

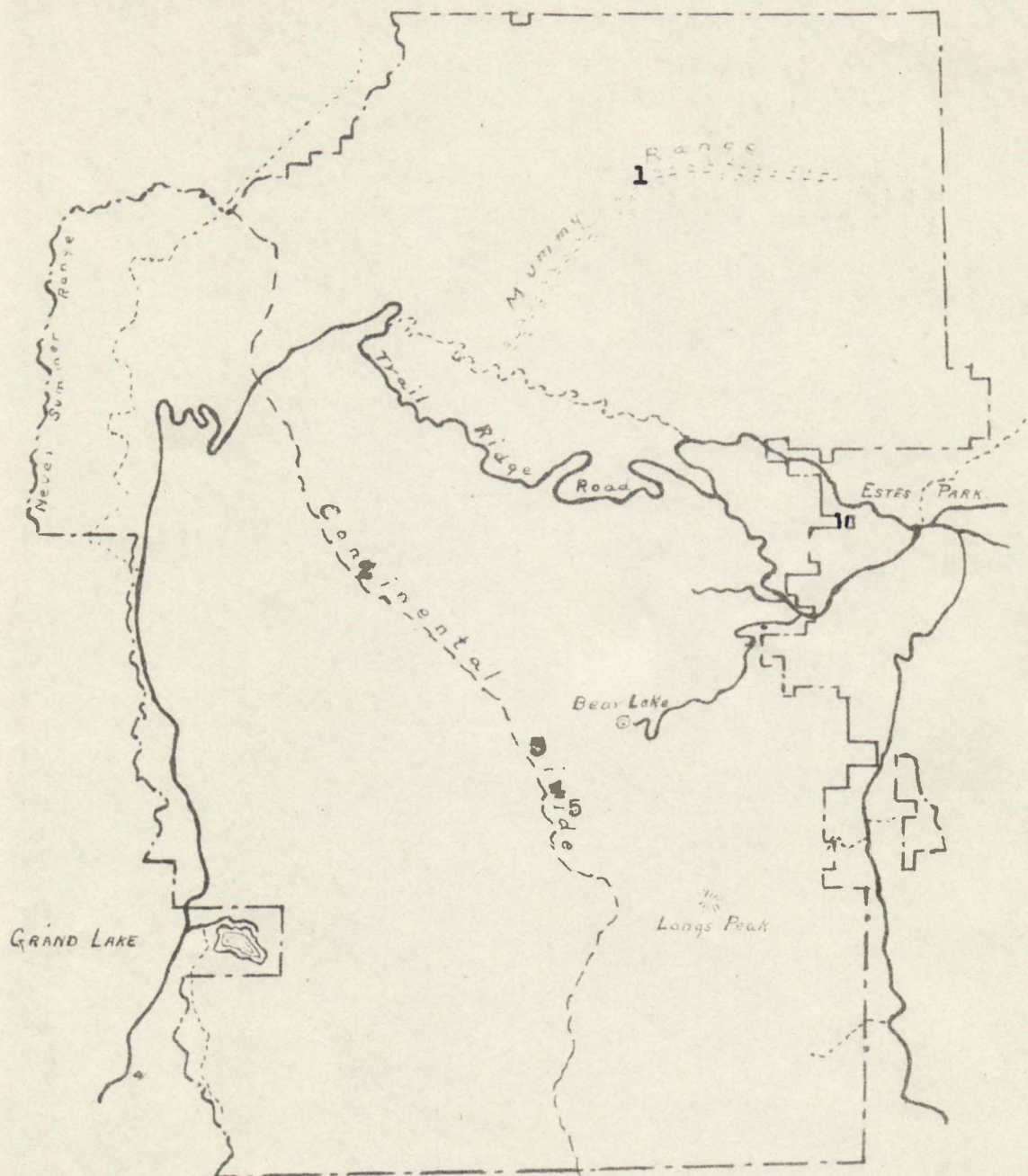
1955 GLACIER MEASUREMENT REPORT

ROCKY MOUNTAIN NATIONAL PARK
Estes Park, Colorado

By

J. Herbert Heger and Edwin C. Alberts
Park Naturalists

December 1, 1955



- Key: 1 - Rowe Glacier
2 - Sprague Glacier
3 - Tyndall Glacier
4 - Andrews Glacier
5 - Taylor Glacier

Glaciers of Rocky Mountain National Park



UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

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Introduction

Since 1932, Tyndall and Andrews Glaciers have been examined except in 1936 and 1943. These glaciers were chosen because they are relatively accessible compared to the other three Park glaciers: Rowe, Sprague, and Taylor. These glaciers were also chosen because they represent two extremes: Tyndall has a very steep angle with large recessional moraines at its base, while Andrews has a gentle slope with a large lake at its terminus.

The 1955 glacier measurement trip was made on August 26 in charge of Mr. Heger, who was assisted by Mr. Hornbein and four visitors.

Early in the morning of August 26 heavy clouds were down in the gorge and on the tops of the peaks, but by 9:30 a.m. all of this had lifted and the rest of the day was bright and sunny. Weather-wise the trip was made under excellent conditions.

Methods of Measurement

As has been mentioned in previous reports, methods of "measurement" are inaccurate for a number of reasons. First, determination of the actual snout of the glacier is rather difficult. Second, the two points from which measurements are made to the snout, particularly on Tyndall, have very likely shifted since 1932. Third, the snout is the apex of an angle measured to X and X' at Tyndall Glacier, and the apex could be shifted one way or the other, producing variations in the distance between the snout and stations X and X'. The most valuable contribution of the measurement project is the fixed photographic positions whereby one can compare the 1955 pictures with other years. These fixed photographic positions are rather stable, and, therefore, they are the best means of gathering data on the status of the glaciers.

It has been suggested in previous reports that the only truly valuable means of measurement would be by means of a plane table and topographic mapping of the glaciers' bases, but this would cost considerably more than our resources permit.

Tyndall Glacier

By the time the party reached the snout of Tyndall Glacier, the weather had cleared up, and a preliminary survey seemed to indicate that there was little change in the glacier from the 1954 season. For example, the 1954 distance from station X to the ice was 66 feet, and in 1955 the distance was 75 feet. In 1954 the distance from X' to ice was 96 feet and in 1955 it was 85 feet.

