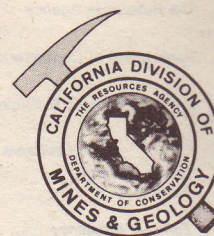


April 1977

GEOLOGY—Foundation of the past; key to California's future.



CALIFORNIA GEOLOGY

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GLACIERS OF MT. SHASTA

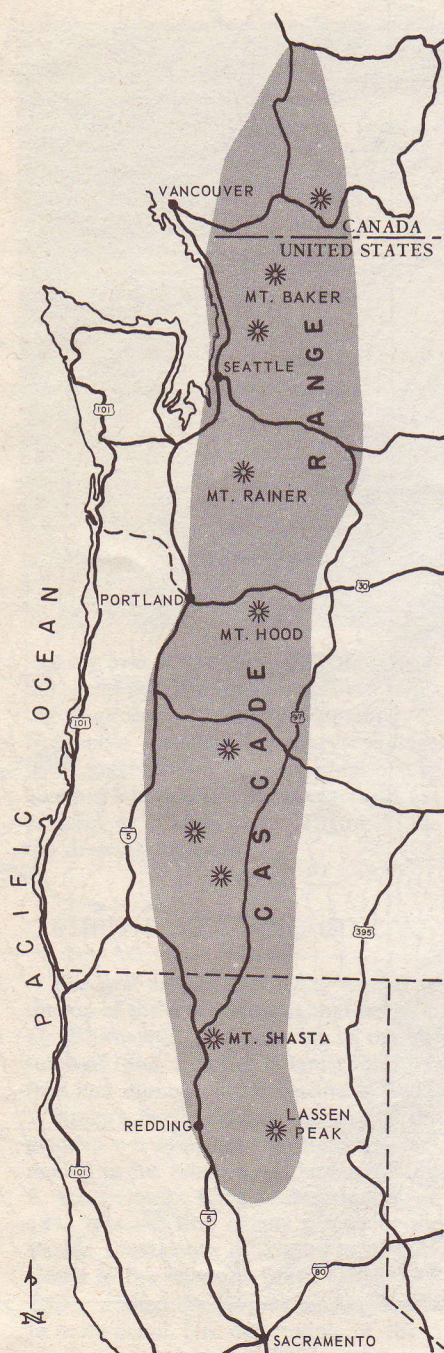


GLACIERS

OF

MT. SHASTA

Figure 1. The Cascade Range.



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This article was written while the author was a member of the CDMG staff.

The Cascade Range is a string of volcanic peaks, all fairly young, geologically speaking. Only one of the volcanic cones—Lassen Peak—has erupted in this century.

The southernmost peak in the Cascade chain—Mt. Shasta—dominates the landscape of north central California. This high (14,161 feet) mountain is about 40 miles south of the Oregon border and 80 miles northwest of Lassen. All of the other main cones in the Cascade Range lie north of Shasta in Oregon and Washington (figure 1).

In Pleistocene time, Mt. Shasta was covered by glaciers; today, there are but 5. In the interim, Shasta has been active as a volcano. Its last activity may have been as late as 1857. Certainly, many of the lava flows of Mt. Shasta are no more than 300 to 500 years old; the youngest portion of the mountain is its crest. Since the 5 glaciers probably are not wasted remnants of Pleistocene giants, but like other glaciers of California, date from the "Little Ice Age" (the Matthes glaciation) of the last thousand years, the most recent flows of basalt and dacite are not much younger than the glaciers (figure 2).

1827 EXPLORATION

Americans in the eastern United States first knew of Mt. Shasta from word spread by Peter Skene Ogden, fur trapper, who wrote "I have named the mountain Sas-tice" in his diary in February, 1827. There is no record of a climb to the top until Captain E. D. Pearce ascended it in 1854. It is a steep climb (figure 3), but a popular one; today there are 11 recognized climbing routes, in addition to numerous variations.

"Shasta, as a whole," wrote geologist Clarence King, "is the single cone of an immense, extinct volcano. It occupies almost precisely the axial line of the Sierra Nevada, but the range, instead of carrying its great, wave-like ridge through this region, breaks down in the neighborhood of Lassen's (Peak) and for eighty miles northward is only represented by low, confused masses of mountain cut through and through by the cañon of the McCloud, Pitt, and Sacramento."

"A broad, volcanic plain, interrupted here and there by inconsiderable chains, occupies the country east of Scott's

Mountains. From this general plain, whose altitude is from twenty-five hundred to thirty-five hundred feet, rises Mount Shasta. About its base cluster hill-ocks of a hundred little volcanoes, but they are utterly inconspicuous under the

shadow of the great peak. The volcanic plain-land is partly overgrown by forest, and in part covers itself with fields of grass or sage. Riding over it in almost any part the one great point in the landscape is the cone of Shasta; its crest of solid

white, its vast altitude, the pale-gray or rosy tints of its lavas, and the dark girdle of forest which swells up over cañon-carved foothills give it a grandeur equalled by hardly any American mountain (King, 1923, p. 282-3)."

