



NUMBER 40

3rd ISSUE 1972

ICE

INTERNATIONAL GLACIOLOGICAL SOCIETY

1973 ANNUAL CONFERENCE

This will be held in Cambridge, England, on 1, 2 and 3 May. The Annual General Meeting will take place on 1 May at 1730 and will be followed by the Annual Dinner at 1930. You are invited to attend and to give a short talk on recent field or laboratory work. Talks on sea ice will be given priority on 2 May.

If you would like to give a talk, please write to the Secretary of the Society so that a programme may be arranged.

3rd ISSUE 1972

CONTENTS

1973 DUES. Please send your dues (£5 for Ordinary Members, £2 for Junior Members) as soon as possible, so that we can send your 1973 issues of the *Journal of Glaciology and Ice* without interruption. Thank you.

1

RECENT WORK

UNITED KINGDOM

N.E. Greenland (*D. J. Drewry*)

Investigations were carried out for the third season on Roslin Glacier, Staunings Alper, N.E. Greenland by a Cambridge University group during July and August 1972. The Roslin is a surge-type glacier and the programme of glaciological investigations was designed to examine aspects of such behaviour.

Radio echo sounding was undertaken using a Scott Polar Research Institute MkII sounder, operating at 60MHz with a logarithmic receiver. Instruments and recording device were mounted on a lightweight sledge, the total package being 30kg. The antenna consisted of a folded dipole with one reflector mounted on a bamboo frame with ski. A close network of sounding lines (0.5km apart) was completed in the zone of confluence of the Roslin and its largest tributary, Dalmore Glacier. The data have enabled detailed ice thickness and sub-ice topographic maps to be made. Investigations of attenuation and echo strength are also being conducted.

A non-retrievable thermal probe for penetrating ice masses up to 500m was developed in the Department of Engineering, Cambridge. The probe, consisting of a 2-element heating unit housed in a brass sleeve, was powered by a 2kw generator and suspended from a frame mounted on the glacier surface. A potted quartz crystal oscillator was installed within the probe for temperature measurements within the ice using a frequency counter. Due to difficulties with heat losses and instability, penetration was only 20 m. Development of this probe is continuing with further tests proposed for 1973. Heat balance measurements were undertaken in the central part of Roslin Glacier. Net radiation and solar radiation were recorded continuously. A programme of meteorological observations at the same site has permitted computation of the other major components of the heat balance.

A steam-drill, modified from the design of S. Hodge, University of Washington, was manufactured in Cambridge using 2 kerosene blow-lamps for power, and a highly insulated flexible extension tube. Trials were carried out with various drill-nozzle configurations. Maximum penetration rate was 0.3m min^{-1} to 20m.

The area was surveyed by cartographic methods to provide a detailed map of ice surface topography. The surface was precisely levelled within a 10km^2 zone. Movement stakes, inserted in 1970, were resurveyed.

Iceland (*G. S. Boulton, D. Dent*)

A programme of observations, initiated in 1970, in natural and artificial tunnels beneath the frontal and lateral margins of Breidamerkurjökull was continued from 20 June to 6 August 1971. Studies were made of the nature and rate of abrasional processes, the incorporation of debris by the ice, its lodgement against the bed, and the properties of newly formed till. Subglacial water pressures and the stress imposed by the moving glacier against obstructions in its path were measured.

This work was continued in Spring 1972 when an abrasion rate of 1-3 mm/yr was determined for a marble slab fixed to bedrock.

Okstindan, Nordland, Northern Norway (*P. J. Worsley*)

This report relates to a continuing series of investigations which were begun in 1968. They have subsequently become the Okstindan Research Project, an interdisciplinary programme which aims to increase the understanding of the natural environment of the Okstindan mountains and adjacent areas. This region lies astride latitude 66°N , in Nordland, north Norway, immediately west of the border with Sweden. Generally the area lies above the tree-line which occurs at about 650m, and culminates in Oksskolten at 1916m. The mean annual temperature is estimated to range from -1 to -7°C and consequently the area is within the zone of sporadic to discontinuous permafrost.

The field work is conducted from the Okstindsjøen Field Station which was built in 1969 by the Department of Geography, University of Reading. During the 1972 field season four major studies were in progress, principally conducted by post graduate students.

(a) Neoglacial morphology and stratigraphy

N. J. Griffey spent the entire season in making a preliminary investigation of the whole area of deglaciation associated with the Okstindan Ice Cap and adjacent glaciers. The basic techniques adopted included field mapping at scales between 1:10,000 and 1:5,000 on sketch maps produced from stereo pairs of air photographs, terrestrial photography, precise levelling along profiles in the north-eastern part of the area and the excavation of sections.

(1) Only small areas of recent moraine were not examined and mapped on the ground. Extensive moraine systems were delineated, together with areas of former outwash aggradation and meltwater erosion. The areas of fluted ground moraine were mapped and the orientation of the flutes established. Lake sediments associated with former ice margin lakes were discovered in two localities. In one, the immediate pro-glacial environment of Vestre Okstindbre, lacustrine deposits were found overlying buried ice which was probably co-extensive with the contemporary adjacent glacier. The second occurrence was immediately outside the outermost moraine ridge of eastern Morkbekkbre, in all probability related to the Neoglacial maximum of the glacier. The only area of significant, contemporary hummocky moraine formation was found in front of an unnamed glacier between Oksfjellbre and Bessedorebre.

(2) Terrestrial photographs were taken of as much of the ice margin as possible, together with the area between it and the maximum limit of Neoglaciation. Experiments were made in the use of infra-red film to establish its usefulness in the delineation of moraine ridges and till plains: the results obtained so far are not particularly encouraging.

(3) Three major levelling traverses were constructed through the moraine sequences of Austre Okstindbre, (western part of the northern lobe), Charles Rabots Bre and Corneliussens Bre.

(4) Meaningful natural stratigraphic sections were very rare and it was necessary to dig sections by hand. The sections in the previously excavated outermost moraine of Austre Okstindbre were deepened and four distinct thin peat beds were established. Unfortunately no other organic material was forthcoming from the many other sections created. Extensive ice cores were located in the moraine ridge system between Morkbekkbre and Jordbrubre.

(b) Structural glaciology of Charles Rabots Bre

Charles Rabots Bre was selected for an attempted mass balance study in 1970, and in connexion with this work the flow characteristics and the structure of the glacier are being examined by M. J. Hambrey. The glacier is situated on the eastern side of the Okstindan massif, descending from 1710 m to 1080 m in a distance of 2 km, in an easterly direction from a col between the peaks Okshornet and Oksskolten. It consists of a roughly circular upper basin from which ice flows over a steep slope. The more gently inclined central part of the glacier is also supplied by ice from steep slopes on the southern side of the glacier. A final increase of the gradient occurs towards the snout.

In spite of its overall steepness, there are few crevasses except in the upper basin. Here they are mainly of the marginal type, there being few transverse crevasses. Strain-rate studies are

being undertaken in a region of marginal crevasses adjacent to a rock nunatak near the edge of the upper basin.

Transverse banding is well displayed at the steepest part of the glacier and elsewhere, forming sets of well-defined arcs, convex down-glacier. At the apexes of the curves the up-glacier dip is low (20-30°) but near the glacier margins, where banding has a longitudinal trend, it is near-vertical. Each set of arcs appears to represent a basin-like structure. It is believed that the structure is the result of passive deformation of sedimentary stratification due to flow. There is a very close relationship between the steeply dipping sedimentary structures and longitudinal foliation near the margins and in zones where two ice streams combine. Longitudinal foliation is displayed in most of the lower part of the glacier and it is most intense where associated with medial moraines. Strain nets have been established in zones where shearing is believed to occur. Ice samples have been collected from foliated and non-foliated ice for fabric analysis.

The overall flow of the glacier is being determined by trigonometrical surveying from rock-based stations around the glacier. Oxygen isotope studies are also being undertaken to help elucidate certain structural problems. The analyses are being done at København, Denmark, and Aldermaston, England.

