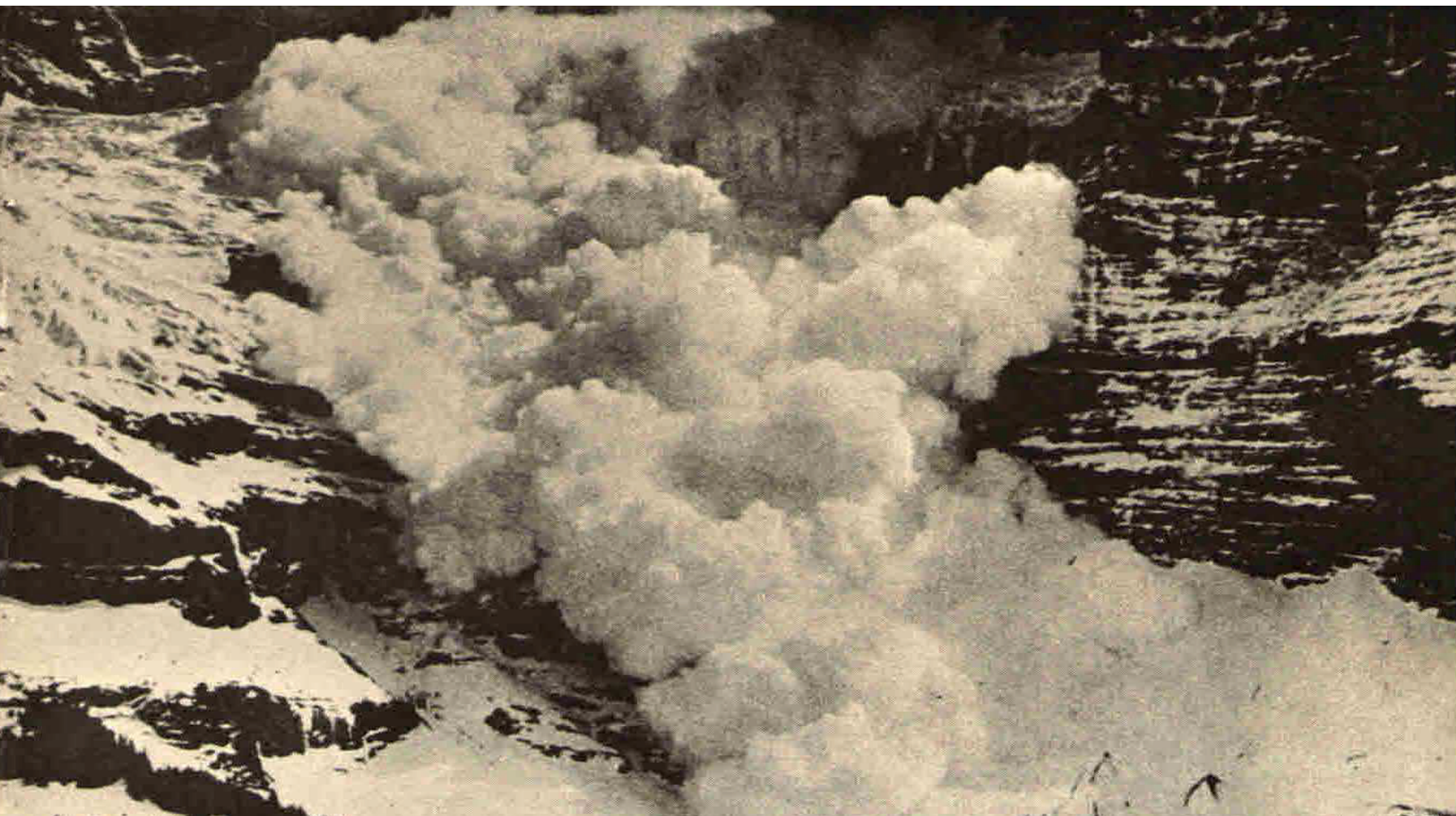
NUMBER 17

APRIL 1965

# ICE



## THE GLACIOLOGICAL SOCIETY

## 1965

## ANNUAL GENERAL MEETING

## AND DINNER

The meeting will take place on Thursday, 6 May, at 5 p.m. in the Roderick Hill Building of Imperial College, Prince Consort Road, London S.W.7.

At 5.30 p.m. Dr. S. Evans will speak on "Radio echo-sounding".

At 7.30 p.m. there will be a dinner in Imperial College Refectory.

Tickets, price 17s. 6d./$2.50 inclusive of wines, may be obtained from the Secretary before 26 April.

Please send your cheque or postal order
(payable to The Glaciological Society)

To:
The Secretary
The Glaciological Society
c/o Scott Polar Research Institute
Cambridge, England.

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**FINAL BOOKING DATE—26 APRIL**

# ICE

## News Bulletin of the Glaciological Society

**APRIL 1965** **NUMBER 17**


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The 1965 Annual General Meeting will take place on Thursday, 6 May at 5 p.m. in the Roderick Hill Building of Imperial College, Prince Consort Road, London S.W.7. At 5.30 p.m., Dr.S.Evans will lecture on "Radio echo-sounding". After the lecture, a dinner will be held in Imperial College Refectory. For details, see inside front cover of this issue of Ice.

COVER PICTURE. Photograph of a powder snow avalanche started by the fall of ice séracs. North side of Jungfraujoch, Switzerland. Photograph taken by André Roch, Eidg. Institut für Schnee- und Lawinenforschung, Weissflujoch, Davos.

ERRATUM- ICE 15, August 1964. New Zealand field work,p. 4, line 19.

The sentence 'This has enabled us to set stakes relatively easily in holes between 15 to 24 metres deep drilling at a speed of 1.87 m/min.' should be ' . . . drilling at a speed of approximately 20 cm/min.'

**Late Notice**

**The 14th General Assembly I.U.G.G. will be held in late September 1967 in Switzerland, at the invitation of the Swiss National Committee.**

# FIELD WORK

## CANADA

### INTRODUCTION

(a) In 1964 field work on glaciers was carried out by Government Departments, Universities, and private organizations in the following areas: the Rocky Mountains, Alberta; the Monashee Mountains, the Interior Ranges, and the Coast Mountains, British Columbia; the Icefield Ranges, Yukon Territory; north-central Baffin Island; and in five areas of the Queen Elizabeth Islands, namely Cornwallis Island, Melville Island, Axel Heiberg Island, Meighen Island, and northern Ellesmere Island. Extensive aerial photographic flights were made over glaciers in western Canada and in the Queen Elizabeth Islands. Photogrammetric and laboratory studies, map compilations, and work on the glacier inventory were continued.

(b) The Sub-Committee on Glaciers held meetings on 27 February and 29 October, at which plans were made for a Symposium on Glacier Mapping. The Symposium, which is also sponsored by the IUGG-IASH Commission of Snow and Ice, will be held in Ottawa from 20 - 22 September, 1965. The programme allows for only a limited number of papers. Glaciologists from various countries have already indicated their willingness to present papers. The Symposium is being publicized in the IUGG Chronicle and in Ice.

### ROCKY MOUNTAINS, ALBERTA: DRUMMOND GLACIER (University of Alberta: J. G. Nelson)

Research on the Drummond Glacier in the upper valley of the Red Deer River was continued for the third summer. Measurements at stakes in a transverse line across the south-eastern lobe of the glacier showed that ablation in the late summer (from early August) and fall of 1963 averaged about 200 cm of ice. Four of these stakes were reset to a depth of 6 m, and during the three-week period after mid-July, when the snow had melted, they showed an average ablation of about 60 cm of ice. Surface movement of the central part of the south-eastern lobe of the glacier was estimated at about 7.6 m for the period early August 1963 to early July 1964. Remeasurement from four stakes near the terminus of the south-eastern lobe indicated a mean recession of about 15.5 m for the period 3 August 1963 to 15 July 1964. Mapping of glacial deposits and measurement of discharge and erosion were continued in the vicinity of the glacier. The research was supported by the National Research Council.

