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RECESSION OF GLACIERS IN GLACIER NATIONAL PARK, MONTANA

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Recent detailed mapping by the National Park Service of several glaciers in Glacier National Park, Montana, has yielded much information about the volume-shrinkage of these glaciers since the area was mapped by the United States Geological Survey in 1900-02. To date, three glaciers, Grinnell, Sperry, and Jackson have been mapped by the plane-table-and-stadia method on a scale of 1:2400. The work was begun late in August 1937 with the mapping of Grinnell Glacier [see 1 of "References" at end of paper], Sperry was mapped in August 1938, and Jackson in August 1939. A resurvey of each glacier every five years is contemplated, so that an accurate check on the total amount of ice-shrinkage may be maintained.

The Chief Mountain, Montana, topographic sheet of the United States Geological Survey which shows these glaciers, as mapped in 1900-02, on a scale of 1:125,000 is too generalized to be of much use in comparing the glaciers in 1900-02 with their counterparts on the new large-scale maps. However, by means of the older, small-scale map and photographs taken about 1900, the approximate borders of the glaciers at that time have been located and placed upon the new maps. Construction of longitudinal and transverse profiles with this information as a guide gives an approximate indication of the amount of surface-lowering and thus the volume-shrinkage since 1900-02. The following determinations have been made with respect to the recession of these recently mapped glaciers in Glacier National Park:

Grinnell Glacier--In 1900-02 the Glacier had a surface-area of about 0.93 square mile. Shrinkage of the ice since then has caused the Glacier to separate into two parts. In 1937 the lower and larger of these two ice-masses had a surface-area of about 0.51 square mile. The upper ice-mass, although not mapped in 1937, was estimated to have a surface-area not exceeding 0.04 square mile. Thus, the total area from 1900-02 to 1937 was reduced by 0.38 square mile, or 40 per cent.

The amount of shrinkage in area, however, has probably been considerably less than the volume-decrease during the same period. Photographs of Grinnell Glacier taken in 1897, the earliest thus far obtained, show that the Glacier then was about 300 feet thick at the point where its north edge lay in 1937. Comparison of recent observations with those of Alden [2], made in 1911, indicate that the ice was about 80 to 100 feet thick at the point where the terminus was in 1937. Further, the surface of the Glacier at the cirque-headwall was lowered by an amount varying between 45 and 90 feet from 1911 to 1937.

Thus, although its surface-area has decreased about 40 per cent, Grinnell Glacier, in the past 40 years, may have lost considerably more than 50 per cent of its volume.

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Fig. 1--Jackson Glacier as it appeared in 1901
(Photograph by F. E. Matthes)

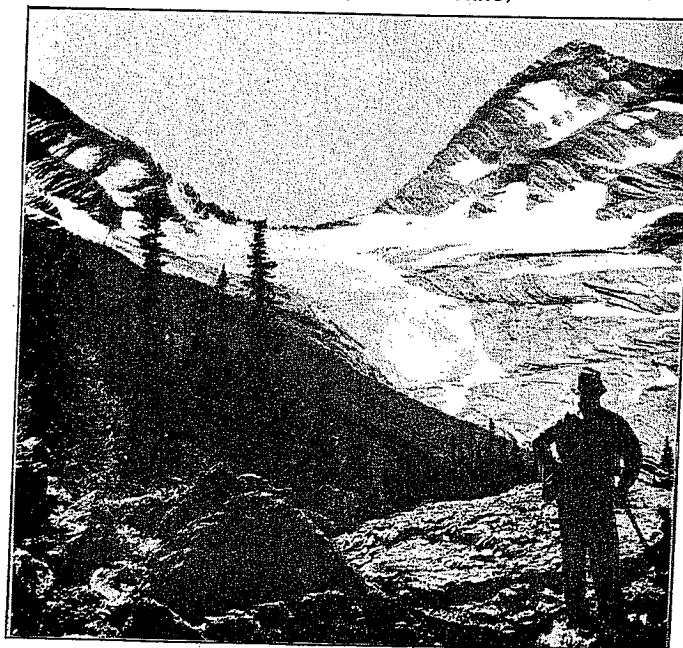


Fig. 2--Jackson Glacier as it appeared in 1939
(Photograph by F. E. Matthes)
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Sperry Glacier--This Glacier, which at present may be the largest single ice-mass in Glacier National Park, in 1900-02 possessed a surface-area of about 1.31 square miles. Between that time and 1938, shrinkage of the Glacier has caused it to separate into several ice-masses, the largest of which has a surface-area of 0.61 square mile. The most prominent of the smaller ice-bodies, which lies at the east base of Mount Edwards and which was contiguous with the main Glacier until 1938, now has a surface-area of 0.04 square mile. Thus the present area of the Glacier represents only about 47 per cent of the area it had in 1900-02.

Jackson Glacier--In 1900-02 this Glacier, which then was joined to the Blackfoot Glacier, possessed a surface-area of approximately 1.25 square miles, and a length of about one and one-half miles. When mapped in August 1939, it was separated from the Blackfoot Glacier by a distance of about one-half mile, its length had been reduced to one mile, and its surface-area to 0.29 square mile. In 1900-02 the ice at the site of the present terminus of the Glacier was about 200 feet thick, and at a point 1,000 feet upstream from the position of the present terminus the ice was at least 100 feet thicker than in 1939. Forty years ago the terminus rested at an elevation between 5,800 and 5,900 feet, whereas when mapped in 1939 it lay at an elevation of 6,440 feet.

Retreat of massive limestone a dip nearly 60°. Thus, the Glacier part than it 1 part of the Glacier during the past years, the Jackson

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- [1] George R. G.
- [2] Glaciers of
- [3] Bull. Geol.

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Retreat of this Glacier has exposed a uniformly sloping surface which is a dip-slope of massive limestone. It apparently continues under much, if not all, of the present Glacier with a dip nearly equal to the angle of slope of the Glacier's surface and in the same direction. Thus, the Glacier appears to have a very uniform thickness, probably being no thicker in any part than it is a short distance back from its terminus. The fact that ablation, in the upper part of the Glacier, has caused the rock-floor to emerge above the ice-surface in several places during the past two years bears out the above conclusion. Unless a distinct climatic change occurs, the Jackson Glacier may disappear almost entirely within the next ten years.

Other glaciers--Wentworth and Delo [3], probably basing their conclusions upon information taken from the Chief Mountain Quadrangle of the United States Geological Survey (1900-02), stated that the group of glaciers consisting of the Blackfoot, Harrison, and Pumpelly, together with the Sperry, about three miles to the northwest, had a combined surface-area of about seven square miles. However, all these glaciers have shrunk notably in size since 1900. Harrison Glacier has receded until it is now not much more than a narrow strip of firn along the base of the south wall of Mount Jackson. The combined area of these glaciers, which in 1900-02 was seven square miles, is now probably less than three square miles. Whereas in 1900-02 there were eight or nine glaciers in Glacier National Park which had surface-areas of one square mile or more, there probably is none of that size today. Furthermore, there are probably less than nine with surface-areas exceeding one-half of a square mile.

For some reason not entirely apparent to the writer, recession of glaciers in Glacier National Park seems to be more rapid than of glaciers farther south in other ranges of the Rocky Mountains and in the Sierra Nevada.

References

- [1] George R. Gibson and James L. Dyson, Bull. Geol. Soc. Amer., v. 50, p. 682, 1939.
- [2] Glaciers of Glacier National Park, U. S. Dep. Int., 1914.
- [3] Bull. Geol. Soc. Amer., v. 42, p. 611, 1931.

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