The photographs (1954 and 1955) are very comparable, and one will note that there is little change in Tyndall Glacier. The snout, for example, is located near the same rocks. The north end of the glacier had changed very little.

However, investigation of the ice cave that existed last year showed that the cave had increased in size and in beauty. This cave is located on the southeast side of the glacier, immediately adjoining the cliff of Halletts Peak. There were three or four entrances to the cave, all of which were about normal door height. The cave was about 200 feet long and 40 feet wide, and approximately 8 to 10 feet in height at its highest point, tapering back to one or 2 feet near to the wall of the mountain.

Particular notice was made of a morainal deposit that has accumulated to the east and southeast of the rocks X and X'. Much of this accumulation is of material naturally sloughing off from Halletts Peak. Photographs, of course, will indicate this large accumulation and possible additional glacial build-up of this moraine.

In 1953, Mr. Hornbein set a row of stakes across the center of Tyndall Glacier from two fixed points. In 1954, he climbed up the glacier by means of crampons and ice axe, but was unable to find any trace of these markers. This year he again examined the surface of the glacier; again there was no sign of the stakes. However, he continued on up the glacier to the bergschrund area of Tyndall Glacier and found it much larger than in 1954. The width of the bergschrund was 25 feet or so in places with a depth of from 100 to 150 feet. Although apparently little had changed since 1954, the increased size of the bergschrund and the ice cone suggests that wasting of the glacier is going on at a steady pace.

Andrews Glacier

The first notable observation at Andrews Glacier was that crevasses, so evident in 1954, were completely covered by snow and ice. It was also noted that at the point where the crevasses had been in 1954 a stream of water was pouring from beneath the ice. About 100 yards from the snout another stream of water is spouting out somewhat like an artesian well. Possibly beneath this point, underlying the ice, a barrier of morainal material forms a "lake" which is overflowing. Since the ice is apparently melting rather rapidly and causing the "lake" to overflow, the water is forced up and over this barrier through the ice. The water spouted up about one foot in height. Reference to Plate 16 and 17 will illustrate this phenomenon.

At the snout it was noted that the tarn lake was higher than in 1954. Point X' was about 6 inches under water. It is normally above water about 6 inches. The delta also had several inches of water over it.

In 1954, the distance from X''' to the ice was 92 feet; and in 1955, the distance was 61 feet. In 1954, the distance from station X' was 160 feet; in 1955, that distance was 172 feet. We should repeat that these measurements are rather inaccurate because of the difficulty in determining the true "snout" at the apex of the angle from X' and X'''. The photographs suggest that the glacier has changed little as far as the retreat or advance of the snout is concerned. However, presence of the "well" suggests under-ice meltings.

It is curious to note, however, that the 1954 crevasses disappeared. There was slight evidence of a few smaller new crevasses, some quite small ones being noted longitudinal to the glacier. These were possibly the result of abrasion by water coursing down the glacier and not true crevasses. The crevasses noted in 1954, however, were definitely the result of bending of the ice as it descended a rock obstruction.

Resume

Both Tyndall and Andrews Glaciers, although apparently little changed from 1954, give evidences of much internal wasting--ice coves, "artesian well," etc. The photographs, if carefully examined, show a slight loss of volume as well.

TABLE I
WEATHER STATISTICS

<u>MONTH</u>	<u>TEMPERATURES</u>				<u>PRECIPITATION</u>	
	<u>Mean Max.</u>	<u>Mean Min.</u>	<u>Days 90° or over</u>	<u>Days 32° or lower</u>	<u>Total</u>	<u>Max. Snow on ground</u>
<u>Estes Park</u>						
July 1954	81.5	49.5	0	0	2.33	0
August 1954	77.4	44.4	0	0	1.22	0
September 1954	72.0	40.0	0	4	2.31	0
1955 "Season"						
October 1954	60.6	33.3	0	13	.54	5 "
November 1954	52.2	24.5	0	24	.41	5 "
December 1954	42.1	20.8	0	26	.39	2 "
January 1955	36.7	14.0	0	31	.24	4.5"
February 1955	34.7	9.5	0	27	.31	2 "
March 1955	42.3	17.9	0	29	.68	3.5"
April 1955	55.9	25.5	0	24	.02	0
May 1955	63.5	33.8	0	15	2.26	0
June 1955	67.7	37.6	0	1	2.11	0
July 1955	79.0	45.8	0	0	2.01	0
August 1955	76.5	47.6	0	0	3.43	0
September 1955	71.4	37.2	0	6	.40	0
1955 "Season"						
Means & Totals	56.9	29.0	0	196	12.80	-

<u>Grand Lake</u>						
July 1954	77.5	39.4	1	0	2.82	0
August 1954	74.5	34.2	0	14	2.80	0
September 1954	69.6	31.1	0	16	2.49	0
1955 "Season"						
October 1954	58.8	22.5	0	27	.67	5 "
November 1954	48.4	15.1	0	30	1.02	8 "
December 1954	33.3	-4.0	0	31	1.14	17 "
January 1955	28.3	-2.1	0	31	1.58	28 "
February 1955	29.1	-3.8	0	28	1.10	32 "
March 1955	38.0	5.5	0	31	1.99	44 "
April 1955	47.8	13.5	0	30	.20	33 "
May 1955	58.9	25.3	0	28	1.65	1.5"
June 1955	66.0	30.0	0	23	2.03	0
July 1955	76.9	33.4	0	13	1.52	0
August 1955	75.8	38.4	0	4	2.26	0
September 1955	72.5	27.3	0	23	.84	0
1955 "Season"						
Means & Totals	52.8	16.8	0	299	16.00	-

