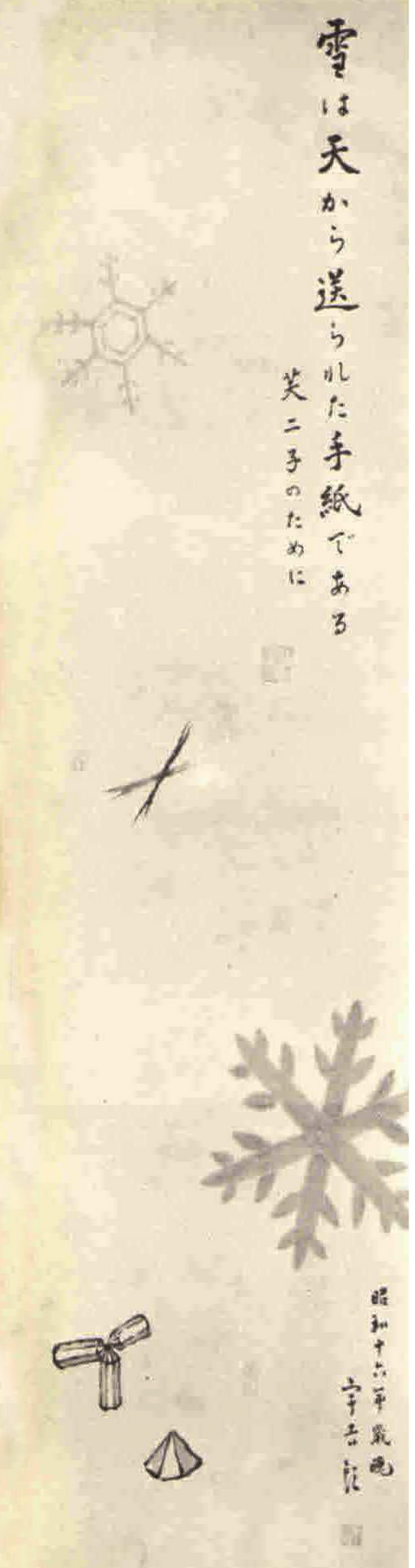

NUMBER 20 APRIL 1966

ICE

THE GLACIOLOGICAL SOCIETY

1966

ANNUAL GENERAL MEETING

AND DINNER

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

At 5.30 p.m. Dr. H. C. Hoinkes (University of Innsbruck) will speak on "Glacier variation and weather".

At 7 p.m. there will be a dinner in the Staff Dining Room, South Side Buildings, Imperial College. Tickets, price £1/$2.80 inclusive of wines, may be obtained from the Secretary before 3 May.

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.

FINAL BOOKING DATE—3 MAY

ICE

NEWS BULLETIN OF THE GLACIOLOGICAL SOCIETY

APRIL 1966 NUMBER 20

CONTENTS

CONGRATULATIONS to Gerald Seligman, Founder President of the Society, on his 80th birthday. We wish him good health and much happiness, and thank him once again for all he has done for the Society in the past thirty years.

The 1966 ANNUAL GENERAL MEETING will take place on Thursday, 5 May, at 5 p.m. in the Roderic Hill Building of Imperial College, Prince Consort Road, London S.W.7. At 5.30 p.m. Dr. H. C. Hoinkes, University of Innsbruck, will speak on "Glacier variation and weather". After the lecture, a dinner will be held in the Staff Dining Room, South Side Buildings, Imperial College. For details, see inside front cover of this issue of ice.

DUES 1966. If members wish to receive all issues of the Journal of Glaciology in 1966, they should make sure that their dues of £3/$9.00 (or £1/$3.00 for Junior Members) have been paid by 1 August.

COVER PICTURE. Photograph of a brush drawing by the late Prof. Ukichiro Nakaya, by kind permission of Mrs. Nakaya. His poem means: A snow crystal is a letter sent from heaven. We use the drawing in honour of Professor Nakaya in this year when celebrations are taking place to mark the 25th anniversary of the founding of the Low Temperature Institute, University of Hokkaido, where he directed many research projects in the physics of snow and ice.

FIELD WORK

AUSTRIA

Measurements of snout positions from markers on bedrock were repeated for about 100 glaciers in the Austrian Alps in late summer, 1965. As in the past, this work was sponsored by Österreichischer Alpenverein; a summary report will be published in "Mitteilungen des Österreichischen Alpenvereins".

HINTEREISFERNER (Ötztal Alps)

Mass budget investigations were continued as part of the Austrian IHD Programme. Owing to the cool and wet summer with an early end of the ablation season the old snow line remained between 2700 and 2800 m. The mass budget according to measurements at 80 points went clearly positive for the first time since the beginning of these investigations in 1953. 12 collecting precipitation gauges in the drainage area of the recording stream gauge in Vent were visited at two-monthly intervals. Field work was carried out by staff members, Institut für Meteorologie und Geophysik, Universität Innsbruck.

Ingrid Lauffer finished a thesis on "The Climate of Vent", analyzing temperature back to 1851 and precipitation back to 1891. This will facilitate the extension of studies of climate — glacier relations back to the beginning of measurements of glacier variations in the Ötztal Alps. Karin Schram finished a thesis on "Ice deformation and the vertical component of glacier movement on Hintereisferner"

Professor H. Schatz and collaborators from the Institut für Mathematik, Universität Innsbruck, resurveyed transverse profiles No. 3 and No. 6 as well as the snout positions of Hintereisferner, Guslarferner and Vernagtferner, in late August.

KESSELWANDFERNER (Ötztal Alps)

The deep pit at 3240 m.a.s.l. was reopened and deformation measured. Eight pits were dug down to the horizon 1961 (average depth 10 metres) in order to study horizontal distribution of annual net accumulation and to collect firn samples for analysis of gros-beta-activity, ^{137}Cs, and pollen content.

In collaboration with E. Picciotto, Bruxelles, ^{18}O content of winter and summer snow was studied as well as ^{210}Pb content of 12 ice samples from the ablation area. Work was carried out by W. Ambach and H. Eisner, Physikalisches Institut, Universität Innsbruck. The Ministry of the Interior supplied a ski-plane for transportation.

Some new surveying points (stone cairns) were built and triangulated in the vicinity of Kesselwandferner and five transverse profiles marked with aluminium poles by H. Schneider and collaborators from the Institut für Mathematik, Universität Innsbruck.

SONNBLICK—KEES (Granatspitzgruppe)

Mass budget investigations were continued, indicating a strongly positive mass budget in 1964/65. Snow samples for analysis of gros-beta-activity and ^{137}Cs were collected. Transverse profiles were resurveyed, and a new longitudinal profile was surveyed on Ödenwinkelkees. A new collecting precipitation gauge was set up. Work was carried out by H. and W. Slupetzky, Geographisches Institut, Universität Salzburg.

PASTERZEN-KEES (Gross-Glockner-Gruppe)

Three transverse profiles in the ablation area and the position of the terminus were surveyed by staff members, Geographisches Institut, Universität Graz. Net accumulation and altitude of the firn surface for several points on Pasterzen-Kees and on Schmiedinger-Kees were measured by H. Tollner, Wetterdienststelle Salzburg. At the end of the budget year 1964/65 most glaciers of the Gross-Glockner-Gruppe were still under a blanket of old snow. The position of the terminus, therefore, could not be detected, and positive mass-budget can safely be assumed for all glaciers in 1964/65.

Results of measurements of alpha- and beta-activity of ice and snow samples, collected in the years 1962 to 1964 mainly on Pasterzen-Kees with some additional samples from Gepatschferner (Ötztaler Alpen), have been published by O. Lanser, A. Frantz and K. Knie: Radioaktivitätsmessungen an österreichischen Gletschern und Gletscherwässern, Österreichische Wasserwirtschaft Vol. 17, No. 11/12, pp. 249-257, 1965.

GOLDBERG-GRUPPE

Kleines Fleisskees, Wurten-Kees and Grosses Goldberg-Kees, in the vicinity of the Meteorological Observatory on the top of Hoher Sonnblick (3106m), were blanketed by old snow down to the terminus at the end of the budget year 1964/65. On one occasion a slight advance of the terminus could be detected. Net accumulation was measured at Fleiss-Scharte. A positive mass budget can safely be assumed for all glaciers, according to H. Tollner, Wetterdienststelle Salzburg.

UEBERGOSSENE ALM (Hochkönig)

A new mass budget programme on this small plateau-type glacier was initiated by J. Goldberger, and sponsored by Österreichischer Alpenverein Salzburg. 20 snow stakes were set in late summer of 1965, and the surface in their vicinity marked with ochre.

History of Climate:

F. Mayr, from the Geographisches Institut, Universität Innsbruck, studied the complex climatic history of the early Würm in the Inn valley. Three cold periods are believed to have taken place between the last interglacial and the last glacial maximum. H. Heuberger finished studies on late-glacial glacier fluctuations in the Western Stubai Alps. Both Heuberger and Mayr took part in the 7th INQUA-Congress in Boulder, Colorado.

H. C. Hoinkes

CANADA

INTRODUCTION

(a) In 1965 field work on glaciers was carried out by Government Departments, Universities, and private organizations in the following areas: the Rocky mountains of Alberta and British Columbia; the Coast Mountains of British Columbia; the Icefield Ranges and the Logan Mountains in the Yukon Territory; Baffin Island; and in five of the Queen Elizabeth Islands, namely Devon, Melville, Axel Heiberg, Meighen, and Ellesmere. Aerial photographic flights were made over a number of glaciers in Western Canada and in Baffin Island. Photogrammetric and laboratory studies, map compilation and production, and work on the glacier inventory were continued.

(b) The Sub-Committee on Glaciers held meetings on 23 February and 4 November. In association with the IUGG-IASH Commission of Snow and Ice a Symposium on Glacier Mapping was held at the Division of Applied Physics, National Research Council, Ottawa from 20 to 22 September. A total of 22 technical papers were presented, and there were 88 registered delegates from ten countries. The National Research Council gave an official reception and dinner during the course of the Symposium. It is intended to publish the papers in the Canadian Journal of Earth Sciences late in 1966.

(c) It is gratifying to record that McGill University has officially recognized the interdisciplinary nature of glaciology by allowing graduate students registered in the departments of Geography, Geology, Meteorology and Physics to pursue glaciological studies under programmes directed by those departments, or by the Faculty of Graduate Studies and Research. At present six such students have glaciology as their main subject.

(d) The first number of Volume 8 of the Geographical Bulletin, to be published early in 1966 by the Geographical Branch, Department of Mines and Technical Surveys, will be devoted entirely to papers resulting from the Branch's various glaciological programmes.

SOUTHERN CORDILLERA, BRITISH COLUMBIA AND ALBERTA

(Geographical Branch, Department of Mines & Technical Surveys)

G. Østrem initiated glaciological investigations in the Cordillera region as a contribution to the programme for the International Hydrological Decade. Several glaciers were selected for detailed mass balance studies. Permanent huts were set up at four of the glaciers and surveys made as a preparation for work throughout the Decade.

ROCKY MOUNTAINS, ALBERTA, DRUMMOND GLACIER

(University of Alberta, Calgary: J. G. Nelson and I. Y. Ashwell)

Research on the Drummond Glacier in the upper valley of the Red Deer River was continued for the fourth summer with support from the National Research Council. Measurements at five stakes in a transverse line across the southeastern lobe of the glacier showed that the mean ablation for the period 16 July 1964 to 26 July 1965 was 98 cm and for the rest of the 1965 summer up to 2 September 150 cm. During the summer of 1965 a bedrock bridge appeared about 800 m from the terminus; in this area rapid retreat may be expected in the next few years. Remeasurement from five stakes in the vicinity of the terminus indicated a mean recession of about 7.3 m for the period 15 July 1964 to 14 July 1965. Measurement of discharge and erosion were continued near the terminus.

COAST MOUNTAINS, BRITISH COLUMBIA

(a) Stewart Area (University of British Columbia: W. H. Mathews)

A glaciological research project has been initiated by Granduc Mines Limited to evaluate changes in existing glaciers in the Stewart area of British Columbia. A photogrammetric study, based on air photographs taken in 1949, 1956, and 1963, has been used to determine recent changes in three of the glaciers — the Berendon, Frankmackie, and North Leduc. Representative stations have been established for the measurement of annual accumulation and ablation at several different elevations. Annual surface movements are to be measured on these three glaciers, and seasonal movements at several sites on the Berendon and Salmon glaciers. A computer programme is to be undertaken to provide a forecast of the speed of kinematic waves on the Berendon Glacier.

(b) Mount Edziza (Geological Survey of Canada: J. G. Souther)

A detailed study of the Mount Edziza volcanic complex in north-central British Columbia was begun in 1965. The symmetrical, 2,700 m central cone is covered by a small névé from which a radial system of valley glaciers and flat ice-lobes extends down to elevations of 1,700 to 2,000 m. The positions of several of these glaciers during the last episode of volcanic eruptions have been determined from the distribution of ash and cinder beds. Ash that fell on the lower parts of the glaciers has been largely removed by surface meltwater, whereas ash that fell beyond the ice is undisturbed. Carbon-14 dates, obtained on charred stems from below the ash, are expected to provide a basis for calculating the rates of recession and ablation of the local valley glaciers. An attempt is also being made to identify the same ash layer in the ice of the central névé, and thus to determine the corresponding rate of snow accumulation in the source area.

ICEFIELD RANGES, Y.T.

(a) Icefield Ranges Research Project (American Geographical Society; Arctic Institute of North America)

The fifth season's work of the IRRP was completed under the direction of Walter A. Wood and the field leadership of Richard H. Ragle, who with C. Bull (Ohio State University) and Melvin G. Marcus (University of Michigan) supervised the broad glaciological programme. The base camp at the south end of Kluane Lake was occupied from 5 May to 20 August. Field support was provided by the IRRP "Helio Courier" aircraft piloted by P. Upton.

