

Department of the Interior
U. S. Geological Survey
Conservation Division

NISQUALLY GLACIER AND
EMMONS GLACIER, WASHINGTON

Progress report 1957

Gordon C. Giles
Tacoma, Washington
March, 1958

CROSS-PROFILE LOCATIONS

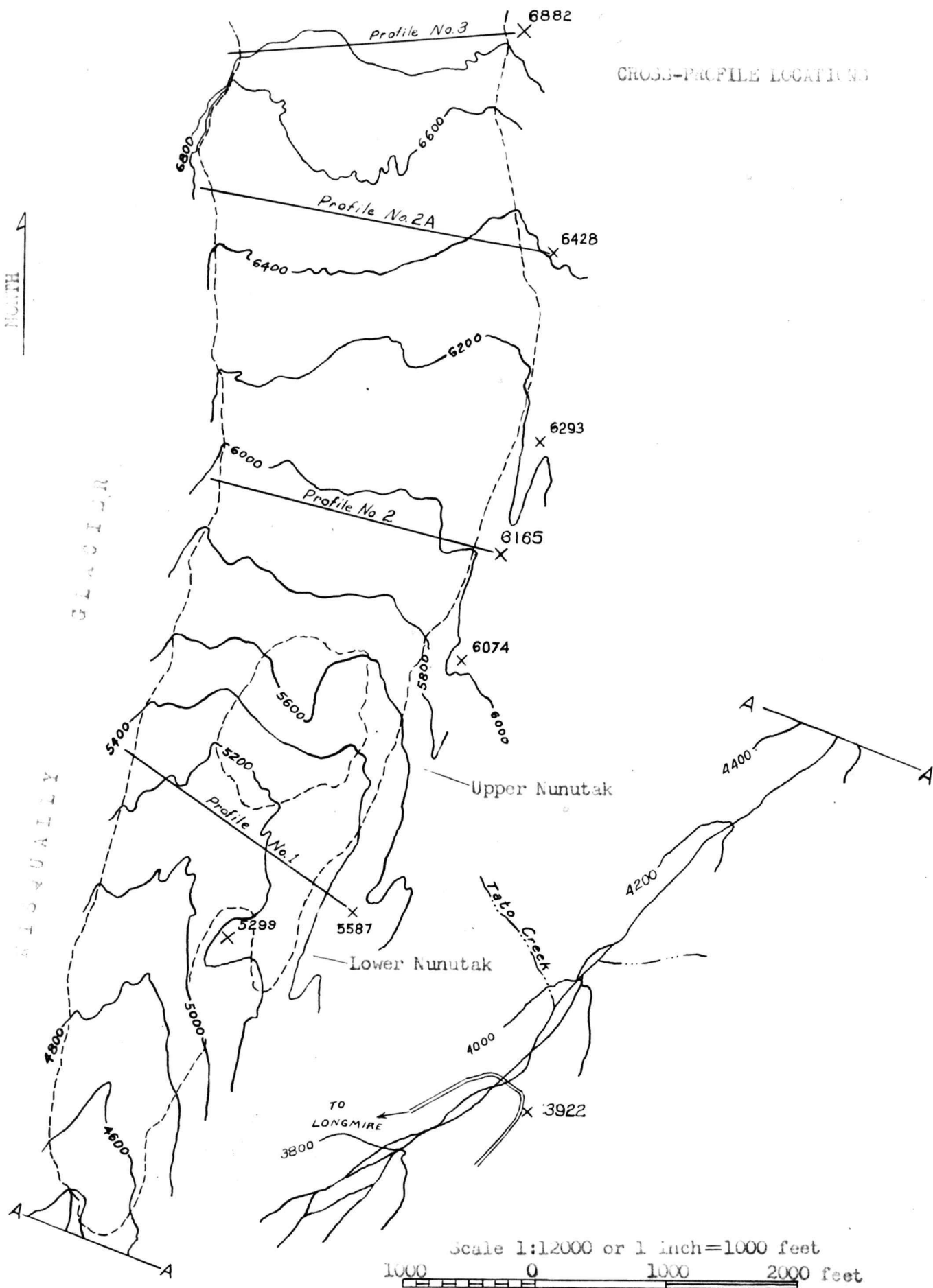


Table of contents

	Page
Field investigations of Nisqually Glacier	1
Field investigations of Emmons Glacier.....	2
Personnel participating in investigations.....	2
Photographic program.....	3
Recession at the 4,500-foot elevation	3
Advance of ice face near Cross-Profile No. 1	4
Movement of marked rocks near Cross-Profile No. 1	5
Cross-Profile No. 1.....	5
Snow and ice stake-melt measurement.....	6
Cross-Profile No. 2.....	7
Movement of marked rocks near Cross-Profile No. 2	8
Cross-Profile No. 3	10
Summary.....	13

Figures

Following page -

Frontispiece	Cross-Profile locations.....	Title	page
Figure 1	Movement of ice face		4
2	Cross-Profile No. 1		5
3	Cross-Profile No. 2		7
4	Movement of marked rocks near Cross-Profile No. 2.....		9
5	Comparison of annual rate of surface movement.....		9
6	Cross-Profile No. 3.....		10

Plates

Plates 1 & 2	Photographs showing advancing ice face near Cross-Profile No. 1.....	4
3 & 4	Photographs showing Wilson Glacier and upper Nisqually Glacier, 1945 to 1957..	11

Tables

Table 1	Summary of changes at the cross profiles	13
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NISQUALLY GLACIER AND EMMONS GLACIER, WASHINGTON

Progress report, 1957

This is one of a series of reports describing the results of periodic surveys which are made to determine the movement and changes in surface elevation of the Nisqually Glacier, Mt. Rainier National Park, Wash. In 1956 phototheodolite determinations were added to the program, and at the suggestion of officials of Mt. Rainier National Park the investigation was expanded in 1957 to include phototheodolite coverage of Emmons Glacier on the northeast side of the mountain. The terrestrial photographs and related control determinations will be used in the stereo-compilation of topographic maps of the glaciers. Phototheodolite determinations possibly may be used in the future for cross-profile surveys on the Nisqually Glacier, now made by transit or plane-table methods.

Previous progress reports on the Nisqually Glacier investigations are available in files of the Geological Survey for the years 1937 to 1953 as prepared by Arthur Johnson; and for the years 1954 to 1956 as prepared by Gordon C. Giles.

