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ICE

INTERNATIONAL GLACIOLOGICAL SOCIETY

INAUGURAL MEETINGS

Two new Branches of the Society are holding their inaugural meetings later this year.
Nordic Branch : Inaugural Meeting in Stockholm, 22 - 24 September 1972
French Branch : Inaugural Meeting in Chamonix, 27 - 29 October 1972

See page 20 of this issue of ICE for details

ICE

NEWS BULLETIN OF THE INTERNATIONAL GLACIOLOGICAL SOCIETY

2nd ISSUE 1972 NUMBER 39

CONTENTS

1972 DUES. Those members who have not paid their subscriptions will not receive the 2nd issue of the Journal of Glaciology 1972. As soon as we receive your money, we shall be delighted to send you your copy.

COVER PICTURE. Part of a map of Iceland drawn by Bishop Guðbrandur Thorlákssson before 1585. Photographed by H. R. Barðarson, Reykjavík, Iceland.

RECENT WORK

AUSTRALIA

ANTARCTICA

According to a recent newsletter issued by Bill Budd (Antarctic Division, Department of Supply) a scheduled traverse from Casey towards Vostok encountered difficulties with vehicles, terrain, and instrumentation, and did not get substantially beyond the summit of the Wilkes ice cap (Law Dome) where the first of a planned series of strain grids was established. The traverse served however to test field equipment (ice thickness and navigational radars and recording barometers) and for a remeasurement of gravity values.

In the first operation of the 1972/73 ANARE, Craig Austin and Murray Rich used a modified CRREL drill to core to 100 m depth near Cape Poinsett. They found the large ice temperature decrease with depth expected on theoretical grounds ("Robin effect") from the high ice flow velocity and accumulation prevailing in that region.

1971/72 summer operations in the Lambert glacier basin were carried out with three helicopters and a fixed-wing (Pilatus Porter) aircraft operating from a fuel depot established about 800 km inland of Mawson by tractor traverses during 1971. Eleven ice movement markers together with small strain grids were set up by Ian Allison about 40 km from rock between the 1500 and 2000 m contours around the basin and surveyed by tellurometer and theodolite. Each site was gravity-tied to rock and heighted from reciprocal vertical angles. Remeasurements are to be carried out in two to three years.

At most sites borehole temperatures were measured to 10 m depth, while at several sites snow samples were collected for measurements of β activity and O^{16}/O^{18} ratios. The ice thickness in the vicinity was measured by radar from the fixed-wing aircraft.

WEST IRIAN

(Indonesian New Guinea)

A five-man team led by Randell Champion spent three months on the glaciers of the Carstensz Range studying the glaciology, geomorphology, meteorology, and biology of the region. The expedition, organized in the Meteorology Department of the University of Melbourne with participants from Monash University, the Australian National University, and the University of New South Wales, received financial support from the Australian Research Grants Committee and logistic and instrumental help from Freeport Indonesia Inc., Bechtel Pacific, and Hewlett Packard Inc. During the explorations, carried out from a base camp at 4300 m altitude just below the tongue of the Meren glacier, 7 km from Freeport's Ertsberg copper mine, the expedition met and climbed with students from the University of Indonesia-Jakarta and was confronted by a raiding party from the Ekagi tribe intent on protecting the gods who reign over the mass balance in those parts.

Preliminary results include evidence of ice advances in the East Otomona valley down to 1700 m above sea level, C^{14} - dated to have occurred since 11 300 B.P., and of substantial retreats of the main glaciers (Carstensz and Meren) since J. Dozy's 1936 survey described in *Z. Gletscherkunde* 36(1/2)45-51 (1938). Long - term meteorological and hydrological recorders were left operating in the area which is to be visited again in August 1972 by a three-man party led by John Bennett for remeasurements of accumulation and movement stakes.

U. Radok

FINLAND

To help the studies of ice in the Baltic an agreement of co-operation with other countries has been signed. Joint field work with the Swedish investigators will start next winter in the Gulf of Bothnia and with Russian investigators in the 1973/74 winter in the Gulf of Finland. The programme includes investigations of factors affecting the cooling of sea water, the freezing of the sea, the deformation of the ice field, especially for pressure and melting.

Last winter two preliminary projects were begun. The first, led by Mauri Määttänen from Oulu University, deals with the studies of strength of brackish-water ice. The second project, led by Erkki Palosuo, deals with the investigation of pressure ridges. This investigation will be part of the ERTS-satellite programme.

E. Palosuo

FRANCE

ANTARCTICA

As part of the International Antarctic Glaciological Project programme which aims at studying a large sector of East Antarctica, a French traverse party supported by U.S. Antarctic Development Squadron Six conducted glaciological investigations, starting from Carrefour (66° 50′ S, 139° 15′ E, about 40 km from the coast near Dumont d'Urville station) and ending at 73° 04′ S, 128° 44′ E.

The party consisted of 10 men (5 scientists and 5 technicians who also participated in scientific programmes), equipped with 5 tracked (Hotchkiss HB40) vehicles, 8 sleds, and 2 wanigans.

The traverse started from Carrefour where an LC130 landed with members of the traverse and some supplies on 1 November; after a few days' preparation of vehicles, sleds, and equipment which had been stored there during the preceding season, the traverse progressed slowly due to very bad weather and very rough surface conditions.

An LC130 crashed on take-off from the plateau after the aircraft had resupplied the traverse party 190 km from the starting point and about 1400 km from McMurdo station. Fortunately, the 10 crew members escaped without injury and the traverse proceeded after aircraft rescue for evacuation of the crew and the completion of scientific work. The party remained about three weeks in all at this station.

From there progress was faster due to better weather and sastrugi conditions, both of which improved considerably in the last part of the traverse which was resupplied by parachuting about 7000 l of fuel at each of three more locations. Because of the quantity of fuel supplied it was possible to make depots for 1972-73 season operations. In order to save time deformation network measurements were also cancelled.

The party returned from 73° 04′ S, 128° 44′ E on 15 January and reached Carrefour on 8 February having covered 1600 km in 100 days.

Vehicles which proved to be reliable and sleds which suffered many breakdowns were stored with other equipment for 1972-73 summer field season operations.

Scientific work included establishment of permanent markers, barometric levelling, slope and gravimetry measurements every 10 km. More detailed glaciological work was done in 7 stations distributed along the traverse with astronomical position determinations, deformation networks (in 2 stations), atmospheric measurements, accumulation stakes network, and snow sampling. Samples were taken in pits and by coring in order to get secular and more recent material for geochemical analysis (lead 210, radioactive fallout, stable isotopes . . .). Maximum sampled depth was 47 m. At these stations and at intermediate locations samples for stable isotopes and chemical determinations were also collected. Near the coast sampling and testing of 500 m thermal drill equipment was carried out by a small separate team.

Thanks to aerial support obtained through the National Science Foundation this project of Terres Australes et Antarctiques Francaises organised by Expéditions Polaires Françaises is expected to continue during the 1972-73 season with a party which will try to go farther South in the direction of Vostok Station.

C. Lorius, J. Vaugelade

GERMANY

Although interest in glaciology is generally increasing, practical contributions to glaciological research within Germany are restricted to a few institutions and persons. Field work is undertaken by the Institute for Geophysics of the University of Münster (IG), the Institute for Applied Geophysics of the University of Munich (IAG), the Institute for Photogrammetry and Cartography of the Technical University of Munich (IPaC), the Institute for Radiohydrometry, Munich (IRH), and the Commission for Glaciology of the Bavarian Academy of Sciences, Munich (CfG).

SEA ICE STUDIES (IG AND GI)

In co-operation with Brock University, St. Catharines, Canada, and the University of Münster, staff members of IG, accompanied by members of GI, took part in a research programme dealing with sea ice. The studies were concerned with physical and electrical properties of sea ice as well as with the movement of the sea ice cover. The programme, carried out in the region of Pond Inlet, N.W.T., was part of the EOS Routing study 1972.

SURVEY OF GLACIERS (IPaC and CfG)

In order to continue the investigations of R. Finsterwalder on the variations of glaciers by geodetic means, i.e. by repeated survey and quantitative analyses of the comparison of contour maps, new maps will be made of the Floiten-, Schwarzenstein-, Horn-, Waxegg- and Furtschagelkees in the Zillertal Alps at a scale 1:10 000 with 10 m contour intervals. The construction of the maps is based on aerial photogrammetry from October 1969 as a part of the Austrian IHD programme. Additional surveying and terrestrial photogrammetry was carried out to provide the high accuracy which is particularly needed for the purpose of comparison.

Cartographic elaboration was concentrated on the Vernagtferner, Ötztal Alps, resulting in a second map of this glacier at a scale of 1:10 000, published by CfG, and showing conditions in 1969. (The first map by S. Finsterwalder, dating from 1889, represents the first photogrammetrically established glacier map.)

