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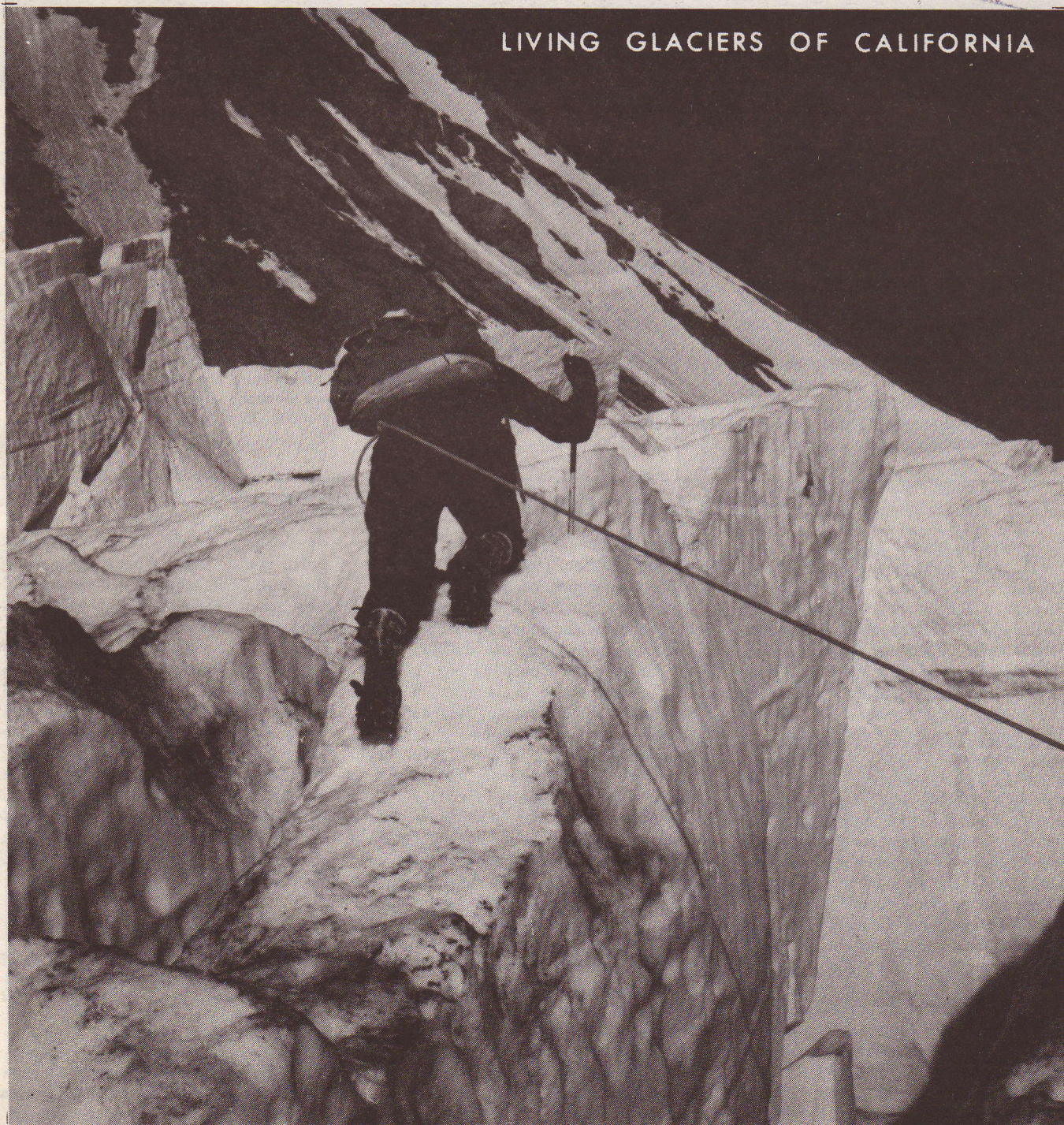
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LIVING GLACIERS OF CALIFORNIA



