

# FLUCTUATIONS OF THE NISQUALLY GLACIER MT. RAINIER, WASHINGTON, DURING THE LAST TWO CENTURIES

by

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## Abstract

A history of the fluctuations of the Nisqually Glacier on the southern slope of Mt. Rainier, Washington, has been reconstructed from evidence found in early reports, old photographs and the ages of trees growing in the area deglaciated since the maximum extent of the ice about 1750. It is hoped that these new data on glacial activity in the United States will be useful in examining the idea of synchronism in glacial behavior in different regions of the world.

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Interest in the recent increase of glacial activity in the United States, (Bengtson, 1951) (Johnson, 1953, 1954), has focused attention on the problem of synchronism

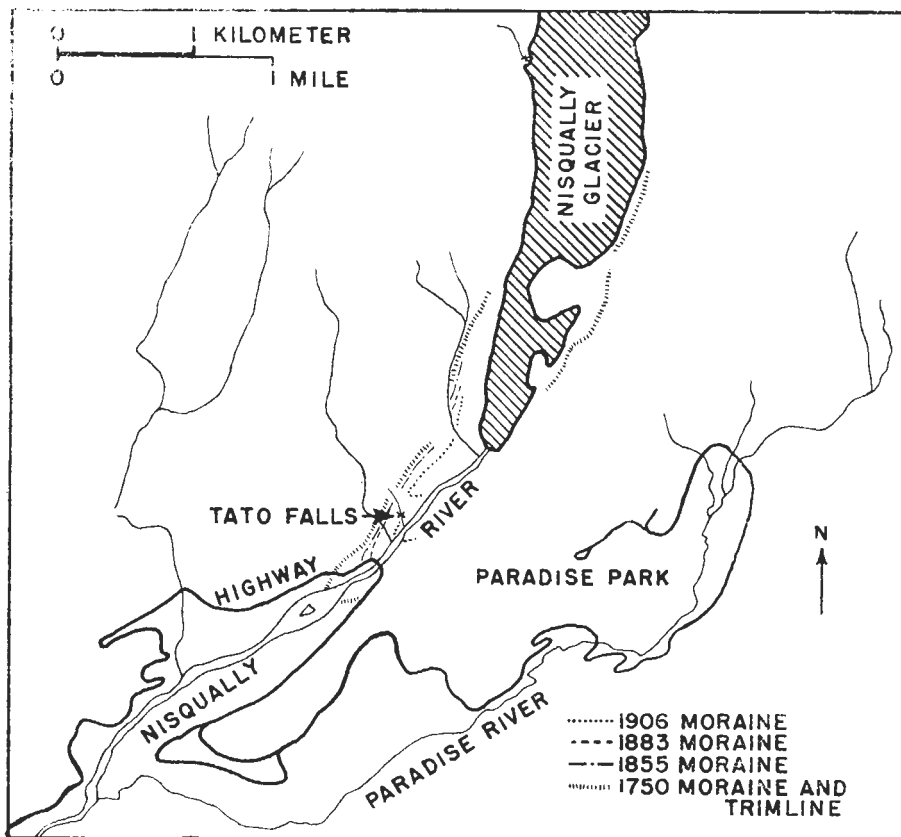


Fig. 1

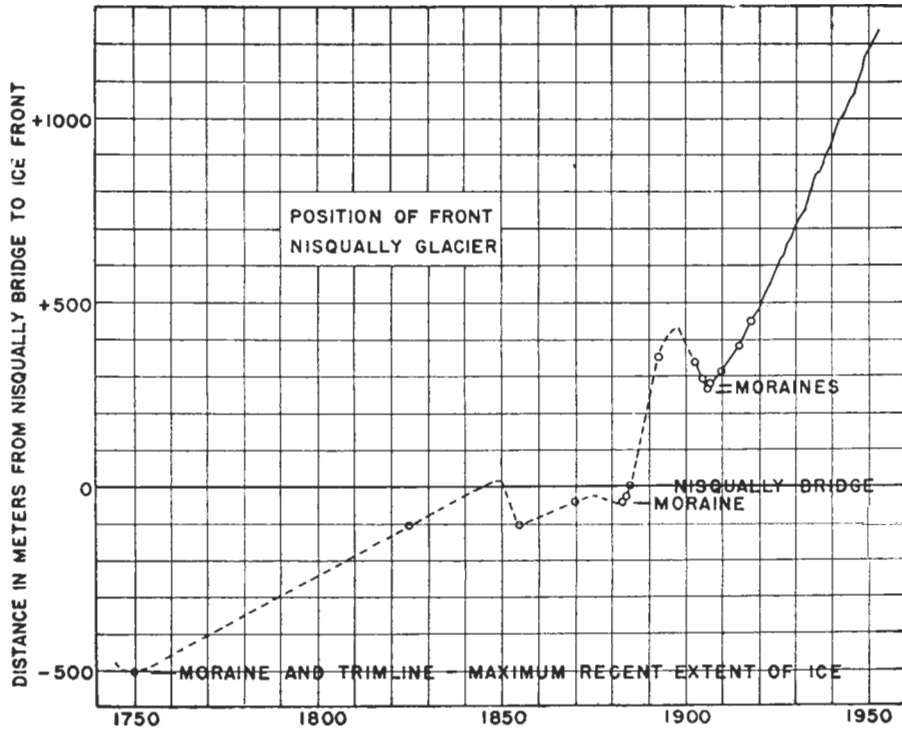


Fig. 2

between glacial behavior in different regions because renewed activity of this intensity has not been observed in other parts of the world. Although there have been examples of anomalous behavior in different regions of the United States during the last ten or fifteen years, the synchronism exhibited by the glaciers in four widely separated regions of the western United States is more striking than the local variations. (Johnson, 1953, 1954) (Baird, 1951) (Bengtson, 1951) (Dightman and Beatty, 1952) (Meier, 1951) (Harrison, 1951a).