ISOTOPIC AND HYDROLOGICAL INVESTIGATIONS (IRH)

The isotope composition of snow samples (efficiency of metamorphic processes) was investigated with respect to deuterium, tritium and oxygen-18 and with respect to the age of the samples and the altitude of the sampling place. These effects, already clearly proved, interrelate in a complicated manner.

In co-operation with the Physical Institute of the University of Innsbruck the same isotopic components were also studied in the glacier discharge (Hintereis- and Kesselwandferner, Ötztal). It was possible to determine the contribution of snow melt and ice ablation to total run-off, and to separate out water from springs. Periodic variations in the analysed isotopic composition of glacier discharge correspond well with the annual and, during the ablation season, the daily fluctuation of run-off. To obtain total run-off quantities additional measurements were made using the dilution method with fluorescent dye (Rhodamin WT) as tracer substance with continuous and instantaneous injection of the tracer. Instrumental improvements made this method well adapted to hydroglaciological field work. The accuracy was checked by current meter measurements and found to be satisfactory.

GLACIOLOGICAL STUDIES (CfG)

The observations of ablation and accumulation on Vernagtferner (9.3 km^2) and Landtalerferner (3.4 km^2), both Ötztal Alps, as well as on Schneeferner (0.3 km^2), Zugspitze, as basic data for mass budget analyses were continued. Related measurements gave information on surface velocity, which is still increasing on Vernagtferner whereas on Langtalerferner values are decreasing after a continuous increase for 5 years.

GEOPHYSICAL CONTRIBUTIONS (IAG)

Studies on the ice thickness of the Vernagtferner have been continued by applying DC—resistivity measurements. In order to complete the geophysical programme radio echo soundings have been prepared.

O. Reinwarth

ITALY

Most glaciological research in Italy is done by the Italian Glaciological Committee which forms part of the National Research Council. There are about 1000 glaciers in the Italian Alps; there is also one in the Apennines. All aspects of these glaciers are investigated regularly by teams of glaciologists. A complete list of Italian glaciers exists: the "Register of Italian Glaciers", in four volumes. It was published in 1958-59 on the occasion of the IGY. A revised and updated edition is now being prepared.

In addition to regular glaciological campaigns, which are reported annually in ICE, various other physical and topographical studies are carried out. The results of this work appear from time to time in the annual Bulletin of the Italian Glaciological Committee, which is published in Turin, the headquarters of the Committee. Scholars wishing to consult this Bulletin may obtain it from the Secretariat of the Italian Glaciological Committee, Palazzo Carignano, 10123 Torino, Italy. Exchange agreements are made with the publications of other Institutes and Universities.

In recent years topographical research has also been resumed; a relief map is being prepared of the Miage glacier on Mont Blanc.

Progress is also being made in research into snow cover in the Alps and Apennines. For this purpose, a special Subcommittee was created, the inspirer and promoter of which was the late Giuseppe Morandini of the University of Padua. These researches have been continued in recent years and the results appear in the Bulletin.

In order to give greater impetus to glaciological studies, the Committee, led by its President, Ardito Desio, organizes an annual Glaciological Congress in areas of particular importance for such studies. The first Congress was held at Barmio in 1970 and the second at Courmayeur, below Mont Blanc, in 1971.

M. Vanni

JAPAN

ANTARCTICA

The glaciological research group (Yamada, Nakao and others) of the 12th Japanese Antarctic Research Expedition (J.A.R.E.) left Showa Station to conduct deep ice core drilling at the Inland Research Station (70° 42.6′ S, 44° 18.9′ E) — the temporary name of this station was "Mizuho Camp" — on 30 May 1971. During this trip, they set many snow stakes every 40 to 50 km to measure snow accumulation. Living huts and snow trenches for workshop and storage were increased at this station. Deep core drilling started from the end of October, using newly designed mechanical and thermal drills. The maximum bore velocity was 80 cm/hour. The planned depth of boring was 400 m, but the preliminary drill hole reached a depth of 71 m. It was found that the value of apparent density of snow exceeded 0.82 g/cm^3 at a depth of 51 m. This project will be succeeded by the 13th J.A.R.E. Pit works and glaciological studies were made at the Inland Research Station. Randomly oriented thermal cracks, 1 to 2 m in depth, were found on the snow surface near the station.

OTHER WORK

In the Institute of Low Temperature Science, Hokkaido University (I.L.T.S.), research projects on glaciology have been concentrated on snow and ice in Hokkaido Island and laboratory works, because there are no glaciers in Japan. Natural glaciers are studied in co-operation with foreign scientists. The Institute has proposed the subject: "metamorphism of snow and its transformation into glacier ice in the Pacific and Arctic area" to the U.S.–Japan Committee on Scientific Co-operation as one of the co-operative research projects between Japan and U.S. The counterpart research organization in U.S. was the Geophysical Institute, University of Alaska. The principal investigators were Daisuke Kuroiwa in Japan and Carl Benson in U.S. The purpose of this project is to investigate the process of the metamorphism of snow and its transformation into glacier ice in various places where the cumulative coldness is different. In the summer of 1971, Gorow Wakahama and three other scientists went up to McCall Glacier, located in the Arctic region of Alaska. They made pit observations and core borings at different places on the glacier in co-operation with staff members of the Geophysical Institute, and found that the superimposed ice existed 1 to 2 metres below the surface in the accumulation area of the glacier. This finding suggests that the melt water percolating within the snow was frozen at an unexpectedly shallow depth to form superimposed ice. A large single crystal of ice, 10 to 15 cm in diameter, was found near the terminus of the glacier. After several weeks' stay on McCall Glacier, they went down to Mendenhall Glacier and the Juneau Ice Field. Measurements of water permeability in glacier ice were made on the Mendenhall Glacier. The value of permeability estimated from the ascending velocity of water in a drilled bore hole was 10^{-3} to 10^{-4} cm/sec, which is similar to the value found in fine-grained sand. On the Juneau Ice Field, they joined Maynard Miller's Summer Institute and made observations on firnification, stratigraphy, and free water content of snow in connexion with metamorphism. In furtherance of this project, C. Benson, G. Wendler, T. Osterkamp and others visited I.L.T.S. in January 1972. They made observations of snow in Sapporo and Mt. Daisetsu, Hokkaido Island. Valuable discussions on glaciology took place with staff members of I.L.T.S. during their stay in Japan.

In order to make a "Glacier Inventory" in Nepal, Iozawa and others (Nagoya University) took many aerial photographs of glaciers in the Himalayas.

SNOW AND AVALANCHES

A research section in the Institute of Low Temperature Science, Hokkaido University (I.L.T.S.) studied the mechanism of snow melting. Detailed micro-meteorological and hydrological observations have been made in relation to snow melting in Moshiri Basin (11.4 km^2), Hokkaido. In order to measure the rate of melting, many snow stakes were set at different altitudes in the basin. The profiles of air temperature and wind speed were measured by the use of balloon, and total and longwave radiations and the rate of run-off were automatically recorded. It was found that the rate of snow melt observed on the summit of the mountain for a period of one week in late April was higher than that observed at a flat place in the basin, but this finding may be examined again.

The Institute of Low Temperature Science built an avalanche observatory in 1965 at Toikanbetsu, in the northern part of Hokkaido, to conduct basic studies on avalanches and avalanche defences. The floor space of the observatory including the cold room was 105 m^2. The rate of creep of snow and pit observations have been made every two weeks through the winter seasons. The data on pit observations are available for distribution (write to T. Huzioka). Toyama University has observed snow and avalanches around Mt. Tateyama and Kurobe Canyon, Honshu. Kurobe Canyon is one of the most abundant hydro-electric energy resources in Japan, but so far many workmen have been killed and their living quarters crushed by

avalanches. In order to measure the velocity and dynamic pressure of avalanches, special instruments and devices were designed by Toyama University and I.L.T.S. and installed in Kurobe in 1971.

The Government Forest Experimental Station has several branch observation stations to investigate disasters caused by snow and avalanches. Yamagata branch station of this Agency has been studying the glide velocity of snow on the artificially prepared slopes as a function of gradient and surface vegetation. The relation between snow pressure and mode of deformation and failure strength of trees has been investigated and the frequency of the disaster caused by snow could be estimated by the statistical analysis of annual tree rings. The Institute of Snow and Ice Studies, Nagaoka Prefecture, has an underground laboratory to observe glide velocity of snow lying on the slope (30°). The surface vegetation of the test slope was *miscanthus.* When snow accumulated to about 30 cm in depth, it began to glide at the rate of 1 mm/min, but when several cracks appeared on the snow surface glide velocity attained 30 mm/min.

