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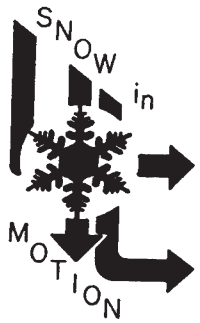
ICE

INTERNATIONAL GLACIOLOGICAL SOCIETY:

1978 SYMPOSIUM ON DYNAMICS OF LARGE ICE MASSES —

See page 18, for the Second Circular.



U.S.D.A. FOREST SERVICE

ROCKY MOUNTAIN FOREST & RANGE EXPERIMENT STATION:

1979 SYMPOSIUM —

See page 25, for the First Circular.

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ICE

NEWS BULLETIN OF THE

INTERNATIONAL GLACIOLOGICAL SOCIETY

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CONTENTS

NEW ADDRESS LIST. This has been published—the first since 1972. Now that we have a suitable typewriter in the HQ Office, we hope to produce camera-ready copy, for a cheaper method of printing, at more frequent intervals. Members will help us to keep the list accurate by sending in corrections and post codes where these are missing. We do not issue our list to libraries or to commercial organizations, in an effort to protect members from unsolicited advertising circulars.

COVER PICTURE. An ice tube protruded from a freezing ice surface. Unfrozen water is visible within the tube. (Photograph by K. Tusima, Institute of Low Temperature Science, Hokkaido University, Sapporo, Japan.)

RECENT WORK

AUSTRIA

VARIATIONS OF GLACIERS:

In 1975/6 the mass balance of Austrian glaciers generally suffered from a shortage of winter precipitation and an exceptionally warm spell in early summer. Up to 20 July most glaciers had lost their snow cover to the extent that firn from previous years was wasted. Continuing bad weather impaired fieldwork in the second half of summer, impeded aerial survey of the accumulation areas, but fortunately did not interfere with the lengths measurements.

H. Kinzl continued the survey of glacier lengths of the Österreichischer Alpenverein. Of 88 glaciers that were checked, 24 were advancing while 64 were retreating or stationary. Detailed results are published in *Mitteilungen des ÖAV* and in *Zeitschrift für Gletscherkunde und Glazialgeologie*.

GLACIER INVENTORY:

G. Patzelt and G. Gross (Geographisches Institut der Universität Innsbruck) have registered 260 glaciers of Dachstein, Großglockner, Zillertal, Stubai and Ötztal totalling 235 km^2. The long history of glaciology in these regions is reflected in 3700 references entered in the bibliography.

REGIONAL FIELD WORK:

DACHSTEIN:

A micrometeorological study of the snow cover at Dachstein-Oberfeld was carried out by H. Dobesch and F. Neuwirth of Zentralanstalt für Meteorologie und Geodynamik, Vienna. Surface heat balance, subsurface temperature profiles and subsurface heat flux were investigated in one-week periods in February, April and May 1975.

HOCHKÖNIG:

J. Goldberger (ÖAV, Sektion Salzburg) finished his mass balance work on Hochköniggletscher, which covers an area of 1.7 km^2 (not including Ostgletscher). He communicates the following values of specific mass balance:

1970/71	−69 g/cm^2
1971/72	−34
1972/73	−86
1973/74	+55
1974/75	−52

The studies at Hochköniggletscher have been particularly interesting as they dealt with a small plateau glacier of little vertical extent. Situated on the wet northern edge of the Alps this glacier presumably has an alimentation regime different from the higher, drier central alpine valley glaciers. Seismic studies in summers 1970-73 by R. Wüstrich (supported by Lehrkanzel für Geophysik und Erdölgeologie der Montanistischen Hochschule Leoben) resulted in the following maximum thicknesses:

Plateaugletscher	58 m
Ostgletscher	26 m
Sailergletscher	30 m

A map 1:10.000 of Hochköniggletscher was produced from aerial photographs of 1969-09-25 by F. Löschner, Geodätisches Institut der Rheinisch-Westfälischen Technischen Hochschule Aachen, Germany.

STUBACHER SONNBLICK:

Investigations of the mass balance by the direct glaciological method have been continued by H. Slupetzky, G. Bauer and students of the Geographisches Institut der Universität Salzburg, sponsored by IHP (Austrian Academy of Sciences) and Hydrographisches Zentralbüro, Vienna. First estimates yield a slightly positive mass balance for 1975/76. It is the third positive in a row and the ninth in the 13 years of observation. The terminus advanced 2.7 m from 1975 to 1976. Work on the evaluation of long-term mass balance was continued.

For the documentation of the transient snow line aerial photos of glaciers in the Hohe Tauern were taken in August and September. A new map of Oedenwinkelkees is being prepared for printing.

PASTERZE (GROßGLOCKNERGRUPPE):

H. Wakonigg (Geographisches Institut der Universität Graz) continued his survey of three profiles on Pasterze glacier. He found an average decrease of the height of 26 stones of 2.43 m. This value, if applied to the ablation area of 6 km^2, means the highest loss since 1968/69 or 1970/71. In all three profiles ice velocity has reached peak values comparable to 1970/71.

G. Patzelt (Geographisches Institut der Universität Innsbruck) has supplemented this survey by measurements of apparent ablation on Pasterze.

UNTERSULZBACHKEES (VENEDIGERGRUPPE):

The dynamics of this glacier are being studied by a team of Zentralanstalt für Meteorologie und Geodynamik, the surveys are evaluated at the Institut für Kartographie und Reproduktionstechnik der Technischen Universität, Vienna. From surveys of the years 1969, 1974, 1975 and 1976 a kinematic wave can be followed that is presently causing an advance of the terminus.

GEFRORENE WANDKEES (ZILLERTAL):

H. Tollner (Wetterdienststelle Salzburg) analyzed the changes of Gefrorene Wandkees from the survey of 15 stakes between 1969 and 1975. In

the three profiles the surface elevation increased by about 1 m, maximum surface ice velocities were of the order of 40 m per year.

DAUNKOGELFERNER (STUBAI):
K. Aric and E. Brückl led a joint effort of Zentralanstalt für Meteorologie und Geodynamik and Institut für Meteorologie und Geophysik der Universität, Vienna. Ice thickness was measured by seismic refraction and reflection on a total profile length of 3.5 km. Maximum thickness is estimated at 80 m.

KESSELWANDFERNER AND VERNAGTFERNER (ÖTZTAL):
Since 1965 the movement of Kesselwandferner has been surveyed on 1 longitudinal and 5 transversal profiles by H. Schneider (Institut für Mathematik der Universität Innsbruck). The 8 m long aluminium stakes used in the profiles are repositioned at the end of each year. The investigation also includes ablation and accumulation measurements. At the beginning of this study Kesselwandferner was one of the few glaciers of the Eastern Alps that was near steady state. The extremely positive mass balance of 1964/65 (104 g/cm^2) led to an advance of the terminus in 1970. Subsequent nourishment by positive mass balance years made the advance continue so that it totalled 106 m by 1976. The place of the 1970 terminus is now covered by 41 m of ice. In the profile E (2850 m) ice thickness has grown by 19.1 m, in the profile D (3070 m) by 8.4 m. Between 1965/66 and 1975/76 flow velocity increased from 36.9 to 69.0 m/year and from 20.8 to 69.6 m/year in the centre of profiles D and E respectively. Since the beginning of the advance the flow at the terminus picked up from 26.7 to 61.8 m/year. From the acceleration observed over the entire glacier a continuing advance can be expected. These studies are sponsored by Geophysikalische Kommission der Österreichischen Akademie der Wissenschaften.

H. Schneider and H. Eisner (Physikalisches Institut der Universität Innsbruck) continue measurements of deformation in the vicinity of the 30 m pit at 3240 m throughout the year. W. Ambach and the staff of Abteilung für Physik von Schnee und Eis, Physikalisches Institut der Universität Innsbruck, continue the investigation of the water table in the accumulation area of Kesselwandferner. Meltwater flow is traced by dye and monitored in several 30 m boreholes. Precipitation and river water in the basin of Rofenache is analyzed for seasonal contribution of meltwater to run-off by means of deuterium, tritium and O^{18} measurements. These studies rely on the co-operation of the Institut für Radiohydrometrie der Gesellschaft für Strahlen- und Umweltforschung (H. Moser), Munich and on support from Österreichische Akademie der Wissenschaften.

The gross beta activity is being investigated by W. Ambach and P. Kirchlechner in two 12 m ice cores from Vernagtferner.

HINTEREISFERNER (ÖTZTAL):
The 24th hydrological year since the beginning of mass balance investigations yielded a specific loss of -32 g/cm^2. Ice temperatures were measured in selected profiles down to 16 m depth. Measurements of accumulation, ablation, precipitation, run-off and operation of three weather stations were continued by the staff of the Institut für Meteorologie und Geophysik der Universität Innsbruck, supported by IHP (Österreichische Akademie der Wissenschaften), Hydrographisches Zentralbüro and Österreichischer Alpenverein.

SNOW STUDIES, EXPERIMENTS AND APPLICATIONS

Daily values of snow cover and fresh snow collected by Hydrographisches Zentralbüro are published in *Hydrographisches Jahrbuch von Österreich*. TIWAG, Illwerke and other hydroelectric power plants maintain snow survey networks in the catchment areas of their reservoirs. At the Zentralanstalt für Meteorologie und Geodynamik, F. Steinhauser completed an analysis of trends in duration and extent of yearly snow cover in Austria since 1930. F. and A. Lauscher computed evaporation from the snow surface at Sonnblick Observatory (3107 m) for the years 1969-1974.

H. Rott (Institut für Meteorologie und Geophysik der Universität Innsbruck) continued his studies of alpine snow cover from satellite and aerial pictures. From Landsat MSS bands 5 and 7 snowcover was mapped for particular days of the melt season in 1973, 1975 and 1976. The recession of the snow cover in a glacierized basin of 165 km^2 was linked to stream flow. Snow areas were determined from Landsat images of Austrian glaciers at the end of the ablation seasons 1972 and 1973.

F. Brugger (Vorarlberger Illwerke AG, Projektierungsabteilung) and W. Good (Eidgenössisches Institut für Schnee- und Lawinenforschung, Davos) conducted experiments with artificial snow fortification. In winter 1976/77 they compared the development of the snowpack at Golm (2000 m) under natural and controlled conditions.

W. Ambach and the staff of Abteilung für Physik von Schnee und Eis, Physikalisches Institut der Universität Innsbruck, continued the technical development of electronic devices for the measurement of free water content of snow. A study was initiated to investigate the changes of snow surface under gliding skis. The flow of meltwater from homogeneous snow layers was studied under controlled conditions in a project assisted by S. Colbeck with support by U.S. Army Procurement Agency.

A new group has joined the Austrian glaciological community in Graz. W. Fritzsche and the staff of Institut für Elektronik der Technischen Universität Graz is thoroughly investigating electromagnetic wave propagation through snow and ice in all spectral bands. These methods are applied to basic snow physics, avalanche prediction, search for avalanche victims and to glaciological problems. One set of devices uses single pulses of 0.1 ns duration for the measurement of snow structure, density and layering, especially on inaccessible slopes. These instruments resolve layers of less than one centimetre. Single pulses of approximately 1 ns penetrate 10 m of snow and are applied for avalanche rescue and for detection of snow covered crevasses in glaciers. Pulses of 2-30 ns duration are suitable for the sounding of firn and temperate glaciers down to 100 m, as was shown by field work on Hallstätter Gletscher (Dachstein).

Another set of instruments uses Doppler radar, preferably in the X-band (9.35 GHz). It is applied to telemetric monitoring of avalanche release and is ultimately intended for use in traffic control in case of avalanche danger. At the moment it furnishes valuable data on avalanche speed.

The miniature transmitting and receiving system working at 2275 Hz has been further improved for rescue work. It has now a longitudinal and transversal range of 90 and 70 m, respectively. Receivers with long Ferrit-antennas reach over 100 m.

M. Kuhn

FINLAND

Activity has again concerned the ice in the Baltic. Winter 1976/77 was rather mild and the big icebreakers were able to keep traffic going through the whole winter, even to the northernmost harbours, Kemi and Oulu. This happened for the 7th time. It is remarkable that on 1877 a little passenger boat called "Express" made her first voyage from Hanko to Stockholm in ice covered seas. This date is generally taken as the beginning of winter navigation in Finland, the 100th anniversary of which will be celebrated on 15 December 1977 in Oulu with an ice symposium.