Field investigations carried on during the summer and fall of 1957 are as follows:

Field investigations of Nisqually Glacier

July 11 Established 2 melt stakes at the 6,150 ft. elevation and 2 melt stakes at the 5,200 ft. elevation; measured cross-profile No. 2 to station 1,155.

- July 12 Measured cross-profile No. 2 from station 1,155 to station 2,193; determined position of 2 newly marked and 1 previously marked rocks
- 16 Melt stake measurements made at the 6,150 ft. elevation
- Aug. 13 Melt stakes checked
- Aug. 30 Photographs taken from selected points by Fred M. Veatch
- Sept. 3 Measurements made on cross-profile No. 2 and position of marked rocks determined.
- Sept. 4 Measurements made on cross-profile No. 3
- Sept. 5 Measurements made on cross-profile No. 1 and position of advancing ice face determined
- Sept. 23
- 24 Phototheodolite photos obtained of Nisqually Glacier
- Oct. 10 Recession of terminus measured by personnel of the National Park Service

Field investigations of Emmons Glacier

- Sept. 25
- 26 Established phototheodolite base line on Sourdough Mountain by triangulation
- 30 Obtained phototheodolite photos of the upper part of Emmons Glacier from Sourdough Mountain base line
- Oct. 11 Measured phototheodolite base line on Burroughs Mountain and obtained phototheodolite photos of lower part of Emmons Glacier

Personnel participating in investigations

The following persons participated in the 1957 glacier measurements of Nisqually and Emmons glaciers.

Geological Survey

Arthur Johnson, Chief, Water & Power Br., Cons. Div.
Fred M. Veatch, District Engineer, Water Resources Div.

Geological Survey - con't.

Gordon C. Giles, Hydraulic Engineer
Mark Meier, Project Hydrologist
Robert K. Fahnestock, Geologist
Jack B. Dugwyler, Jr., Engineering Aid
Charles K. McDonald, Topographic Field Assist.
David Tillson, Topographic Field Assist.

National Park Service

Ross Bender, Park Naturalist
Richard W. Neal
P. Peterson

In addition to the above mentioned personnel, the National Park Service provided a packer and a pack horse.

The results of the 1957 glacier measurements are described in the following sections.

Photographic Program

Photographs of the Nisqually glacier and vicinity have been taken from up to 30 different points annually since 1942 by Fred M. Veatch, District Engineer, Water Resources Division, USGS Tacoma, Washington. The negatives of these photographs are numbered, described, and on file at the U. S. Geological Survey office, 207 Federal Building, Tacoma. All photographs included in this report are from this file, and were taken by Mr. Veatch.

Recession at the 4,500-foot elevation

The recession of the terminus at the lower end of the stagnant ice block, measured by personnel of the National Park Service, continues at about the same rate as for previous years. Measurements made on October 10, 1957 show the recession to be 75 feet since September 21, 1956.

Advance of ice face near Cross-Profile No. 1

The forward movement of the ice face appears to be somewhat less from 1956 to 1957 than the annual movement in three previous years 1953 to 1956. The maximum movement measured on the east side of the valley parallel to the axis of the glacier was 130 feet, 1956 to 1957. Movement measured in this area for the period 1955 to 1956 was 160 feet.

The lower end of the ice tongue, extending down-valley west of and immediately below the upper nunatak, seems to be spreading out or expanding east toward the center of the valley. A portion of the ice face from a point about 400 feet north of Cross-Profile No. 1 to a point about 600 feet from the profile has receded laterally about 20 feet from the 1956 position. (See Fig. 1) Along the alignment of Cross-Profile No. 1, the ice face has moved eastward from station 1,150 in 1956 to station 1,000 in 1957. The downstream end of the ice face is now about 400 feet below the alignment of Cross-Profile No. 1. This is measured between the base of the exposed ice and the accumulation of debris. (See photos in plates 1 and 2). The advance of the downstream end of the ice tongue was only slightly over 100 feet for the past year. Reference to photos in plate 1 for the years 1951 and 1953 indicate some forward movement of the ice face on the west side of the nunatak during this period. From 1953 to 1956 measurements indicate a forward movement of about 800 feet.