Avalanche defence is becoming a more serious problem in Japan because of the building of roads and high speed railways in snowy districts. A simple plastic rocket shot has been developed by the Highway Construction Agency of Japan to release avalanches. Artificial release of avalanches by the use of dynamite explosions was not always successful when the snow lying on the slope was stable. D. Kobayashi succeeded in increasing the reliability of this method by using successive explosions of dynamite cartridges.

The National Research Center for Disaster Prevention established a branch laboratory in Shinjo, Yamagata Prefecture, to conduct investigations of disasters caused by snow and avalanches and to make engineering studies on snow removal. The floor space including two cold rooms is 400 m^2. This laboratory constitutes a sister institution of the Institute of Snow and Ice Studies, Nagaoka, Niigata Prefecture, established by N.R.C.D.P. in 1964. In snowy districts in Honshu, ground water has been used to remove snow from road surfaces, because the average air temperature in winter in Honshu is higher than the melting point of ice. Warm ground water was sprinkled on the snow from nozzles of underground pipes laid beneath the centre line of the road. This method is very effective, but it is necessary to use the ground water economically in order to avoid heavy depletion of water resources. Gondaira, Hirosaki University, designed a sophisticated device to control automatically the sprinkling of water and succeeded in reducing the amount required by two-thirds.

SEA ICE AND FROZEN GROUND

Monbetsu Sea Ice Research Laboratory has been observing drifting sea ice by three ice radars installed along the Okhotsk Sea coast of Hokkaido Island. These installations cover a sea area approximately 45 km x 200 km. The first drifting sea ice appeared off Monbetsu in the beginning of January and went out at the end of March. The three simultaneous observations of drifting sea ice were made at 0900 h every day and the ice-covered area was recorded on the map. The time-lapse cinematography of radar images of drifting sea ice showed very complex movements near the sea coast. A powerful electronic computer was installed to analyze the radar echo intensities reflected from drifting sea ice. The atlas of drifting sea ice near Hokkaido Island observed by radar in 1971 is available for distribution (write to T. Tabata).

The relation between frost heaving and underground water has been studied by S. Kinosita and others (I.L.T.S.). Two concrete water tanks (3m x 3m x 2m) were placed underneath the ground surface and filled with soils susceptible to frost heaving. The water levels in the tanks could be measured by U-tubes. The depth of frost penetration and the profiles of water content and temperature in the soil were measured in relation to the change of air temperature through the winter. The effect of thermal insulators in the prevention of frost heaving was studied. Glaciological studies on the permafrost and frozen ground at the summit of Mt. Fuji were made by Nagoya University.

INVESTIGATION OF SNOW AND ICE IN XITH OLYMPIC WINTER GAMES

XIth Olympic Winter Games were successfully held in Sapporo from 3 to 13 February 1972. In order to support this event an Olympic Support Corps was organized by the Japanese Self Defence Force. The Corps was composed of 3641 personnel, 393 vehicles and 8 helicopters. The preparation of ski runs was begun by the Corps on 1 December 1971. Each time it snowed they dug up and turned over the snow with shovels to increase the hardness of the snow. Then it was compressed by foot and ski. On Mt. Eniwa, the site of downhill events, precipitation was small, and snow had to be transported from the forest surrounding the ski courses by corrugated aluminium troughs and 0.4 m-diameter plastic tubes. At Mt. Teine, the site of slalom events, snow was abundant, but the requirements for the snow surface were more stringent. For the speed skating events, de-ionized water was used for the preparation of the skating rink ice. E. R. LaChapelle, University of Washington, joined I.L.T.S. as a visiting Professor from 1 January to 30 March 1972. As he was asked by the Organizing

Committee of XIIth Olympic Winter Games, Denver, to investigate the preparation of ski runs in the Sapporo Olympics, he made observations of the Olympic ski courses with staff members of I.L.T.S. during the games. These results may be helpful in the preparation of ski runs for the Denver Olympics of 1976.

DEEP CORE ANALYSIS

The Department of Supply, Antarctic Division, Australia, and the U.S. National Science Foundation offered about 500 kg of deep ice cores obtained at different places in Antarctica to G. Wakahama (I.L.T.S.) and A. Higashi (Faculty of Engineering, Hokkaido University). A research group was organized to analyze these core samples in co-operation with many scientists working in different research organizations. The preliminary results were: 1) **Amery Shelf Ice**: Clear discontinuities in grain size, density, stratification and fabric diagrams were found in the samples obtained at 100 m and 270 m in depth. In the layer above the discontinuous plane, the ice was transparent and average grain size was 2–3 cm in diameter and the preferred orientation in fabric diagrams showed 3–4 poles. However, in the layer below the discontinuous plane, distinct foliations which included air bubbles and soil particles were seen. The grain size was 2–3 mm and fabric diagrams indicated belt-like patterns. 2) **Wilkes Dome Ice Core**: This core was obtained at the centre of Wilkes Dome where the horizontal flow velocity of the ice sheet seemed to be ignored. The size of grain increased from 1 mm to 2–3 cm in diameter and the fabric diagram indicated that the preferred c-axis orientation became gradually vertical with increase of depth. 3) **Cape Folger's Ice Core**: The preferred orientation of c-axis was two-pole type for the samples obtained near the surface, but it changed to four-pole type for the samples taken at the depth of 330 m. 4) **McCall Glacier Ice Core**: The fabric diagram of core samples obtained at the terminus of the glacier showed three maxima of the preferred orientation. 5) **Byrd Ice Core**: The rate of deformation and yield strength of this core were investigated as a function of strain rate and temperature. The value of yield strength was found to be approximately 10 kg/cm^2, depending on the strain rate. It was found that the value of yield strength was reduced when the diameter of the prepared test piece of ice was less than twice that of the average grain size, and that the yield strength of specimens prepared from a horizontal section of the core was less dependent on strain rate than those prepared from a vertical section of the core. This finding seems to suggest the existence of heterogeneity in the mechanical properties of an ice sheet. The chemical analysis of ice core and snow samples obtained during the 10th and 12th oversnow traverses of J.A.R.E. has been made at Muroran Technical College and the University of Nagoya.

LABORATORY WORKS

Instrumentation: As snow deposited in Honshu is wet because of the high mean winter temperature, the measurement of free water content in wet snow is very important. The calorimetric and centrifugal method for measuring free water content have been exploited, but a more simple and easy-to-work apparatus has been needed. Dielectric methods for measuring free water content are being developed at I.S.I.S., Nagaoka, Hirosaki and Fukui Universities. T. Kimura (I.S.I.S., Nagaoka) developed a new method to record continuously the rate of precipitation of snow, using a He-Ne gas laser beam.

Basic studies: H. Narita (I.L.T.S.) measured the specific surface area of snow as a function of density and type, using photomicrographs of thin sections of snow and the statistical method developed by Smith and Guttmann. The lowest obtained value of surface area was 5 cm^2/g (firn snow) and the highest value was 800 cm^2/g (new snow). The dielectric properties of KCl-ice were studied by N. Maeno (I.L.T.S.) as a function of frequency and concentration of KCl. When the values of dielectric constant and loss factor measured at given frequency were plotted against the concentration of KCl, maxima appeared around 10^{-3}M. In Higashi's laboratory, stacking faults, velocity of dislocations, and lattice vibrations in pure and doped ice crystals have been studied by the use of X-ray diffraction microscopy and X-ray diffuse scattering. Miss Y. Mizuno (I.L.T.S.) studied the crystallographic orientation of hoar crystals by X-ray diffraction and the mosaic structure of ice single crystals by studying the angular spreads of diffracted beams. Y. Suzuki (I.L.T.S.) studied recrystallization and grain boundary migration, using artificially prepared ice bi-crystals. Z. Yosida and —. Aburakawa succeeded in measuring low frequency Young's modulus of snow and ice, using a double pendulum developed by Le Rolland.

Prof. Z. Yosida retired from the Institute of Low Temperature Science, Hokkaido University, and has left Sapporo. Gorow Wakahama became full professor. M. Shoda left Shiozawa Experimental Station of Snow, National Railway, and was appointed Director of I.S.I.S., Nagaoka.

D. Kuroiwa

NEW ZEALAND

During 1971-72 glaciological investigations were continued by the glaciology section in the water and soil division of the Ministry of Works, Christchurch. Additional projects were carried out in conjunction with the University of Canterbury and the geophysics division of the Department of Scientific and Industrial Research (DSIR).

SEASONAL SNOW

Two snow courses in the foothills of the Southern Alps were monitored as in previous years. The 1971 winter was characterised by infrequent snowfalls and no substantial accumulation of snowpack. Photographic records of snow cover variations were obtained on a trial basis from climatological stations at the Hermitage and Mt John.

TASMAN GLACIER

Balance measurements were made at three index sites, representing the névé (near Saddle hut) and the upper and lower parts of the glacier tongue (near Malte Brun and Ball Huts). Winter and summer balance values for 1971-72 are close to the average for the previous five years and the annual snow line reached an altitude of about 1850 m. Marker poles opposite Ball Hut have been surveyed for annual movement.