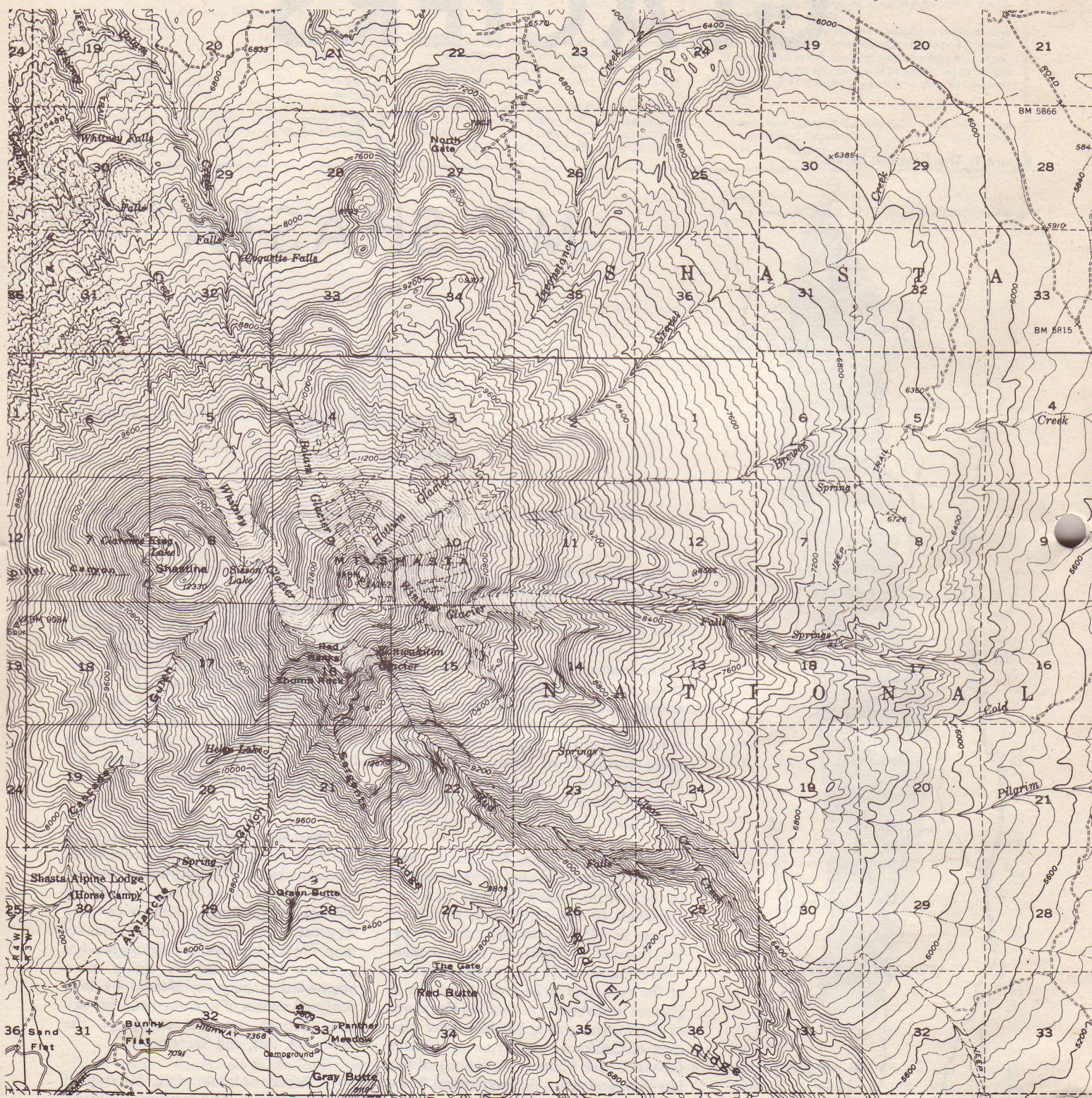


Figure 2. Mt. Shasta and the 5 glaciers which occupy its higher slopes. From USGS Mt. Shasta quadrangle, 15-minute series.

Captain Pearce counted a "cluster of boiling hot sulphur springs, about a dozen in number, emitting any amount of steam, smoke, gas, etc." Today, these springs are far less active; another group, called "Carneal Springs" by B.A. Colonna, who spent 9 days on the summit of Mt. Shasta on behalf of the U.S. Coast and Geodetic Survey, are virtually extinct.