Ice face near cross-profile No. 1 Photo No. 4155
8/22/51

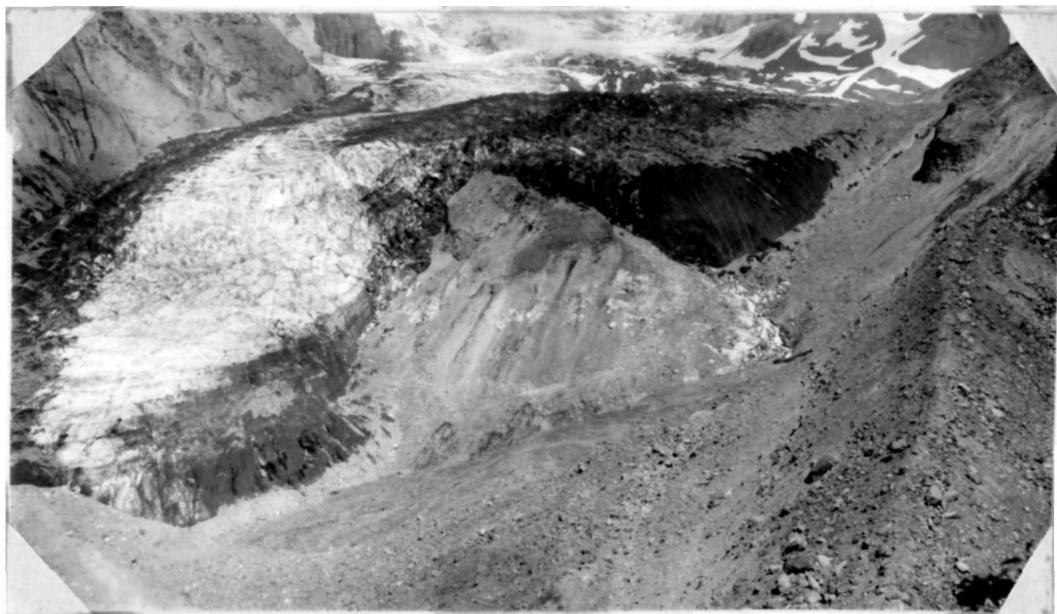


Ice face near cross-profile No. 1 Photo No. 4668
8/30/53



Ice face near cross-profile No. 1

Photo No. 5377
8/30/56



Ice face near cross-profile No. 1

Photo No. 5792

8/30/57

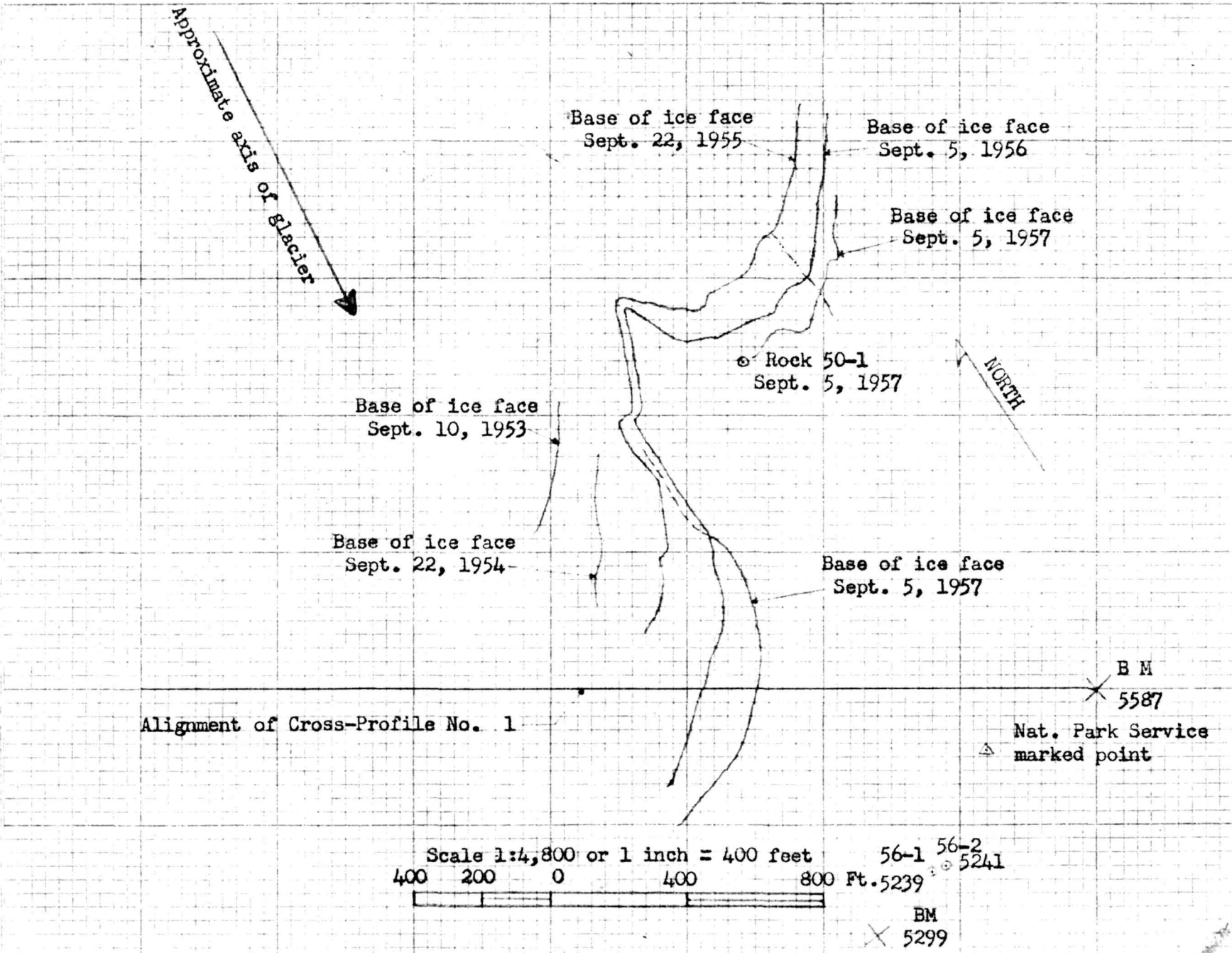
NISQUALLY GLACIER

MOVEMENT OF ICE FACE NEAR CROSS-PROFILE NUMBER 1

FIGURE 1

(DO NOT USE THIS SPACE EXCEPT FOR BINDING PURPOSES)

Sheet No. _____ of _____ sheets. Prepared by _____ Date _____ Checked by _____ Date _____



Scale 1:4,800 or 1 inch = 400 feet

400 200 0 400 800 Ft. 5239

56-1 56-2
5241

B M 5299

Movement of marked rocks near Cross-Profile No. 1

The movement of marked rocks on the stagnant ice near the east side of the glacier was negligible this past year as has been the case for several previous years.

The position and elevation of two rocks 56-1 and 56-2, located in the saddle between the lower nunatak and the east lateral moraine, was determined in 1956. The 1957 measurements indicate the movement to be negligible. Rock 56-2 lowered about 1.5 feet while rock 56-1 remained about the same as the 1956 measurement. The position of rock 50-1, found near the top of the upper nunatak in 1957, was determined by intersection. The last previous measurement of rock 50-1 was in 1951 when it was found to be about 150 feet downstream from the alignment of cross-profile No. 2. The approximate movement for the 6 year period was 1,520 linear feet.

Cross-Profile No. 1

The lowering of the glacier surface on the east side of the valley continued at about the same rate as during the past few years. (See Fig. 2) The trough has been moved 300 feet eastward by the advancing ice face since 1953. From 1956 to 1957 the surface of the glacier continued to rise on the west side of the valley, with the largest increase between stations 1,100 and 1,400 of the cross-profile alignment. From station 1,400 westward the increase ranged from 5 to 10

