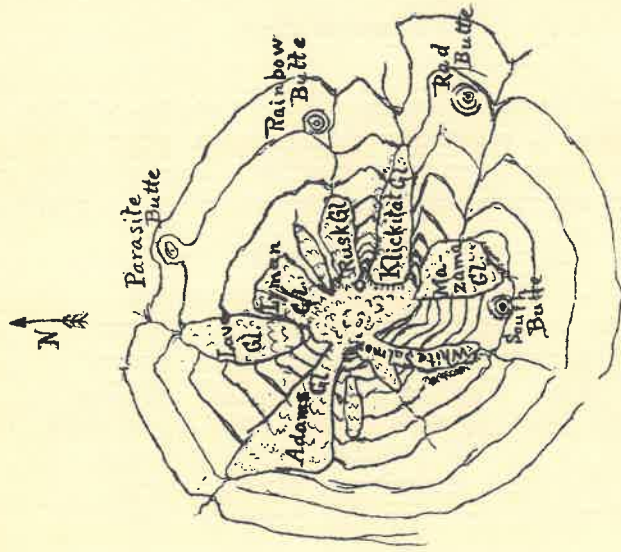
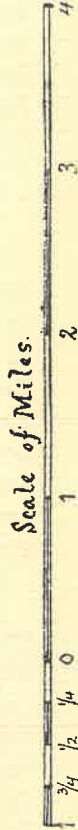


Mount Hood.



Mount Adams



The Glaciers of Mt. Hood and Mt. Adams*

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Mt. Hood and Mt. Adams are extinct volcanic cones, situated on the Cascade Mountains, which I had the pleasure of visiting in 1901; the first, in company with the Mazamas, and the second with Mr. Rusk.

The general form of the mountains, isolated conical peaks, materially affects the form of the glaciers. In mountain ranges, such as the Alps, the glaciers usually have large, broad gathering grounds and flow into narrow valleys; and in some cases many tributaries unite to form one trunk glacier. On isolated peaks the gathering ground is contracted and there are no opportunities for tributaries to unite; on the contrary, the spreading form of the mountain and the diminishing slope cause the glaciers to expand laterally and in cases to break up into distributaries. This last characteristic is strongly developed among the glaciers of Mt. Rainier, but is well marked only in one instance on each of our two mountains.

The mountains themselves show marked differences. Mt. Hood retains the conical form of the volcano much better than Mt. Adams and seems to be more recent. It is made up very largely of ejected material, though lava flows also occur here and there. About half of the original crater wall remains, the southern half being broken down. On the other hand, Mt. Adams has a very irregular broad summit, and the appearance of the stratification on the eastern precipices seems to indicate that there were originally several craters and not simply one, and lava makes up a larger proportion of its mass.

Glaciers stream from Mt. Hood on all sides; one would expect the crater to be a great gathering ground of the principal glaciers, but on account of its relatively small size and of its southern exposure, this is not

