

## Snow on the Summits of Hawai‘i Island: Historical Sources from 1778 to 1870

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TODAY, THE TWO HIGHEST summits on the tropical island of Hawai‘i, Maunakea<sup>1</sup> (4,205 m) and Maunaloa (4,169 m), are only occasionally covered with snow with annual mean temperatures on both summits well above freezing. The summits are exceptionally dry and their climate is classified as Alpine desert. Snowfall can occur at any time of the year but preferentially occurs between October and April.<sup>2</sup> After a storm, snow remains on the ground for at most a few weeks. Writings by early voyagers and residents suggest snow was more common in the past; some historical narratives even claim that Maunakea was once covered with snow all year round. And it has been hypothesized that a concentration of shrines at an altitude of 13,000 ft may correspond to an ancient snowline.<sup>3</sup> From a climatological point of view this would be plausible. Europe experienced cooler temperatures

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from around 1400 to around 1850, a period known as the Little Ice Age.<sup>4,5</sup> Scientists still argue about the physical cause of the Little Ice Age (changes in solar activity, increased volcanic activity, changes in ocean circulation, or others), and different causes lead to different regional patterns of the climate response. Historical writings about snow on the high summits of Hawai'i provide a rare glimpse into the past climate of the region. In this study, we identify and evaluate first-hand accounts and primary historical references of snow on the summits of Maunakea and Maunaloa to determine whether there is any reliable evidence in these documents that support the supposition of a prolonged snow cover.

The Hawaiian Islands are thought to have been settled by Polynesians around AD 1000,<sup>6</sup> but written records did not emerge until the arrival of Captain Cook in 1778, who named them the Sandwich Islands. This year marks the beginning of modern Hawaiian history. Our study encompasses about the first century of written records in English, German, and Hawaiian. Nearly arbitrarily, we stop at 1870, but include sources published later if they are relevant to the study

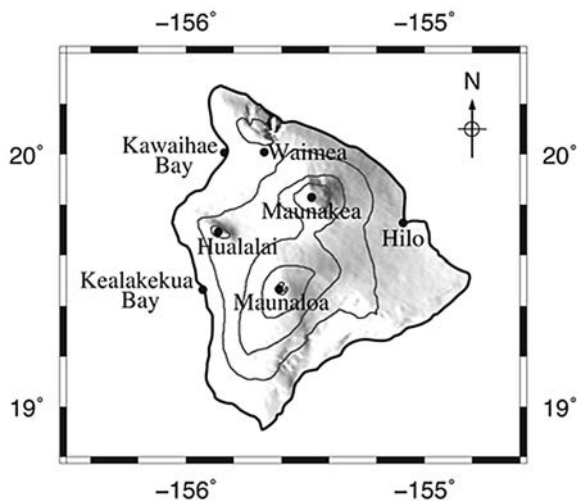


FIGURE 1. Map of the island of Hawai'i with elevation contours in 1,000 m intervals and points of interest, including the three great mountains of the island: Maunakea, which faces the windward side, Maunaloa, and Hualālai.

period. The Weather Bureau began to publish instrumental temperature and precipitation records of Hawai‘i in 1897. With few exceptions, the eighteenth century being one of them, we do not include the numerous reports of one-time sightings of snow. We focus on statements pertinent to the duration of snow and, when relevant, we researched the itinerary of the author. Reports about the absence, rather than the presence, of snow on Maunakea on individual days are included.

The focus of this study is Maunakea, which receives more snowfall than any other summit on the Hawaiian Islands. A few sporadic patches of permafrost are left on the summit.<sup>7,8</sup> We also study historical records of snow on Maunaloa and Hualālai. Figure 1 shows a map of the island of Hawai‘i, the largest in the Hawaiian group, with points of interest.

#### HISTORICAL TEXTS ABOUT MAUNAKEA AND MAUNALOA

##### *1778 and 1779: The first documented observations of snow*

Captain James Cook (1728–1779) first arrived at the Hawaiian Islands in January 1778, stayed a few weeks on the western islands, and then continued his exploration of the northern Pacific. He returned in November of 1778. Close to the north side of the island of Hawai‘i, he mentions snow for the first time on December 2, 1778: “The 2nd in the Morning we were surprised to see the summits of the highest [mountains] cover[ed] with snow; they did not appear to be of any extraordinary height and yet in some places the snow seemed to be of a considerable depth and to have laid there some time.”<sup>9</sup>

His ships entered the fateful Kealahou Bay on January 17, 1779. While anchored in the bay the journals mention on January 26 “the peak, the tip of which is generally covered with snow and had excited great curiosity.”<sup>10</sup> Based on the ship’s position, the statement refers to Maunaloa. Captain Cook was killed the next month and the ships, now under the command of Captain James King, left the Hawaiian Islands for good in March 1779. The following are excerpts from journal entries written in March 1779:

The interior parts rises into two very high mountains whos summits are cover’d with eternal snow tho’ in so warm a Climate.<sup>11</sup>

The districts of Amakooa and Aheedoo are separated by a mountain, called Mauna Kaah (or the mountain Kaah), which rises in three peaks, perpetually covered with snow, and may be clearly seen at 40 leagues' distance. . . . On doubling the East point of the island, we came in sight of another snowy mountain, called Mouna Roa [Maunaloa] (or the extensive mountain), which continued to be a very conspicuous object all the while we were sailing along the South East side. It is flat at the top, making what is called by mariners table-land: the summit was constantly buried in snow, and we once saw its sides also slightly covered for a considerable way down; but the greatest part of this disappeared again in a few days. . . . The peaks of Mouna Kaah [Maunakea] appeared to be about half a mile high; and as they are entirely covered with snow, the altitude of their summits cannot be less than 18,400 feet.<sup>12</sup>

The observations spanned at most a few months, thus there could not have been enough observational evidence to conclude that the snow is "eternal" or "perpetual" on either of the two summits. The following passage by Captain Clerke is worded more carefully: "This isle is one continued Mountain on which are Peaks of various heights, particularly two of vast elevation which were covered with snow all the time we were about the neighborhood; the great altitude of these snow Peaks was by no means striking to the eye."<sup>13</sup>

#### *1786–1799: Individual Sightings of Snow*

Beginning in 1785, ships began to arrive every year, British, French, and American. Explorer La Pérouse of the *Boussole* sighted the snow-capped mountains on May 28, 1786<sup>14</sup> and James Colnett, captain of the *Prince of Wales*, wrote of them in January 1788.<sup>15</sup> Nathaniel Portlock and George Dixon mention "a high mountain on the island of Owhyhee [Hawai'i], with some patches of snow on its summit" on November 14, 1786.<sup>16</sup> Archibald Menzies famously reached the snow-clad summit of Maunaloa in February 1794 and observed Maunakea to be "at this time more whitened over with snow."<sup>17</sup> Richard Jeffrey Cleveland saw a snow-capped summit on July 19, 1799.<sup>18</sup>