From most vantage points, Shasta is imposing. From the west, Shasta and its smaller cone, Shastina (figure 4), form a double mountain as they do from the northwest (front cover). From the east,



Figure 3. Mt. Shasta, southernmost peak in the Cascade Range, rises to an elevation of 14,161 feet and dominates the landscape of north central California. In this view from the east looking over Little Glass Mountain (lower center) from the top of Mt. Hoffman, Mt. Shasta is seen as a striking single cone. *Photo by Mary Hill.*



Figure 4. Aerial view of Shastina, covered by winter snow. The small lava plug in its crater forms a conspicuous hump. *Photo by Ernest Carter.*

looking over Little Glass Mountain from the top of Mt. Hoffman, Shasta is a striking single cone (figure 3). Captain J. C. Fremont's mid-19th century vantage point must have been an unusual one to give his lithographer the exaggerated expression of "Shastl Butte" (figure 5), as the drawing is labeled.

FIRST SCIENTIFIC STUDY

The first scientific party to ascend to the top of the mountain was that led by J. D. Whitney, State Geologist, in the autumn of 1862, although botanist John Jeffrey had climbed to timberline in 1852. Whitney's party did not see any of the glaciers—not even the "Whitney glacier" named in his honor by Clarence King 8 years later. King's description in 1871 was the first of any glacier in the Pacific slope south of Alaska to be published in the scientific press. Later, J. S. Diller studied the glaciers on Mt. Shasta in more detail. His description of the 5 glaciers was written in 1895.



Figure 5. This view entitled "Shastl Butte" was drawn by a lithographer during Captain J.C. Fremont's expedition in the mid-1800s.



Figure 6. (a) Head of Whitney glacier, Mt. Shasta; (b) Foot of Whitney glacier. *Figures 6-10 from Russell, 1885.*

MT. SHASTA GLACIERS

(as described by J. S. DILLER, 1895)

The glaciers of Mt. Shasta are five in number, and all are found side by side, forming an almost continuous covering for that portion of the mountain at an altitude of about 10,000 feet [figure 2]. On the northwestern slope of the mountain is Whitney Glacier, with its prominent terminal moraine; to the eastward Bulam [Bolam] Glacier, with a large pile of debris at its lower end; next comes the broad Hotlum Glacier, and then the Wintun. McCloud [Konwakiton] Glacier, which is the smallest of the group, lies on the southeastern side of the mountain.

Whitney Glacier.

Whitney Glacier is more like those of the Alps than any other one of the group [figure 6]. Its snow field lies on the northwestern slope of the mountain, from whence the icy mass, with well-defined limits, moves down a shallow depression between Shasta and Shastina. Its width varies from 1,000 to 2,000 feet, with a length of about $2\frac{1}{2}$ miles, reaching from the summit of the mountain down to an altitude of 9,500 feet about the sea. It is but little more than a decade since the first glaciers were discovered within the United States; and the largest of them, about the culminating point of the Cascade Range, would perhaps appear Lilliputian beside the great glacier of the Bernese Oberland; and yet they are as truly glaciers. Diller wrote this in 1895. The world did not become fully aware of the magnitude of Alaskan glaciers until the gold rush of 1898 to the Klondike and Yukon brought many argonauts past the

great fields—many who saw a glacier for the first time in their lives. In the upper portion of its course passing over prominent irregularities in its bed, the Whitney Glacier becomes deeply fractured, producing the extremely jagged surface corresponding to ice falls of the Alpine glaciers. Lower down the crevasses develop; and these, with the great fissure which separates the glacier from the steep slopes of Shastina, attest the motion of the icy mass. They frequently open and become yawning chasms, reaching 100 feet into the clear green ice beneath. Near its middle, on the eastern margin, Whitney Glacier receives contributions of sand, gravel, and boulders from the vertical cliffs around which it turns to move in a more northerly direction. In this way a prominent lateral moraine is developed. From the very steep slopes of Shastina, on the western side, the glacier receives additions in the form of avalanches. Here the snow clings to the rocky bed until the strain resulting from its accumulation is great enough to break it from its moorings, and it rushes down upon the glacier below. The most striking feature of Whitney Glacier, and that which is of the greatest interest from a geologic point of view, is the debris [moraine] it brings down the mountain and piles up, making a large accumulation [terminal moraine] at its lower end. This moraine appears to be fully a mile in length, measured down the slope of the mountain. Its apparent length is much greater than the real, however, from the fact that the glacier ice extends far beneath the covering of detritus. It is so huge a pile of light-colored debris, just about the timber line, that it is plainly visible from afar.