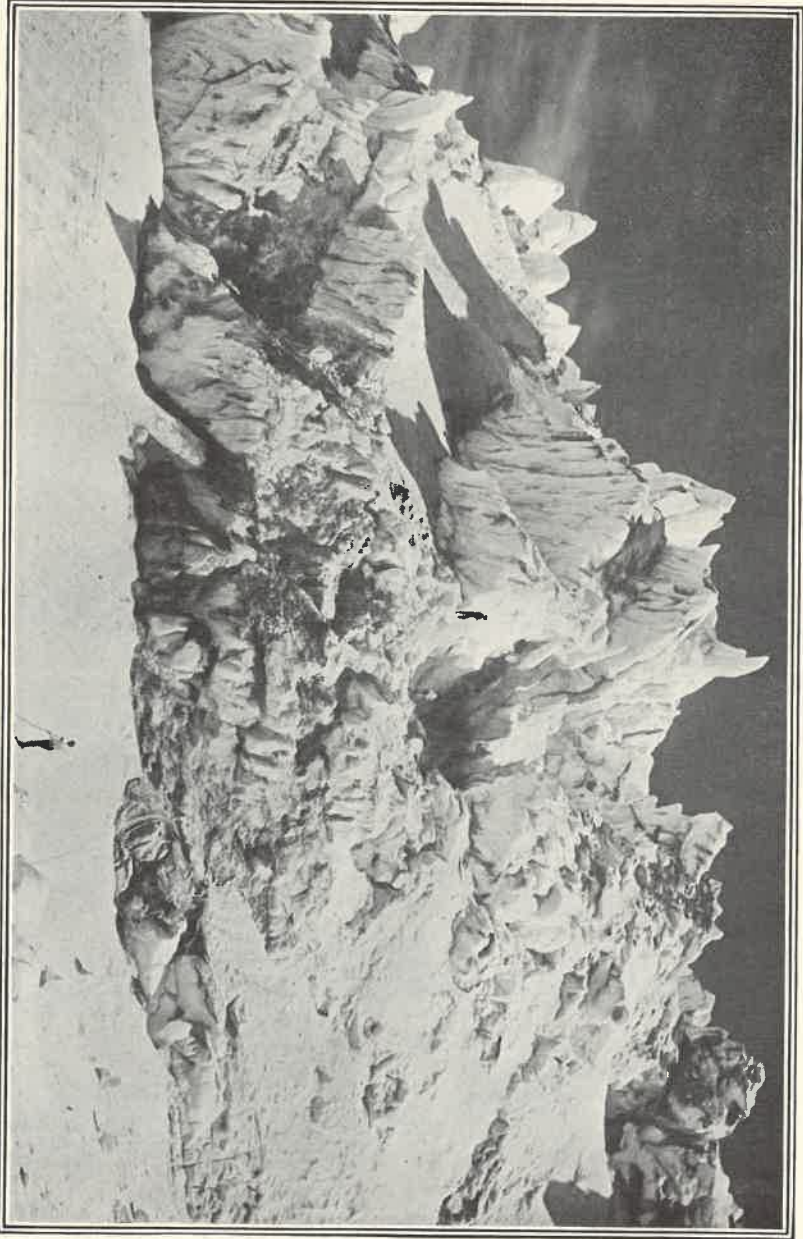
* NOTE Regarding the Maps.—The sketch map of Mt. Hood is taken principally from Mr. H. D. Langille's map of the "Northern Portion of the Cascade Range Forest Reserve" which accompanies "Forest Conditions in the Cascade Range Forest Reserve," published by the United States Geological Survey. I have introduced some slight modifications from my own observations. The sketch map of Mt. Adams is from my own surveys but the scale was taken from Mr. Fred G. Plummer's map of the Mt. Rainier Forest Reserve, accompanying the 21st Annual Report of the United States Geological Survey, Part 5. The southern branch of the White Salmon glacier is very inaccurate, as I was unable to get a good view of it and had to judge of its position by the moraines. The scale of the two mountains is the same for comparison.

ERRATUM.—A mistake has been made in the scale of the Mt. Adams map. This map should be twice as large as it is to be on the same scale as that of Mt. Hood. And the distances and heights given in the text regarding Mt. Adams should be doubled.—H. F. R.

the case, the reservoirs being considerably lower down on the flanks of the mountain. With the exception of the one small glacier on the west, the glaciers do not occupy deep depressions on the mountain's slopes, but lie in shallow depressions or stand up supported by their moraines. A very curious feature is the general existence of deep canyons beginning at the ends of the glaciers and extending to the gentle slopes of the mountain below. This is due to the fact that where the snow fields and glaciers lie, the water is prevented from collecting in streams and therefore can erode but little, but where this protection ceases, the streams cut rapidly into the very soft scoriae; we have here a case where the glaciers are eroding so much more slowly than the streams that they may be looked upon as conservative agents.

Beginning at the south, we find the *White* glacier taking its origin high up on the mountain and receiving some supplies from the crater. It is a mile and three-quarters long, and the altitude of the end is about 6900 feet; it lies in a shallow trough bounded on the east by a cliff and ends at the head of a very deep canyon, which, two miles lower down, opens into a great desolate plain where much of the material eroded from the canyon is deposited. In the bottom of the canyon is a long, somewhat mesa-shaped elevation surrounded on all sides by stream-cut ravines. The smooth top of this elevation consists of from 5 to 15 feet of ground moraine, and it may therefore be called the *Moraine* mesa; it shows that the glacier formerly extended about two miles below its present ending; the deep ravines which bound *Moraine* mesa have been cut out by streams since the retreat of the ice. On the east side of the canyon are two or three sharp ridges, which at first sight look like moraines, but which are really made up of ejected material from the volcano, cut into this shape by the action of running water. The slight gullies in the glacier's bed, which can be seen under the end of the ice, have all the appearance of being cut by water and appear to have been made when the glacier was somewhat smaller than at present. How long ago the glacier reached the end of the canyon could not be determined, but the existence of comparatively fresh wood under the moraine of *Moraine* mesa and the barren nature of its surface, which in addition to a few low plants, supports only two small cottonwood trees not more than thirty years old, indicate that the retreat of the glacier has been very recent and that *Moraine* mesa was probably covered with ice less than a hundred years ago.