● living glaciers of California... A PICTURE STORY

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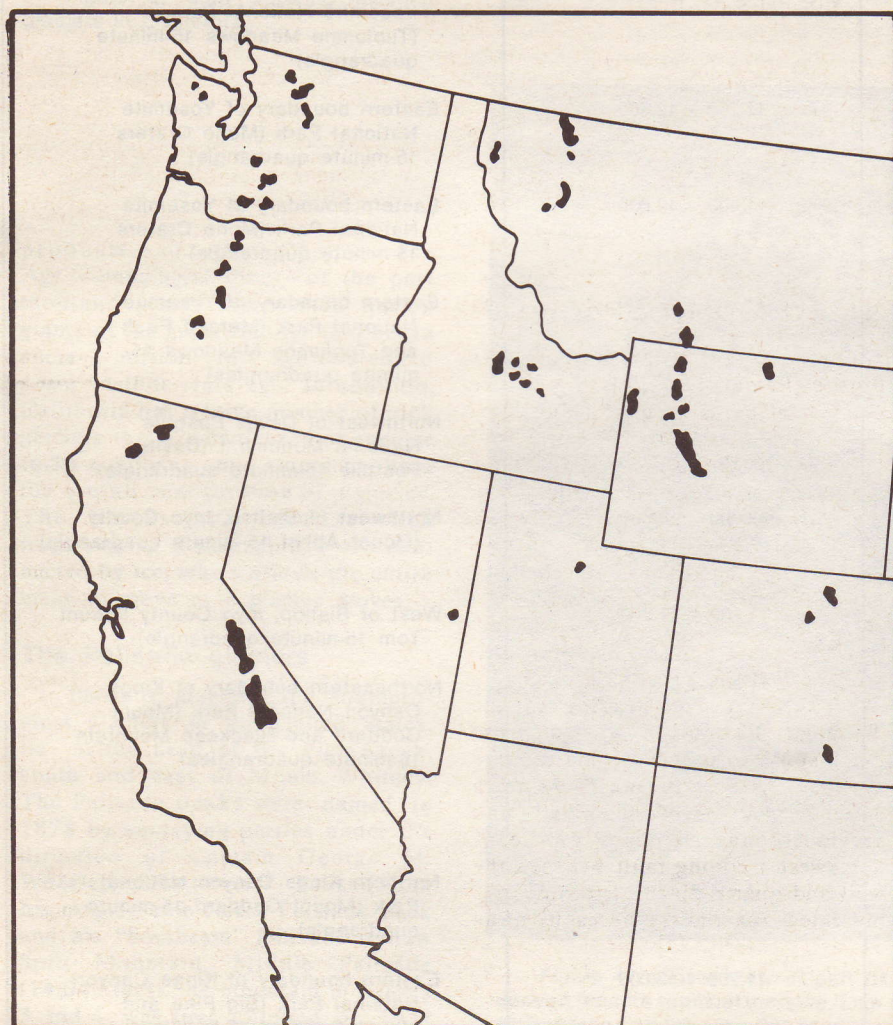


Figure 1. Areas of existing glaciers in the western United States (except Alaska and Hawaii). Modified from American Geographical Society.

In the 49 states south of Alaska, there are about 1100 glaciers. All are in the western states; Washington, Montana, California, and Wyoming have the lion's share (figure 1, table 1). Much of the early work on California glaciers was done by pioneers of California geology--John Muir, Israel C. Russell, W. D. Johnson, G. K. Gilbert, and A. C. Lawson.

About 80 tiny glaciers lie in small cirques of the Cascades, Trinity Alps, and Sierra Nevada Ranges of California (figure 2, table 2). These interesting and accessible glaciers are

Table 1. Number and size of glaciers in the United States. Modified from U.S. Geological Survey

State	Approximate number of glaciers	Total glacier area in square miles
Alaska	5000?	About 17,000
Washington	800	160
Wyoming	80	18
Montana	106	18
Oregon	38	8
California	80	7
Colorado	10?	1
Idaho	11?	1
Nevada	1	0.1
Utah	1?	0.1?

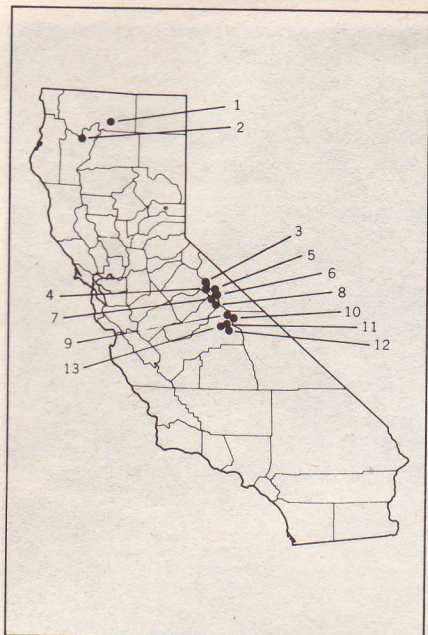


Figure 2. Map showing existing glaciers in California.

products of the "Little Ice Age"—neoglacial times—of the past thousand years, rather than wasted giants of the great Ice Age that began some 3 million years ago and ended some 11,000 years ago. In addition, California has a large number of rock glaciers that are composed of angular rocks similar to talus slopes but have the overall configuration of a glacier. The blocks and smaller rock fragments in a rock glacier are connected by ice, which allows the entire mass to move as a glacier moves.