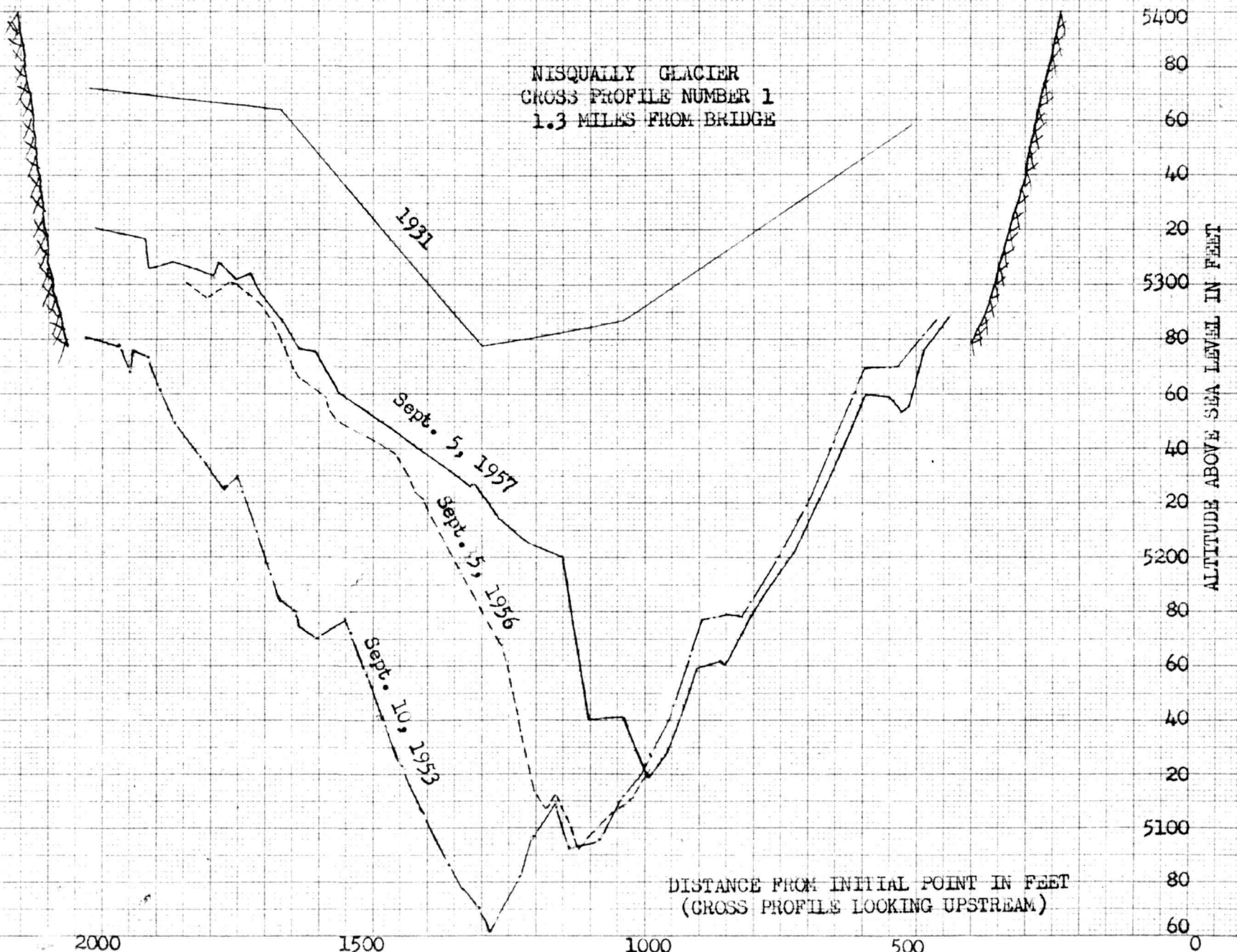


FIGURE 2

feet, which is somewhat less in this area than in the previous year. The over-all increase in mean altitude was 27 feet (see Table 1).

From 1953 to 1957 the glacier surface on the west side of the valley raised slightly more than half the amount it had lowered since 1931. Photographs on Plates 1 and 2 provide a comparison of the appearance of the glacier in the area of the upper nunatak between the years 1951, 1953, and 1956 and 1957. These photos were taken from a point on the ridge downstream from BM 5587.

Snow and ice stake-melt measurement

For all practical purposes, it appears that the attempted stake-melt measurements were a failure. This was due to the fact that we were unable to drill in the ice beyond a depth of 4 feet even though extensions were available for the hand-operated ice drill. Whether or not this was the result of lack of know-how or the fault of the drill is still not known. At a depth of slightly over three feet, the drill would jam, probably a result of the ice chips packing or freezing. Many attempts were made to clean the hole of ice chips after various depths of drilling but we were still unable to go beyond 4 feet in depth.

Two stakes were placed near the 6,150 foot elevation, one in snow and one in ice. Two stakes also were placed in the ice at approximately the 5,200-foot elevation. The two

stakes at the 6,150-foot elevation were checked by personnel of the National Park Service 5 days later and it was found that the melt was approximately 30 inches both in snow and ice. On August 13th it was observed that all of the stakes were down on the ice.

The attempted stake-melt measurements were intended for determination of the amount of ablation in the areas on the glacier where the surface has been rising. Stakes placed deep enough would also provide a more accurate means of determining the rate of surface movement which could then be correlated with many years of measurements of marked rocks.

Cross-Profile No. 2

Two measurements were made 53 days apart on cross-profile No. 2 during the summer of 1957. The first measurement was made on July 11th and 12th and the second measurement was made on September 3.

At the time of measurement on July 12, most of the glacier in this area was covered with winter snow. Rocks and debris were exposed between stations 500 and 600 and between stations 800 and 900 along the cross-profile. Near station 1,330, the snow cover appeared to be about 3 feet in depth. This is near the west edge of the rifted area which is covered with debris. Rod measurements were made in a crevasse of what appeared to be the snow cover above the ice near stations 1,600 and 1,700 and it was found to range from 8 to 12 feet in depth.

NISQUALLY GLACIER
CROSS PROFILE NUMBER 2
1.8 MILES FROM BRIDGE

B M
X
6165

40
70
6100

80

60

40

20

ALTIITUDE IN FEET

6000

30

60

40

20

5900

80

60

FIGURE

3

Sept. 3, 1957
July 11 & 12, 1957

Sept. 19, 1955

Aug. 31, 1948

DISTANCE FROM INITIAL POINT IN FEET
(CROSS PROFILE LOOKING UPSTREAM)

2000

1500

1000

500

0

Only scattered patches of snow covered the glacier in this area on September 3rd. Some of the larger pockets and crevasses between stations 600 and 1,300 still contained packed snow.

The surface of the glacier continued to rise in this area, although it was not so pronounced as in previous years. Figure 3 provides a comparison of the glacier surface for the two measurements in 1957 and the surfaces of 1955 and 1948. The 1956 surface was omitted from the graph because of its proximity to the September 3, 1957 surface. The increase in mean altitude between August 21, 1956 and September 3, 1957 was only 2 feet (See Table 1).

The lowering of the glacier surface for the 47-day period, August 21, to Oct. 7, 1956, amounted to 6 feet in mean altitude and for the 53-day period, July 12 to September 3, 1957, amounted to 7 feet in mean altitude. This may indicate approximately the same rate of melt for snow during the summer months as for glacier ice during the fall months providing the inflow of ice was at the same rate during both periods.