A traverse was made across the glaciers of the Icefield Ranges to determine the gross accumulation. Test pits at a vertical interval of about 150 m extended from an elevation of 1,200 m on the Seward Glacier across the upper basin of the Seward to the hydrological divide between the Hubbard and Kaskawulsh glaciers, and down to an elevation of 1,600 m on the Kaskawulsh. Preliminary results show that precipitation increases orographically from the western maritime region up to an elevation of 1,900 m, above which it decreases, so that at 2,520 m it is only 35 per cent of its maximum value. Pit studies and accumulation measurements were continued near the divide (2,700 m) and Seward (1,860 m) stations, englacial temperatures being measured to a depth of 14.5 m. Snow temperatures at the divide station were more strongly negative than in any year since 1961. Measurements were made of the dielectric constant of snow in order to gain knowledge of radio wave propagation in snow at temperatures above —10°C.

At the Kaskawulsh station petrographic studies of ice cores and strain rate measurements were made, and water samples were obtained for tritium analysis. A number of exploratory descents of 20 to 25 m were made into moulins. Preliminary results of seismic work showed a steep, down-glacier bedrock slope below the influence of the north and central arms of the Kaskawulsh Glacier, in an area of strong ice crystal orientation. A detailed gravity network was established on the median moraine immediately below the glacier confluence. Stream development on the surface of the north and central arms of the Kaskawulsh Glacier was mapped and studied in detail.

Synoptic and pibal observations were made on a 24-hour schedule at the Kluane, Kaskawulsh and divide stations. At the Seward station micrometeorological, mass balance and energy exchange measurements were continued and intensified.

In the laboratory at the University of Alberta D. S. Macpherson completed an analysis of 83 measurements of $^{18}O/^{16}O$ ratios in ice samples obtained from the Hubbard and Kaskawulsh glaciers. The variations indicated an enrichment of the ^{16}O istotope by 1.8 to 2.9% correlating with annual meteorological trends and elevation of the accumulation area. The percolation of summer melt-water produces a homogenization of the $^{18}O/^{16}O$ ratio which is diluted significantly. Samples along a transverse section show less enrichment of ^{16}O at the centre of an ice stream. This supports the idea that the central ice comes from a lower altitude in the accumulation area than the ice at the sides. The laboratory work was supported by the Arctic Institute of North America and the Canadian National Advisory Committee on the Geological Sciences.

(b) Comparative Landforms Study (Geological Survey of Canada: V. Rampton)

A comparative study was begun of glacial landforms extending from ice cored moraines at the snout of the Klutlan Glacier to the all-time limit of glaciation north of Snag.

LOGAN MOUNTAINS, Y.T.: MEASUREMENTS ON A ROCK GLACIER (Geological Survey of Canada: O. L. Hughes; Geografiska Institutionen, University of Uppsala, Sweden: A. Rapp)

A rock glacier near Canada Tungsten mine was re-examined in 1965. In two years the snout of the 2.5-km long glacier has advanced up to 2.5 m into forest. Points along transverse lines 400 m from the snout have moved as much as 6.5 m. Minor collapse features on the surface of the glacier suggest that it may have a melting core, and hence may be a debris-covered glacier rather than a true rock glacier in which ice is only present interstitially.

SOUTHERN BAFFIN ISLAND: RECENT GLACIER FLUCTUATIONS (Geological Survey of Canada: W. Blake, Jr.)

Reconnaissance glacial geology formed part of the programme of Operation "Amadjuak", for which helicopter service was available. In conjunction with the mapping of moraines, a study of marginal variations of the numerous small ice caps and valley glaciers to the north and south of Frobisher Bay was started. Several glaciers that were visited by J. H. Mercer and W. Blake in 1952 were re-photographed, and all the outlet glaciers of the Grinnell and Terra Nivea ice caps were photographed from low-flying aircraft by Blake. In addition, a number of low-level photographs of the ice caps and outlet glaciers on Hall Peninsula were obtained by the bedrock geologists on the operation. In the few areas where any change had occurred, the snouts of the glaciers had receded slightly since 1952.

SOUTH CENTRAL BAFFIN ISLAND: PENNY ICE CAP (Observatories Branch; Topographical Survey, Department of Mines and Technical Surveys: J. R. Weber and K. C. Arnold)

Geophysical and glaciological work begun in 1962 was continued. Positions and elevations of 14 aluminium poles across the crest of the ice cap were resurveyed. The movement of the south-west end of the line was 18 m in three years and the spread of the two centre poles over the same period was 3 m. The gravity differences between the poles and the gravity base on a rock outcrop were remeasured with LaCoste and Romberg gravity meters. The precision of the gravity measurements was not as high as had been hoped due to the frequent spontaneous and rapid drift of both meters which is now being investigated.

Gravity, radar, seismic, and electrical depth determinations were carried out on profiles across and along the major outlet glacier to the edge of the ice cap. Gravity observations were taken at 100 to 200 m intervals. The radar equipment, an SCR-718F 440 mc altimeter on loan from the RCAF, was mounted on a Nansen sledge and pulled by a motor toboggan. The party had the services of an experienced radio-technician from the RCAF. The maximum ice depth that could be recorded was 500 m. Seismic reflections indicated that the ratio between the travel times of the sound waves and the radar waves was constant. DC resistivity measurements were carried out by P. Andrieux. Fifteen ablation stakes were drilled across the outlet glacier at the same locations as in 1962, and their down-glacier and cross-glacier movement components were measured. The flow rate in 1965 was 44 per cent greater than in 1962. Pits were dug at 1 km intervals from the movement line to the ice cap and the snow densities and accumulations were determined. A number of survey points on nunataks on either side of the outlet glacier were marked and photographed from the air as an aid to plotting a map of this part of the glacier.

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

The Baffin Island project continued under the direction of O. H. Løken. A helicopter assisted the group throughout the summer, and three other aircraft were engaged as required. Studies in glaciology, glacial geomorphology, hydrology, geology and botany were carried out. A permanent building was erected at the head of Inugsuin Fiord to serve as a base of operations in future years.

(a) Barnes Ice Cap (J. T. Andrews, O. H. Løken, G. Østrem and R. B. Sagar)

In order to intensify the studies of variations in mass balance between the eastern and western sides of the ice cap, two stake profiles were inserted during May and early in June. They run approximately north-east to south-west, one across the crest of the northern part of the ice cap, the other across the southern dome. The distance between the stakes is approximately 1 km. The already existing stake network was re-surveyed and an accumulation map of the northern part of the Barnes Ice Cap has been constructed. The southern profile shows a much heavier accumulation of the north-east than on

the south-west side. The past history and extent of the south dome of the Barnes Ice Cap was studied with reference to adjacent moraines dated by lichenometry. An attempt is being made to relate ice marginal variations to the accumulation distribution on the ice cap.

(b) Lewis Glacier (M. Church)

Measurements at the stake net from previous years and hydrological measurements in the Lewis River were continued. A rating curve for the river was obtained, partly by means of discharge measurements made by the salt dilution method. Meteorological observations were also made.

(c) Decade Glacier (C. Bridge and B. Rannie)

After reconnaissance in 1964, Decade Glacier, 8.7 km^2 in area, was chosen as representative of the glaciers in this area, and work on this glacier has been included in the International Hydrological Decade programme. A detailed study of its mass balance for 1964-65 was completed; the accumulation measurements were made in early June and ablation readings throughout the ablation season. About 40 snow depth soundings per km^2 were made and the stake net comprises approximately 5 stakes/km^2. Pits were dug throughout the ablation season to study the variations in snow and firn density, and refreezing of meltwater. Meteorological observations were made continuously from the beginning of June to the end of August. Run-off studies were performed in the river draining the glacier and silt-content measurements were made at least twice a day. Run-off measurements were also made in an adjacent river draining an almost glacier-free area.

(d) Geomorphological Studies (J. T. Andrews, M. Barnett, C. A. M. King, O. H. Løken and J. E. Smith)

Geomorphological investigations concentrated upon evaluating the history of deglacierization and ranged from Foxe Basin to Baffin Bay. Of particular significance was O. H. Løken's determination of the persistence through the past 50,000 years of low-lying ice-free areas on the Baffin Bay coast. Considerable progress was also made in determining relationships between marine and glacial features, in measuring direction and amount of glacio-isostatic tilt and in dating, through radiocarbon methods, the age of the Cockburn moraine system.

DEVON ISLAND (Arctic Institute of North America: R. M. Koerner)

The field party was flown from Resolute Bay to the base camp near Cape Sparbo during the second half of May and returned to Resolute Bay by icebreaker at the end of August. The mass balance measurements on the Devon Island ice cap and three of its outlet glaciers, started in 1961, were continued. The traverse lines radiating from the centre to the edges of the ice cap were resurveyed for accumulation and ablation. Dye and percolation trays were placed at each station, and 5 m cores from five points on the north-west side of the ice cap were studied. The 1965 melt season was short and late, and for the third successive year the entire ice cap lay in the accumulation area. At the end of the season long-period markers with percolation trays were put out to allow future mass change assessments. The work was supported by grants from the Defence Research Board and the Department of Northern Affairs and National Resources; the Polar Continental Shelf Project assisted with logistic support.

MELVILLE ISLAND (Polar Continental Shelf Project: W. S. B. Paterson and F. P. Hunt)

Routine mass balance measurements were continued on the four ice caps. All the ice caps had positive budgets for 1963-64. Values of mean specific budget ranged from 20 gm cm^{-2} for the east ice cap to 31 gm cm^{-2} for the north ice cap. The mean specific accumulation from the start of the 1964-65 budget year until the end of April 1965 was 15 gm cm^{-2}. This is about the same as the figure for 1962-63, but only about half that for 1963-64. Additional ground control was established around the margins of the ice caps in preparation for aerial photography planned for 1966.

MEIGHEN ISLAND (Polar Continental Shelf Project: W. S. B. Paterson)

Routine mass balance measurements were continued on the ice cap. For the 1963-64 budget year the whole ice cap was a percolation zone; in other words, there was accumulation of firn and superimposed ice in all areas. The mean specific budget showed a gain of 35 gm cm^{-2}, or almost twice the mean specific accumulation averaged over the 5 years for which data are available. In July 1964 the mean temperature at Isachsen, about 150 km to the south-west, was 3.3°C below the average for that month. Thus the high positive budget of the ice cap was associated with both above-average precipitation and a colder than average summer. The mean specific accumulation for the budget year 1964-65, as measured in early July 1965, was 16 gm cm^{-2}, or close to the average value. About 40 per cent of this accumulation occurred in June and early July.

A borehole was drilled through the ice cap using the thermal drill developed by the U.S. Army CRREL for relatively shallow holes. The hole was located near the highest point of the ice cap which is also the region of greatest ice thickness. Bedrock was reached at a depth of 121 m. The top 4 m of the hole was cased to prevent the entry of meltwater. Temperatures in the borehole ranged from —18.0°C at a depth of 7.6 m to —15.9°C at the bottom. The diameter of the hole was measured at intervals of 7.6 m, so that future measurements will determine rate of closure. Inclinometer measurements were not made because the ice cap is stagnant. Recovery of cores from the borehole was complete. As the Polar Continental Shelf Project does not have staff qualified to analyze these cores, parts of them can be made available to other scientists for study.

AXEL HEIBERG ISLAND (McGill University: F. Müller)

From 20 July to 29 August C. S. L. Ommanney (glaciologist-in-charge) and P. Altosaar (assistant) continued the long-term measurements begun in 1959. In addition two automatic weather stations for year-round operation were established; geophysical and geochemical investigations were carried out during the same period. The work was made possible by a grant from the National Research Council. Logistic support for the operation was provided by the Polar Continental Shelf Project.

(a) Mass balance, temperature and movement measurements

Mass balance studies were continued on the White Glacier with accumulation and ablation measurements at 81 sites. Englacial temperature profiles were measured at 8 profiles. Preliminary analysis of the data indicates that the strongly positive mass balance of 1964 had the effect of delaying the normal melt process in the 1965 summer. Old snow from 1964 was observed in many areas even at the end of the summer, and the deep pack of residual snow acted as a storage place for much of the percolating meltwater that would otherwise have been lost as run-off. Preliminary calculations indicate that the budget for the hydrological year 1964-65 was slightly positive, with the equilibrium line at an elevation of about 700 m. Further mass balance studies were carried out on the Baby Glacier, situated between 750 and 1,000 m a.s.l.; this glacier showed a net gain. Movement studies on the White Glacier involved the repositioning of 16 surface points, and the resurveying of another 25 points in various longitudinal and transverse profiles. Snout surveys were also made of the Thompson, White and Crusoe Glaciers, and three new cairns were established on the outer limit of the push moraine of the Thompson Glacier.

(b) Automatic weather stations

Further understanding of the glacier-climate relationship depends largely on the success of automatic weather stations in areas where detailed mass balance measurements are carried out. Two automatic glacio-mesoclimatological stations of relatively low cost were installed in the expedition area on Axel Heiberg Island. "Sumner" Mk. II, double pen, strip chart, long-period recorders were used. Three recorders each registering two meteorological parameters —namely, temperature and humidity, pressure and sunshine, wind-speed and direction—were put into operation on the ice near the moraine camp on the White Glacier (900 m a.s.l.). Three special power supply and clock unit containers were frozen into the ice at a depth of 11 m — the depth of the seasonal isotherm in the equilibrium zone. Recorded data for the periods from 28 July to 8 August at the base camp (180 m a.s.l.), where the recorders were checked out, and from 10 August to 26 August at the moraine camp are now being analysed. One recorder registering temperature and wind speed is operating at the base camp, where its power supply and clock unit are buried 60 cm below ground. The records so far retrieved cover the period 27 July to 29 August. Standard synoptical observations were made every six hours during the entire stay on the island. A weather hut was set up on ice at the moraine camp and 6-hourly synoptic observations were taken from 9 to 26 August. This information will provide sufficient material for calibration and check purposes of the automatic stations. After elimination of some minor technical difficulties, the recorders were functioning properly and yielding satisfactory records. It seems that during July and August the stations were capable of producing data of almost equally good quality as a manned station. Both stations on Axel Heiberg Island are being left to operate unattended for at least 8 to 10 months during the arctic winter. It is realized that some of the data may be subject to various errors which are very difficult to assess and to correct. Nevertheless, the data obtained provide a much better source of information for the assessment of the meso-climate (which is directly related to the mass balance changes) than would be obtained from the nearest weather stations.