E. Palosuo

FRANCE

GLACIERS

OBSERVED GLACIERS

For many years, many French glaciers have been observed by the Forest and Water Administration. About 16 years ago, many observations were stopped. We are now organising an aerial survey for 20 glaciers. Each 3 years, aerial pictures are collected for the following glaciers:

Mont Blanc range-
1 Tour - 2 Argentières - 3 Mer de Glace
4 Bossons - 5 Taconnaz - 6 Bionnassay
7 Tré-la-Tête

Vanoise range-
8 Sources de l'Isère - 9 Sources de l'Arc
10 Mulinet - 11 Grand Méan - 12 Evettes
13 Arnès - 14 Gebroulaz

Oisans range-
15 Pilatte - 16 Chardon - 17 Selle
18 Glacier blanc - 19 Glacier noir
20 Sarennes.

MASS BALANCE

Since 1948, the mass balance of the small cirque glacier of Sarennes (about 100 ha) has been calculated. The 1975-6 season was characterised by a very small accumulation (33 cm water equivalent) and much ablation (240 cm water equivalent, 207 cm ice ablation). This is one of the worst mass balances for Sarennes.

SNOW STUDIES

In the two experimental snow fields of Col de Porte and Autrans, we study the interaction with the forest snow cover. More than 200 snow sticks are randomly placed in the Autrans forest (Vercors) and twice a week data are collected, and calculations are made in order to separate the different parameters.

Snow pressure is measured on various types of avalanche defence works. Wind effects are also studied with the aim of improving snow control.

AVALANCHES

At Lautaret, the artificial release of avalanches is continued and much information has been collected, in collaboration with the Laboratory of Special Physical Application.

The exploitation of the "powder snow avalanche model" (water model, with Mecaflu) continues. Pressures and density profiles are measured.

A mathematical model (with C.T.G.R.E.F. ANTONY) for powder snow avalanches is to-day operational. The morphological profiles and the snow heights are recorded and the principal parameters are obtained (V, D, h).

F. Valla
(Centre Technique du Génie Rural
des Eaux et des Forêts - C.T.G.R.E.F.
- Grenoble)

USSR

In 1976 Soviet glaciological expeditions studied the glaciers of the Caucasus, Central Asia, Altay, Sayany, Polyarnyy Ural, Khibiny, Siberia, Kamchatka, Sakhalin (along the Baykal-Amur railway), the Arctic and Antarctica.

CAUCASUS

The Institute of Geography, the USSR Academy of Sciences, continued investigations of the Marukh, Kolka and Bezengi glaciers. Studies under the 2nd class programme of glacier variations surveys were carried out on the Marukh and Kolka glaciers. They comprised establishment of a long-term reference network of stakes, geodetic survey of velocity points, accumulation and ablation observations. Phototheodolite and albedo surveys of all the accessible areas, actinometric and meteorological observations were undertaken on the Marukh glacier. Deep pits were dug and mass-density of the firn sequence was determined. Studies of glacier run-off were continued. Horizontal run-off inside the firn was found to increase with the angle of the glacier slope. The relationship between vertical and horizontal water streams within the firn sequence under different climatic and topographic conditions was evaluated for the first time. New calculation methods, evaluating internal nourishment and the run-off from firn areas according to data on solid precipitation, melting and ice porosity were worked out. The ratio between the ions of sodium and chlorine in ice samples was used to establish that the formation of the Marukh glacier ice occurred under maritime climatic conditions.

Mainly palaeoglaciological studies were carried out on the Bezengi glacier. The contours of this glacier during the Holocene climatic optimum were reconstructed according to topographic and aerial surveys. Radio-carbon datings of the organic sediments, overlying till, and analysis of geomorphological and stratigraphic data revealed the fluctuations of the Bezengi glacier edge in the Late Holocene and recent times. Radio-carbon datings of submorainic charred detritus indicated that the main surges of this glacier took place in Mid-Holocene time.

Interpretation of maps of glacier regime in the west Caucasus, compiled for the World Atlas of Snow and Ice Resources, made it possible to get new data on atmospheric precipitation and accumulation in the alpine zone of the Caucasus. The maximum precipitation belt was found to be on the wind-exposed side of the main Caucasus range, at some distance from it. Abnormally low values of accumulation on the northern slope of Elbrus, a dry zone in the upper-reaches of the Kuban' and other peculiarities of the accumulation field were found.

Studies of the Marukh glacier were also carried out by the **North Caucasian Hydrometeorological Service.** They contained meteorological, hydrological and heat balance observations, surveys of ablation, accumulation and glacier variations (under the 2nd class programme). Observations of another 10 glaciers on the northern slope of the main Caucasus, the basins of the Terek and Kuban' tributaries were carried out under the 3rd class programme. The height of the firn line, maximum snow accumulation and total ice melting were determined on some glaciers. On the Khakel', Bezengi and Kelbashi glaciers the hydrometeorological service carried out snow surveys. Observations show that the majority of glaciers continue to retreat. The advance of the Kozytsyti and Vilpata glaciers, observed before, has stopped. In 1976 only the Bol'shoy Azau and Skazka glaciers were advancing.

The Laboratory of Aerospace Observations, Moscow University, repeated (after 1973) partial phototheodolite surveys of glaciers in the El'brus vicinity. Surveys have shown that the glaciers situated in that area are in an active phase. The Shkhel'da glacier, whose tongue is protected by a thick morainic cover, is the only exception.

The Laboratory on the Problems of Snow Avalanches, Moscow University, continued the stationary studies of heat and ice balance of the Dzhankuat glacier. A map of the snow cover density of the glacier was compiled and the hydrochemical regime of the Dzhankuat river run-off studied.

Multi-disciplinary studies of snow avalanches were undertaken in different areas of the Caucasus. 126 avalanches, including extremely large ones, were registered in the El'brus area in the winter 1975/76. The Laboratory investigated the disastrous influence of avalanches upon vegetation and topography. The actual properties of snow/air waves accompanying avalanches were clarified. **The Institute of Mechanics, Moscow University,** performed experiments to estimate the impact of snow samples, with density from 0.2 to 0.55 g/cm^3, upon vertical walls of various dimensions. The loadings of moving snow upon the simulated anti-avalanche barrier were determined. Experiments were performed in Terskol (the El'brus area) with the help of the "Snow Flume" installation.

The Institute of Geography, Georgia, studied the glaciers on the southern slope of the central Caucasus. Surveys of the Klich (the Kodori river basin), Tbilisa, Boko and Kirtisho (the Rioni river basin) glacier variations were undertaken under the 3rd class programme. A phototheodolite survey (1:5000) of the surface of these glaciers was carried out. Surface movement velocities, vectors and values of ablation

were determined and the position of lobes was clarified by geodetic and quasi-parallax methods. The glaciers of the Rioni river basin continue to retreat, though with smaller velocity than before (in the period 1930-1960 the Buba, Kirtisho and Zopkhito glaciers diminished annually by 10-15 m).

The studies of the Tbilisa glacier regime and of its melt waters were continued, including glaciological, hydrological and meteorological surveys, glacial run-off, ice and snow melting, water balance of the firn sequence and the glacial stream during the ablation period, Meteorological, actinometric and gradient observations were undertaken at 2600-3500 m altitude, including precipitation measurements. Palaeoglaciological studies of glacier degradation in the Fernau stage were continued.

Kharkov University continued glaciological studies of ablation processes in the Caucasus. Several altitudinal zones with different ablation conditions and different sources of heat expended on ablation, were identified on the surface of accumulation areas and glacier tongues. Snow cover, conditions of occurrence of glacial mud flows and traces of former glaciations were studied in the Baksan, Tseydon, Terek and Aragvi river basins. The data of dendrochronological analyses permitted reconstruction of the height of the firn line on the Khakel' glacier (the Teberda river basin) from 1700 and meteorological conditions, determining snowiness from 1674.

The Alpine Geophysical Institute paid great attention to avalanche activity. Avalanches of young snow in Dombay were found to be closely connected with snowfalls at the orographic occluded front. The basic relationship between meteorological avalanche - forming factors and avalanche probability, depending on the joint activity of these agents in the El'brus area, were established. Algorithms to forecast the time and place of avalanches and a computer programme for compiling a bulletin of avalanche hazard were worked out. Comparison was made between seasonal periods of avalanches in the west, central and east Caucasus. In the more westward areas the maximum of avalanche activity has shifted to the end of the cold period.

The Transcaucasian Hydrometeorological Institute and Hydrometeorological Service of Armenia continued glaciological studies of the Zangezurskiy range. 14 hitherto unknown glaciers situated in shaded places, with a general area of 1.3 km^2, have been found. The whole area numbers 42 glaciers with a total area of 3.8 km^2. The majority of glaciers were found to be degrading, however some of them, especially those buried under morainic cover, had advanced.

The Hydrometeorological Institute studied the surging Devdoraki glacier (the Kazbek massif), where it revealed essential changes in the surface morphology. The bed of the glacier tongue is filled with ice up to the mark of the disastrous level observed in the first half of the nineteenth century. The glacier lobe is situated 30-40 m above the cliff: "Masakh", which blocked the glacier's advance during the surge and always caused the Kazbek calamities.

CENTRAL ASIA

The Section of Physical Geography of the Academy of Sciences, Kazakhskaya SSR, continued the studies of glaciers in the Dzhungarskiy and Zailiyskiy Alatau. A series of current studies was undertaken in the Zailiyskiy Alatau, analysing glacier variations, regime, water, ice and heat mass balance, and the representativeness of individual glaciers as related to the glaciation of the range as a whole. Dynamics of glacier pulsations were studied on the Shokal'skiy glacier. Changes in the fields of glacier motion, ablation and accumulation processes and mass balance were analysed on the Tsentralniy Tuyuksu glacier. In Dzhungarskiy Alatau investigations were concentrated on the Shumskiy glacier. During the year snow surveys and thermo-sounding of 5 points of the glacier down to the depth of 10 m were carried out. In summer 230 points were surveyed, ablation was measured and spatial position of the glacier snout determined according to 32 profiles. With the object of creating an automated system of data processing of glacier variation, the Section of Geography, Kazakh Academy of Sciences, together with the Institute of Mechanics, Moscow University, determined the periods, amplitudes and phases of induced oscillations spectrum of the Shumskiy glacier during the last 7 years.

Conditions of formation and peculiarities of snow avalanche spreading were investigated in the Zailiyskiy Alatau during the cold period. Researchers studied the regime of the snow cover, the nature of snow storage distribution, regularities of time-spatial changes in the strength of the snow cover, meteorological conditions of avalanche formation, and relationships of avalanche activity to different types of mountain slopes. Representative territories were observed in the Zailiyskiy, Dzhungarskiy, Kungey and Terskey Alatau and also in the Ketmen' ranges, for a large-scale survey of typical avalanche sources and to determine the characteristics of avalanche hazard.

The Central Asia Hydrometeorological Institute has completed the long-term IHD studies of the Abramov glacier. After a long break, glaciological studies of the Fedchenko glacier were resumed. Data on the morphometric characteristics of glaciers of the Pamir-Alay have been analysed. The Institute investigated the snow avalanche regime in the Kudara and Bartang river-basins (Pamirs), and compiled a map of the avalanche hazard zones of Central Asia.

The Institute of Geology and Geophysics, the Uzbek Academy of Sciences, made preliminary studies of the Pamir Alay glaciers. Data indicating the role of orographic peculiarities of the wind regime of glaciers were obtained. It has been established that calculated profiles of glacial winds are close to natural profiles and that the nature of glacial circulation of the air depends on the structure of the valley and the wind velocity in the free atmosphere. The studies revealed the changes of the Imat glacier: its shrinkage observed in the 1960's was evidently succeeded by growth of the ice mass and advance of its front. Investigations of the effect of geological environment upon glacier melting and run-off under Central Asia conditions were started. The concept of regeneration of glaciers buried under till, explaining cycles of glaciation anew, has been advanced.

The Institute of Geography, the USSR Academy of Sciences, continued glaciological studies of the Pamirs. Phototheodolite surveys, geodetic survey of stakes, ablation and accumulation, actinometric and meteorological observations, albedo surveys of all the accessible areas, and also establishment of a long-term reference network of stakes have been carried out on the Medvezhiy glacier. The data of previous observations permitted compilation of 7 plans (1:5000) of changes in the surface height during the 10-year cycle of pulsation and its separate intervals. A map of ice velocities has been compiled for 1972. The rate and total melting of ice in the surging part of the glacier was calculated for 10 years. Mass balance of that part was measured and the mass of ice engaged in the surge of 1973 was defined more exactly.