TABLE I-A
YEARLY PRECIPITATION RECORDS
1948 - 1955

<u>Year</u>	<u>Estes Park</u>	<u>Grand Lake</u>
1955 Oct. 1954 - Sept. 1955, inc.	12.80"	16.00"
1954 Oct. 1953 - Sept. 1954, inc.	9.85"	17.59"
1953 July 1952 - Sept. 1953, inc.	15.38"	26.43"
1952 July 1951 - June 1952, inc.	17.41"	27.63"
1951 Aug. 1950 - June 1951, inc.	12.00"	16.01"
1950 Aug. 1949 - July 1950, inc.	10.15"	15.27"
1949 Aug. 1948 - July 1949, inc.	20.04"	19.16"
1948 Sept. 1947 - July 1948, inc.	15.10"	21.10"

Table II

Tyndall Glacier

<u>Year</u>	<u>Station X to "Ice"</u>	<u>Station X' to "Ice"</u>
1932	-	30'8"
1933	-	63'4"
1934	-	72'5"
1935	-	38'6"
1936	-	No measurements
1937	-	196'9"
1938	-	62'4"
1939	-	105'4"
1940	-	56'0"
1941	-	No measurements
1942	-	0'0"
1943	-	No measurements
1944	-	56'3"
1945	-	54'4"
1946	-	112'11"
1947	-	5'0" (estimated)
1948	-	260'0"
1949	-	106'0"
1950	94'	110'0"
1951	3'	10'0"
1952	54'	50'0"
1953	60'	90'0"
1954	66'6"	96'6"
1955	75'	85'0"

Table III

Andrews Glacier

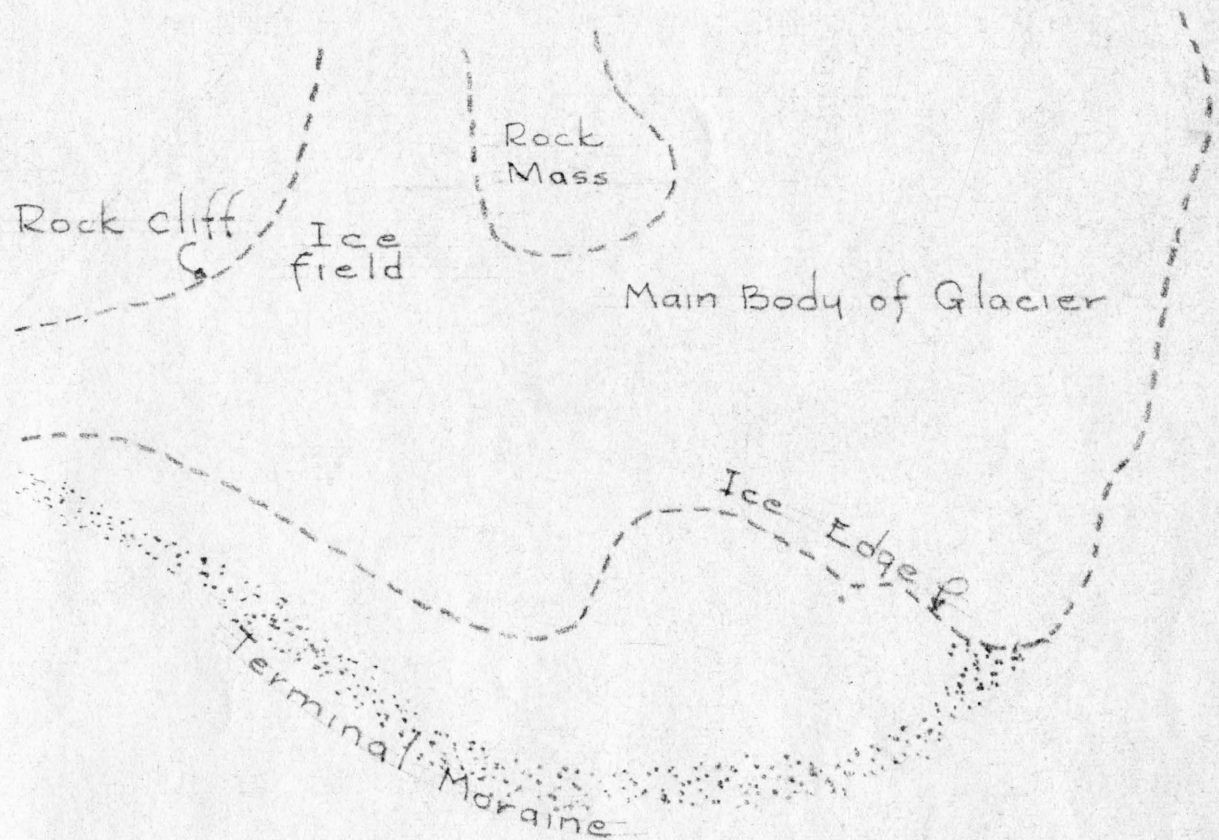
<u>Year</u>	<u>Station X' to "Ice"</u>	<u>Station X''' to "Ice"</u>
1932	48'7"	-
1933	58'10"	-
1934	139'0"	-
1935	66'0"	-
1936	No measurements	-
1937	96'10"	-
1938	32'3"	48'11"
1939	92'0"	23'0"
1940	170'0" (estimated)	16'9"
1941	212'5"	54'3"
1942	155'8"	49'1"
1943	No measurements	No measurements
1944	253'0"	79'2"
1945	210'6"	65'7"
1946	224'9"	60'8"
1947	201'9"	66'0"
1948	210'0"	56'0"
1949	164'0"	64'0"
1950	194'0"	68'0"
1951	165'0"	63'0"
1952	142'0"	81'0"
1953	167'0"	46'0"
1954	160'0"	92'6"
1955	172'0"	61'0"