Captain Joseph Ingraham (1762–1800) visited Hawai'i three times, first on the ship *Columbia* in 1789, but the journal he kept has been lost, and then two more times on the brig *Hope* in 1791. The first visit to Hawai'i on the *Hope* began on May 20, 1791. Ingraham, on the north side of the island, writes on May 22, 1791: "the summit

of the mountain Monakaa [Maunakea], which had been obscured by the clouds since our making the land, was now clear, and we observed on its summit a large spot covered with snow which indicates its vast height, it remaining visible in this low latitude with the sun verticle.” The *Hope* returned for a second visit in October 1791. On the 13th, the day they left the island for good, Ingraham writes: “The snow on Mownakoa [Maunakea] which occasioned the vast cascades on this side of the island and of which I made mention when we last saw it [May 22, 1791], was now dissolved and we saw but 2 solitary small cascades remaining.” In summary, there was snow on Maunakea on both visits, a large spot in May and two small cascades in October of 1791. These observations reveal that the snow was not in form of a large continuous mantle all year round.<sup>19</sup>

1798 & 1816/17: *Ebenezer Townsend, Adelbert von Chamisso: No Snow*

Visitors reported not only snow, but also the absence thereof. Ebenezer Townsend Jr. (1742–1824) was a merchant who visited the Hawaiian Islands from August 12 to August 31, 1798 on the *Neptune*. One of the locations he visited was Kawaihae Bay, from where Maunakea and Maunaloa are both visible. An entry in his diary implies that there was no snow on Maunakea at the time of his visit:<sup>20</sup> “It is said there is frequent snow on the mountains and it is calculated that the region of perpetual snow in this latitude is but between three and four thousand feet higher. It is therefore probable that in the winter months there is sometimes snow on these mountains.”

Adelbert von Chamisso (1781–1838) visited Hawai‘i twice on the brig *Rurik*, in November 1816 and in September 1817. The world traveler writes (in German):

Hawaii steigt in großartig ruhigen Linien majestätisch aus den Wellen empor, und gestaltet sich mit enormer Masse zu drei verschiedenen Berggipfeln, von denen auf zweien der Schnee mehrere Monate im Jahre liegt.

Wir haben beidemal die Sandwich-Inseln im Spätjahr besucht, und auf den Höhen von Hawaii keinen Schnee gesehen.<sup>21</sup>

Hawai‘i rises majestically with grandiosely smooth lines from the waves, and its enormous mass forms three distinct summits; snow lies on two of them for several months of the year.

We visited the Sandwich Islands both times late in the year, and saw no snow on the heights of Hawai'i.

In April of 1815, Mount Tambora erupted in Indonesia, one of the most powerful volcanic eruptions in recorded world history. Its ash spread over the entire globe, and northern hemisphere observers referred to 1816 as the “year without summer.” The eruption’s global effect on climate subsided within a few years. Its effect on the Hawaiian Islands is unknown, but elsewhere it led to cooling and increased precipitation. Von Chamisso’s observations of 1816/17 fall within this anomalous period.

*1822: Daniel Tyerman, George Bennet*

Daniel Tyerman (1773–1828) and George Bennet (b. 1774) mention snow several times during their visit in 1822. They reached Kawaihae Bay, on the northwest side of the island, on March 29, where they mention “several streaks of snow” along the ridge of one of the high mountains. Maunakea, Maunaloa, and Hualālai are all visible from Kawaihae Bay.<sup>22</sup>

On March 31 they arrived at Kealakekua Bay. On April 6, they write: “The principal mountain is seldom entirely divested of a coronet of snow, and sometimes the upper region appears altogether clothed with a splendid mantle of the same.” When leaving the island they note on April 13 “the volcanic crest of Hawaii, a cone of snow.” Their time at the island thus spans about two weeks. Passing near the island again on August 24, they refer to the “snow-topped mountains of Hawaii.”<sup>23</sup>

*1823: William Ellis, Joseph Goodrich*

In the summer of 1823, missionaries Artemas Bishop, William Ellis, Joseph Goodrich, and Asa Thurston and a Mr. Harwood went on a tour of the island of Hawai'i to investigate suitable sites for mission stations. The tour lasted a little more than two months, throughout July and August. Ellis returned to O'ahu afterwards and then to England, and published extensively on the experience. Goodrich and Bishop were part of a group of missionaries from the American Board of Commissioners for Foreign Missions that arrived at the Hawaiian Islands in April 1823. Goodrich spent over a decade in Hawai'i and

visited the summit of Maunakea several times. He left Hilo for the United States in November of 1835.

During his tour of the island in the summer of 1823, Ellis writes: “The summit of Mauna Roa [Maunaloa], while we were there, was never free from snow, though a greater portion of it appeared covered in the morning than in the evening.”<sup>24</sup> Ellis also comments on snow on Maunakea: “Admitting the snow to remain permanent on mountains of the torrid zone at the height of 14,600 feet, we conjecture the above [15,000 to 16,000 feet] to be the height of Mauna Roa, and Mauna Kea, as the tops of those two mountains are covered with perpetual snow.” Since Ellis had an observational timeline of only a few months, use of the word “perpetual” must have been an extrapolation. Nevertheless, he observed snow throughout the two-month period whenever either summit was visible.

Joseph Goodrich made the first documented ascent to the summit of Maunakea in August 1823. He left on August 25 and reached the summit on the morning of the 26th. Upon returning on the 27th, Ellis reports about Goodrich’s observations: “The whole of the summit was not covered with snow. There were only frequent patches, apparently several miles in extent, over which the snow was about eight inches or a foot in thickness.”<sup>25</sup> Goodrich provides his own description in a letter to the editor of the *American Journal of Science*. “I have been twice to the summit of Mauna Kea. The first time I was at the highest peak about three o’clock at night, in the month of August [1823]; the thermometer stood at 27 deg [Fahrenheit], 5 [Fahrenheit] below the freezing point. I passed over several banks of snow, that lay to the northward of the highest peaks.”<sup>26</sup>

These reports from Ellis and Goodrich provide concrete evidence that there was snow on Maunakea and Maunaloa in the summer of 1823, and long enough to make the impression that it was permanent. Goodrich, during his extended stay on the island, made additional ascents of Maunakea that mention the snowy summit and a half frozen over Lake Waiau.<sup>27</sup>