The studies of icings in the east Pamirs showed that up to 150 cm of ice melts in summer months: their role in the water balance of that mountain area is significant. New information about the morphometry of alpine lakes in the east Pamirs was obtained and the glacial stream of the Karadzhilga river was calculated. Analyses were made of long-term data on meteorological parameters of the Pamir glacial area.

Investigations aimed at the reconstruction of the Central Asia glaciation in the Holocene and Late Pleistocene were continued. The ratio of melting and evaporation during the degradation of Pleistocene glaciation in the Pamirs suggested that big heat losses on evaporation, however, caused insignificant melting and resulted in small glacier melt-water streams. This fact accounts for the well-preserved morainic complexes of the last Pleistocene glaciations. However, the driest and coldest climate existed in the Pamirs during the Late Pleistocene because of tectonic elevation nearly up to the present height and the general climatic cooling. Therefore well-preserved terminal moraines of former glaciers should mark the limits of the Late Pleistocene rather than of Mid-Pleistocene glaciation. Palaeoglaciological reconstructions of the Fedchenko glacier in the Late Pleistocene were made. The reverse problem was solved in that case - to determine the position of the glacier snout according to the known precipitation and the value of the general climatic cooling. It appears that in the Late Pleistocene the glacier was twice as long as it is now.

The Kirgiz Hydrometeorological Service continued glaciological studies of the Kirgiz range. Meteorological observations, surveys of ablation and accumulation, surface movement of ice, variations of the glacier tongue and changes in its surface level were carried out on the Golubin glacier. This year the glacier mass balance was negative. Variations of glacier tongues and the surface heights were observed on the Aksu Vostochniy and Aksu Zapadniy glaciers, the Dolonata (Kungey Alatau range) and Korzhenevskiy (Zaalayskiy range) glaciers. It was found that during the observed period the Golubin and Aksu Zapadniy glaciers continued to advance, the former advanced 15 m, the latter 13 m. The Aksu Vostochniy and Dolonata glaciers ceased to retreat and advanced respectively 20 m and 16 m. As compared to 1970 the At-Dzhaylyu and Korzhenevskiy glaciers have retreated, the first glacier by 80 m, and a 2000-metre long portion was detached from the snout of the Korzenevskiy glacier through ablation.

Tashkent University completed a glaciological description of the Zeravshan river-basin. Oro-climatic conditions of the existence of glaciation were formulated, its area (557 km^2) was evaluated more precisely and the volume of ice in the basin was determined to be 55km^3.

POLYARNYY URAL AND KHIBINY

The Institute of Geography, the USSR Academy of Sciences, continued long-term studies of the mountain glacier basin of the Bol'shaya Khadata river. Surveys of variations of the Obruchev, IGAN and MGU glaciers were performed under the 1st and 2nd class programmes.

Radio-echo-sounding of glacier thickness and subglacial topography, geodetic surveys of stakes, observations of ablation and accumulation were conducted on the Obruchev and IGAN glaciers. A long-term reference network of stakes was created on the Obruchev glacier. Actinometric, meteorological and albedo surveys of all the accessible parts of this glacier were undertaken. Deep pits were dug down to the depth of 17 m and the mass density of the firn sequence was determined. Comprehensive measurements of the relative displacement of ice were carried out in the tunnel of the Obruchev glacier. Despite small mobility of ice in that glacier the sliding mechanism of local surfaces (evidently former surfaces of ablation) was found to play a significant role in glacier movement.

Calculation and analysis of long-term meteorological parameters of the Polar Urals glacial area

was accomplished. Results of field studies of the Obruchev glacier and the data of the Bol'shaya Khadata weather station suggested interrelations between total solar radiation and cloudiness. Total values of solar radiation in summer were calculated for a period of 25 years on the basis of this relationship. The areas of dissected, middle height and low height topography were analysed for conditions of snow cover formation and its regime. Comparison of results of these studies with similar data for Spitsbergen showed that only one (western) maximum of the average curve of snow storage is typical of the Urals, while Spitsbergen has two maxima of the latitudinal profile. Absolute values of snow accumulation on glaciers as well as on glacier-free Ural territories are higher than on Spitsbergen, despite approximately the same heights of mountains and similar topography. Spatial variability of snow storage is much greater in the Urals.

The Mining Institute of the Kola Branch of the USSR Academy of Sciences, Novosibirsk Institute of Railway Transport and the Laboratory on the Problems of Snow Avalanches, Moscow University, carried out glaciological studies in Khibiny. The Laboratory on the Problems of Snow Avalanches performed route and stationary studies of water snow streams and improved the methods of calculating snow melting in small basins.

SIBERIA

Tomsk University continued long-term studies of the river Aktru mountain glacier basin in the Altay. The University carried out actinometric, meteorological and hydrological observations, analysed the temperature regime of the ice sequence down to a depth of 13 m, studied ablation and accumulation processes, silt content and electric conductivity of glacier waters. In spite of the cold and nasty summer of 1976, the total value of ice melting on the tongue of the Maliy Aktru glacier was 40 cm above the norm. However, due to big amounts of snow, wind-blown on to the glacier tongue, it did not actually retreat. The boundary of seasonal snow rose to 2950 m, which is 400 m lower than in 1974. The temperature of ice at the depth of 12-13 m was found permanent and equalled -1.4°. Comparison of silt content of streams, running from two neighbouring glaciers, showed that dimensions of suspended particles (0.5-0.7 μm) in the Maliy Aktru stream are smaller than in the Bolshoy Aktru stream (0.5-1.5 μm).

The reason is in different discharges of water. Salt-content in water streams of different origin varies within the Aktru basin. When emerging from under the glacier the stream contains 20-30 mg/l of salt, and at the distance of 2 km - about 40 mg/l.

Short-term glaciological studies were accomplished in the Korumdu basin. Comparison between the observation data of the Aktru and Korumdu basins at the same height of 2150 m convincingly confirms the representative capacity of the Aktru basin. Balance estimation of the dimensions of the Aktru, Yan-Karasu and Korumdu glaciers in the Holocene was undertaken. Calculations proved that in the Holocene the snow line was 500-550 m below the present level, which was mainly caused by lower temperatures in the ablation period.

Studies of glacio-nival phenomena of the Altay-Sayan highland were continued. The data on the values of ablation and accumulation, precipitation, snow storage of representative glaciers and basins were obtained. Aero-visual surveys of avalanche areas were performed. In the Mul'ta river-basin the amount of precipitation for 1975/1976 budget year equalled 450-650 mm in the altitudinal zone of 900-1200 m. In the zone of 1600-2200 m it made up 1060-1380 mm. For the Tomich glacier this year turned out to be similar to the mean perennial values. During the summer season the value of ablation in the altitudinal zone of 2600-2800 m on the Rodzevich glacier, most typical of the mean melting conditions of the glaciers of this massif, equalled 3100-3200 mm. Decrease of snow-drifting when moving southward from the axis of Western Sayans was established. Giant icings were found in the Tuva basin, which is poor in snow.

Studies and data processing of previous observations made it possible to accomplish glaciological zonation of the Altay-Sayan highland, to work out comprehensive properties of its separate areas and to define more exactly spatial differences in relations between avalanche hazard and formation of icings. A map of the mean maximum snow thickness of this area has been compiled. Dynamics of snow cover formation was studied.

Section of Geography of the Kazakh Academy of Sciences studied the glaciers of the Belaya Borel river-basin, Altay, including the dynamics of glacier variations, ablation and accumulation processes, meteorological observations, and tacheometric surveys of the Malyy Berel'skiy and Popovich glacier snouts.

The Laboratory of Aero-space methods, Moscow University, carried out comparative identification of avalanches on normal and high aerial pictures and space images. The adequacy of identification of avalanche sources on high aerial pictures is 100%, and on space images 70%.

The Institute of Geography, the USSR Academy of Sciences, clarified the dynamics of the seasonal snow boundary in east Siberia, according to the data of the earth satellite "Meteor" and weather stations. Processing of the data collected by West Siberian weather stations suggested that evaporation from snow surface in winter (before the maximum snow storage is reached) is negligibly small. The difference between snow storage of the forest and that of the field is

mainly caused by snow transport and is on average in linear dependence on the duration of snow drifts. Distribution of snow storage in varying landscape (patterned tundra, forested tundra, steppe with groves, etc.) is uneven and, as a rule, statistically non-isotropic.

The Novosibirsk Institute of Railway Transport observed snow drifts and changes in the physical properties of snow in avalanche-hazardous areas of the western portion of the Baykal-Amur railway. **The Alpine Geophysical Institute** analysed avalanche-prone parts of the Baikal-Amur railway in the Udokanskiy range. To determine the extent of avalanche hazard, the methods used consisted of evaluating the probability of the length of avalanche routes according to the traces left on the locality (when direct observation is lacking).

The Central Asia Hydrometeorological Institute evaluated conditions of avalanche formation along the Baykal-Amur railway in the Baykal'skiy and Severo-Muyskiy ranges. Avalanche-prone areas of the Amgun' river-basin were mapped.

KAMCHATKA AND SAKHALIN

The Institute of Volcanology, the USSR Academy of Sciences, continued to investigate the relationship between recent glaciation and volcanism. Actinometric, meteorological and gradient observations of the accumulation area were made on the Kozelskiy Glacier (Avachinskaya group of volcanoes). Snow surveys were carried out and stakes established along two transverse and one longitudinal profiles.

In the Klyuchevskaya group observations were made on the glaciers of Bol'shoy Tolbachik, Ostryy Tolbachik and Ploskiy Tolbachik volcanoes. The interrelationship of the snow cover and the after-products of the last eruption of the Tolbachik volcano was studied. Snow cover was found to be the main part of the newly-formed scoria cones. Lava that erupted over a snow surface caused snow melting only in the initial period and in the direct neighbourhood of the lava-ice margin. Then the lava flow acted as a snow-dozer, shovelling snow. The main part of the Tolbachik glacier was destroyed by the eruption. Ice masses were preserved only on steep internal slopes. The glacier melting caused the occurrence of a lake in the sunken bottom of the caldera of the Ploskiy Tolbachik volcano. The lake is constantly shrinking. Its total disappearance and the occurrence of a new glacier is quite possible in future.

The Institute of Geography, the USSR Academy of Sciences, studied snow storage and ablation processes in spring-summer snow patches in Kamchatka. The regularity of abrupt growth of melting in the marginal zone of a snow patch, proposed theoretically and then tested in the Urals, was confirmed once again. It was concluded that the perimeter of a snow patch (together with its area) is one of the most important parameters of snow-patch landscape. The role of pyroclastics in the morphology and melting of snow-patches was studied.

The Novosibirsk Institute of Railway Transport carried out the studies of snow drifts and developed methods of snow protection in Kamchatka. On Sakhalin the Institute continued investigations of artificial avalanches on a 100-metre avalanche flume.

THE ARCTIC

The Institute of Geography, the USSR Academy of Sciences continued long-term glaciological studies in Spitsbergen. A 210-metre deep borehole was drilled on the Lomonosov glacier plateau, west Spitsbergen. The temperature of the ice sequence was measured down to a depth of 100 m. Ice samples for oxygen-isotope analysis were selected at all the depths and were also analysed for caesium-137, strontium-90, tritium and lead. Micro elements were also analysed (by melting 2.5-3 tonnes of ice) in order to determine the age of the ice at the lobes of the three glaciers. Aerial snow surveys of some glaciers were conducted in the period of maximum snow accumulation; melting of the ablation period was measured.

Structural forms of moraines and connected with them littoral-marine and lacustrine-glacial sediments were studied. The data obtained last year permitted establishment of a stage of Spitsbergen glacier advance, unknown earlier. It took place 7800-7600 years ago and is called the Dames moraine stage. Time intervals of the Late Pleistocene glaciation stages of the archipelago were defined more exactly. Results of aero-radiosounding show that ice divides of the Grønfjord-Fridtjov and Dahlfonna-Erdmann glaciers are localized to elevations of subglacial topography and the thickness of glaciers on the western coast of Spitsbergen (the vicinity of Grønfjord) decreases southward. This may be caused by the significant role of moisture-bearing streams in the nourishment of glaciers.