TABLE IV

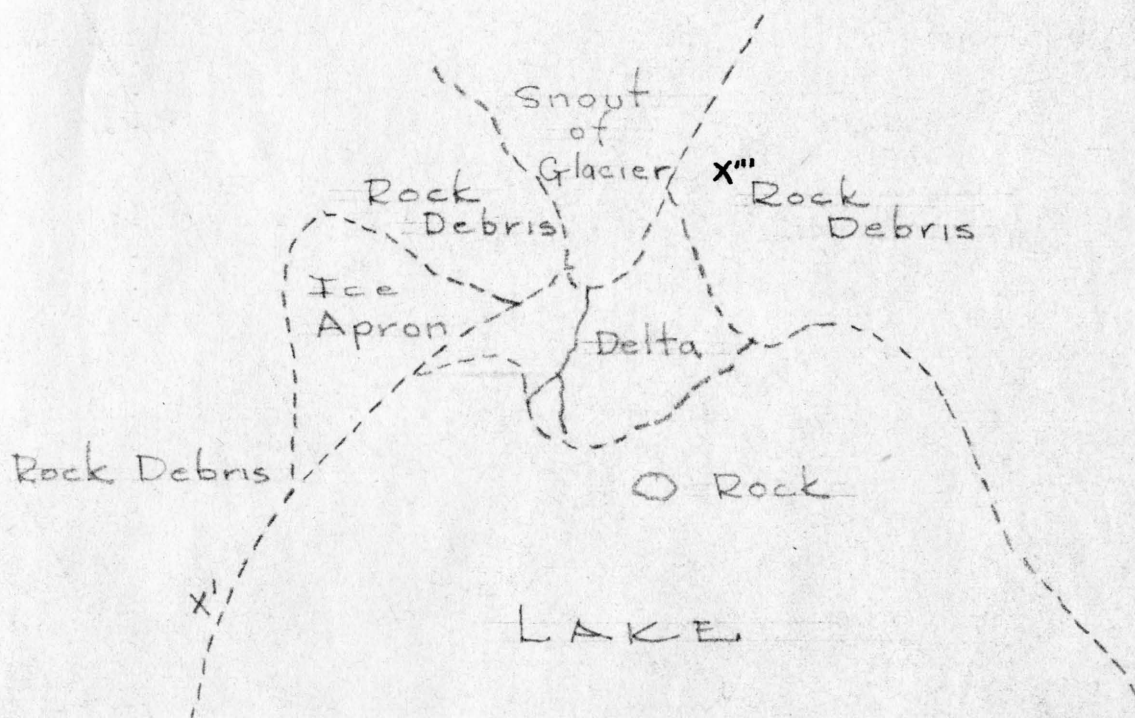
SNOW DEPTHS AND WATER CONTENT FOR PARK

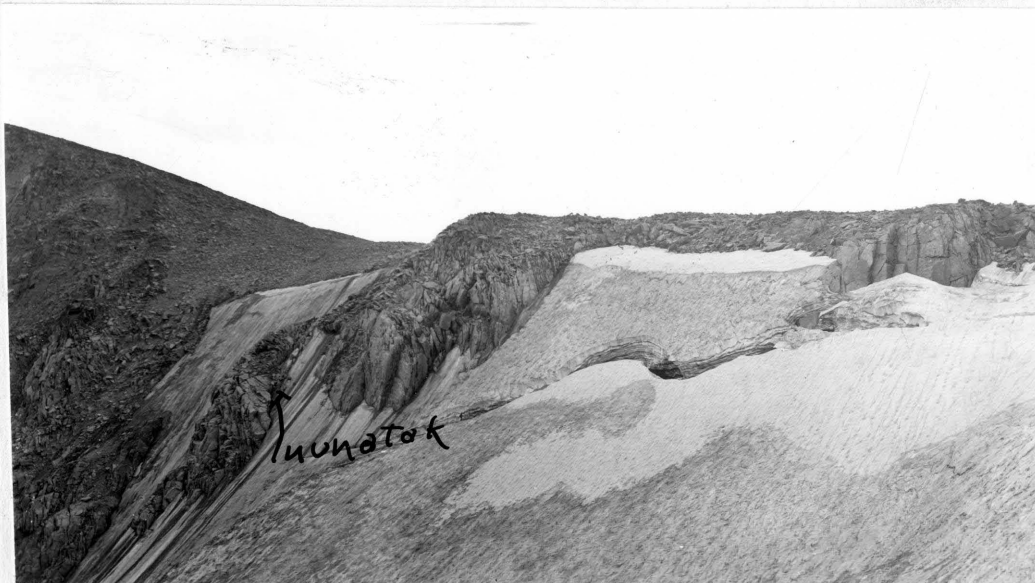
Dates	1955		1954		Means		Yrs.
	Snow D.	H ₂ O	Snow D.	H ₂ O	Snow D.	H ₂ O	
#116 - Copeland Lake (Alt. 8,600)							
Jan. 31	6.27"	1.54"	9.36"	1.72"	16.69"	4.19"	7
Feb. 28	9.64"	2.09"	11.18"	2.18"	17.45"	4.82"	7
Mar. 31	12.91"	4.27"	14.36"	4.27"	18.46"	5.71"	7
Apr. 30	No Snow		1.70"	0.70"	5.75"	2.35"	7
#41 - Wild Basin (Alt. 10,000)							
Jan. 31	20.54"	4.58"	25.50"	5.50"	31.81"	8.01"	17
Feb. 28	28.75"	5.42"	31.51"	7.80"	39.49"	10.54"	18
Mar. 31	35.25"	8.58"	45.24"	11.49"	46.12"	13.96"	18
Apr. 30	18.70"	6.75"	23.55"	7.38"	38.63"	13.98"	18
#115 - Deer Ridge (Alt. 9,050)							
Jan. 31	9.07"	2.21"	10.70"	1.70"	17.75"	3.96"	7
Feb. 28	13.51"	2.43"	6.00"	2.00"	18.61"	4.92"	7
Mar. 31	18.07"	5.20"	14.40"	4.00"	21.65"	6.12"	7
Apr. 30	2.71"	0.71"	2.30"	0.50"	9.55"	2.93"	7
#95 - Hidden Valley (Alt. 9,550)							
Jan. 31	18.93"	4.21"	26.40"	5.70"	29.99"	6.74"	15
Feb. 28	28.92"	5.50"	26.50"	6.20"	36.37"	8.81"	15
Mar. 31	35.07"	9.07"	45.70"	10.78"	42.87"	11.98"	15
Apr. 30	25.21"	7.42"	26.92"	7.07"	42.51"	12.91"	15
#127 - Grand Lake (Alt. 8,600)							
Jan. 31	27.92"	4.67"	20.58"	3.50"	31.23"	6.19"	7
Feb. 28	29.29"	5.62"	20.12"	3.54"	31.76"	7.49"	7
Mar. 31	34.50"	8.62"	29.87"	6.00"	35.83"	9.21"	7
Apr. 30	No Snow		No Snow		17.11"	5.80"	4
#64 - North Inlet (Alt. 9,000)							
Jan. 31	23.87"	4.80"	Not taken		24.83"	5.76"	16
Feb. 28	28.22"	5.97"	21.38"	4.33"	30.15"	7.33"	17
Mar. 31	33.65"	8.55"	32.50"	6.70"	33.42"	9.57"	18
Apr. 30	No Snow		No Snow		24.90"	8.17"	15
#12 - Phantom Valley (Alt. 9,038)							
Jan. 31	27.50"	5.19"	21.28"	4.28"	26.31"	5.92"	19
Feb. 28	30.12"	7.20"	20.09"	4.34"	32.67"	8.38"	19
Mar. 31	33.12"	9.18"	36.56"	9.12"	34.89"	10.14"	19
Apr. 30	No Snow		No Snow		20.79"	7.49"	15
#65 - Lake Irene (Alt. 10,600)							
Jan. 31	43.21"	8.89"	42.07"	11.53"	48.31"	12.97"	16
Feb. 28	47.35"	12.72"	50.68"	13.32"	58.40"	17.61"	18
Mar. 31	63.54"	17.71"	69.50"	17.14"	66.03"	21.63"	18
Apr. 30	39.21"	14.64"	48.20"	16.85"	62.20"	23.49"	17

