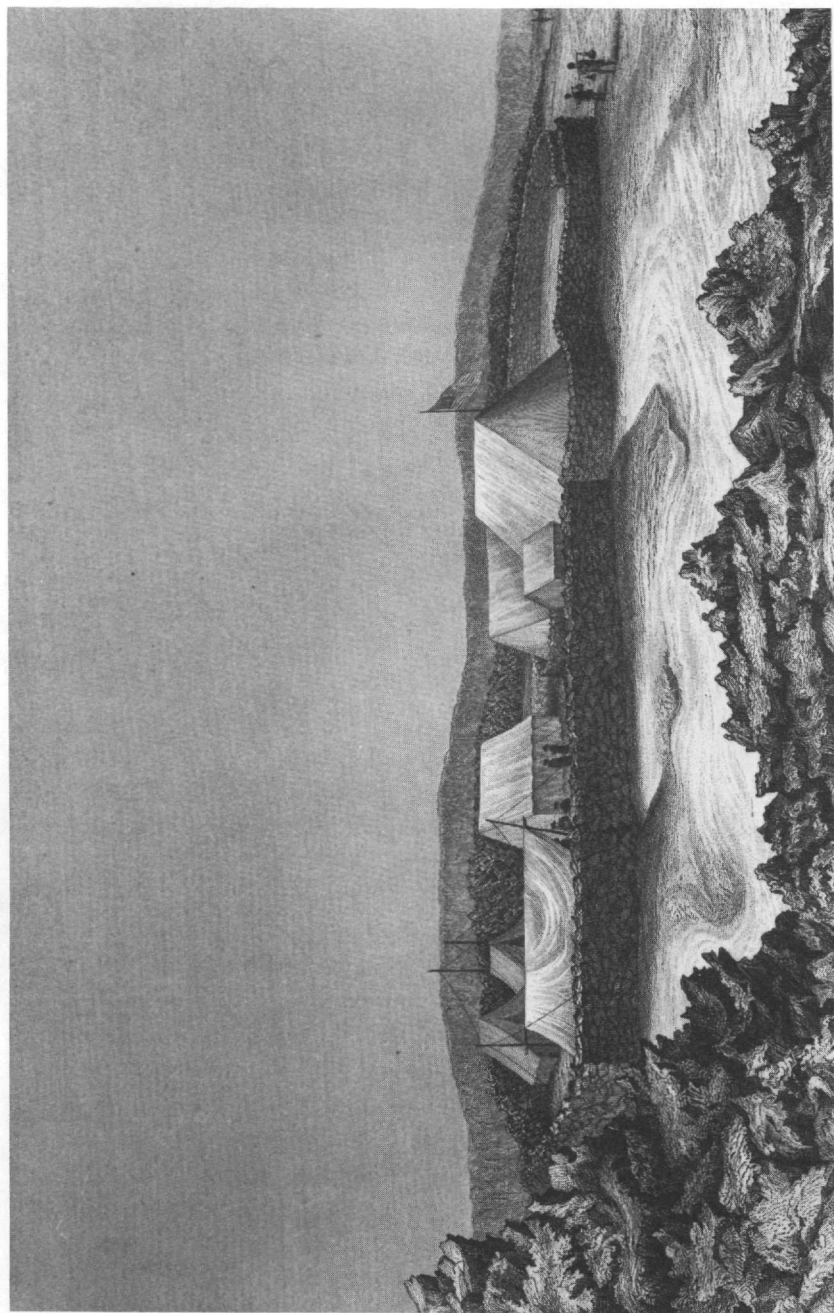


FIG. 3. The Wilkes camp on Pendulum Peak, named for the pendulum apparatus that Wilkes installed, in Charles Wilkes, *Narrative of the United States Exploring Expedition*. . . . (Philadelphia: Lea & Blanchard, 1845). (HHS photo collection.)

account of the rarified state of the air. On examination it was also found that our pulses varied and were very easily excited—mine fluctuated from 80 to 120 beats.<sup>26</sup>

Sailors from the ship began to arrive at the summit that day with some of the equipment. They reported that many men at the lower stations were ill with mountain sickness. Others were bare-footed as their shoes had disintegrated on the hike, and consequently they could not move over the sharp lava. Concerned about the condition of his crew, Wilkes decided to go down to “Recruiting Station” to see for himself, taking Judd with him. He felt his appearance would

. . . give the men encouragement, and renew the spirit with which they had left the ship, as volunteers. I have always found that sailors are easily encouraged; and by putting a light heart and cheerful face upon the times, they quickly reassume their good spirit; and this I found to be the case in the present instance.<sup>27</sup>

The men soon felt they were in “good pluck” and set about mending their shoes or improvising sandals. Leaving Judd behind, Wilkes and a seaman returned to the summit, six hours of hard walking. As they climbed, they marked the trail with small flags. The next day the sailors were carrying small loads up the mountain.

