

F. E. MATTHES COLLECTION

YOSPS/31MA - P01

(Belongs to Glaciology P.O.)

YOSEMITE NATIONAL PARK

REPORT OF GLACIER MEASUREMENTS

MT. LYELL, MT. MACLURE, MT. DANA

October 1, 2, and 3, 1931

YOSPS/31MA-P35

C. A. Harwell
Park Naturalist

to Suzanne

DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
YOSEMITE NATIONAL PARK
CALIFORNIA

YOSPS/31MA-P02

OFFICE OF THE SUPERINTENDENT

October 27, 1931

Dr. F. E. Matthes
U. S. Geological Survey
Washington, D. C.

Dear Dr. Matthes:

I transmit herewith what I consider a fine report by Mr. Harwell on the measurement of the Mt. Lyell Glacier.

Mr. Harwell was assisted by temporary ranger-naturalist Borrell and by temporary ranger Archie Westfall. The excellent photographs were taken by Arnold Williams, also a member of the party through the courtesy of the Yosemite Park and Curry Company.

For some reason this glacier measurement hit the public fancy and has received excellent publicity; it even came in for a nice mention in the news items over KGO. I believe this sort of activity is one of our best outlets, combining as it does a scientific viewpoint with a real virility. The measurements will, of course, be made at regular intervals hereafter so that we can gradually accumulate authentic data.

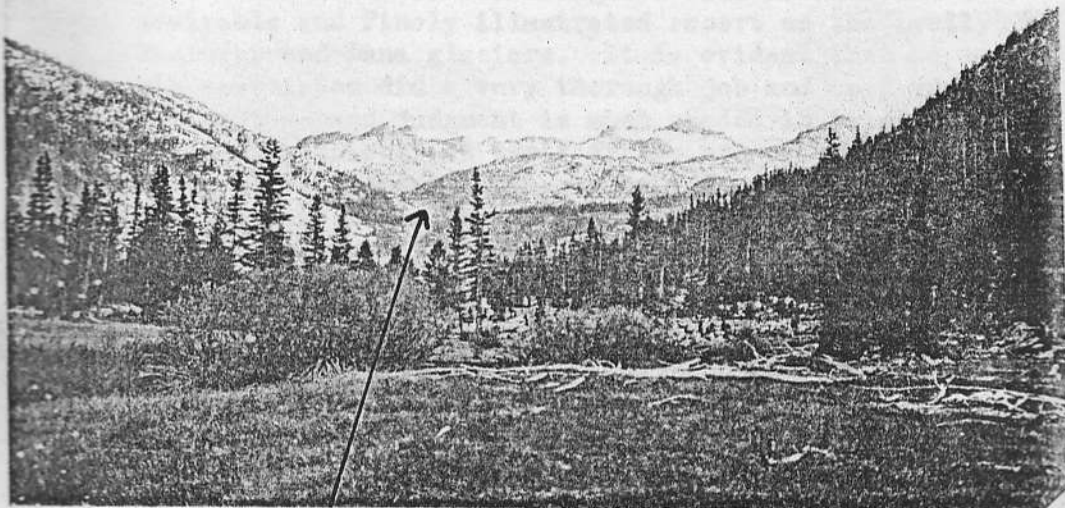
Very respectfully,

C. G. Thomson
Superintendent

Inclosure

YOSPS/31MA-P03

1



September 30th.

A party of four consisting of Ranger Naturalist A. E. Borell, Ranger Archie Westfall, photographer Arnold Williams, and myself established ourselves for a three day stay at the Lyell Base Camp.

YOSPS/31MA-P04

Nov. 9, 1931

Col C. G. Thomson,
Superintendent, Yosemite Nat. Park,
Yosemite National Park, Calif.

Dear Col. Thomson:

I am indeed delighted with Mr. Harwell's admirable and finely illustrated report on the Lyell, Maclure, and Dana glaciers. It is evident that he and his associates did a very thorough job and used good judgment -- and judgment is much needed in this measuring of glaciers, as their fronts are often indefinite and good reference points scarce. The photographs by Mr. Williams are a valuable addition. Without them it would have been difficult to make clear at just what points the measurements were made, and what sort of conditions prevailed at the glacier fronts.

It is not too much to say that the report as a whole is immensely satisfying and sets a standard for others to work up to. The other members of the Glacier Committee (as we call it for short) are as greatly pleased with it as I am. They ask me to convey to you their appreciation as well as my own and to extend the congratulations of all of us to Mr. Harwell, Mr. Borrell, Mr. Westfall, and Mr. Williams. May I ask you also to express my appreciation to Mr. Tressider for making Mr. Williams available for the occasion.

I expect to use some of the photographs as illustrations in the annual report of the Committee. Data are coming in from various localities, and the prospect is that our first annual report will be a substantial one.

Equipped with what pleases me most about Mr. Harwell's work is that he did not neglect to give it popular interest! More power to him!

Very respectfully

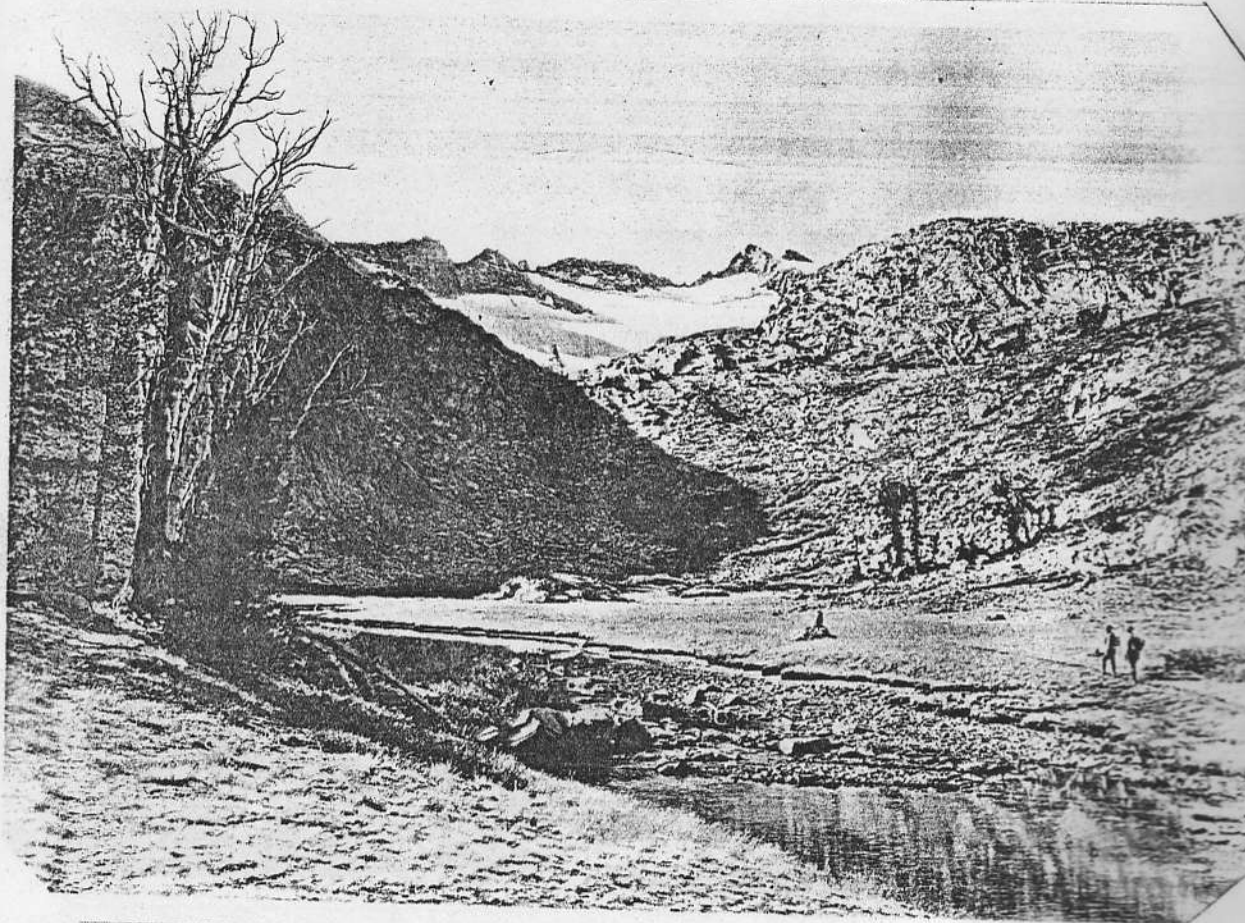
Chairman, Committee on the Hydrology
of Glaciers.