TYNDALL GLACIER



ANDREWS GLACIER

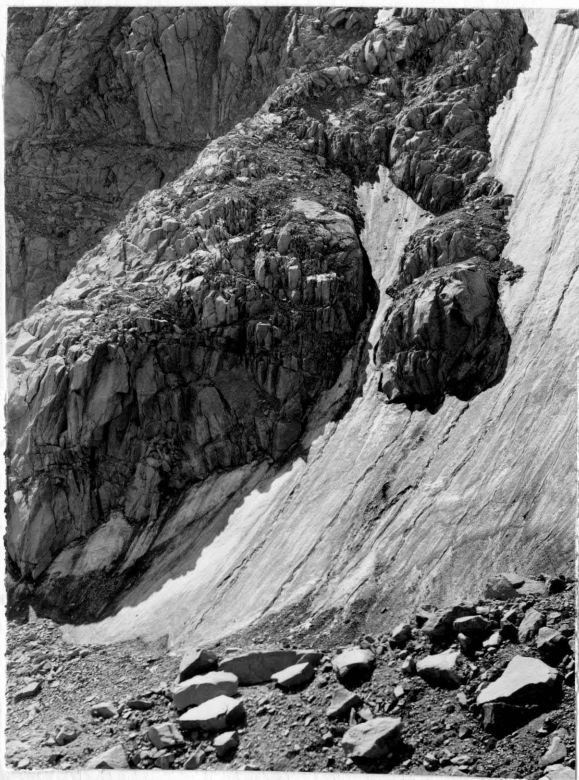




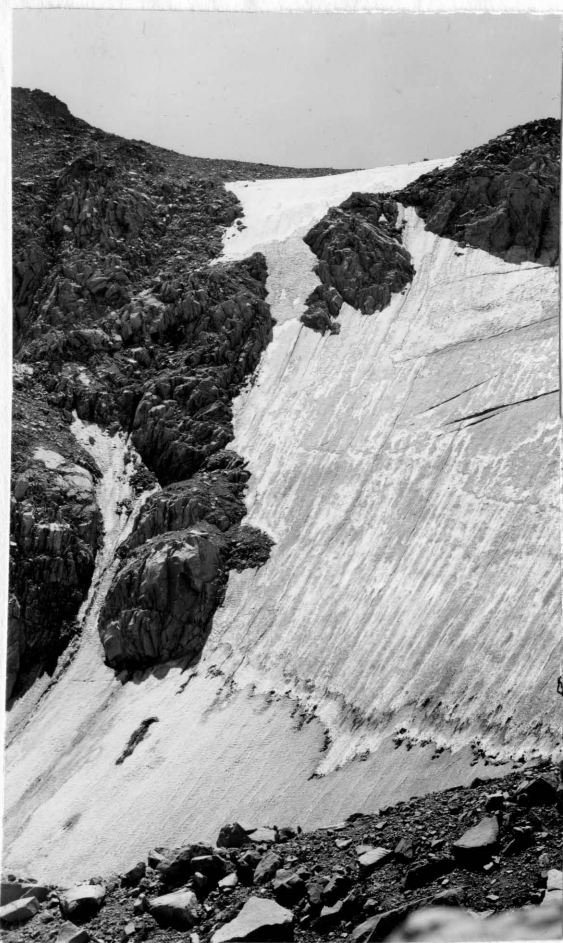
Tyndall Glacier from near P-3 showing bergschrund and nunataks at head of glacier. August 30, 1954



Tyndall Glacier from near P-3 showing bergschrund and nunataks at head of glacier. August 26, 1955



General view of the southeastern
end of Tyndall Glacier from P-1.
August 30, 1954



General view of the southeastern
end of Tyndall Glacier from P-1.
August 26, 1955



Recessional moraine at the base of Tyndall Glacier, showing stations X and X' and the snout of the glacier. August 30, 1954



Recessional moraine at the base of Tyndall Glacier, showing stations X and X' and snout of the glacier. August 26, 1955



Recessional moraine at base of Tyndall Glacier, taken from snout of glacier, showing stations X and X'. August 30, 1954



Recessional moraine at base of Tyndall Glacier, taken from snout of glacier, showing stations X and X'. August 26, 1955



General view of snout of Tyndall Glacier from P-2 looking north, showing stations X and X' and also snout. August 30, 1954