Wilkes soon had enough instruments at the summit to begin his scientific observations, but he was dismayed to discover that the level on his transit had broken. He promptly sent Thomas Budd back to the ship for a replacement. On December 29, Judd again joined the summit party. He reported that the remainder of the contingent from the ship had arrived with 60 days of provisions. Wilkes was relieved:

I now felt that through our own perseverance we should succeed in obtaining our wishes, for with this supply we could remain sufficiently long to effect my object in visiting the mountain.

Supplies, primarily food and wood, began arriving regularly from below. In return, the summit camp furnished melted snow-water

to the lower stations. Wilkes sent to the ship for more shoes and rawhide sandals for his men. He was "extremely provoked" to learn that Hilo's Reverend Titus Coan refused to let the Hawaiian porters set out with them on the Sabbath. Lieutenant Alden declared the matter an emergency, and Coan relented.<sup>28</sup>

On New Year's eve and New Year's day, sailors at the summit erected the portable house and installed the pendulum apparatus which measured the earth's gravity. Budd returned to the summit encampment with the replacement transit-level, and Wilkes began his triangulations to determine the configuration and altitude of the mountain crest.

Busy and cold as they were, the explorers nevertheless marvelled at the unique perspective they had of the world. Wilkes described a sunset during which

. . . we had a beautiful appearance of the shadow of the mountain, dome-shaped, projected on the eastern sky: the colour of a light amethyst at the edges, increasing in intensity to a dark purple in the centre; it was as distinct as possible, and the vast dome seemed to rest on the distant horizon. The night was clear, with moonlight, the effect of which on the scene was beautiful: the clouds floating below us, with the horizon above them, reminded us of the icebergs and ice-fields of the Antarctic: the temperature lent its aid to the deception.

They were fascinated by the panorama of the clouds moving in response to the tradewinds, seabreezes, and heat from the eruption at Kilauea. On a trip around the summit crater with Judd and Budd, Wilkes was overwhelmed by a scene which he called "surpassingly grand":

In the distance, the island of Maui emerged from and broke the line of the deep-blue horizon, while its lower side was dimmed by a whitish haze, that seemed to unite it to the island of Hawaii. Nearer to us was Hualalai, the third great mountain of Hawaii, up whose sides a compact mass of white fleecy clouds was impelled by the sea-breeze. To our right rose in bold relief Mauna Kea, covered with its snowy mantle; and at our feet was spread out, between the three great mountains, the black plain of lava, over-



hung by a dusky pall of clouds. All these features were so blended into each other by mist, as to exhibit a tone of harmony that could hardly be conceived, considering the variety of the forms, characters and distances of the objects, and which seemed to blend earth, sea and sky into one. I can never hope again to witness so sublime a scene. . . .”

Wilkes’s surveys had established which of the knolls on the Mauna Loa summit was the highest. On his trek around the crater, he set up his transit on that site in order to determine the height of Mauna Kea. He reported feeling some “nervous excitement” at the prospect:

I was still in doubt which mountain I should find the highest; for although previous measurements had given it in favour of Mauna Kea, yet I had found Mauna Loa about three hundred feet higher than it had been reported to be. Double the zenith angle was soon obtained, and decided it in favour of Mauna Kea, and subsequent calculations gave the cone of it as one hundred and ninety-three feet above the place where I stood.<sup>29</sup>

Night had fallen, and the hikers were exhausted when they returned to the summit encampment. Wilkes was dismayed to find a crowd of “half-naked natives, who had come up, lured by the fine weather, and in the hopes of getting their loads to return immediately, for the following day had been originally fixed upon for breaking up our camp.” There was nothing to do but put up the party overnight. Wilkes dismantled his pendulum apparatus and gave them the portable house for a dormitory. While he was seeing to the requirements of his overnight lodgers, he began “to feel as if cobwebs had passed over my face and eyes.” It was the onset of snowblindness, and, in spite of Judd’s ministrations, the pain increased and he spent a sleepless night, unable to see. He was determined to leave the summit the following day, “if I had to be led down the mountain, which I thought very probable.”<sup>30</sup>

#### THE DESCENT

Wilkes’s sight evidently returned since he does not mention having to be assisted down the mountain when the party broke camp

and left the summit the following day, January 13, 1841. A few men were left behind to complete some observations. To commemorate their adventure on Mauna Loa, Wilkes ordered "Pendulum Peak, January 1841" carved into the lava within the rock-walled encampment. "U.S. Ex. Ex." was added at the request of the men, "in order that there might be no mistake as to who had been there."<sup>31</sup>

Wilkes and his party camped one night en route, at "Sunday Station," and reached Kilauea the following afternoon where they stopped to make further observations. They had been gone from Kilauea 28 days. Six days were spent in reaching the summit, two days on the return trip. The American explorers had been at the top of the Hawaiian island chain for 20 days.