### BRITISH COLUMBIA

(a) Selkirk and Monashee Mountains: Recent Glacier Fluctuations[1] (Geological Survey of Canada: J. O. Wheeler). During the past six years cores have been obtained from mature trees as close as possible to the outermost moraines of fifteen glaciers in this area of south-eastern British Columbia. A review of the cores indicates that the slowest growth took place principally during two periods, from about 1685 to 1750 and 1800 to 1885. Glaciers in southern British Columbia were probably in an advanced position for much of these periods, which accords reasonably well with times of glacier advance inferred from elsewhere in the North American Cordillera. Some of the glaciers appear to have advanced slightly farther during the earlier advance than during the later, whereas others appear to have done the reverse. The greatest rate of growth of many of the trees cored occurred prior to the earlier advance, and suggests that the climate of that time may have been rather warmer than at any time since.

Carbon-14 dates by the Geological Survey of Canada on logs preserved within the trim line of the last maximum glacier stand, and at least 275 m above the tree line, give some insight into glacier behaviour prior to the earliest advance. The logs indicate that trees 30 cm or more in diameter grew at least 275 m above the present tree line in the interval between the advance at the end of the 17th century and about 5,500 years ago. Consequently the glacier advances in the early part of the 18th and 19th centuries were the most extensive that have taken place in south-eastern British Columbia within at least the last 5,500 years.

[1] Published by permission of the Director of the Geological Survey of Canada.

(b) Interior Ranges and Coast Mountains (Water Resources Branch, Department of Northern Affairs and National Resources: I.A. Reid). The Bugaboo and Kokanee glaciers in the Interior Ranges, and the Sentinel Glacier, Sphinx Glacier and the glacier on Nadahini Mountain, all in the Coast Mountains, were surveyed. Permanent control points were established around the glacier perimeter, in bedrock where possible, or in a large rock embedded in glacial debris, and their positions were determined by triangulation. Stereoscopic terrestrial photographs were taken of each glacier, from which a topographical map will be compiled with a Wild A-5 photogrammetric plotter.

WESTERN CANADA (United States Geological Survey: Austin S. Post)

In the course of aerial photographic flights to Alaska from other western States, glaciated areas in western Canada were examined and photographs of snow conditions, glacier activity and various glacier features were obtained. Vertical and oblique photographs were obtained of thirty-nine glaciers in the Selkirk, Rocky, Caribou, and Coast mountains, and in the Alsek and Fairweather ranges, from heights of 2,340 to 4,560 m, on 21 and 22 August. Previous vertical photographs were taken of eight of these glaciers by the University of Washington in August 1963. In addition oblique photographs only were obtained of nineteen glaciers in the Monashee, Selkirk, Rocky, Coast and St. Elias mountains. Previous vertical photographs of twelve of these glaciers were obtained by the University of Washington between 1960 and 1963.

LABRADOR (McGill University Subarctic Research Laboratory, Knob Lake)

The programme of snow, lake ice and permafrost measurements was continued on a routine basis.

ICEFIELD RANGES, Y.T. (American Geographical Society; Arctic Institute of North America)

The Icefield Ranges Research Project (IRRP) completed its fourth season's field work under the direction of Walter A. Wood and the field leadership of Richard H. Ragle. The base camp at the south end of Kluane Lake was occupied from 29 May to 2 September, and three semi-permanent summer research stations were established on glaciers; four auxiliary camps were also used. Logistic support was provided by the AINA "Helio-Courier" aircraft. C. Bull (Institute for Polar Studies, Ohio State University), M. Marcus (Department of Geography, University of Michigan), and M. Mellor (U.S. Army Cold Regions Research and Engineering Laboratory) and members of AINA staff were assisted in field work by fourteen students from seven universities, of whom six students were working for post-graduate degrees.

Research in glaciology included snow pit and ice fabric studies, surface velocity determinations, accumulation and ablation measurements, ram hardness profiles, crevasse mechanics, optical measurements on snow, and sampling of ice and snow for tritium dating. Studies were also made in seismology and gravimetry, glacial meteorology and climatology, and glacial geology, and a programme of survey and aerial photography was carried out.

A research group of six scientists, led by A. Higashi (Hokkaido University, Sapporo, Japan) visited IRRP in late July. They made measurements of snow stratigraphy and of impurity content of snow by electrical conductivity methods; snow samples were taken for analysis of extra-terrestrial particles.

Snow and ice samples from the Kaskawulsh Glacier are being analyzed for oxygen isotope by D.S. MacPherson of the University of Alberta, using a new 12-inch mass spectrometer with a dual collecting system. The ratio of oxygen-18 to oxygen-16 is obtained directly from a digital voltmeter to an accuracy of 1 in 10,000. It is hoped to establish the usefulness of the $O^{18}/O^{16}$ ratio as a natural tracer of glacier flow.

BAFFIN ISLAND (Geographical Branch, Department of Mines and Technical Surveys)

For the third consecutive season Geographical Branch field work was strongly concentrated in northern Baffin Island, where a party of eighteen men under O. H. Løken were in the field from mid-May until late August. The programme included extensive glaciological studies, related geomorphological and botanical work, and the collection of material for carbon-14 ageing.

(a) Barnes Ice Cap (R. B. Sagar and C. Bridge). The field work in late May and early June involved measurements at the accumulation and ablation stakes of previous years, determination of snow depth and snow densities at many sites, and extraction of ice cores for tritium analysis. A new station was established in mid-June at the north-western margin of the ice cap, where observations were carried on until mid-August.

The net regime of the Barnes Ice Cap for the 1961-62 budget year was strongly negative, for 1962-63 positive, and from preliminary examination of data for 1963-64 strongly positive. The 1963-64 winter accumulation was comparable to that of 1961-62, but slightly less than that of 1962-63. A June snowfall, which added about 2 $g/cm^{-2}$, and low temperatures in July combined to give a low net ablation for the 1964 summer. From early August until the end of the field season temperatures were higher and ablation more rapid than in July.

Climatic trends at observing stations in the general area, of which Clyde provides the longest record, show a halt in the tendency to reduced precipitation which marked the period from the late 1940's to the late 1950's. This knowledge has been used with data on summer temperatures, ice-core stratification and tritium analysis in an attempt to establish a sub-surface reference at the 1962-63 station on the crest of the ice cap. Further detailed extraction of weather elements and associated sea level, 850, 700 and 500 mb pressure patterns was undertaken for an analysis of the relationship between climate and glacier mass fluctuations

(b) Lewis Glacier (M. Church). Hydrological investigations of the Lewis River, including measurements of silt content and chemical and physical properties of the melt-water, were continued. An automatic recording gauge provided a continuous record of the volumetric fluctuations. Meteorological observations were made and a network of ablation stakes established on the Lewis Glacier, in order to study the relationship between run-off and meteorological conditions.

(c) McBeth Fiord (D. A. Harrison). From a camp at 69° 42' N, 68° 38' W a detailed study was undertaken of the recent history of two small cirque glaciers and a valley glacier, so that a comparison could be made between recent fluctuations of the coastal glaciers and those of the more continental Barnes Ice Cap. Lichenometry and dendrochronology were used in conjunction with a study of old air photographs and geomorphological survey. Distinct lichen trim lines around all three glaciers indicated recent retreat. Accumulation and ablation stakes were set down on all three glaciers, and remeasurement of these in future years will provide information about the total mass budgets of the glaciers. The lowest ablation stake (at an altitude of 104 m) showed that 208 cm of ice melted between 1 July and 15 August, in spite of a very cool summer, indicating a high total budget for the glacier. An examination of air photographs taken in 1948, 1957, 1958 and 1960 showed that the glacier remained snow-covered for a much longer period in the summer of 1964 than in the other four years.

(d) Inugsuin Fiord (D. M. Barnett and O. H. Løken). Recent changes at the snout of glaciers in the area surrounding the head of Inugsuin Fiord, 69° 35' N, 69° 57' W were studied. With the combined use of air photographs, lichenometry and dendrochronology, it is hoped to date the large readvance moraines that surround all the glacier snouts in this area, as well as more recent moraine features. Cairns were set up in front of three glaciers, photographs of the termini were taken and the distances to ice margins were measured, in order to provide a basis for the study of future changes. Accumulation and ablation stakes were set down on one glacier for a detailed study of its mass balance, which will be supplemented by run-off measurements in the meltwater stream in 1965.

(e) Photography of Glaciers (O. H. Løken). During the 1964 season, air photographs were taken of many cirque and outlet glaciers in the coastal mountains between McBeth Fiord and the Walker Arm of Sam Ford Fiord, as part of the glacier inventory programme.