(c) Geomorphology

Geomorphological observations were carried out on Between Lake, a glacier-dammed lake between the Thompson and White Glaciers which failed to overflow in 1964, the first time since these studies were begun in 1959. Further measurements were made on the Between River overflow channel, the drainage channel along the eastern margin of the Crusoe Glacier, and the Thompson Glacier push moraine.

(d) Areal study

C. S. L. Ommanney is conducting a study of the snow and ice cover of Axel Heiberg Island as a whole by applying knowledge gained on the glaciers in the expedition area during the last five years to other parts of the island. This study is a "type" investigation for the snow and ice inventory recommended for the International Hydrological Decade.

NORTHERN ELLESMERE ISLAND

(Defence Research Board; University of New Brunswick; Topographical Survey, Department of Mines & Technical Surveys)

The Defence Research Board operated Tanquary Camp from early May until late August. Mass balance studies were continued on the Per Ardua Glacier at the head of Tanquary Fiord by G. Hattersley-Smith of the Defence Research Board (in July and August) and U. Embacher of McGill University (from May to July); survey work was carried out by K. C. Arnold of the Topographical Survey. Strain rate measurements on the Ward Hunt Ice Shelf, started in 1964, were completed in late May and early June by W. Faig of the University of New Brunswick, supported by a National Research Council grant. Accumulation and ablation measurements on the Ward Hunt ice rise were made by H. Serson of the Defence Research Board. Logistic support was provided by an RCAF ski-wheel DC-3 aircraft in early May, and subsequently by an "Otter" aircraft under commercial charter.

(a) Per Ardua Glacier

The mapping of the Per Ardua Glacier was completed early in 1965 under the direction of G. Konecny of the University of New Brunswick. A map of the whole glacier at the scale of 1:10,000 and of the ablation area at the scale of 1:2,500 are available for mass balance studies. In 1965 the number of accumulation and ablation stakes was increased from 44 to 97. The equilibrium line was at an elevation of 890 m, and preliminary calculations indicate a slight net gain for the 1964-65 budget year. A total of 91 stakes were located by theodolite intersection, based on control established in 1964 by W. Faig. In the accumulation area, movement over one year can be determined by comparison with similar observations made by N. E. Cleary of the Topographical Survey in 1964. In the ablation area, movement over an interval of one month can be determined from the 1965 observations. Along a cross-profile of stakes at the 500-m level, where the glacier is 250 m wide, the movement was 18 to 22 m/yr.

(b) Ward Hunt Ice Shelf

In order to measure the strain rate at the surface of the Ward Hunt Ice Shelf, the quadrilateral laid out on the ice shelf to the east of Ward Hunt Island in 1964 was resurveyed by NASM 4-D geodimeter. The resurvey showed that there was some internal movement of the ice shelf of the order of 5 to 10 cm over a distance of 1 km, but that the movement had no special pattern. A mass shift seaward along the strand crack between the ice shelf and the Ward Hunt ice rise was found to have a mean value of 27 cm. Measurements were made at 42 stakes, set on the ice rise; they showed an average net accumulation of 13.5 gm cm^{-2} of superimposed ice between 25 June 1964 and 12 June 1965. The average snow depth was 57 cm.

ICE ISLANDS (Polar Continental Shelf Project and Geographical Branch, Department of Mines & Technical Surveys: D. Lindsay)

The distribution of major ice islands in the Canadian Arctic Archipelago and the adjoining Arctic Ocean was observed as part of a systematic survey of sea ice. There was a general concentration of large ice islands and ice island fragments along a zone between the polar pack and the Arctic Islands from long. 98°W to 113°W. It is certain that some of these ice masses broke away from the Ward Hunt Ice Shelf during the winter of 1961-62. By October 1965 the ice islands had drifted south-west along the western coast of the Archipelago and were disposed as follows: 1. an ice island that can be identified with reasonable certainty as WH-1 lay at lat. 78°55′N, long. 110°20′W or about 20 km north of Cape Malloch; 2. an ice island that may be WH-2 had drifted to lat. 79°25′N, long. 107°20′W; 3. a large ice island, not recognized as any seen previously, lay at lat. 80°13′N, long. 99°55′W, north of Meighen Island; 4. an ice island that can be identified positively as WH-3 owing to its characteristic suture line lay at lat. 79°07′N, long. 109°00′W; 5. a smaller ice island still carrying the aluminium trailer, left by the USAF-AINA Ward Hunt Ice Shelf Party in 1960, lay at lat. 79°40′N., long. 103°30′W, or almost due north of Isachsen.

T-1, the first recognized and still the largest known ice island, remains in relatively healthy condition and freely floating. During the 1965 summer it drifted 20 km in a south-easterly direction down the east coast of Victoria Island to the position lat. 71°05′N, long. 103°09′W, near Cape Stang. This ice island has had a remarkable journey in the Arctic Ocean and through the Canadian Arctic Achipelago, and now appears to be approaching its final resting place in the shallow waters surrounding the Royal Geographi-

cal Society Islands. When last seen in October 1965, T-1 still maintained its characteristic triangular form and an area of about 125 km².

RESISTIVITY STUDIES IN GLACIERS AND ICE CAPS (National Research Council, in collaboration with Observatories Branch, Polar Continental Shelf Project, and McGill University: P. Andrieux, University of Paris)

Measurements of the electrical resistivity of polar ice caps and glaciers were made on the Penny Ice Cap, Baffin Island, Meighen Ice Cap, and White Glacier, Axel Heiberg Island. The study is in part a contribution to a world-wide comparison of geophysical characteristics of glaciers in different geomagnetic and geographic latitudes and climatic environments. The measurements confirm a distinct difference in gross resistivity between polar ice caps ($5 — 10 \times 10^5 \Omega m$), active polar glaciers ($5 — 50 \times 10^6 \Omega m$), and temperate glaciers ($5 — 10 \times 10^7 \Omega m$). The internal resistivity of a polar ice cap was measured at 4-m increments from top to bottom in the borehole that penetrated the thickest part of the Meighen Ice Cap. Macroscopically the ice cap is electrically homogeneous and isotropic. Daily and hourly measurements of the resistivity using electrodes frozen in place in the upper 6 m of the Meighen Ice Cap and the White Glacier have been carried out. Besides the variation due to changes in temperature, a fluctuation has been observed which must be related to the fluctuations of other geophysical parameters. Determinations of ice thickness by resistivity were made on all three ice masses, and compared with direct measurements (by borehole) and gravity and seismic determinations. The resistivity of the bed on which the ice is resting has also been determined; significant differences in resistivity have been found between the three islands which are not yet explained.

AVALANCHE RESEARCH (Photogrammetric Research Section, National Research Council: T. J. Blachut; McGill University: M. Kahn, University of Paris)

In a joint NRC-McGill University project, avalanches are being studied with the help of photogrammetric techniques. So far, theoretical investigations into the phenomenon of snow avalanches have lacked precise determination of several parameters. With photogrammetry, it is hoped that not only the terrain conditions under which avalanches occur but also several kinetic and dynamic components will be precisely determined. In the initial experiment carried out at Banff last winter, avalanches, which were artificially set off, were recorded by high-frequency photography and the results analysed photogrammetrically. Snow studies and micrometeorological observations were also made.

MAP COMPILATION AND REPRODUCTION (Surveys and Mapping Branch, Department of Mines and Technical Surveys)

During the past year a total of 33 new map compilations have been produced of glacierized areas in Western Canada and the Northwest Territories; 27 of these are at the 1:50,000 and the remainder at the 1:250,000 scale. At the 1:250,000 scale, advance prints are also available of much of northern Ellesmere Island and north central Baffin Island. Production of 1:250,000 maps in these heavily glacierized areas of the Arctic Islands is continuing. Special glaciological maps of Meighen Island were compiled by the Topographical Survey in collaboration with the Polar Continental Shelf Project, and were exhibited at the Symposium on Glacier Mapping. The whole island was mapped on two 1:50,000 sheets with a contour interval of 10 m, and the ice cap was mapped at a scale of 1:25,000 with a contour interval of 5 m. Maps of the Kokanee, Bugaboo, Sentinel, Sphinx and Nadahini Glaciers in British Columbia were compiled on a Wild A-5, first order, photogrammetric plotter by N. E. Cleary at the request of the Water Resources Branch, Department of Northern Affairs and National Resources. I. A. Reid of the Water Resources Branch provided the ground control and terrestrial photography taken with a Wild Photo-theodolite. These maps, which were also exhibited at the Symposium, are at a scale of 1:2,500 with a contour interval of 50 ft (15.2 m) for the Bugaboo and 20 ft (6.1 m) for the other glaciers.

OFFICE STUDIES (Geographical Branch, Department of Mines & Technical Surveys)

(a) Glacier inventory and maps

Work on a report summarizing information about the glaciers and glacier variation in north-east Baffin Island was continued by G. Falconer and W. E. S. Henoch.

Compilation of glacier maps at the scale of 1:1,000,000 was initiated by G. Østrem and G. Falconer, and one sheet covering the southern part of the Canadian Cordillera has been printed for distribution with the Geographical Bulletin early in 1966.

(b) Elevation of the glaciation limit

From map studies of glacier-covered areas, G. Østrem has started a study of the glaciation limit (the minimum elevation necessary for obtaining glaciers) in Southern British Columbia and Alberta.

(c) Cirques of Torngat Mountains, Quebec-Labrador

O. H. Løken is studying the distribution of cirque glaciers and empty cirques in a cross section of the Torngat Mountains from the Atlantic to the Ungava Bay coast. The distribution pattern is being related to the local climate as recorded at adjacent weather stations.

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

(a) Deformation behaviour of ice

The study of the dependence on crystallographic orientation of crack formation during creep has been completed. Observations are continuing on the dependence of the crack-forming process on stress, time and temperature. Observations have been initiated on the plastic behaviour of ice in tension.

(b) Ice pressure against structures

Small scale experiments modelling the pier and pile situation were conducted in the cold room. It was observed that a slab of columnar-grain ice, about 50 x 30 x 12 cm with the long direction of the columns normal to the 50 x 30 cm face, could sustain loads up to 28 kg cm^{-2} over periods of more than 3 days. The load was applied either through an axle 5 cm in diameter and about 18 cm long placed in a hole drilled through the plate, or through a flat plate 5 cm wide and about 18 cm long placed on the 50 x 12 cm face. The principal stresses were normal to the long direction of the columns. Recrystallization of the columnar ice into a fine-grained ice occurred under the area of application of the load. Observations were undertaken on ice movements about a pier of the MacDonald-Cartier bridge, Ottawa, with the aid of photogrammetry. The technique proved to be suitable for measuring horizontal and vertical movements of ice cover. It was found that most of the horizontal movement was associated with crack formation due to changes in water level, and was predominantly across river rather than up or down river. Information on the properties of ice was obtained from the vertical movement of ice cover and crack patterns that developed in association with that movement.

(c) Ice-dusting

Field trials to determine the feasibility of using dust to advance break-up were undertaken at Milne Inlet, Baffin Island in the spring of 1965. These trials demonstrated that under favourable conditions melting of ice could be advanced by two weeks or more. The ice in Milne and Pond Inlets usually goes out before that in the intervening Eclipse Sound, which indicates that, if dust is to be used, it should be applied to the ice cover on Eclipse Sound. This would require dusting a strip about 110 km long and 50 m wide. It is yet to be determined if such a strip could be maintained open under the wind conditions that occur in the area.

(d) Heat exchange at surfaces

The observations initiated in the summer of 1964 on a bog near Ottawa were continued during the winter. The summer studies had indicated that the average air temperature at the bog site was lower than for nearby sites on grassed surfaces. A similar difference was observed for winter when both sites were snow-covered.

G. Hattersley-Smith

DENMARK

In 1965 the Geographical Institute of the University of København carried out resurveying of glaciers in the Thule district of Greenland in connection with investigations on Hurlbut Gletscher Geomorphological investigations were undertaken at Disko Island as part of the limnological work in that area. On Carey Island glacial-geological observations were made of the former extent of the ice sheet. Dr. R. L. Nichols, Tufts College, U.S.A., collaborated in this work.

The Geological Survey of Greenland was engaged in several programmes during the summer. In the Frederikshaab and Godthaab-Holsteinsborg areas the stages of extension of the inland ice were dated. In the Ilimaussaq massif, Julianehaab district, a hyrdological survey was started. Earth temperature measurements have been continued throughout 1965 in Holsteinsborg; earlier measurements from Frederikshaab have been published (Olesen, 1965).

B. Fristrup

WESTERN GERMANY

AUSTRIAN ALPS (University of Münster)

In August/September 1965 geophysical observations were carried out by the Institute of Pure and Applied Geophysics, University of Münster, on the Pasterze Glacier and the Schmiedinger Glacier in the Austrian Alps.

The seismic investigations on the Pasterze Glacier are of great importance because seismic measurements had been made on this glacier in 1928 and 1955. The elastic properties of glacier ice are derived from seismic velocities and the mass balance for 36 years is determined by reflection shooting. The seismic profiles are situated beyond the firn line; in this part the glacier shows a great mass deficit between 1929 and 1965. This fact is obvious in the maps of the glacier of 1925 and 1965. Ultrasonic measurements showed a decrease of velocities with increasing water content of the ice samples caused by the daily temperature variation. By electrical methods the specific resistance of the glacier ice was determined.

The Schmiedinger Glacier is situated at an altitude of 2600 - 3000 m; in 1965 this glacier was completely covered with snow and firn during the whole year. It is very difficult to determine the mass budget of this glacier, because good reflections could scarcely be obtained. Detailed studies and a full report about our work on these two glaciers will be published in "Polarforschung".