On their return to Kilauea, they established camp at a site to which Wilkes gave the name it bears today:

Wishing to be more protected from the cold wind that draws from Mauna Kea . . . we passed over to what I have called Waldron's Ledge (after Purser Waldron of the *Vincennes*), which is the usual and by far the most commodious point to encamp at, besides offering one of the most beautiful views of the volcano.

On the evening of January 16, Wilkes and some of the party watched an eruption in progress. With its "great burning lake" and lava streams "glowing cherry-red colour, illuminating the whole crater around," Wilkes thought it surpassed the eruption they had seen earlier. "The sight was magnificent," he wrote, "and worth a voyage around the world to witness."<sup>32</sup> By January 17, the remainder of the summit party reached Kilauea, and the entire group descended from the mountain on a route roughly parallel to the present Chain of Craters road, reaching Waiakea and the *Vincennes* on January 23.

Wilkes spent the month of February making various scientific observations in the Hilo area. He was perplexed at the discrepancies in his measurement of gravitational force from those he had made on the summit of the mountain. He moved his recording pendulum to three different locations, each farther from the shore, finally deciding that the influence of the tide caused the dif-

ference. The experiments were all concluded and the instruments embarked on March 3. The *Vincennes* attempted to leave Hilo on the evening of March 4 but was becalmed and forced to drop anchor. Though there was no danger to his ship or men, Wilkes grumbled that it was "a disagreeable situation to be placed in."<sup>33</sup> A successful departure was made on the morning breeze of March 5. The *Vincennes* called at Maui and charted a shoal off Kaho'olawe before reaching Honolulu harbor on March 18.

### CONCLUSION

Wilkes's remarkable adventure made a significant contribution to the world's store of geographical knowledge. Using the best scientific methods available in 1840, he reported the height of Mauna Loa at 13,760 feet and that of Mauna Kea as 13,883 feet, a variance of less than 90 feet or six-tenths of one per cent from present measurements. He determined the altitude of Mauna Loa using two methods: triangulation, and barometer and temperature readings made simultaneously with those at the expedition's observatory at sea level. From the peak of Mauna Loa, he measured the height of Mauna Kea by triangulation.

It is still difficult, apparently, to determine the altitude of the two peaks accurately, and the figures continue to change as more precise information becomes obtainable. The first edition of Thrum's *Hawaiian Annual* in 1875 gives the highest elevation of the island of Hawai'i as 13,953 feet but does not cite a source for the figure. In 1878, Thrum quotes "records of a [Hawaiian?] government survey that gives the figure as 13,805 feet. Government survey is again cited in 1881 when the heights of both peaks are given for the first time: Mauna Kea is still 13,805 feet and Mauna Loa "about 13,600." The figure for Mauna Loa is changed in 1887 to 13,675. There is no further change until 1901 when Mauna Kea gains 25 feet, to 13,825. In 1937, the *Annual* quotes "U.S. Geol. Survey" and uses the figures derived from that service's reevaluation in 1925-1926: 13,680 feet (Mauna Loa) and 13,784 feet (Mauna Kea).<sup>35</sup>

From aerial photographs in 1954 and field checks in 1956, the U.S. Geological Survey revised Mauna Kea's altitude to 13,796

feet. Ten years later, photogrammetric analysis of the 1954 photos produced a correction of Mauna Loa's height to 13,677 feet. Another set of aerial photos in 1977-1978 and field checks in 1981 and 1982 furnished the most recent altitude figures of the two peaks, which now appear on U.S.G.S. maps: Mauna Loa, 13,679 feet, and Mauna Kea, 13,796 feet.