DOMESTIC REGIONAL BANK SETTLE
SUBSIDIARY BANK DOMESTIC REG. BANK
COY C. G. THOMPSON

MOA. 3. 1921

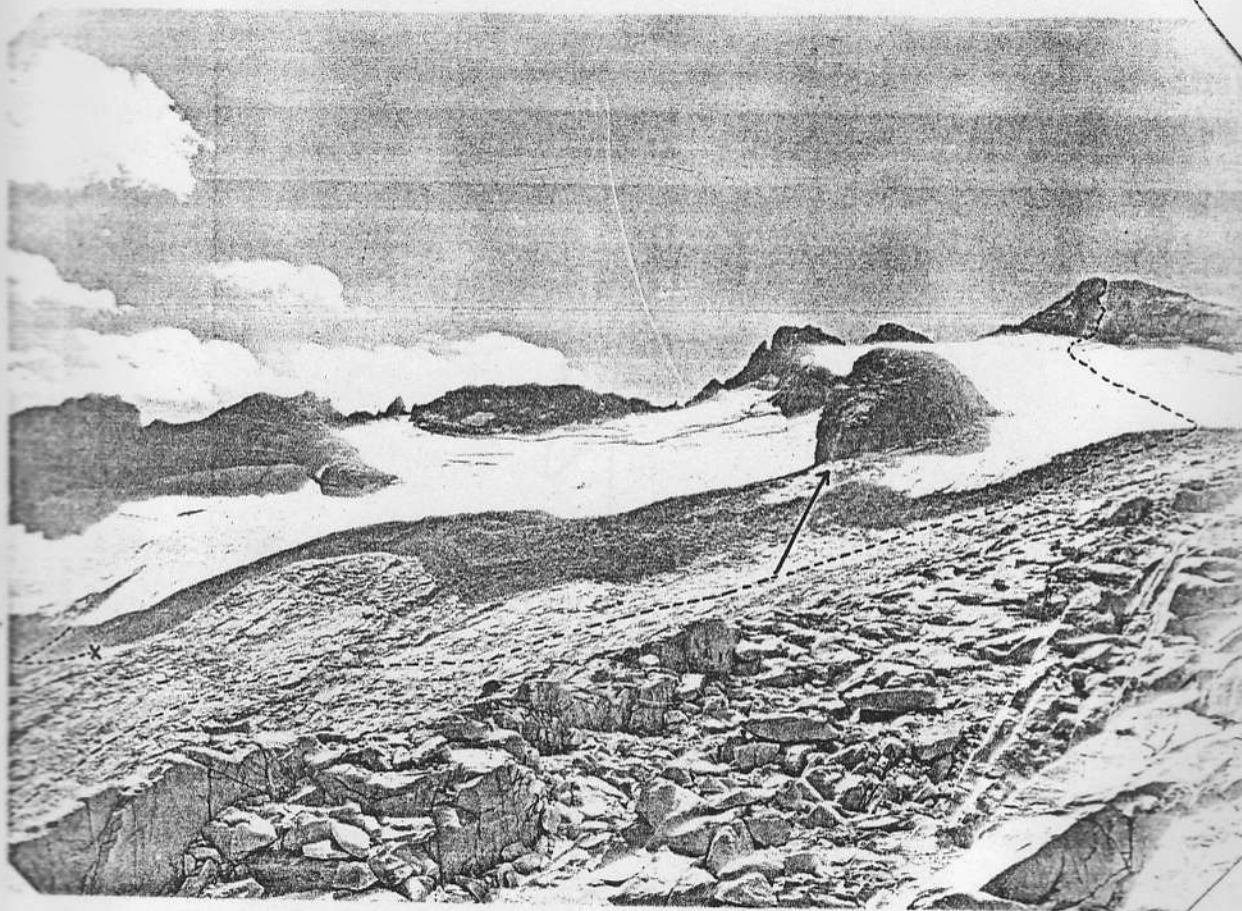
2

YOSPS/31MA-PO5



October 1

Equipped with a surveyor's transit, 300 foot steel tape, can of green paint and brush, and photographic equipment we proceeded directly up the Lyell Fork to the most easterly lobe of the Lyell glacier.



We found this lobe extends approximately one mile from the summit of the mountain. A well defined lateral moraine extends completely along its north edge, joining the frontal moraine in a sweeping curve. The dotted line indicates usually followed route to the summit of Lyell from Base Camp. This route is ducked to the top of moraine. Arrow indicates location of ice front shown on Page 9. Base line discussed on Page 4 indicated at point X.

YUSPS/31MA-P07

4

2

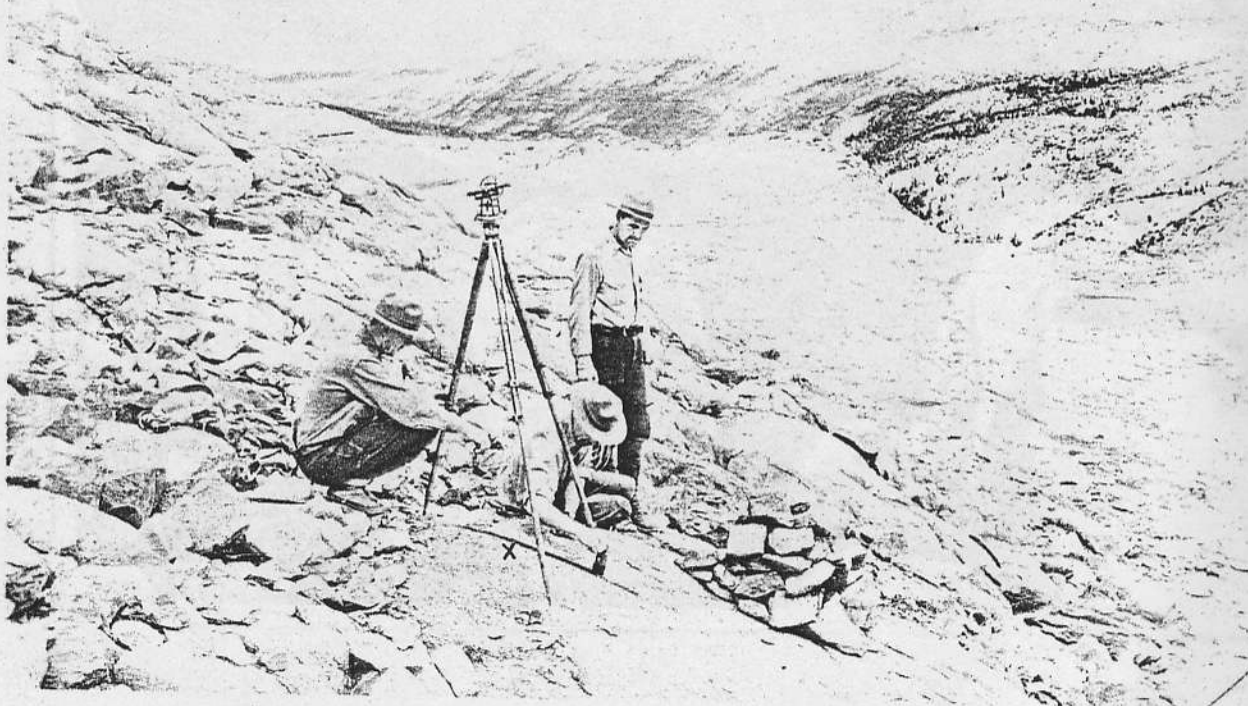
From the top of the frontal moraine to the glacier's very steep front the distance is approximately 550 feet. This frontal moraine is just at the top of a 50 foot cliff at C. This morainal debris seemed too unstable to use as reference points so we chose natural ledges at X and Y, 1500 feet apart, for end points of our base line set up perpendicular to the ice front of this easterly lobe.

YOSPS/31 MA/PO8

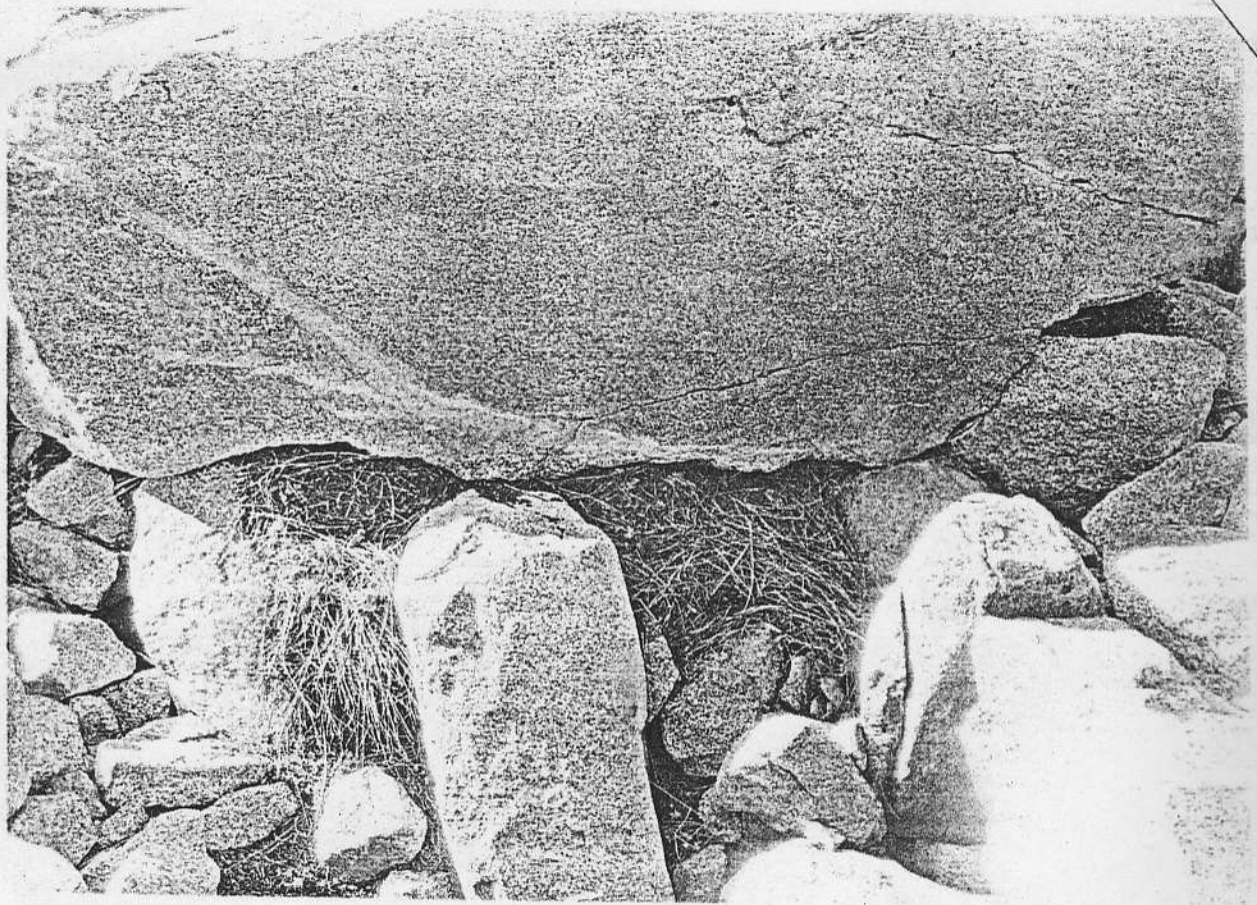
5



The end points X and Y of the base line just described we marked with green paint on the native granite. We also built monuments to make these reference points more easily found for future measurements. This photo, looking north, shows the glaciated canyon of the Lyell Fork of the Tuolumne River.