In September 1971 a seismic survey was carried out by DSIR. Two transverse profiles across the glacier tongue and one profile across the terminal area were recorded. Opposite Malte Brun Hut, the maximum ice thickness is 460 m and opposite Ball Hut the maximum thickness is about 600 m. Seismic records from the terminus were difficult to interpret but indicated that the ice thickness close to the terminus is about 300 m, and that ice interspersed with morainic material may occur beneath the outwash gravels.

IVORY GLACIER
(IHD representative basin)

A map of the glacier has been prepared at a scale of 1:2500 from aerial photographs taken in 1971. Mass balance values have been recomputed to conform with the new map and show negative net balances of about 2 m water equivalent for 1969-70 balance year and 1 m water equivalent for 1970-71 over a surface area of 0.75 km^2. Avalanche activity controlled the snow accumulation pattern in both years.

Snow accumulation during the 1971 winter was less than in the preceding two years and avalanche effects were relatively small. The snowpack sampled in November showed evidence of considerable melt in early spring followed by heavy falls of spring snow. The 1971-1972 summer was characterised by little precipitation and generally cool conditions apart from a hot, dry period in February.

From mid-November 1971 to mid-February 1972 a summer study of micrometeorology and heat balance was carried out at a site on the glacier by students from the geography department, University of Canterbury, supported by Ministry of Works staff. The glacier is situated in an area of high precipitation (about 10 m per year) and it was expected that data would be obtained on the effects of heavy rainfall on ablation. However, the summer proved unusually dry, much to the relief of the field workers. Considerable instrumentation problems were encountered during the first month of the project and special precautions had to be taken to protect equipment from keas, the local mountain parrots, which have exceedingly inquisitive and destructive habits. A multi-channel event recorder developed by the Ministry of Works was successfully tested with three sensors, recording precipitation, wind-run, and incoming short-wave radiation.

P. W. Anderton

ANTARCTIC

During the 1971-72 summer season a programme of glaciological and hydrological research was carried out in the Wright Valley, southern Victoria Land, by the Antarctic Division of the Department of Scientific and Industrial Research (DSIR).

Glaciological investigations were continued on selected "alpine" glaciers of the Asgaard Range, Wright Valley. Mass balance and margin studies were continued on the "Jeremy Sykes", "Heimdall" and "Alberich" glaciers. All accumulation and ablation stake networks were extended. A cross-section of poles installed on the "Jeremy Sykes" glacier in 1970 was resurveyed for glacier movement and the photo-theodolite monitoring of the Upper Wright and "Heimdall" glacier snouts was continued. In comparison to the negative mass balances recorded in previous seasons this year's results indicate a positive net balance on all three glaciers.

A survey to measure movement of the McMurdo Ice Shelf was carried out. Selected points in the network established in 1962 were resurveyed this summer to provide information for planning future airstrips and roads.

Uninterrupted records of Lake Vanda water level changes and the discharge of the Onyx River were obtained for the season. Lake Vanda rose by 0.6 m. The Onyx River had a peak instantaneous discharge of 6.6 $m^3\ sec^{-1}$ (234 cusecs) and a daily mean discharge of 0.66 $m^3\ sec^{-1}$ (23 cusecs) resulting in a total discharge

of 4.1 x 10^6 m^3 into Lake Vanda. Conventional SCUBA diving gear was used to obtain a number of undisturbed sediment samples from the lake bottom on the Onyx detta. It is hoped that apart from biological interest, the strata in these cores will give some indication of past Onyx discharges.

Variation in rise and fall of lakes Vida, Vashka, Webb, Fryxell, Chad and Bonney was monitored over the summer. These lakes, situated in the Taylor and Victoria "Dry Valleys", were measured for comparison with Lake Vanda.

Julian Hawes

POLAND

POLISH MOUNTAINS

Systematic snow cover investigations in the Karkonosze Mountains were continued in 1971 (see details in ICE, No. 33, 1970). Most detailed measurements were carried out in the region of Szrenica Mountain, where is the Mountain Branch (established by A. Kosiba in 1957) of the Meteorological and Climatology Observatory of Wrocław University, in pits and on stakes installed in places representing different hypsometric, orographic, radiational, aeolian, lithological and vegetational conditions.

Karkonosze Ridge, because of its steepness and NW-SE direction, because the prevailing winds (SW,S,SSW,WNW) are perpendicular to the ridges, and because of the very high frequency of foehns, is a classical region for researches on:

(i) differential deflation, accumulation and conservation of the snow cover;
(ii) the role of foehns in the above mentioned processes, especially in the often rapid ablation of snow: the foehns cause very intensive turbulent evaporation and in consequence a deficit in water resources;
(iii) rime frost, which is a very important component in water resources in Karkonosze and so in Silesia;
(iv) the influence of topography and wind on the formation of firn and glaciers in ancient glacial cycles.

Thus the results of the investigations on Karkonosze Ridge provide material for the International Hydrological Decade.

Measurements are carried out also on Sniezka Mountain, at the Meteorological Station of the State Hydrological and Meteorological Institute, and in the Tatra Mountains, mainly connected with the Mountain Station of the State Hydrological and Meteorological Institute, on Kasprowy Mountain.

In the Karkonosze and Tatra Mountains, investigations are also made into avalanches, which are very frequent and cause serious damage to the forest and claim some victims during the winter-spring period.

Some results of the investigations in Karkonosze and Tatra were published and some were presented at the Symposium of the Climatology and Hydrology of Sudetes (especially Karkonosze), organized in 1971 by the author within the framework of the Polish Geophysical Society. Among 29 papers, 4 of them referred to snow cover problems: Snowcover, snowfalls and rime frost on Szrenica, 1957-1970: A. Kosiba. Snowcover and snowfalls in Sudetes: A. Kosiba. Snow cover and rime frost in Szrenica Valley: B. Głowicki. The rime frost and fog water sediment in the water balance of Karkonosze: Z. Wozniak.

Some glaciological problems were also discussed at the Symposium of the Committee for Quaternary Research (INQUA) of the Polish Academy of Sciences.

SPITSBERGEN

In 1971, the glaciological and meteorological and periglacial investigations in SW-Spitsbergen were carried out during the summer, 25 June to 25 September, as a continuation of the investigations from 1970 (see ICE, No. 33, 1970). The 8-man expedition was organized by the Geographical Institute of Wrocław University with the co-operation of the Geophysical Institute of the Polish Academy of Sciences, and was led by S. Baranowski.

The following investigations were undertaken:

Meteorological investigations (S. Baranowski, B. Glowicki)

a) At the Main Base of the Expedition in Polar Bear Bay of Hornsund Fiord: radiation intensity: direct, global, and albedo; temperature: standard observations at 7h, 13h, and 19h, and by thermograph; ground temperatures of tundra: humidity; precipitation; visual observations: cloudiness, etc.
b) At the end of Werenskiold Glacier: global radiation intensity; temperature; humidity; wind direction and velocity; visual observations.
c) At the upper part of Werenskiold Glacier: global radiation; temperature and humidity.

Glaciology (S. Baranowski, B. Glowicki)

a) Measurements of movement and ablation of Werenskiold Glacier along the two transverse profiles: at the end and the middle part of the glacier, in relation to the profiles measured by A. Kosiba 1957-60.
b) Movement measurements of Hans Glacier, along the 1957-60 profile.

Morphology and periglacial processes (J. Cegla, S. Kozarski)

These investigations concentrated on the structure of soils and on glacial accumulation forms.

Seismology of Hans Glacier (R. Czajowski, J. Uchman)

Recordings of microseismics in the lower part of Hans Glacier were carried out by means of a seismograph.

The preliminary reports on the results of the investigations on Spitsbergen in 1970 and 1971 were given at the special Spitsbergen Symposium organized in Wrocław jointly by the Geographical Institute of Wrocław University, the Polish Geophysical Society and the Polish Geographical Society. The papers were:

Organization of Polish Spitsbergen Expeditions 1970 and 1971: S. Baranowski. Film of the Polish Spitsbergen Expedition 1971: R. Czajowski. The glaciological problems on Werenskiold Glacier 1970 and 1971: S. Baranowski. Ablation of ice-cored moraines and its morphological role: A. Sponar. Glacioclimatological investigations during the expeditions of 1970 and 1971: B. Głowicki, S. Baranowski. The slope surface cover in Hornsund Region: A. Martini. The process of growth and decay of knolls on the ice-cored moraines, in the marginal zones of some glaciers in the Hornsund Region: S. Kozarski. Geomorphological and sedimentological effects of "naliedi" in Gåshamna: J. Cegła, S. Kozarski. The structural soils on SW Spitsbergen in the light of the unstable stratification theory: J. Cegła, S. Kozarski. The results of microseismic soundings on Hans Glacier: R. Czajowski. The technical and instrumentation problems in seismic soundings on the Spitsbergen Glaciers: J. Uchman.