The Palisade glaciers

Palisade glaciers, the southernmost glaciers in the United States, lie at the head of Big Pine Creek, south and east of Mount Whitney. The Palisade peaks were named in 1878 by surveying parties under the direction of Captain George M. Wheeler. "Northwest" Palisade on his map is now North Palisade Peak and his "Southeast" Palisade is now Split Mountain. Middle Palisade (14,049 feet), the mountain in figures 3 and 4, was first climbed in 1921 by Francis P. Farquahar and Ansel F. Hall.



Figure 3. Middle Palisade glacier is made up of the patches of ice to the left. Ice patches and the snow fields to the right are part of the snow and ice field in the shadow of Middle Palisade Peak (hidden from view by clouds) that includes the glacier that bears its name and about 3 other small glacierets. Middle Palisade glacier is about 1 1/2 miles long, making it the largest in the Sierra Nevada.



Figure 4. Closer view of part of Middle Palisade glacier showing the debris derived from its terminal moraine. Like many Sierran glaciers, Middle Palisade glacier probably has an ice core. The face of the mountain shows a rounded notch to the left, which serves as an "avalanche chute." The channel of the chute was probably smoothed and rounded by ice from earlier glacial times. *Photo by Ernest Carter.*

Table 2. Existing glaciers in California.*

Mountain peak and associated glaciers	Approximate elevation of lower and upper margins of glaciers (feet above sea level)	Location
CASCADE RANGE		
1. Mount Shasta - Whitney, Bolam, Hotlum, Wintun, and Konwakiton glaciers	9800 - 13,600	East of Weed, Siskiyou County (Shasta 15-minute quadrangle)
TRINITY ALPS		
2. Thompson Peak, Sawtooth Mountain—glaciers and snowfields	7500 - 9000 (some snow fields as low as 6400)	Crest of the Trinity Alps (Cecilville and Helena 15-minute quadrangles)
SIERRA NEVADA		
3. Sawtooth Ridge—many small glaciers	10,600 - 11,200	Northeastern boundary of Yosemite National Park (Matterhorn Peak 15-minute quadrangle)
4. Mount Conness - Conness glacier and others to the southwest	11,000 - 12,000	Northeastern boundary of Yosemite National Park (Tuolumne Meadows 15-minute quadrangle)
5. Mount Dana—Dana glacier	11,200 - 12,300	Eastern boundary of Yosemite National Park (Mono Craters 15-minute quadrangle)
6. Kuna Peak, Koip Peak—several glaciers	11,400 - 12,600	Eastern boundary of Yosemite National Park (Mono Craters 15-minute quadrangle)
7. Mount Lyell—Lyell glacier and other small glaciers to the northwest and south	11,500 - 12,800	Eastern boundary of Yosemite National Park (Merced Peak and Tuolumne Meadows 15-minute quadrangles)
8. Ritter Range—many small glaciers	10,500 - 12,200	Northwest of Devils Postpile National Monument (Devils Postpile 15-minute quadrangle)
9. Mount Abbot - several glaciers to the northwest and southwest	12,000 - 13,000	Northwest of Bishop, Inyo County (Mount Abbot 15-minute quadrangle)
10. Mount Humphreys - several glaciers to the northwest	11,400 - 12,800	West of Bishop, Inyo County (Mount Tom 15-minute quadrangle)
11. Glacier Divide, Mount Darwin, Mount Haeckel, Mount Powell—Goethe glacier, Darwin glacier, and many others to the northwest and southeast	11,400 - 13,000	Northeastern boundary of Kings Canyon National Park (Mount Goddard and Blackcap Mountain 15-minute quadrangles)
12. Mount Goddard, Black Divide—many glaciers	11,400 - 12,800	Northern Kings Canyon National Park (Mount Goddard 15-minute quadrangle)
13. The Palisades, Mount Bolton Brown, Split Mountain—Palisade Glacier and many other small glaciers	11,200 - 13,000	Eastern boundary of Kings Canyon National Park (Big Pine and Mount Goddard 15-minute quadrangles)

*Modified from Burnett, 1964. Numbers match those on the map in figure 2.