CORNWALLIS ISLAND (Defence Research Board: H. Serson)

On a visit to the ice-filled gully 3 km east of Resolute Bay, 74° 41' N, 94° 40' W, on 1 September 1964, it was found that there had been an average net accumulation of 3 m of superimposed ice and snow in the budget year 1963-64. Stakes placed in September 1963, the tallest of which was 2.43 m, were completely covered. The melt stream, which formerly flowed through the ice cave at the bottom of the gully, had changed its course to the north side.

WESTERN QUEEN ELIZABETH ISLANDS (Polar Continental Shelf Project, Department of Mines and Technical Surveys)

Glaciological studies continued to form part of the scientific programme of the Polar Continental Shelf Project which is under the general direction of E. F Roots, with W. S. B. Paterson responsible for glaciology in the field.

(a) Melville Island. The snow accumulation for the winter of 1963-64 and the ablation for the summer of 1963 were measured on each of the four small ice caps. The pattern of accumulation on the ice caps is somewhat complex, but in general accumulation is greater at lower levels than on the more exposed upper parts. As a result, although the ablation of snow plus ice during the season decreases with elevation, the amount of ice which is removed shows little variation with elevation. This conclusion is based on the data of a single season, and so is only tentative.

In the 1963 summer, the whole of each ice cap was an ablation area. The mean specific budget for the year 1962-63 showed a loss of 12 g/cm$^{-2}$. The net budget total represented roughly 0.25% of the volume of the southern ice cap, which is the largest of the four. The mean specific accumulation on the ice caps in the winter 1963-64 (as measured at the end of April) was 29 g/cm$^{-2}$, or about 1.8 times the figure for the previous winter. Variations in accumulation and ablation between the different ice caps were relatively small.

(b) Meighen Island. F. P. Hunt redetermined the positions of 14 movement markers on the southern part of the ice cap, where ice thicknesses and surface slopes are greater than elsewhere on the ice cap. Comparison of the results with those of K. C. Arnold's survey in 1960 showed that the ice cap is virtually stagnant or, more precisely, that any movement is less than 30 cm/yr. This result is not unexpected as at no point does the calculated shear stress at the bed exceed 0.3 bars, and the temperature of the ice is -17° C. Moreover, the ice cap has had a negative net budget total in each of the four years for which data are available, and in two of these years the whole ice cap was an ablation area.

For the year 1962-63, the net budget was slightly positive at a few markers on the south-east part of the ice cap, but was negative elsewhere. The mean specific budget showed a loss of 25 g/cm$^{-2}$. The mean specific accumulation for the 1963-64 winter (as measured in early June 1964) was 30 g/cm$^{-2}$, or about 1.5 times that of the previous winter.

EASTERN QUEEN ELIZABETH ISLANDS: PHOTOGRAPHY OF GLACIERS (University of Washington; Polar Continental Shelf Project)

Oblique aerial photographs were taken of a large number of glaciers in Ellesmere, Axel Heiberg and Devon islands, and also, by kind permission of the Danish Government, in north-west Greenland. This work was carried out by A. S. Post of the University of Washington (now with the United States Geological Survey). Logistic support was provided by the Polar Continental Shelf Project.

The object of the programme is to try and obtain some general idea of the present status of these glaciers by the methods which have been employed for glaciers in western North America by Post and others. Certain features of Arctic glaciers - the difficulty of locating the equilibrium line, the fact that changes in position of the terminus are normally very slow - may limit the amount of useful information which can be obtained. However, even a little information may be valuable, because it is only practicable to make detailed measurements on the ground of a very few glaciers, which is inadequate as a sample for drawing general conclusions about the status of glaciers in an area. Detailed analysis of the results is in progress.

AXEL HEIBERG ISLAND (McGill University: F. Müller)

For ten days in August 1964, C. M. Keeler (glaciologist-in-charge), C. S. L. Ommaney (glaciologist), and P. Cress (surveyor) worked on the White, Thompson, Crusoe and Baby glaciers to assess the 1963-64 mass balance in the second year of long-term glacier variation studies.

Some 30 glacier surface positions on the White Glacier were resurveyed, as were also the snout positions of the Thompson, White and Crusoe glaciers; and englacial temperatures were again measured in eight profiles 10-30 m deep in the ablation and accumulation areas of the White Glacier. It was found that the equilibrium line, which had fluctuated between elevations of 900 m and 1300 m in the years 1959-63, was as low as 400 m in 1964. In 1963-64, the mass balance was strongly positive for the first year since the beginning of measurements on Axel Heiberg Island in 1959.

NORTHERN ELLESMERE ISLAND (Defence Research Board; University of New Brunswick; Topographical Survey, Department of Mines and Technical Surveys; Army Survey)

The Defence Research Board operated Tanquary Camp at the head of Tanquary Fiord from late April until late August for the second full season's field work. G. Hattersley-Smith, who was in charge of the station, H. Serson and U. Embacher carried out glaciological studies. G. Konecny, W. Faig and three students from the University of New Brunswick, assisted by Sgt. D. W. Falls, RCE, of the Army Survey, conducted surveys of glacier "C" near the head of Tanquary Fiord, of the Otto Fiord glacier, and of the Ward Hunt Ice Shelf. N. E. Cleary of the Topographical Survey continued a survey of glacier "A" near the head of Tanquary Fiord, started in 1963, and also co-operated in the work of the University of New Brunswick group.

(a) Two glaciers at the head of Tanquary Fiord. Glacier "C", a prominent feature at the head of Tanquary Fiord, drains the ice cap between the north and north-east valleys. A terrestrial photogrammetric survey of the glacier was made; a control net on rock was established and measured The survey points were tied to the Topographical Survey network, established by tellurometer traverse in 1962; this will allow computation of coordinates on the National Topographic System. Vertical air photography of the glacier was carried out in mid-August from flying heights of 2,440 and 3,350 m; the survey points and a number of stakes in the accumulation area of the glacier, fixed by theodolite intersection from the survey points, were signalized for the air photography. Accumulation and ablation measurements were made at a total of 44 stakes. The terminus of the glacier is at an elevation of about 320 m, and the highest part of the accumulation area at about 1.640 m. The 1963-64 snow pack averaged about 1 m in depth in the accumulation area. With the equilibrium line at an elevation of only 750 m, there is little doubt that the mass balance was strongly positive in the 1963-64 budget year. Seismic sounding along a transverse profile near the equilibrium line indicated a maximum ice thickness of about 134 m. Detailed computation of mass balance awaits the preparation of the map.

Glacier "A" is a hanging glacier on the south-east side of the north-east valley. Ablation measurements, started in 1963, were continued at a total of 15 stakes with a view to obtaining hydrological balance of the tongue of the glacier; the stakes were also observed for movement. Stereo-photographs were taken from stations off the terminus of the glacier, established in 1963. These photographs will be used to prepare a map of the ablation area of the glacier.

(b) Otto Fiord Glacier. The Otto Fiord glacier made a remarkable advance between 1950 and 1959, as shown by air photographs, and since 1959 has continued to advance. Unfortunately in early May the glacier was very difficult to approach owing to a combination of thick weather, deep snow and a chaos of icebergs off the terminus. Under these conditions it was impossible to carry out a terrestrial photogrammetric survey. A base for scale control was measured with a subtense bar, and in mid-August vertical air photography of the glacier was obtained from a height of 3,350 m. The new photography will allow an assessment of the glacier advance since 1959, but experience in 1964 showed that provision of adequate ground control is only practicable with helicopter support.

(c) Ward Hunt Ice Shelf. Measurements were made at a total of 40 stakes which were set up on the ice rise in 1960. In the 1962-63 budget year, at only 3 stakes had there been net ablation (2 to 14 cm of ice); at the remaining 37 stakes there had been a mean net accumulation of 20 cm of superimposed ice. The mean snow depth was 50 cm. A net gain at the surface of the ice rise is also likely to have occurred in the 1963-64 budget year.

In order to measure the strain rate at the surface of the ice shelf, a net of quadrilaterals was laid out on the ice shelf to the east of Ward Hunt Island for future resurvey.