In comparing the morainal material about Mount Shasta with that of the Alpine glaciers, a feature that is particularly noticeable is the smallness of the boulders. On Alpine glaciers boulders frequently have a diameter greater than 10 feet, but about the Whitney and other glaciers of Mount Shasta they are rarely so much as 3 feet in diameter. This is readily explained by the fact that the glaciers of Mount Shasta do not move in deep valleys, bounded by long, steep slopes, with many high cliffs, affording an opportunity for the formation of large boulders. Although Whitney Glacier has its boundaries more clearly defined than any of the other glaciers about Mount Shasta by the depression in which it moves, the valley is very shallow, and one looks in vain along its slope for traces of polished rocks like those so magnificently displayed in the Alpine valleys. Whitney Glacier looks young; it has hardly made a beginning toward carving out a valley for itself.

Below the terminal moraine the milky water of Whitney Creek wends its way down the northern slope, plunges over a fall hundreds of feet high into a deep canyon, and near the base of the mountain is consumed by the thirsty air and earth.

The presence of marginal crevasses, lateral and terminal moraines, and the characteristic milky stream which issues from the lower end, are proofs that Whitney Glacier moves, but the rate of motion has not been definitely measured. The stakes planted in July, 1884, were covered with snow before the party could reach them in October, and they have since disappeared.



Figure 7. Bolam glacier.

Bulam [Bolam] Glacier

On the northwestern slope of the mountain, to the left of Whitney Glacier, is the Bulam [Bolam, figure 7], differing chiefly in that it is contained in a broader, less definite valley, and forming an intermediate step toward Hotlum Glacier, which is one of the most important and remarkable of the group.

Hotlum Glacier

Unlike the ordinary glaciers, Hotlum [figure 8] has no valley in which it is confined, but lies on the convex surface of the mountain. Its upper surface is convex throughout from side to side, and its width (1.23 miles) is almost as great as its length (1.62 miles). At several places the surface of the glacier is made very rough by the inequalities of its bed. This is especially true of the southern portion, where prominent cliffs furnish material for the only medial moraine discovered on Mount Shasta. Throughout the greater portion of its expanse the glacier is deeply crevassed, exposing the green ice occa-



Figure 8. Hotlum glacier.

sionally to the depth of 100 feet. The thickness of this glacier has been overestimated. In reality, instead of being 1,800 to 2,500 feet thick, it does not appear where greatest to be more than a few hundred feet, for at a number of places it is so thin that its bed is exposed. Its terminal moraine is a huge pile nearly half a mile in width measured in the direction of glacial motion, and twice as long measured along the end of the glacier.

Wintun Glacier

Next south of Hotlum Glacier is Wintun [figure 9] which attains a length of over two miles, and ends with an abrupt front of ice in a canyon. In this respect it is strongly contrasted with the other glaciers of Mount Shasta. There is no well-marked terminal moraine, although there are accumulations of debris on the northern side near the end. The detritus is apparently swept out of the canyon by Ash Creek as fast as it is brought there by the glacier, and thus the accumulation of a terminal moraine is prevented.

McCloud [Konwakiton] Glacier

On the southeastern slope of Mount Shasta, at the head of a large canyon, is the McCloud [Konwakiton] Glacier [figure 10]. It adjoins the Wintun, and is the smallest glacier in the group. Notwithstanding its diminutive size, its crevasses and the muddy stream it initiates indicate clearly that the ice mass continues to move. The amount of morainal material upon its borders is small, and yet, of all the glaciers about Mount Shasta, it is the only one which has left a prominent record of important changes. The country adjacent to the southwestern side of Mud Creek Canyon has been distinctly glaci-ated, so as to leave no doubt that McCloud [Konwakiton] Glacier was once very much larger than it is at the present time. The rocks over which it moved were deeply striated, and so abraded as to produce the smooth, rounded surface so common in glaci-ated regions. At the time of its greatest extension the glacier was over 5 miles in length, and occupied an area of at least 7 square miles, being twenty times its present size. Its limit is outlined at several places by prominent terminal moraines,



Figure 9. Wintun glacier.



Figure 10. Konwakiton glacier.

which mark stages in the recession of the glacier. The thickness of the glacier, where greatest, was probably not more than 200 feet; for several hills within the glaciated area were not covered, and the striated surfaces and moraines do not extend up their slopes more than 200 feet. The thickness of the glacier is completely in harmony with the limited extent of its erosion. Although the rocks are distinctly planed off, so that the low knobs and edges have regularly curved outlines, it is evident that a great thickness has not been removed by the ice, and that the period of ice erosion has been comparatively brief. During the lapse of time, however, there have been climatic oscillations, embracing epochs of glacial advance and recession.

With the exception of McCloud [Konwakiton] Glacier, there are no records upon the slopes of Shasta that any of the existing glaciers were ever very much larger than at present.

Excerpts from Diller, J. S., 1896, Mount Shasta, a typical volcano, in the physiography of the United States: National Geographic Society Monographs, v. 1, no. 8, p. 237-268.

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