The results of the investigations are to be published. The preparations for publication of the final results of the glacio-climatological investigations carried out by A. Kosiba and assistants in 1957-60 are also continuing.

The Polish glaciological-meteorological investigations on SW Spitsbergen will be continued during the summer of 1972.

A. Kosiba

USSR

In 1971, Soviet glaciological expeditions carried out investigations in the mountains of the Caucasus, Central Asia, Altay, Polar Urals, Kamchatka, Antarctica and also in the mountains of the Khibini, Trans-Baikalia, Sayany and Sakhalin.

CAUCASUS

The Caucasian expedition of the **Department of Glaciology of the Institute of Geography of the USSR Academy of Sciences** continued the investigations under the IHD programme in the representative mountain-glacier basin Marukh (West Caucasus) and in the basin of the surging Kolka Glacier. On the Marukh and Kolka glaciers the relation between repitition of weather types on the glaciers and at the valley weather stations was studied, and observations were made of the heat balance and of the variations in meteorological and heat balance characteristics in different weather types. The input and output constituents of the ice glacier balance and meteorological parameters determining them were measured.

As in previous years great attention was attached to the study of surging glaciers. By the spring and summer observations it was established that the velocity of the Kolka glacier tongue movement slowed down in comparison with 1970 and its surface became more even. The moraine cover became denser and it was complete on the glacier tongue. The subglacial run-off stabilized and the network of the subglacial water streams became simpler. Gravimetric measurements were made at three profiles on the same glacier. These measurements made it possible to specify the form of the glacier bed. The following studies were also made: stratigraphy and lithology of friable deposits of the glacial zone; facies differences of glacial and postglacial deposits comprising loose rocks; geomorphological features of rapid surges.

On the Kolka and Maili glaciers, internal nourishment was studied, and the methods of moraine field survey as the main factor of glacier melting reduction were developed. A radar sounding was made on the Bezengy glacier. Sounding shed light on the influence of water on the propagation of radio signals through the glacier and on possibilities of interpretation of the radiolocation data for temperate glaciers.

The Laboratory on the Problems of Snow Avalanches, Moscow University, continued the IHD investigations in the representative mountain glacier basin Dzhankuat in January and from April to October. The following work was done: snow surveys, study of the stratigraphy of the snow-firn layer in the accumulation area, ablation observations, hydrometric and meteorological observations, precipitation observations, observations of the heat balance of the glacier surface (temperature measurements by a new set

of electrical thermometers down to a depth of 70 m were included), ice radar soundings, study of the water movement in the glacier body. The data obtained showed that the total accumulation and total ablation were somewhat higher than average and glacier mass balance was close to zero in 1970-71 on the Dzhankuat glacier. The Moscow University Station "Azau" in the El'brus area studied snow avalanches and snow cover genesis recording of triggered avalanches and wave impact, and analysis of the relation of weather conditions to avalanches.

The Institute of Geography, Georgia, carried out glaciological investigations on the glaciers of the southern slope of the central Caucasus. A phototheodolite resurvey of the fronts of two glaciers and a survey of the whole area of the Tbilisi glacier were made. The velocities of glacier surface movement, their vectors, ablation and deformation values and the positions of glacier tongues were determined. During the summer months a number of glaciological and meteorological investigations were carried out with the aim of studying the regime of ablation and glacier run-off on the Tbilisi glacier in the river basin Bubistskali.

The Kharkov University Caucasus Expedition studied the cyclic changes in the Caucasus glaciation. On one of the glaciers the following observations were carried out: actinometric, gradient heat balance observations, albedo survey of the glacier tongue, observations of ice movement velocity and melting under different conditions of exposure, steepness, moraine cover and altitudes and geomorphological investigations on the glacier and in the valley. The Baksan, Chegem, Cherek, Genaldon, Gizel'don and Ardon valleys were investigated. Water samples for solid sediment discharge analysis were taken. The loess deposits were studied in the submontane zone and dendrochronological investigations were made. From samples of tree branches taken in the Teberda, Baksan and Chegem valleys the relationship of tree growth to meteorological conditions was established.

The Transcaucasian Hydrometeorological Institute continued observations of 13 glaciers in the river basins Ingury, Tskhenitskali Rioni, Terek and others. They surveyed glacier velocities at permanent transverse profiles, total ablation, changes in the level of the ice surface (by levelling) and position of the tongues of the glaciers at the beginning and at the end of the ablation season. Glacier advances were noted. The maximum advance of 18 m of the Devdoraki glacier was recorded in the river basin Terek. During the ablation period the surface level was stationary on almost all the glaciers. The velocity of ice movement considerably increased on the Abano glacier.

The IHD field work was continued on the Gergety glacier. Gradient observations were made in the area of Kazbegy weather station as well as hydrological observations at six hydrosections.

The Alpine Geophysical Institute carried out meteorological, actinometric and stake observations at the tongue of the Bashil' glacier (Chegem river basin) during the ablation period. glacier melting was calculated by the data of the stake observations. A linear relation was established between the melted ice layer per day and the daily sum of the radiation balance. In the course of 80 days 444 cm on the average melted at the glacier tongue and 341 cm of ice under the moraine.

The North Caucasian Hydrometeorological Service continued observations in the Kuban and Terek river basins. The observations in the mountain glacier basin Marukh continued from July to December and included: glaciological, hydrological, meteorological and heat balance observations during the warm period, and snow surveys, hydrological and meteorological observations during the cold period. The precipitation was measured by a network of gauges in the alpine zone of the Bezengy and Marukh glaciers (2000–3500 m asl). The observations of glacier tongue variations were made on 12 glaciers situated in the western and central Caucasus. It was found that almost all these glaciers were slowly retreating (2–12 m a year). In 1971 only two glaciers advanced.

CENTRAL ASIA

The Section of Physical Geography of the Academy of Sciences, Kazakhskaya SSR, continued the IHD observations of the variations of the glaciers in the Zailiyskiy Alatau (8 glaciers) and in the Dzhungarskiy Alatau (9 glaciers). These observations included the measurements of the levels of the glacier surfaces at fixed profiles, the velocity of glacier movement and deformation of its surface, accumulation and ablation of the glaciers, precipitation, the mass heat exchange between the glaciers and the air. The changes in the position of the ends of the glaciers and the heights of the firn line were determined. The hydrophysical processes in the firn basin (rate, depth of infiltration, humidity of the firn, its temperature, density and other properties) were investigated. Hydrometric observations at the glacier tongues, tacheometric and phototheodolite surveys were made. In the firn area of the Central Tuyusku glacier 11 boreholes were drilled, to depths from 30-102 m, by a petrol burning hydraulic method. A map of the glacier thickness was drawn up on the basis of the data obtained.

In 1971 the activity of the left and middle tributaries of the Shokal'skiy glacier continued. The velocities of movement increased, new morphological features appeared, such as ice bulging over the rill between the lateral moraines

and the glacier body. Almost all the fronts of the glaciers retreated and only some of them were stationary. The mass balance of the year was negative.

A glaciological expedition from the **Central Asia Institute** continued its work for the IHD programme on the representative Abramov glacier. The number of observations was increased that year. The snow and ice ablation was observed. Geodetic observations and investigation of the role of avalanches in the nourishment of the glacier were made. Glacier thickness determination by radar soundings and palynological observations were continued. In 1971 in the firn area (4400 m asl) a glaciological station was set up. It observes glaciological and meteorological processes. Under the IHD programme of observations of glacier variations some surveys of glacier tongues in the Pskem river basin (7 glaciers), Sokh (2) and Kashkadar'ya (2) were made. From July to August expeditionary observations of seasonal snow accumulation in the firn areas of four glaciers and from August to September ground and aerial observations of the glaciers in the Bartang river basin were made for mapping purposes.

Great attention was paid to the observations of avalanches in the Akhangaran, Pskem, and Kashkadar'ya river basins. Special attention was attached to the formation of different types of snow-wind relief. Experimental determination of the snow cover height were carried out on separate areas in the mountains by aerial surveys. It was found that aerial surveys can give large-scale vertical photographs of the ground and snow cover for measurements and snow cover height determination in snowy regions where the snow may be 1.5 m and more thick.

Leningrad University continued their IHD investigations on the Abramov glacier. A number of glaciological and meteorological observations were carried out there to specify methods for the study of the heat balance of glaciers. Glaciogeomorphological observations were made to estimate thickness and mass of the glacier. A radar sounding of the glacier tongue was made. A map of the bedrock was drawn up. The palynological investigations showed that there was a possibility of utilizing this method to distinguish annual and seasonal horizons in the firn and ice under the conditions of alpine Central Asia. The velocity of the glacier movement was determined by photogrammetric methods. The temperatures of different surface types were determined by an infrared radiometer.