Movement of marked rocks near Cross-Profile No. 2

The positions of one previously marked and two newly marked rocks were determined on July 12, 1957. On September 3, 1957, the positions of nine previously marked rocks were determined. At the time of measurements on July 12, all but one of the marked rocks were covered with snow.

The movement of marked rocks between measurements are shown in Figure 4 in relation to the alignment of Cross-Profile No. 2.

The following tabulation was prepared to show the movement of marked rocks between measurements, along with the computed annual rate of movement.

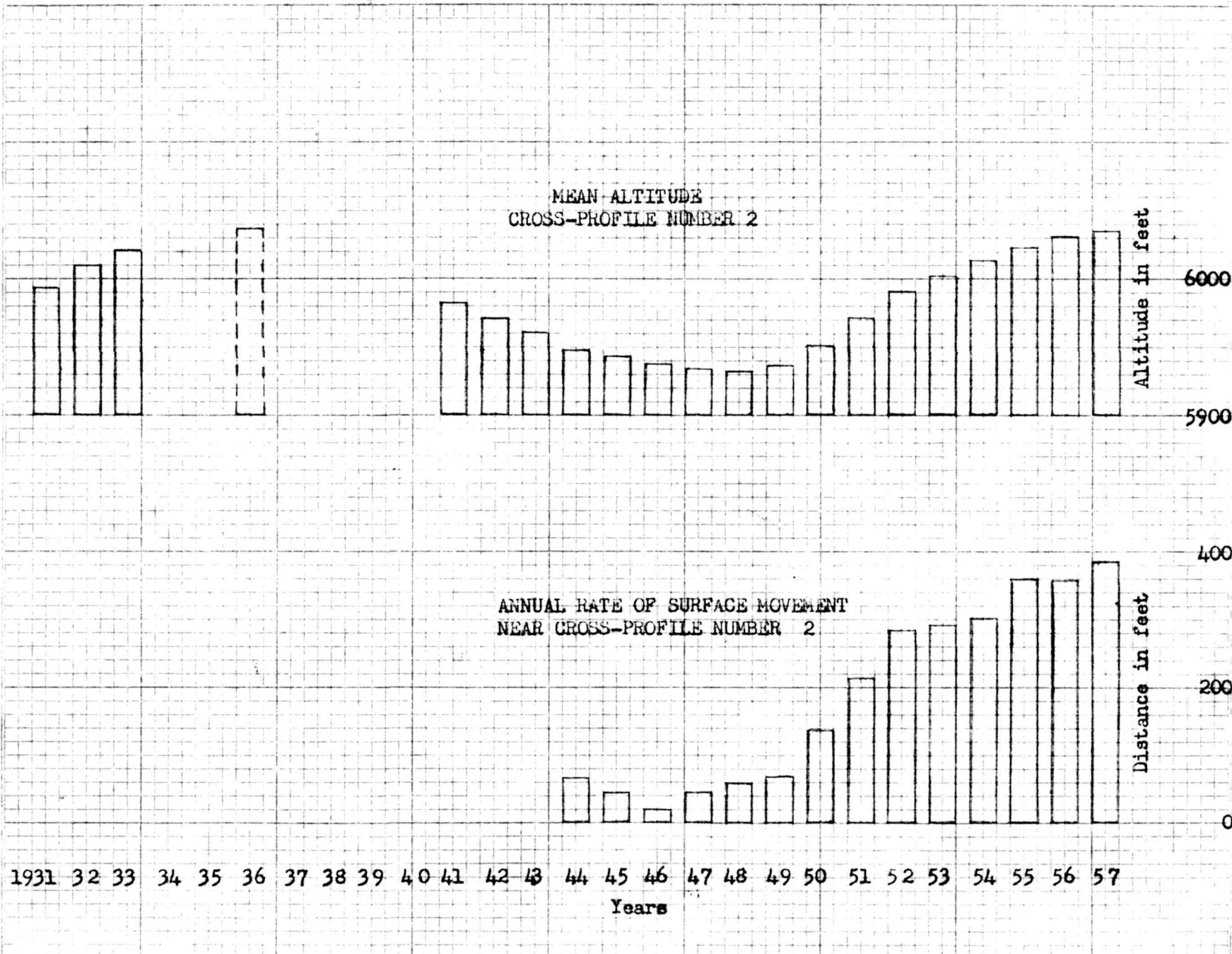
Movement of marked rocks near Cross-Profile No. 2

Date of measurement	Rock number	Number of days between measurements	Movement in feet	Rate of movement per year
Aug. 26, 1943	13	0	0	0
Sept. 24, 1944	13	396	70	65
Aug. 22, 1945	13	322	40	44
Aug. 28, 1946	13	372	20	20
Sept. 11, 1947	12	380	46	44
Aug. 31, 1948	12	354	57	59
Aug. 22, 1949	47-1	355	65	67
Sept. 14, 1950	47-1	389	150	138
Aug. 21, 1951	47-1	340	200	216
Sept. 5, 1952	50-2	381	294	283
Sept. 11, 1953	52-2	372	294	290
Sept. 20, 1954	52-3	375	310	303
Sept. 19, 1955	54-3	365	360	360
Aug. 21, 1956	55-1	334	315	358
Oct. 7, 1956	55-1	47	57	445
July 12, 1957	55-1	278	291	382
Sept. 3, 1957	57-2	53	60	413

Figure 5 provides a comparison of the maximum annual rate of surface movement with fluctuation of mean altitude at cross-profile No. 2. The rate of surface movement was decreasing during the period the glacier was shrinking except for the years 1947 and 1948. The surface of the glacier had been rising three-quarters of a mile upstream since September 1944, which may have been reflected at Cross-Profile No. 2 and caused the increase in surface movement between 1946 and 1947.

Sheet No. _____ of _____ sheets. Prepared by _____ Date _____ Checked by _____ Date _____

GEOLOGICAL SURVEY WATER RESOURCES DIVISION
COMPARISON OF ANNUAL RATE OF SURFACE MOVEMENT WITH MEAN ALTITUDE AT CROSS-PROFILE NUMBER 2
FIGURE 5
Plate Number District



The above table shows that the annual rate of surface movement was slightly more in 1957 than in either of the years 1955 and 1956.