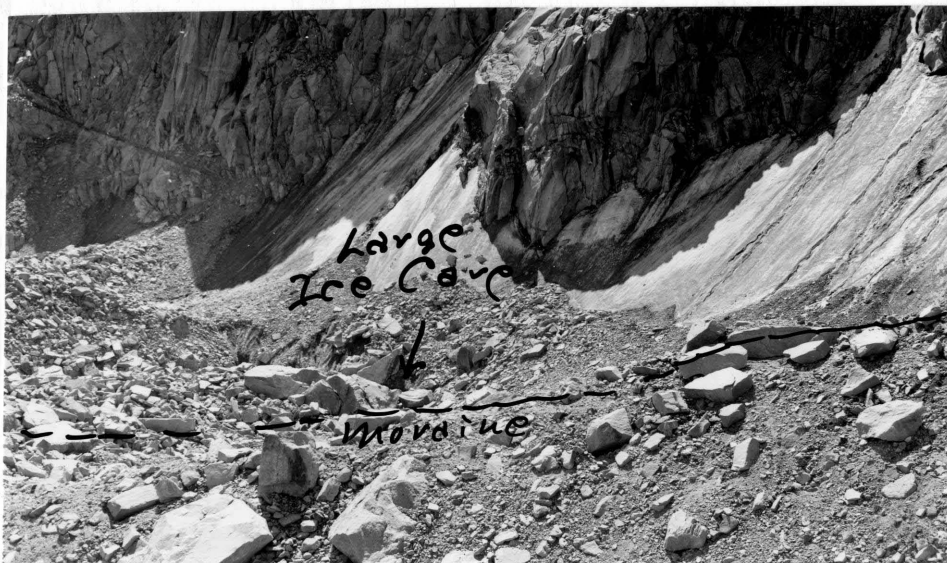
General view of snout of Tyndall Glacier from P-2 looking north, showing station X and X' and also snout. August 26, 1955



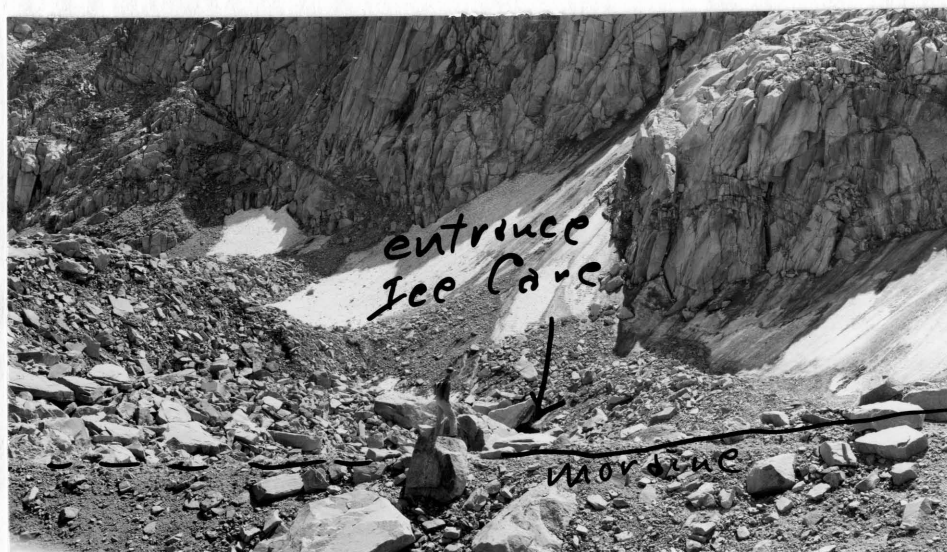
General view of snout of Tyndall Glacier from station X, showing farthest extent of exposed ice. August 30, 1954



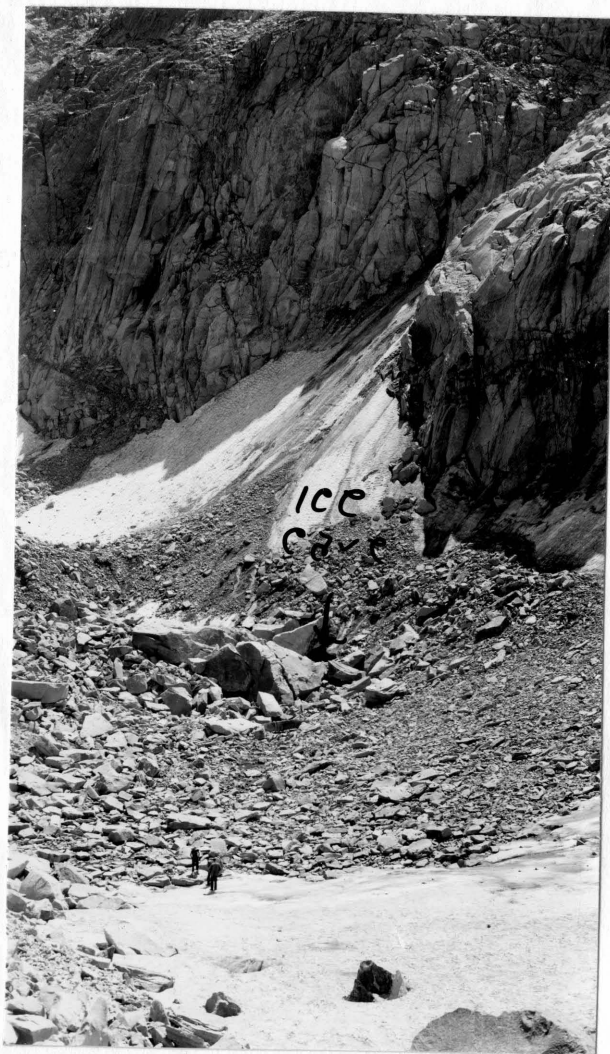
General view of snout of Tyndall Glacier from station X, showing farthest extent of exposed ice. August 26, 1955