Figure 5. Norman Clyde in 1970.
Photo by Tom Ross.

In 1973, a small glacier lying north of Middle Palisade near Elinore Lake was named "Norman Clyde glacier" in honor of one of the Sierra Nevada's foremost mountaineers. Norman Clyde (figure 5) crossed the glacier in 1930, when he made the first ascent of Norman Clyde Peak (figure 6).

Lyell, McClure, and Dana glaciers

Three of California's best known existing glaciers are Lyell, McClure, and Dana (photos 7 through 13), all within Yosemite National Park. When these glaciers were first explored and described, Yosemite National Park did not yet exist. Through the labors of John Muir, who first climbed Mount Lyell and described its glaciers, and others interested in wilderness preservation, Yosemite was set aside as a national park in 1890.



Figure 6. Norman Clyde Peak, highest peak in background, in 1961. The glacier in the foreground is smaller than usual, because the year was uncommonly dry. A prominent bergschrund snakes around the top of the glacier. Below it, the change in color marks the line of clear ice; snow has melted from the surface of the glacier, leaving the crystalline ice visible. Photo by Tom Ross.

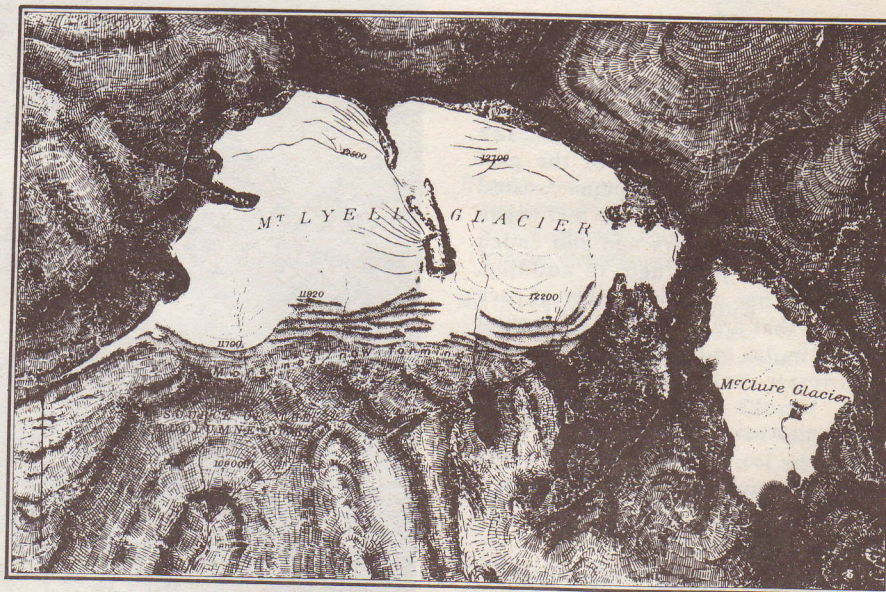


Figure 7. Map of Lyell and McClure glaciers in 1883. The map has essentially the same orientation as figure 8. Taken from I. C. Russell (1885); W. D. Johnson, topographer.



Figure 8. Drawing of Lyell glacier, made from a photograph taken by G. K. Gilbert in 1883 during his exploration of the glacier with Israel C. Russell. Note the moraine at the foot of the glacier and the rounded rock island in its center. Drawing by H. H. Nichols.



Figure 9. Lyell glacier in the early 1900s. G. K. Gilbert had marked his photographic spot (figure 8) with a large cairn; the cairn is now hidden by trees. Photographs taken in the different years may be compared to note changes in the glacier. *Photo by A. C. Lawson.*

Figure 10. Ice ship on Lyell glacier. Many small glacial features such as ice ships and ice tables (see CALIFORNIA GEOLOGY, February 1974, p. 40) can be seen on glaciers in Yosemite National Park. All of the glaciers show crevasses. *Drawing by G. K. Gilbert.*