B. Brockamp

ITALY

VARIATIONS IN ITALIAN GLACIERS IN 1965

On the whole there was little snow in the Central-Western Alps (Maritime, Cottian, Graian, Lepontine) in the winter of 1964-65, but the nearness of the Adriatic to the Central-Eastern chain (Rhaetian, Dolomitic, Carnic and Julian) favoured condensation. This is shown by the data obtained by two Alpine meteorological stations, that of Goillet (2526 m above sea level) in the Aosta Valley (Pennine Alps) and that of Fedaia (2054 m) in the Marmolada Group (Dolomitic Alps). In the former, the total snowfall from November 1964 to June 1965 reached 500 cm, which is lower than the average (650 cm); in the latter it reached 834 cm, which is higher than the average (700). Summer falls, however, were more important for glacial variations. Even in August there were still vast stretches of residual snow and copious falls began towards the end of August. The high mountain region above 2600 m was covered by a thick snow cover and the region took on a typically wintery appearance. These conditions intensified in September; in many Alpine regions there was a snow cover of 50 cm even at 2200 metres. Glaciological investigations are mainly carried out at the end of August and in the first fortnight of September, when glacier snouts are normally free of snow. This year a thick snow cover was found and this often made it impossible to take the usual measurements of frontal variations. In the statistics shown separately, there is a very high percentage of glaciers **covered in snow.** Thus it was impossible to make a certain assessment of the extent of variations, whether positive or negative, in 1965.

142 glaciers were investigated; of these 63 (44%) were retreating; 10 (7%) were advancing; 16 (12%) were stationary; 50 (35%) were covered in snow.

There follows a list of the glaciers investigated; numbers correspond to the Register of Italian Glaciers.

M. Vanni

WESTERN ALPS

Register number	Hydrographical Basin	Glacier	Variations in m 1964	1965
Maritime Alps				
1	Stura — PO	Clapier	−1.0	−0.5
2	" "	Pelrabroc	−0.80	stat.
3	"	Maledia	−2	−0.70
4	"	Muraion	−1	stat. ?
5	"	Ciafraion	− ?	stat ?
6	"	Gelas	−0.7	snow
Cottian Alps				
27	Dora Riparia	Galambra	−6	−4
29	"	Agnello	−8	−8
Graian Alps				
34	Dora Riparia	Lamet	−11.90	snow
40	Stura di Lanzo	Bessanese	−5	−4
43	"	Ciamarella	−6	−4
72	Orco	Noaschetta	−1.5	snow
69	"	Breuil	=	snow
57	"	Nel	=	− ?
61	"	Della Capra	?	−2
64	"	Basei	=	snow
112	Grande Eiva	Tribolazione	+ ?	− ?
111	"	Grand Croux	−2	−12
			+8	+2
121	"	Traio	=	− ?
130	Valsavara (Dora Baltea)	Gran Paradiso	−3.30	−2.20
131	"	di Moncorvè	−21.20	−43.40
132	"	di Monciair	−4.75	−18.10
155	Valle di Rhêmes	del Torrent	−8.6	snow
144	"	di Lavassey	−16	snow
145	"	del Fond (E.)	−8	snow
147	"	di Seches — Centelina	=	snow
189	Dora di Verney	Rutor	=	stat.
204	"	Chavannes	−11	−5
Mont Blanc				
209	Dora di Veni	Lex Blanche	−2	−2
208	"	Estellette	=	−5
213	"	Miage	−2	−4
216	"	Brouillard	−2	− ?
218	"	Frenay	−1	− ?
219	"	Brenva	?	?
235	Dora di Ferret	Prè de Bar	+9	+5
234	"	del Triolet	=	stat.
229	"	Frebuzie	=	stat.
226	"	Grandes Jorasses	=	+ ?
225	"	Planpincieux	=	stat.
224	"	Rochefort	=	stat.
222	"	Mont Frety	=	+ ?
223	"	Colle del Gigante	=	+ ?
221	"	Toula	=	stat.

CENTRAL ALPS

Register number	Hydrographical Basin	Glacier	Variations in m 1964	1965
Pennine Alps				
244	Acqua Bianca (Bathiér)	Mont Gelé	−15	+8
			−5	+2
259	Buthiér	Tza de Tzan	−24	−20
	"	Grandes Murailles	−25	−18
267	Buthiér	Chavacour	=	−30 (since 1963)
266	"	Balanselmo	=	− ?
272	Marmore	Roisette	−8 (mean)	−3 (mean)
281	"	Montabel	−2	−5
282	"	Cherillon	−2.50	snow
283	"	del Leone	=	snow
284	"	Tyndall	stat.	stat.
285	"	Cervino	stat.	stat.
286	"	della Forca	−14.5	−10.6
289	"	Valtournanche	−21	−7.5
			−15	−35
290	"	della Gran	?	snow
297	Evancòn	Sometta Grande Verra	−15	−23
298	"	Piccolo Verra	−20	snow
299	"	del Castore	−9	snow
304	Lys (Dora Baltea)	Lys	−11.60	−29.7
306	"	Indren	− ?	− ?
308	"	Netscho	− ?	−6
312	Sesia (Po)	Piode	− ?	− ?
314	"	Sesia	− ?	−2
325	Anza (Toce)	Belvedere	−12	−18
324	"	Nordend	−5	−10
Lepontine Alps				
338	Diveria (Toce)	Aurona	−63.5	snow
337	"	Leone	?	− ?
339	"	Rebbio	=	− ?

Central Alps, Lepontine Alps (continued)				
340	,,	Taranciona	?	— ?
341	,,	Mottiscia	?	— ?
342	,,	Boccareccio	=	stat.
363	Scelp. (Toce)	Basogino	=	stat.
361	Sabbione	Siedel	=	— ?
354	,,	Gemelli di Ban	?	snow
355	,,	Costone	—	snow
356	,,	Hohsand south	—62	—50
357	,,	Hohsand north	=	?
360	,,	Blindenhorn	=	snow
Rhaetian and Orobian Alps				
365	Adda	Pizzo Ferret	—20	—8
371	,,	Sud Suretta	— ?	—3
367	,,	Val Loga	—	snow
368	,,	Passo Zoccone	—	snow
372	,,	Orsareigls	—6	snow
408	,,	Preda Rossa	stat.	snow
409	,,	Corna Rossa	—2	snow
467	Viola (Adda)	Val Lia	?	?
468	,,	Cordonné east	—200	—3
469	,,	Cordonné west	—2	—1.5
471	,,	Verva Maggiore	+2	+1
473	,,	Dosdé east	—10	—8
483	Braulio (Adda)	Vitelli	=	7
511	Gavia	Tresero	=	—6.7
512	,,	Dosegù	=	+4
516	,,	Sforzellina	=	—1.5
517	,,	Lago Bianco	=	—19
518	,,	Gavia	=	snow
567	Serio-Trolio	Trobbio	?	snow
566	,,	del Gleno	?	snow
549	Venino (Adda)	Porola	?	snow
550	,,	di Scais	—7	snow
649	Sarca di Vallesinella	Vallesinella	?	snow
650	,,	Tuckett	+ ?	snow
652	Brenta alta	Brentei	?	snow
653	,,	Sfulmini	—5	snow
655	,,	Crozzon	?	snow
657	Lagol	Lagol	—6	snow
658	,,	Prafiori	—4	snow
659	Dalgone	XII Apostoli	?	snow
632	Sorca	Caré Alto	—0.5	stat.
633	,,	Niscli	—6.8	—4.7
634	,,	Lares	—8.2	—2.6
637	,,	Lobbia	stat.	+22
639	,,	Mandron	—8.5	—5.1
640	,,	Nardis	—41.5	—8.7
644	,,	Amola	—13.2	—16.7
646	,,	Cornisello	—6	—23
678	,,	Presanella	—18	stat.
697	Noce (Adige)	Vedretta Rossa	=	snow
699	,,	La Marè	+21	—8
700	,,	Marmotte	—37	snow
701	,,	Caresér	—37	+13
702	,,	Cavajon	—25	snow
Western Venoste Alps				
777	Carlin (Adige)	Vallelunga	=	—5
778	,,	Barbadorso di Dentro	+3	snow
779	,,	Barbadorso di Fuori	—14	snow
780	,,	Fontana	—9	snow
794	Saldura (Adige)	Saldura	—20	snow
795	,,	Ramudla	—1.6	snow
813	Senales (Adige)	Giogo Alto	=	—1

EASTERN ALPS

Register number	Hydrographical Basin	Glacier	Variations in m 1964	1965
Dolomitic Alps				
936	Adige	Papena	stat.	stat.
937	,,	Cristallo	—2.60	—0.40
963	Piave	Cresta bianca	—1.5	snow
973	,,	Sorapis east	—3.40	snow
974	,,	Sorapis central	—0.30	snow
975	,,	Sorapis west	—2	—0.70
Julian Alps				
985	Tagliamento	Canin west	—7	snow
984	,,	Canin east	—28	snow
983	,,	Ursic	=	snow
Livignasco (Valle dell'Inn—Danubia)				
996	Spöl (Inn)	Val Nera west	—3	—2
997	,,	di Campo north	—1	—1

APENNINES

Register number	Hydrographical Basin	Glacier	Variations in m 1964	1965
1006	Vomano	Calderone	stat.	+1

M. Vanni

JAPAN

The Institute of Low Temperature Science, University of Hokkaido, worked on the second year of a project to study the firn on the mountain range Taisetu, Hokkaido, last summer. We have no true glaciers in Japan, but much firn in the alpine area throughout the seasons.

The major themes of the project were metamorphism of snow texture, melting of snow and its creep on sloping ground. The firn subjected to observation was located on a slope of 35° inclination facing to the south-west, 55 m x 60 m in surface area and 8 m thick at the centre in early September, 1965. Total volume of the firn was estimated as roughly 8,700 m^3. Elevation of the firn site was 1730 m above sea level. The firn area was small, but its smallness is a feature favourable for the detailed physical studies to which we are accustomed.

Texture and structure of the firn were observed through pits and the cores were taken out by boring. Texture was very uniform from the top to the bottom of the firn, and was composed of compacted coarse snow grains 1 mm in diameter. The density of snow was 0.7 g/cm^3. Thin or thick ice layers composed of ice grains ranging from 2 mm to 6 mm in diameter were occasionally found within the body of the firn.

Through the observations, it was concluded that there had remained only little of the old snow deposited before the previous winter beneath the new firn, and the new firn had been metamorphosed into a uniform texture during the summer by soaking melt water. A study was begun in our cold rooms to see experimentally how water acts in uniformalizing the snow grains and in forming the ice layers within the firn.

Surface ablation of the firn was approximately 6cm/day-water in the late summer and 2.8 cm/day-water in the early autumn. A network of surface relief was seen on the firn surface, and just beneath the ridges there were found fairly big veins composed of ice grains reaching 10 mm in diameter.

It was found that long period observation, annual or seasonal at least, will be necessary to study creep of the firn.

Z. Yosida

SWEDEN

MASS BALANCE STUDIES

The studies on Storglaciären, Kebnekaise, which have now gone on for 20 years, were started with the general snow inventory at the end of May. The total winter accumulation, based on 421 observations spread fairly evenly over the glacier's 3.1 km^2, amounted to 4.54 . 10^6 m^3 of water or 148 g/cm^2. The 20-year average is 4.03 . 10^6 m^3.

The summer was cool — August had the highest monthly mean temperature of +5.6°C and the mean for the whole summer (1 June - 30 Sept.) was +4.0°C — and the total ablation amounted to only 3.22 . 10^6 m^3 of water (105 g/cm^2). The 1945-1965 average is 5.65 . 10^6 m^3.

The total net mass balance of 1964-1965 was +1.32 . 10^6 m^3 (+43 g/cm), which could be compared with —1.62 . 10^6 m^3 for 1945-1965. It is interesting to note that positive mass balance has been recorded for only four years since the studies were started, and three of these years have been in the sixties.

SURFACE PROFILES

Three of the four last budget years have had a positive mass balance and even if this has not yet caused an advance of the front of Storglaciären, the increase in mass can be observed as an increase in thickness over almost the whole glacier and a very pronounced increase in surface slope near the front.

RETREAT OF GLACIER FRONTS

Storglaciären: In 1964 the entire front was snow-covered at the end of August, but the retreat between 24 August 1963 and 27 August 1965 amounted to 2 m, 12 m and 11 m at the three fixed points used.

Isfallsglaciären: 18 August 1964 - 28 August 1965, retreat 4 m at point B-57. Two new fixed points established. Three fixed points temporarily less representative because of local disturbances.

S.E. Kaskasatjåkkaglaciären: Entire front snow-covered.

Rabots glaciär: 31 August 1963 - 22 August 1965, retreat 10 m.

Stuor-Räitaglaciären: 31 August 1963 - 23 August 1965, retreat 15 m.

Unna-Räitaglaciären: 31 August 1963 - 23 August 1965, retreat 0 m.

Fixed points were established and surveyed along the front of another 8 glaciers in the mountains south and south-west of Kebnekaise. A total of 18 glaciers are now surveyed fairly regularly.

WINTER RUN-OFF FROM GLACIERS IN KEBNEKAISE

Very few quantitative data are available concerning the winter run-off from Swedish glaciers. As a part of an IHD hydrological programme, certain studies were started during the glaciological

field course in May 1965 and were later continued in the following autumn and winter.

Isfallsglaciären: The run-off during the second half of May stayed remarkably constant at about 20 litre/min. On 15 November it was 100 1/min., on 16 Dec. 22 1/min. and on 1 Jan. 1966 only 15 1/min.

Storglaciären: During the last week of May, when some radiation melting had started in marginal areas, the run-off was about 250 1/min. On 15 Nov. it was still approximately 1000 1/min. on 17 Dec. 375 1/min. and on 2 Jan. 1966 it was measured to 490 1/min. This is about 0.1 per cent of the values reached during high-water periods in the summer.

V. Schytt

SWITZERLAND

ALETSCHGLETSCHER

Mass budget and surface velocity observations continued as usual. Since May 1965 the run-off has been measured at the new Massa river gauging station of the Swiss Federal Water Resources Bureau located only 1 km downstream from the snout of Grosser Aletschgletscher in a straight stretch of the narrow Massa gorge. This station is a remarkable piece of construction, large enough to record run-off up to 150 m^3/sec of a torrent carrying considerable sediment loads and at the same time giving accurate values during winter, when the run-off may drop to a few tenths of a m^3/sec. Model studies of the gauging station had been carried out at the Hydraulics Section of VAWE.