(c) Analysis of periglacial processes and phenomena in an area of sporadic-discontinuous permafrost

This study by R. S. Giles is focussed on a transect extending from the local base level, Grasvatn, a large lake at 690 m, to the summit of Oksskolten at 1916 m. The transect is some 2 km wide although it becomes more restricted as the higher parts are attained. It has a reasonably constant aspect to the north-east and the lithology is generally uniform, being for the most part mica schist which has a gentle dip to the west. Within the altitudinal range of 1200 m the type and intensity of periglacial effects naturally change, and the major objective is to identify the significant parameters which appear to control the observed variations in response. To accomplish this the investigation has been designed to concentrate on two major activities in the field:

- (a) mapping the entire surface geomorphology, together with the identification and classification of the periglacial forms in the transect, and
- (b) setting instruments on various experimental plots at selected points within the traverse.

During 1972 the field work was concentrated on the lower part of the transect, the field station at Okstindsjøen being centrally located within this latter area. A short visit was made during March-April to examine the area whilst winter

conditions prevailed. This was particularly valuable at the onset of the study since it is now appreciated that the pattern of snow accumulation is one of the important factors in the location of particular surface patterned ground. During this period the Okstindsj  n meteorological station was operational. In the summer the detailed mapping began and the experimental sites in the lower area were selected and instruments set up.

Within the logistical constraints it was only possible to install one 'Grant model D' automatic recorder. Previous to the summer field work a device to measure frost heave on a continuous basis was designed and constructed in Reading. This consisted of a frame on which were mounted six transducers linked to six channels in the Grant recorder. The device was installed over a field of earth hummocks with the framework on bedrock. In addition a number of thermistors were buried at various depths to measure the temperature profile during freeze and thaw. Numerous heave targets to measure relative surface heave and horizontal movement were also installed, together with Rudberg pillars to measure subsurface movement at various experimental plots.

(d) Identification and measurement of the factors contributing to nivation

K. J. Hall spent the period mid-June until mid-September in setting up instruments on a relatively large snow patch on the north-facing valley side of Austre Okstindbredal. In this area there was much field evidence to suggest that nivation was an active process and it is hoped that, in seeking quantitative data by continuous measurement throughout as much of the year as the instrumentation will permit (mainly limited by the durability of dry cell batteries at low temperatures), a realistic analysis of the responses of the processes may be made. Thirty-two thermistor probes were installed in the snow patch area late in the ablation season, and linked to two 'Grant model D' automatic recorders with the aim of establishing temperature conditions with depth, bedrock-sediment surface conditions beneath the snow, and the thermal regime on the surrounding backwall. Four ground temperature probes have been set to read at two-hourly intervals and the remaining twenty-eight at six-hourly intervals from September 1972 onwards. The exact duration of the recording will be established by the battery power, but we hope that it will continue well into the winter, perhaps to February 1973. The site will be revisited at the start of the 1973 field season in April, when it will be possible to recharge the batteries and ensure that the subsequent full ablation cycle is monitored. Immediately adjacent to the site a meteorological station was maintained during the 1972 season and will be re-established during 1973. Sixteen high-pressure polythene tubes

were inserted into the ground at various locations within the area of the snow patch. The object was to determine their change in shape with time as a function of ground movement, by inserting a simple device to measure the change in inclination. Eight sets of Rudberg pillars and ten lines of stakes were set up; these should yield data on the type and amount of debris movement out of the snow patch area.

In 1973 a further snow patch will be selected, with a different elevation and aspect to the one described above but with similar instruments, so that comparative data may be obtained. These will make possible a more accurate assessment of the nivation activity in the north-east Okstindan area.

The latter two studies are an extension of the project, to gain a more realistic appraisal of the periglacial geomorphology of this particular type of environment, which lacks the attractive types of ground pattern upon which much previous research in this subject has concentrated. The initial investigation by C. Harris (1969-1972), on solifluction and related processes on a specific experimental plot in the area, has been completed, although the plot will continue to be monitored in the coming years. Both of the two snow patches will be close to the transect studied by Giles, and the solifluction site mentioned above is also adjacent. Thus during the 1972-3 period temperature data will be recorded from four experimental sites within reasonably close proximity, and will be augmented by the meteorological record obtained from the station at Okstindsj  n during the period of occupation.

Spitsbergen

(G. S. Boulton, J. Jarvis)

A programme of study of glaciomarine sedimentation beyond the calving snouts of glaciers was initiated in the period 9 July to 1 September 1971. This involved bottom sounding, coring, grab sampling, water turbidity measurements and water sampling, measurements of sedimentation rates, collection of marine plankton, etc. Studies were concentrated in Kongsfjord, Forlandsundet, and Eckmanfjord. ¹⁴C determinations on fjord muds have given an estimate of postglacial sedimentation rates.

Studies were also made of the till produced on Cora Island (Eckmanfjord) by the surge of Sefstrombreen, and the push-moraine formed as a result of a surge of Holmstrombreen (Eckmanfjord). D. B. Boulton studied raised beaches on both sides of Forlandsundet, on Broggerhalv  ya in Kongsfjord and Eckmanfjord. M. Paul worked on the geotechnical properties of tills at the margins of Kongsvegen, Aavatsmarkbreen, and Sefstrombreen.

Switzerland

(D. N. Collins)

Measurements were made in 1972 to assess the rate of glacier erosion in two basins in southern Switzerland (Valais). Ablation and meltwater discharge were measured at the north tongue of the Feegletscher, together with the bedload and suspended sediments in the two outwash streams. The run-off season was shorter than in 1971, and the quantities of sediment carried were less. We hope to calculate the relationship between sediment transport and the climatological variables controlling the discharge. Geochemical aspects of the water and ice are

under analysis in the laboratory at Nottingham.

Surface and englacial debris transport were observed and debris falling from the Feegletscher snout collected on traps for analysis. The snout is steeper than in 1971, but less debris fell from the surface.

The small basin of Tälliboden, Saastal, was investigated during the summer, July to September. Its run-off season was short, and the measurements of the mass balance indicate that it is strongly positive. Sedimentological and hydrological observations were made at the glacier snout.

Correspondent for U.K.—J. G. Paren



FRITZ MÜLLER

Fritz Müller was born near Zürich, Switzerland, in April 1926 and was educated at the local schools, Teachers Training College and University. His early love of the mountains led him to concentrate on geography and natural sciences, from which developed more specialised interests in glacial geomorphology and glaciology. As a student he spent his vacations with Danish expeditions to study patterned ground in East and North-East Greenland, under the leadership of Lauge Koch. On the third expedition, in 1954, he studied pingos in East Greenland, and this led to similar studies in the period March to July 1955 in the Mackenzie Delta, N.W.T.,

Canada, while on a Carnegie Research Scholarship at the Arctic Institute of North America and McGill University. From July to September he again worked on the pingos of East Greenland.

Mountaineering and glaciology took him next to the Himalaya, as a member of the Swiss Mount Everest Expedition. For 8 months in 1956 he worked on the Khumbu Glacier at 17,000 feet, studying the glacier and nearby soils. The following year he was appointed research scientist in the Hydrology Department of the Versuchsanstalt für Wasserbau und Erdbau, Eidgenössische Technische Hochschule in Zürich. Work included studies on the ice tunnel

on Jungfrauoch, concentrating on thermal drilling and temperatures. During this period at E.T.H., the University of Zürich awarded Fritz a doctorate for his work on pingos.

It was the northern lands that exerted their pull and were to shape his life for the next 11 years. He was invited to lead the scientific group on the Jacobsen-McGill University Expedition to Axel Heiberg Island, N.W.T., 1959, and was appointed research associate in the University's Department of Geography. The expeditions to Axel Heiberg were repeated annually and many students received their first experiences in glaciological field work under Fritz's enthusiastic guidance. Mass balance, climatic variations, englacial temperature measurements, zonation in the accumulation areas, and instrumentation were some of the studies for which the expeditions have become well known in the glaciological world. Fritz was one of the first people to put into regular service for glaciological research automatic recording stations for meteorological parameters. His work in Canada also included studies of the mechanical properties of snow and ice, and the preparation of inventories of snow and ice masses for the International Commission of Snow and Ice.