The end points X and Y of the base line just described we marked with green paint on the native granite. We also built monuments to make these reference points more easily found for future measurements. This photo, looking north, shows the glaciated canyon of the Lyell Fork of the Tuolumne River.

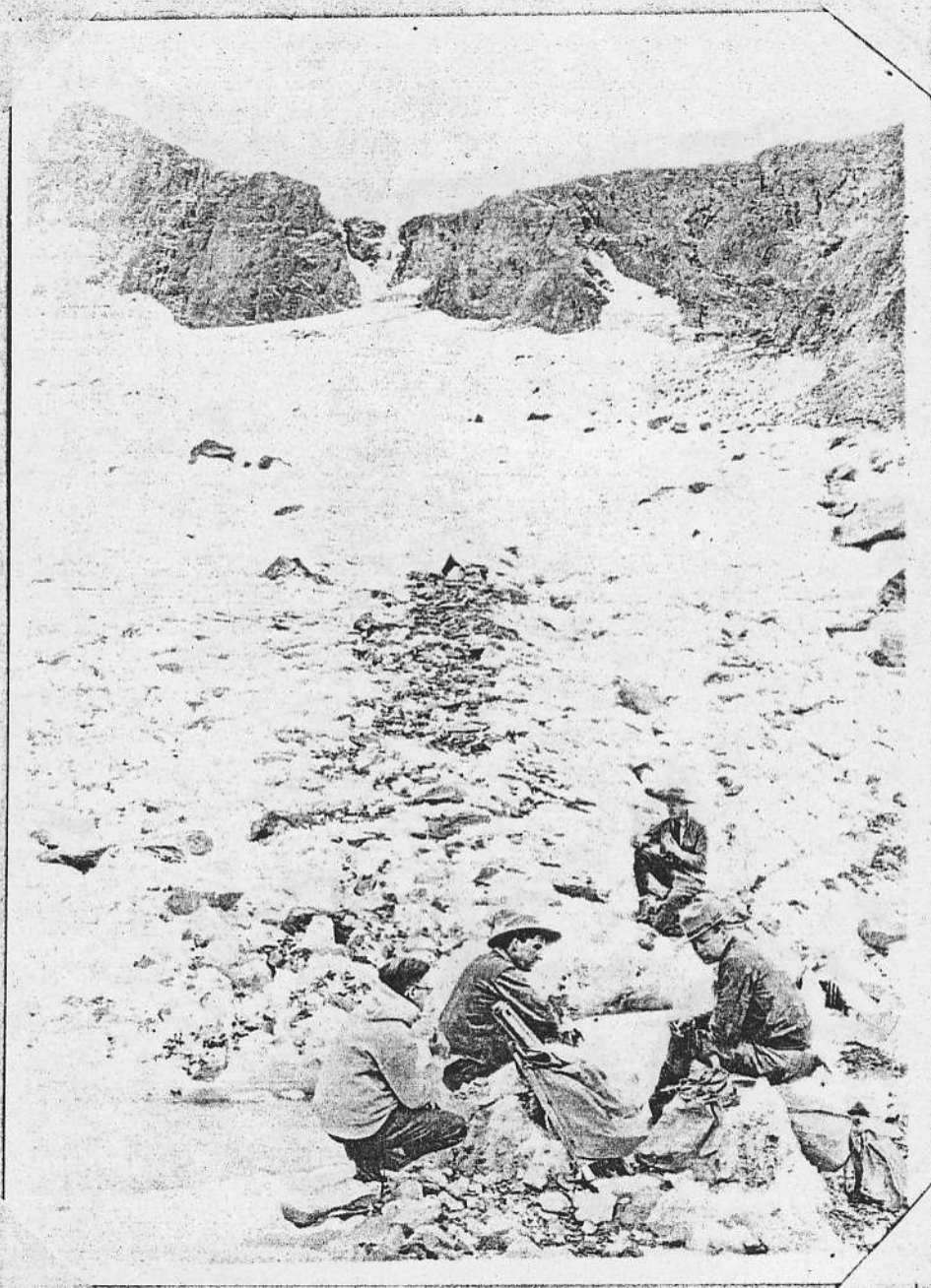


A very fine example of cony's hay pile under a large sheltering block of granite.



By means of surveyor's transit at point X, on opposite canyon wall, a natural vertical crack in the cliff was sighted, painted, and monumented to mark the permanent point Y for easterly end of this base line. Sighting from X the marker at Y appears about 15' above the top of the easterly lateral moraine. Now with third man at center a middle point of the base line was located by use of transit and was painted on a 10 foot diameter boulder. From this point to ice front distance was directly measured along the slope by means of steel tape. It was found to be 460 feet.

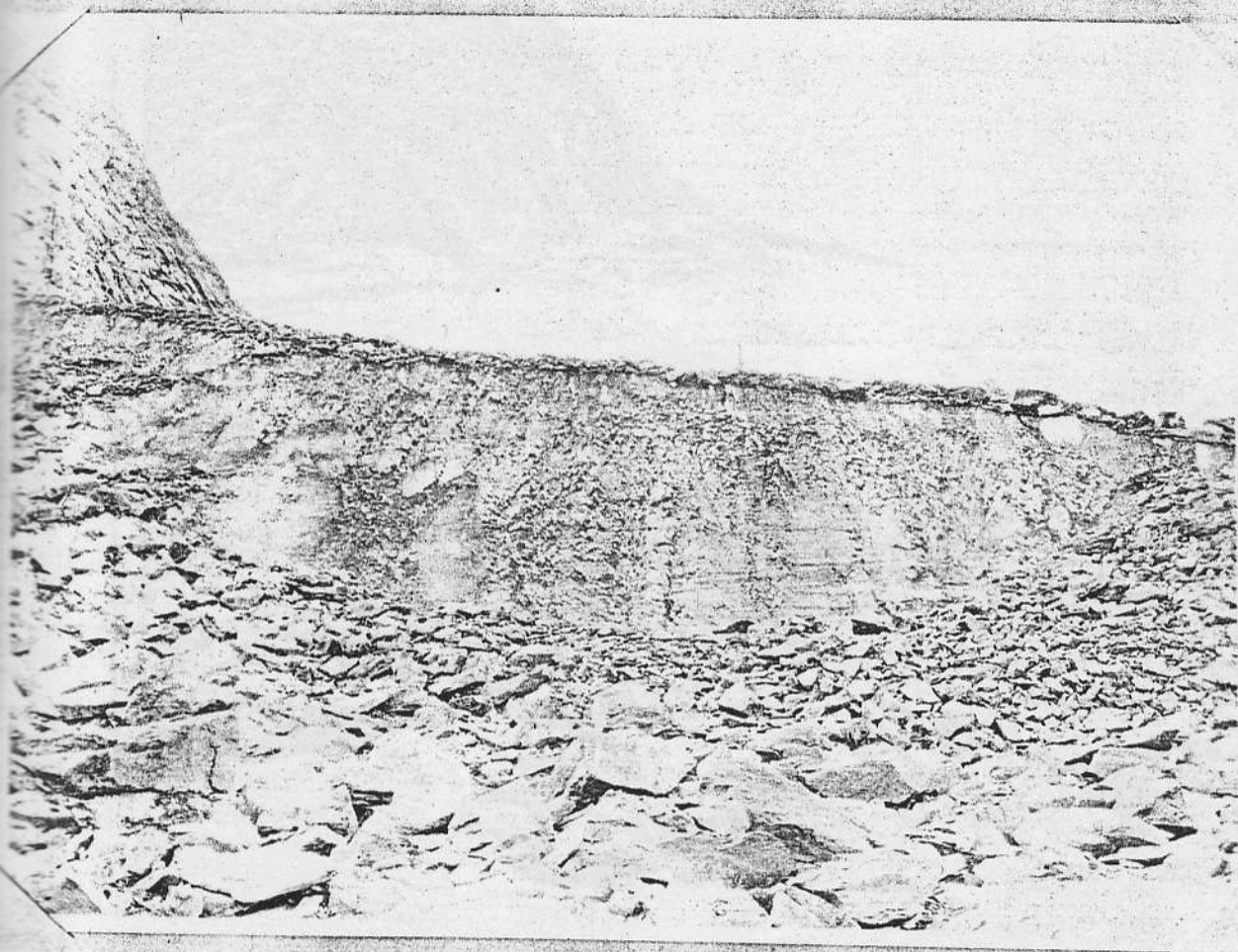
After traversing this morainal material from the edge of the visible ice front to the cliff marking the frontal moraine I think ice underlies practically the entire mass. Exposed ice could be seen only along the shaded portions of the lateral moraine near point Y. Especially along the frontal moraine indicated by arrows in photograph on Page No. 4 the very moist condition of the fine loose rock indicated that the shade furnished by this debris was protecting quite a mass of ice. Not having a suitable implement we were unable to uncover this ice so indicated no measurement of it. We did observe that the approximate front of this ice was parallel to the face of the cliff C in photograph on Page No. 4



We ate our lunch at the edge of the glacier. This photograph shows how rock material is being carried and how ice from the main Lyell glacier spills over this 200 foot cliff to help form the easterly lobe we had just measured. The location of the camera for this photograph is behind the moraine at the extreme right of the photograph on Page No. 4.