Detailed ablation and heat balance studies were carried out from mid-July until the end of August on Grosser Aletschgletscher at an altitude of 2200 m a.s.l. at the glacier surface in an area of some 4000 m^2 drained by a single meltstream, which was gauged at a limnigraph station installed in the ice. The technique of tapping the meltstream completely had been developed previously. The boundaries of the catchment area were lined with white water-resistant Syntosil paper 30 cm wide (partially 60 cm), causing a ridge to develop by differential ablation. Ablation was registered at 10 points by means of ablatographs (type Kasser), while a number of about 50 plexiglass stakes (small tubes) were measured each morning before sunrise. To get heat balance values of the whole field micrometeorological observations were performed in collaboration with the Osservatorio Ticinese, Locarno-Monti. The radiation components were recorded with a newly constructed four-component radiation balance meter of the Physical-Meteorological Observatory of Davos. A single solarimeter was used to measure the albedo at many sites all over the field. The vertical distribution of temperature and water vapour pressure was recorded by ventilated and shielded thermistors. The marked relief of the field suggested the recording of wind speed profiles at two sites and also of wind direction. In addition smoke was used to improve information about wind structure. Water content, density and temperatures of the surface ice layers were also observed in order to increase the accuracy of ablation measurements.

Surveying: Vertical aerial photographs of the ablation and heat balance study area were taken at low elevation by the Topographical Survey in August, while the annual flight was carried out in September, covering only the lower part of the tongue due to early snow. A volume change study for the 30 to 31 year period from 1926/27 to 1957 is progressing.

CONSULTING PROJECTS ON VARIOUS GLACIERS

Budget studies for hydro projects were continued in the following areas:

1. Gries/Blinnenhorn (Ct. Valais): Probability of glacier advance within the next decades.
2. Limmern (Ct. Glarus).
3. Mattmark (Ct. Valais).
4. Vereina (Ct. Grisons).

Movement studies of the ice fall of Allalingletscher have been carried out and are continuing in connexion with the ice avalanche at Mattmark on 30 August 1965.

P. Kasser, H. Röthlisberger
(Laboratory for Hydraulic Research and Soil Mechanics (VAWE, Director G. Schnitter) at the Federal Institute of Technology, Section of Hydrology and Glaciology)

Note: The report by R. Haefeli on other glaciological work in Switzerland in 1965 will appear in the next issue of Ice.

UNITED KINGDOM

LEEDS UNIVERSITY ARCTIC UNGAVA EXPEDITION, 1965

The six-man expedition, supported by grants from the Arctic Institute of North America, Leeds University, the Scott Polar Research Institute and other sources, visited the Cape Wolstenholme-Deception Bay area at the north-west tip of the Labrador-Ungava Peninsula during the summer of 1965. A few days were also spent working in the vicinity of Frobisher, Baffin Island.

The projects were varied, ranging from a study of the Late Quaternary history of the area to mapping plant communities.

The glacial geomorphological investigations of 1961 and 1962 were continued.

Late Pleistocene events

The direction of flow of late Wisconsin ice was determined by a statistical analysis of the orientation of erratic boulders on flat summit areas and by examination of other glacial lineations.

Postglacial land emergence

Marine terraces, elevated above sea level by glacioisostatic rise of the land following ice unloading, were studied. The postglacial warm period 'Gemma' beach (40 ft. a.s.l. strandline) was thoroughly examined, especially at Deception Bay where sections had been exposed during recent excavations by the Canadian Bechtel Construction Company. Samples of sand were collected from these sections for foraminifera and ostracod analyses.

Evidence of late Pleistocene and Holocene climatic oscillations has been gained from these investigations.

Further fossils indicative of warmer sea temperatures some 3,900 B.P. were found at Deception Bay and Frobisher Bay, Baffin Island, and six species of molluscs new to the post-Pleistocene deposits of Ungava were discovered. Samples of peat, shell and bone were collected for dating by the radiocarbon method.

"Glacierets"

Banks of snow and ice in cirque valleys in the north-west fiord region between Cape Wolstenholme and Sugluk were examined to determine whether they were small glaciers. However, if any glacier ice existed it was buried beneath deep accumulations of snow, the snowfall of the previous winter being the highest within memory of the local Eskimos. The snout and associated retreat moraines of the 'Glacierette de Nouveau Quebec', 40 miles west of Sugluk, were mapped. Stakes, erected in 1962 to measure the rate of accumulation, were completely buried and could not be re-located. A snow pit dug on 12 August indicated that 6 ft 8 ins of snow and ice had accumulated in the last two years.

Lichen dating

Lichenometry was used in conjunction with geomorphological survey to try and date the protalus moraines in cirque valleys in the north-west fiord region, an area of granite-gneiss bedrock. The size of the largest lichens on the 1935 monument and the 1913 granite gravestone at the ruined Hudson's Bay Company post at Wolstenholme (Eric Cove) were used to calculate lichen growth rates for the area.

Preliminary results indicate that the 6 ft high fresh-looking retreat moraine 80 ft in front of the 'Glacieret de Nouveau Québec' was formed between 1865 and 1890, and the retreat moraine and roches moutonées ½-mile to the north of the snout between 1565 and 1685. Well-formed end moraines in other valleys were also deposited during the Little Ice Age.

B. Matthews

MARTIN RIVER GLACIER AND SIOUX GLACIER, SOUTH CENTRAL ALASKA

The first season in the investigation of the regimen of these glaciers was initiated in June, 1965 by a team of 4 from the University of North Dakota under the direction of John R. Reid, with support from the National Science Foundation. A total of two months was spent in the field.

To determine the regimen of the two glaciers a series of ice-movement ablation stations was installed at selected sites on the glaciers and baselines were established from which these stations could be triangulated.

1) A set of nine ice-movement ablation stations were emplaced transverse to the Martin River Glacier at the point of outflow of the Charlotte Lobe. These stations were either set into the glacier ice or marked on conspicuous boulders on the ice. The baseline for this set is approximately half-way up the side of Charlotte Ridge along one of the eighteen lateral moraines found there. The baseline was only about 100 metres in length because of the nature of the terrain, and so a third point was established across the Charlotte Lobe along a lower lateral moraine. All stations were triangulated with a Kern DK-1 theodolite from at least two of the base points.

2) A second line of stations was set into or on the ice at the terminus of the Martin River Glacier immediately upglacier from Miller Lake (approximately 7.3 km down-glacier from the first set). The baseline of approximately 260 metres length has one end at the Miller Lake camp and the other across the Miller Lake outlet stream at the crest of a small knoll. A third point was marked and occupied along a lateral moraine two-thirds of the way to the top of "Salalom Ridge" along the north side of the glacier. As in the case of all the base points, this station was carefully tied to other permanent markers for future reference.

3) The third system of ice-movement ablation stations consists of seventeen stations set in two transverse and one longitudinal pattern on the Sioux Glacier. The baseline, the most difficult of all to measure, was along the most recent lateral moraine on the east side of the valley. Chaining of this 194-metre long baseline was greatly hindered by the presence of large blocks along the line.

A third point was established across the glacier on the slope of the same age moraine. As in the case of the stations on the Martin River Glacier, each Sioux Glacier station was triangulated from at least two base points.

Additional projects that were initiated for later remeasurements and comparison included the following:

1) One transverse and one longitudinal detailed profile of the Sioux Glacier was made and all turning points were marked in order that the same points can be occupied again next summer to determine the differential ablation caused by the avalanche-debris cover on the glacier surface. This is already seen to be an important factor in the regimen of this glacier, as the cover has already relatively raised the surface approximately fifty feet above the bare ice adjacent to it.

2) One special set of seven ablation stations was established in relatively active ice on the east side of Miller Lake on the Martin River Glacier. Rapid ablation during warm or very rainy days necessitated resetting of all of the stakes several times during the summer. Preliminary data suggest that as much as three metres of ablation occurs in this area during the ablation season.

3) Stream volume-velocity measurements of the Miller Lake outlet stream were made several times during the season to permit construction of a flow curve. The fluctuations in associated lake levels were recorded twice each day and compared both to the daily rain gauge measurements (taken as part of a more complete meteorological observation project) and the calculated stream flow to determine whether any discrepancies exist. It appears that a large volume of the lake water drains subglacially and emerges from the ice approximately three-quarters of a mile down-glacier to the west-north-west near the Sioux Glacier outlet stream.

J. R. Reid

Zyungo Yosida

Prof. Yosida was born in 1908 in Tokyo, Japan. He was named as "Zyungo". Japanese people can easily understand from his given name that he was born as the fifth son, because "Zyun" means order, "go" means 5. His and his brothers' names are numbered successively from one to six.

In 1931 he graduated at the physics school at Tokyo Imperial University and then joined the research institute of Furukawa Electric Co., Tokyo. He studied there the magnetic properties of permalloy. From 1933 to 1935, he was lecturer in physics at Nagaoka Technical College, Niigata prefecture. Niigata prefecture is one of the most snowy districts in Japan. In winter the depth of deposited snow sometimes reaches 3 metres or so. During this period, he made contact with the late Prof. Ukichiro Nakaya, Hokkaido University, and following Nakaya's suggestion he took his first microphotographs of snow crystals, which charmed him very much. In 1938, he was invited to Hokkaido University, Sapporo, as an assistant professor to Nakaya. In order to study the formation mechanism of thunderstorm electricity, he made experiments with the electrification of snow crystals and ice particles caused by mutual collision and friction. He worked hard in a cold room for three years, and discovered several important facts on the electrification of ice particles. In summer seasons many photographs of lightning flashes from thunder clouds were taken by a rotating camera designed by him. In 1941, the Institute of Low Temperature Science was established at Hokkaido University by the efforts of Prof. Nakaya and others, and he became a member of the research staff of this institute. During the war he joined two war-time research projects: removal of icing from airplanes and artificial dissipation of fog at aerodromes. The project on icing was conducted at the summit of Mt. Niseko (altitude: 1300 m) and the project on artificial fog dissipation was carried out on the east coast of Hokkaido Island. In 1943 he became a Doctor of Science of Hokkaido University. His thesis was thunderstorm electricity. He became full professor and was appointed to be head of the research section of applied physics at the Institute of Low Temperature Science. After Prof. Nakaya transfered from the Institute to the physics school of the University, he was actually the leading scientist of the Institute. Since then he has been actively engaged in the study of the physical properties of deposited snow, and has thrown a strong light on this field.

Scientists who have much interest in snow and ice usually make trips to polar regions to observe natural glaciers or huge masses of snow and ice. Prof. Yosida has never been to polar regions and has never seen glaciers except on colour slides taken by his staff and students. He does not like going on trips to far places from Sapporo city. But one terrible accident which forced him to make a trip to remote mountains occurred in the winter of 1961. A big avalanche swept over several workmen's houses at the construction site of an electric power plant; 33 people were killed and 12 injured. Prof. Yosida was asked to investigate this accident by the Hokkaido Government. He proposed there some useful ways of controlling avalanches. After this accident, a research section to study the mechanism of avalanches was established at the Institute of Low Temperature Science. A couple of years ago he was awarded a prize for his research works on snow and ice by the Hokkaido Press.

From 1953 to 1956, he was the Director of the Institute of Low Temperature Science, and was elected again in 1962. The present Institute is composed of 8 research sections: physics, applied physics, meteorology, oceanography, snow disaster, frost heaving, biology, and medical science.

Prof. Yosida looks, at a glance, very gentle and delicate, but he has a strong will to accomplish his object. Most Japanese suffered from stringent living conditions in the ten years after the war. In this period, he was bereaved of his lovely former wife, Teiko. He was very sad, but happiness came back again to him when he married Tsutako. Prof. and Mrs. Yosida's hobby is to play "No", a traditional dramatic dance of Japan. "No" is danced very elegantly in slow tempo, using Japanese traditional musical instruments and song. Scientists who visit him in Japan can learn not only physics of snow and ice, but also, if lucky, can enjoy the "No" play of Prof. and Mrs. Yosida.

MEETINGS

THE GLACIOLOGICAL SOCIETY

LECTURES IN BRITAIN 1966

CAMBRIDGE 4 February 8.15 p.m. — Geography Department
"Arctic coastal geomorphology"
by Dr. Cuchlaine King (Nottingham University)
Joint meeting with the University Geographical Society.

NOTTINGHAM 24 February 4.30 p.m. — Geography Department
"Glacial erosion in the Antarctic"
by Professor D. Linton (Birmingham University)
Joint meeting with the University Geographical Society.

BRISTOL 25 February 5 p.m. — Geography Department
"Glacier research during a year with the Russians in the Antarctic"
by Dr. C. W. M. Swithinbank (Scott Polar Research Institute)
Joint meeting with the University Geographical Society.

CAMBRIDGE 26 February 8.30 p.m. — Scott Polar Research Institute
"Soviet exploration of central Antarctica"
by Dr. A. Kapitsa (U.S.S.R.)
Joint meeting with the Scott Polar Research Institute.

LONDON 27 April 5.45 p.m. — Burlington House, London W.1
"Toward an understanding of the physical properties of sea ice"
by Dr. W. F. Weeks (U.S. Army C.R.R.E.L.)
Joint meeting with the Challenger Society.

BIRMINGHAM 10 May 5 p.m. — Geology Department
"Sea ice — a study in igneous petrology"
by Dr. W. F. Weeks
Joint meeting with the Lapworth Society of the University.

U.S.S.R. THIRD SYMPOSIUM ON GLACIOLOGY

At the end of August 1965 the third scientific symposium on glaciology was held on the shore of the Issik Cool Lake. The two previous symposia had taken place in 1961 in Moscow and in 1962 in Alma Ata. At the third symposium about 150 scientists from the Academies of Sciences of the USSR, the Kirghiz SSR, the Uzbek SSR, the Kazakh SSR and also from Moscow, Leningrad, Kharkov, Tomsk and Tashkent universities took part. 89 reports were made on glaciology questions: general problems of glaciers (43 reports); morphology and regime of individual, mainly mid-Asia, glaciers (7); glacier water flow and its effect on feeding rivers, and the contribution of glaciers in the formation of sediment flow (9); seasonal snow cover (4); avalanches and glacial mudflow (13). An additional 13 reports covered general summaries and further planning of glaciological researches in different regions of the Soviet Union.