It is evident that additional data on past fluctuations of glaciers in the United States would be important in evaluating the usefulness and limitations of the idea of synchronism. The Nisqually Glacier has been chosen for study because it has been observed more frequently than other glaciers in the United States and there is evidence that other glaciers have behaved in a similar manner. Although it has been generally believed that glaciers in the United States have receded continuously since the time of the discovery of the Nisqually Glacier on Mt. Rainier by Lieutenant A. V. Kautz in 1857, several minor advances have actually occurred during this time. Results of the latest studies indicate that earlier, tentative data (Harrison, 1951b, 1953) need to be modified slightly, but the conclusions regarding the history of the Nisqually Glacier since 1857 are essentially correct. Considerable new data have been added, extending the history back to the time of the maximum extent of the Nisqually Glacier, about 1750.

The area included in these studies is shown in Fig. 1, a map prepared from aerial photographs made for the United States Geological Survey in August, 1951. The positions of the moraines and trimlines have been indicated in relation to the present area of the ice. A summary of the data on the position of the Nisqually Glacier, including sources of information, has been tabulated below and these data have been plotted in Fig. 2. All distances are in meters and are measured horizontally from the north side of the highway bridge across the Nisqually River. Positions indicated by negative distances are downstream from the bridge.

*Location of the Nisqually Glacier Front in relation to the present Nisqually Bridge*