*1825: John Young, James Macrae, and the visit by the Blonde*

The *HMS Blonde* passed Hilo on May 3, 1825. On board were botanist James Macrae and artist and draftsman Robert Dampier (1800–1874). Macrae reports on May 4 that the summit of Maunakea was “in

places covered with snow”, while Maunaloa was without.<sup>28</sup> The ship went to O‘ahu, and made landfall on the island of Hawai‘i on June 9, 1825, where it stayed for about one month, until July 7. Macrae reports again that the summit of Maunakea was “in places covered with snow” on June 10. The reports are corroborated by Dampier: “In the distance the gigantic forms of Mowna Kaah, & Mowna Roa, rear their towering crests to the clouds; the summits of the former are continually veiled in snow.”<sup>29</sup>

Goodrich guided a party including Macrae to the summit of Maunakea. The day before the trip, Macrae had a conversation with John Young (ca. 1742–1835), who arrived in Hawai‘i in 1790. The conversation took place in June 1825 between James Macrae and John Young, who was already in his 80s, and is recorded in the diary of James Macrae: “During the 26 years that Mr. Young has been on the island, he has never seen Mouna Kaah [Maunakea] free from snow, but has not seen snow on Mouna Roah [Maunaloa] in summer, and on this he bases his theory of the greater height of Mouna Kaah.”<sup>30</sup> This is the earliest statement about perennial snow cover on Maunakea by someone who observed the mountain over many years.<sup>31</sup> The second part of the sentence, that Maunaloa never has snow in summer, contradicts the statement by Ellis above, who reported that Maunaloa had snow over an extended period in summer of 1823. Even today there is occasionally snow on Maunaloa in summer. Young’s statement, or Macrae’s recollection thereof, would be consistent if “in summer” was replaced by “throughout summer.”

Macrae reached the summit of Maunakea on June 17, 1825. “At 12:30 I reached the snow on the summit, . . . The snow in some parts was about three feet deep, congealed into solid ice, excepting from two to three inches at top of rough particles of loose snow. . . The forest which encircles the island of Owhyee [Hawai‘i] below the pasture land, was hidden in fog, so that I only saw about 20 miles in a direct line, but the high land like Mouna Roa [Maunaloa] and other hills could be easily distinguished above the fog, although none of them were covered with snow.”<sup>32</sup>

Hence, Maunaloa was free of snow while Maunakea was covered with snow. The *Blonde* visited the island again from July 14 to July 18. On this last brief visit, Macrae writes: “July 14. Saw the high land of Owhyee [Hawai‘i], above the clouds, covered with snow.”



Also reported by the visitors from the *HMS Blonde*: “[Maunakea] is very seldom without snow, perhaps never entirely without it; hence its name of Keah [Kea], or the White.” And Lieutenant Charles Robert Malden wrote, “the sublimity of the scene is completed by the tremendous Mowna Keah [Maunakea], which rising in the back ground to the height of 17,000 feet above the level of the sea, pierces the clouds with its continually snow-clad summits.”<sup>33</sup>

*1830–1834: A Missionary Letter and David Douglas*

In a letter from missionaries in Hawai‘i, dated February 20, 1830: “On the southeast, south, and southwest, Mauna Kea, Mauna Roa and Hualalai; the two former raising their summits to the clouds, and generally covered with snow, present a prospect with which the eye is not soon satisfied.”<sup>34</sup> The author of this text was presumably among the missionaries on the island listed in the same volume of the *The Missionary Herald*: Asa Thurston, Artemas Bishop, Joseph Goodrich, Samuel Ruggles, and their spouses, and natives John Honorii and Thomas Hopu. Bishop and Goodrich arrived in 1823, Ruggles and Thurston in 1820. Hence, the author could have had an observational timeline of seven or more years.

Botanist David Douglas (1799–1834) briefly visited the Hawaiian Islands in 1830 and in 1832, and returned for a longer stay in December of 1833.<sup>35</sup> He climbed Maunakea, Kilauea, and Maunaloa, all within the month of January 1834, and returned to Honolulu in April.<sup>36</sup> After having returned for another visit, he died in July 1834—on the slopes of Maunakea.

Douglas documented a number of insightful observations: “On Tuesday, the 31st of December [1833], we stood in for the island of Hawaii, and saw Mauna Kea very clearly, a few small stripes of snow lying only near its summit, which would seem to indicate an altitude inferior to that which has been commonly assigned to this mountain.” In January of 1834, he writes: “The next day the atmosphere was perfectly cloudless, and I visited some of the high peaks which were thinly patched with snow,” and on the 13th: “The rain fell fast all night, and continued accompanied by a dense mist, this morning, only clearing sufficiently to give us a momentary glimpse of the mountain, covered with snow down to the woody region. We also saw Mauna Roa [Loa] which was similarly clothed for a great part of its height.”<sup>37,38</sup>

Referring to Maunakea, Douglas reports on May 3, 1834: "This extraordinary mountain does not reach the limit of perpetual snow, though snow, even to deepness, is occasionally seen in July and August. On the 12th of January this year [1834], there was no covering of snow, and only a little lay here and there, on the northern blocks of lava on the extreme summit of the mountain." Referring to Maunaloa, he writes: "Much rain had fallen within the previous fourteen days to my visit, yet the snow was three to five feet deep on the summit. Mowna Kaah [Maunakea] was also covered with snow at this time 1500 feet down; the dome of Mowna Roa [Maunaloa] being a larger mass, the snow on it always descends lower than on the sister mountain."

*1835–1881: Titus Coan*

Titus Coan (1801–1881) replaced Joseph Goodrich at the Hilo mission station. Coan sailed to Hilo in July of 1835, where he spent most of the remainder of his life. About his arrival in July, Coan writes: "Behind all this in the background, tower the lofty, snow-mantled mountains, Kea and Loa, out of one of which rush volcanic fires."<sup>39</sup>

In the last month of 1836, Coan made a tour around the island. After the tour he reports, "The land rises rapidly from the sea, to the centre of the island, where it is crowned by the lofty Mauna Kea, which is usually mantled in snow."<sup>40,41</sup>

Maunakea is clearly visible from Hilo, so Coan must have been well informed about the occurrence of snow on its summit. In the last year of his life, he finished an autobiography based on his many years on Hawai'i, where he writes, "Still higher up tower Mauna Kea and Mauna Loa, nearly 14,000 feet above the sea, the former being a pile of extinct craters, often crowned with snow, the latter a mountain of fire."<sup>42</sup> Thus, the period 1835–1881 is characterized as Maunakea being "often crowned in snow."

*1840: James Jackson Jarves*

James Jackson Jarves (1818–1888) was the editor of the weekly newspaper *The Polynesian*. He made a trip to the island of Hawai'i and the summit of Maunakea in the summer of 1840. He landed in Kailua on June 26, reached the summit on July 2, and returned to O'ahu on July

16 of the same year. Subsequently, he described his adventures in a series of articles in *The Polynesian* and in two books.