The Arctic and Antarctic Institute continued stationary studies in Severnaya Zemlya. Investigations of the Vavilov dome made it possible to determine the values and annual variability of the main constituents of external mass and heat exchange of glaciers. Meteorological and actinometric surveys and studies of ice structures in the upper horizons of the Vavilov dome were continued. Ice temperatures were for the first time measured here down to a depth of 200 m. New data on peculiarities of radio-echo-sounding of cold glaciers and also new information on periglacial geomorphology of Ostrov Oktyabr'skoy Revolyatsii were obtained.

ANTARCTICA

The Institute of Geography, the USSR Academy of Sciences, accomplished oxygen isotope studies of the ice core obtained from two bore-holes of

Vostok station down to a depth of 950 m. Geological and geomorphological analysis suggests great variability of glacier cover of western Antarctica in the Pleistocene and its spreading up to the margin of the continental shelf of the Ross Sea during the last glaciation of the northern hemisphere. Results of analysis also suggest some probability of a disastrous disintegration of the west Antarctic ice sheet in the relatively near future. The programme of calculating the main parameters of the ice sheet for three-dimensional space (horizontal, vertical co-ordinates and time) by means of the BESM 6 computer was worked out. Field temperatures were calculated for the spatial simulation of glaciers, according to several profiles of the Antarctic ice sheet, including the profile from Vostok station to Byrd glacier.

The Arctic and Antarctic Institute studied the interaction between the atmosphere and underlying surface of the Antarctic plateau. Calculation of heat balance constituents of the surface was made. The 1:3,000,000 scale maps of Antarctica, prepared for re-publication, provided new data on its main morphometric properties. The area of the continent, the main types of glaciers, and the length of the coast line were defined more exactly.

Explorers from Moscow University studied the group of different types of glaciers in the area of Dry Valleys (Victoria Land). Maps of changes in contours and thickness of ice and also in velocities of three glaciers' snouts were compiled. Palaeoglaciological studies revealed some features of warming and moistening of the Antarctic climate by the end of the Pliocene.

V. M. Kotlyakov

UNITED KINGDOM

BRITISH ANTARCTIC SURVEY

This year has seen the completion of a 5-year study of the heat, ice and water balance of Hodges Glacier in South Georgia. Despite complex and steep topography on the glacier, the total melt estimated from the heat balance data agreed within experimental error with that estimated directly by observation of budget stakes. Hodges Glacier survives in a largely ice-free region as a direct result of its orientation which leads to above average accumulation and screening from solar radiation. The ice budget is controlled primarily by the extent of winter accumulation which determines the mean albedo during the following ablation season. In contrast to the heat budget of high polar glaciers the income of sensible heat from frequent Föhn winds is comparable with the radiative heat input. In an attempt to generalise the relationship between glacier mass balance and meteorological factors observed at Hodges Glacier to other glacierized areas in South Georgia, three glaciers representing alternative regimes were visited during the 1976/77 field season. Short term relationships between measured meteorological parameters and glacier mass balance will be compared with simultaneous behaviour at Hodges Glacier. Surface elevation profiles have been determined at these locations as a baseline for long-term glacier fluctuation studies. BAS is developing methods for relating physico-chemical properties of snow with climatological parameters. Relationships deduced from recent snow will be applied to ice cores for the purpose of establishing palaeoclimatic records. A network of stations throughout the Antarctic Peninsula has been sampled as part of the international Glaciology of the Antarctic Peninsula (GAP) programme which, recognising that the climate of the area may be a sensitive indicator of changes in the global atmospheric circulation, aims to build up a palaeoclimatic record of the region. In the first phase of the GAP programme BAS has investigated the spatial variation of oxygen isotope ratios in the upper 10 metres of the snow cover. Results show that there is a simple trend of mean annual air temperature with mean isotope ratio which is similar to the relationship deduced from a simple model in which an air mass is cooled progressively as it moves from a subtropical source region towards the Antarctic Peninsula. Detailed isotope profiles from the network have been used to identify the most suitable sites for deeper drilling. For accurate dating it is important to ensure that annual waves in the isotope profile, which can be counted like tree rings, will be visible in a long core. Additional dating methods are being sought from vertical profiles of electrical conductivity and particulate content. In order to understand the mechanisms of global dispersal of major airborne pollutants a primary objective is to establish realistic baseline concentrations of these materials in various sectors of the environment. The Antarctic Peninsula offers a convenient study area well removed from immediate sources of pollution where samples of the atmosphere are being continuously collected in accumulated snow and where there are several meteorological stations gathering data that may be used to deduce the major input routes of airborne pollutants. Attention is currently

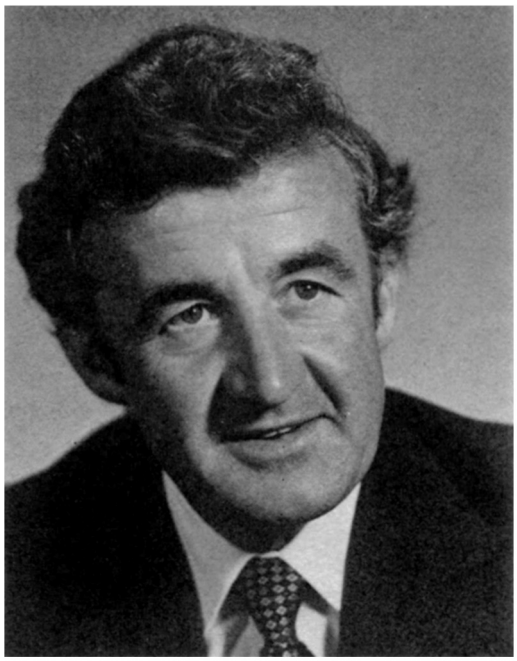
focussed on the heavy metals, typically lead, cadmium, zinc and mercury. Work this year has involved further development of experimental techniques for carrying out all or part of the analyses in the field in order to reduce the risk of contamination in sampling.

Ice shelf, ice dome, and ice rise studies have been continued. The reason for concentrating on such glaciers is that they are in principle the most simple large scale formations amenable to precise mathematical treatment of their dynamic behaviour. To establish whether the floating sea water interface of an ice shelf is growing by accretion from sea water or melting from below, accurate surveys of the surface movement and strain have been integrated with ice thicknesses determined by radio-echo sounding. On George VI Ice Shelf the bottom melting rates have been calculated for a large section of the ice shelf. Since it is expected that the boundary structure will be sensitive to bottom melting or freezing rates, details of the sea-water interface are being investigated by observing variations in the strength and phase of radio-echo pulses reflected from it. Pronounced azimuthal variations in reflected echo strength have been found. Similar radio-echo polarization studies above ice/rock interfaces have been started on ice domes. At the same time, oceanographic soundings and current metering have provided data on the characteristics of the water flow at the base of the ice shelf. Gravimetric readings show that solar rather than lunar components dominate the tides in George VI Sound. One by-product of the radio-echo sounding of glaciers is a measurement of the attenuation of radio waves in ice sheets. This temperature-dependent process is related to the audio frequency dielectric relaxation spectrum in ice and has been suggested as a method for remote sensing of glacier temperature. BAS has measured this relaxation spectrum in the Antarctic Peninsula and finds that, in spite of widely differing impurity levels, values correspond closely with those obtained earlier in the Arctic.

Images scanned in the near infra-red wavelengths (0.7 μ to 1.1 μ) from LANDSAT satellites have proved useful in polar regions for delineating surface water on glaciers and for differentiating accumulation and ablation zones. Aerial photography has been carried out from a BAS Twin Otter aircraft using commercially available false-colour infra-red film which is sensitive between 0.7 μ and 0.9 μ. Most images obtained were striking in their clarity. In a direct comparison with conventional colour film, crevasse systems were much more clearly displayed and distance detail obscured by atmospheric haze on the conventional film registered only on the infra-red film.

Glaciologists interested in the long-term stability of ice sheets and in possible future climatic trends have been looking back to evidence of former ice ages. It has been noted that some reversals of the earth's magnetic field during the Pliocene period were apparently nearly coincident with dates when there were changes in planktonic foraminifera populations recorded in deep sea cores and which are thought to indicate variations in sea water temperature. If a relationship can be shown to exist between geomagnetic field reversals and periods of climatic change, then the established geomagnetic chronology might be used to increase the resolution with which earlier glacial epochs could be dated.

C. W. M. Swithinbank



MALCOLM MELLOR

Designing structures for flood protection schemes, drilling in polar ice, handling explosives, sailing boats, piloting planes, climbing mountains—these are but a few of the skills and interests of Malcolm Mellor. He was born in 1933 in Stalybridge, a hilly area close to Manchester in the north of England, a region where the inhabitants are noted for their pragmatic approach to life and for their earthy humour.

He attended school near home, and then went to Nottingham University in 1952 to read civil engineering. After receiving a B.Sc. honours degree in 1955, he went to work for the Trent River Board as an Assistant Engineer, designing minor structures and buildings for a flood protection scheme.

1956 saw him established in Melbourne, Australia, as a Civil engineer with the Victoria State River and Water Supply Commission, responsible for survey and design for flood protection and erosion control measures. As part of this work, he undertook snow studies in mountain catchment areas. This was not the first time, however, that Malcolm had been involved with snow, for while an undergraduate at Nottingham he had been on the University's Vatnajökull Icecap Expedition in 1954, as surveyor and assistant glaciologist, with Cuchlaine King and Jack Ives. It was in Iceland that he first undertook studies on snow stratigraphy, glacier movement, glacier margins, mass balance, crevassing and jökullhaups. The next year similar studies were made when he took a University expedition to Spitzbergen, as surveyor and glaciologist, with John Hollin as co-organizer. In connexion with this expedition, he first made contact with the Scott Polar Research Institute.

It was not long after his arrival in Australia that these early interests in snow and ice became a major influence in Malcolm Mellor's life. He was seduced away from engineering by Uwe Radok and Fritz Loewe and persuaded to join the Antarctic Division in Melbourne. Soon he was off to the Australian Antarctic stations of Mawson, Davies and Wilkes, for the Australian National Antarctic Research Expedition (ANARE). He worked in a group headed by Keith Mather and made significant contributions to the Australian effort for the International Geophysical Year, travelling widely by ship, plane and surface vehicles. Studies included snow stratigraphy, ice movement, mass balance, blowing snow, glacier margins, sea ice, ice drilling and temperatures, astrosurvey for air photogrammetry ground control, and navigation for inland travel. His report on the factors governing the mass economy of Antarctica became in 1959 his Master's thesis for the University of Melbourne.

After the IGY efforts, Malcolm worked for a short while in Melbourne for the Meteorology Department of the University—and married Anne, as talented as he, but in the artistic fields. In 1959 they moved to Hanover, New Hampshire, U.S.A., where they still live, with their son and daughter.

For two years he worked as a Research Associate for the Thayer School of Engineering, Dartmouth College, under contract (courtesy of Henri Bader) to the U.S. Army's Snow, Ice and Permafrost Research Establishment, soon to become the Cold Regions Research and Engineering Laboratory (CRREL). In 1961, he became a full-time research civil engineer and physical scientist for CRREL, working on snow, ice and frozen ground. He was concerned particularly with experimental and theoretical work, especially in applied mechanics, in advisory and consultant services, state-of-the-art reviews and in machine design. Field activity took him to Antarctica, Greenland, Alaska, Siberia, Yukon, and high mountain zones.

In 1969 he was awarded a D.Sc. in Applied Science by Melbourne University, and in 1970 a Ph.D. in Civil and Structural Engineering by Sheffield University, England. Since 1970, in addition to his CRREL work, he has acted as a direct private consultant and associate consultant for Creare, Inc. and IRAD Consulting Engineers, on engineering mechanics, construction problems in terrestrial and marine environments, machine design and explosions technology.

Although Malcolm counts himself a part-time glaciologist, nevertheless his contributions to both the science and engineering of snow and ice are major and broad ranging. They include studies of the mass balance of both Antarctica and Greenland; the mechanical properties of snow and ice; the nature of high mountain snowfields; light scattering by snowstorms; avalanches; blowing snow; explosions in snow, ice and frozen ground; oversnow mobility, and structures on ice sheets.

He is probably best known for his varied and informative review articles published as part of the CRREL Cold Regions Science and Engineering series and presented as invited papers at a number of recent symposia.