Year	Distance from Bridge in Meters	Source of Data
1750	— 500	Estimated age of trees from incomplete ring count.
1825	-- 107	Ring count of trees in area not covered by 1855 ice.
1855	- 107	Ring count inside trimline; A. V. Kautz Diary (Meany, 1916).
1870	-- 46	Descriptive report by S. F. Emmons (Emmons, 1877).
1883	-- 46	Moraine three meters high with three closely spaced loops.
1884	-- 30	A. C. Mason Photograph (Tacoma City Light No. 2678).
1885	0	James Longmire report (Brockman, 1938).
1893	+ 350	E. T. Allen Photograph (Park Museum, Longmire).
1903	335	O. A. Piper Photograph (Park Museum, Longmire).
1905	290	Joseph N. LeConte measurement (LeConte, 1906).
1906	259	Single moraine one meter high.
1907	274	Single moraine less than one meter high.
1910	317	F. E. Matthes measurement (Matthes, 1942).
1915	380	Asahel Curtis Photograph No. 33159 (Curtis, 1915).
1918	442	Measurement by National Park Service..
1919	460	» » » » »
1920	474	» » » » »
1921	506	» » » » »
1922	526	» » » » »
1923	540	» » » » »
1924	565	» » » » »
1925	587	» » » » »
1926	614	» » » » »
1927	626	» » » » »
1928	654	» » » » »
1929	670	» » » » »
1930	705	» » » » »
1931	721	» » » » »
1932	736	» » » » »
1933	749	» » » » »
1934	796	» » » » »
1935	813	» » » » »
1936	845	» » » » »
1937	850	» » » » »
1938	877	» » » » »
1939	904	» » » » »
1940	925	» » » » »
1941	961	» » » » »
1942	979	» » » » »
1943	1003	» » » » »
1944	1029	» » » » »
1945	1049	» » » » »
1946	1062	» » » » »
1947	1096	» » » » »
1948	1123	» » » » »
1949	1161	» » » » »
1950	1181	» » » » »
1951	1203	» » » » »
1952	1226	» » » » »
1953	1241	» » » » »

Several questions regarding the interpretation of the gaps in the record naturally arise when the graph in Fig. 2 is examined. The rapid rate of recession between 1884 and 1893, apparently much greater than in recent times, was difficult to accept. It is natural to suspect an error in the data of one or both of the pictures used to establish the position of the front on those years. The validity of the date of the 1884 photograph is substantiated by Willis' report (Russell, 1896) of an active

advancing front at the North Mowich Glacier (Willis Glacier) on the northwest side of Mt. Rainier in 1881 and 1885. The 1893 date may be questionable, but it was related by E. T. Allen to a spectacular fire which supposedly occurred in 1895. The picture was obviously taken several years before 1903 because there is no sign in Allen's picture of the increased ice thickness needed to produce the later advances.

The 1855 advance has been indicated with a forward velocity identical to the 1906 advance, followed by an abrupt retreat, because the moraines of both advances are quite similar. If this hypothesis is accepted, then it appears that the 1855 advance was of short duration although the ice moved forward to a position vacated by the glacier thirty years earlier.

The similarity and size of the 1883 and 1750 moraines suggests that these two advances probably had periods of several years with almost equilibrium conditions. The 1883 moraine may represent a pause in the retreat rather than a readvance.

It seems unlikely that the period between 1750 and 1825 would be free of fluctuations. However, there is no evidence in the young forest of moraines or trimlines to indicate pauses or advances. It is probable that the Nisqually Glacier becomes overextended during times of advance and minor variations in glacial activity never reach the front. For example, there is evidence of a small lateral moraine built by the Nisqually Glacier during a brief period of increased activity in 1936 which never reached the front. It is possible that the recent increase in glacial activity may never reach the front of the Nisqually Glacier because the lower 3000 feet of the glacier is virtually dead ice.

This history of the fluctuations of the Nisqually Glacier offers the possibility of comparing glacial activity in this region with other regions of the world and checking on the theory of synchronism. Further study is in order before we can determine whether climatic conditions during the earlier advances were greatly different from the conditions which caused the recent wave of increased ice thickness on the Nisqually Glacier (Johnson, 1953, 1954). Reports by early Seattle residents suggest that the weather was much colder in 1880, 1881 and 1901 than during the winters of 1949 and 1950, but the margin between glacial growth and shrinkage is apparently much smaller than generally believed. The opportunities to study the causes of glacial fluctuations while a change is in progress is invaluable and work in this field should be intensified.

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