At the end of June 1840, he writes, "Mauna Hualalai, with its craggy peaks rose abruptly in the back ground, and occasionally Mauna Kea gleamed its snowy tops from out the surrounding mist."<sup>43</sup> About his visit to the summit of Maunakea in July of 1840, Jarves reports:

Up at sunrise, Thermometer 30° [Fahrenheit], and a fine bracing morning it was. My companions, not having seen the snow, disbelieved the guide's statement the evening previous, and started themselves to seek the summit. Having ascended the hill which the guide had pointed out, they found another arising two hundred or more feet above that, which after great labor they scaled. These hills are composed of loose sand, into which one slips knee deep at every step. The second one was frozen hard. This they found to be the highest point; it was composed of slag, lava, and gravel. The snow or rather ice lay in the chasms, in spots in masses ten feet deep, fourteen wide, and three hundred long. About five hundred feet down, in a southerly direction, lay the pond of water [Lake Waiiau], the existence of which has been often doubted.<sup>44</sup>

Later, he retells the story of the ascent in a way that suggests it was merely his own judgment that snow survives through the summer in a few spots, "The snow, or rather ice, lay in chasms, in a few spots, in masses ten feet deep, fourteen wide, and three hundred long. It had gone but recently from where we were the evening before, traces of it still remaining on the ground. Snow falls during storms throughout the summer, but rarely remains long. Some, doubtless, in sheltering situations, survives the season."<sup>45</sup>

After returning from the summit, Jarves notes: "Of a clear day, the snowy peaks of Mauna Kea, with its brown sides are to be seen rising abruptly from the plain, while in the back ground the dome of Mauna Loa and the smoke of Kilauea, are distinctly visible."<sup>46</sup> There was snow on Maunakea probably throughout his June/July visit.

Jarves also writes, "On the highest mountains snow remains during most of the year, and in a few exposed situations throughout the whole."<sup>47</sup> Jarves was only a few weeks on the island of Hawai'i, but as a newspaper publisher he was likely well informed. He credits as his source acquaintance with chiefs, natives, and others with personal

knowledge of historical events, Ellis' *Tour Around Hawaii*, and material from early voyagers. "Accuracy in all statements has been diligently sought," Jarves writes.

*The 1840/41 Exploring Expedition*

The United States Exploring Expedition of 1840/41, under the command of Charles Wilkes, centered around Maunaloa and Kīlauea.<sup>48</sup> Wilkes mentions snow on Maunakea several times, but nowhere does he describe snow as perennial. Wilkes, accompanied by a large group of men, arrived at the island of Hawai'i in December 1840 and stayed until March 5, 1841.

James Dwight Dana (1813–1895), the geologist on the expedition, writes, "Mount Loa is a flat dome. Mount Kea rises to the same altitude, and differs only in having the summit somewhat pointed. The two stand side by side, bathed below in the ocean, and usually mantled above with clouds. In winter they are both covered at top with snow; but in summer Kea is mostly bare, and Loa, owing probably to its fires within, is wholly without snow."<sup>49</sup> Dana arrived at the island on November 14, 1840 and was back in Honolulu on the 28th. His characterization of Maunakea in summer differs from that of Jarves, but the two observers did not overlap in time.

*1858 & 1859: Carl Friesach*

Toward the end of 1858, Austrian Carl Friesach (1821–1891) visited the Hawaiian Islands. About Maunakea, he writes, "*Der langgestreckte, etwa den vierten Theil des Jahres mit Schnee bedeckten Rücken des Mauna Kea trägt an der Ostseite eine Gruppe von Auswerfkegeln, welche ihm, von dieser Seite aus gesehen, ein spitziges Aussehen ertheilen.*"<sup>50</sup> [The elongated, about the fourth part of the year with snow covered ridge of Maunakea carries on its east side a group of volcanic cones, which, viewed from this side, bestow a spiky appearance.] However, Friesach was at the islands only for a few months at most. His article reveals that he traveled extensively on the island in December and January, conversed with the natives, and was familiar with the published literature, but the source of this specific statement remains unclear. The German phrase "*den vierten Theil des Jahre*" [the fourth part of the year] could mean October to December, but it could also mean any quarter of the year.

1864: *William Tufts Brigham, Horace Mann*

William Tufts Brigham (1841–1926) and Horace Mann Jr. (1844–1868) carried out a botanical survey on the Hawaiian Islands from 1864 to 1865. Their trip to the island of Hawai‘i began on July 27, 1864 and lasted four weeks; they saw no snow during that time.<sup>51</sup>

Brigham writes about Maunaloa: “No snow was visible, and it is a mistake to suppose these summits within the limits of perpetual snow, as is sometimes stated. Seldom in summer is any snow found here except in the caves where it is preserved as in ice-houses. Snow frequently falls on Mauna Loa and Mauna Kea, but, except in winter, it disappears as soon as the sun rises.” He also notes, “Snow is common on Maunas Loa and Kea, . . . , but does not extend down the sides below and altitude of eight or nine thousand feet.”<sup>52</sup>

1867–1869: *Hawaiian-language Newspapers*

Author Lihauanu writes in the November 7, 1867 issue of *Ke Au Okoa*, “*Na poohina o Hawaii—He wa poohina ole mai nei hoi keia o ua mau elemakule nei, o ke ka no ka Maunakea, aole he wahi mea a kau mai ka papale kapu, o ka waiho kahela mai no hoi ka Mauna Loa, ua ilinune i kahi papale kapu keokeo ole.*” [The grey-heads of Hawai‘i Island—This is a time when those old men are not grey-headed, and surprisingly for Maunakea, there is no sign of the cap, and Maunaloa is completely open to view, deprived of the white headgear.]

The May 8, 1869 issue of *Nupepa Kuokoa* reports:

*Aohe Kau Hau. - Ua lohe mai nei makou, i keia hooilo, aohe i kauia na elemakule (kuahiwai) ekolu o ka moku-puni o Keawe e ko lakou kahiko mau o ka wa hooilo, oia ka aahu hau. He mea hou keia ma Hawaii, aka, aohe no paha e hoole ia mai ana kela olelo kahiko. Na ke au o ka manawa, e hoike mai i kona ano iho.*

No Snow - We’ve heard that this winter the three old men (mountains) of the isle of Chief Keawe are not covered with their usual finery of winter, namely the cloak of snow. This is new for Hawai‘i Island, but one cannot deny the old saying, ‘Time will show its own nature.’

A lack of snow on Maunakea and Maunaloa by November 1867 was considered surprising. And the lack of a cloak of snow in winter of 1868/69 was considered unusual.