His knowledge of the engineering aspects is encyclopaedic. His colleagues have learned long ago that whatever your problem may be, if Malcolm cannot immediately solve it, or give you five references in which it is treated, you must have a difficult problem indeed. In that case, should you yourself be rash enough to suggest a solution to the problem, the reply comes immediately: "That is the most ridiculous thing I have ever heard!" Retreat is essential at this point, followed by a return two days later when you will be greeted with enthusiastic news of the problem and its solution.

Dealing with Malcolm is well known to be an interesting experience. He has a generally low opinion of his work—and an even lower opinion of yours. But his saving graces are his offbeat sense of humour and his innate kindness and helpfulness: he has been known on many occasions to go out of his way to help colleagues and friends.

He is in great demand for service on international committees, societies and groups, and is at present the Secretary of the International Commission on Snow and Ice. Australian, British and American Academies and Societies have honoured him with awards, showing how widespread is recognition of his expertise.

INTERNATIONAL GLACIOLOGICAL SOCIETY

ANNUAL GENERAL MEETING 1977

MINUTES OF THE ANNUAL GENERAL MEETING OF THE INTERNATIONAL GLACIOLOGICAL SOCIETY 28 APRIL IN THE SCOTT POLAR RESEARCH INSTITUTE, CAMBRIDGE, ENGLAND

The President, Dr Marcel de Quervain, was in the chair.

1. **The Minutes of the 1976 Annual General Meeting,** published in ICE, No. 52, 3rd issue 1976, were approved and signed by the Chairman.

2. **The President** gave his report for 1976-77: Since our last General Assembly, in 1976, 7½ months only have elapsed. As you remember we had combined all business matters of the Society with the Symposium on Applied Glaciology, taking advantage of the presence of many of our members here in Cambridge. It appeared to be a great rush for the Council, and in particular for the Secretary and myself, and we decided that in 1977 we would have a spring session for such business, rather than hold sessions during the Physics and Chemistry of Ice Symposium in September.

Reporting on the state of the Society, I wish first to recall with a few words the Symposium on Applied Glaciology, which was an attempt in a certain respect. Was it a success? Did it change the face of the Society? 112 participants followed 16 invited and 46 submitted papers and discussed them as far as the scarce time allowed it. We have realized that snow and ice offer a great number of practical problems, sometimes being far away from what is commonly called glaciology. The idea that engineers struggling with these problems might approach the scientists of the Society and ask for help was not quite correct. In most cases our scientists had been engaged themselves long ago with such problems and now took the opportunity to inform their colleagues on these aspects of glaciology. But the Symposium did open a wide door, and a large tour d'horizon was presented. From this point of view the Symposium was a success. I have observed many personal contacts and discussions which have led to new research ideas in various fields, although the official discussions had to be kept short. Successful also was the organization and the social activity of the event, and for this we have to thank our Secretary General Mrs H. Richardson and her small staff.

As to the present activity of the Society we have to mention 3 fields: a chain of Symposia ahead of us with varying topics; the *Journal of Glaciology*; the activity in our regional branches.

Symposia and the *Journal* are closely related, inasmuch as a Symposium leads to a special volume of the *Journal*. The Council has agreed—together with our editors—on a policy of publishing also proceedings of glaciological symposia organized by other groups, provided that the capacity of all our staff is sufficient to handle the matter, that the standard of the *Journal* is maintained, and that this activity is financially self-supporting.

Looking along this chain of symposia we notice that:
work and business arising from the Remote Sensing (1974) and Thermal Regime (1975) symposia are now finished; publication of the Applied Glaciology Symposium (1976) is in full progress, and this year's Symposium on Physics and chemistry of ice is in preparation. It looks as though 7 invited and close to 60 contributed papers will be presented.

The first circular for our own Symposium in 1978 on "Dynamics of large ice masses" (to be held in Ottawa) has found a big response and preparations go well ahead. A group travel plan from Europe to North America, arranged to include the preceding Symposium of NRC on "Glacier beds: the ice-rock interface" and visits to CRREL and other Institutions of the region, has met with great interest.

On the horizon, in 1979 a Symposium on "Avalanches and blowing snow", organized by the US Forest Service, has appeared. It will be held in Fort Collins, Colorado and we have been asked to co-sponsor the meeting and to publish the proceedings. The Council has already given its consent under the conditions mentioned before.

Our Secretary visited Ottawa and Fort Collins in March to discuss matters for the respective Symposia and obtained very promising results. Contacts have been made with other groups, leading beyond 1980, but no definite proposals can be submitted as yet.

All these plans imply that until 1980 at least one extra *Journal* Volume a year will be published in addition to the normal one. The Treasurer's Report will refer to this extra "bonus" for members of the Society. I support the Treasurer's view that the Society is performing a valuable service to all who study ice and snow by disseminating information quickly in a high quality and accurately edited journal.

We have to recognize that this is loading an extra burden on our editorial and administrative staff and our reviewers—even if additional assistance is organized—and we have to thank them for their work.

From our branches I can report the following activity. The Western Alpine Branch had a meeting in September 1976 in eastern Switzerland, and is planning a meeting in Swedish Lapland for July this year, at Tarfala. The North East North American Branch held a meeting in February this year in Montreal with presentation of papers and also a ski race (with a sweeping victory for the Canadians due to the lack of skiers from the USA).

Now a few points of our organization will be touched. The present number of our members stands at 1040 and that of library subscriptions at 625. As you know, 3 changes on the Constitution of the Society have been voted on. One was related to the number of Honorary Members, and proposed raising it from 10 to 12. A second change concerned the word "subscription" which had to be avoided now in U.K. for tax reasons. The third change was inspired by one of our Council members. Recognizing that the position and activity of our Secretary is the permanent management of the Society and not just typing letters, the title Secretary General was proposed. All changes have been accepted with an overwhelming majority of the votes. I wish to congratulate Hilda for this world-wide recognition.

As already announced in the last annual report, the headquarters of the Society will now be extended by hiring additional office space nearby. This will allow the Secretary General and her assistants to have more than one room, and will also provide space for handling and storing stocks of the Journal.

Coming to the end, I wish to thank all those who have contributed to the Society's progress: first of all, our two efficient ladies of our Cambridge headquarters, the Secretary General, Hilda Richardson, and her assistant, Beverley Baker; the editors, John Glen, Ray Adie and Doris Johnson, and the assistant editor, David Homer; all reviewers of papers incognito, and the authors, of course. I wish to thank the members of the Council for their co-operation. It is important for the Council not to be composed only of eminent names on paper but to get from its members active response and if possible presence in common meetings.

To the departing Council members who have served since 1973 I say goodbye (these are Corrado Lesca, Olav Orheim, Andrew Palmer, Elton Pounder).

Particular thanks go to the Scott Polar Research Institute and its Director, Dr Gordon Robin, for his hospitality towards the Society, which involves the space for the Secretariat, the use of lecture rooms and above all the good neighbourhood.

At the very end, I wish to remind you that in September 1976 the Council awarded the distinction of the Seligman Crystal to Dr Barclay Kamb of the California Institute of Technology. It will be presented at the Symposium on Physics and chemistry of ice in September this year, here in Cambridge.

3. **The Treasurer's Report** was presented, in his absence, by Dr. T. E. Armstrong:

My first report to you as your new treasurer is a 'first' in two other respects. We can now see the results of the first year of increased dues (both to members and to libraries) and I have to report a change in policy. The result of the increase in dues is reflected by a corresponding increase in our income over the last year, much as had been expected. We now show a fairly healthy profit, but this is not the time to be complacent. Rates cannot be raised again in the immediate future and it is necessary to take the opportunity to look ahead and try and anticipate any problems that may arise from inflation or other causes. In this regard we have raised the level of the Contingencies Fund by £1,000 as agreed by the Council last September.

The new policy I spoke of is the decision to write off everything we own (furniture, equipment etc.), instead of gradually phasing it out by depreciation every year. In future any new purchases will be shown as straight expenditures - this, I feel, gives a more realistic picture of our financial position.

Another reason that our assets appear healthy is because of our large stock of journals - reflected to a certain extent by the sale of back issues. Both the Accumulated Fund and the Contingencies Fund are up, which is cause for some comfort. However, we cannot afford to let them drop, and, as I have already said, we must plan ahead for the future.

You may recall that in 1975 two volumes of the Journal were published - the three normal issues making up one volume and the proceedings of a symposium the second volume. At that time there were some worries that such a venture would not be financially successful - as it turned out, a profit of over £1,100 was made and further symposium volumes have now been planned at present until 1980. Negotiations for volumes beyond that date are in progress. These volumes are of course free to members. The work that the International Glaciological Society is doing in this regard is much appreciated and if possible we should continue to meet any requests - printing costs at the moment are much cheaper in the U.K. than in the U.S.A. or western Europe. But as your Treasurer pointed out last year, this entails much pressure on the Society's administrative and editorial staff. Ways and means must be found to help relieve this pressure and this will inevitably lead to increased costs to the Society.

J. A. Jacobs

4. **Elections of auditors for the 1977 accounts:** Dr. G. Boulton proposed and Dr. J. T. Andrews seconded that Messrs Peters, Elsworthy and Moore, of Cambridge, be elected for the 1978 accounts. This was carried unanimously.
5. **Elections to the Council 1977-80:** After circulation to all members of the Society of the Council's suggested list of nominees, no further nominations had been received. The following people were therefore elected unanimously:

Elective Members:

L. de Crécy
M. Martinelli
J. Schwarz
G. Wakahama

ANNUAL CONFERENCE 1977

50 members of the Society, from 10 countries, gathered in Cambridge from 27-28 April to hear about the latest research projects and to join in discussions. The following are some of the contributions. (For further information, please write to the authors.)

J. G. Paren - British Antarctic Survey glaciological field work, summer 1976-77.
J. Bishop & J. Walton - Dynamics of George VI Ice Shelf.
T. Sanderson - Thermal stresses near the surface of a glacier.
M. Kuhn - Heat transfer coefficients derived from vertical ablation gradients.
D. Limbert - Antarctic temperature changes since 1900.
V. Humphrey - Analogue experiments on dislocations and focussing in pulsed echo sounding systems.
M. Walford - Useful phase measurements in radio glaciology.
G. de Q. Robin - Steady state isotopic profiles.
M. de Quervain - Problems of survival in avalanches.
D. Drewry - 18,000-year reconstruction of the Ross Sea region, Antarctica.
P. Wadhams - Co-operative submarine and aircraft profiling of the Arctic Ocean.
J. T. Andrews - Neoglacial events on Baffin Island, NWT: against a 2500-year Little Ice Age periodicity.
D. Sugden - Glacial erosion and its relationship to the basal thermal regime of the Laurentide Ice Sheet.
G. Golubev - Classification of glacier drainage systems.
G. Boulton - Push moraines of Pleistocene ice sheets.
H. Lister - Rock wear by sliding ice.
L. W. Morland - Glacier sliding.

JOURNAL OF GLACIOLOGY

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

SYMPOSIUM ON APPLIED GLACIOLOGY (Vol. 19, No. 81)

Malcolm Mellor:
Engineering properties of snow.
Bruno Salm:
Snow forces.
David M. McClung:
Direct simple shear tests on snow and their relationship to slab avalanche formation.
R. L. Brown :
A fracture criterion for snow.
U. Radok:
Snow drift.
Daisuke Kuroiwa:
The kinetic friction on snow and ice.
Theodore E. Lang and Richard A. Sommerfeld:
The modeling and measurement of the deformation of a sloping snow-pack.
R. J. Evans and J. L. Langdon:
Approximate solutions for the interruption of creep and glide by avalanche defenses.
Gorow Wakahama and Atsushi Sato:
Propagation of a plastic wave in snow.
J. Martinec:
Expected snow loads on structures from incomplete hydrological data.
L. W. Gold:
Engineering properties of fresh-water ice.
F. D. Haynes and M. Mellor:
Measuring the uniaxial compressive strength of ice.
Katutosi Tusima:
Friction of a steel ball on a single crystal of ice.
D. E. Nevel:
Concentrated loads on a floating ice sheet.
Anthony J. Gow:
Flexural strength of ice on temperate lakes.

Per Tryde:
Ice forces.

A. S. J. Swamidas, D. V. Reddy and G. Purcell:
Ice structure interaction with artificially generated force records.

B. Michel and N. Toussaint:
Mecanisms and theory of identation of ice plates.

K. R. Croasdale, N. R. Morgenstern and J. B. Nuttall:
Indentation tests to investigate ice pressures on vertical piers.

Edward R. LaChapelle:
Snow avalanches: a review of current research and applications.