In 1961, McGill University appointed him Associate Professor of Glaciology, a position he held until 1970, when he became Professor of Glaciology. Soon after arriving in Canada, he married Barbara Battle, widow of Ben Battle, the British glaciologist who had died on an expedition to the north. Barbara's own expertise, in her knowledge of glaciology and in editing, and her enthusiasm for the subject have been counted by Fritz as his greatest encouragement during these years. He took 150 people to Axel Heiberg in 13 summers, stimulating many of them to take up further research in glaciology. He became an acknowledged authority in the subject and was in great demand for service on committees and commissions. Here, his dedication and his willingness to work for the various aspects of glaciology made him a sought-after member of several Canadian committees, the Council of the Glaciological Society, a commission of the International Geographical Union, working groups of

the International Commission of Snow and Ice, and Swiss, German and U.S. scientific bodies. Since 1971 he has been Secretary of the International Commission of Snow and Ice. In Canada, his chairmanship of the Sub-Committee on Glaciers, National Research Council, involved him in much work for 6 years, ending in 1971.

It has been Fritz Müller's conviction for many years that glaciology is a discipline in its own right, and should be given proper consideration in the arrangement of courses by University administrators. He achieved this in McGill, so that glaciology students could attend courses in meteorology, geology, physics and other related disciplines under the umbrella of his Department. Up to this time, the students had spent much effort in often fruitless pursuit of the various courses, many of which unhappily coincided or overlapped in the time-table.

1970 was a year of great change for the Müller family, for they moved eastwards across the Atlantic and settled in Switzerland. Fritz had been offered the chairmanship of the Department of Geography in E.T.H. in Zürich—a job full of challenges, to which he always responds; but their life in Canada had been happy, with great opportunities for Fritz to work in the north. The most recent involvement had been the initiation of the Northwater Project, to study the climatological and glaciological features of the area between the Canadian arctic islands and the Greenland coast, and he was reluctant to leave it. The result of negotiations was that he was awarded an Honorary Professorship of Glaciology at McGill and his Department in Zürich includes the Northwater Project in its research curriculum, while Fritz commutes across the Atlantic.

The Müller children may now be seen walking around with big maple leaf signs on their sweaters, thus making it clear to everyone, according to their father, that it is not by chance that their mother cannot yet pronounce her Swiss name properly. Friends have also become accustomed over the years to the sight of the children with legs in plaster, for they have inherited their father's enthusiasm, though not yet his expertise, for skiing and mountaineering.

INTERNATIONAL GLACIOLOGICAL SOCIETY

FUTURE MEETINGS

1973 ANNUAL CONFERENCE

The dates have been changed from those previously announced: the sessions will begin on Tuesday 1 May and continue until Thursday afternoon, 3 May. Talks on sea ice will be given priority on 2 May. The Annual General Meeting at which the President's annual report, the Treasurer's annual report, the presentation of accounts, and the election of Council members

will take place, will be held at 1730 on Tuesday 1 May. Circulars to members about accommodation and the Annual Dinner (scheduled for Tuesday evening, 1 May) and about nominations to the Council have been sent out at the appropriate times. Last year, members from 11 countries attended the Conference, which grows in size every year.

1974 SYMPOSIUM ON REMOTE SENSING IN GLACIOLOGY

The Advance Notice, printed in ICE no. 39, p. 27, was also issued as a separate leaflet, and distributed at several conferences in 1972 by the President and the Secretary and by other willing messengers. Several hundred copies were also mailed to individuals and organizations known to be interested in remote sensing techniques. The tear-off forms at the end of the leaflets have been completed and returned to the Secretary by many potential participants and indicate a widespread interest in the Symposium.

The First Circular will be issued in May 1973 and will include booking forms for registration

and accommodation, for both of which deposits will be required. Instructions about the submission of summaries of papers will be given in the Circular, which will also be published in ICE.

Block bookings for accommodation have been made in colleges: all rooms have basins, and bathrooms are shared by not more than three people. Charges are moderate and represent very good value: the colleges are noted for their cuisine and their cellars. Some rooms will also be available in hotels, but Cambridge is very short of hotel rooms. Early booking, using the forms in the First Circular, will be advisable.



Cambridge, 15-21 September 1974

BRANCH NEWS

NORDIC BRANCH

The inaugural meeting of the Nordic Branch was held in Stockholm 22-24 September 1972. Sessions were held in the Naturgeografiska Institutionen of Stockholm University. The meeting was chaired by Prof. Valter Schytt, who had taken the initiative in forming the Branch. The proposed constitution had been approved by the Council of the International Glaciological Society in April 1972, and, in accordance with that constitution, elections of officers of the Branch took place:

President W. Dansgaard
Vice-President O. Orheim
Secretary/Treasurer O. Orheim

It was agreed that the next meeting of the Branch, to be organized by the President, should be held in Greenland in June 1973, using special flight facilities from København.

The opening session began with the reading of telegrams from the President of the Society, Dr W. F. Weeks, and from Icelandic members, who were unable to participate this year. 34 members from the other four countries comprising the Branch were present (Norway, Sweden, Denmark, Finland), and visitors included the Secretary of the Society, Hilda Richardson.

The following papers were read and discussed:

W. Dansgaard & H. Oeschger—Isotop-glaciologi.

W. Dansgaard, S. J. Johnsen & H. B. Clausen— O^{18} sæsonvariationer i borekerner.

H. B. Clausen— Si^{32} datering af sne og is.

C. Hammer—Datering af firn ved isotopiske og optiske metoder.

C. Hammer—Vulkansk støv: en ny dateringsmetode for Indlandsisen?

O. Orheim—En massebalanse serie fra Deception Island og klimakorrelasjoner mellom nordlige og sørlige halvkule.

E. Palosuo—Studier av Östersjöisar.

P. Gudmandsen—Elektromagnetisk remote sensing i glaciologien.

O. Mellander—Storleksvariationer hos svenska glaciärer.

M. Seppälä—Vindformade marginala sjöar på Juneau Icefield i Alaska.

B. G. Andersen—Kvartære israndstadier i Norge.

C. Hjort—Studier av israndlägen och marina nivåer, NO Grønland.

A. Hillefors—Var der dalbreer i Halland, Vest-Sverige, under siste innlandsisens avsmeltning?

N. Reeh—Bevægelsesmålinger på Daugaard-Jensen Gletscher, Nordvestfjord, Scoresbysund, Østgrønland.

E. Forslind—Det defekte isgitterets struktur och plastiska deformationsegenskaper.

Two excursions took place after the sessions and were greatly enjoyed. On the Saturday afternoon Prof. Gunnar Hoppe showed classic localities for eskers, strand-lines, striations and annual moraines. On Sunday, there was a boat trip on the research vessel "Sunbeam" (a rebuilt British trawler) round part of the archipelago. Ice movement and retreat could be deduced from striations and other morphological details. One island was visited, but other landings were impossible because of the strong wind.

Two delightful evening arrangements helped further to promote co-operation between members of the Branch. The first evening Valter and Anna Nora Schytt gave a supper party at their home, and the second evening there was a lively dinner in the cellar of the Institute, with student-songs forming some of the courses. We can assume that co-operation will flourish if the same standard of parties can be maintained at future meetings.

1973 meeting

The second meeting will be held in the period 8-18 June in Narssarssuak, South Greenland. Members of the Branch will get priority in booking, as total numbers are limited. Narssarssuak lies in an area which is very interesting for glaciology and geomorphology, with good opportunities for excursions on foot, by boat and by helicopter. Meetings and lectures will be held in the Arctic Hotel where delegates will be living. In Narssarssuak there is a Meteorological Institute and an ice reconnaissance service, a satellite station, a radiosonde station, an ionosphere station, and a geomagnetic station, all of which may be visited. We may also get an opportunity to take part in the ice reporting services reconnaissance flights over Julianahab Bay, the Cape Farewell area or a part of the East Greenland coast, if weather conditions permit.

Lecturer B. Fristrup, known for many years' geographical researches in Greenland, Mag. Fabricius, chief of the ice reporting service, and Dr A. Weidick, expert in the inland ice border areas, all experienced Greenland travellers, have promised to contribute actively to a satisfying completion of the plan.

There will be good time and opportunity to hold lectures with slides and/or films. Information about recent research in glaciology and related subjects, general reviews, and talks about the Nordic settlement in Greenland will be

welcome. (We shall be living in the middle of Østerbydnen, the East Greenland settlement of the Vikings.)

Nordic Branch members have received detailed notices about the meeting and bookings have already been made. Further notices will be sent direct to those who have booked.