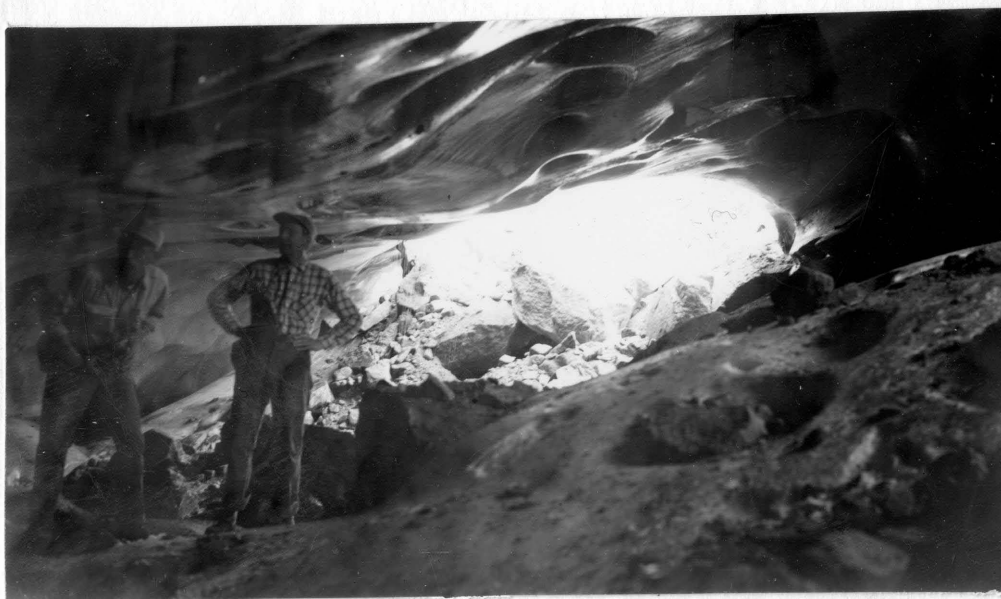
View from P-1 looking south, showing lateral moraine and entrance to large ice cave. August 30, 1954



View from P-1 looking south, showing lateral moraine and entrance to ice cave. August 26, 1955



Taken from top of north lateral moraine looking south. August 26, 1955



General view of ice cave at southeastern end of Tyndall Glacier.
August 30, 1954



General view of ice cave at southeastern end of Tyndall Glacier.
August 26, 1955



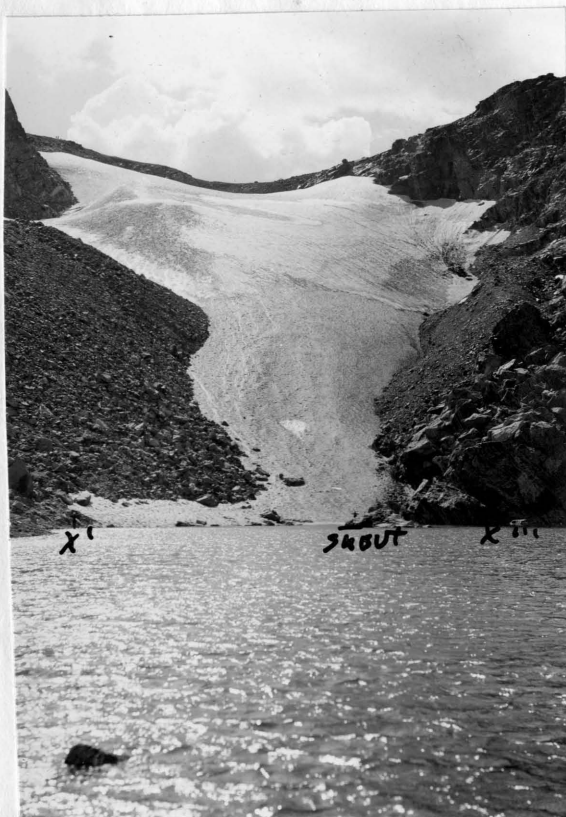
General View, looking south, of the bergschrund at the head of Tyndall Glacier, taken above P-1 on North Wall. August 30, 1954



General view, looking south, of the bergschrund at the head of Tyndall Glacier, taken above P-1 on North Wall. August 26, 1955



General view, looking west, showing X' and X''', the snout, and large crevasses. August 30, 1954



General view looking west, showing X' and X''' and snout. Note lack of crevasses from that of picture taken in 1954. August 26, 1955

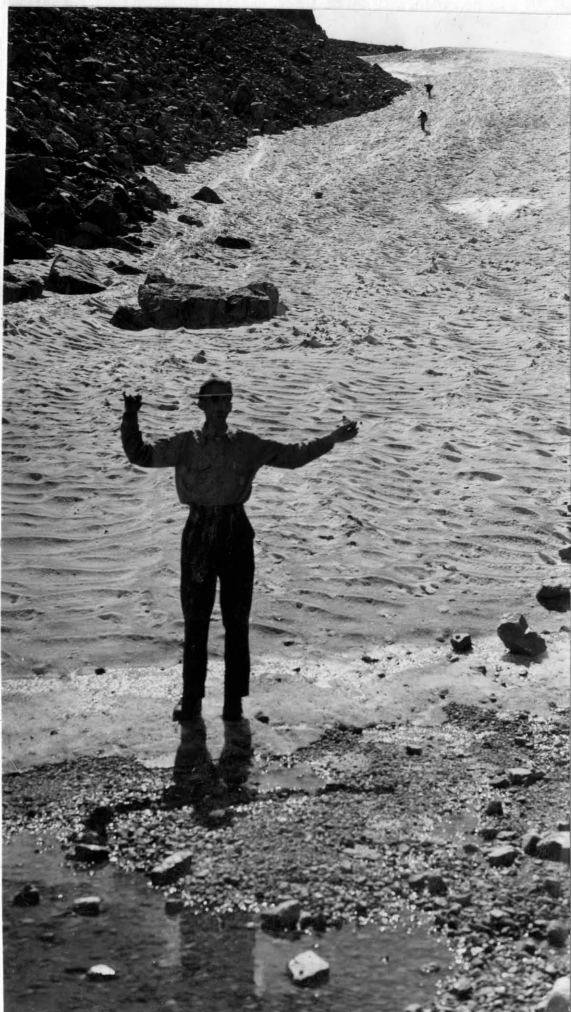
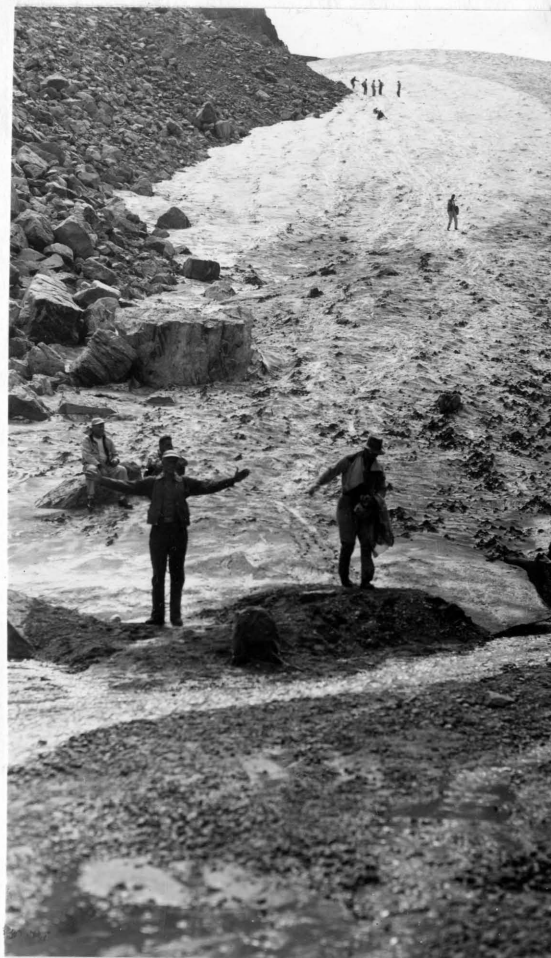