The Department of Glaciology, Institute of Geography, USSR Academy of Sciences, investigated the internal nourishment of the Abramov glacier and the run-off from its firn area. Some measurements were made in a deep pit of the firn basin in spring and autumn. In connexion with the compilation of the Glacier Inventory, ground and aerial observations on the glaciers in the Obikhingou (West Pamirs), Markansu river basins and the Lake Karakul (East Pamirs) were performed. The process of formation of snow and ice penitentes and their significance were studied in the East Pamirs.

The observations of the RGO and Medvezhiy surging glaciers were continued. Analysis of the data revealed the main regularities in the dynamics of surging glaciers between their surges, and gave an indication of the character of ice movement during a surge and during the stage of reconstruction. The work on the glaciers in the basin of the river Vanch (summer) included: a phototheodolite survey, determination of ice movement velocities by geodetic intersection points and pseudoparallaxes, investigations of ablation and run-off processes, glaciotectonic and glaciogeomorphological observations.

The Tadzhik Meteorological Service continued glaciological and hydrometeorological investigations on the Skagach (Darvazskiy range) and GGP (Gissarskiy range) glaciers which included meteorological observations at the glacier snouts and in the ablation areas, measurements of ice and snow ablation on the tongue surface, ice movement, hydrometric observations on the stream flowing from the glacier, observations of the changes in the position of the ends of the glacier and snow surveys in the firn area. According to international programme of observations of glacier variations the work was performed on 6 glaciers: 3 in the Zerafshan river basin, 2 in the Vanch river basin and 1 in the Muksu river basin. Three glaciers were stationary, two glaciers continued retreating, and the Mushketov glacier in the Muksu river basin advanced.

KHIBINY

The Laboratory on the Problems of Snow Avalanches and Mudflows, Moscow University, continued investigations of snow avalanches including the study of the snow cover genesis, its mechanical properties and snow balance, snow creep on slopes, the pressure of snow on engineering constructions, meteorological observations and recording of avalanches. Some mechanical properties of snow against structures and some parameters were specified. These data are necessary in the designing of avalanche defence constructions.

The "Apatit" mine service investigated avalanche impact under natural conditions. Maximum dynamic pressure was 96 t/m^2. The qualities of snow transport and avalanching in these mountains were also studied by the **Novosibirsk Institute of Railway Transport.** The work included an immediate forecast of avalanches and the study of snow cover flow on the slopes and the movement of the avalanche body.

POLAR URALS

The Department of Glaciology, Institute of Geography, USSR Academy of Sciences, continued observations according to the IHD programme in the representative basin of the Bol'shaya Khadata river. Studies were made of the formation processes of the water and ice elements in the balance, moisture content and water filtration in the firn, and of the formation mechanism of glacier climates and their peculiarities. The position was found of the temperature drop zone at the transition from rock surface to ice surface, and the dependence of the zone on meteorological parameters was elucidated.

Stereophotogrammetric resurveys of a number of glaciers were analyzed, and showed the changes of volume, areas and boundaries on the glaciers for separate time intervals. The co-ordinates of 70 velocity points for six annual intervals on the glaciers IGAN and Obruchev were calculated. The study of the variation mechanism of the Obruchev glaciers during 1953-1969 showed that the velocity fields of the internal mass exchange were much less variable than the fields of external mass exchange and that the kinematic nourishment boundary of the Obruchev and IGAN glaciers was practically stationary for 15 years.

In the southern part of the Polar Urals and in the surrounding lowlands the regularities of the distribution and structure of ancient relief forms were studied. The quaternary deposits were investigated with a view to studying the changes in the vegetation and climate of the region in the Upper Pleistocene and Holocene by pollen analysis.

ALTAY

Tomsk University continued observations in the representative glacier basin of the Aktru river. They included meteorological, actinometric, gradient and hydrometric observations, measurements of ablation and accumulation, glacier movement velocities and snow surveys on the Malyy Aktru and "Uchitel" plateau, and a survey of the Malyy Aktru glacier snout. Analysis of the data showed that the glaciers in that basin were still retreating.

Observations were also made in the western part of the Katun range in the Mul'ta river basin. Palaeoglaciological investigations were performed in the Chui river basin. On the basis of the latter it was established that the boundary of movement of the ancient glacier was 20 km farther to the south than had been previously thought. Further studies were the peculiarities of the moraines formed under lake conditions and the degradation peculiarities of the glaciation in the Chuisk valley.

Section of Geography, Academy of Sciences, Kazakhskaya SSR studied the regime and ablation of the glaciers in the Berel river basin. The following observations were performed: tacheometric survey of two glacier snouts, the velocity of movement at transverse profiles, surface levelling, ablation measurements, meteorological, actinometric and gradient observations.

The Institute of Geography of Siberia and the Far East, USSR Academy of Sciences, continued investigations of the ancient glaciation of the Altay. A map was drawn up and the total area of the Altay glaciers in the late Quaternary period (over 3200km^2) was established.

EAST SIBERIA

The Geographical Institute of Siberia and the Far East carried out field observations of snow avalanches in the North Transbaikalia. The results of the regime observations of 900 snow avalanches in the Udokan and Uyzhno-Muisk ranges were generalized. There is much danger from avalanches here and they play a significant role in the formation of the relief.

In the alpine regions of the Vostochnyye Sayany there is a considerable storage of water, and this regulates the discharge. In the Zapadnyy Sayan the traces of glacierization were investigated. Preliminary investigations showed that the ancient glaciers were small, evidently not exceeding 20–30 km in length.

The Department of Glaciology of the Institute of Geography, USSR Academy of Sciences, carried out field investigations on the glaciers of the Suntar-Khayata range in connexion with the compilation of the Glacier Inventory.

KAMCHATKA AND SAKHALIN

The Department of Glaciology, Institute of Geography, USSR Academy of Sciences, carried out investigations on the Koryto glacier in the Kronotskiy peninsula in July. The material collected was on the input of the balance; a pit on the nourishment area was made. It was found that the peninsula had the heaviest accumulation in the USSR. The values of snow storage, ablation and melt run-off at the nourishment line were in the range of 3000-3500 mm and in the periglacial zone of the peninsular 1800 mm.

From September to October this work was continued by the **Institute of Vulcanology, USSR Academy of Sciences.** The position of the snow cover boundary on the Koryto glacier was determined. Material was obtained of snow accumulation over the warm period and the temperatures of firn and ice in the nourishment zone down to a depth of 6.5 m were measured. Ablation over the period 10 June to 25 September was 830 cm and over the period 25 September—15 October it was 50 cm.

The Novosibirsk Institute of Railway Transport started investigations of snow storms in the region of Petropavlovsk-na-Kamchatka. The Institute also continued investigations of avalanches in southern Sakhalin. The development of the theory of avalanche body movement based on the mechanics of multicomponent media was accompanied by experiments on "mesomodelling" of avalanches. With this aim an avalanche trough was set up, 98 m in length, 37° gradient, with bottom roughness varying within necessary ranges. Experiments of the power of impact of snow masses and separate snow blocks on a vertical wall were made. With the help of remote devices the kinematic field of the moving mass was fixed. The velocities of the artificial "avalanche bodies" were up to 32 m/sec.

ANTARCTICA

The Soviet Antarctic Expedition carried out glaciological investigations near the stations Molodezhnaya, Mirny and Vostok. Near Molodezhnaya station and on a 200 km profile observations of snow accumulation were made. The temperatures of glacier thickness in the bore-hole at depths of 0, 1, 2, 3, 5, 10, 15, 20, 27 m and the velocities of movement of the ice cover edge were measured. Stratigraphic observations in pits were performed.

At the station Mirny a snow survey was made at the stakes set every 2-3 km on the profile Mirny-Vostok. Drilling by a thermodrill was continued at Vostok station. The cores were collected for stratigraphic, crystallographic and geochemical analysis. Measurements were made of temperature in the bore-hole and snow accumulation rates. The expedition made crystallographic studies of fall-out and deposited atmospheric precipitation and ascertained the chemical content of the precipitation.

V. M. Kotlyakov

U.S.A.

SOUTH SHETLAND ISLANDS

The fourth consecutive season of glaciological studies at Deception Island, and the second season of studies at Livingston Island, were conducted in the 1971-72 summer by a five-man group including C. B. Bull and O. Orheim, Institute of Polar Studies, and V. Schytt, University of Stockholm. The main work was a continuation of studies, started the previous season, of the ice exposed in the walls of a 100 m deep crater formed by the August 1970 eruption. The annual mass balance history of the island was extended to about 1680 A.D. by stratigraphic studies. Ice samples, totalling several tons, were collected from the walls of the crater. These will mostly be used for radiometric dating of the ice, but some geochemical studies are also planned. Glacier G1 on Deception Island showed the third year of negative net mass balance. Mass balance studies on Rotch Ice Dome, Livingston Island, were continued and the stake net expanded. Some glacial geological studies were also made along the western margins of Rotch Ice Dome on Byers Peninsula, including the collection of samples of marine organisms for C-14 datings.