Rock 55-1 was found to move 663 feet during the 659 day period between 1955 and 1957 while rock 56-2 was found to move 420 feet during the 378 day period between 1956 and 1957. This would indicate about a 10 percent increase in the rate of surface movement for 1957 over 1956.

The rate of surface movement as determined by measurements of marked rocks probably should be used with caution because of rolling, slippage, and melt. However, the measurements indicate there is a variation in the rate of movement annually and also between the summer and winter months.

Cross-Profile No. 3

The 1957 surface was below the 1956 surface for almost the entire length except for a 90 foot reach near the west side of the glacier (See Fig. 6) The lowering of the glacier surface averaged about 15 feet between August 22, 1956 and September 4, 1957. The lowering ranged from about 7 feet near station 400 to about 30 feet near station 1,300. The glacier surface was at the same mean altitude between station 100 and 950 for the years 1955 and 1957. (See Table 1) During this same period, there was an increase of 12 feet in mean altitude between stations 950 and 1,800.

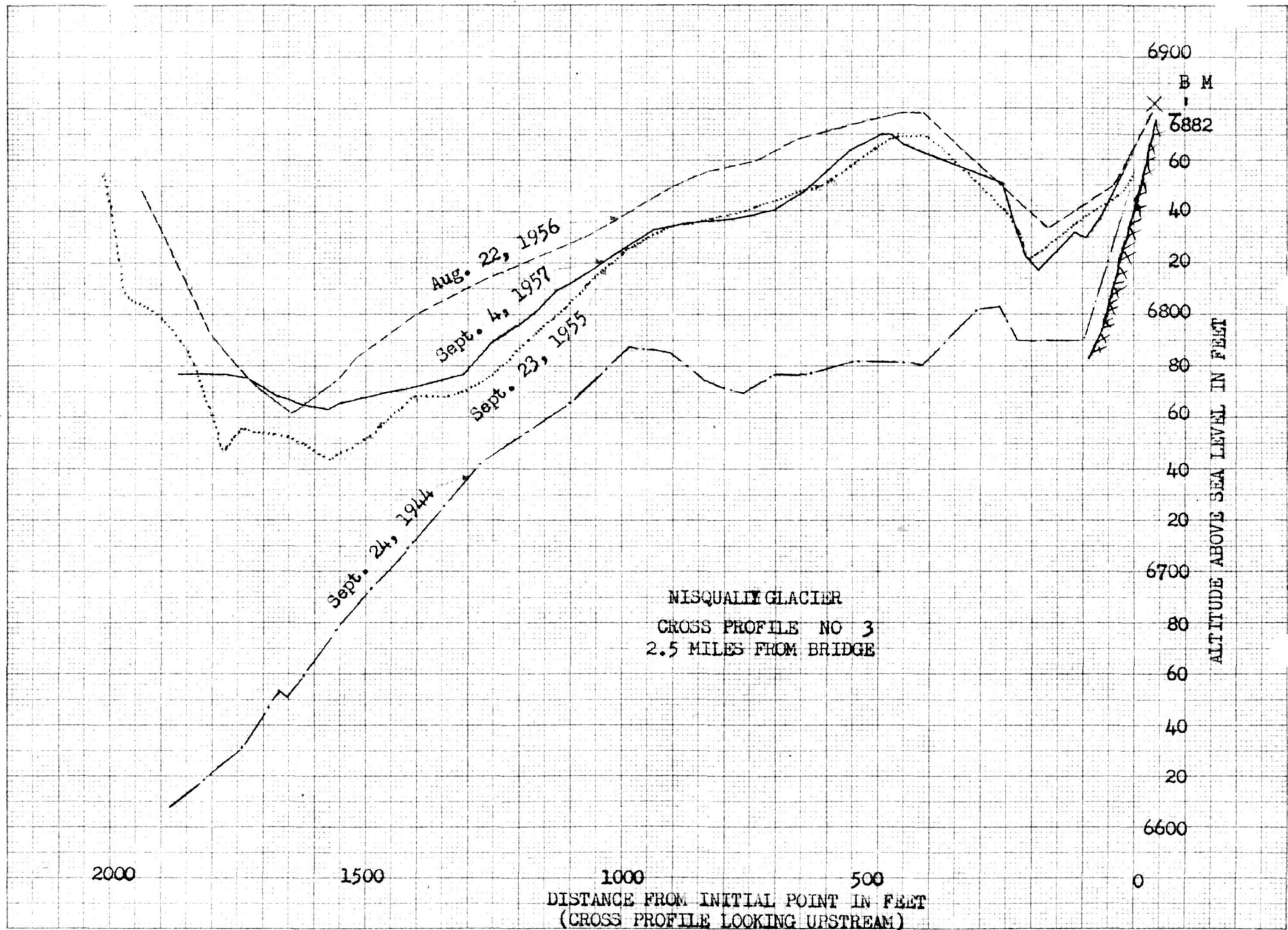
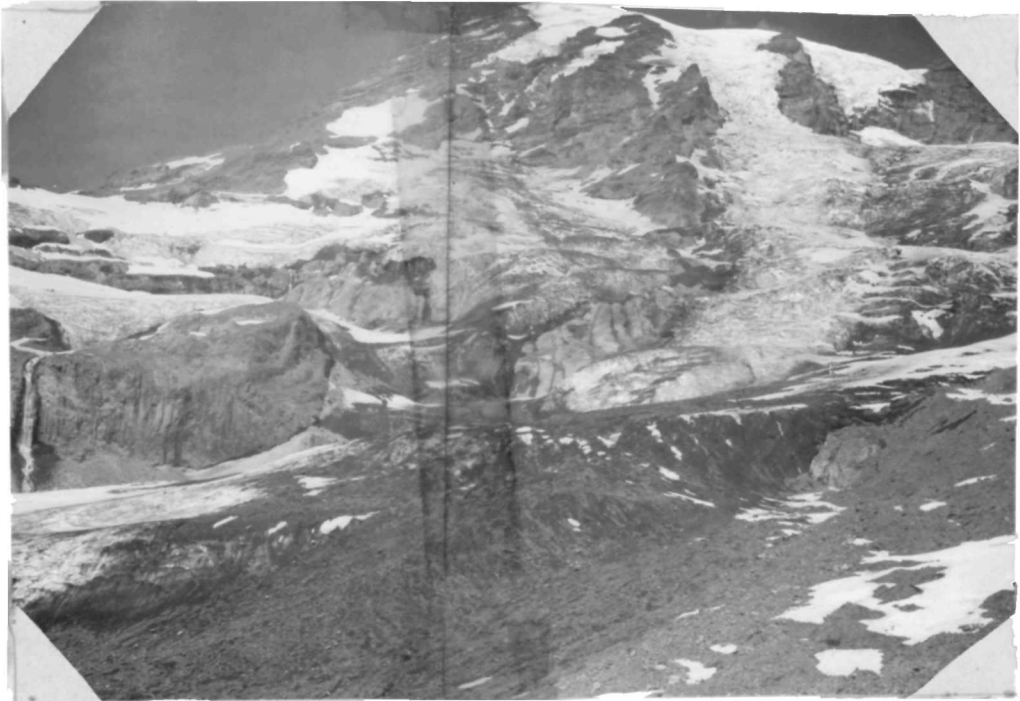