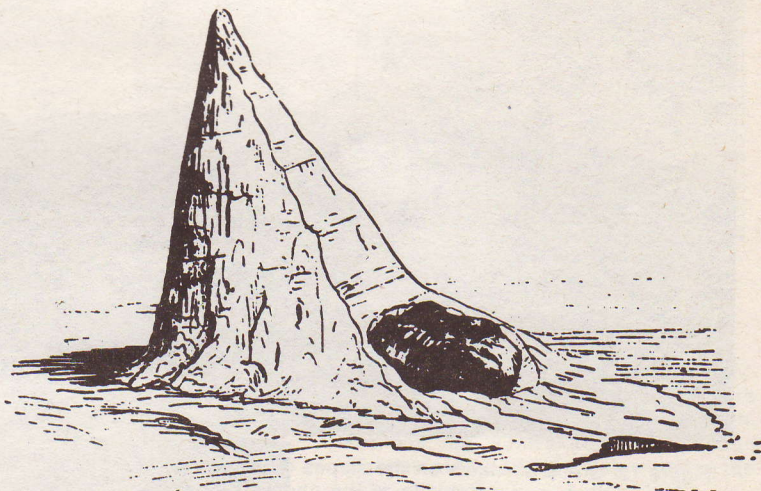


Figure 11. Dana glacier, named in 1863 for James Dwight Dana, a prominent geologist of that time, by members of the California Geological Survey. Ten years later, 3 members of the survey—J. D. Whitney, W. H. Brewer, and C. F. Hoffman—made the first recorded ascent of the glacier. Note the moraines in the left center of the photograph. *Photo by Ernest Carter.*



Figure 12. Group of hikers on the slopes of Dana glacier at the turn of the century. Note the ice chute above the bergschrund at the head of the glacier. The ice in the chute has been too thin to have moved as a glacier since Russell and Gilbert's visit in 1883, but it has never completely disappeared. *Photo by A. C. Lawson.*



Figure 13. Dana glacier close up, showing its pronounced bergschrund. *Photo by A.C. Lawson.*

Mount Shasta

The first California glaciers to be recognized as such were those at the top of Mount Shasta. The glaciers are named Hotlum, Bolam, Wintun, Konwakiton (McCloud), and Whitney. Although J. D. Whitney, the second California State Geologist, for whom Whitney glacier was named, led the first scientific party to the top of Mount Shasta in 1862, he did not actually see the glaciers. It remained for Clarence King to describe them, and to advertise to the world that there were glaciers in the United States south of Alaska.

Figure 14. Map of Mount Shasta showing Hotlum, Bolam, Wintun, Konwakiton (McCloud), and Whitney glaciers at the top.

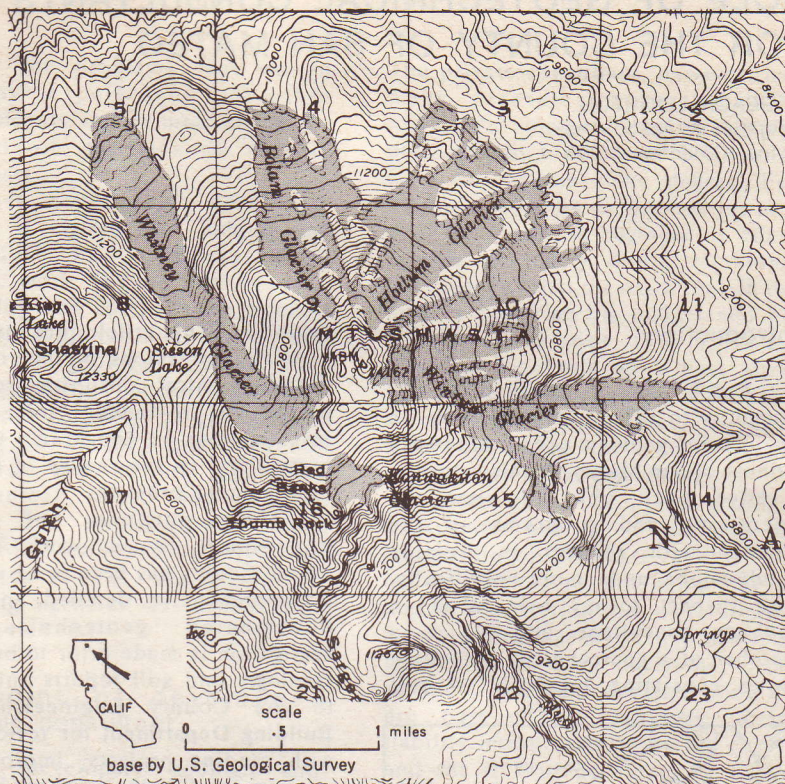


Figure 15. View of Mount Shasta taken from McCloud to the south. Portions of Konwakiton and Wintun glaciers are visible just below and to the right of the peak.

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