(d) Other studies. Snow pit studies were made at about 20 stations on the sea ice between Tanquary Fiord and Kruger Island on an oceanographic traverse, which included detours up all the fiords off Nansen Sound.

A good deal of data bearing on the glacial history of the Tanquary Fiord area has been obtained, and samples of shells, peat, and driftwood - the latter from elevations up to 550 m - have been collected for carbon-14 ageing. A sample from the deep saline layer in the glacial lake at the head of Greely Fiord was collected for carbon-14 analysis of the bicarbonate content. Carbon-14 ages of shells collected in 1963 indicate that Tanquary Fiord ceased to be occupied by glacial ice at least 6,000 years ago.

ICE ISLANDS (Naval Oceanographic Office and Office of Naval Research, United States)

On an air reconnaissance flight of 24 October 1964, "five large ice fragments" were reported on radar lying outside the entrances of the Peary and Sverdrup channels. They are believed to be ice islands calved from the Ward Hunt Ice Shelf in the 1961-62 winter. Reports from the scientific station on the ice island "Arlis-II" gave the position of the island on 18 November 1964 as about 200 km east-north-east of Kap Morris Jesup, the northernmost point of Greenland. From this critical position the future drift of the island cannot be predicted.

PHOTOGRAMMETRY AND MAPPING

(a) Alberta (University of New Brunswick: G. Konecny). Maps at the 1:10,000 scale with 10 m contours were prepared from terrestrial photogrammetric surveys of the Saskatchewan and Athabasca glaciers in 1963. A map of the eastern part of the Columbia Icefield at the 1:25,000 scale is being prepared in two editions, one with 100 ft (c. 30 m) contours and the other with 25 m contours. The map is being scribed by G. Gloss, and will be printed by the Department of Mines and Technical Surveys.

A photogrammetric test was carried out to determine the accuracy of photogrammetric contouring in snow and ice covered areas with varying conditions of detail, albedo and illumination, and from photographs taken at various flying heights. Contouring was generally less accurate on snow than on bare ground, but for the lower flying heights the reliability was acceptable.

(b) British Columbia (Topographical Survey). Photogrammetric plotting is being undertaken of the five glaciers in the Interior Ranges and Coast Mountains surveyed in 1964 by I. A. Reid of the Water Resources Branch.

(c) Arctic Islands (Topographical Survey). Two map compilations of the Hell Gate area are being prepared at the 1:125,000 scale with 200 ft (c. 60 m) contours and at the 1:50,000 scale with 100 ft (c. 30 m) contours. The area includes ice covered parts of North Kent Island, north-western Devon Island and south-western Ellesmere Island. A map of the ice cap on Meighen Island is being produced at the 1:25,000 scale with 5 m contours. It is expected that complete map coverage of the Arctic Islands at the 1:250,000 scale will be available in 1966.

(d) Axel Heiberg Island (Photogrammetric Research Section, National Research Council: T. J. Blachut). A 1:10,000 map of the entire White Glacier was produced for members of the McGill University Axel Heiberg Island expedition. On the map, which is approximately 100 x 150 cm in size, an attempt was made to portray all the information required by the glaciologists, as complete as possible Because there was a lack of ground control in the accumulation area, an aerial triangulation had to be carried out beforehand. A contour interval of 10 m, and occasionally 5 m, was used. The map is being published in two colours by McGill University.

INVENTORY OF CANADIAN GLACIERS (Geographical Branch, Department of Mines and Technical Surveys: G. Falconer)

Work on a second report in the series summarizing historical glacier variations was started by G. Falconer and W. E. S. Henoch. This report deals with the glaciers of the north-east coast of Baffin Island between Coutts and Clyde inlets. Additions to the Geographical Branch collection of glacier photographs include a valuable series taken by the late Dr. H. R. Thompson and presented by his widow. Many of the photographs record the positions of glacier termini and related features in the Pangnirtung Pass area of Baffin Island in 1953, during the Arctic Institute of North America expedition. These photographs will be compared with low level air photographs to be taken in the area in 1965.

EXPERIMENTAL STUDIES (Snow and Ice Section, Division of Building Research, National Research Council: L. W. Gold)

(a) Heat exchange. Observations were made during the winter of 1963-64 on the influence of "styrofoam" sheets in reducing or inhibiting the thickening of ice covers. Two 2.4 by 2.7 m sheets, one 2.5 cm thick and the other 5 cm thick, were placed on the ice when it was about 12 cm thick. It was observed at the time of maximum ice thickness that no increase in thickness had occurred under the two styrofoam sheets, whereas the ice thickness away from the sheets had increased by about 23 cm.

(b) Ice-dusting. In the spring of 1964, ice-dusting trials were carried out on a small lake at Inuvik, N. W. T. Three methods of accelerating break-up were tried: (1) the snow was removed from the ice surface; (2) the snow was removed and sand spread on the ice surface; and (3) the snow was removed and mud pumped from the lake bottom over the ice surface. Unseasonably cold weather during the period immediately preceding break-up was unfavourable for the purpose of the trials. But under these conditions removal of snow cover appeared to be as effective as dusting the ice with sand or spreading a thin layer of mud on the ice surface. Further trials under more favourable conditions are needed to check the relative effectiveness of removal of the snow cover and ice-dusting.

(c) Deformation behaviour of ice. The analysis of observations on the initial creep behaviour of ice have been completed and written up. It was observed that previously undeformed columnar-grained ice exhibits a relatively high initial resistance to deformation when loaded in compression perpendicular to the long axis of the grains. During primary creep, small angle boundaries and, if the stress is high enough, internal cracks are formed. These structural changes lead to a considerably lower initial resistance to deformation when the ice is reloaded under the same conditions as before. With continued deformation, however, the resistance on reloading exceeds that for first load. The results of the observations from these simple compression experiments were found to be in agreement with earlier observations on the deformation of ice beams.

Observations are being continued on crack formation in ice during compressive loading. It has been found that the rate at which cracks form depends on the applied compression stress, the time since the application of load, and the temperature. It has also been found that the cracks tend to form parallel and perpendicular to the basal planes of grains which are not favourably oriented to deform under the applied stress.

G. Hattersley-Smith

## GERMANY

In 1964, glaciological activity in Germany was organized by the Commission for Glaciology at the Bavarian Academy of Sciences, Munich, which, in collaboration with the Institute for Photogrammetry of the Technical University of Munich, continued the routine observations and studies of glaciers in the Eastern Alps.

Photogrammetric surveys were executed at the following glaciers:

| | |
|---|---|
| Zillertall: | Schwarzensteinkees |
| | Hornkees |
| | Waxeggkees |
| Oetztal: | Langtalerferner |
| | Hintereisferner |

The glaciological field work was extended to include the determination of accumulation and ablation at Langtalerferner (Oetztal) and Schneeferner (Zugspitze).

During 4 field trips to Langtalerferner the existing net of 33 markers was measured and preserved by drilling. Reserves of old snow in the higher regions were extremely small; ablation in the lower parts was considerably higher compared with 1963. Maximum ablation was 4.91 m in 1964 as against 3.91 m in 1963.

In 4 more field trips the test field at Schneeferner was re-measured. Maximum ablation was 2.48 m as against 2.02 m in 1963; however, this value is smaller than the ablation in comparable altitudes (2630-2650 m) at Langtalerferner.

A new test field was explored by members of the Commission for investigations during the Hydrological Decade. It extends over the glaciers in the Niedertal (upper Oetztal) and is close to Prof. Hoinkes' test area in the Rofental.

For the summer 1965 a new Glacier Course (Course for Research in High Mountains and Polar Regions) is planned.

After the retirement of Prof. Geiger the Academy elected Prof. Dr. J. Büdel, Würzburg, as the new Permanent Secretary of the Commission.

W. Hofmann

## ICELAND

### ICELAND GLACIOLOGICAL SOCIETY - FIELD WORK PRIOR TO 1964

Since 1953 the Iceland Glaciological Society has sent expeditions to Vatnajökull every spring and most autumns. The main tasks of these expeditions have been to study the annual changes in the Grímsvötn area, measure accumulation and ablation in different parts of Vatnajökull and carry out different kinds of geophysical work such as temperature measurements, seismic soundings and gravimetric and magnetic measurements. Some of these expeditions have covered the entire Vatnajökull. An expedition in 1956, doing geodetic work, travelled 1000 km on the glacier. The vehicles used for these expeditions are weasels and a Canadian Banbarider.