## PAINTINGS AND DRAWINGS OF MAUNAKEA

Louis Choris (1795–1828) was a painter on board the *Rurik* who visited Hawai'i in November 1816 and September 1817. He drew a panorama of the entire width of the island with the summits labeled as Mona-kea, Mona-roa, and Mona-vororay [Hualālai].<sup>53</sup> None of the summits had snow, in agreement with Adelbert von Chamisso's description from the same voyage.

A drawing of Kawaihae Bay in 1822 by John Dennis, from a sketch by Daniel Tyerman, shows snow on three summits, Maunakea, Maunaloa, and Hualālai.<sup>54</sup> Tyerman and Bennet were in the bay at the end of March 1822 and mentioned only a few streaks of snow on one of the mountains, which casts doubt on the authenticity of the snow in the drawing at this exact time; they mentioned a snow mantle only after they had moved to another location on the island.

A drawing of Hilo with a snow-covered Maunakea in the background is attributed to William Ellis, and thus based on his observations in the summer of 1823.<sup>55</sup>

Robert Dampier (1800–1874), the artist and draftsman of the *HMS Blonde* who resided on the island in 1825, produced several drawings that include Maunakea.<sup>56</sup> Although he wrote about the snow, the drawings are too faint to discern any snow. We consider them as inconclusive in this regard.

The book by Hiram Bingham (1847) includes a picture titled *View of Hilo, Mauna-Kea and Mauna-Loa* from 1830 that shows a snow-covered Maunakea and no snow on Maunaloa. The text explains, "The well executed engravings on wood, by Mr. B. F. Childs, are . . . from sketches taken by the writer [Hiram Bingham], on the ground."<sup>57</sup>

Charles Wilkes' sketch of the *Crater of Moku-a-weo-weo* was drawn in January of 1841 and engraved by J. Andrews.<sup>58</sup> It shows Maunakea in the background with a snowy mantle.

James Gay Sawkins (1806–1878) resided in the Hawaiian Islands between January 1850 and June 1852. He was a naturalist painter with an interest in geologic landforms. Sawkins left Honolulu on August 27, 1851, ascended Maunaloa, visited Kīlauea volcano, and returned to Honolulu on November 24 of the same year. Hence, the paintings are all based on observations from end of August until November 1851. Among them are three of Maunakea: 1. *A View Across Hawaii*

from Waimea, watercolor. It shows Maunakea with a faint snow cover. 2. *Hilo from Coconut Island*, oil painting signed and dated 1852, executed in Sawkins' Honolulu studio after watercolors done on Hawai'i the previous year. Maunakea and Maunaloa are snow-capped. 3. *View of Mauna Kea from Hilo* shows the mountain with snow.<sup>59</sup>

*Hilo from Coconut Island* is an oil painting from 1868 by Joseph Nawahi.<sup>60</sup> It shows Maunakea and Maunaloa with winter snow.

In summary, eight of the nine paintings and drawings of Maunakea, from before 1870, show snow on Maunakea. The one drawing without snow is that of Louis Choris in 1816 or 1817. Maunaloa appears with snow in three of them and without snow in two of them.

#### SNOW ON MOUNT HUALĀLAI

Mauna Hualālai (2,523 m) is significantly lower than Maunakea and Maunaloa; snow has been observed on it a number of times in the twentieth century, but is unusual.<sup>61</sup> Historical information about snow on its summit comes from Hawaiian language newspapers.

In *Ka Hae Hawaii*, issue of April 13, 1859: "*Hau Nui. - I ka pule i hala ae nei, ua aāhu ia na mauna nui ekolu o Hawaii i ka hau. Nani loa o Hawaii ke nana'ku, keokeo, hīnuhīnu i ka la na pōo o Mauna Kea, Mauna Loa a me Mauna Hualalai.*" [Heavy Snow. - Last week the three great mountains of Hawai'i were cloaked in snow. Hawai'i was beautiful to see, white, with the peaks of Maunakea, Maunaloa and Mount Hualālai glistening in the sun.]

Two newspapers report about the snow of February 15, 1862. *Hau Nui. - Ua palapala mai o Z. P. Kumukula, o Waimea, Hawaii, i ka nui o ka hau o Mauna Kea, a me Hualalai, ma ka la 15 o Feb. nei. He elua hāpakohu o ka mauna i uhiia'i e ka hau.*<sup>62</sup> [Heavy Snow. - Z. P., a Teacher from Waimea, Hawai'i, wrote about the extent of snow on Maunakea and Hualālai on the recent 15th of Feb. Two-thirds of the mountain was covered with snow.]

*Hau nui, me ka anu.*

*Auhea oukou e ka pōe e heluhelu ana i ka Hoku Loa. He Nu Hou i ikeia ma Waimea nei, ma ka la 15 o Feb. nei, he anu ikaika loa; he hau ma Mauna Kea, a ane hala loa ilalo i ke kumu, a he hau maluna o Hualalai. Akahi no au a ike i ka hau ma Hualalai iloko o na makahiki he 30. Heaha la ke ano? He noailona ia no ke aha? He ua ikaika loa kekahi, mamua aku nei.*<sup>63</sup>

Much snow, and cold.

O People reading the Hoku Loa. There is News seen here in Waimea; on the 15th of February, there was extreme cold; there was snow on Maunakea, and it almost reached its base, and there was snow atop Hualālai. It was the first time I saw snow on Hualālai in 30 years. What is this? What is it a sign of? There was also heavy rain earlier.

(Incidentally, the article from 1859 demonstrates that Hualālai was not without snow for 30 years.)

In the issue of January 30, 1864 of *Nuʻpepa Kuokoa*: “*Uhiia E Ka Hau - Ua loa mai makou ia S. Haluapo, o Keauhou, Kona, Hawaii, ua uhiia ka o Hualalalai e ka Hau, ma ka po o ka la ehiiku o Ianuvari nei.*” [Covered By Snow - We get from S. Haluapo of Keauhou, Kona, Hawai‘i, that Hualālai was supposedly covered by snow on the night of the recent 7th of January.]

*Nuʻpepa Kuokoa*, issue of Nov 10, 1866:

Ka Hau O Keia Kau: - Ua hiki mai i o makou nei ka lono, ua kau hou ia maluna o na elemakule a kakou o Hawaii na papale kapu hinuhinu o keia kau; a aia lakou a ekolu ke hulali like la i ka la. I ko makou lohe ana i keia, hoomanao ae la makou, no ka hiki mai no paha i ka wa a ka hau e iho mai ai e kau maluna o na piko o ko kakou mau mauna kiekie.

The Snow This Season: - News has come to us that the glistening caps of the season are again placed on our old gents of Hawai‘i Island; all three of them [Maunakea, Maunaloa, and Hualālai] are sparkling in the sun. When we heard this, we figured it is because the season has come when the snow falls and settles on the tops of our highest mountains.