O. Orheim
Secretary, Nordic Branch

FRENCH BRANCH

The inaugural meeting of the French Branch was held in Chamonix 27-29 October 1972. The Branch had been created through the initiative of Prof. L. Lliboutry, whose proposal had been accepted by the Council in 1971. Over 30 members of the Society in France were present, plus members from Switzerland and Italy, and visitors. In accordance with the Constitution of the Branch the election of officers of the Branch took place.

President R. Vivian
Vice-President A. Bezingé
Secretary/Treasurer F. Valla

A revised version of the constitution was agreed and will be submitted to the Council of the Society for comment. It was agreed that the next meeting of the Branch, to be organized by A. Bezingé, should be held in Zermatt, Switzerland, in September 1973.

The sessions were held at the Ecole Nationale de Ski et d'Alpinisme and were chaired by M. le Ministre Maurice Herzog, M. Cettour, R. Vivian, H. Röthlisberger and P. Veyret. The following papers were read and discussed:

- P. Courdouan—Les rapports hydroélectricité-captages sous-glaciaires.
- A. Bezingé—Les prises sous-glaciaires dans les Alpes.
- M. Ricq & P. Duval—Mise au point sur les questions concernant la cristallographie, la physicochimie et la chimie de la neige et de la glace.
- G. Charpentier—Recherches sous-glaciaires à la mer de glace.
- P. Kasser—Le glacier Gruben.

H. Röthlisberger—Actualité sur le glacier de Bis (Valais).

R. Souchez & R. Lorrain—Preuves chimiques de la formation de glace, de dégel dans une cavité sous-glaciaire du glacier d'Argentières.

L. Lliboutry—Quelques nouveaux développements sur la théorie du glissement des glaciers.

C. Lesca—Observations sur les stratifications de fond et de surface dans les glaciers tempérés.

A. Baudoin—Utilisation de la télédétection pour l'étude de la neige et de la glace.

M. Brochu—Les trous à cryoconite du glacier GIL AN (Ile d'Ellesmere).

Communications sur les premiers résultats de l'expérience "Glaciolab 72", glacier d'Argentières.

Participants enjoyed several visits to nearby glaciers, with talks from the people responsible for the research. The Municipality of Chamonix and Electricité de France gave cocktail parties which were greatly appreciated, and on one evening the Branch's Banquet was held. (It is noteworthy that the circular to Branch members about the meeting gave the Banquet menu; a proper attention to detail.—*Ed.*)

NORTHEASTERN NORTH AMERICAN BRANCH

1973 meeting

The next meeting will be held at Le Château Montebello, located about 40 miles east of Ottawa on the Quebec side of the Ottawa River, on the weekend 2 and 3 March 1973. In addition to the usual technical sessions which will begin Friday evening, it is planned to run field investigations on the co-efficient friction between treated wood and snow, steel and ice and stone and ice. The U.S. members of the Branch feel that they can perform these tests with greater dexterity, skill and speed than Canadian glaciologists. This claim is, of course, challenged but it is doubtful if the matter will be fully resolved.

L. Gold
Vice-President, NENA Branch

JOURNAL OF GLACIOLOGY

The following papers have been accepted for publication in forthcoming issues of the Journal of Glaciology.

M. Seppälä:

On the formation of small marginal lakes on the Juneau Icefield, south-eastern Alaska, U.S.A.

Paul M. B. Föhn:

Short-term snow melt and ablation derived from heat and mass balance measurements.

G. Holdsworth:

Ice calving into the proglacial Generator Lake, Baffin Island, N.W.T., Canada.

M. Martinelli:

Snow-fence experiments in alpine areas.

L. Reynaud:

Flow of a valley glacier with a solid friction law.

D. VanWormer & E. Berg:

Seismic evidence for glacier motion.

R. M. Koerner:

The mass balance of the Arctic Ocean.

W. D. Hibler, W. F. Weeks, S. F. Ackley, A. Kovacs and W. J. Campbell:

Mesoscale strain experiments on the Beaufort Sea pack ice (AIDJEX 1971).

J. A. Matthews:

Lichen growth on an active medial moraine, Jotunheimen, Norway.

G. de Q. Robin & J. Weertman:

Cyclic surging of glaciers.

R. H. Thomas:

The creep of ice shelves: theory.

R. H. Thomas:

The creep of ice shelves: interpretation of observed behaviour.

S. C. Colbeck & R. J. Evans:

A flow law for temperate glacier ice.

J. L. Davis, J. L. Halliday & K. J. Miller:

Radio-echo sounding on a valley glacier in East Greenland.

F. K. Fahnestock, D. J. Crowley, M. Wilson &

H. Schneider:

Ice volcanoes of the Lake Erie shore near Dunkirk, New York, U.S.A.

Heinz Kohnen & Charles R. Bentley:

Seismic refraction and reflection measurements at "Byrd" station, Antarctica.

W. F. St. Lawrence, T. E. Lang, R. L. Brown &

C. C. Bradley:

Acoustic emission in snow at constant rates of deformation.

K. Itagaki & T. M. Tobin:

Mass transfer along an ice surface observed by a groove relaxation technique.

W. D. Harrison & Barclay Kamb:

Instruments and methods: Glacier bore-hole photography.

Nils-Axel Mörner:

"Postglacial"—a term with three meanings.

John W. Clough:

Radio echo sounding: brine percolation layer.

THE LIBRARY

BOOKS RECEIVED

Antartida, No. 1, 1971.

[A new journal, published by the Dirección Nacional del Antártico, Buenos Aires, for the general reader and covering a wide range of topics about the Antarctic.]

Bushnell, V. C. and Ragle, R. H. *Icefield Ranges Research Project. Scientific results. Vol. 3.* New York, American Geographical Society; Montreal, Arctic Institute of North America, 1972. ix, 261p.

[To be reviewed.]

Carson, M. A. *The mechanics of erosion.* London, Pion, 1971. [xviii], 174p. £2.50 hard cover, £1.80 soft cover. (Monographs in spatial and environmental systems analysis, no. 4.)

[Section 5 deals with the mechanics of glacial erosion, p.125-65.]

Denisov, Yu. M., ed. *Chislennoye modelirovaniye protsessa stoka gornyykh rek* [Numerical modelling of the processes of flow of mountain rivers].

Glavnoye Upravleniye Gidrometeorologicheskoy Sluzhby pri Sovete Ministrov SSSR. Sredneaziatskiy Nauchno-Issledovatel'skiy Gidrometeorologicheskii Institut. Trudy, Vyp. 52(67), 1970, 104p.

Denisov, Yu. M. and Ivanov, Yu. N., ed. *Chislennoye modelirovaniye protsessa stoka gornyykh rek* [Numerical modelling of the processes of flow of mountain rivers].

Glavnoye Upravleniye Gidrometeorologicheskoy Sluzhby pri Sovete Ministrov SSSR. Sredneaziatskiy Nauchno-Issledovatel'skiy Gidrometeorologicheskii Institut. Trudy, Vyp. 39(54), 1968, 63p.

Mashukov, P. M. *Gidrometeorologicheskoye usloviye zimnikh navodneniy na r. Syrdar'ye* [Hydrometeorological conditions of winter flooding on the Syr-Dar'ya river].

Glavnoye Upravleniye Gidrometeorologicheskoy Sluzhby pri Sovete Ministrov SSSR. Sredneaziatskiy Nauchno-Issledovatel'skiy Gidrometeorologicheskii Institut. Trudy, Vyp. 45(60), 1969, 138p.