In 1959 a group of geodesists levelled with tachymeters a section 3,3 km in length from Nýjafell at the western edge of Tungnárjökull inwards over the ablation area, and another section, 19.3 km in length, between Kerlingar at the north-western edge of Tungnárjökull to the nunatak Pálsfjall. In 1961 the geodesists levelled a 42 km section between a trigpoint on Svíahnúkur eystri, in the south rim of the Grímsvötn Caldera, and a trigpoint on Kverkfjöll, at the northern edge of Vatnajökull. The plan is to repeat these levellings at intervals (the Nýjafell section is levelled every second year) and to extend the Nýjafell line to Grímsvötn.

In order to facilitate the annual accumulation-ablation measurements strong iron masts were erected in October 1961, one 6 km north-east of Svíahnúkur eystri, one 7.5 km north-west of Pálsjall. Every year some meters are added to the height of each mast. With the help of these masts the net accumulation or ablation during a given period can be read from an aeroplane.

The research work on Vatnajökull has been greatly facilitated by the establishing of the glaciological Station Jökulheimar, on the west side of Vatnajökull, near the margin of Tungnárjökull, at the altitude of 674 m. The first hut was built there in 1955. Store huts for weasels, fuel etc. were built later. A hut was built in 1957 on the summit of Sviahnúkur eystri on the Grímsvötn Caldera rim, at a height of 1719 m. The surface ground temperature is there 11° C so that the summit is usually free of snow. The Sviahnúkur hut is very useful for the research work in the Grímsvötn area.

## FIELD WORK IN 1964

In 1964 only one expedition was sent to the Grímsvötn area, in spring. This expedition, led by G. Gudmundsson, carried out the routine work of measuring the winter accumulation, by drilling and digging, and the changes in the height of the surface of the Grímsvötn Caldera.

The main efforts of the Iceland Glaciological Society during 1964 were connected with the catastrophic advances of two of the big outlets from Vatnajökull, Brúarjökull and Sídujökull. The entire front of Brúarjökull, about 45 km in length, advanced over the relatively flat inland plateau, mainly between the middle of October and the end of the year 1964. The maximum advance in the Kringilsárrani area was at least 8 km. Reconnaissance flights were made 16 November 1963 and 12 January, 11 March and 26 July 1964. These flights revealed that the entire ablation and accumulation areas of both Brúarjökull, about 1000 $km^2$, and Sídujökull, on the south-west side of Vatnajökull, were heavily broken up.

During 1964 the margins of these two glaciers and their Vorlands were photographed from the air by the Iceland Geodetic Survey and expeditions were sent to study more closely the advance of these glaciers. The first expedition reached Brúarjökull 4 January 1964, when the glacier was still advancing at a rate of 1 m/hour. A second expedition visited Brúarjökull in July and also visited the glaciers of the extinct volcanic cone, Snaefell, altitude 1833 m, which have not been studied since J. N. Jennings and W. V. Lewis visited them in 1937. Sídujökull was visited both in the spring and autumn of 1964.

The entire interior of Iceland is deserted. Consequently all weather stations in the country are found within its peripheral areas and far too little is known about the climate in the interior. Since 1962, however, a weather station has been operated by the Icelandic Weather Bureau during the summer months at Hveravellir, altitude 600 m, between Hofsjökull and Langjökull.

During the summer of 1963 the Glaciological Society run a weather-station in Jökulheimar and this station was also run during the summer of 1964. There are now plans to make the Hveravellir station and possibly the Jökulheimar station permanent ones, working throughout the whole year.

The longitudinal glacier variations were as usual measured by J. Eythorsson, who has carried out this work since 1930. Between 40 and 50 glaciers are measured. Eythorsson's 70th birthday was 27 January 1965, but he is still untiring in his glaciological work.

Sigurdur Thorarinsson

# ITALY

## THE VARIATIONS OF ITALIAN GLACIERS IN 1964

SUMMARY: The results of the annual glaciological campaign, organized by the Italian Glaciological Committee in the summer of 1964, are examined. 119 glaciers were inspected. Of these 94 were retreating, 10 advancing and 15 were uncertain or stationary. The very intense retreat is therefore continuing.

During the summer of 1964 the annual glaciological campaign to check frontal variations in Italian glaciers in the Alps and Apennines was carried out as usual.

From a first cursory examination of the data collected, it is immediately obvious that 1963-64 was an unfavourable period for the glaciers The negative effects of 1964 will be still further noted in the next few years because the influence on glaciers of changes in temperature and snow formation is delayed.

In any case, the 1964 data do not confirm what 1963 seemed to suggest, namely the beginning of a slowing down in retreat in view of a new advance period.

Snowfalls were slight on the whole; we report the data obtained in an Alpine meteorological station, that of Goillet in the Aosta Valley (Penine Alps) situated 2526 m above sea level (see Table I).

Table I - Goillet meteorological station (2526 m a.s.l.) (Aosta Valley)

| | Snowfalls | Snowfalls in cm | |
|---|---|---|---|
| 1963 | October | 47 | |
| | November | 120 | Beginning of snow cover = 3 October 1963 |
| | December | 40 | |
| 1964 | January | 13 | Total: 487 cm (in 1962-63 |
| | February | 46 | 633 cm were measured) |
| | March | 83 | |
| | April | 126 | End of snow cover = 12 June 1964 |
| | May | 12 | |

The only months with a comparatively large quantity of snow were November and April. Snow accumulations in the other basins were therefore also slight. The mean summer temperature also showed a slight increase in comparison with previous years; the mean in 1964 from May to September was 5.9° C, while that of 1963 was 5.3.

Table II - Goillet meteorological Station (2526 m a.s.l.)

Mean summer temperatures in °C

| | 1963 | 1964 | |
|---|---|---|---|
| May | -0.1 | 2.1 | In 1964, the month of July |
| June | 4.7 | 5.9 | favoured an extensive ablation. |
| July | 6.9 | 8.7 | Further, the higher mean |
| August | 9.8 | 7.2 | temperatures in May and June |
| September | 5.1 | 5.8 | anticipated the ablation process. |

All workers noted generally a veritable decomposition of glaciers in the frontal areas, while in the collection basins numerous crevasses were formed which often impeded movement on the high glaciers.

| | | 1963 | 1964 |
|---|---|---|---|
| Total glaciers inspected | 119 | | |
| advancing | 10 | 9.6% | 8% |
| retreating | 94 | 45% | 79% |
| stationary and uncertain | 15 | 45% | 13% |

M. Vanni

## SWEDEN

The field work at the Tarfala Station in Kebnekaise, Swedish Lapland, started with a shorter period in March and went on continuously from 5 May to 15 September. In May a British party led by Hal Lister studied the heat exchange close to the snow surface, and during June, July and August several students from abroad visited the station for longer or shorter periods.

The mass balance studies gave a positive balance for the budget year 1964-1965:

| | | |
|---|---|---|
| Total winter accumulation: | $4.9.10^6 m^3$ of water | (159 $g/cm^2$) |
| Total summer ablation: | $3.4.10^6 m^3$ | (110 $g/cm^2$) |
| Balance: | $+1.5.10^6 m^3$ | (+49 $g/cm^2$) |

This is the third year with a positive balance since the studies were initiated in 1945/46.

Because of the cool summer, snow was still left along the front of most Kebnekaise glaciers at the end of the summer and thus the average frontal retreat was quite close to 0 m.

A more comprehensive report has been submitted to Geografiska Annaler and will appear in the first issue of 1965 (April).

V. Schytt

## UNITED KINGDOM

NORWAY - SVARTISEN EXPEDITION. The Expedition, which continued an annual series commenced in 1956, arrived at the Svartisdal hut on 28 June 1964 to find that the snowline was lower than at any time during the previous five summers. On 20 July the main base was moved to the corrie west of Blakkåtind, at a height of 864 m. Snow remained within the corrie throughout the summer, and the lake still was almost completely ice-covered when the base camp was vacated on 23 August.

Observations of the movement of 13 stakes placed below the icefall of Østerdalsisen between 1960 and 1962 were continued in 1964, and six additional stakes were set in the ablation zone of the glacier; ten were inserted in the accumulation area, above the icefall.