In summary, snow on Hualālai was reported April 1859, 15 February 1862, 7 January 1864, and November 1866. Hence, there were at least four snowfall events from 1859 to 1870, and some indication that snow was rarer the 30 years preceding 1862. It is not apparent whether snow on Hualālai was more frequent than in the twentieth century. In the 44-year period 1915–1958, snow was unusual but not uncommon from December to March; it never occurred in April, but twelve of the 44 years had snow in February.



CONCLUSIONS

Figure 2 illustrates the timeline of some of the observations relevant to snow on Maunakea. Based on the evidence quoted above, we draw the following conclusions.

1. Maunakea was not mantled with snow throughout the year. If any snow was perennial, it lasted through the year in form of a few isolated patches, rather than in form of a continuous snow mantle. Overall, the written historical record provides no compelling evidence for any perennial snow on Maunakea.

Maunakea has been seen many times without a snow cover, when it had only a few small spots of snow, or no snow at all. This was documented by Joseph Ingraham in October 1791, Ebenezer Townsend

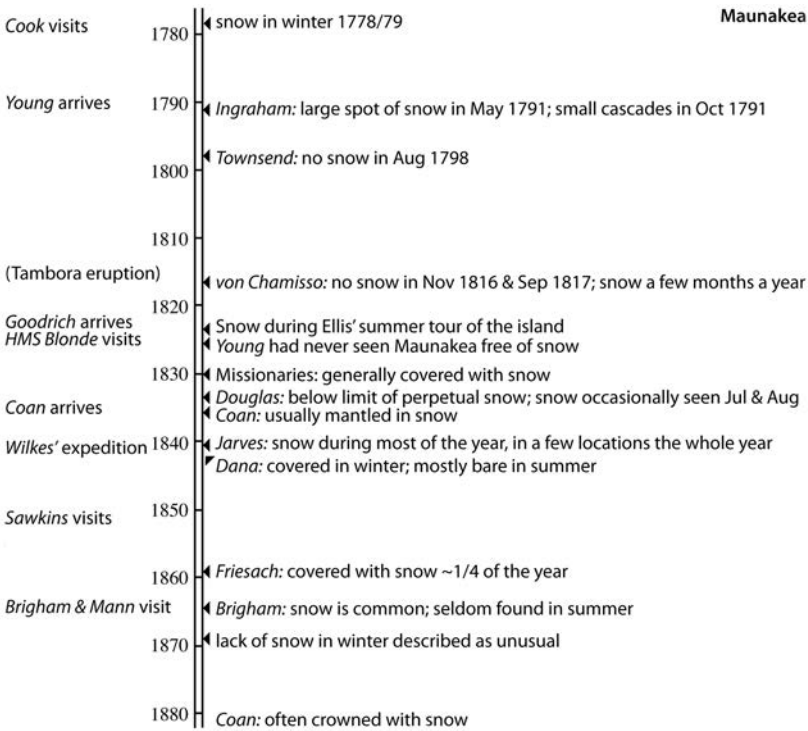


FIGURE 2. Timeline of select events and observations of snow on Maunakea.

in August 1798, and Adelbert von Chamisso in November 1816 and September 1817, and was also illustrated in a drawing by Louis Choris. David Douglas stated in 1834 that Maunakea did not reach the limit of perpetual snow, based on four months of observations on the island, from December to April. Titus Coan, who arrived in 1835, described Maunakea as “usually” covered in snow by the end of 1836. Much later, Brigham’s and Mann’s observations confirm that there was no perpetual snow in 1864. James King and William Ellis wrote, in 1779 and 1825 respectively, that the snow was “perpetual” or “eternal,” but these authors did not spend enough time on or near the island to draw this conclusion. Both books circulated widely. Overall, the literature contradicts the supposition of a perennial snow mantle, but may be consistent with small perennial snow patches.

Maunakea has been seen with small spots, cascades, stripes, and streaks of snow near the summit. Ingraham described seeing “2 solitary small cascades” on the north side of Maunakea in October 1791. Bennet and Tyerman saw “several streaks of snow” on one of the mountains in March 1822. James Macrae described the summit as “in places covered with snow” in May and June 1825. In December 1833, Douglas reported “a few small stripes of snow” near the summit and on January 12, 1834, “there was no covering of snow, and only a little lay here and there, on the northern blocks of lava.” All these observations may have been made from the north and north-west side.

With regards to whether or not small patches survive throughout the year, evidence is found in both directions. John Young had never seen Maunakea free from snow in the period 1790 to 1825. Townsend, von Chamisso, and Choris saw no snow during their visits in this time interval. The credibility of Young’s statement, or Macrae’s recollection thereof, is weakened by the second half of the same sentence, saying that he has never seen snow on Maunaloa in summer, which not only contrasts with witness reports of a prolonged snow cover in the summer of 1823, but is also difficult to accept, because snowfall occasionally occurs in summer even today. James Jarves claimed that snow undoubtedly survives throughout the year at a few locations, but spent only three weeks on the island of Hawai‘i in 1840. Overall, the evidence for permanent snow patches is weak, but the possibility cannot be discarded. Small patches could be consistent with reports that no

snow was seen on Maunakea, if these authors did not observe in sufficient detail or if the patches were on the back side of the mountain.

The survival of small snow stripes or cascades is due to localized climatic effects and, even if some snow patches were perennial, it can be safely concluded that the snowline, defined as the elevation above which snow covers the ground throughout the year, was always above the summit. The modern mean July freezing isotherm, used as a proxy for snowline altitude, lies about 500 m above the summit.<sup>64</sup>

2. Snow on Maunakea was far more common than today, in winter and summer.

This finding is based on several lines of evidence. Summarized first are the witness accounts of long-time residents. John Young, who had arrived on the island in 1790, had by 1825 never seen Maunakea free from snow. Missionaries, who arrived in 1823 and earlier, wrote in 1830 that Maunakea and Maunaloa are “generally covered with snow.” Titus Coan, who lived in Hilo almost continuously from 1835 to 1881, characterized Maunakea as being “often crowned in snow,” and in the year after he arrived even as “usually mantled in snow.” If “usually” is taken literally, it implies more than half the year, referring to 1835/36.

In the German language literature, von Chamisso speaks of snow for several months a year in 1816/17, based on his two visits to the island but otherwise unknown sources. James Dana of the 1840/41 U.S. Exploring Expedition, wrote that Maunakea was covered at top with snow in winter and mostly bare in summer.