Among the reports on the first question, 5 dealt with the mechanics of the movement of ice in glaciers, 4 with the morphology, tectonics and geology of glaciers, 14 with the surface thermal balance of glaciers and melting processes, 6 with the interrelations between climate and glaciation, 3 with the modern mass budget of glaciers and 9 with the change of dimensions and paleogeography of large glacier regions.

The reports themselves and the discussions showed a continuing and great interest in the theoretical study of the movement and thermal regime of glaciers. New information on the morphology and the volume of recent and ancient ice cover was obtained and progress was made in studying the thermal and substance budget of the mountain glaciers. The climatological and glaciological characteristics of some glacial mountain regions of the USSR were outlined, the hydrological role of glaciers in arid regions was roughly estimated and instructions on working out the Glacier Catalogue of the USSR was developed (the cataloguing of glaciers is being carried out in many regions).

The most lively discussion took place on the reports devoted to the prospects of further glaciological research in the USSR and to the mechanics of movement of glaciers and snow

avalanches. The last group of reports showed the urgency of investigations of the physical processes in glaciology, of development of hypotheses and their verification in nature and on models.

A great practical trend of modern glaciology was noted. Nowadays a new direction — engineering glaciology — has been formed which is concerned with: a) controlling glacier flow to improve the irrigation (including both artificial melting of glaciers and their conservation); b) using glacier surfaces for landing the aircraft and for ground transport; c) using mountain glacier regions as resorts, camping and skiing bases; d) working out methods of forecasting and preventing avalanches and mountain mudflows; e) preventing snow-drifts; snow meliorations; f) controlling melting of mountain snow by erecting artificial avalanche snow patches; g) engineering with application to snow and ice; h) the prevention of sea, river and lake ice and their application as the aid in transport.

The symposium resolved to regard the following scientific problems on glaciology in the USSR as major ones: 1) the problem of mass and energy exchange between natural ice formations and environment; 2) the problem of the internal mass and energy exchange in glaciers; 3) the problem of stability of the snow cover on the slopes, formation and movement of avalanches.

To approach these three main scientific problems of glaciology and to achieve the most important practical aims as soon as possible, Soviet scientists are planning further analysis and summaries of the glaciological data of IGY in the theoretical, regional and global aspects, and are also studying some national and international projects: 1) compilation of the Glacier Catalogue; 2) rational use of natural resources of mid-Asia for the needs of irrigation; 3) International Hydrological Decade; 4) international programme on glacier regime fluctuation; 5) international project on the solution of the problem: "The physics of the solar-terrestrial relationships".

V. M. Kotlyakov

FOURTH SYMPOSIUM ON REMOTE SENSING OF ENVIRONMENT

The following papers of interest to glaciologists were read at the Symposium, held at the University of Michigan, Ann Arbor, U.S.A., on 12, 13, 14 April, 1966.

M. F. Meier, R. H. Alexander, W. J. Campbell— Multispectral sensing tests at South Cascade Glacier, Washington.

J. M. Kennedy, R. T. Sakamoto—Passive microwave determinations of snow wetness factors.

M. A. Meyer — Remote sensing of ice and snow thickness.

A. O. Poulin, T. A. Harwood—Infra-red imagery in the Arctic under daylight conditions.

J. R. Greaves — Sea surface temperature determination from TIROS satellite data.

R. D. Leighty — Terrain information from high altitude side-looking radar imagery of an Arctic area.

R. D. Ketchum, W. I. Wittmann — Infra-red scanning the Arctic ice pack.

J. N. Rinker, S. Evans, G. de Q. Robin — Radio ice-sounding techniques.

V. H. Anderson — High altitude, side-scanning radar images of sea ice in the Arctic.

EXPEDITION GLACIOLOGIQUE INTERNATIONALE AU GROENLAND ((EGIG)

The General Assembly of the Comité de Direction of EGIG will take place in Montreux, Switzerland, on 29-30 April 1966. On 1 May there will be celebrations to mark the tenth anniversary of the formation of EGIG.

SYMPOSIUM ON THE ECOLOGY OF SUB-ARCTIC REGIONS

The Symposium will take place in Helsinki, Finland, 25 July-3 August 1966, and will be organized by the Government of Finland and by UNESCO in co-operation with the International Geographical Union. The main topics for discussion which are of interest to glaciologists are: meteorology of sub-arctic regions with special emphasis on the problems of microclimatology; snow cover as an ecological factor; weathering and geomorphological processes; permafrost as an ecological factor.

All qualified scientists from UNESCO Member States who are interested in participating are invited to contact the UNESCO Secretariat (attention: Mr. S. Evteev, Natural Resources Research Division, Place de Fontenoy, Paris 7, France). Information about local arrangements may be obtained from Professor P. Kallio, Department of Botany, University of Turku, Turku, Finland.

INTERNATIONAL CONFERENCE ON LOW TEMPERATURE SCIENCE

I. CONFERENCE ON PHYSICS OF SNOW AND ICE, 14-19 August, 1966

II. CONFERENCE ON CRYOBIOLOGY, 14-17 August, 1966

THE INSTITUTE OF LOW TEMPERATURE SCIENCE, HOKKAIDO UNIVERSITY, SAPPORO, JAPAN

CIRCULAR

January 1966

The institute of Low Temperature Science of Hokkaido University, established in 1941, has been actively engaged in basic studies of various problems of low temperature science for the last twenty-five years. On our 25th Anniversary, we will conduct an International Conference on Low Temperature Science composed of:

I. Conference on Physics of Snow and Ice
   Chairman: Prof. Zyungo Yosida
   Session 1. Physical properties of ice
   Session 2. Physical properties of deposited snow
   Session 3. Mechanism of snow avalanches
   Session 4. Physical properties of sea ice
   Session 5. Physics of frost heaving
   Session 6. Snow and ice in polar regions

II. Conference on Cryobiology
   Chairman: Prof. Tokio Nei
   Session: Mechanisms of cellular injury and resistance in freezing organisms.

Low temperature science involves many problems related to almost every science — physics, geophysics, engineering, biology and others. Solution of the problems depends much upon the international co-operation and the mutual understanding of the many scientists working in the field of low temperature science. The primary purpose of our projected conferences is to exchange information through face-to-face discussion. We believe that our plans could make a significant contribution to future developments of studies in physics of snow and ice and in cryobiology.

1. ORGANIZING COMMITTEE

Address: Organizing Committee of the International Conference on Low Temperature Science, The Institute of Low Temperature Science, Hokkaido University, Sapporo, Japan.

2. DATE AND LOCATION

14 August, 1966 Registration. Reception: Given by President of Hokkaido University and Director of the Institute of Low Temperature Science.

15-19 August Conference on Physics of Snow and Ice

15-18 August Conference on Cryobiology

Sapporo is the capital city of Hokkaido Island (approx. 800,000 in population) and 1 hour trip from Tokyo by jet plane, twenty hours by express train. One of the best hotels in the city and the Institute of Low Temperature Science will be used for meetings. The Institute will be open to visitors during the conference.

3. PAPERS AND PUBLICATION

Approximately one hundred tentative titles have been registered so far with organizing committee of the conference. This number is far more than expected. We feel very glad to know that such a large number of scientists are interested. It is and has been our greatest desire to have as many scientists as possible to make contact with each other here. A manual for the preparation of manuscripts may be obtained from the Organizing Committee.

4. ACCOMMODATION

We have been strongly advised to make reservations at the earliest time because August is the most crowded tourist season in Hokkaido. The organizing committee will make reservations for participants per individual request.

Hotel prices (including service charge and taxes. No tip is necessary).

Room	Price range (approx.) per person per day		
	Single occupancy	Double occupancy	Quadruple occup.
Single	$ 6.00-$12.00		
Twin	$ 8.60-$14.00	$5.00-$9.00	
Double	$12.00-$17.00	$8.50-$11.50	
Japanese style	$15.50	$8.60	$6.00

Bath and telephone are available in each room.

5. TRANSPORTATION

Three domestic air lines connect Tokyo and Sapporo (Fare: $34.44 by Jet, $31.11 by Prop.). There are two airports near Sapporo, Chitose and Okadama, with limousines service between the airports and downtown.

6. IMPORTANT

To make the practical arrangement and reservations, all participants are requested to inform us of their attendance at the earliest opportunity.

7. FURTHER INFORMATION

The final circular with detailed programme of the conference will be issued in June 1966.

8. RELATION OF THE CONFERENCE ON PHYSICS OF SNOW AND ICE TO THE ELEVENTH PACIFIC SCIENCE CONGRESS

The Eleventh Pacific Science Congress will be held in Tokyo, from 22 August to 10 September, 1966, under the sponsorship of the Japanese Government and the Science Council of Japan. The main purpose of this Congress is to initiate and promote co-operation in the study of scientific problems relating to the Pacific regions. The Pacific Science Congress is composed of many symposia and concurrent meetings on various fields — geography, geology, biology, agriculture, fisheries, social science and others. Our Conference on Physics of Snow and Ice has been approved by the Science Council of Japan as one of the concurrent meetings of the Congress, although our conference is held in Sapporo prior to the Congress in Tokyo. Scientists attending this Congress will be welcome at our conference, and scientists attending the Sapporo conference can be registered as participants of the Tokyo Congress. The following two symposia will be held in the Tokyo Congress:

I) Snow and Ice in Pacific Area. 23-24 Aug.
Convener: Prof. Zyungo Yosida. Chairman: Dr. Goldthwait.

II) Antarctic Research 23-27 Aug.
Convener: Prof. Takeshi Nagata.

Further information concerning the Eleventh Pacific Science Congress may be obtained from Prof. Yoshio Hiyama, Secretary-General 11th Pacific Science Congress, Fisheries Institute, Faculty of Agriculture, University of Tokyo, Bunkyo-ku, Tokyo, Japan.

LIST OF PAPERS

1. Physical properties of ice

NAME	COUNTRY	TITLE
Dillon, H. B. and Andersland, O. B.	USA	Deformation and flow of polycrystalline ice.
De Micheli, S. M. and Licenflat, A. R.	ARGENTINA	Experimental study of the evaporation of ice in controlled conditions of subsaturation.
Levi, L.	,,	Electrical properties of ice doped with different electrolytes.
,,	,,	Helical whiskers of ice.
Stehle, N. S.	USA	Migration of bubbles in ice under a temperature gradient.
Camp, P. R.	,,	Photo-production of point defects in ice.
Glen, J. W. and Jones, S. J.	UNITED KINGDOM	The deformation of ice single crystals at low temperatures.
Itagaki, K.	USA	Particle migration on ice surfaces.
Gold, L. W.	CANADA	Time to formation of cracks in columnar-grain ice.
Jaccard, C.	SWITZERLAND	Electric conductivity of ice.
Shumskiy, P. A.	USSR	The distribution of stress, velocity, and temperature in glaciers.
Voitkovsky, K. F.	,,	The relaxation of stresses in ice.
Vialov, S. S. and Ermakov, V. F.	,,	Simplified method of testing ice for creep and relaxation.
Zotikov, I. A. and Gow, A.	,,	Thermal and compositional structure of floating tongue of Koettlitz Glacier, Antarctica.
Suzuki, Y.	JAPAN	Pauling entropy of a finite ice crystal.
Maeno, N.	,,	Air bubble formation in ice crystals.
Kobayashi, T.	,,	Epitaxial growth of ice crystals on a cleaved surface of covelite (16 m/m).
Yosida, Z.	,,	The equilibrium form of ice crystals.
Wakahama, G.	,,	Plastic deformation and internal fracture of ice crystals.
Nakamura, T.	,,	Lowering of melting point of ice due to non-hydrostatic pressure and friction between ice and other materials.
Higuchi, K. and Yoshida, T.	,,	Crystallographic orientation of frozen water droplets on ice surfaces.
Magono, C. and Shio, H.	,,	Frictional electrification of ice.
Higashi, A.	,,	Mechanisms of plastic deformation of ice single crystals.
Takahashi, T.	,,	Thermoelectric properties of ice.

2. Physical properties of deposited snow

NAME	COUNTRY	TITLE
Chae, Y. S.	USA	Frequency dependence of dynamic moduli of and damping in snow.
Bilello, M. A.	,,	Relationships between climate and variations in seasonal snow cover density in North America.
Beaumont, R. T.	,,	Accuracy and evaluation of field techniques of measuring the equivalent water content of snow.
Herrmann, M. R. and Stehle, N. S.	,,	Protective coverings for ice and snow.
Moser, E. H. Jr.	,,	The bearing capacity of depth-processed compacted-snow on deep snow fields.
Mellor, M. and Smith, J. H.	,,	Creep studies on snow and ice.
Ager, B.	SWEDEN	Snow cover properties and winter climate in North Sweden.
,,	,,	A method of measuring trafficability of the snow cover.
Hanagud, S.	USA	Snow as a locking material.
Bender, J. A.	,,	Deformation of excavations in a high polar névé.
Krasser, Leo, M. A.	AUSTRIA	Sound phenomena of deposited snow.
Nakaya, U. and Kuroiwa, D.	JAPAN	Some physical properties of Greenland snow revealed by internal structures.
Wakahama, G.	,,	Compression of thin section of snow (16 m/m).
Kojima, K.	,,	Densification of snow.
Kinosita, S.	,,	Compression of snow at constant speed.
Watanabe, Z.	,,	Texture of snow cover.
Onuma, T.	,,	Studies on the heat balance at the natural snow surface and promoting the melting of snow.