Six pits were dug in the accumulation area, and snow depth soundings were made at 271 points. The great depth of snow remaining above 1100 m prevented sounding at higher levels, and continuous cores were taken from the bottom of the three highest pits to provide information about net accumulation.

The highest pit was dug at a height of 1368 m, and density samples were taken from the 320 cm-deep walls at intervals of 25 cm. A continuous core was extracted from the bottom of the pit, to a total depth of 1676 cm below the snow surface. Similar cores were taken to depths of 773 cm at 1322 m, and to 1726 cm at 1121 m. The pit at 1121 m was excavated in an area known to have retained snow and/or firn in 1960 and 1961, when much of the ice of the accumulation area of Østerdalsisen was laid bare.

Conditions within the lower accumulation basin contrasted with those of the previous few years, for the equilibrium line remained as low as 900 m until late August. Above this height, bare ice was revealed only on some of the steeper slopes. Meltwater pools formed at a number of flatter places in late August, but no system of surface drainage existed, and much of the water probably refroze at lower levels within the snow and firn cover.

The depth of old snow in late August generally was greater in the western part of the accumulation area than at equivalent altitudes in the eastern part. Much snow fell during the summer: early on 17 August after $2\frac{1}{2}$ days of snowfall, the depth of new snow at the base camp was 55 cm. On 29 August the depth of new snow remaining at 1368 m was 30 cm; at 1121 m there was 26 cm, and at 1085 m 20 cm.

On 23 August a 700 m-long orange-coloured, rot-proof cord was laid across the upper accumulation area to provide a datum for later studies. The cord was attached to a cairn at the foot of the south-east ridge of n. Kamplitind. It passed through a large loop encircling a stake near the pit at 1368 m, and stretched across the basin south-east of Sniptind.

The eastern end of Østerdalsisen, which terminates in a meltwater lake, retreated 40-45 m between 25 August 1963 and 25 August 1964; since August 1959 it has retreated about 250 m. Ablation at the centre of the glacier in 1963-64 totalled about 6 mm.

In July, survey markers were erected on many of the mountains surrounding the Østerdalsisen accumulation area, and on nunatak peaks within it, but bad weather prevented completion of triangulation there. Stake positions in both the accumulation and ablation areas of the glacier were fixed by resection, but the co-ordinates of the upper stations cannot be determined until the triangulation programme is completed.

Meteorological observations were made twice daily at the Svartisdal hut (250 m a.s.l.). The 1964 summer was the wettest since 1956, and was said by local people to be one of the worst in memory. Precipitation was recorded during exactly half of the twelve-hourly periods of the 57 days of observation (1 July - 26 August); total precipitation was 308.6 mm. 106.4 mm fell in one spell of 60 hours, of which 65.8 mm was recorded between 2100 hours 26 July and 2100 hours 27 July.

The maximum recorded temperature (9 August) was 25.0° C and the minimum (17 August) was 0.0° C. Between 10 July and 24 August there were 14 sunless days and 157 hours of sunshine. The average wind speed for the period 4 July - 24 August was 10.2 km/hour. Winds blew predominantly from the west or north-west (63% of observations).

An extensive programme of geomorphological studies in the Svartisen area was continued in 1964. Active processes (nivation, solifluction, the formation of abrasion marks by creep of the snow cover, and fluvial erosion) were studied. A detailed investigation has been carried out at Svartisen during the last few years, with the aim of elucidating the problems connected with the history of the glaciation and the geomorphological development of the area. Studies in 1964 were concentrated to the south of the ice cap.

Geological observations and vegetational studies were made by members of the expedition, which was led by W. H. Theakstone.

The Svartisen area is covered by four sheets of the 1:100,000 topographic survey (Gradteigskart) published by Norges Geografiske Oppmåling - Svartisen (J13), Melöy (K13), Dunderlansdalen (J14) and Beiardalen (K14).

W. H. Theakstone

## U.S.A.

U.S. ARMY COLD REGIONS RESEARCH AND ENGINEERING LABORATORY: FROZEN GROUND INVESTIGATIONS, BARROW, ALASKA. An integrated pedologic and near-surface stratigraphic study has been underway at Barrow, Alaska since 1962. The summer 1964 was marked by abnormally low precipitation which resulted in a dramatic drying up of the commonly wet tundra. The depth of seasonally thawed soil was considerably reduced with an average thaw at 720 points of 33 cm as compared to 40 cm in 1963 and 42 cm in 1962. Radiocarbon dating from this area of perennially frozen ground further substantiated the existence of a buried, organic soil layer some 8300 to 10,700 years old. Below this zone a massive, buried ice wedge yielded radiocarbon dates of 14,000 and 8200 years B.P. on organic residue recovered from the foliated ice. Pollen analyses of the older sample suggested a more severe climate at that time. Other activities during the spring and summer of 1964 included a coring program in which frozen, chemically uncontaminated cores were recovered to depths of 20 meters in an effort to establish the late-Pleistocene depositional environments of this coastal plain deposit. Studies continued on the erosional characteristics of frozen ground, ground temperature - microenvironmental relationships and the hydrogeochemical balance in an arctic watershed. Assistant project leaders were Paul V. Sellmann (CRREL) and Robert I. Lewellen (University of Denver).

1964 publications and reports:

1. Near-surface stratigraphy, Barrow, Alaska: Core analysis.
P. V. Sellmann, J. Brown and R. I. Lewellen, 15th Alaskan Science Conference, p. 39-40.

2. Pedo-ecological investigations, Barrow, Alaska: J. Brown and P. L. Johnson, CRREL Technical Report 159 (in press).
3. Coring of frozen ground, Barrow, Alaska: P. V. Sellmann and J. Brown, CRREL Operational Report (mimeo copy available).
4. Barrow, Alaska Bibliography, a select list of investigations on frozen ground and related subjects: J. Brown (mimeo copy available).
5. Radiocarbon dating, Barrow, Alaska: J. Brown. Manuscript submitted to Arctic, September 1964.

Jerry Brown

MICHIGAN STATE UNIVERSITY. 1964 SUMMER INSTITUTE OF GLACIOLOGICAL SCIENCES and the associated JUNEAU ICEFIELD RESEARCH PROGRAM. The emphasis in 1964 was on combining instruction with field research in the inter-disciplines of peri-glacial geomorphology, glacier regimen, glacio-climatology, glacier mechanics and geophysics, glacio-photogrammetry, glacio-botany and glacier and Pleistocene palynology. Formal sessions of the Institute covered the 6-week period 18 July - 29 August.

The program was under aegis of the Glaciological Institute and the Geology Department of Michigan State University and was supported by the National Science Foundation, Michigan State University, the Abrams Aerial Survey Co., the Margaret Trust Fund, the Readers Digest Foundation, the MSU Development Fund, the Potter Aeronautical Co., and the Foundation for Glacier Research. Forty men were involved in the field program, including 17 graduate students and 5 undergraduates from a dozen universities in the United States. Two foreign graduate students, one from India and one from Iraq, also participated. The academic staff consisted of five professors, two instructors, and several visiting lecturers. The non-academic staff comprised nine persons and included a senior M.D. and a terrain safety instructor. Five men were associated with the Institute as research associates or field assistants.

Preceding and following the Institute field activities, the long-term Juneau Icefield Research Program was carried out by a nucleus of nine of the staff members and six selected student assistants. The periods involved were 15 June - 17 July and 30 August - 27 September. This was the 19th successive year of the research program. This season's work was supported by a grant from the National Geographic Society, which support also concerned a regional glacier survey in five other localities along the coast, with emphasis on the effects of the 1964 earthquake in the region between Yakutat and Prince William Sound. In the regional assessment the Juneau Icefield was taken as a "control" locality, where glacio-climatic effects could be observed outside of the areas of tectonic sensitivity. This year's investigation was concentrated primarily in the peri-glacial realm of the Berners Trench and the Taku Fiord to Lynn Canal sectors, leaving the Institute's emphasis on aspects of glaciology in the areas of the icefield proper.