There are several witness accounts of extended periods of snow in summer. Ellis always saw snow during his two-month tour in summer of 1823, beginning in July, when either summit, Maunakea or Maunaloa, was visible. The visitors of the *Blonde* were on the island for about one month in June/July of 1825 and frequently mentioned snow on the summit. They reported snow when they passed the island on May 4, when they anchored at the island on June 10, during ascent of the summit, and again during another visit on July 14. Jarves observed snow on Maunakea when he arrived on the island at the end of June 1840, when he ascended the summit, and when he left the island three weeks later. These historical records indicate snow was present for many weeks, or longer, in the summers of 1823,

1825, and 1840. The observations made by visitors can be considered random sampling intervals. Statistically, the duration must have been longer than the periods reported. And statistically, this will apply to numerous other years as well. The writings by Douglas and Dana indicate less snow in summers. They stated that “snow, even to deepness, is occasionally seen in July and August” and “in summer Kea is mostly bare.” Adding to the evidence for a prolonged snow cover are the many sightings of snow at all seasons.

Based on multiple lines of evidence, the number of days per year with snow was undoubtedly more than in the modern climate, where snow occurs on Maunakea a few times in winter after storms and rarely in summer. As of the writing of this article, there still are no systematic records of snowfall or snow cover on Maunakea. The characterization of the Western Regional Climate Center is that “at times the upper slopes of Maunakea and Maunaloa are covered with snow during the winter,” and “several times a year, on the average, and almost always between October and May, major storms may deposit a foot or more of snow on the upper slopes of one or more of Hawai‘i’s highest mountains: Haleakala, Mauna Kea and Mauna Loa.”<sup>65</sup>

Proceeding further in time, Carl Friesach stated, based on his visit in 1858/59 and unknown sources, that Maunakea is covered in snow a quarter of the year. Brigham and Mann reported after their fieldwork in 1864 that snow was common on Maunakea and Maunaloa, although they had not seen any during their four-week visit in summer. In 1866 a Hawaiian language newspaper speaks of the season “when the snow falls and settles on the tops of our highest mountains” in a general manner. Hawaiian language newspapers articulate surprise by the lack of a snow cover in winter for the years 1867–1869. The 1867 statement was written in November, but the circumstance was not new; no snow was seen in November of 1816 either. The lack of snow in the following winter of 1868/69 may have been truly unusual.

In conclusion, there is ample evidence that Maunakea had snow many more days of the year than it has presently. Maunakea was covered with snow a significant portion of the year. Even in summer, it sometimes had snow for weeks or longer. There is sporadic evidence for a prolonged winter cover until 1866. The last well-documented year with prolonged summer snow is 1840. Overall, the historical record reveals a systematic change in high-altitude climate from then

to now. A suitable comparison interval is 1791–1841 (or longer), the half century from Ingraham’s visits to Wilkes’ expedition; its beginning also nearly coincides with John Young’s arrival on the island. The comparison is made with the part of the twentieth century that has been characterized by the Weather Bureau.

3. Maunaloa did not have snow all year round, and it had snow less often than Maunakea.

Some of the early European voyagers of 1779 spoke of Maunaloa only as “generally covered with snow.” In addition, there is significant evidence that Maunaloa was free of snow even when there was snow on Maunakea: in May 1825 by Macrae, in June 1825 also by Macrae during his visit to the summit, in 1830 in the sketch by Bingham, and, at least not to the naked eye, during Wilkes’ arrival in Hilo in December 1840. Menzies reported in February 1794, from the summit of Maunaloa, that Maunakea is “more whitened over with snow” than Maunaloa. Dana of the 1840/41 exploring expedition, wrote, “in summer Kea is mostly bare, and Loa . . . is wholly without snow.” Dampier and Coan both point out Maunakea over Maunaloa as being covered with snow. A rare piece of counterevidence is Douglas’ remark that snow on Maunaloa always descended lower than on the sister mountain. Ellis’ claim that snow was perpetual on Maunaloa could not have been based on his own observations and should not be taken literally.

## NOTES

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of Maunakea by Kumu Pono Associates LLC, *Mauna Kea—Ka Piko Kaulana O Ka 'Āina (Mauna Kea—The Famous Summit of the Land): A Collection of Native Traditions, Historical Accounts, and Oral History Interviews for: Mauna Kea, the Lands of Ka'ōhe, Humu'ula and the 'Āina Mauna on the Island of Hawai'i* (Hilo, Hawaii: 2005) 640.

- <sup>1</sup> Following the 1978 guidelines of the 'Ahahui 'Ōlelo Hawai'i/Hawaiian Language Association, proper names like Maunakea [Mauna Kea] and Maunaloa [Mauna Loa] are spelled as a single word in modern texts. Quoted text and published titles using other spellings and word divisions reflect the original sources.
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- <sup>7</sup> A. H. Woodcock, A. S. Furumoto, and G. P. Woollard, "Fossil ice in Hawaii?" *Nature* 226 (1970): 873.
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- <sup>10</sup> John Ledyard, *Journal of Cook's Last Voyage to the Pacific Ocean and in Quest of a North-West Passage, between Asia & America* (Hartford: Nathaniel Patten, 1783) 117.
- <sup>11</sup> George Gilbert, *Narrative of Cook's Last Voyage, 1776–1780*, Hawaiian Historical Society Reprints, no. 5 (Honolulu: Paradise of the Pacific Press, 1926) 24.
- <sup>12</sup> James King, *A Voyage to the Pacific Ocean*, vol. 3 (London: Strahan, 1784) 102–104.
- <sup>13</sup> Clerke in Beaglehole, *The Journals of Captain James Cook*, 591.
- <sup>14</sup> M. L. A. Milet-Mureau, *Voyage de la Pérouse autour du Monde*, vol. 2 (Paris: 1798) 125.
- <sup>15</sup> James Colnett, *Voyage to the Northwest Side of America: The Journals of James Colnett 1786–89* (Vancouver: UBC Press, 2011) 169.
- <sup>16</sup> Nataniel Portlock, *A Voyage Round The World; But More Particularly To The North-West Coast of America: Performed in 1785, 1786, 1787, and 1788, in the King George and Queen Charlotte, Captains Portlock and Dixon* (London: 1789) 144.
- <sup>17</sup> Archibald Menzies and William Frederick Wilson, *Hawaii Nei 128 Years Ago* (Honolulu: [s.n.], 1920) 198.
- <sup>18</sup> Richard Jeffrey Cleveland, *A Narrative of the Voyages and Commercial Enterprises*, vol. 1, (Cambridge: John Owen, 1843) 96.
- <sup>19</sup> Joseph Ingraham, *The Log of the Brig Hope called The Hope's Track among the Sandwich Islands May 20–Oct 12, 1791*. Hawaiian Historical Society Reprint No. 3. (Honolulu: Paradise of the Pacific, 1918) 5 & 33.