Richard L. Armstrong:
Continuous monitoring of metamorphic changes of internal snow structure as a tool in avalanche studies.

C. C. Bradley, R. L. Brown and T. R. Williams:
Gradient metamorphism, zonal weakening of the snow-pack and avalanche initiating.

E. J. Hopfinger and J. C. Tochon-Danguy:
A model study of powder-snow avalanches.

M. Heimgartner:
On the flow of avalanching snow.

T. E. Lang:
Wave pattern of flowing snow slab.

P. Föhn, W. Good, P. Bois and C. Obled:
Evaluation and comparison of statistical and conventional methods of forecasting avalanche hazard.

Edward R. LaChapelle:
Alternate methods for the artificial release of snow avalanches.

Richard A. Sommerfeld:
Preliminary observations of acoustic emissions preceding avalanches.

William St. Lawrence and Charles Bradley:
Spontaneous fracture initiation in mountain snow-packs

H. Gubler:
Artificial release of avalanches by explosives.

V. M. Kotlyakov, B. M. Rzhevskiy and V. A. Samoylov:
The dynamics of avalanching in the Khibins.

A. K. Dyunin, B. A. Anfolofiyev, M. G. Istrapilovich, Ya. D. Kvon and N. T. Mamayeva:
Strong snow-storms, their effect on snow cover and snow accumulation.

Roland List:
Ice accretions on structures.

S. F. Ackley, K. Itagaki and M. D. Frank:
De-icing of radomes and lock-walls using pneumatic devices.

Gorow Wakahama, Daisuke Kuroiwa and Kazuo Goto:
Snow accretion on electric wires and its prevention.

S. Baranowski and J. Liebersbach:
The intensity of different kinds of rime on the upper tree line in the Sudety mountains.

J. Schwarz and W. F. Weeks:
Engineering properties of sea ice.

W. F. Weeks, A. Kovacs, S. J. Mock, W. B. Tucker, W. D. Hibler and A. J. Gow:
Studies of the movement of coastal sea ice near Prudhoe Bay, Alaska, U.S.A.

Hajime Ito and Fritz Müller:
Horizontal movement of fast ice in the North Water area.

D. Eyre:
The flexural motions of a floating ice sheet induced by moving vehicles.

S. C. Colbeck:
Short-term forecasting of water run-off from snow and ice.

W. Haeberli:
Experience with glacier calving and air-bubbling in high alpine water reservoirs.

Almut Iken:
Movement of a large ice mass before breaking off.

K. Philberth: ...
On the disposal of radioactive waste in ice sheets.

T. E. Osterkamp:
Frazil ice nucleation by mass exchange processes at the air-water interface.

T. E. Osterkamp and W. D. Harrison:
Sub-sea permafrost regime at Prudhoe Bay, Alaska, U.S.A.

Robert Vivian:
Tourism, summer ski-ing, hydroelectricity and protection of the public in the French Alpine glacial area: the development of an applied glaciology.

INTERNATIONAL GLACIOLOGICAL SOCIETY

SYMPOSIUM ON DYNAMICS OF LARGE ICE MASSES

Carleton University,
Ottawa, Canada
21—25 August 1978

SECOND CIRCULAR

July 1977

INTERNATIONAL
GLACIOLOGICAL SOCIETY

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H. Richardson (Secretary General IGS)

General information about the Symposium may be obtained from:

The Secretary General
International Glaciological Society
Lensfield Road, Cambridge CB2 1ER
England

Detailed information about arrangements in Ottawa may be obtained from:

Dr L. W. Gold
Division of Building Research
National Research Council of Canada
Ottawa, Ontario K1A OR6
Canada

A Symposium on Dynamics of large ice masses will be held in Ottawa, Canada, 20-25 August 1978, with the assistance of Carleton University. Registration will take place on Sunday 20 August at the University, and sessions will be held from Monday 21 to Friday 25 August.

For those people who also plan to attend the partner symposium (see section 3 below) registration facilities will be available on Monday 14 August in the University.

1. PARTICIPATION

This circular includes a booking form for registration, accommodation and travel. The form should be sent to the address given below before 1 May 1978 with the appropriate deposits, as indicated. (Registration fees cover organization costs and distribution of preprints of summaries.)

Payments should be made in **Canadian dollars**-

by **cheque** payable to: International Glaciological Society, and submitted with the registration form to IGS Symposium, c/o Dr L. W. Gold, Division of Building Research, National Research Council of Canada, Ottawa, Ontario K1A OR6, Canada; or

by **bank transfer** to: International Glaciological Society Symposium, Account Number 25146NP, Bank of Nova Scotia, Carleton University, Colonel By Drive, Ottawa, Ontario K1S 5B3, Canada.

Registration Fees:

Participants ..... Can $40.00

Junior Members of the International Glaciological Society ..... Can $20.00

Accompanying persons aged 18 or over Can $10.00

(There is no fee for those under the age of 18.)

2. TOPICS

The Dynamics Symposium will be concerned with the dynamics of ice sheets past and present, ice caps, large valley glaciers, floating ice.

3. PARTNER SYMPOSIUM

During the previous week, 15-19 August, a Symposium on "Glacier beds: ice-rock interface" will be held in Ottawa. This Symposium is organized by the Sub-Committee on Glaciers of the National Research Council of Canada's Associate Committee on Hydrology. Information concerning this Symposium may be obtained from:

C. S. L. Ommanney, Glaciology Division, Fisheries and Environment Canada, Ottawa, Ontario K1A 0E7, Canada.

It is hoped that, in bringing together the two Symposia in this way, individuals will be able to attend both. **Please note that it is necessary to register separately for each Symposium.**

4. PROGRAMME

A detailed programme will be given in the Third Circular. On Sunday evening, 20 August there will be an informal party, and on Thursday 24 August, the Symposium Dinner will be held. Visits in the Ottawa area will be arranged for those interested in local tours, and may be booked when registering on Sunday 20 August.

5. ACCOMMODATION

Carleton University

The charges for 1978 have not been finalised yet, but will be approximately as follows:

Single accommodation and breakfast Can $17.00

Shared accommodation and breakfast Can $12.50

(children 16 or younger accompanied by parents) Can $9.25

The residences are adjacent to dining facilities, with elevators and air-conditioning and a high ratio of washrooms to bedrooms. Meals are served buffet-style in dining rooms; tickets for meals may be purchased at the time of registration. (Lunch Can $3.30, Dinner Can $4.40.)

Deposits for accommodation: A $20 deposit per person must be paid when booking any of the above accommodation. This deposit is returnable if notice of cancellation reaches Dr L. W. Gold, Division of Building Research, National Research Council of Canada, Ottawa, Ontario K1A 0R6, Canada, **before 13 July 1978.**

Hotels

The University is connected by bus with the city centre, where several hotels of various grades are located. Prices range from $12.00 to $47.00 for single rooms and $15.00 to $53.00 for double rooms. If you wish to stay in a hotel, please write to Dr L. W. Gold (at the address shown at the beginning of this circular) for a leaflet giving names, addresses and rates. You are asked to make your own reservations at hotels. Meals may be obtained on campus: tickets may be purchased at the time of registration. (Lunch $3.30, Dinner $4.40.)

Note: all prices are approximate.

Last date for registration and accommodation bookings: 1 May 1978.

6. PAPERS

(i) SUBMISSION OF PAPERS

Those participants who would like to contribute to the Symposium should first submit a summary of their proposed paper in English; this summary should contain sufficient detail to enable the Papers Committee to form a judgement on the likely merit of the proposed paper, but should not exceed three pages of typescript. Summaries must be submitted on paper of international size A4 (210 x 297 mm) with wide margins and double spaced lines. Summaries should be sent to: Secretary General, International Glaciological Society, Lensfield Road, Cambridge CB2 1ER, England.

Last date for submission of summaries:
1 December 1977

(ii) SELECTION OF PAPERS

Each summary will be assessed by the members of the Papers Committee, acting independently of each other, taking into account scientific quality and relevance to the theme of the Symposium. The Papers Committee will then invite a strictly limited number of papers for presentation and thorough discussion at the Symposium (not necessarily confining themselves to authors who have submitted summaries). It is hoped to notify authors of papers during March 1978.

(iii) DISTRIBUTION OF SUMMARIES

The summaries of the accepted papers will be distributed by surface mail to all participants before the Symposium.

(iv) SUBMISSION OF FINAL PAPERS AND PUBLICATION

The Proceedings will appear in the Society's *Journal of Glaciology*. Papers presented at the Symposium will be considered for publication in these Proceedings, provided they have not been submitted for publication elsewhere. Final typescripts of these papers should be submitted to the **Secretary General, International Glaciological Society, Lensfield Road, Cambridge CB2 1ER, England, by 1 July 1978.** They should be written in English and prepared in accordance with the instructions for preparation of papers for the *Journal of Glaciology* to be found inside the back cover of the *Journal*. Fuller details will be sent to authors with the notification of acceptance of papers for the Symposium. The maximum length for papers will be 5000 words or the equivalent length including any illustrations. The papers will be refereed according to the usual standards of the *Journal of Glaciology* before being accepted for publication. The Society can normally publish proceedings within one year after a Symposium, provided authors co-operate as indicated above. Members of the International Glaciological Society will receive the proceedings volume free. Others may place orders for the volume with the Society's office.

Last date for submission of final papers:
1 July 1978

7. SOCIAL EVENTS

(i) PARTY

On the evening of Sunday 20 August there will be a mixer hosted by Carleton University to mark the beginning of the Symposium on Dynamics of large ice masses and the end of the Symposium on Glacier beds.

(ii) DINNER

The Dinner will be held on Thursday 24 August. In addition to being the main social event of the Symposium, it will also be the Annual Dinner of the International Glaciological Society and members of the Society will be very welcome, whether or not they are participants in the Symposium. The cost, inclusive of wines and coffee, will be approximately $15.00. Tickets for the dinner may be bought when registering.

(iii) LOCAL TOURS

There will be a programme for people accompanying participants. There are also several local tours; arrangements can be made at the time of the Symposium for going on these.

8. DISPLAY SPACE

There will be a limited amount of space available outside the lecture room for displays of photographs and maps related to the theme of the Symposium. Those participants who wish to use such space are asked to write to the Secretary General of the Society in Cambridge, giving details of the material they wish to display and the area required.

9. POST SYMPOSIUM TOURS

Two tours are planned, leaving Ottawa on Saturday morning 26 August. Both are available to all participants in the Symposium.

Tour No. 1—Finger Lakes. 5 days

The tour will leave Ottawa by bus, cross the St. Lawrence River near Prescott, proceed to Syracuse and then to Cornell University on Cayuga Lake. From there the route will be westward along Lake Ontario to the Buffalo and Niagara Falls region. Return to Ottawa will be via Toronto and Kingston.
Cost of Tour No. 1—approximately Can $200.

Tour No. 2—Eastern Canada. 8 days

The tour will leave Ottawa by bus for Quebec City. It will then go to Saguenay, Gaspé, Halifax, Cabot Trail (Cape Breton Island) and Sydney, Nova Scotia. At Sydney there will be a choice: **either** (a) return to Ottawa by bus **or** (b) go by plane to St. John's, Newfoundland, to visit Memorial University and C-CORE; this latter tour will terminate at St. John's, and participants will make their own arrangements for their return home (except those on the special travel arrangement from Europe—see section 10 below).

Cost of Tour No. 2—
approximately Can $325 for those choosing (a)
approximately Can $375 for those choosing (b)

Further information on the Tours may be obtained from Dr L. W. Gold (see address on registration form).

A deposit of Can $50 per person should be paid before 1 May 1978, as indicated on the registration form. This deposit is returnable if notice of cancellation is received by Dr Gold before 15 June 1978.

10. TRAVEL FROM EUROPE

Substantial savings on trans-Atlantic fares can be made by booking APEX (Advance Purchase Excursion) tickets, starting from and returning to London. There are some rules for the purchase of these tickets, however: (i) the bookings must be made with and the payment received by the airline at least 50 days before the departure date; (ii) the bookings for both the outward and the return journeys must not be changed once they have been made (a change will mean that the full normal fare will have to be paid), and (iii) the length of stay in North America must be between 14 and 45 days.