M. M. Miller

OHIO STATE UNIVERSITY, INSTITUTE OF POLAR STUDIES. INVESTIGATIONS IN THE NORTH, SUMMER 1964. During August 1964, Arthur S. Rundle, assisted by Ronald A. Spahn, carried out glaciological investigations on the Sukkertoppen Ice Cap, south-west Greenland. The work included the placing of accumulation stakes on an east-west line across the ice cap; examination of firn stratigraphy, density, and temperature to a depth of 12 meters; and investigations in the ablation and superimposed ice zones. Analysis of this data is currently underway in Columbus, Ohio. Initial results show that accumulation does not vary significantly across the ice cap. Means for a period of years at four selected sites are 29.5 $g/cm^{-2}$, 32.3 $g/cm^{-2}$, 32.2 $g/cm^{-2}$, and 31.1 $g/cm^{-2}$.

Several related glaciological studies were carried out on the upper end of the north arm of the Kaskawulsh Glacier in the Icefield Ranges, Yukon Territory, Canada. These programs were also supported by the Arctic Institute of North America.

Henry H. Brecher investigated the short-term variation of glacier surface motion. Five determinations of the positions of 25 stakes on the glacier were made between 14 July and 14 August by intersection from cairns established on rock and tied to existing known points on a local coordinate system. Preliminary calculations for some of the stakes indicate motion on the order of 3 meters per week with no significant variation from week to week.

Gerald Holdsworth made a study to relate a critical surface strain rate to the occurrence of transverse crevasses in a previously undeformed ice mass. Factors which govern the magnitude of the strain rate were examined and measured. Depths and spacings of crevasses were measured in order to verify certain theories which specify their values.

Peter W. Anderton is making a glaciological study at the confluence of the north and central arms of the Kaskawulsh Glacier. This includes ice core studies of crystal structure at eleven localities selected for strain rate and movement measurements Fabric shows a 2 to 4 maxima pattern related directly to foliation at the glacier margins and in the zone of confluence, and related partly to coarse foliation and partly to cross-cutting blue bands in the center of each arm. Crystal dimensions ranged from 1 mm - 7 mm. Bubble orientation is variable with respect to foliation. Observations were made of foliation and fracture patterns at 64 localities chosen for velocity measurements on ice, and information was obtained on thickness and composition of ice-cored moraines at a further 28 points chosen for velocity measurements. Also recorded were ablation readings and observation of surface conditions at each of the above 92 locations, related to rudimentary meteorological records.

Seismic reflections and refraction observations were made by Gilbert Dewart on the central arm and at the confluence of the central and north arms of the Kaskawulsh Glacier. Experiments were made with variations of energy parameters on different types of glacier surface such as ice-cored moraine and crevassed ice. Bedrock reflections were obtained at 500-600 meters under the central arm. Data reduction is in progress.

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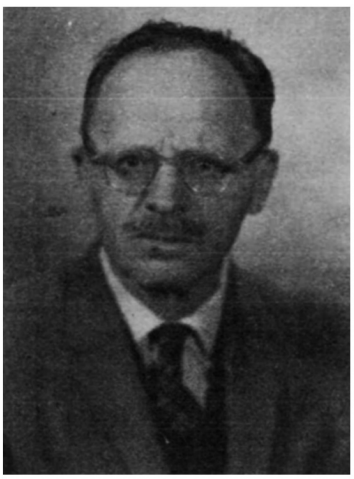

## Fritz Loewe

When Fritz Loewe was born in Berlin on March 11th 1895 as son of a Prussian judge environment and tradition pointed to the law as his future. But although he began to study law in Grenoble in 1913 there were early signs of nonconformism, such as a fascination with the new flying machines. The war interfered and took him as a signaller first into a cavalry regiment to the east and later to the western front where he obtained the Iron Cross first class.

After the war Loewe turned to physics, geography, and especially meteorology, the subject that held promise of flying. From 1922 to 1925 he was Scientific Assistant at the Meteorological Observatory at Potsdam, and during that time he also became a member of the Institute of High Mountain Climatology at Davos and the Institute of Oceanography, Berlin, and was President of the University Branch of the German and Austrian Alpine Club. In 1923 he obtained his degree of Doctor of Philosophy in Geography.

In 1925 he became the first head of the new Meteorological Research Flight of the Prussian Meteorological Service. In the three years that followed Loewe made more than 500 flights, many of them to 20,000 ft and all of them without such frills as insurance or oxygen. The passion for flying has remained with him and even now he misses no opportunity to do so (not long before his 70th birthday he had his first hour in a glider); as a result studies of meteorological conditions in the free atmosphere figure prominently in his published work.

He always had other interests. He made a prolonged stay at the Jungfraujoch in the summer of 1924 in order to co-operate in the study of cosmic radiation. In 1925 he joined the "Meteor" on a preliminary Atlantic Expedition, and during 1926 he made a study of the heat economy in the high mountains at the Lötschenlücke (Aletschgletscher). He next went to Central Anatolia, and also made studies by aeroplane in Iran.

In 1929 Loewe went for the first time to Greenland, where he took part in a preparatory expedition to the ice cap. The expedition made the first estimates of the thickness of the ice, took measurements in the accumulation region, and made glacier surveys. He was a member of Wegener's Greenland Expedition of 1930-31, and took part in extensive sledge journeys. He made mass balance observations in the ablation and accumulation zones of the ice cap, wintering at "Eismitte". In 1932 he visited the Umanaq district of Western Greenland, to make oceanographic and glaciological studies.

The rise of the Nazis brought serious personal difficulties for Loewe. In 1934, after a short spell in a concentration camp, he left Germany as a political refugee and found a welcome in England at the Scott Polar Research Institute. There he worked as a Research Guest of Cambridge University - mainly on problems related to Greenland and Antarctic Meteorology - until early in 1937. He was one of the many hundreds of displaced scholars and scientists who at that time received transient help from the Academic Assistance Council (later the Society for the Protection of Science and Learning), an organization which had its executive office in the Scott Polar Research Institute.

In 1937 Loewe and his family went to live in Melbourne, where he created the first and only University department of meteorology in Australia. In the 25 years that followed he trained the present top echelon of the Australian Bureau of Meteorology and published numerous studies on Australian and southern hemisphere meteorology. His Greenland experiences had left their imprint, however, and his thoughts were attracted more and more to the other major ice cap. In 1947 there came his first chance to go south, in the "Wyatt Earp". He failed to reach the Antarctic continent that time, and so tried again in 1950, when he sailed with a French expedition in the "Commandant Charcot". For good measure, he went south once more in 1951 and wintered with the French at Port Martin.

Loewe's year at Port Martin led to a broad study of the Antarctic heat and mass balance, and he reached the conclusion that the ice cap may be growing at the present time. This study also initiated the Australian work on drifting snow which grew to considerable proportions during and after the IGY.

One major ambition remained - the Himalayas. This he realised in 1958 when, during a year in Pakistan as a UNESCO expert entrusted with the creation of a meteorological training school, he was able to carry out a glacier survey of the Nanga Parbat region together with W. Kick.

Loewe's retirement from the chairmanship of the Meteorology Department in Melbourne has been merely an excuse for further exploits. As research fellow of the Institute of Polar Studies at the Ohio State University he has crossed the world several times by unorthodox routes, twice revisited the Greenland ice cap, and only missed an expedition to the Ross Ice Shelf through an untimely but passing illness.

His masterly surveys of Antarctic and Greenland results, his aerological studies and many other meteorological papers, and his students and colleagues who have for many years benefited from his encyclopaedic meteorological and polar knowledge, testify to a well-spent life.

## MEETINGS

SIXTH INTERNATIONAL SOIL MECHANICS CONFERENCE, MONTREAL, CANADA, SEPTEMBER 1965. Sessions begin on Wednesday, 8 September, and end on Wednesday, 15 September. Excursions will be organized for the 11th, 16th and 17th September. The sessions will be held in La Grande Salle of the Place des Arts, 175 St. Catherine Street West, Montreal. To make application to attend this conference, write for forms to: The Secretary, Organizing Committee, Sixth International Conference, c/o National Research Council, Ottawa, Canada.

Registration fees are $60.00 if paid before 1 July, and will include one set of the Proceedings in three volumes, entrance to all technical sessions, the receptions and dinner, or $70.00 if paid after 1 July.

Full details of the conference are given in Bulletin No. 2, January 1965, which may be obtained from the address given above. We give here a brief résumé of the programme.