YOSPS/31 MA-P12

9



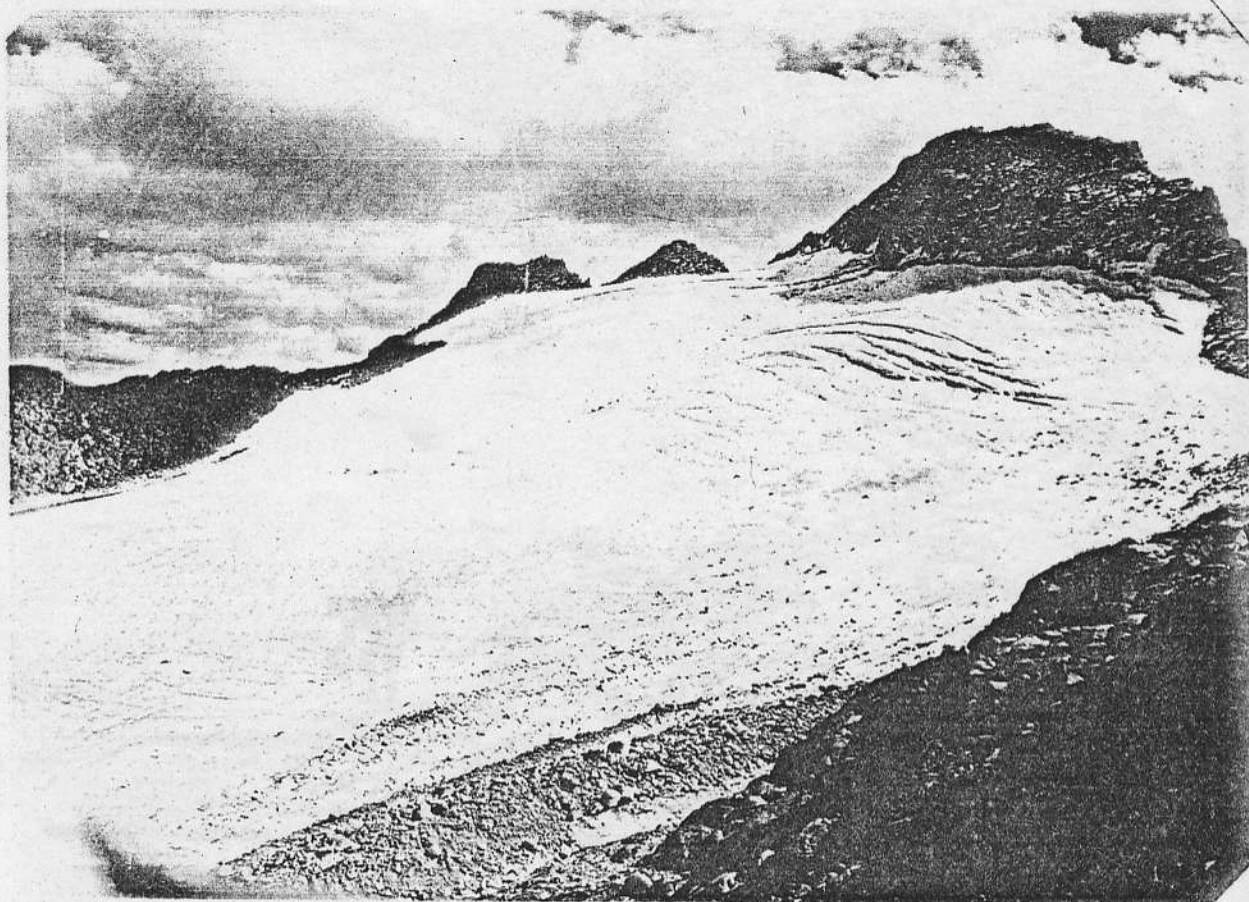
East facing ice front between eastern and western lobes of
Lyell glacier. This front is indicated by arrow in photograph on
Page 3.



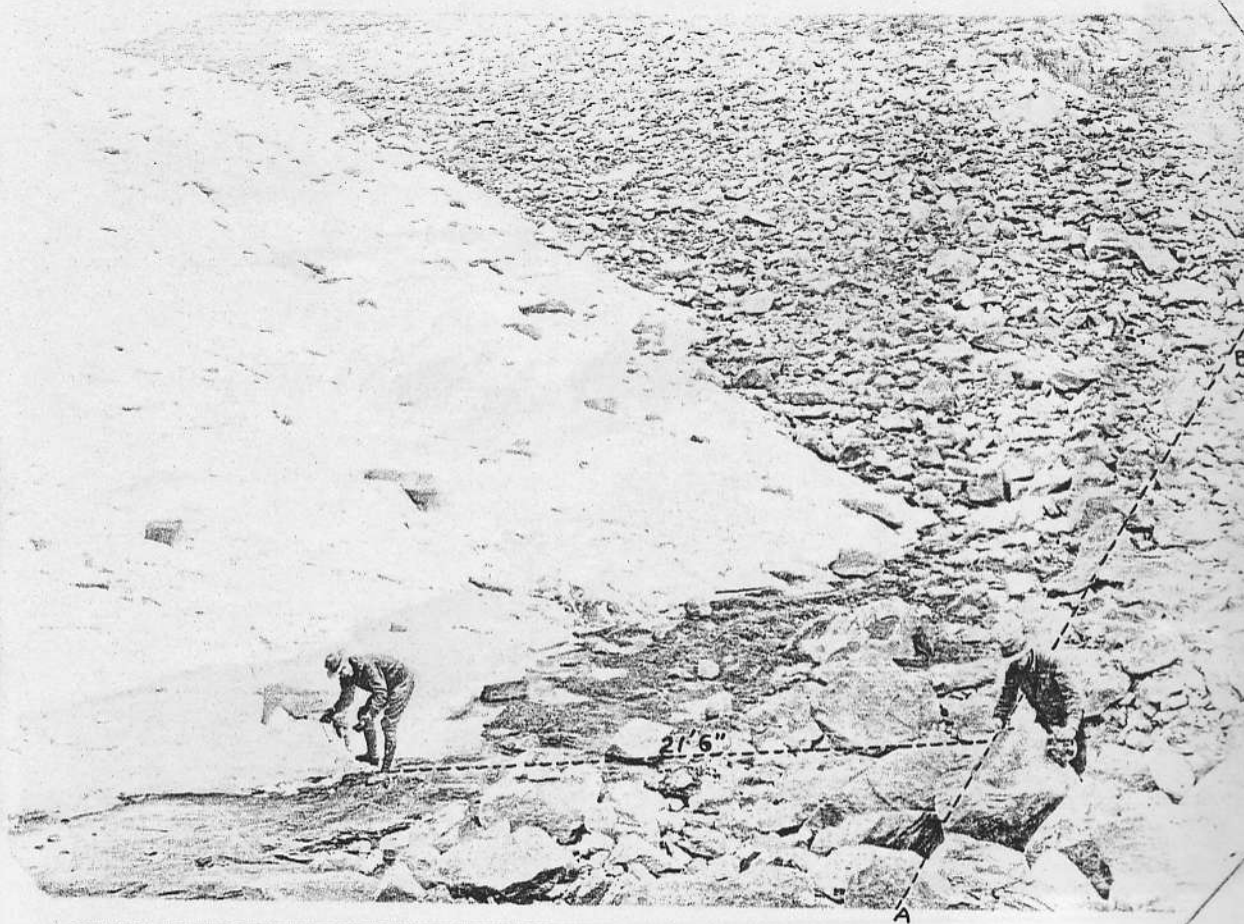
This lobe of the main body of the Lyell glacier just west of the knob that juts out from the summit had no definite "end" unless it was out front and below its terminal moraine. We followed down from ice field which became more rock covered. About 60 yards below last white ice we could see between the rocks what seemed to be its most northern limit. This front we marked with one green line on a large boulder with the inscription "10-1-31".



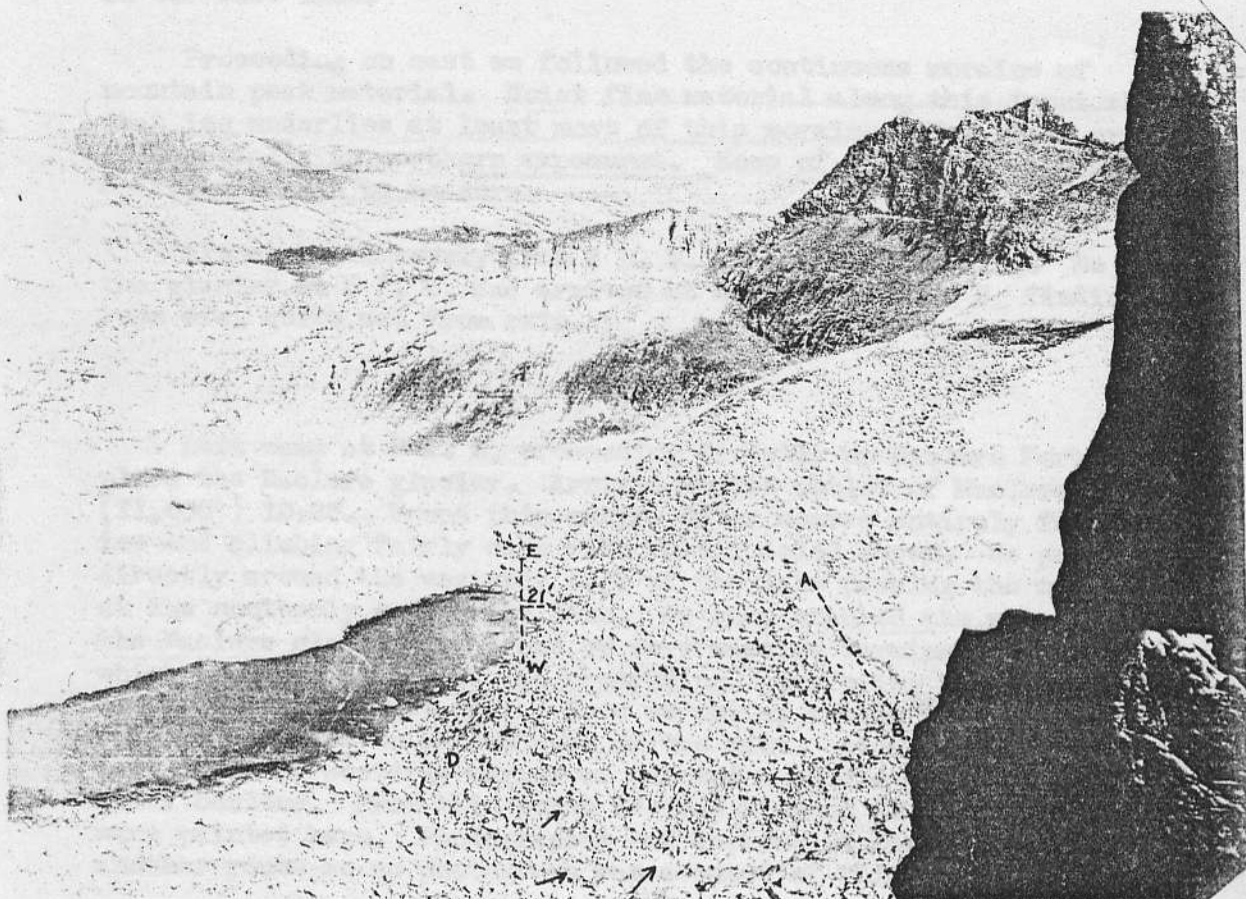
Proceeding north from measurement recorded on Page 10 we came to the great pile of boulders forming a terminal moraine of this lobe with ice showing below it. This we indicated by painting a green line —→ on boulder at most easterly point of this ice field. In the above photograph ice under shaded portions of the moraine is indicated by arrows.