- O. Reinwarth and G. Stäblein. 1972. Die Kryosphäre, das Eis der Erde und seine Untersuchung. *Würzburger Geographische Arbeiten*, Ht. 36, 71p.
[Survey of different manifestations of ice on Earth. Includes methods of assessment of mass balance of glaciers with examples from Vernagtferner, Ötztaler Alpen, and discusses importance of surges of the Antarctic ice sheet.]
- Runich, A. V., ed. *Rasprostraneniye i rezhim lavin na territorii SSSR (Kratkiy katalog izvestnykh svedeniy)* [Distribution and regimes of avalanches in the territory of the U.S.S.R. (Short catalogue of known information)]. Leningrad, Gidrometeorologicheskoye Izdatel'stvo, 1970. 92p.
[Nineteen regions.]
- Simonov, I. M. *Oazisy Vostochnoy Antarktidy* [Oases of eastern Antarctica]. Leningrad, Gidrometeorologicheskoye Izdatel'stvo, 1971. 176p.
[Study of formation, landscape, climate and natural history of oases along the coast from Dronning Maud Land to Wilkes Land.]
- Sparks, B. W. and West, R. G. *The ice age in Britain*. London, Methuen; New York, Barnes & Noble, [c1972]. xvii, 302p., plates. £5.50.
[To be reviewed.]
- Whitten, D. G. A. with Brooks, J. R. V. *The Penguin dictionary of geology*. Penguin Books, [1972]. 516p. 75p.

RECENT MEETINGS (of other organizations)

A WORKSHOP ON THE STUDIES OF ICE, WATER AND HEAT BALANCE

(El'brus, February 1972)

The Glaciological Section of the Soviet Geophysical Committee regularly holds workshops devoted to important problems in modern glaciology. The 1970 workshop, on the topic "Precise methods in the study of mountain glaciers and snow avalanches", was attended not only by glaciologists, but by a number of prominent mathematicians, engineers and physicists.

A workshop, on the problem "Comprehensive studies of ice, water and heat balance in mountain-glacier basins", was held in February 1972 at the Moscow University Laboratory at "Azau", at the foot of El'brus. 35 glaciologists from Moscow, Leningrad, Tashkent, Alma-Ata, Tbilisi, Rostov, Dushanbe, Frunze and Tomsk participated in the workshop.

The purpose of the workshop was to discuss modern methods for observing and calculating the main components of ice, water and heat balance and to exchange experiences of such studies in representative mountain-glacier basins under the IHD programme.

The following classes were held:

- 1) Methods for observation and calculation of accumulation—convener V. M. Kotlyakov.
- 2) Methods for observation and calculation of ablation—G. Ye. Glazyrin.

- 3) Zones of ice formation, calculation of internal glacier nourishment, mass balance and methods of mass balance calculation—A. N. Krenke.
- 4) Water in glaciers, methods of observation and calculation—G. N. Golubev.
- 5) Methods of observation and calculation of water balance for mountain-glacier basins—G. N. Golubev.
- 6) Methods of observation and calculation of glacier heat balance—A. P. Voloshina.
- 7) Climate of glacier zone, peculiarities of observations and calculations—A. N. Krenke.
- 8) Problems of terminology in the study of ice, water and heat balance—V. M. Kotlyakov.
- 9) Problems of interpretation and systematization of data obtained in mountain-glacier basins—G. N. Golubev, A. N. Krenke.

The Soviet Section of Glaciology suggested the following topics for future workshops: observations of glacier variations; problems of paleoglaciology in mountain regions; internal mass and energy exchange of glaciers; study of snow cover in mountain areas; utilization of modern equipment in glaciological studies.

V. M. Kotlyakov

SYMPOSIUM ON THE PHYSICS AND CHEMISTRY OF ICE

(Ottawa, Canada, 14-18 August 1972)

The Symposium was sponsored by the Royal Society of Canada, with support from the National Research Council of Canada, Canadian Department of the Environment, Arctic Petroleum Operators Association and Eastcoast Petroleum Operators Association. Organization was in the hands of a Committee, chaired by E. Whalley, with M. K. Ward (National Research Council) as Executive Secretary. About 120 participants from North America, Europe, Japan and Australia enjoyed the fruits of the excellent organization, both in the working sessions and for the social occasions.

The Symposium was opened by J. Tuzo Wilson, President, The Royal Society of Canada, and L. Onsager gave the Introductory Address. The scope of the Symposium—the fundamentals of the physics and chemistry of ice—was reflected in the titles of the invited papers:

- | | |
|----------------|--|
| B. Kamb | — Crystallography of ice. |
| L. C. Allen | — Molecular orbital theory of water polymers with particular reference to ice. |
| S. L. Miller | — The clathrate hydrates. |
| E. Whalley | — Lattice dynamics of ice. |
| N. H. Fletcher | — The surface of ice. |
| T. Owen | — Ice in astronomy. |
| H. Engelhardt | — Protonic conduction in ice. |
| P. V. Hobbs | — Ice in the atmosphere: a review of recent work. |
| J. Weertman | — Mechanical properties of ice. |
| J. F. Nye | — The motion of ice past obstacles. |
| J. W. Glen | — Closing remarks. |

Short papers from contributors completed the sessions, with discussions taking up a major part of the time: a most productive arrangement, as discussions served to emphasize the need for further research as much as to demonstrate the advances made to date.

INTERNATIONAL SYMPOSIA ON THE ROLE OF SNOW AND ICE IN HYDROLOGY

(Banff, 6-20 September 1972)

Almost two hundred participants from many countries enjoyed the mountainous scenery of the Canadian Rockies during this eight day conference. With excellent accommodation provided by the Banff School of Fine Arts and smooth operations provided by the highly efficient organizing committees, this conference was a pleasure to attend. Even the local meteorologist co-operated by providing a reminder of what we had come to discuss—on the first night an early season storm covered the landscape with fresh snow.

Only a quick review of the one hundred papers can be given here. The theme paper of each session featured an expert on his subject:

- 1) T. L. Richards—The physics and chemistry of snowfall and snow distribution.
- 2) H. Kraus—Energy exchange at air-ice interface.
- 3) M. R. de Quervain—Snow structure, heat and mass flux through snow.
- 4) G. A. Alexeev, I. L. Kaljuzhny, V. Ya. Kulik, K. K. Pavlova, V. V. Romanov—Infiltration of snowmelt water into frozen soil.
- 5) M. F. Meier—Hydraulics and hydrology of glaciers.
- 6) B. Michel—Properties and processes of river and lake ice.
- 7) E. L. Peck—Measurement in space and time.

- 8) E. G. Popov—Snowmelt run-off forecasts: theoretical problems.
- 9) M. C. Quick—Forecasting run-off: operational practices.
- 10) D. M. Rockwood—New techniques in forecasting run-off from snow.
- 11) G. Østrem—Run-off forecasts for highly glacierized basins.
- 12) B. M. Ginsberg—Measurement and forecasting specific to river and lake ice.
- 13) D. Kuroiwa, E. R. La Chapelle—The preparation of artificial snow and ice surfaces for the XI Olympic Winter Games, Sapporo, (Japan).

Many other papers were presented in each session, with special interest being shown in measurement of snow cover and snow properties; measurement and forecasting river and lake ice; and modification of snow and ice covers. Relatively little was said about the processes of melting or mass and heat flux through snow cover and frozen ground. Considerable interest in these processes was apparent, however, and much research will probably be done as a result of this meeting.

During the weekend break many people took to the local mountains on individual hikes or enjoyed the hospitality of Alan Stanley by spending a day at the research site on the Peyto

Glacier. This most enjoyable experience included a night spent watching Alan fight off a local bear who wanted to join the party for a midnight snack. In the morning transportation into the glacier was provided by helicopter for informal discussions of the scientific work on the Peyto Glacier, and the beauties of the area. At mid-afternoon Gunnar Østrem led the walk back to

the road, pointing out the significant hydrologic points along the way.

At the conclusion of the meeting four additional study tours were conducted. These featured the most interesting aspects of mountain hydrology and were well attended by the conference participants.

S. C. Colbeck

SYMPOSIUM ON THERMODYNAMIC SEA/AIR INTERACTION IN THE ARCTIC

(Leningrad 25-30 September 1972)

The Symposium on the Thermodynamic Sea/Air Interaction in the Arctic was held in Leningrad from 25-30 September 1972. Sponsored by the Arctic and Antarctic Research Institute (AARI) of Leningrad, the symposium was attended by 150 scientists from the Soviet Union and 15 participants from seven other countries. The main topics for discussion were theories for the interaction of the ocean-ice-atmosphere system, and both analytical and numerical models were presented. Papers by Ye. P. Borisenkov and Yu. P. Doronin were of especial interest since they stressed that the feedback effects of all three components were necessary to any correct interpretation of cause-effect relationships. Field measurements from the North Pole series of Soviet drifting stations and the AIDJEX Program were presented on the topics of heat regime, deformation, drift and water stress in the Arctic Basin.