General view looking southwest, showing contact between delta and glacial ice. August 30, 1954



General view looking southwest, showing contact between delta and glacial ice. August 26, 1955

General view looking up
glacial snout from delta.
August 30, 1954



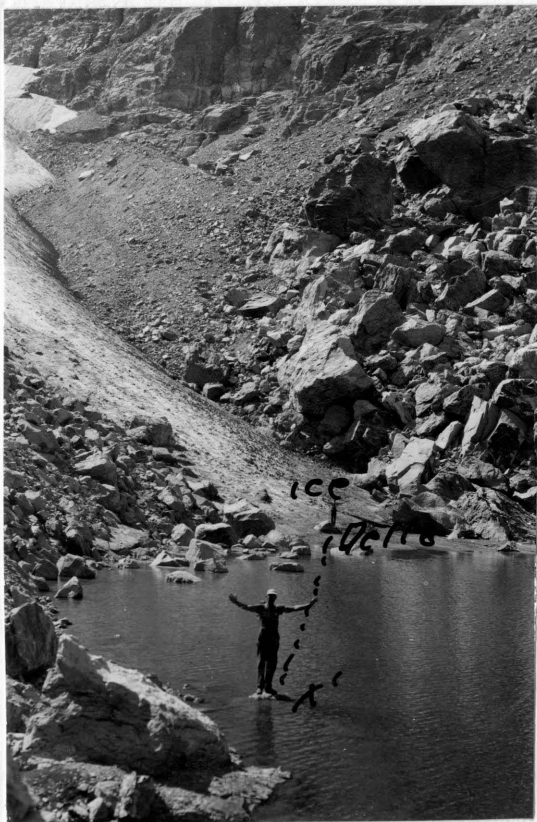
General view looking up
glacial snout from delta.
August 26, 1955



View south from near station
X''', showing position X
and the contact of glacial ice
with delta. August 30, 1954

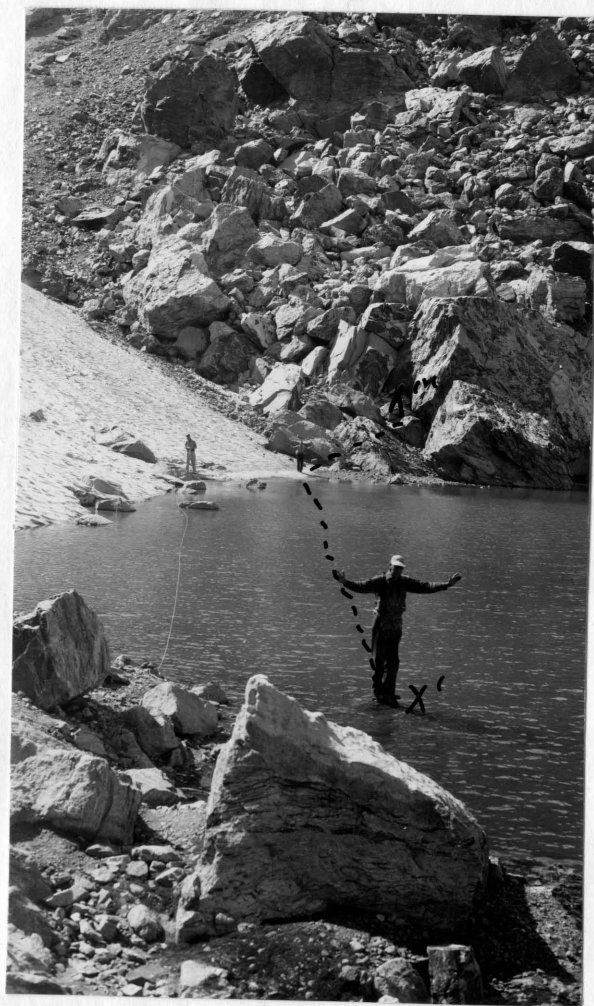


View south from X''', showing position X' and the snout. August 26, 1955



View along line of measurement
from X' to snout. August 30, 1954

View along line of measurement
from X' to snout.
August 26, 1955





View down glacier, showing contact between glacial ice and delta.
August 30, 1954



View down glacier, showing contact between glacial ice and delta. Note
light area to right of "W" where water runs out like that of an artesian
well. See Plate 17. August 26, 1955



View of water spilling out of center of glacier like an artesian well.
August 26, 1955



General view along the southern margin of the glacier, showing the crevasses that were evident on August 30, 1954. Very little evidence of crevasses on August 26, 1955.