Main body of Lyell glacier and peak (13,090'). Shows bergschrund and crevasses are well open at this time of year, shows typical lateral moraines and other evidences of movement. The westerly front of this ice proved most easily measured. See Page 13.



The definite front of most westerly lobe of Lyell glacier and most easily measured lobe encountered. We found it necessary to use morainal boulders in marking the base line A - B so painted our marks on five large rocks along this line. The end points A and B are approximately 300 feet apart. Measuring to the ice front from the third of these markers from either end showed a distance of 21' 6".



AB in this photograph indicates location of measurements discussed on Page 13. Following our line from A to B we crossed the lateral moraine and decided to follow along down-hill front of this series of moraines all the way toward the east looking for possible points of measurement. Ice (indicated by arrows) shows in foreground. Here again a pick surely would have disclosed ice at the most northerly point of the moraine at left foreground of photo at D. At the upper end of the lake well defined ice protruded. Locating base line WE we painted marker at W on large rock in edge of lake and at E on native cliff 250 feet distant from W. Our center mark is on the rock at edge of lake. From this center mark direct to first front of ice was 21 feet.

At a point 25 feet along line from E the ice front was directly on our base line.

Proceeding on east we followed the continuous moraine of mountain peak material. Moist fine material along this front showed that ice underlies at least most of this moraine. Ice often protruded especially in northern exposures. None of these places seemed definite enough to measure.

Almost continuously from 2 P. M. it had been hailing. We left the glacier at 5 P. M. and arrived at camp at 6:15 P. M. finding our beds etc. quite wet from rain.

October 2

Left camp at 8 A. M. proceeding directly up Maclure Fork to explore the Maclure glacier. Arrived at the outlet of Maclure Lake (11,600') 10:25. Found this entire water course entirely free from ice and climbing fairly easy with rubber soled shoes. We proceeded directly around the westerly edge of the lake passing the névé field at the southerly end of the lake. We soon reached the main lobe of the Maclure glacier as marked by very massive terminal moraine, which showed fine lot of ice protruding. Exploring this ice we found one cave some 25 feet deep. Here we set up a base line from cliff wall on the east to native rock on the west. At a point 75 feet east from our westerly marker we painted a middle point on a fairly small boulder. From this point ice was distant 36 feet. Four lines were painted here. Photographer had approached the glacier from another route so no photograph was secured of this point.

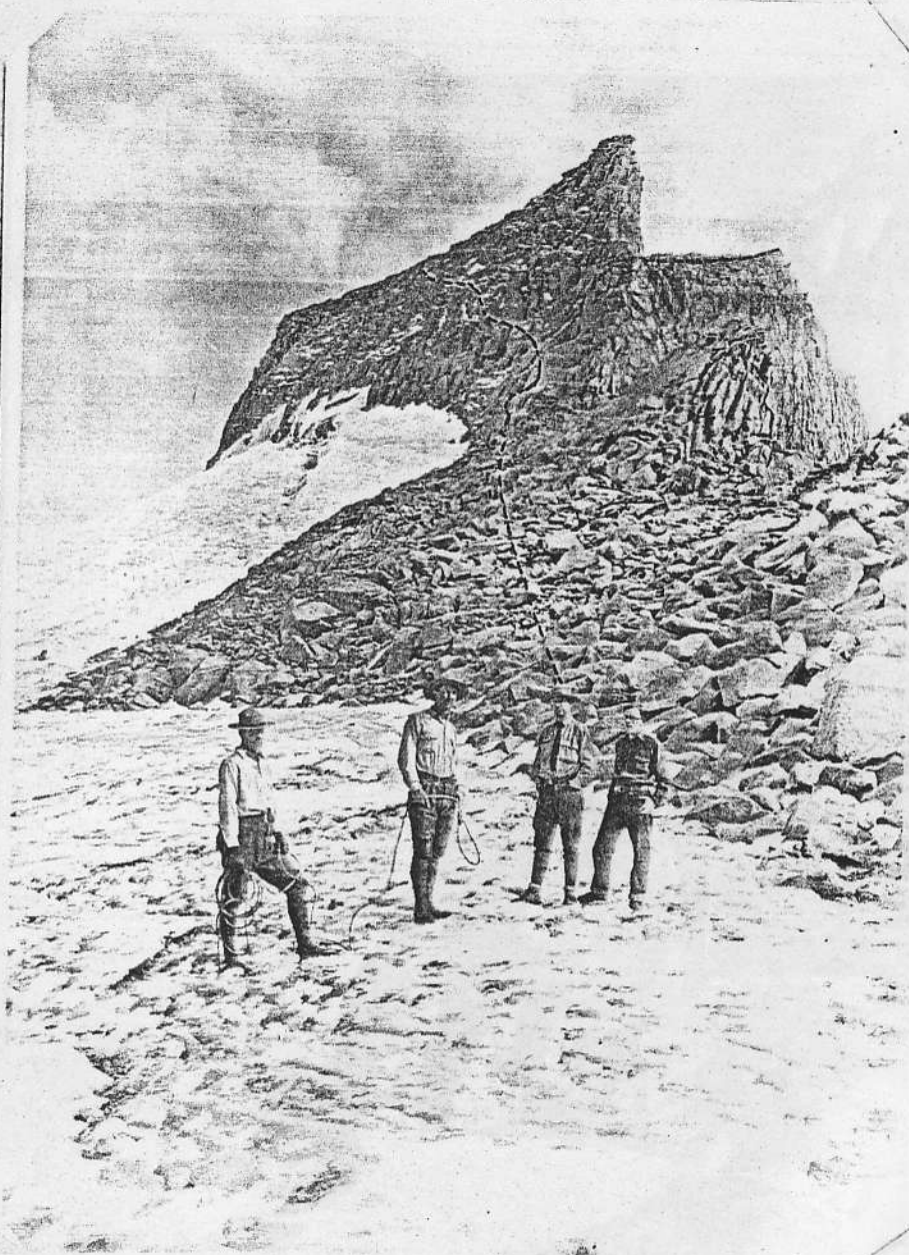
Climbing directly over this frontal moraine we reached the main body of the Maclure glacier. We found it impossible to make any measurement of this front because all was so rock covered. After lunch we proceeded directly up the easterly edge of the Maclure glacier, climbing without much difficulty to the top of the arête separating the Maclure and Lyell glaciers.



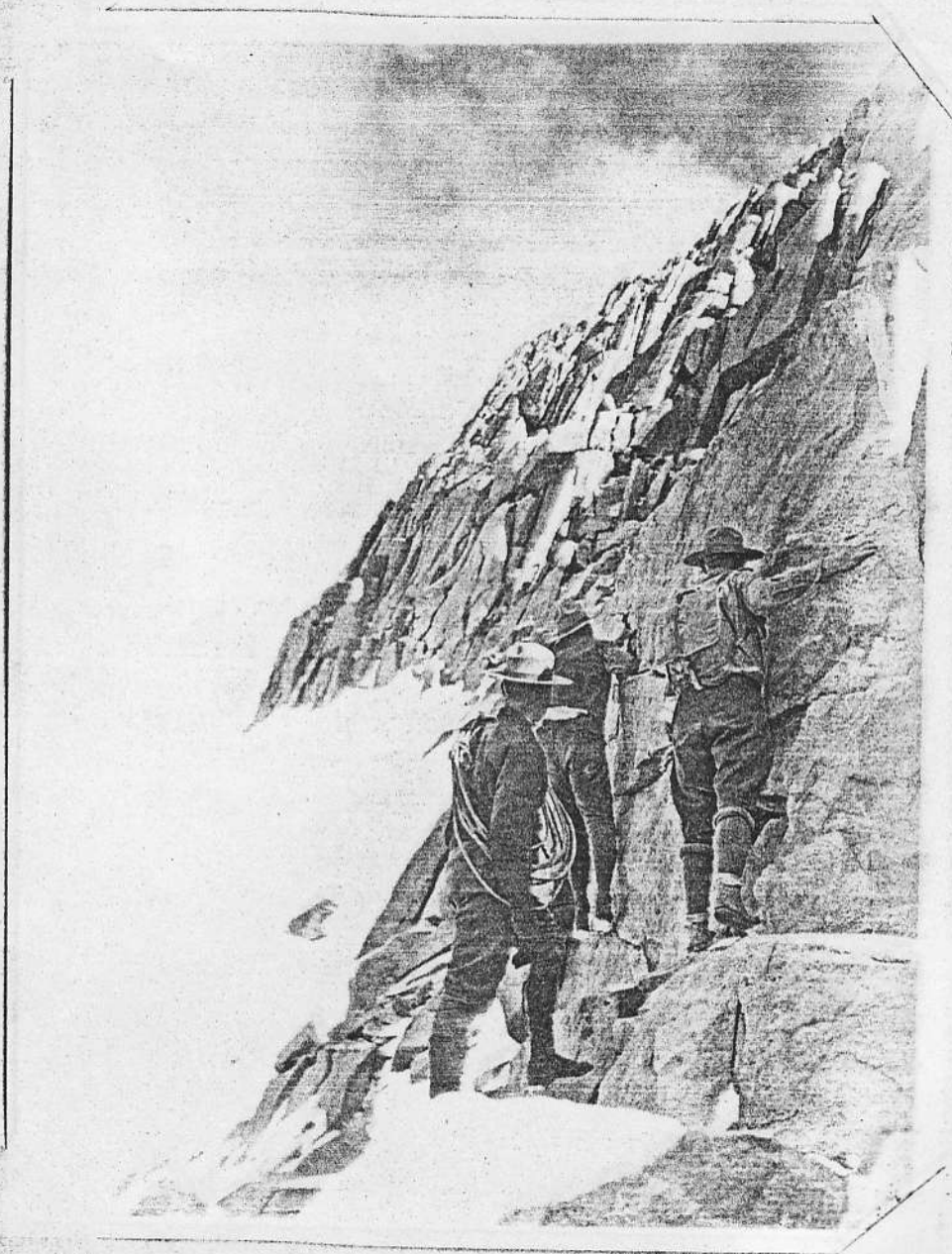
Just out on the ice of the Maclure glacier because it looked like it would make a good picture. We kept to the rocks in climbing.