Additional papers on global effects associated with Arctic air mass fluctuations, internal wave propagation in ice-covered seas, and ocean

currents in the Antarctic Regions were also presented and discussed. Plans were made to publish the proceedings of the symposium.

Organizational discussions on possible international co-operative programmes in Polar Regions were also held. The main areas discussed were the current work in AIDJEX, planning for the Soviet Polar Experiment (POLEX) and integration of the whole into the Global Atmospheric Research Programme (GARP). A statement from the International Commission on Polar Meteorology of IUGG on the general organization was later made as a result of these discussions.

Tours of the AARI, Hermitage, and other historical sites in Leningrad were arranged. As well, two evenings at the ballet were most appreciated by the foreign participants. Thanks go to the hosts at AARI who presented a stimulating scientific programme as well as a brief but highly enjoyable introduction to the history and culture of Leningrad.

S. F. Ackley

SYMPOSIUM ON ICE AND ITS ACTION ON HYDRAULIC STRUCTURES

(Leningrad, USSR, 26-29 September 1972)

The Symposium was organized by the Committee on Ice Problems of the International Association of Hydraulic Research and the IAHR Soviet National Committee. Nine or ten short papers were read each session. The following longer papers were also presented:

- K. N. Korzhavin — Ice engineering and hydro-electric development.
- T. Carstens — Structure and physico-mechanical properties of ice.
- A. Assur — Ice engineering in the American experience.

- B. Michel — Ice management in hydraulic design—recent Canadian experience.

Participants enjoyed visits to historic parts of the city and an entertaining evening at the Circus. A study tour in the following week took 16 people to Novosibirsk, Irkutsk, Bratsk and Lake Baikal, for visits to research institutes and power plants with practical interest in ice problems. The tour concluded with a delightful evening at the Bolshoi Ballet in Moscow.

FUTURE MEETINGS (of other organizations)

CONFERENCE ON PORT AND OCEAN ENGINEERING UNDER ARCTIC CONDITIONS

(Reykjavik, Iceland, 27-30 August 1973)

The purpose of this conference is to exchange experience and discuss matters of mutual interest regarding port and ocean engineering under Arctic conditions, i.e. conditions obtaining in: North Atlantic, Arctic and Antarctic seas, North Sea, Baltic Sea, Great Lakes in Sweden, Bering Sea, Hudson Bay, Great Lakes in the United States and Canada. The conference is sponsored by the University of Iceland, Department of Engineering and Science. Icelandic co-sponsors are: State Harbour Authority; State Directorate of Shipping; Icelandic Association of Harbours; and Icelandic Association of Chartered Engineers. Foreign co-sponsors (to date): Technical University of Norway, Trondheim, Norway; University of Alaska, Fairbanks, Alaska.

The themes of the Conference are:

Section 1—BASIC SCIENCES

Arctic Ocean environments.

Meteorology, hindcasting and forecasting of waves and currents.

Observations of ice in the ocean, in fjords, and in estuaries.

Longperiod waves, including seiches, surges, and waves caused by land and ice slides.

Forces due to winds, waves, currents and ice in the ocean.

Coastal morphology, littoral drift, and sediment transport.

Collection of data on waves, currents, temperatures, salinity, etc.

Special soil mechanics problems.

Instrumentation.

Section II—APPLIED SCIENCES

Surveying.

Harbours, jetties, piers and breakwaters.

Coastal protection, including protection against erosion by ice.

Offshore structures, platforms, buoys, etc.

Minerals recovery under arctic conditions.

Pipelines under arctic conditions.

Transportation problems.

Fishing ports.

Fishing technology.

Collection of data for fisheries.

Formation of ice on ocean and coastal structures.

Model technology on ice problems in the ocean.

Ice breaking.

Further information may be obtained from: Secretary of the Conference, "Port and Ocean Engineering Under Arctic Conditions", P.O. Box 645, Reykjavik, Iceland.

SYMPOSIUM ON RIVER AND ICE

(Budapest, Hungary, 15-17 January, 1974)

The Symposium is organized jointly by the Sections for Fluvial Hydraulics and for Ice Problems of the International Association for Hydraulic Research and by the Inland Navigation Section of the Permanent International Association of Navigation Congresses, under the auspices of the Hungarian Academy of Sciences and the National Water Authority of Hungary.

TOPICS

Flood control and river control, river canalization and water power development; ice phenomena in natural or controlled and canalized rivers; inland navigation. Special attention will be given to papers dealing with hydraulic phenomena interrelated between the above disciplines. Results of both prototype experiences and those gained on physical or mathematical models are of interest. Therefore papers are invited on the following subjects:

i) Relationships of fluvial and ice hydraulics

The effects of the flow conditions on the ice formation, drift, cover development, jamming and break-up with special regard to multipurpose river control and navigation.

ii) Interrelations between river control, river canalization, low head water power development and navigation with special regard to ice control.

River control works for improving ice flow conditions, interrelation between river morphology and ice regime. Strategy of ice breaking for ice flood prevention on rivers, melting from upstream, considering meteorological forecasting. Problems connected with ice phenomena on canalized rivers of small slope including effects of run-off on power plants. Effect of natural and artificial effluents, including cooling water, on the ice regime of rivers. Ice regime of controlled or canalized rivers with respect to navigation.

iii) Effects of run-off regulation

Effects of run-off regulation on water and ice and bed regimes in upstream and downstream reaches of rivers, caused by natural or man-made reservoirs with special regard to navigation.

Further information may be obtained from: Dr Zoltan G. Hankó, Secretary, Local Organizing Committee, IAHR/PIANC Symposium, 1974, VITUKI, Rákóczi út 41, Budapest VIII, Hungary.

INTERNATIONAL COMMISSION OF SNOW AND ICE

SYMPOSIUM ON SNOW MECHANICS

(Grindelwald, Switzerland 1—5 April 1974)

The Symposium will be under the sponsorship of the International Association of Hydrological Sciences and will be organized by the International Commission of Snow and Ice. It will be held in Grindelwald (altitude 105 m), a well-known mountaineering and skiing resort in the Bernese Oberland, Switzerland.

The Symposium will be concerned with the basic physics of the mechanics of deposited and moving snow. The influences of weather and water will be involved where they are relevant to the main subject. Problems not relevant to the basic physics and mechanics of snow will be excluded. The detailed topics envisaged are as follows:

Physical Fundamentals

Structure and texture of snow in relation to mechanical parameters.

Properties of ice which are of importance in the mechanical behaviour of snow.

Physical processes within and at the boundary surface of the snow pack influencing mechanical properties.

Index properties of snow (e.g. hardness, permeability, attenuation of light, etc.) and mechanical parameters.

Mechanical fundamentals

Basic experimental techniques.

Relations between stress, deformation and history in natural and disaggregated snow (constitutive equations).

Friction of snow on snow or other materials.

Strength and failure criteria of snow.

Mechanical characteristics of blowing snow.

Fluid dynamics

Theoretical and experimental investigations on stress and strain rate or strain within the

natural snowpack, including acting forces, failure etc.

Calculations and observations of rapid movements of snow.

Model tests and laws of similarity.

In order to provide ample time for discussion the number of papers will be limited to 30 or 40.

In addition, 3 or 4 invited review papers are planned.

Tentative titles, extended abstracts and final papers should be submitted to the ICSI Secretariat according to the following deadlines:

January 1973: Declaration of interest in the symposium and submission of tentative titles including a brief note on contents.

31 May 1973: Submission of extended abstracts (maximum 300 words, in 4 copies).

31 January 1974: Submission of final papers in duplicate (maximum 3500 words including summaries and figures) and registration forms.

The papers must be written either in English or French, with abstracts in both languages. The extended abstracts will be screened by a Committee appointed by ICSI and results will be communicated to authors in due time. The final papers will be mimeographed and distributed at the beginning of the symposium.

Further information may be obtained from Dr F. Müller, Secretary ICSI, International Symposium on Snow Mechanics, Geographisches Institut ETH, Sonneggstrasse 5, CH-8006 Zürich, Switzerland.