FIGURE 6

Photographs in plates 3 and 4 taken from BM 6428 on the lateral moraine, provide a comparison of the appearance of the Wilson glacier and upper Nisqually glacier in the years 1945, 1948, 1949, and 1957. The photos for the year 1945 show that the Wilson glacier was almost completely separated from the Nisqually glacier except for the extreme lower portion near the exposed large rock shoulder. Rock ledges are exposed along the lower part of the Wilson glacier and also along the upper part between the Wilson and Nisqually glaciers. Portions of these rock ledges appear as late as 1949. The lower edge of the white ice stream on the Nisqually glacier, shown near the center of the 1945 photo, is at approximately the 7,000 foot elevation. This is only slightly upstream from the alignment of Cross-Profile No. 3. The surface of the glacier in this area, measured at cross-profile No. 3 showed an increase in mean altitude in 1945 and continued to rise until 1952. The surface of the glacier at the 6,000 foot elevation, about three-quarters of a mile downstream, started rising in 1949 and has continued to rise ever since. It would appear from the comparison of the photos and also the cross-profile measurements that the increase in ice flow from 1945 to 1949 was mostly from the accumulation area on the Nisqually glacier. Cross-Profile No. 3 was not measured in 1950 because of the large crevasses and rifted areas which made travel difficult and hazardous, but it is believed that the period between 1949 and 1950 was the first year the Wilson glacier contributed any appreciable amount to the advancing ice wave.



Showing Wilson & Upper Nisqually Glaciers Photos 3043 & 3044
8/22/45



Showing Wilson & Upper Nisqually Glaciers Photos 3078 & 3079
8/30/48



Showing Wilson & Upper Nisqually Glaciers Photos 5426 & 3425
8/28/49



Showing Wilson & Upper Nisqually Glaciers Photos 5778 & 5779
8/30/57

A tabulation of winter precipitation (November through April) recorded at Longmire, Washington from November 1914 to April 1957 shows a mean of 57.24 inches for the 43 year record. A tabulation of the deviation from the mean for periods of varying lengths for this station is as follows:

Period	No. of winters	Average winter precip. for the period	43 year average winter precip.	Percent of mean
1916-1921	6	67.56	57.24	118
1922-1931	10	54.80	57.24	95
1932-1935	4	71.75	57.24	125
1936-1944	9	48.95	57.24	85
1945-1951	7	63.44	57.24	111
1951-1957	6	59.64	57.24	104

If winter precipitation is an important factor contributing to the fluctuation of the glacier, and if the ratio of precipitation on the area of accumulation is in direct proportion to that recorded at Longmire, then the amount corresponding to the 43 year average of 57.24 inches of winter precipitation appears to be somewhat less than that needed to keep the glacier in equilibrium for this period. Although the lower part of the glacier has been gradually shrinking for nearly a hundred years, there may have been periods of short duration when waves of ice moved down the upper part of the glacier similar to the one measured by Arthur Johnson from 1945 to the present date. Cross-profile measurements and a comparison of maps made in 1931 and 1936 indicate some increase in the glacier surface near the 6,000 foot elevation between the years 1932 and 1936 which corresponds to the 4-year period

of high winter precipitation 1932 through 1935 as recorded at Longmire, Washington. One other period of high winter precipitation recorded at Longmire occurred during the years November 1915 through April 1921. Glacier measurements for this period are not available, however, a comparison of photographs, if available, may show some significant changes from about the 5,200 foot elevation upstream.

SUMMARY

Recession of the terminus at the 4,500 foot elevation continues as in the past.

The advance of the ice face near the 5,100 foot elevation continues; - however the amount of advance is less than in either of the two previous years.

The surface of the glacier at Cross-Profile No. 1 continues to shrink on the east side of the valley and rise on the west side.

The surface of the glacier at Cross-Profile No. 2 continues to rise; - however the amount is considerably less than in previous years.

The rate of surface movement at Cross-Profile No. 2 was slightly greater in 1957 than in 1956. The rate of surface movement during the summer appears to be more than during the winter.

The 1957 surface of the glacier at Cross-Profile No. 3 was below the 1956 surface on an average of 15 feet. The continued rise in the glacier surface from 1944 ended in 1951. The total increase in mean altitude between the years 1944 and 1951 amounted to 83 feet. The 1957 surface is below the 1951 surface on an average of 16 feet.

SUMMARY OF CHANGES AT CROSS PROFILES

Cross-profile 1

Date	Sta. 500-900		Sta. 900-1600		Sta. 1600-2000		Sta. 500-2000	
	Mean Alt. (ft)	Chge. (ft)	Mean Alt. (ft)	Chge. (ft)	Mean Alt. (ft)	Chge. (ft)	Mean Alt. (ft)	Chge. (ft)
a/ 1931	5304		5283		5360		5309	
b/ 1932							5305	- 4
c/ 1933		- 28		- 1		- 6	5323	+18
d/ 1936	5276		5282		5354		5300	-23
		- 13		-50		-39		-37
Aug. 26, 1941	5263		5232		5315		5263	
		- 1		-16		+ 1		- 8
Aug. 21, 1942	5262		5216		5316		5255	
		- 4		-14		-14		-12
Aug. 26, 1943	5258		5202		5302		5243	
		- 2		-16		-14		-11
Sept. 18, 1944	5256		5186		5288		5232	
		- 8		-14		-18		-14
Sept. 11, 1946	5248		5172		5270		5218	
		-10		-19		-22		-17
Sept. 2, 1948	5238		5153		5248		5201	
				- 4		+ 1		- 3
Sept. 22, 1949	5238		5149		5249		5198	
		- 5		-13		- 2		- 7
Sept. 15, 1950	5233		5136		5247		5191	
		- 4		- 6		- 6		- 5
Sept. 5, 1951	5229		5130		5241		5186	
		- 3		- 6		- 6		- 6
Sept. 9, 1952	5226		5124		5235		5180	
		- 2		- 9		- 3		- 5
Sept. 10, 1953	5224		5115		5232		5175	
		- 1		- 5		+ 4		- 2
Sept. 22, 1954	5223		5110		5236		5173	
		- 5		+10		+25		+10
Sept. 22, 1955	5218		5120		5261		5183	
		- 3		+50		+28		+22
e/Sept. 5 & 6 1956	5215		5170		5289		5205	
		- 1		+31		+14		+27
Sept. 5, 1957	5214		5201		5303		5232	