## NOTES

- <sup>1</sup> Charles Wilkes, *Narrative of the United States Exploring Expedition During the Years 1838, 1839, 1840, 1841, 1842*, 5 vols. (1845, rpt. Upper Saddle River, N.J.: Gregg P, 1970); Herman J. Viola and Carolyn Margolis, *Magnificent Voyagers, The U.S. Exploring Expedition, 1838-1842* (Washington, D.C.: Smithsonian Institution, 1985) 104; William Stanton, *The Great United States Exploring Expedition* (Berkeley: U California P, 1975) 224.
- <sup>2</sup> James Kenneth Mumford, ed., *John Ledyard's Journal of Captain Cook's Last Voyage* (Corvallis, Or: Oregon State U P, 1963) 117; James Cook, *A Voyage to the Pacific Ocean*, vol. 3 (London: W. and A. Strahan, 1789) 104-5.
- <sup>3</sup> Archibald Menzies, *Hawaii Nei 128 Years Ago*, ed. and intro by William F. Wilson (Honolulu: [New Freedom], 1920) 198.
- <sup>4</sup> William Ellis, *Narrative of a Tour Through Hawaii . . .* (1826, rpt. Rutland, Vt.: Charles Tuttle, 1979) 181. Ellis, of the London Missionary Society, assisted ABCFM missionaries in Hawai'i for two years beginning in 1822. Joseph Goodrich, "Notice of the Volcanic Character of the Islands of Hawaii . . .," *American Journal of Science*, II (1826): 3-4 and 31. Goodrich, with the ABCFM second company, was stationed at Hilo from 1823 to 1835.
- <sup>5</sup> Francis Baily devised tables and formulae from which these figures could be converted to altitude readings. These tables, with a correction for the hygrometric state of the atmosphere, were revised in John Frederic Daniell, *Meteorological Essays and Observations*, 2nd ed. (London, 1827).
- <sup>6</sup> Wilkes, *Narrative* 3:373; Catherine Roberta, Sister, S.N.D., "Journal of John S. Whittle, Assistant Surgeon on the United States Exploring Expedition, 1838-1842," master's thesis, U of Hawaii, January 1962.
- <sup>7</sup> Wilkes, *Narrative* 4:112. Peter A. Brinsmade, one of the Islands' leading American businessmen, served as U.S. commercial agent in Hawai'i from 1839 to 1846.
- <sup>8</sup> Wilkes, *Narrative* 4:111.
- <sup>9</sup> Charles Pickering, *The Geographical Distribution of Animals and Plants* (Boston: Little, Brown & Co., 1854) 393.
- <sup>10</sup> Sydney, whom some sources say was given to Wilkes in that Australian port, was his master's almost constant companion and bodyguard. Accounts of the expedition's excursions into Kilauea crater relate that Sydney scorched his feet on the hot lava, but no references report him making the journey from Kilauea to the summit of Mauna Loa.

- <sup>11</sup> Wilkes, *Narrative* 4:118.
- <sup>12</sup> Wilkes, *Narrative* 4:120.
- <sup>13</sup> Wilkes, *Narrative* 4:121-2.
- <sup>14</sup> Wilkes, *Narrative* 4:122-4. The ledge, about 650 feet below the rim of the caldera, varying between 600 to 2,000 feet in width, formed when lava rose to this level in the early 1830s. Later flank eruptions drained the central core area but left a rim of old lava. A portion of the ledge slanted downward, giving access to the level of active lava pools about 380 feet below. The ledge disappeared when the crater filled above this level in 1886.
- <sup>15</sup> William Briskoe, Journal, vol. 1, 19 Dec. 1840, Records of the United States Exploring Expedition, 1838-1842, National Archives and Records Administration, mf. 577, roll 13, Washington, D.C.
- <sup>16</sup> Briskoe, Journal, vol. 1, 14 Dec. 1840.
- <sup>17</sup> Wilkes, *Narrative* 4:130 and 135.
- <sup>18</sup> Wilkes, *Narrative* 4:136.
- <sup>19</sup> Wilkes, *Narrative* 4:137.
- <sup>20</sup> Wilkes, *Narrative* 4:139.
- <sup>21</sup> Wilkes, *Narrative* 4:141.
- <sup>22</sup> Wilkes, *Narrative* 4:141-2 and 144.
- <sup>23</sup> Wilkes, *Narrative* 4:145 and 149.
- <sup>24</sup> George W. Colvocoresses, *Four Years in a Government Expedition* (New York: Cornish, Lamport & Co., 1852) 214. Passed Midshipman Colvocoresses included some excerpts from Eld's journal in his account of his own adventures with the expedition.
- <sup>25</sup> Wilkes, *Narrative* 4:142.
- <sup>26</sup> Colvocoresses, *Four Years* 214-5.
- <sup>27</sup> Wilkes, *Narrative* 4:147.
- <sup>28</sup> Wilkes, *Narrative* 4:150.
- <sup>29</sup> Wilkes, *Narrative* 4:152 and 159-60.
- <sup>30</sup> Wilkes, *Narrative* 4:161-2.
- <sup>31</sup> Wilkes, *Narrative* 4:167.
- <sup>32</sup> Wilkes, *Narrative* 4:167 and 174-5.
- <sup>33</sup> Wilkes, *Narrative* 4:230.
- <sup>34</sup> Charles Wilkes, *United States Exploring Expedition During the Years 1838, 1839, 1840, 1841, 1842 Under the Command of Charles Wilkes, U.S.N.*, vol. 23, *Hydrography* (Philadelphia: C. Sherman, 1861) 463.
- <sup>35</sup> HAA (1875) 7; HAA (1878) 17; HAA (1881) 12; HAA (1887) 30; HAA (1901) 17; HAA (1937) 38.