The general history seems to be as follows: the glacier at one time extended about two miles below its present ending, and occupied the canyon which then had a broad smooth floor at the height of *Moraine* mesa.



WESTER, PHOTO, JULY 4, 1908

Ice Pinnacles Surrounding the Great Crvasse, Eliot Glacier, Mt. Hood.



The Newly Explored "Adams Glacier," Showing Ice Cascade 1100 Feet High.
Photographed by Dr. Harry Fielding Reid, August, 1901, at the time the glacier was named by him. This, in his opinion, is the finest glacier on Mt. Adams.

Several small moraines were deposited near the mouth of the canyon and then a retreat began, steady and rapid enough not to allow the formation of well defined terminal moraines. The streams from the melting ice cut through the ground moraine into the soft scoriae below and isolated Moraine mesa, which keeps its form on account of the more resistant layer of ground moraine on its surface. Later, the ice made a slight advance, but is probably now again retreating; the evidence for the late advance is not altogether satisfactory, as we cannot be sure that the slight gullies seen in section under the end of the glacier may not have been formed while still covered with ice, but the explanation offered seems to me the more probable.

To determine future changes, two stations were selected—one on the western and one on the eastern side, from which photographs of the glacier's end were made. The western station is a large flat rock four or five feet in diameter lying on a point projecting into the canyon and marked on top with a red "W," and on its western side with a dab of red paint; it is about 500 yards from the ice. The eastern station is at the northern end of the highest ridge on that side and is also marked by red paint. It is about 750 yards from the ice. Future photographs taken from these points will show the changes which the glacier has suffered.

The *Zigzag* glacier lies on the broad southwestern slope; but there was so much snow in 1901 that it was not possible to see the form of this glacier. The deep canyons cut just below its end were very marked.

To the west two glaciers descend; one, narrow and deeply sunk between high lava cliffs, has no name on Langille's map. North of this lies the *Sandy* glacier, which, unfortunately, I did not have the opportunity to see.

Cascading down the broad northern slope and partly falling over Pulpit rock, lies the common neve of two glaciers, which is divided by Barrett spur into the *Ladd*, flowing to the northwest, and the *Coe*, flowing to the north. These glaciers have high moraines on each side, indicating considerable recession, but they have not eroded deep channels, for the valleys outside the moraines are apparently as deep as the beds of the glaciers; but their ends pitch forward into deep canyons. The *Ladd* was so snow-covered that no determination of its end could be made, but photographs were taken of the *Coe* glacier from the points on the top of the lateral moraines where they suddenly pitch down into the canyon; these points were marked with red paint and can easily be found. A very marked peculiarity of the moraines of these glaciers is their double character; they consist of two parallel ridges separated by a deep depression;

I consider that this indicates variations in the size of the glaciers; Professor Russell has described a very similar appearance which he found in the moraines of a glacier on the Three Sisters and which was due to the melting of the ice under the debris.

The gathering grounds of the *Eliot* glacier lie in an amphitheater on the northeastern flank of the mountain, fed by the snows of avalanches from above and by a stream of ice descending from the northern slope of the mountain. The glacier has a length of over two miles and extends nearly to "Cloud-Cap Inn." Near its end, like the *Coe* and the *Ladd*, it pitches down into a deep canyon. The two stations on the sides of the canyon from which the end was photographed, are marked by paint. Between 1890 and 1896, Mr. W. A. Langille found the velocity of the ice near the middle of the glacier and about 300 feet from the end, to be 50 feet a year. The three northern glaciers are so covered by debris at their ends that it is very difficult to see where the ice ends; whereas the southern glaciers are very much cleaner. This is due to the greater amount of debris brought down by avalanches on the northern side, carried along the body of the glacier under the snow and ice and finally appearing at the end when the ice melts down.

On the eastern side lies the *Newton Clark* glacier, a rather broad and ill-defined mass of ice, a part of which lies upon a series of lava benches from which the ice breaks off and falls into the very deep canyon immediately below.

Except in the case of the *White* glacier, there is little indication that the glaciers of Mt. Hood have ever been very much larger than they now are. The moraines bordering the northern glaciers, which in places stand 50 or 100 feet above the level of the ice, come to an end at a short distance below where the ice now ends, and the large trees growing a short distance further show that the glaciers have certainly for a long time not been much more extensive.