a/and d/ Profiles measured from maps made in 1931 and 1936

b/ Mean altitude computed between stations 513-2000

c/ Mean altitude computed between stations 511-1992

e/ Mean altitude computed between stations 500-1838

Cross-profile 2

Date	Sta. 400 - 1200		Sta. 1200 - 2000		Sta. 400 - 2000		
	Mean Alt. (ft)	Chge. (ft)	Mean Alt. (ft)	Chge. (ft)	Mean Alt. (ft)	Chge. (ft)	
	1931	6005		5985		5995	
Sept. 30, 1932	a/ 6017	+12		6008	+23	6013	+18
July 31, 1933	b/ 6039	+22		6032	+24	6036	+23
	c/ 1936	+ 6		6027	- 5	6036	0
	d/ 1940	-35		5982	-45	5996	-40
Aug. 26, 1941	6006	- 4		5959	-23	5983	-13
Aug. 21, 1942	5998	- 8		5944	-15	5971	-12
Aug. 26, 1943	5989	- 9		5935	- 9	5962	- 9
Sept. 24, 1944	5979	-10		5916	-19	5948	-14
Aug. 22, 1945	5977	- 2		5910	- 6	5944	- 4
Aug. 28, 1946	5971	- 6		5906	- 4	5939	- 5
Sept. 11, 1947	5966	- 5		5903	- 3	5934	- 5
Aug. 31, 1948	5964	- 2		5899	- 4	5932	- 2
Aug. 22, 1949	5962	- 2		5912	+13	5937	+ 5
Sept. 14, 1950	5966	+ 4		5938	+26	5952	+15
Aug. 21, 1951	5977	+11		5968	+30	5972	+20
Sept. 5, 1952	5991	+14		5989	+21	5990	+18
Sept. 11, 1953	6008	+17		5997	+ 8	6003	+13
Sept. 20, 1954	6016	+ 8		6012	+15	6014	+11
Sept. 19, 1955	6031	+15		6016	+ 4	6023	+ 9
Aug. 21, 1956	6039	+ 8		6024	+ 8	6032	+ 9
Oct. 7, 1956	6036	- 3		6015	- 9	6026	- 6
		+13			+17		+15

Cross-profile 2
con't.

	Sta. 400 - 1200		Sta. 1200 - 2000		Sta. 400 - 2000	
	Mean		Mean		Mean	
	Alt.	Chge.	Alt.	Chge.	Alt.	Chge.
	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
July 11						
12, 1957	6049		6032		6041	
		- 4		- 9		- 7
Sept. 3, 1957	6045		6023		6034	
a/	Mean altitude computed between stations 400 and 1900					
b/	Mean altitude computed between stations 400 and 1800					
c/ and d/	Profiles measured from maps made in 1936 and 1940					

Cross-profile 2-A

Date	Sta. 400-1100		Sta. 1100-1800		Sta. 1800-2500		Sta. 400-2500	
	Mean Alt. (ft)	Chge. (ft)	Mean Alt. (ft)	Chge. (ft)	Mean Alt. (ft)	Chge. (ft)	Mean Alt. (ft)	Chge. (ft)
Sept. 1, 1948	6378		6445		6465		6429	
		+21		+28		+24		+25
Sept. 24, 1949	6399		6473		6489		6454	
		+17						
Sept. 14, 1950 ^{a/}	6416		-		-		-	
		+12		+38		+11		+36
Aug. 23, 1951	6328		6511		6500		6480	
		+ 5		- 6		- 4		- 2
Sept. 15, 1952	6433		6505		6496		6478	
		0		- 5		- 5		- 3
Sept. 15, 1953	6433		6500		6491		6475	
		+12		+14		+ 4		+10
Sept. 21, 1954	6445		6514		6495		6485	
		+ 7						
Sept. 23, 1955 ^{b/}	6452		-		-		-	

a/ Measured only to station 1,170
b/ Measured only to station 1,100

Cross-profile 3

Date	Sta. 100 - 950		Sta. 950 - 1800		Sta. 100 - 1800	
	Mean Alt. (ft)	Chge. (ft)	Mean Alt. (ft)	Chge. (ft)	Mean Alt. (ft)	Chge. (ft)
Aug. 21, 1942	6791		6713		6752	
		+ 4		+ 6		+ 5
Aug. 26, 1943	6795		6719		6757	
		- 11		- 5		- 8
Sept. 24, 1944	6784		6714		6749	
		+ 5		+ 8		+ 7
Aug. 22, 1945	6789		6722		6756	
		+13		+ 6		+ 9
Aug. 22, 1946	6802		6728		6765	
		+ 7		+13		+10
Sept. 12, 1947	6809		6741		6775	
		+18		+16		+17
Sept. 1, 1948	6827		6757		6792	
		+22		+15		+19
Aug. 24, 1949	6849		6772		6811	
		+13		+31		+21
Aug. 22, 1951	6862		6803		6832	
		-12		-25		-18
Sept. 4, 1952	6850		6778		6814	
		-17		- 1		- 9

Table 1 con't.

	Cross-profile 3					
	Sta. 100 - 950		Sta. 950 - 1800		Sta. 100 - 1800	
	Mean Alt. (ft)	Chge. (ft)	Mean Alt. (ft)	Chge. (ft)	Mean Alt. (ft)	Chge. (ft)
Sept. 14, 1953	6833		6777		6805	
		+15		+ 1		+ 8
Sept. 4, 1954	6848		6778		6813	
		- 2		- 4		- 3
Sept. 23, 1955	6846		6774		6810	
		+14		+28		+21
Aug. 22, 1956	6860		6802		6831	
		-14		-16		-15
Sept. 4, 1957	6846		6786		6816	