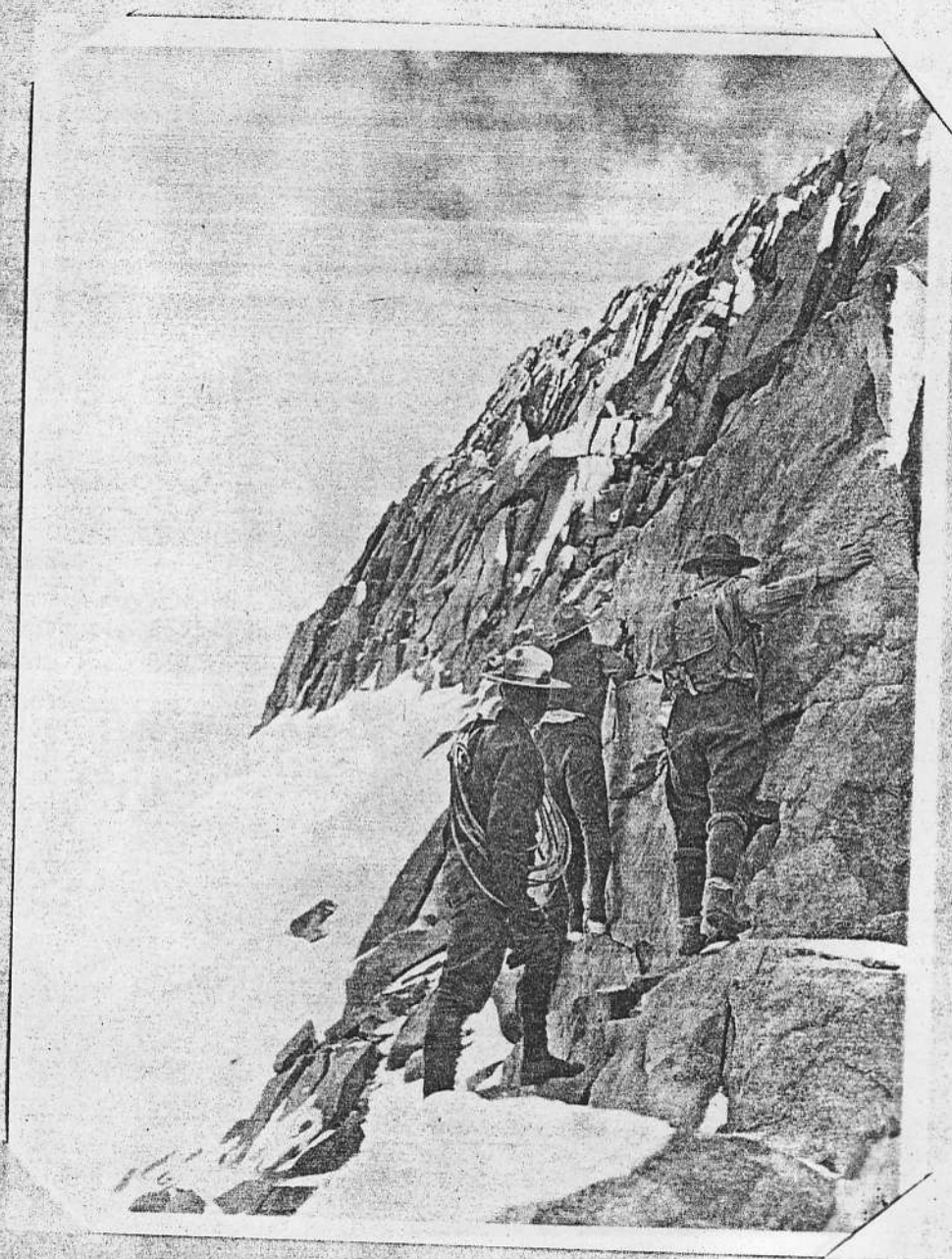
Mt. Maclure and glacier from a point on the arête which separates the Lyell and Maclure glaciers. Photograph appearing on Page 14 was taken easterly from this same point. We found some rather difficult rock work confronting us to get from this arête down to the Lyell side. We proceeded on up the slopes of Lyell to secure more typical glacier photographs.



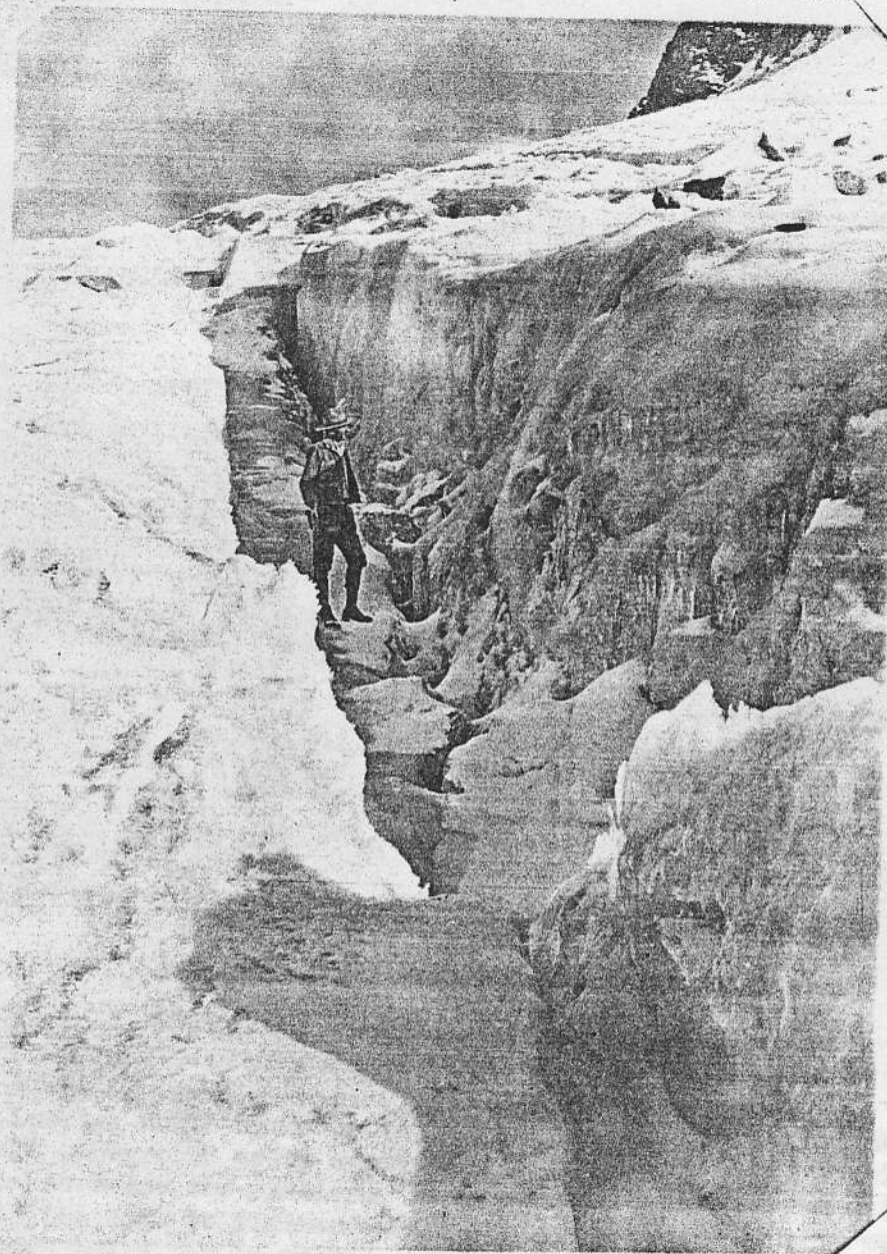
Our party at top edge of Lyell glacier, showing summit 13,090 feet. Left to right, Ranger-Naturalist A. E. Borell, Ranger Archie Westfall, Park Naturalist C. A. Harwell, photographer Arnold Williams. I have indicated on this photograph route I have used twice and other naturalists have used on several occasions in conducting parties to the summit of Lyell.



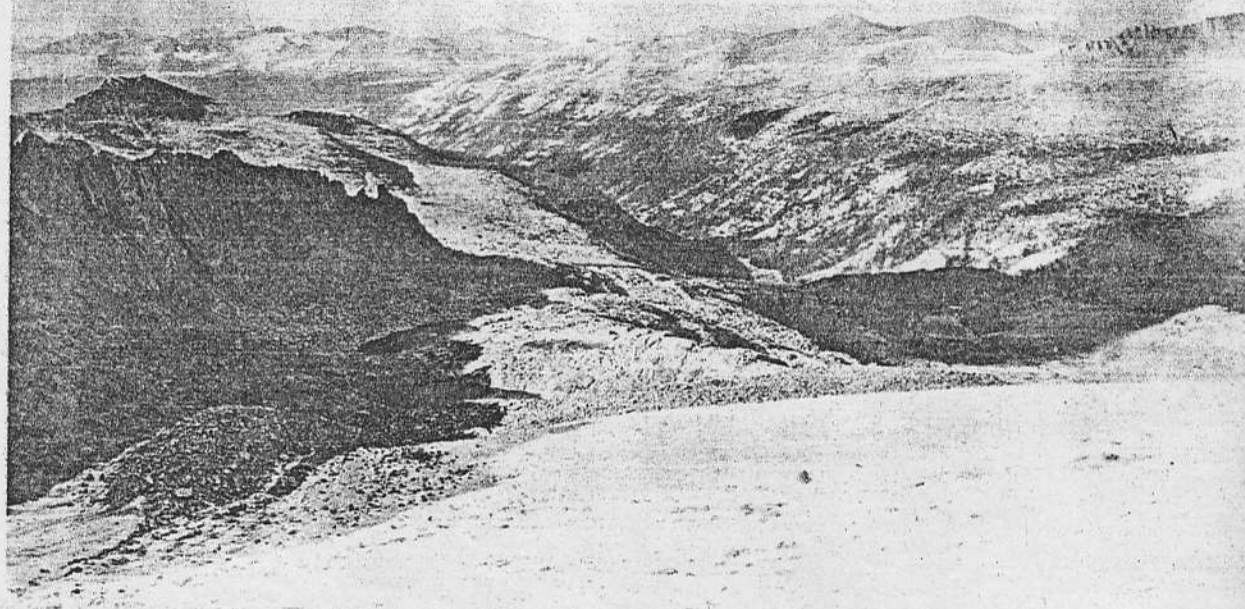
Frozen snow and hail on all small ledges caused us to give up an attempt to climb to the summit.