OUTWARD JOURNEY

Several people who received our First Circular indicated interest in cheap travel from Europe. We have arranged the following special IGS tour from London to Ottawa, for the two symposia at Carleton University:

Saturday 12 August—fly from London to Boston. (Those coming to London from other European countries can be booked into an airport hotel for the Friday night.) A special coach will meet the tour at Boston airport and travel directly to Hanover, New Hampshire—the home of CRREL (Cold Regions Research and Engineering Laboratory).

Sunday 13 August—visit CRREL. In the evening —a party.

Monday 14 August—visit Dartmouth College (optional). After lunch, the bus will take participants to Carleton University, Ottawa, in time to register for the first of the two symposia.

RETURN JOURNEY

The second symposium will finish on Friday evening 25 August. People who have come on our IGS tour from London have several choices, but they must have made their booking in accordance with the APEX rules listed above.

(i) They may join Post Symposium Tour No. 1 (Finger Lakes), returning to Ottawa in time for a return flight to London from Montreal on 31 August, or later if they choose, provided the booking has been made in accordance with APEX rules.

(ii) They may join Post Symposium Tour No. 2 (Eastern Canada) to Newfoundland visiting C-CORE, for a return flight from Gander to London on Sunday 3 September.

(iii) They may return to London from Montreal immediately after the symposium ends—or extend their stay privately in North America, provided the booking has been made in accordance with APEX rules.

The cost of the basic IGS tour (London-Boston-Hanover-Ottawa; Montreal-London) will be approximately £265, and includes air and bus travel, 2 nights in hotel (twin-bedded rooms). Single rooms £8 extra per night.

For those joining Post Symposium Tour No. 1 (London-Boston-Hanover-Ottawa; Finger Lakes Tour-Ottawa; Montreal-London) the total cost will be the basic IGS tour (£265) plus the tour cost of approximately $200.

For those joining Post Symposium Tour No. 2 (London-Boston-Hanover-Ottawa; Eastern Canada Tour-Gander-London) the total cost will be approximately £295 plus the tour cost of approximately $375.

If you are interested in any of these IGS travel arrangements from and to London, please write to Mrs H. Richardson, Secretary General, International Glaciological Society, Lensfield Road, Cambridge CB2 1ER, England, for further details. In order to make sure of these APEX fares, bookings will eventually have to be made with the Cambridge office by 1 May 1978. Payments will be required in £ sterling at the Cambridge office.

Your bookings for the Post Symposium Tours (see section 9 above) should be made in accordance with the instructions on the registration form: to Dr L. W. Gold in Canada.

Your copy

INTERNATIONAL GLACIOLOGICAL SOCIETY SYMPOSIUM ON DYNAMICS OF LARGE ICE MASSES

20-25 August 1978

The following reservations were made on the forms returned to Dr L. W. Gold on ...../ (day) ...../197... (month)

A. REGISTRATION FEES

(i)	Participant	Can $ .....
(ii)	Junior Member IGS	Can $ .....
(iii)	Accompanying person	Can $ .....

B. ACCOMMODATION DEPOSITS

Can $20.00 per person

Carleton University Can $ .....

C. TOURS

Can $50.00 per person

No. 1 Can $ .....

No. 2 Can $ .....

TOTAL

PAYMENT (sum of A, B, C) ... Can $ .....
Sent by cheque/Bank transfer.

Tickets for Symposium Dinner:

Number required .....

Payment to be made upon registration in Ottawa.

DATES TO REMEMBER

1 December 1977:
Last date for submission (to Secretary General) of summaries of papers for consideration.

1 May 1978:
Last date for reservations (via Dr L. W. Gold) for registration, accommodation, tours, travel from Europe.

1 July 1978:
Last date for submission (to Secretary General) of final version of accepted papers for consideration for publication in the Proceedings.

METHODS OF MAKING PAYMENT

By cheque payable to: International Glaciological Society, and submitted with the registration form to IGS Symposium, c/o Dr L. W. Gold, Division of Building Research, National Research Council of Canada, Ottawa, Ontario K1A 0R6, Canada.

By bank transfer to: International Glaciological Society Symposium, Account Number 25146NP, Bank of Nova Scotia, Carleton University, Colonel By Drive, Ottawa, Ontario K1S 5B3, Canada.

Registration, Accommodation, Tours

SYMPOSIUM ON DYNAMICS OF LARGE ICE MASSES

20-25 August 1978

Mail to: IGS Symposium, c/o Dr L. W. Gold,
Division of Building Research,
National Research Council,
Ottawa, Ontario K1A 0R6, Canada.

See previous page for methods of making payment BEFORE 1 MAY 1978

A REGISTRATION FORM

(please type or print in black ink)

Name of participant .....

Title .....

Address .....

.....

.....

Accompanied by (indicate age if under 18)

Name .....

Name .....

I send registration fee/s as follows:

(i) Participants .....Can $40 each.....

(ii) Junior Members ... Can $20 each.....

(iii) Accompanying persons .....Can $10 each.....

(There is no registration fee for accompanying persons under the age of 18.)

TOTAL REGISTRATION FEE/S = Can $.....

B ACCOMMODATION FORM

1) CARLETON UNIVERSITY

Please reserve the following accommodation for the nights of ..... for which I enclose a deposit of Can $20 per person.

(a) Single room and breakfast .....

(b) Shared room and breakfast .....

2) HOTELS

Please make your own reservations. No deposit required.

DEPOSIT FOR UNIVERSITY ACCOMMODATION

Can $20 per person = Can $ .....

C TOURS

I wish to reserve ..... place/s on

★ Tour No. 1 (Finger Lakes) and enclose a deposit of Can $50 per person.

★ Tour No. 2 (Eastern Canada) and enclose a deposit of Can $50 per person.

★ I am travelling on the special flight from London and have sent my payment to the Cambridge office (in £ sterling).

★ delete as appropriate

D SYMPOSIUM DINNER

I hope to attend the Dinner and will wish to reserve ..... tickets. (Payment to be made at time of arrival in Ottawa.)

TOTAL PAYMENT

(sent by Cheque/Bank transfer for A, B, C)

= Can $.....

GLACIOLOGICAL DIARY

1978

8–10 March
Symposium on Ground freezing. Bochum, Germany. Ruhr — University Bochum. (Dr H. L. Jessberger, Soil Mechanics Division, Civil Engineering, Ruhr-University Bochum, P.O. Box 102148, D-4630 Bochum 1, Germany.)

– April
Meeting about snow and avalanches, Grenoble, France. Association Nationale pour l'Etude de la Neige et des Avalanches. (ANENA, 46 avenue Félix-Viallet, 38000 Grenoble, France.)

16–18 May
Symposium on Snow removal and ice control research. Hanover, NH, USA. Transportation Research Board; CRREL; US Department of Transportation. (A. Clary, Transportation Research Board, 2101 Constitution Avenue NW, Washington, DC 20418, USA.)

10–13 July
Third International Conference on Permafrost, Edmonton, Alberta, Canada. National Research Council of Canada. (M. K. Ward, c/o National Research Council of Canada, Ottawa, Ontario K1A 0R6, Canada.)

1–4 August
Symposium on Physics and mechanics of ice. Copenhagen, Denmark. (International Union of Theoretical and Applied Mechanics.)

15–19 August
Symposium on Glacier beds: the ice-rock interface, Ottawa, Canada. Sub-Committee on Glaciers of the Canadian National Research Council. (C.S.L. Ommanney, Glaciology Division, Environment Canada, Ottawa K1A 0E7, Canada.)

21–25 August
Symposium on Dynamics of large ice masses, Ottawa, Ontario, Canada. International Glaciological Society. (Mrs H. Richardson, Sec. Gen., Cambridge CB2 1ER, England.) (see p. 18-23 of this issue of ICE.)

JUST RECEIVED: Notice of a Meeting on Snow runoff modeling, to be held at the Cold Regions Research & Engineering Laboratory, Hanover, NH, USA, *26-29 September 1978*. (Contact Dr S. C. Colbeck, CRREL, Hanover, NH 03755, USA.)

1979

24–28 April
Symposium on Electronics and avalanches. Graz, Austria. (Dr W. Fritzsche, Institute of Electronics, Technical University of Graz, Inffeldgasse 12, A 8010 Graz, Austria.) **Note change of date.**

12–17 August
Symposium on Snow in motion — Avalanches and blowing snow. Fort Collins, Colorado, USA. Rocky Mountain Forest and Range Experiment Station. Co-sponsored by International Glaciological Society. (Dr M. Martinelli, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO 80302, USA.) (See p. 25 of this issue of ICE.)

1980

24–30 August
Symposium on Processes of glacial erosion and sedimentation. Geilo, Norway. International Glaciological Society. (Mrs. H. Richardson, Secretary General, Cambridge CB2 1ER, England.)

JOINT MEETING

SYMPOSIUM ON SNOW IN MOTION

12-17 August 1979, Fort Collins, Colorado, U.S.A.

FIRST CIRCULAR

LOCATION:
A scientific symposium covering the major aspects of "Snow in motion" will be held at Colorado State University, Fort Collins, Colorado USA in 1979. Registration will be held on Sunday 12 August. Sessions will be held from Monday 13 August to Friday 17 August. The Symposium is jointly sponsored by the U.S.D.A. Forest Service Rocky Mountain Forest & Range Experiment Station and the International Glaciological Society.

TOPICS
The following topics were selected because of our appraisal of current trends in snow and avalanche research. We feel the socio-economic aspects related to avalanche warnings, public awareness, and zoning are especially deserving of recognition and emphasis at this time.

I. **Snowcover stability evaluation and avalanche prediction**
   - A. Statistical approach
   - B. Physical approach
   - C. Casual-intuitive approach
   - D. Avalanche warnings and public education avalanche awareness

II. Snow and avalanche mechanics
   - A. Theoretical considerations
   - B. Field and laboratory measurements
   - C. Modeling efforts
   - D. Interaction of avalanches with stationary objects

III. Avalanche zoning
   - A. As a technical problem
   - B. As a socio-political problem
   - C. Current zoning situations in various countries

IV. **Wind transport and deposition in irregular terrain**
   - A. Theory
   - B. Measurements
   - C. As a factor in avalanche areas
   - D. Application of control techniques

PAPERS
The papers committee will be happy to consider papers on any of the above or closely related topics. Special consideration will be given papers covering new concepts of innovative ideas, but papers of a strictly operational nature will not be accepted. All papers and presentations will be in English. Details on submission of summaries (due Oct. 1978) and the preparation of accepted final papers will be given in the 2nd circular.

PUBLICATION
Papers presented at the Symposium will be refereed according to the usual standards of the Journal of Glaciology and will be published as a special issue of the Journal.

ACCOMMODATIONS
Rooms and meals will be available at reasonable rates on the University Campus or at hotels and motels in Fort Collins. Prices and more details will be given in the 2nd circular.

FURTHER INFORMATION
If you plan to attend this symposium or if you wish to receive the 2nd circular please fill out the form and mail it as soon as possible. The 2nd circular will be mailed in July 1978. It will include details about submission of summaries, selection of final papers, expenses, preparation of accepted final papers, accommodations, and post symposium field trips.

Response Form

SCIENTIFIC SYMPOSIUM ON SNOW IN MOTION

12-17 August 1979 Fort Collins, Colorado, USA

Family Name .....

First Name ..... Title .....

Address .....

.....

.....

Please send 2nd Circular .....

*I hope to attend the Symposium .....

*I plan to submit a paper ..... on topic No. .....

*I may be interested in Group travel to North America .....

*I may be interested in a short (1 to 3 day) field trip .....

*I may be interested in a more extensive (4-10 day) excursion .....

**Without obligation*

Please mail as soon as possible to:

Dr. R. A. Sommerfeld
Rocky Mountain Forest and
Range Experiment Station
240 West Prospect Street
Fort Collins, Colorado 80521

REVIEWS

The Ice Age: past and present. Brian S. John. Collins, 1977. 254 p. £4.95

The book aims to provide a simple, yet comprehensive, account of a wide range of topics associated with ice for "the person who knows very little about ice and glaciers and even less about the Ice Age". It succeeds admirably in this purpose as it is clearly written with the minimum amount of jargon; nevertheless many technical terms and names are introduced, but they are explained before they are presented.