O. Orheim

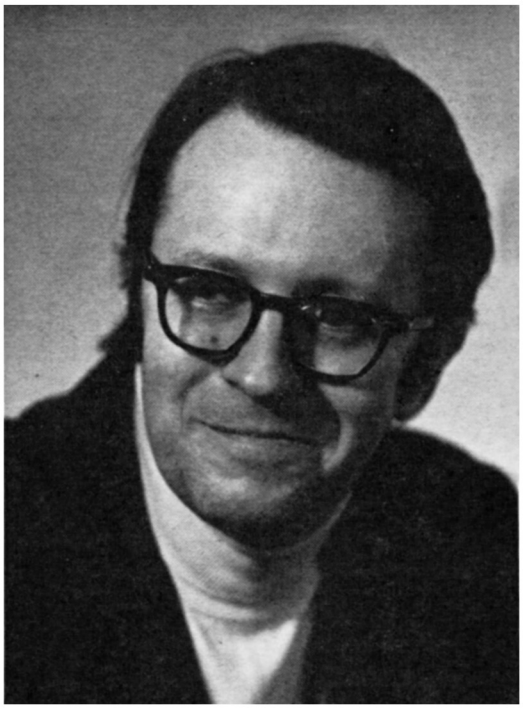
SHERMAN GLACIER, SOUTH-CENTRAL ALASKA

Field study by M. J. McSaveney, Institute of Polar Studies, The Ohio State University, of the effects of a rock avalanche in 1964 on Sherman Glacier was concluded in the fall of 1971. Analysis of the changing dynamics of the debris-covered glacier is continuing. Work with P. J. Morgan has begun on a photogrammetric determination of the changing surface-velocity field of the glacier over the period 1964 to 1969. Other analyses in progress include that of a 450 year climatic record from tree rings, and snow and ice stratigraphy. All efforts to evoke a surge of Sherman Glacier have failed and the glacier has resumed its slow retreat.

MESERVE GLACIER, WRIGHT VALLEY, ANTARCTICA

During the austral summer of 1971-72 a study of surface wave ogive formation on polar alpine glaciers by members of the Institute of Polar Studies was continued by M. J. and Eileen McSaveney at Meserve Glacier. The study is chiefly one of surface and near surface strain rate determination but meteorological and ice fabric parameters are also being investigated. The two parallel wave trains on Meserve Glacier are ablation modified, stress initiated buckles. Work is in progress to iron out the many wrinkles in buckling theory as applied to surface wave formations in glaciers.

M. J. McSaveney



WILFORD W. WEEKS

Willy Weeks was born on a cold night in early January 1929 in Champaign, Illinois, U.S.A. For the next 20 years he stayed in central Illinois and became enamoured with music. After experimenting with the violin, he turned to the string bass, which soon proved to be his real métier. He played in all the friendly nearby honky-tonks, filling the air with boogie-woogie and bebop and all styles betwixt and between. Playing string bass is still his principal hobby, though his repertoire has long since expanded from what we now call 'pop' to encompass classical and jazz music, and his standard has risen so high that he has played as an amateur with several leading orchestras.

After High School, he attended the University of Illinois and majored in geology and chemistry. At that time the University primarily trained geologists for the petroleum industry, but Willy decided to be a "hard rocker", because it was rumoured that "hard rockers" got to climb mountains as opposed to sitting on oil wells. In 1950 he went east to New England to assist his principal professor in a study of igneous rock suites and saw his first mountain. The next four summers he worked in western Colorado, where the mountains were even bigger and better and convinced him that the flats of the midwest were not for him.

1953 was a busy year: he talked Beverly Smith, better known as Smitty, into marrying him, completed his Master's degree at the University of Illinois, and moved to the University of Chicago to work on his doctorate in geochemistry under Hans Ramberg. His thesis was on the thermodynamics of a series of metamorphic calc-silicate reactions. Upon completing his thesis the Air Force called him to active duty and deposited him in Boston at the Air Force Cambridge Research Center. Here he encountered the small Arctic Section with Bert Crary and the group that was manning the Ice Island T-3. It was an encounter that changed the whole direction of his professional life.

The Arctic Section had been given a new project to study sea ice along the Labrador coast. As no one was immediately available to go, Willy volunteered. The main reason for his interest in the project was that there was so little literature available on the structure and properties of sea ice — a situation that intrigued him and made a refreshing change from that in petrology. The so-called "Sea Ice Physics Project" operated out of Hopedale, Labrador, the first year and out of Thule, Greenland, the next year. Among the organizations involved in the work was the Snow, Ice and Permafrost Research Establishment of the U.S. Army (SIPRE), and the scientists included D. L. Anderson, A. Assur and T. R. Butkovich.

In 1957, Willy's Air Force tour was completed and he joined the staff of the Earth Sciences Department of Washington University in St.

Louis, where for the next five years he taught geochemistry and petrology During the same period he initiated a series of experiments at SIPRE, started as a result of an argument between himself and Assur, on the growth, structure and properties of sea ice. By 1962 the fascination of ice had become so great that he left Washington University to join the staff of the Cold Regions Research and Engineering Laboratory (formerly SIPRE) in Hanover, New Hampshire. He is Research Glaciologist in the Snow and Ice Branch of CRREL and also teaches in the Earth Sciences Department of Dartmouth College. Floating ice remains his chief interest, particularly the crystal growth aspects and the interrelations between the structure and the physical properties of the material. Since 1958 he has been one of the steadiest and most productive contributors to the subject: his studies of the structure and salinity of young sea ice were followed by a series of fundamental papers on tensile strength, solute partition, and the generation of substructures during the freezing process, brine migration and desalination, and other subjects. Recently his interest has been focussed on sea ice morphology and phenomena associated with the effects of mesoscale strain in sea ice.

In all this work he has shown such an unfailing talent for finding important and useful facts that his name is on the list of references of practically every paper on sea ice written today. According to a perfunctory count in his bibliography he has worked with about 25 co-authors, which must say something about his ability to get along with people. He has also worked on the properties of alpine snow, avalanches, the temperature distribution both in rivers and on the Greenland ice cap, and the origin of certain unusual types of ice shelf in the Antarctic. He was instrumental in planning and carrying out the ice test programme on the two experimental Arctic voyages of the oil tanker *S.S. Manhattan*, and is now primarily occupied with the programme of the Arctic Ice Dynamics Joint Experiment (AIDJEX) project.

As a man who writes good reports on time, Willy carries a heavy load of responsible work on advisory committees involved in the continuing evolution of research policies of the federal government. He is a member of the Committee on Polar Research of the U.S. National Academy of Sciences and is at present the Chairman of its Panel on Glaciology. He is a member of the AIDJEX Steering Committee and the North Water Advisory Panel.

Wider international service claims him, too. He is Chairman of the Division on River, Lake and Sea Ice of the International Commission of Snow and Ice, and has served on the Council of the International Glaciological Society. He was instrumental in organizing the Northeastern North American Branch of the Society and served as its first President. He has just completed a term as Vice-President and became President in April 1972: the first from North America. To all these organizations he brings his good humoured expertise and his inimitable phraseology, which is always lively, though sometimes incomprehensible to those whose native tongue is not American.

Between field trips and committee meetings, Willy resides on a New Hampshire hillside, with a lovely view of Vermont. The nearest ski lift is 10 minutes away and his two children have been carefully trained to insist that he ski with them every week-end of the ski season. Willy feels that glaciology is of great importance in a large number of geophysical and environmental problems and that advances in the basic understanding of snow and ice will help to unravel an increasingly complex series of practical problems. Furthermore, he thinks the subject is fun — to which his wife replies: "Then why not stay out of the field some spring and shovel out the driveway?" (A question echoed by the family's very short-legged dog — Wolfgang Amadeus Mozart Weeks.)

INTERNATIONAL GLACIOLOGICAL SOCIETY

ANNUAL GENERAL MEETING 1972

MINUTES OF THE ANNUAL GENERAL MEETING OF THE INTERNATIONAL GLACIOLOGICAL SOCIETY 20 APRIL 1972 AT THE SCOTT POLAR RESEARCH INSTITUTE CAMBRIDGE, ENGLAND

The President, Dr V. Schytt, was in the chair.

1. **The Minutes of the 1971 Annual General Meeting,** published in ICE, No. 36, 2nd Issue 1971, were approved, and signed by the Chairman.