Frozen snow and hail on all small ledges caused us to give up an attempt to climb to the summit.



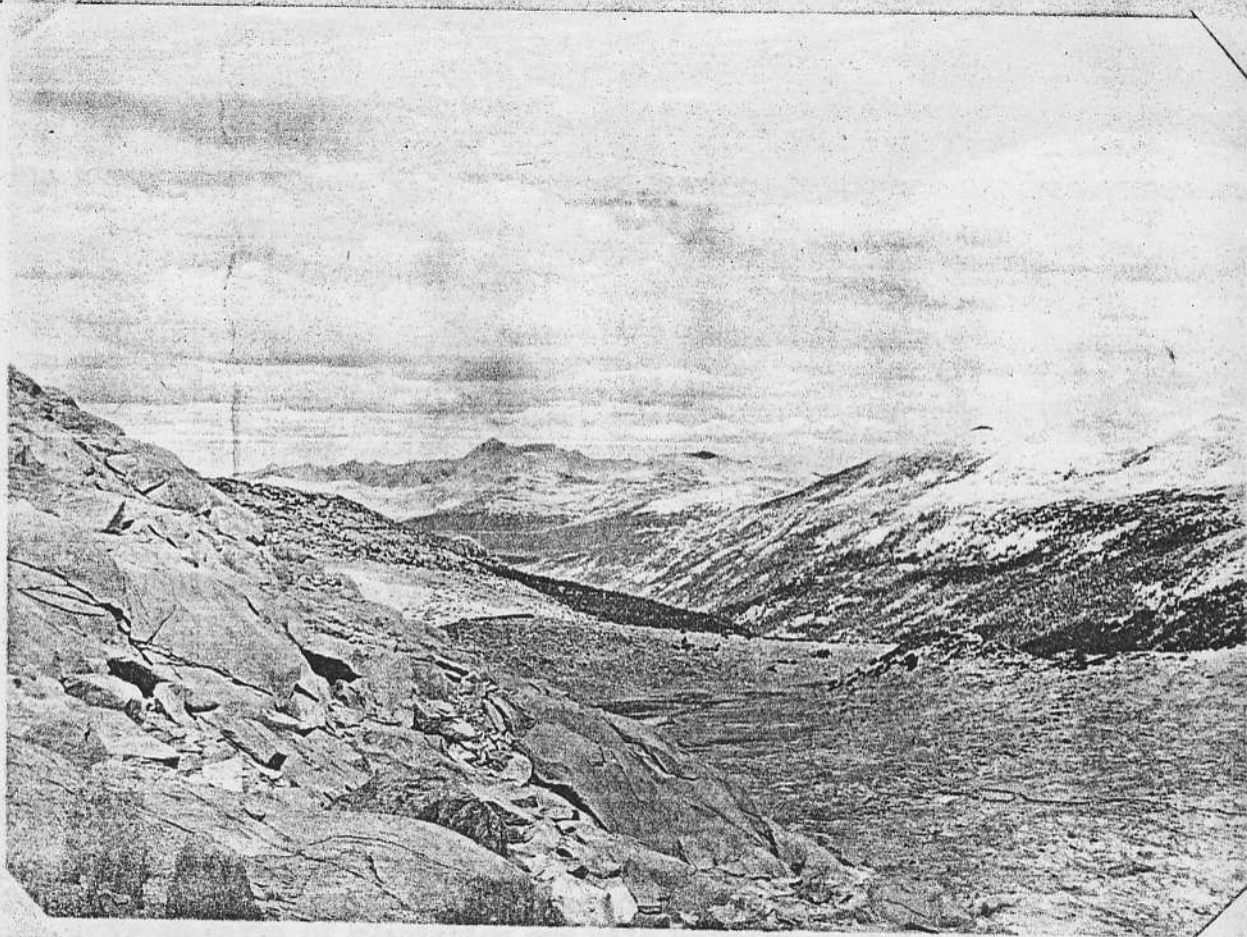
Ranger Westfall, 6' 2", demonstrating depth of one of Lyell's many crevasses.



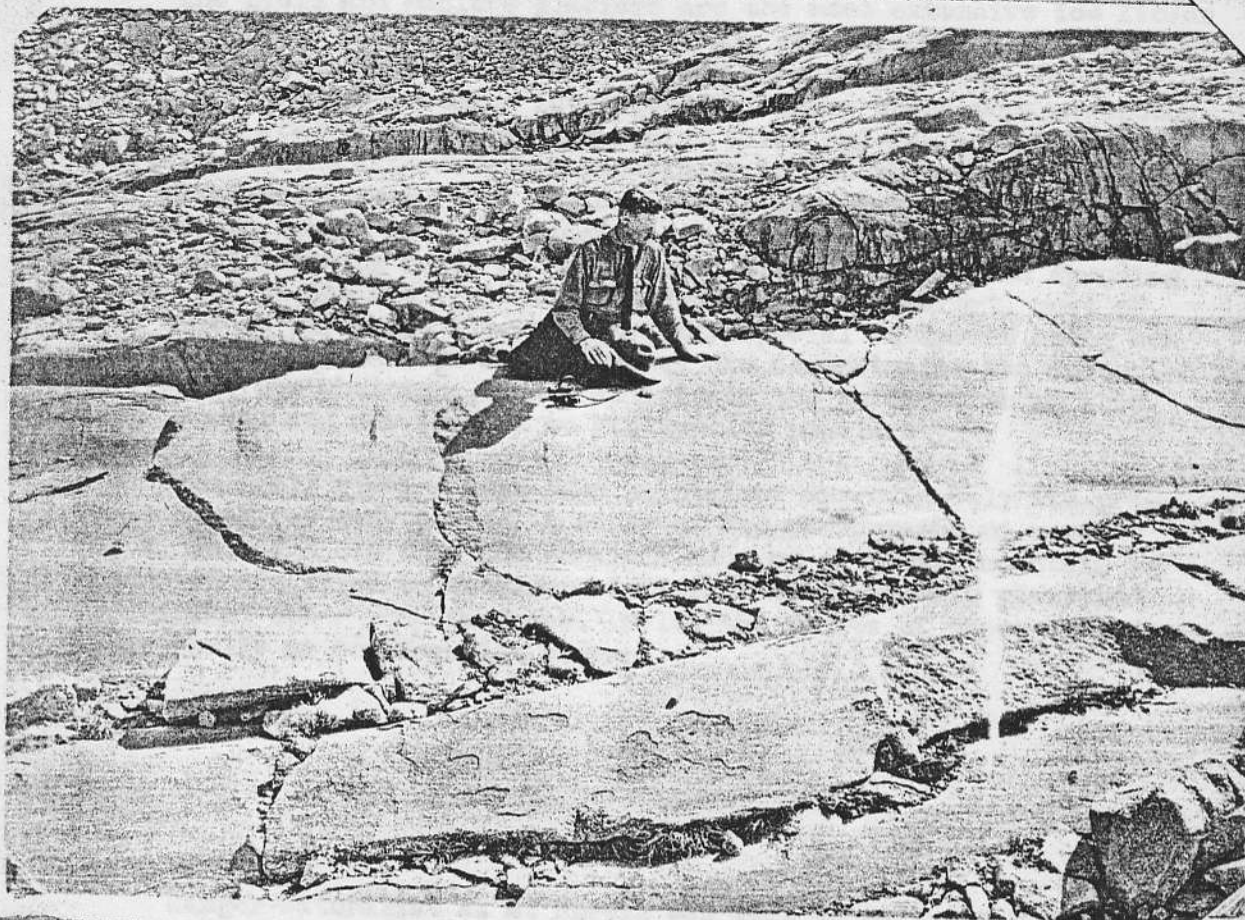
Looking north from the top edge of the Lyell glacier showing in left foreground arête separating Maclure from Lyell glaciers and lakes below the glacier. The glaciated Lyell Canyon extends off to the left to Tuolumne Meadows, beyond which Comness and other northern peaks may be seen.

VOSPS/31MA-P25

22



Looking down canyon from marker X shown on Page 4, Mt. Conness dominates the distant view.



Park Naturalist C. A. Harwell on roches moutonnées showing fresh marks of glacialiation one mile below present ice front. In the ice epoch the Lyell glacier certainly extended sixty miles beyond this point.

YOSPS/310A-P27

SUMMARY

The Lyell and Maclure glaciers are the most extensive ice fields in the central Sierra. They are the only glaciers within the boundaries of Yosemite National Park. From year to year more of our Park visitors are becoming interested in making these more strenuous climbs to study the interesting alpine flora and fauna, to gain the marvelous views afforded, but especially to see these beautiful living glaciers at work. Our two day survey during which we scouted the entire length of these glaciers, climbing up and down moraines, often encountering rocks of very unstable equilibrium, and spending hours out on the ice field with perfect ease and comfort, most of the time in our shirt sleeves, our only special equipment being hob nailed shoes and a rope for emergency use demonstrates the accessibility of the phenomena, and I anticipate the publication of this report will add new impetus to Mt. Lyell's popularity.

The Lyell glacier must have maintained approximately its present front for many years. A study of the photographs on pages 3, 4, and 14 shows that the moraines made up of darker mountain material lie piled to considerable height on previously glaciated granite and other rock surfaces. Below the fronts of these moraines practically no boulders lie strewn.