3. Mechanism of snow avalanches

Haefeli, R.	SWITZERLAND	Some physical aspects on the mechanism of snow and ice avalanches.
Bradley C. C. and Bowles, D. A.	USA	Consolidation and metamorphic weakening: opposing correlatives in avalanche initiation.
Mackay, J. R. and Mathews, W. H.	CANADA	Observations on pressures exerted by creeping snow, Mount Seymour, B.C.
LaChapelle, E. R.	USA	Forecasting avalanches in new snow.
Kahn, M.	CANADA	Rheological interpretation of snow avalanche motion with measurements obtained by stereophotogrammetric methods.
,,	,,	A study of snow avalanche by remote methods: a) stereophotogrammetric measurements, b) relationship of an avalanche to the external milieu.
Moskalev, Yu. D.	USSR	The stability of snow cover on mountain slopes.
Plam, M. Ya. et al	,,	Mechanism of snow avalanches.
Tushinsky, G. K.	,,	Avalanches of the USSR.
Salm, B.	SWITZERLAND	Creep of snow under special states of stress.
Schaerer, P. A.	,,	A study of the amount of snow deposited at avalanche sites.
Huzioka, T.	JAPAN	Stress in the snow cover on the slopes of Teshio district, Hokkaido.
Shimizu, H.	,,	Texture and structure of avalanche debris at Satsunai valley, Hidaka Mts., Hokkaido.
Akitaya, E.	,,	Some experiments on the growth of depth hoar.
Shoda, M.	,,	Study on snow avalanches.

4. Physical properties of sea ice

Ross, B.	USA	Penetration and fracture of sea ice due to impact loading.
Dykins, J. E.	,,	Tensile and bending properties of sea ice grown in a confined system.
Lowis, E. L.	CANADA	Heat flow through winter ice.
Weeks, W. F. and Lofgren, G.	USA	The effective solute distribution coefficient during the freezing of salt solutions.
Untersteiner, N.	,,	Natural desalination and equilibrium salinity profile of old sea ice.

4. Physical properties of sea ice (cont.)

NAME	COUNTRY	TITLE
Assur, A.	USA	Flexural properties of sea ice sheets.
Addison, J. R. and Pounder, E. R.	CANADA	The electrical properties of saline ice.
Vyalov, S. S.	USSR	On the flow of ice.
Tabata, T.	JAPAN	Flexural strength of sea ice.
Ishida, T.	,,	Rupture of sea ice.
Ono, N.	,,	Thermal properties of sea ice.
Fujino, K.	,,	Electrical properties of sea ice.
Suzuki, Y.	,,	Wind stress and water drag on floating ice.
Kusunoki, K.	,,	Measurements of drift of ice island ARLIS-II in 1965.

5. Physics of frost heaving

Jumikis, A. R.	USA	Upward migration of soil moisture by various mechanisms upon freezing.
Yong, R. N.	CANADA	On the relationship between partial soil freezing and surface forces.
Penner, E.	,,	Experimental pavement structures insulated with a polyurethane and extruded polystyrene foam.
,,	,,	Pressures developed during the unidirectional freezing of water-saturated porous materials—experimental and theory.
Uhlmann, D. R.	USA	Estimate of the maximum heave rate.
Grave, N. A.	USSR	The temperature regime of permafrost in different geographical and geological conditions.
Corte, A. E.	ARGENTINA	Mound formation by multicyclic freeze-thaw.
Kinosita, S.	JAPAN	Heaving force of frozen ground.
Ifukube, M.	,,	Frost-heave of roads and its counter measures in Hokkaido.

6. Snow and ice in polar regions

Doumani, G. A.	USA	Surface structures in snow.
Bentley, C. R.	,,	The ice cap of Roosevelt Island, Antarctica.
Bull, C.	,,	Transverse crevasse formation on the Kaskawulsh Glacier, Yukon Territory, Canada.
Ohtake, T.	,,	Alaskan ice fog.
Lossev, K. S.	USSR	The role of avalanches in the mass budget of glaciers.
Dunin, A. K.	,,	Fundamentals of the mechanics of snow storms.
Avsyuk, G. A. and Kotliakov, V. M.	,,	Mountain glaciation of the Soviet Union: distribution, classification, ice reserves in glaciers.
Stephenson, P. J.	AUSTRALIA	Some considerations of snow metamorphism in the Antarctic ice sheet in the light of ice crystal studies.
Budd, W.	,,	Ablation from an Antarctic ice surface.
Jiracek, G. R. and Bentley, C. R.	USA	The velocity of radio waves in the Antarctic ice sheet.
Oura, H.	JAPAN	Studies on drifting snow.

ELEVENTH PACIFIC SCIENCE CONGRESS, TOKYO

ICE IN THE PACIFIC AREA, 23-24 AUGUST, 1966

Convener: Prof. Yosida. Chairman: Dr. Goldthwait

I. C. McKeller — Some aspects of glacier ice ablation and snow accumulation in a temperate maritime climate. Measurements in the High Alps of New Zealand.

W. O. Field — Advancing glaciers in southern coastal Alaska.

M. F. Meier — Glacier mass budgets in northwest America, 1962-65.

C. S. Benson — Polar regions snow cover.

C. Bull — Glaciological studies in Alaska and Yukon Territory.

A. Higashi — Ice crystal growth in a temperate glacier in Alaska.

K. Ishihara — Characteristics of snow cover of Japan.

K. Watanabe — Drift ice of the Okhotsk Sea.

M. Dunbar — The ice cover of the Bering Sea and its relation to ice covered seas of the Northern Hemisphere.

W. Budd — The Amery Ice Shelf.

SYMPOSIUM ON POLAR METEOROLOGY

Arrangements have been made for a Symposium on Polar Meteorology to be held in the World Meteorological Organization Secretariat in Geneva from 5-9 September 1966. This Symposium is being sponsored jointly by the International Commission on Polar Meteorology (IUGG), the Scientific Committee on Antarctic Research (SCAR) and the World Meteorological Organization (WMO). The proposed programme for the Symposium has been divided into the following seven fields:

1. Local effects.
2. Synoptic analysis and forecasting.
3. Circulation studies.
4. Mass and energy budgets, exchanges and interactions.
5. Snow, ice, instruments and special phenomena.
6. Climatological aspects.
7. Recommendations for further research.

About half the papers presented will be invited contributions, but the remainder may be individually submitted. Persons wishing to present papers are requested to send the title and a very brief note indicating the scope of their proposed paper as soon as possible to: Dr. K. Langlo, Chairman, Joint Arrangement Committee, WMO Secretariat, 41 Avenue Giuseppe-Motta, 1200, Geneva, Switzerland.

Extended abstracts (six copies in English) and, if possible, necessary diagrams should be sent before 1 June 1966 to: Dr. Svenn Orvig, Secretary, ICPM, Department of Meteorology, McGill University, Montreal, P.Q., Canada.

The abstracts will be printed and distributed to all participants by 15 August 1966. Finished manuscripts should be submitted by 15 November in order that the Symposium proceedings may be published by June 1967. In accordance with the practice at earlier symposia of this kind, interpretation services will not be provided. It is expected that most of the speakers will present their papers in English.

Further information on the programme and the arrangements for the Symposium will be distributed in due course.

S. Orvig

INTERNATIONAL GEOLOGICAL CONGRESS, 1968

The 23rd Session of the Congress will take place in Prague, Czechoslovakia, 19-28 August 1968. The first circular has been published and may be obtained from the Organizing Committee of the XXIII International Geological Congress, Ustredni ustav geologicky, Malostranske nam. 19, Praha 1, Czechoslovakia. Registration is requested soon—as near to 30 April 1966 as possible.

COMMISSION OF SNOW AND ICE

XIV IUGG GENERAL ASSEMBLY, 1967

The XIV General Assembly will be held in Switzerland during the period 25 September - 7 October 1967 at the invitation of the Schweizerische Akademie der Naturwissenschaften. Meetings will be held simultaneously in four cities—Zürich, Berne, Basel and Lucerne. The opening and closing plenary sessions, the IUGG Council meetings and several joint symposia will be held in Zürich, and meetings of the International Association of Scientific Hydrology will be held in Berne.

The Swiss National Committee plan to issue the first circular early in 1966, the second circular containing a tentative programme in July 1966 and the final circular giving the full programme in the Spring of 1967.

As Switzerland has particular interest for glaciologists the Commission of Snow and Ice anticipates a large attendance and hopes to arrange some instructive visits to glaciers and research institutes. Further information will be published in Ice.

W. H. Ward, Secretary, CSI.

PROCEEDINGS OF THE OTTAWA SYMPOSIUM ON GLACIER MAPPING

The August issue of the Canadian Journal of Earth Sciences will be entirely devoted to the proceedings of the Symposium, including a general statement on the Symposium, edited discussion of each paper and a folio of large maps. 700 more copies than the normal run of the Journal will be printed.

G. Hattersley-Smith

NEWS

NEW ZEALAND

FRANZ JOSEF GLACIER

A glacier-burst (Icelandic: jökulhlaup) occurred on 19 December 1965 at the Franz Josef Glacier, which recently has thickened and re-advanced substantially after years of continual wasting and recession. Two days before the event, intensely heavy rain lasting for several hours caused heavy flooding of the Waiho River, which is fed by the glacier, and resulted in some spectacular changes. The river bed was raised by as much as 40 ft. in places, according to local estimates (the maximum was certainly at least half that amount) while deep holes were scoured elsewhere. Large boulders in the hundred-ton range were moved by the preliminary flood and the position of the main water outflow from the glacier snout also changed. These happenings were noted by a National Park ranger who visited the glacier during 18 December. About 0300 hours on the 19 (or earlier — reports conflict) a thunderous roar was heard at Franz Josef, four miles distant from the glacier. At daylight it was found that a mass of water, ice and other debris had surged down the valley, leaving a litter of ice blocks extending over its full width and up amongst the trees on both sides to about 20 ft. above normal river level. The flooded river carried a large amount of ice and continued to do so for the next two days.

The glacier was found to have lost an estimated three million tons of ice from the south side upstream from the snout, leaving a marginal trench about 1,200 ft long and 300 ft wide and a separate large collapse-crater beyond it. There were signs of a great torrent having issued from this side at levels two- to three-hundred feet higher than the main outlet before the flood. For a time on 20 December water ceased to flow from the new low-level outlet on the north side of the snout and after an ominous delay again discharged from higher outlets in the trench. By nightfall the lower outlet was again emitting a violent torrent, and the next morning the higher outlets had ceased to flow. The Waiho River had then subsided, though still discoloured and well above its normal summer fine-weather volume.

The steep lower part of the glacier, already unstable and exceptionally broken owing to its rapid rate of advance, which has recently averaged 9 ft per day, suffered continual hydraulic shock and buoyant underpressures at the height of the flood on 16 December. The observed temporary blocking of the main outlet and subsequent events on the 20th suggest a likely explanation for the great burst of the previous day. If slumping of the ice snout blocked the main lower outlet at a time when the normal meltwater discharge was still swollen from effects of intense precipitation in the névé area, in the form of rain at abnormally high altitudes of over 6,000 ft, water backing up rapidly in tunnels beneath the lower part of the glacier would have developed hydraulic pressures which alone may have been responsible for the burst. Alternatively, the great ice collapse may have resulted merely from relaxation of hydraulic stresses in the lower part of the glacier after the peak of the flood, assisted perhaps by accelerated melting at the time; but this suggestion is less attractive because of the delay before collapse occurred and because it does not so readily account for the great volume of water suddenly released at the time of the burst. Newspaper reports did not make it quite clear that the prolonged deluge, from which more than 7 inches of rainfall were recorded at Franz Josef, and the preliminary flood in the Waiho River and the accompanying changes constitute a separate series of events, which preceded the glacier-burst by more than 48 hours.

Some interesting secondary effects were observed. Joints in the hard schist forming ridges across the uneven valley bottom near the snout were found to be newly opened into long cracks up to 1 inch wide. Some joint-bounded slabs and blocks of schist had sprung upwards, displacing the freshly ice-worn rock surface by

as much as 2 ft. Bruises and gouged-out hollows the size of an armchair attest to the violent blows received from large blocks in transit across the surface, and justify speculation that the rock having emerged only a few years previously from beneath hundreds of feet of ice had been still in decompression stress until relief was triggered by the hammering it experienced in the flood. Unfortunately these features will soon be covered by the advancing glacier.

As part of a current programme of studies at the Franz Josef Glacier, holes were drilled into the ice-worn rock in a variety of situations, their depths were measured with an accuracy of about 1 mm., and then they were plugged with material much softer than the rock. If the glacier should recede again after a few years it is hoped that the holes can be re-located and measured again to give an indication of the thickness of rock worn away in the interval.

M. Gage (University of Canterbury)

THE QUATERNARY RESEARCH ASSOCIATION IN THE UNIVERSITY OF CANTERBURY

The Association has been formed to serve as a focal point for recording, discussing and disseminating scientific information relating to the Quaternary era, to promote research projects in appropriate fields, including glacial geology and glaciology, to be undertaken by individuals or ad hoc groupings of local and visiting scientists and post graduate students. The University of Canterbury has given its sponsorship and permission for the group to identify itself with the University. The initial activities of the group include first steps in compiling a bibliography of Quaternary affairs in New Zealand and in inviting New Zealand scientists to participate in interdisciplinary studies and to outline their current and proposed research programmes.

The first research activity of the group is a regional investigation, known as the "Mount Cook project", which is an attempt to bring together scientists in various fields working in the central Southern Alps and adjacent areas stretching from the west coast to the Mackenzie Plains. The secretary of the group is Mr. Peter M. Johns, Zoology Department, University of Canterbury, and the chairman is Dr. Maxwell Gage, Geology Department, University of Canterbury. The Association hopes to hold regular evening meetings and would be interested to know of any distinguished Quaternary scientists who plan to visit New Zealand, so that they may be invited to speak to the Association when in Christchurch.

SWITZERLAND

THE MARJELEN SEE AND ITS FLUCTUATIONS

In July 1965, after attending the Matterhorn centenary celebrations at Zermatt and Breuil-Cervinia, a visit was made to the Eggishorn above the upper Rhone Valley, in order to inspect the present condition of the Märjelen See, situated at 2351 m above sea level. To one's great surprise and indeed disappointment the lake had vanished, and an empty bare rock basin with a few puddles only were to be seen. As is well known, the waters of this celebrated and usually very beautiful lake are dammed up against the ice of the Grosser Aletschgletscher, from whose cliffs ice-bergs break off and float out on the lake surface, enhancing the gorgeous blue coloration of the water. Movements of the Aletschgletscher, and the development of cracks and crevasses, are responsible for the draining away of the lake waters; but, as far as the writer is aware, it is quite unusual for the whole body of pent-up water to have been discharged in this way. It would be interesting to hear, therefore, if in the recent past there have been any records of the latter phenomenon. From the evidence of old shore-lines it is known that the lake level has fluctuated markedly over the years, in accordance with the varying amounts of melt-water and of leakage through the ice-dam. But how often is the lake entirely drained?