The conference has been organized into six technical divisions and the technical programme will be presented in nine consecutive sessions All technical sessions will begin with a 50-minute lecture. Discussion at each session will be opened by the General Reporter for the Division, and then the session will be open to discussion by a panel of experts and by members of the conference.

8 September - 1000 hours: Terzaghi Memorial Session
First Technical Session, Division 1
1400 hours: Presidential Address by Prof. A. Cassagrande.
1500 hours: General soil properties. General Reporter - J. E. Jennings.

9 September - Second Technical Session, Division 2
0900 hours: "The geology of Canada" by Dr. J. M. Harrison.
1000 hours: Soil properties - shear strength and consolidation.
General Reporter - O. Moretto.
Third Technical Session, Division 2
1400 hours: "Rock mechanics" by Dr. Armand Mayer.
1500 hours: Soil properties - shear strength and consolidation.
General Reporter - O. Moretto.

10 September - Fourth Technical Session, Division 3
0900 hours: "Pleistocene geology of North America" (lecturer to be announced later).
1000 hours: Shallow foundations and pavements.
General Reporter - E. E. De Beer.
Fifth Technical Session, Division 3
1400 hours: "Creep and progressive rupture in snow, soil, rock and ice" by Prof. R. Haefeli.
1500 hours: Shallow foundations and pavements.
General Reporter - E. E. De Beer.

11 September - Excursions, Montreal and vicinity.

13 September - Sixth Technical Session, Division 4
0900 hours: "Engineering geology and public works" by J. Hode Keyser.
1000 hours: Deep foundations. General Reporter - A. Kezdi.
Seventh Technical Session, Division 5
1400 hours: "Permafrost in the U.S S.R." by Prof. N. A. Tsitovich.
1500 hours: Earth and rock pressures. General Reporter - V. Mencl.

14 September - Eighth Technical Session, Division 6
0900 hours: "Modern Canadian dams" by J. K. Sexton.
1000 hours: Earth and rock dams, slopes and open excavations.
General Reporter - Dinesh Mohan.
Ninth Technical Session, Division 6
1400 hours: "Factor of safety in soil and rock problems" by Dr. Jacob Feld.
1500 hours: Earth and rock dams, slopes and open excavations.
General Reporter - Dinesh Mohan.

15 September - Closing Session.

16 September - Post-conference tours.

The original papers presented to the conference will be published in Volumes I and II of the Proceedings - 218 papers from 40 countries. The volumes will be ready on 1 July and will be despatched to all those who have registered by that date. Volume III will contain the Special Lectures, the reports of the General Reporters, and a record of the discussion at the conference. Additional sets of the Proceedings may be ordered by members or others before the conference at a price of $50.00. After the conference the Proceedings will be available at a price of $100.00 per set through local booksellers or on order from: University of Toronto, Toronto 5, Canada, to whom all enquiries should be addressed after 15 September 1965.

CONFERENCE ON PHYSICS OF SNOW AND ICE. The Institute of Low Temperature Science of Hokkaido University was established on 25 November 1941, and since then has been actively engaged in basic studies of snow and ice. In 1966, we will celebrate our 25th anniversary and we plan to conduct a conference on "Physics of Snow and Ice" at the end of August in that year.

Although twenty-two volumes of our journal, Low Temperature Science - Physics (Teion Kagaku, in Japanese) have been published, and eighteen issues of our Contributions from the Institute of Low Temperature Science - Physics (in English), we feel that the fact that the majority of reports from the Institute have been presented in Japanese has limited their circulation among investigators in similar fields in other countries. The primary purpose of our projected conference is to exchange information in these fields through discussion and personal contact. Distinguished members from the Japanese Society of Snow and Ice will be present, and the conference will be conducted entirely in English.

The following topics are tentatively proposed:

1) Physical properties of ice
2) Physical properties of deposited snow
3) Mechanism of snow avalanches
4) Physical properties of sea ice
5) Physics of frost heaving
6) Practical methods of field observation of snow and ice
7) Snow and ice in polar regions

We believe that the members of the Glaciological Society could make a significant contribution to the success of this conference. Unfortunately, the Institute is unable to provide travel expenses for the participants, but we would like to invite all scientists who are working on snow and ice. We would be very pleased if you would send tentative titles by the end of September 1965, abstracts by the end of December 1965, and full papers, in duplicate, by the end of April 1966. There are no limitations as to pages, illustrations, or photographs, and acceptance of the papers will be communicated to the authors. After the conference, the papers will be published by the Institute. A more detailed programme and tentative plans for the conference will be announced in March 1966.

Our proposed conference on Physics of Snow and Ice will be held concurrently with the "Pan-Pacific Science Congress" organized by the Science Council of Japan and supported by the Japanese Government. The tentative dates for this congress in Tokyo are 20 August to 10 September 1966, and a symposium on "Snow and Ice in the Pacific Area" is proposed for the first week of the congress. Scientists attending this congress will be welcome at our conference in Sapporo.

Prof. Zyungo Yosida, Director
The Institute of Low Temperature Science,
Hokkaido University, Sapporo, Japan.

January 1965

# COMMISSION OF SNOW AND ICE

**(Int. Association of Scientific Hydrology of the Int. Union of Geodesy and Geophysics)**

## A PILOT STUDY OF RECENT FLUCTUATIONS OF GLACIERS

A contract has recently been placed by UNESCO with the Federation of Astronomical and Geophysical Services (FAGS) in consultation with the Commission of Snow and Ice of IASH for a pilot study of recent fluctuations of glaciers with a view to the establishment of a permanent service. This study will be made by Ing. Peter Kasser and his colleagues at the Department of Hydrology and Glaciology of the Swiss Federal Institute of Technology in Zürich.

The work involves the collection and analysis of data on glacier fluctuations since 1959 in various parts of the world, and for this purpose arrangements are being made with the National Committees for Geodesy and Geophysics in appropriate countries for the collection and transmission to Zürich of recent glacier data. The pilot study is due to be completed by 30 November 1965, when it is hoped that plans for a Permanent Service on the Fluctuations of Glaciers will be established.

This pilot study follows up the report of the Commission's sub-committee on the variations of glaciers, set up in Helsinki in 1960 under the chairmanship of Prof. A. Bauer, and the appendix to that report prepared by a new sub-committee set up in Obergurgl in 1962 under the chairmanship of Docent V. Schytt. The report and its appendix together with a check list of glacier variation observations and measurements was published in IUGG Chronicle No. 54, p. 112-20, August 1964.

All National Committees for Geodesy and Geophysics, or their appropriate sub-committees, and other national organizations concerned with glacier fluctuation measurements should welcome this good opportunity of co-operation with UNESCO and FAGS in the integration of their observations into a co-ordinated world-wide network. They are asked to write directly to Ing. P. Kasser (Abteilung für Hydrogie und Glaziologie, Voltastrasse 24, Zürich 7/44, Switzerland) offering to help him in establishing plans for the Permanent Service.

W. H. Ward
Secretary

## SYMPOSIUM ON GLACIER MAPPING
(in association with the National Research Council, Canada)

A Second Circular on the Symposium, to be held in Ottawa from 20 to 22 September 1965, will be sent out very soon to all who have responded to the First Circular, published in the December issue of Ice. It is expected that about twenty papers from authors in eleven countries, for which abstracts are now in hand, will be presented. It is probable that these papers will be published in the "Canadian Journal of Earth Sciences" early in 1966, but arrangements for publication have not yet been confirmed. The date for receiving Abstracts of papers has passed, but registrations for the Symposium will continue to be received c/o Liaison Office, National Research Council, 100 Sussex Drive, Ottawa, Ontario, Canada.

G. Hattersley-Smith
Chairman, Sub-Committee on Glaciers
National Research Council
Canada

## THE SOCIETY'S LIBRARY

Works received for the Society's library since November 1964.

We thank the following authors or donors of papers and pamphlets, and regret that it is impossible to acknowledge them individually. The glaciological works, with their complete references, will be listed in the "Glaciological Literature" at the end of the Journal of Glaciology, and bound in the Society's collection of glaciological papers.

Field, W.O.
Harland, W.B. (4 items)
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**Further details may be found in the *Journal of Glaciology*, published in February, June and October.**

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## ICE

*Editor*: MRS. H. RICHARDSON

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