- <sup>20</sup> Bruce Cartwright (editor), *Extract from the Diary of Ebenezer Townsend, Jr. As published in Papers of the New Haven Historical Society*, vol. 6, New Haven, 1888. Hawaiian Historical Society Reprints, no. 4, 1921, 22 & 23.
- <sup>21</sup> Adelbert von Chamisso, *Reise um die Welt mit der Romanzossischen Entdeckungs-Expedition in Jaiwen 1815–18*. 2. Teil. Anhang. Bemerkungen und Ansichten (Leipzig: 1884) 260.
- <sup>22</sup> Daniel Tyerman and George Bennet, *Voyages and Travels*, vol. I (Boston: Crocker & Brewster, 1832) 269.
- <sup>23</sup> Tyerman and Bennet, *Voyages and Travels*, vol. II, 20, 25, 96.
- <sup>24</sup> William Ellis, *A Journal of a Tour around Hawaii, the Largest of the Sandwich Islands* (Boston: Crocker & Brewster, 1825) 146.
- <sup>25</sup> Ellis, *A Journal of a Tour around Hawaii*, 219.
- <sup>26</sup> B. Silliman, "Notices of the volcanic character of the island of Hawaii, and of various facts connected with the late observations of the christian missionaries in that country," *American Journal of Science* 11 (1826) 1–38.
- <sup>27</sup> B. Silliman, "Notices of some of the volcanos and volcanic phenomena of Hawaii (Owyhee), and other islands in that group, in a letter from Mr. Joseph Goodrich, missionary, dated Nov. 17, 1832," *American Journal of Science* 25 (1834): 199–203.
- <sup>28</sup> James Macrae, *With Lord Byron at the Sandwich Islands in 1825: Being Extracts from the MS Diary of James Macrae, Scottish Botanist* (Honolulu: np, 1922) 7.
- <sup>29</sup> Robert Dampier, *To the Sandwich Islands on the HMS Blonde* (Honolulu: University Press of Hawaii, 1971) 53.
- <sup>30</sup> Macrae, 46.
- <sup>31</sup> The 26 years must be referring to portions of the 35-year period 1790–1825; Mr. Young may have lived intermittently on other islands. In this context, it is noteworthy that Tyerman and Bennet, who met John Young in 1822, quoted him as being a resident for 36 years, although it could have been only 32 years. To make matters even more confusing, Ellis mentions one year later that Mr. Young has resided on the island for 36 years. Hence, Young's statements about the number of years on the island never appear to make good sense.
- <sup>32</sup> Macrae, 55 & 56.
- <sup>33</sup> M. Callcott, G. A. B., Bryon, and R. R., Bloxam, *Voyage of H. M. S. Blonde to the Sandwich Islands, in the years 1824–1825* (London: John Murray, 1826) 172 & 255.
- <sup>34</sup> "Sandwich Islands. Extracts from a general letter of the missionaries," Feb. 20th, 1830, *MH*, vol. 26 (1830): 310–319, 316.
- <sup>35</sup> Athelstan George Harvey, *Douglas of the Fir: A Biography of David Douglas Botanist* (Cambridge, Massachusetts: Harvard University Press, 1947).
- <sup>36</sup> Ann Lindsay Mitchell and Syd House, *David Douglas: Explorer and Botanist* (London: Aurum Press, 1999).
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- <sup>38</sup> David Douglas, "Extract from a private letter addressed to Captain Sabine." *Jour-*

- nal of the Royal Geographical Society, London* 4 (1834): 333–344, 401, 405, 335, 339, and 340.
- <sup>39</sup> Titus Coan, *Life in Hawaii. An Autobiographic Sketch of Mission Life and Labors (1835–1881)* (New York: Anson D. F. Randolph & Company, 1882) 25.
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- <sup>41</sup> “Sandwich Islands. Letter from Mr. Coan, dated at Hilo, Feb. 27, 1837,” *MH*, vol. 34 (1838): 36.
- <sup>42</sup> Coan, 29, 30.
- <sup>43</sup> *P*, July 28, 1840, 27.
- <sup>44</sup> *P*, July 28, 1840, 26.
- <sup>45</sup> Jarves, James Jackson, *Scenes and Scenery in the Sandwich Islands and a Trip through Central America 1837–1842* (Boston: Munroe, 1844) 228.
- <sup>46</sup> *P*, August 22, 1840, 42.
- <sup>47</sup> James Jackson Jarves, *History of the Hawaiian or Sandwich Islands* (Boston: Tappan and Dennet, 1843) 13.
- <sup>48</sup> Charles Wilkes, *Narrative of the United States Exploring Expedition*, vol. 4 (Philadelphia: Lea & Blanchard, 1845).
- <sup>49</sup> James D. Dana, *United States Exploring Expedition during the Years 1838, 1839, 1840, 1841, 1842 under the command of Charles Wilkes, Vol. X, Geology* (Philadelphia: C. Sherman, 1849).
- <sup>50</sup> Carl Friesach “Ueber die Vulkane des stillen Ozeans,” *Mitteilungen des Naturwissenschaftlichen Vereins für Steiermark* 4 (1867): 81–121, 106.
- <sup>51</sup> Horace Mann, *The Hawaiian Islands*, unpublished draft article, Bishop Museum Archives, 1864.
- <sup>52</sup> William Tufts Brigham, *Notes on the Volcanoes of the Hawaiian Islands* (Boston: Riverside Press, 1868) 46, 107.
- <sup>53</sup> Louis Choris, *Voyage Pittoresque Autour Du Monde, avec des portraits de sauvages d’Amérique, d’Asie, d’Afrique, et des îles du Grand Océan; des paysages, des vues maritimes, et plusieurs objets d’histoire naturelle; accompagné de descriptions par m. le Baron Cuvier, et m. A. de Chamisso, et d’observations sur les crânes humains, par m. le Docteur Gall* (Paris: Firmin Didot, 1822).
- <sup>54</sup> James Montgomery (editor), *Voyages and Travels Round the World by the Rev. Daniel Tyerman and George Bennet* (London: John Snow, 1840) plate 4, 97.
- <sup>55</sup> William Ellis, c.1826 “Hawaii, Big Island, Hilo, With Mauna Kea,” Hawaiian Legacy Archive 1760–16314.
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- <sup>57</sup> Bingham, xiii.
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<sup>61</sup> S. Price, 278.

<sup>62</sup> *Nupepa Kuokoa*, March 8, 1862, 2.

<sup>63</sup> Laiana, *Ka Hoku Loa*, 1862, 34.

<sup>64</sup> S. C. Porter, "Hawaiian glacial ages," *Quaternary Research* 12 (1979) 161–187.

<sup>65</sup> D.I. Blumenstock and S. Price, *Climates of the States: Hawaii*, (Washington, DC: U.S. Department of Commerce, Climatography of the United States 1967.) No. 60–51.