The book is divided into 16 short chapters, the first seven dealing with various aspects of ice, largely from the geomorphological point of view. The introduction gives facts and figures concerning ice cover and glaciers, and mentions research aims. The second chapter deals with the growth, health and decay of glaciers, and the third discusses how they work and their movement. The next chapter is concerned with glaciated landscapes and the fifth with the effects of glacial meltwater on the landscape, both as an erosional and depositional agent. The sixth chapter deals with periglacial processes in a very comprehensive manner, and the seventh with ice on the sea.

The eighth chapter considers the effects of past glaciers, introducing first the Glacial Theory. The Little Ice Age is the subject of the ninth chapter, while the tenth goes on to discuss the extent of ice advances in the present ice age, in North America, Europe and elsewhere. The ancient ice ages are introduced in the eleventh chapter. Chapter 12 deals with the changes of sea level associated with the glacial fluctuations, mentioning both isostatic and eustatic changes. The next three chapters are devoted to ice age plants, animals and man, respectively. The final chapter considers causes of ice ages and the future prospects of renewed glaciation. The book ends with an up-to-date bibliography of 65 items and an index.

One of the outstanding features of the book is the really excellent collection of plates. Many of these are spectacular aerial views of glaciers. There are also 52 unnumbered figures, including pen sketches, mainly of landforms, which suffer by comparison with the photographic plates. There are also several useful maps.

The book fulfils its aim well. It is simply written, easy to follow and conveys clearly the author's own enthusiasm for the beauty and interest of all aspects of ice. There are very few misprints, although one set of plates is mislabelled. The book has the merit of a very wide coverage of all aspects of the Ice Age, introducing many geomorphological features, chronologies and dating techniques, glaciological processes, as well as Pleistocene botany, zoology and archaeology. Naturally in a limited space, as it is a relatively short book, detailed arguments cannot be discussed, but there is no attempt to hide the doubts and difficulties that still remain in interpreting the many facets of the Ice Age. A great many theories and ideas are introduced briefly. The book can be strongly recommended to those for whom it is intended, and those that already know something of the Ice Age and its fascination will also read it with pleasure and interest. Its cover is wide both in topics covered and the global extent of the features mentioned, although most emphasis is placed upon the British Isles and North America.

C. A. M. King

The Ice Age in Yorkshire and Humberside. Patrick Boylan. 18.5 x 22.5 cm, 32 p. Yorkshire Museum, 1977. 50 p.

This pamphlet provides an excellent synopsis of the Pleistocene geology of the traditional county of Yorkshire and that part of north Lincolnshire which is now South Humberside. It is clear and concise, and, considering its length, remarkably comprehensive. The author briefly but interestingly summarises the development of understanding, from the early ascriptions of the drift deposits with their included bones of exotic animals to the effects of Noah's flood, to current views. He also indicates the importance of particular sites within his area for the progress of geological thought in general, for example the contribution of Buckland's studies of the bone fragments of Kirkdale Cave to the acceptance of a geological time scale extended greatly beyond the limits of biblical chronologies. He goes on to discuss in turn the Lower and Middle Pleistocene, and usefully brings together Waltham's interpretation of cave development in west Yorkshire and an account of the Kirmington deposits of north Lincolnshire (South Humberside) with their pollens and Palaeolithic flint flakes. The more abundant Upper Pleistocene remains receive correspondingly more extended treatment and the achievements of Bisat, Catt and Penny in the discovery of the mosses of the Dimlington Silts, the establishment of their age as c. 18,500 years B.P. and the elucidation of the relative ages of the Basement Clay and the Sewerby Beach, and of Madgett in his demonstration that the 'Hessle Clay' is not a distinct till but merely an effect of weathering of other tills, are duly recognised. It is a measure of these achievements that a subject which not so very long ago was a welter of conflicting views can now be set forth so lucidly as in this admirable summary.

G. de Boer

NEWS

PUBLICATIONS

A special issue of *Seppyo* (the Journal of the Japanese Society of Snow and Ice) has been published, entitled "Glaciers and climates of the Nepal Himalayas - Report of the Glaciological Expedition to Nepal". The volume (1976, Vol. 38) is written in English and records the work of the expedition, led by Keiji Higuchi, of Nagoya University.

Copies may be obtained from Dr. K. Higuchi, Laboratory of Hydrological Physics, Water Research Institute, Nagoya University, Chikusa-ku, Nagoya, Japan 464.

KOHYO [Lake Ice]

Akio Tokairin, Associate Professor of Physics at Hokkaido University of Education, Kushiro Branch, has presented to the Society's library a beautiful book on ice formation in a natural lake. The lake is one near his home, and has a shore line of 5 km and a maximum depth of 9 m. The water begins to freeze at the beginning of December and the ice attains a thickness of 30-40 cm by mid-winter. The book is lavishly illustrated to show the figures formed on the surface of the ice when unfrozen water comes up from small holes produced vertically throughout thick ice layers or fissures of ice and spreads rapidly on the surface to form circular or spider-like figures. The vertical holes are created by the continuous bubbling of natural gases or by the boring action of warm water which rises up from the bottom of the lake. Prof. Tokairin also observed the formation and migration processes of Tyndall figures within ice.

Although the book was originally devised for reading by students and the general public in order to arouse interest in the scientific observation of lake ice, it will also be of interest to scientists working on this aspect of glaciology. Dr D. Kuroiwa, Director of the Institute for Low Temperature Science, Hokkaido University, highly recommends the book. Further information may be obtained from Akio Tokairin, Hokkaido University of Education, Kushiro Branch, Shiroyama 1-15-55, Kushiro, Hokkaido, Japan.

AUSTRALASIAN CONFERENCE ON CLIMATE AND CLIMATE CHANGE

A multidisciplinary conference was held at Monash University in Melbourne over the period 7-12 December 1975. There were 57 papers formally presented and 35 presented in 3 poster sessions. The topics covered were wide, including: General atmospheric circulation, mathematical modelling, economic and social implications, quaternary land, ocean and Antarctic records, oceanography on climate scales, recent climate variations, climate extremes and variability, global cycles and climate prediction, theories of climate change, possible future trends.

Many of the papers bore indirectly on glaciology but the following 8 papers may be considered as more directly glaciological:

S. F. Ackley and T. E. Keliher—Antarctic sea ice dynamics and its possible climatic effects.

S. Hastenrath—Glacier recession in East Africa.

D. Jenssen—Climate change from glaciological data.

V. I. Morgan and J. C. Wilson—The relation between measured climatic parameters and oxygen isotope ratios of Antarctic precipitation.

N. W. Young and W. F. Budd—Past climate change from Antarctic borehole and core analysis.

I. F. Allison and P. Kruss—Estimation of recent climate change in Irian Jaya by numerical modelling of tropical glacier systems.

J. Chappell—Causes of the last ice age and prospects for the next.

W. F. Budd and B. J. McInnes—Periodic surging of the Antarctic Ice Sheet—an assessment by modelling.

A book based on the conference but not a straight conference proceedings is being published by Cambridge University Press. The title is *"Climate Change and Variability: a Southern Perspective"*. It contains 8 chapters: an overview, the physical basis of climate, the long-term climatic record, patterns of shorter term change and variability, models of climate change, modification of climate, the effect of climate change and variability on mankind, and progress and prospect. The book is expected to become available in late 1977.

INSTITUTE OF POLAR STUDIES, OHIO STATE UNIVERSITY

Dr Lonnie Thompson has accepted a position as Research Associate with the Institute. His responsibilities include operation of the Institute's Microparticle Laboratory and long-term microparticle research.

Dr Ian Whillans, Research Associate in the Institute, has accepted a position as Assistant Professor of Geology.

Recent grants to the Institute of interest to glaciologists include:

Dr Michael Kuhn, Institute of Polar Studies and Institute for Meteorology and Geophysics, University of Innsbruck, "Micrometeorological studies at the South Pole",

$30,000 for the second year of a multi-year project. Total funding from the NSF Division of Polar Programs is now $42,200.

Dr John H. Mercer and Dr Lonnie G. Thompson, "Paleoclimate investigations on the Quelccaya Ice Cap, Peru", $79,400 in a third award. Total funding from the NSF Office of Climate Dynamics and the Division of Polar Programs is now $159,100.

Dr Ian M. Whillans has received a grant of $22,800 from the Division of Polar Programs to continue his analysis of the Byrd Station Strain Network.

Dr John Rayner, Polar Studies and Geography, has received $25,000 from the National Aeronautics and Space Administration for an "Analysis of the spatial and temporal variation of the ice in Antarctica."

Dr Lonnie G. Thompson has received $15,700 from the Division of Polar Programs for the "Microparticle variations in a 101-meter South Pole ice core".

INHOUSE NEWS

The Editor of ICE publishes the following two news items reluctantly and only as a result of persuasion (?threats?) by officials of the Society —including the Senior Editor of the *Journal of Glaciology* who said he would publish them in the *Journal* if they were not published in ICE . . .

In February 1977 Mrs Hilda Richardson was elected an Associate Fellow of Newnham College, Cambridge.

In July 1977 Mrs Hilda Richardson was elected world President 1977-79 of Soroptimist International, a classified service organization for women in positions of executive responsibility in the professions and in business (the male equivalent is Rotary International). There are 60,000 members in 52 countries, and the organization has consultative status with UNESCO, UNICEF, ILO, FAO and other United Nations bodies. The Society's Immediate Past President, Dr W. F. Weeks, and Mrs Weeks were present at the Installation Banquet in Washington, D.C. on 30 July. The table and stage decorations were based on an ice crystal theme and the flowers were white. The 650 guests present at the function certainly went home knowing something about glaciology and the International Glaciological Society.

NEW MEMBERS

Birchfield, G. E., Department of Geological Sciences, Northwestern University, Evanston, IL 60201, U.S.A.

Bradley, S. W., Department of Plant Ecology, Institute for Northern Studies, University of Saskatchewan, Saskatoon, Saskatchewan, Canada.

Collins, Sam G., 927 Military Avenue, Council Bluffs, IA 51501, U.S.A.

Emery, John J., Department of Civil Engineering and Engineering Mechanics, Hamilton, Ontario L8S 4L7, Canada.

Kozarski, Dr. S., Adam Mickiewicz University, Institute of Geography, Fredry 10, 61-701 Poznan, Poland.

Kuivinen, K. C., Ross Ice Shelf Project, 135 Bancroft Hall, University of Nebraska-Lincoln, Lincoln, NB 68588, U.S.A.

Lanquetuit, Anne-Marie, 52 Avenue des Chasseurs Alpins, 73200 Albertville, France.

Lennon, P. W., British Antarctic Survey, Madingley Road, Cambridge CB3 0ET, England, U.K.

MacKay, Don K., Glaciology Division, Water Resources Branch, Inland Waters Directorate, Fisheries and Environment Canada, Ottawa, Ontario K1A 0E7, Canada.

Noll, Günter, Department of Physics, University of Birmingham, P.O. Box 363, Birmingham B15 2TT, England, U.K.

Pisón, E. Martinez de, Plaza Doctor Laguna-9 (14-E), Madrid 9, Spain.

Robinson, P. H., Geology Department, Victoria University of Wellington, Private Bag, Wellington, New Zealand.

Smith, F. W., Department of Mechanical Engineering, Colorado State University, Fort Collins, CO 80521, U.S.A.

Sodhi, D.S., Faculty of Engineering and Applied Science, Memorial University of Newfoundland, St. John's, Newfoundland A1C 5S7, Canada.

Steffen, K., Geographiches Institut der ETH, Sonneggstrasse 5, CH-8006 Zürich, Switzerland.

Walder, J., Department of Geology, Stanford University, Stanford, CA 94305, U.S.A.

Wills, Robert, Meteorology Department, University of Melbourne, Melbourne, Parkville, Victoria 3052, Australia.

INTERNATIONAL GLACIOLOGICAL SOCIETY

Lensfield Road, Cambridge CB2 1ER, England

DETAILS OF MEMBERSHIP

Membership is open to all individuals who have scientific, practical or general interest in any aspect of snow and ice study. Payment covers purchase of the Journal of Glaciology and Ice. Forms for enrolment can be obtained from the Secretary General. No proposer or seconder is required. Annual payments 1977:

Private members	Sterling:	£10.00
Junior members	Sterling:	£4.00 (under 25)
Institutions, libraries	Sterling:	£20.00 for Volume 18 (Nos. 78, 79, 80) £20.00 for Volume 19 (Number 81)

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: Hilda Richardson

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