DANA GLACIER

October 4

Ranger-Naturalist A. E. Borell was sent to mark the present front of the Dana glacier. The following account is his.

To reach the glacier I rode in from the new Tioga Ranger Station around the flank of Mt. Dana and up along the creek. About a mile below the glacier the canyon became a solid mass of slide rock so I left the horse and continued on foot. I believe this is the best approach to the glacier as one can easily walk from the Tioga Ranger Station in two hours. It is easier to follow the bottom of the canyon than to try to contour the sides.

This glacier is a small compact mass of ice on the northeast slope of Mt. Dana. It is more furrowed and hummocked than that on Lyell or Maclure. Some of the hummocks are at least four feet deep. The glacier is melting rapidly and streams of water are flowing over the top and from beneath. This glacier is fully twice as wide as long and has a definite (more or less regular) front. It is quite warm in the sun at this hour (1 P. M.). Near the center there is a narrow chimney of ice which extends up the slope of Mt. Dana. In height this chimney is about two thirds of the length of the glacier.

YOSPS/31 MA-P27

This glacier looks as though it were much more of a "remnant" than Lyell glacier. It is down much lower from the top of the mountain and does not extend out to its terminal moraine. That is, there is from ten to twenty feet between the end of the glacier and the moraine. In no place could I see any of the glacial ice on the lower edge of the moraine. There are two very distinct terminal moraines below the glacier and five glacial lakes. One is quite large and two are deep. There are several crevasses near the top.

A flock of twenty five Rosy Finches were foraging over the glacier - no other birds were seen.

First Measurement.

Began on left (east) hand side as I faced the glacier and worked to the right or west. The first mark (a green +) is on the top of a three foot rock which lies on a level with the exposed base of the ice at this point. Distance from marker to ice front is 31' 11".

Second Measurement.

From five foot boulder which lies slightly higher than base of ice to ice front is 27 feet.

Third Measurement.

From boulder 2' x 4' by 4', rock varicolored, grayish, and purplish, to ice front 31' 8". Rock on level with base of ice. All of the above are to the closest ice which is in the direction of the center of the upper chimney of ice. All of the above paint marks are on loose boulders.

Fourth Measurement.

In center of the canyon is a knob of bare rock. I measured from the west side of this to the nearest ice which is in the direction of the right hand side of the upper chimney, indicated by line P0 on photograph Page 28. The paint (+) mark is on the upper corner which extends only a short way above the talus. Between this mark and the ice is a low (4 ft.) moraine over which I measured. Distance from marker to ice 152' 2".

Fifth Measurement.

This is very positive. On the northwest side of the glacier is a solid ledge of granite. This is the first above knob of rock where measurement four was taken. Here I put such a mark \perp in green paint. The vertical line marks the advance of the ice, the horizontal marks the height at that point. At this paint mark the ice had pulled about 6 feet away from the rock. By 4:35 P. M. the glacier had stopped melting and the melted ice was refreezing.

YUSPS/31 MA-F2



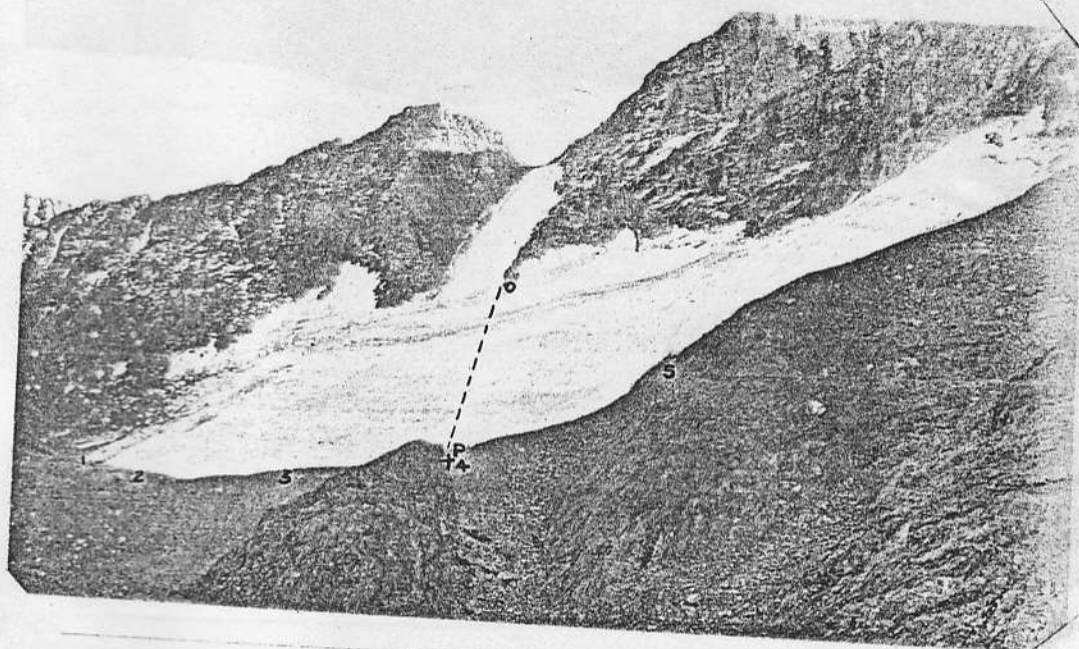
This picture shows the upper chimney referred to in the descriptions of measurements.

Y05PS/31MA-P30

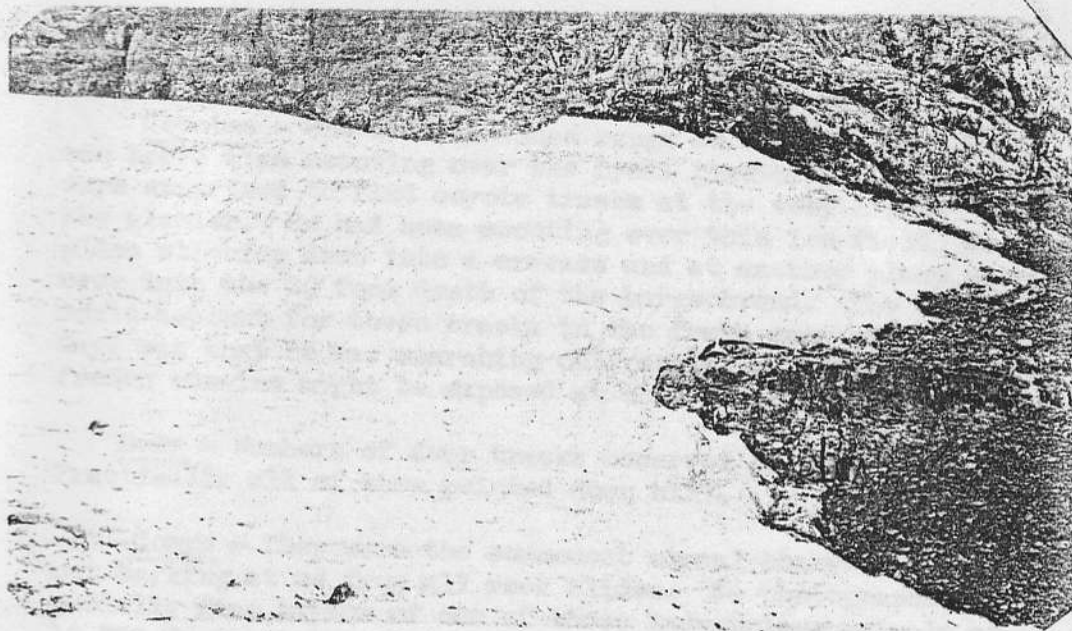
27



The crosses show the approximate places where measurements 1, 2, 3, and 4 were taken. Note the successive accumulations of fine morainial material. The ice has now receded from the moraine along the line marked with crosses. There is now a flattened area between the edge of the ice and the moraine along this line.



Cross was placed at point P and measurement taken in direction of line PO. The distance from point P to nearest ice was 152 feet 2 inches. Mark at point P is on a base rock outcrop which is exposed in middle of canyon. In taking this measurement it was necessary to measure over a moraine which extends about four feet above point P.



The ink mark on the right side of this picture shows the condition as described for the fifth measurement. It is on base rock. The vertical line marks the downward advance of the ice, the horizontal marks the height of the ice against the rock at that point. Note the deep furrowing on the surface of the ice. Small streams flow down each where the sun shines on the ice.

Carlsberg
Park Naturalist

YOSPS/31MA-P35

OTHER OBSERVATIONS RECORDED WHILE ON LYELL TRIP
SEPTEMBER 30 TO OCTOBER 3, 1931

MAMMALS

Marmots - One seen at top of Yosemite Creek grade.

Belding Ground Squirrels - All have been in hibernation for several weeks according to Ranger Skelton.

Coyotes - One seen at close range on trip up Lyell Fork. In two hours time scouting over the Lyell glacier Mr. Borell and I were surprised to find coyote tracks at the very highest point of the glacier. He had been scouting over this ice field, at one place climbing down into a crevass and at another place peering over into the 20 foot depth of the bergschrund. The only way we could account for these tracks in the fresh snow of the past few days was that he was searching out remains of any birds whose frozen remains might be exposed at this season of very low ice.

Deer - Numbers of deer tracks observed on Lyell Fork trail. Practically all of them pointed down hill.

Conys - They were the commonest mammal observed. They were out barking at us from all rock slides. We photographed an especially fine haymow of one of these industrious animals at 10,000 feet altitude on the Maclure Fork.

Mountain Weasels - One in summer coloration was observed near this cony retreat on the Maclure Fork of the Lyell Fork. Altitude here was 10,000 feet. This is 200 feet higher for this animal than recorded by Grinnell and Storer.

Bears - About eight bears are still to be seen at the garbage dumps at Tuolumne Meadows, according to Ranger Skelton.

Douglas Squirrels - Many were seen in the pine and fir forests.

Chipmunks were plentiful.

Badgers - About Tuolumne Meadows and up the Lyell Fork we observed fresh workings of badgers. They are more than likely busy digging out hibernating belding ground squirrels.