GLACIOLOGICAL DIARY

1973

- 2-3 March
International Glaciological Society, Northeast North American Branch Meeting, Le Château Montebello, P.Q., Canada.
- 25-27 April
Annual Meeting of the German Society of Polar Research, München: "The ice regions of the earth, their climatological and ecological conditions". (Dr H. Kohnen, Institut für Geophysik, D-44 Münster/Westf., Gievenbecker Weg 61, W. Germany.)
- 1-3 May
Annual Conference of International Glaciological Society, Cambridge, England. (Part of the Conference will be devoted to discussion of sea ice research.) (Mrs H. Richardson, Secretary, Cambridge CB2 1ER, England.)
- 8-18 June
International Glaciological Society, Nordic Branch, Annual Meeting, Narssarsuaq, Greenland. (Dr W. Dansgaard, President, Nordic Branch, Geophysical Isotope Laboratory, København Universitet, Haraldsgade 6, København 2200, Denmark.)
- 11-14 June
Symposium on Remote sensing of water resources. Burlington, Ontario, Canada. (R. K. Lane, Lakes Research Division, Canada Centre for Inland Waters, 867 Lakeshore Road, P.O. Box 5050, Burlington, Ontario, Canada.)
- 16-28 July
Conference on Permafrost. USSR Academy of Sciences, Yakutsk. (Institut Merzlotovedeniya, Yakutsk, USSR.)
- 23-27 July
Symposium on the Hydrology of lakes. Otaniemi, Helsinki, Finland. (Organizing Committee, P.O. Box 436, 00101 Helsinki 10, Finland.)
- 27-30 August
Conference on Port and ocean engineering under arctic conditions. University of Iceland. (Secretary of Conference, "Port and ocean engineering under arctic conditions", P.O. Box 645, Reykjavík, Iceland.) (See p. 14 of this issue of ICE.)
- early September
International Glaciological Society, French Branch, Annual Meeting, Zermatt, Switzerland. (Dr R. Vivian, President, French Branch, Institut de Géographie Alpine, Rue Maurice-Gignoux, 38-Grenoble, France.)
- 2-6 December
Symposium on Advanced concepts and techniques in the study of snow and ice resources. Monterey, California, USA.

(Dr H. S. Santeford, Jr., US National Committee for the IHD, National Academy of Sciences, 2101 Constitution Avenue, Washington DC 20418, USA.)

- 2-10 December
International Union for Quaternary Research, Congress, New Zealand. (Dr Jane M. Soons, Secretary-General, Department of Geography, University of Canterbury, Christchurch, New Zealand.)

1974 15-17 January

Symposium on River and ice. Budapest, Hungary. Hungarian Committee of International Association for Hydraulic Research, and Inland Navigation Section of the Permanent International Association of Navigation Congresses. (Dr Z. G. Hankó, Secretary, Local Organizing Committee, IAHR/PIANC Symposium, Budapest 1974, VITUKI, Rákóczi út- 41, Budapest VIII, Hungary.) (See p 14 of this issue of ICE.)

- 1-5 April
Symposium on Snow mechanics. Grindelwald, Switzerland. (Int. Commission of Snow and Ice, IAHS, Dr F. Müller, Secretary, Geog. Inst. der ETH, Sonneggstrasse 5, Zürich 8006, Switzerland.) (See p 15 of this issue of ICE.)

- 15-21 September
Symposium on Remote sensing in glaciology. Cambridge, England. (International Glaciological Society, Mrs H. Richardson, Secretary, Cambridge CB2 1ER, England.)

1975 mid-August

International Association of Hydraulic Research Committee on Ice Problems and US Army Cold Regions Research and Engineering Laboratory — Symposium to include ice management and engineering as related to extended season navigation of inland waterways, ice jam control, and effects of sea ice on marine structures. (Dr G. Frankenstein, IAHR Symposium, P.O. Box 282A, Hanover, NH 03755, USA.)

1976 August

23rd International Geographical Congress, Moscow, USSR. (V. Annenkov Institute of Geography, Academy of Sciences USSR, Staromonetny 29, Moscow 109017, USSR.)

September
Symposium on Problems of applied glaciology. Cambridge, England. (International Glaciological Society, Mrs H. Richardson, Secretary, Cambridge CB2 1ER, England.)

NEWS

Dr Albert P. Crary was presented on 24 April 1972 with the Vega medal of the Swedish Society for Anthropology and Geography for his important contributions to the geophysical and geographical exploration of the polar regions. The special title of Reader in Ice Physics has been conferred on Dr. J. W. Glen by the University of Birmingham. Dr E. Palosuo has been appointed to the Professorship of Geophysics at the University of Helsinki.

PUBLICATIONS

The Institute of British Geographers (1 Kensington Gore, London SW1, England) announces the publication of:

"Polar geomorphology", following a Symposium on Polar Geomorphology held at the University of Aberdeen, 4 & 5 January 1972, and compiled by R. J. Price. £3.60.

"Post-glacial uplift in Arctic Canada", a geomorphological study by J. T. Andrews. £2.50.

REVIEW

Till—A symposium. Edited by R. P. Goldthwait, assisted by J. L. Forsyth, D. L. Gross, and F. Pessl. Ohio University Press, 1971, 402 pp.

Books are being written on topics that become ever more narrow and specialised. This is the first one to be devoted entirely to till. It is the proceedings of a symposium held by the Geological Society of America at Columbus, Ohio, in 1969, attended by 200 people. Only two of the 22 papers were written specially for the volume; the remainder were read at the symposium. Most of the papers have been revised as a result of the discussions following their presentation. The two specially requested papers are a useful general review by R. P. Goldthwait, the chief editor, and a very valuable account by G. S. Boulton of one of the few studies of till actually being deposited at present in Svalbard.

The papers are arranged in 7 sections. The first, consisting of two papers by R. P. Goldthwait and A. Dreimanis, is introductory. The second section, with 4 papers, deals with genesis of till. The fabric is an important characteristic in studying till genesis and is dealt with by all four authors, who are G. S. Boulton, L. D. Drake, F. Pessl, and D. P. Stewart and P. MacClintock. The third section consists of three papers and deals with till thickness and structure. The authors are L. H. Nobles and J. Weertman, S. R. Moran and G. W. White. The first is more theoretical, and the second and third more descriptive. The fourth section has three papers on stratigraphic correlations by E. A. Christiansen, W. H. Johnson, D. L. Gross and S. R. Moran, and J. P. Kempton, P. B. Du Montelle and H. D. Glass. The areas covered are southern Saskatchewan and Illinois. The four papers in

the fifth section deal with the composition of till in terms of grain size distribution and mineralogical content. They are A. Dreimanis and U. J. Vagners, D. L. Gross and S. R. Moran, J. R. Steiger and N. Holowaychuk, and L. P. Wilding, L. R. Drees, N. E. Smeck and G. F. Hall. The sixth section is devoted to four papers on till fabric by J. T. Andrews, J. A. Lineback, J. Ransden and J. A. Westgate, and E. B. Evensen. The problems and uncertainties of fabric analysis and measurement are commented upon in these useful reviews. The final section consists of two papers, the first describing a mudflow, by N. C. Hester and P. B. Du Montelle, and the second till balls, by W. A. Pettyjohn and R. W. Lemke.

The papers as a group provide much detailed information on many aspects of the study of till, which provides some of the best evidence of processes of glacial deposition as well as of glacial chronology. The papers are mostly well written, and are illustrated by good photographs and clear, well-drawn maps and diagrams. They have useful abstracts and reference lists. The book, which is very well produced, ends with notes on contributors and an index. As with all symposia of this type, there is a wide variety of approach and emphasis, but this adds to the cumulative value of the papers, which together form a very useful introduction to and sample of till studies. The book is a worth indication of the significance of till, which covers such extensive areas north of latitude 40°N and thus forms the foundations of so many constructions that its qualities cannot be ignored.