Mt. Adams appears never to have had the symmetrical form of Mt. Hood and weathering is also more advanced, so that it presents a much more irregular form than the other mountain. Its broad top is twice as long from north to south as from east to west; and the central dome rises considerably higher than the two ends. At the time of my visit, the whole of this top was covered with snow, but Mr. Rusk tells me that the highest summit is frequently entirely bare. On all sides, except toward the south, the slopes drop off steeply from the top. On the eastern side they form great precipices, over which avalanches from the snow-cap pour upon the glaciers below.

The upper part of the great southwest slope is too steep to support a glacier. A little further to the north, the *White Salmon* glacier, beginning on the northern summit of the mountain, flows down the western slope and divides into two branches; one ends in a vertical wall at the top of precipices, and the other, turning towards the south, flows along the base of the southwestern slope and deposits great moraines, which are clearly visible from Trout Lake.

North of the White Salmon a small glacier nestles between two ridges, and north of that is the finest glacier of the mountain, which I have called the *Adams* glacier. It descends from the summit of the mountain in a fine cascade 1100 feet high and spreads out in a very broad surface on the gentle slope below, surrounded by high and well-developed moraines. It is nourished by the northern snow-cap of the mountain and by snow falling on the cascade. Its total length from the top of the cascade to the terminal moraine, measured horizontally, is only a little more than a mile, and the breadth of the cascade is only about 600 feet, but the beauty and harmony of its form make it the most beautiful glacier on Mount Adams.

Next, to the east, ensconced between two ridges, and at a low level, lies the *Lava* glacier, which is fed by avalanches from the slopes of the ridges, but not from the summit of the mountain. It flows to the north and comes in close contact with a comparatively recent lava flow; hence its name. As we pass around the mountain to the northeast, we come to a group of glaciers separated by narrow rock projections which derive their sustenance from the snow-cap and cascade down very steep slopes. I have called them the *Lyman* glaciers in honor of Professor W. D. Lyman, of Walla Walla, who was the first to describe any of the Mt. Adams glaciers; his account was published in the first number of this magazine. To the south of the Lyman glacier is another small glacier which has not been named and is not very important.

A little below the summit on the eastern side, a fine tower, *Castle* rock, stands boldly up. From this a sharp ridge extends toward the east. North and south of Castle rock, the top of the mountain breaks down in great precipices 600 to 800 feet high, and drops its ice and snow over them in avalanches to the two glaciers below, to the *Rusk* on the north of Castle rock and to the *Klickitat* south of it. Rusk glacier is, in general, the steeper of the two and the smaller. The Klickitat occupies a very deep depression in the mountain side, and the avalanches of ice and stones which fall upon its upper part produce a very dirty lower end, so much covered, indeed, with debris that we could not determine from a short distance where the ice ends. It is about a mile long. Numerous moraines extend

around these two glaciers, indicating that they are now smaller than formerly.

The southern slope of Mt. Adams carries the broad Mazama glacier, which descends at a gentle angle and ends in a great moraine on the south. The very deep canyon of Hell-roaring Creek heads on its eastern side in such a way as to give the appearance of being its natural outlet, but the glacier really flows toward the south.

Glacier scratches were found at some distance from the present glaciers on ridges which were higher than the ice now is. This indicates that there was at one time a very much greater extension of the ice than now prevails; to such an extent, indeed, as to materially alter the present distribution of the glaciers. The comparatively fresh appearance of the lava, both on the northern and southern slopes, raises the question of the relative age of the lava and the glaciers. If the lava had flowed out after the glaciers were formed, it is almost certain that the melting produced would have caused great floods largely modifying the moraines. As the moraines I saw did not show such a modification, it seems that the lava flow was earlier than they, but its very fresh character makes it pretty certain that it is not more than a few hundred years old. Some, at least, of the present moraines are therefore younger than this; but an examination of the mountain some distance below the present glaciers might show that great floods have really occurred, which might have been caused by the outflow of lava.

It is the general impression that the glaciers of Mt. Adams are larger than those of Mt. Hood; but it appears that this is a mistake and that several glaciers of Mt. Hood are nearly, if not quite twice as long as the longest of Mt. Adams. But each mountain has its peculiar attractions; the eastern precipices and the northern glaciers of Mt. Adams have no rivals on Mt. Hood, whereas the longer and better developed ice streams of the latter, its beautifully symmetrical form and the fine semi-circle of its crater walls, cannot be equalled on the former. The charming "Cloud Cap Inn," situated close to the Eliot glacier, will attract many visitors to Mt. Hood, who are unwilling to undertake the camping expedition necessary to visit Mt. Adams.

May 1, 1905.