The writer is particularly interested from observations which he made some years ago of a similar, but larger, glacial lake, the so-called "Mystery Lake" first seen by a Cambridge party in 1929 from the top of Petermann Peak in N.E. Greenland. The waters of this lake, pent up in a bend on the border of the Jaette Glacier, had so greatly changed in volume by 1933 that immense ice-bergs had been floated off and were seen stranded on the mountain side some 30.5 to 61 m above the existing water-line. (N. E. Odell, Scottish Geograph. Mag., 53. 5, 1937).

The fluctuations of the Märjelen See, and the higher stand of the ice of the Aletschgletscher and its moraines in the past, have lately been commented on by Jacques Martin-Chavannes in "Les Alpes" (Revue du Club Alpin Suisse) 1 Trimestre, 1965, with illustrations of the existence of the lake as recently as September 1964.

The present recession of the Aletschgletscher may inexorably alter the stand of the ice-dam and expunge the past glories of this beautiful glacial lake altogether.

N. E. Odell (Clare College, Cambridge)

JAPAN

PROFESSOR UKICHIRO NAKAYA, who devoted his life to study snow and ice, passed away on 11 April 1962. On the third anniversary of his death, his beautiful gravestone was set in the cemetery of Katayamazu, his home town in Japan, by his disciples. The gravestone was designed by his second daughter, Fujiko, and it is composed of three granite stones as shown in the picture. Six flat equilateral triangular stones were placed on dark gravels to form a hexagonal pedestal. A thick hexagonal stone was placed at the centre of this pedestal to support a heavy main stone on which the beloved teacher's name was engraved. Six typical shapes of snow crystals — bullet, dendrite, plate, sector, tsuzumi and needle — were carved on six prismatic faces of the thick hexagon. The approximate height of this gravestone is 6 feet. Prof. Nakaya's epitaph was written by Dr. Kaya, former president of Tokyo University, and carved on another granite stone. The epitaph says: "Snow crystals are letters sent from the sky, Dr. Nakaya said. In order to solve this secret of hieroglyphic letters sent from the sky, he began to study snow crystals at Hokkaido University from the winter of 1930. He took thousands of microphotographs of natural snow crystals in the terrible cold of the mountains of Hokkaido. He solved, at last, the secret of hieroglyphic letters of snow when he succeeded in making artificial snow crystals in a cold room. After the completion of the study of snow crystals, he was engaged in a study of mechanical deformation of a large single crystal of ice found in an Alaskan glacier lake. He obtained much useful experimental data, but he was attacked by a severe disease and went down to the other world before he could begin to organize his work. Ukichiro Nakaya, who left many scientific papers, beautiful essays and lovely brush paintings, sleeps eternally in his homeland."

D. Kuroiwa

PERU

The Hydrological Decade will be marked by the first programme of glaciological studies on a national scale ever to be arranged in Peru. The National Glaciological Committee has been formed for the organization of these studies.

Glaciological investigations will be carried out with the collaboration of the "Corporacion Peruana del Santa", an entity responsible for the development of hydroelectricity in the Valley of the Santa River. All the glaciological studies will be made by the "Corporacion Peruana del Santa" in the Cordillera Blanca (8° 40 — 10° South).

The programme of glaciological investigations for 1966 consists of the following items:

BASIC GLACIOLOGICAL INFORMATION: Basic data from various glacial regions are being assembled in order to compile a comprehensive inventory of the glaciated areas of the country.

AVALANCHES AND "ALUVIONES": A reconnaissance will be made of the Cordillera Blanca to determine which hanging glaciers and glacial lakes might constitute natural hazards, liable to produce disastrous avalanches or "aluviones".

MASS BUDGET: A reconnaissance of the various glacial areas is being made with the object of selecting areas which fill the conditions necessary for mass budget studies, as recommended in the Helsinki Symposium (Commission of Snow and Ice), 1960.

GLACIAL RETREAT: Measurements of the retreat of the Yanasinga glaciers (Central Cordillera) and two Quebrada Honda glaciers (Cordillera Blanca) will be continued. In addition measurements of retreat will be initiated on other glaciers.

METEOROLOGICAL AND HYDROLOGICAL OBSERVATIONS: Meteorological and hydrological observations are contemplated in areas of particular scientific interest. The installation of some meteorological stations is under consideration.

STUDIES WITH INTERNATIONAL COLLABORATION: The Committee will give sympathetic consideration to inquiries from foreign or international institutions interested in carrying out glaciological investigations in Peru during the International Hydrological Decade. Proposals for joint programmes of investigation in co-operation with Peruvian scientists will be welcomed.

B. Morales A.

STEFANSSON COLLECTION

The following reply has been received from the Librarian of Dartmouth College (see Ice 19, page 17):

I am particularly pleased to be able to inform you that the core of unusual material which distinguishes the Collection as assembled by Dr. Stefansson will continue to be maintained by a special staff in the Collection's own quarters in our main library building where it has been housed for nearly fifteen years. At the same time a reshelving, elsewhere but almost entirely within the same building in juxtaposition to like materials, will occur for some of the less unusual monographs and serials, the latter often incomplete. This will facilitate rather than hinder use by scholars, by making these particular materials accessible in more complete form and for more hours during the week. In short, all the resources of the Stefansson Collection will still be available in the College's library. The catalog of the collection will be on hand to lead readers to individual items, whether within the Collection itself or elsewhere in the library.

In a large research library such as that at Dartmouth, which acquires materials in many disciplines touching directly or tangentially on the north, it must be evident that it is not feasible to incorporate into a separate collection everything with a northern slant. Under these conditions it must also be clear that to assure to the Stefansson Collection a continuing justification for separate existence in the service of scholarship it should be made up of a well defined body of material having an unusual value to scholars and which holds together naturally and with a high degree of completeness. It was to accomplish this kind of integrity that we have defined the scope of the Collection to focus on its centers of greatest strength and uniqueness, both geographically and chronologically, and to exclude extraneous, as well as common or routine materials, which tended in any case to exist in only incomplete form within the Collection. As indicated above, these latter items henceforth will be gathered into the College's central collection. It should also be recalled that much of this more common or tangentially related material found its way into the Stefansson Collection in the first place simply because the Collection was dependent on that sort of thing at a time when it was in private hands far removed from the general resources of a large research library.

I assure you that the College's concern to encourage scholarly attention to the north has not diminished. It is important to be aware that the main library of the College, quite apart from the Stefansson Collection, has long been strong in materials relating to the polar regions. This of course stems from an established and enduring interest in the north in this community, an interest which accounted to a considerable degree for Dr. Stefansson's election to make Dartmouth his Collection's home. While the major emphasis of the Stefansson Collection itself will, as suggested above, continue to be on its strong points, namely the history of the exploration and opening up of the polar regions, the staff of the Collection is also specifically charged with responsibility for bibliographic coverage of the polar areas for the library as a whole.

BOREAL INSTITUTE

Applications are invited for the position of Executive Director of the Boreal Institute, University of Alberta, Edmonton, Canada. The function of the Institute is to foster research in northern areas on an inter-disciplinary basis. Duties of the Executive Director will include formulation of Institute policy in consultation with the Board of Directors, promotion of its activities within and outside the University, and co-ordination of various research projects.

Applicants should preferably have a record of experience in the Arctic or sub-Arctic and proven administrative ability.

Salary and rank will be commensurate with the appointee's qualifications, and may be made at the rank of Professor with a minimum salary of $15,100 per annum. Applications, together with references and supporting documents, including educational, professional and personal dossiers, should be submitted without delay to: Dr. C. S. Brant, Chairman, Board of Directors, Boreal Institute, c/o Department of Anthropology, University of Alberta, Edmonton, Alberta, Canada.

GERMAN SOCIETY OF POLAR RESEARCH

The library of the Society is in the Institute of Pure and Applied Geophysics of the University of Münster. Please send all journals, publications and books to this address:

Deutsche Gesellschaft für Polarforschung, Institut für Reine und Angewandte Geophysik der Universität Münster, 44 Münster/Westf., Steinfurterstrasse 107, Germany.

R. G. CARRUTHERS — "THE GLACIAL DRIFTS AND THE UNDERMELT THEORY". This privately published paper may be obtained from Mr. Peter Worsley, Quaternary Unit, Department of Geography, The University, Reading, England. The price is 2/9d. Profits will go to the funds of the Svartisen Expedition 1966

THE SOCIETY'S LIBRARY

WORKS RECEIVED FOR THE SOCIETY'S LIBRARY SINCE NOVEMBER 1965

We thank the following authors or donors of papers and pamphlets. 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.

Andrews, J. T.
Ambach, W. (6 items)
Behrendt, J. C.
Bloch, M. R.
Campbell, W. J.
Gold, L. W.
Hofmann, W.
Loewe, F.
Meier, M. F.
Magnani, M.
Marcus, M. G.
Nye, J. F.
Østrem, G.
Paschinger, H.
Post, A. S.
de Quervain, M.
Ray, L. L.
Shumskiy, P. A.
Smith, D. D. (3 items)
Stenborg, T.
Tricart, J. (6 items)
Voigt, U.

Antarctic Division, Department of External Affairs, Melbourne, Australia (2 items).
Association Internationale d'Hydrologie Scientifique.
Australian National Antarctic Research Expeditions (3 items).
British Antarctic Survey (2 items).
British Schools Exploring Society.
Danske Meteorologiske Institut, Charlottenlund.
Department of Mines & Technical Surveys, Ottawa, Canada (2 items).
Division of Building Research, National Research Council, Canada (3 items).
Eidg. Institut für Schnee- und Lawinenforschung, Weissfluhjoch/Davos, Switzerland.
Expéditions Polaires Francaises (2 items).
Institution of Civil Engineers, U.K.
Institute of Low Temperature Science, Hokkaido University, Japan (8 items).
Institute of Polar Studies, Ohio State University, U.S.A. (6 items).
Instituti Geographici Universitatis Ouluensis, Helsinki, Finland.
Instituto de Geografia, Universita Nacional de Cuyo, Argentina (2 items).
IGY World Data Center A: Glaciology, New York, U.S.A. (2 items).
Internationale Union für Geodesie und Geophysik, Wien, Austria (2 items).
National Research Council, Canada (5 items).
Société Royale Belge de Géographie.
U.S. Army Cold Regions Research and Engineering Laboratory, Hanover, N.H. (12 items).

BOOKS RECEIVED

The history of the study of landforms, or the development of geomorphology. Vol. 1: Geomorphology before Davis. Richard J. Chorley, Antony J. Dunn, and Robert P. Beckinsale.

London, Methuen & Co., John Wiley & Sons Inc., 1964. 678 p., illus., 24 cm, 84s. 0d.

Traité de Glaciologie. Tome 2 (Glaciers — Variations du Climat sols gelés). Louis Lliboutry.

Paris, Masson & Cie, 1965. p. 429-1040, illus., maps, 27 cm.

The physics of ice. E. R. Pounder.

London, Pergamon Press, 1965. 160 p. hard-cover 25s. 0d., flexicover 17s. 6d.

Klimatologische Beobachtungen in Südostspitzbergen 1960. Günter Wagner.

Wiesbaden, Franz Steiner Verlag GMBH, 1965. p. 1-69, illus., 25 cm. (From — Ergebnisse der Stauferland — Expedition 1959-60. Deutsche Expedition nach Südostspitzbergen. Julius Büdel and Alfred Wirthmann.)

Geophysics of the Karakorum. (Vol. 1) Antonio Marussi.

Leiden, E. J. Brill, 1964. 242 p., illus., maps, 28 cm. (Italian Expeditions to the Karakorum (K^2) and Hindu Kush, Prof. Ardito Desio, Leader, Scientific Reports, II Geophysics.)

Antarctic Bibliography, Vol. 1. George A. Doumani (Ed.)

Washington, Library of Congress, 1965. 506 p., 27 cm, $4.25.

Jahrbuch des Österreichischen Alpenvereins 1965.

Innsbruck, Pinguin Verlag, 1965. 202 p., illus., maps, 26 cm, Ö.Sch. 39.

Antarctica (A New Zealand Antarctic Society survey). Trevor Hatherton. (Ed.)

London, Methuen & Co., 1965. 511 p., illus., map inserts, 24 cm, 90s. 0d.

NEW MEMBERS

Aidney, Miss D. L., 78 Ley Hill Road, Four Oaks, Sutton Coldfield, Warwicks., England.

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Loomis, S. R., 10944 — 123 Street, Edmonton, Alberta, Canada.

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Westgate, J. A., c/o Department of Geology, University of Alberta, Edmonton, Alberta, Canada.

Wilson, S. O., Department of Geography, Colgate University, Hamilton, New York, U.S.A. (rejoined).

Zimmerman, J. Th. F., Billitonkade 66, Utrecht, Netherlands.

THE GLACIOLOGICAL SOCIETY

c/o Scott Polar Research Institute, Lensfield Road, Cambridge, England

President: Sir V. Fuchs

Secretary: Mrs. H. Richardson

DETAILS OF MEMBERSHIP

Membership is open to all who have scientific, practical or general interest in any aspect of snow and ice study. Members receive the Journal of Glaciology free. Forms for enrolment can be obtained from the Secretary. No proposer or seconder is required. Annual subscription rates are as follows:

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	U.S. dollars:	$9.00
Junior members	Sterling:	£1 0s. 0d.
(under 25)	U.S. dollars:	$3.00
Institutions, libraries—	Sterling:	£6 0s. 0d.
	U.S. dollars:	$17.00

(The dollar rates include Bank conversion charges)

Further details may be found in the Journal of Glaciology, published in February, June and October

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I C E

Editor: Mrs. H. Richardson

This news bulletin is issued free to all members and subscribers of The Glaciological Society, and is published in April, August and December. Contributions should be sent to Mrs. H. Richardson, c/o Scott Polar Research Institute, Lensfield Road, Cambridge, England.

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