C. A. M. King

NEW MEMBERS

- Adams, W. Peter, Geography Department, Trent University, Peterborough, Ontario, Canada.
- Armstrong, Richard L., Institute of Arctic and Alpine Research, Avalanche Research Center, Box 456, Silverton, CO 81433, USA.
- Ashley, Mrs Gail M., 435 Pine Street, Amherst, MA 01002, USA.
- Baird, Robert D., Mustians, Eton College, Windsor, Berks., England.
- Baudoin, Alain, Service de télédétection, Institut Géographique National, 2 avenue Pasteur, 94160 Saint-Mande, France.
- Beauregard, Jean de, Electricité de France-Equipment, 3 rue de Messine, 75008 Paris, France.
- Bédard, M. G., 333 Notre-Dame, Chambly, Co. Verchères, P.Q., Canada.
- Bocquet, G., Les Primevères No. 5, Rue Philippe Rameau, Poizat 38320, Eybens, France.
- Dalager, F., Grønjordsskollegiet room 1505, 2300 København S, Denmark.
- Edwards, Jr., Roderick Y., 9473 Pine Cone Row, Talbott Springs, Columbia, MD 21043, USA.
- Gaudet, Madame Françoise, 8 place Malessherbes, 75017 Paris, France.
- Gross, G. W., 1209 Vista Drive, Socorro, NM 87801, USA.
- Gudmandsen, P., 348 Technical University of Denmark, DK 2800 Lyngby, Denmark.
- Hellen, Stephen B., 65 Dunmowe Way, Fulbourn, Cambridge, England.
- Hoekstra, P., USA CRREL, P.O. Box 282, Hanover, NH 03755, USA.
- Holm, Sven-Ove, Brännkyrkagatan 68, S-117 23 Stockholm, Sweden.
- Humlum, Ole, Nordre Fasanvej 95 st.th., 2000 Frederiksberg, Denmark.
- Humphrey, John H., Box 1287, Tahoe City, CA 95730, USA.
- Ito, Hajime, Geographisches Institut ETH, Sonneggstrasse 5, CH 8006 Zürich, Switzerland.
- Johansson, Hans G., The Geological Survey of Sweden, Fack, S-104 05 Stockholm 50, Sweden.
- Jørgensen, P., Lindevej 49, DK 2890 Hareskov, Denmark.
- King, T. P. L., Fitzwilliam College, Cambridge, England.
- Kreitler, Charles W., Department of Geological Sciences, University of Texas, Austin, TX 78752, USA.
- McClung, David M., Geophysics Program, AK 50, University of Washington, Seattle, WA 98105, USA.
- Martin, Annie, 14 Residence les Terres Rouges, 91120 Palaiseau, France.
- Mrowka, Jack P., Department of Geography, University of Chicago, 5828 S. University Avenue, Chicago, IL 60637, USA.
- Onuma, Tadayuki, Hokuriku National Agriculture Experimental Station, Takada, Jōetu, Niigata, Japan.
- Rasmussen, K., Geophysical Isotope Laboratory, University of København, Haraldsgade 6, DK 2200 København N, Denmark.
- Repp, K., 10B466 Stud.by Kringsdå, Oslo 8, Norway.
- Sitzmann, P., 30 Rue du Muscat, 68000 Colmar, France.
- Sutherland, Donald G., University of Edinburgh, Department of Geography, Infirmary Street, Edinburgh EH1 1NR, Scotland.
- Thompson, Aylmer H., Meteorology Department, Texas A & M University, College Station, TX 77843, USA.
- Thorogood, J. L., High Trees, Common Lane, Hemingford Abbots, Huntingdon PE18 9AW, England.
- Valla, F., ANENA, 46 Avenue F. Viallet, 38 Grenoble, France.
- Williams, P. D. L., The Trolls, 94 Higher Drive, Banstead, Surrey, England.
- Wuilloud, L., Champlan, Valais, Switzerland.

Glaciers and Glacial Erosion

Edited by
Clifford Embleton

Geographical Readings

This book contains a selection of the most significant contributions on the theme of glaciers and glacial erosion published between 1842 and 1965. Although several of the papers are abbreviated, they do not lose their original style or any part of the argument or content. Dr. Embleton's Introduction evaluates each article and relates it to others in the volume.

£3.75 paper £2.10

Macmillan



WORLD EXPEDITIONARY ASSOCIATION

Reliable Charter Flights
Discount Scheduled Flights
NEW YORK £58 return

NAIROBI £105 return		TORONTO £65 return	
Destination	Return Fare	Destination	Return Fare
Accra	£105	Los Angeles	£105
Auckland	£320	Lusaka	£175
Bangkok	£140	Nairobi	£105
Bombay	£150	New York	£58
Buenos Aires	£275	Oakland	£105
Delhi	£150	Rio de Janeiro	£160
Entebbe	£105	Singapore	£120
Hong Kong	£180	Sydney	£285
Johannesburg	£135	Tehran	£120
Kuala Lumpur	£120	Tel Aviv	£70
Lagos	£115	Tokyo	£290
Lima	£295	Toronto	£65

• scheduled flights
36 other worldwide destinations on request
Special Group Quotations

Chairman: Dr. Ian M. Wilson, MA D.Phil (Oxon)
Vice Chairman: Penny Watts-Russell, BA (Lond)
Phone Nos.: 01-589 0500/3315

Address: 13½ Beauchamp Place
Knightsbridge
London S.W.3

Send for brochure to:
The General Secretary, Dept S10,
Central Office,
WEXAS, 13½ Beauchamp Place,
Knightsbridge, London S.W.3
Please send me details of
WEXAS's services.

I am particularly interested in

Name

Address

INTERNATIONAL GLACIOLOGICAL SOCIETY

Cambridge CB2 1ER, England

SECRETARY: Mrs H. Richardson

Council Members 1972-1973

			Date first elected to Council (in present term of service)
PRESIDENT	W. F. Weeks	1972-75	1969
VICE-PESIDENTS	J. W. Glen	1970-73	1966
	E. R. LaChapelle	1972-75	1971
	M. de Quervain	1972-75	1969
IMMEDIATE PAST PRESIDENT	V. Schytt	1972-75	1967
TREASURER	*J. A. Heap	1970-73	1967
ELECTIVE MEMBERS	*L. Gold	1970-73	1970
	*R. P. Goldthwait	1970-73	1970
	Miss C. A. M. King	1970-73	1969
	*H. Röthlisberger	1970-73	1970
	*W. Ambach	1971-74	1971
	*W. Dansgaard	1971-74	1970
	G. de Q. Robin	1971-74	1970
	*W. F. Budd	1972-75	1972
	*A. Corte	1972-75	1972
	*V. M. Kotlyakov	1972-75	1971
	*W. S. B. Paterson	1972-75	1971
	*R. Vivian	1972-75	1972
CO-OPTED	*D. Jenssen	1972-73	1972
EDITORS appointed to serve on the Council:			
	R. J. Adie	1972-73	1964
	J. W. Glen	1972-73	1966

*No previous service on the Council

Appointments to Posts & Committees

(made by the Council 22 April 1972, under Rule 10 of the Constitution)

Founder: Gerald Seligman.

Library Committee: J. W. Glen, B. B. Roberts, Treasurer (ex-officio), Secretary as secretary.

Awards Committee: J. W. Glen, J. F. Nye, M. de Quervain, President (ex-officio), Secretary as secretary.

Research & Education Fund Committee: Sir V. Fuchs, J. F. Nye, H. Röthlisberger, A. L. Washburn, President (ex-officio), Secretary as secretary.

1974 Symposium Committees:

Local Organizing Committee—G. de Q. Robin, C. W. M. Swithinbank, President & Treasurer (ex-officio), Secretary as secretary.

Papers Committee—W. J. Campbell, S. Evans, M. F. Meier, J. W. Glen (Journal of Glaciology), President (ex-officio), Secretary as secretary.

Both these committees were given power to co-opt.

INTERNATIONAL GLACIOLOGICAL SOCIETY

Cambridge CB2 1ER, England

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 1973:

Private members	Sterling : £5.00
Junior members (under 25)	Sterling : £2.00
Institutions, libraries	Sterling : £10.00

Note—Payments from countries other than Britain should be calculated at the exchange rate in force at the time of payment. If you pay by bank draft, rather than by personal cheque, please ensure that sufficient money is included to cover the bank charges of £0.50p per cheque. Thank you.

I C E

Editor : Mrs Hilda Richardson

This news bulletin is issued free to members of the International Glaciological Society and is published three times a year. Contributions should be sent to Mrs H. Richardson, International Glaciological Society, Cambridge CB2 1ER, England.

Annual subscriptions for libraries, &c, and for individuals who are not members of the Society : Sterling £1.50.