2. **The President** gave his report for 1971-72: This is the first AGM with the International Glaciological Society, our new name since the first of January. 358 of our members submitted their ballot papers before the end of December and 93% of the votes were in favour of the new name. We know that this change will make it easier for glaciologists in some countries to join the Society and to come to our meetings, and we hope that this will mean a really significant improvement. You may have noticed that the number of participants from outside Britain is greater during this AGM than ever before.

   The other changes in the constitution were probably of less significance, but they were important in that they have made the constitution more adjusted to the actual needs of the Society. After ten years' experience with one set of rules, the Council ought to have found ways to make further improvements.

   The Constitution, which we now have, is the result of a lot of thinking, long discussions and years of practical experience resulting in gradual improvements. It defines the scope of the Society and it provides rules for election of officers and council members; rules that are supposed to guarantee each member his chance to influence the running of the Society.

   After the last AGM, in Moscow University, I heard some criticism from a few of the younger members. They thought that the AGM was merely a show put on by the Council — without giving the members a chance to express their wishes. In a way they were right — the minutes could almost have been written before the meeting. But we must all realize that our Society is an international body of approximately 1000 members, whereas the AGM, which has to elect the Council and the Officers on behalf of the whole Society, is usually attended by some 50 members. We just cannot accept a procedure making it possible for this small group to make far-reaching decisions on behalf of all members — possibly against the majority's desire. The Constitution provides means for our business to be conducted with every member by mail over a period of several months. This ensures that every member may play a part in the decisions taken at the Annual General Meeting. Whenever there are proposals from members they are carefully considered by the Council.

   And after all these years that I have been on your council I can assure you, that it has only been "the good of the Society" that has been the guiding principle of the Council. To assure this the Council members have been picked from different nations, from different specialities, from different age groups — the only common denominator has been that we have tried to get **good people** whom we can expect to really work for the Society. I hope, personally, that we will never get into a situation when our Council will consist of representatives of certain organizations, age groups, professional groups and so on, but always stay as a group of individual glaciologists picked both because of their scientific qualifications and because of their devotion to the International Glaciological Society.

   In all scientific work the success of any activity depends on the individuals involved. This goes for the basic research as well as for the Society's work. Where would we be without our Secretary, our executive director who runs the Society between the meetings, who represents the Society at various conference and symposia, and who is a personal friend of most of our members.

   We have one of the very best scientific publications in the world — and why ? because we are so lucky as to have John Glen as our chief editor — and he is not only a good glaciologist, soon with a

Seligman Crystal, he is also an excellent editor who likes that job. He has even managed to keep Ray Adie, Doris Johnson and Charles Swithinbank happy as co-editors. I hate to think of a day when this group retires — they are not doing it for the salary or for the fame, they do it for the fun of it — and for the Society.

I do hope we can keep our Society unchanged in this respect — if we lose the sense of personal affiliation, of the individual loyaty towards the Society — then I am afraid we will run into trouble.

These were all my own thoughts caused by some proposals and discussions during the last year. But there are also some facts to report. We have **not** passed the 1000-member mark yet as I hoped for in my previous President's report, but it won't take long and we look forward to the next few years without fear for our economy. The Nordic Branch of the Society with members from Denmark, Finland, Iceland, Norway and Sweden has been set up this Spring and got its constitution approved by the Council yesterday. Our Soviet colleagues have not yet appeared in great numbers, but I trust that during the next President's period, or during the one after that, they will be able to join.

It is only 2 years ago that the AGM was expanded to cover two days and with the bigger attendance each time, we may soon wish to make it a three-day meeting. One day could be set aside for the discussion of one particular aspect of glaciology, and the other two days kept for the usual pattern of informal reporting of recent research. We would appreciate knowing what members and correspondents would like.

Two larger Society symposia are being planned. One on remote sensing in glaciology in 1974 and one on applied glaciology for our 40th anniversary in 1976. In parenthesis I may add that the 1969 Symposium volume is now at page proof stage, and we hope that it will be published at least this year by the International Association of Hydrological Sciences. We have been accused sometimes of having made glaciology too much into glacier-ology, but that has really not been intentional. The flow of **glacier** papers has been the dominant source for the Journal. Last year we decided to strengthen our relations with the people engaged in applied research, and we have now good reason to believe that soon we shall begin to get a regular flow of such articles to the journal. I know that it will please the Editors, but I can see that it will add more work and more problems to their already difficult task.

Before I ask the Treasurer to read his report, I would like to refer to a news item in No. 36 of ICE. In Moscow the Council decided to award Seligman Crystals to B. Lyle Hansen and John Glen, and you will be pleased to see these Crystals being presented during the dinner tonight.

This, ladies and gentlemen, was my last report to you. I wish we could have done more during the past three years: that we could have passed the land-mark of 1000 members, that all local obstacles against membership would have been cleared away, that we could have done more to assist our Editors, etc, etc. But, on the whole, I think that our Society's general situation is good. Our membership has gone up, our meetings are well attended, our Journal keeps its high standard, and we manage to publish without subsidies. Our financial independence permits us to set our own course in our ambition to further the interests of Glaciology.

3. **The Treasurer,** Dr J. A. Heap, gave his report: The accounts for 1971 show that the Society operated last year at a loss of £1512. In my report to the Society covering the accounts for 1970 I reported a loss for that year of just over £1000 and forecast a greater loss for 1971. Despite successful efforts by the Secretary of the Society and the Editors of the Journal to restrain expenditure the deficit is a little larger than expected. This was largely due to the drop in income from the sales of back numbers of the Journal and its indexes. When your Council budgets for each year's expenditure there are two major unknowns on the income side of the equation; the first is the income from the sales of back numbers of the Journal and the second is the income from contributions to cover the publication costs of papers which appear in the Journal. These sources of income vary from year to year.

   Following the loss in 1970 and the expected loss in 1971 the Council decision that the subscriptions should be raised in 1972 has been implemented. The number of resignations from the Society as a result of the increased subscriptions has been small and the Council expect that the accounts for 1972 will show a surplus. For the present, and for the next few years at least, the Society's finances are sound as long as the costs of providing services to the Society do not rise too steeply due to inflation.

   At the last Annual General Meeting I echoed the President's hope that we would be able to increase the membership of the Society and this still remains a matter of high priority. If we are to continue our policy of improving services to members of

the Society without more frequent and larger increases in subscriptions the need for increasing membership becomes even more urgent.

4. **Election of auditors for the 1972 accounts:** Dr J. F. Nye proposed and Dr W. F. Weeks seconded that Messrs Peters, Elworthy and Moore, of Cambridge, be elected auditors for the 1972 accounts. This was carried unanimously.

5. **Elections to the Council 1972-75:** 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:

President	W. F. Weeks
Vice-Presidents	E. R. LaChapelle M. de Quervain
Elective Members	W. F. Budd A. Corte V. M. Kotlyakov W. S. B. Paterson R. Vivian

The President thanked the retiring Council members for their years of service: C. S. Benson, A. Higashi, L. Lliboutry, J. F. Nye.

THE LIBRARY

We are grateful to the donors of reprints, pamphlets, maps, expedition reports and other material. Glaciological works will be listed in *Glaciological Literature* at the end of the *Journal of Glaciology* and kept in the Society's collection, for the use of members.

BOOKS RECEIVED

K. W. Butzer. *Environment and Archeology. An ecological approach to prehistory. Second edition.* London, Methuen, 1972. xxvi, 703p. £8.00.

[English edition of book listed in **Ice**, No. 36, 1971, p. 18.]

R. Goldthwait. *ed. Till, a symposium. Ohio* University Press, 1972. £20.00.

[Presents some of the papers given at the north-central meeting of the Geological Society of America in Columbus, Ohio, in 1969. This book will be reviewed.]

A. Post *and* E. R. LaChapelle. *Glacier Ice.* Seattle, Mountaineer, Seattle and London, University of Washington Press, 1971 [xiv], 110p., illus. 29 x 37 cm. $20.00. (£9.50).

[Photographic study of glaciers and the features produced by the natural processes working on them. A glossary of glacier terms with cross-references to appropriate photographs is included. This book will be reviewed in the *Journal of Glaciology.*]

Society of Ski Science, *ed. Scientific study of skiing in Japan. Papers in European languages.* Tokyo, Hitachi, 1971. xii, 141p.

[Published to mark the Winter Olympic Games in Sapporo, February 1972. Contains the following papers: U. Nakaya and others, "The physics of skiing, preliminary and general survey", p.1-32; I. Tani and M. Iuchi, "Flight-mechanical investigation of ski jumping", p.33-52; M. Iguro and A. Yamaki, "Design of ski-jumping hill for 1972 Winter Olympic Games", p.53-62; N. Hosaka, "Cubic parabola schanze", p.63-66; T. Ohnishi, "Die physikalischen Eigenschaften des Schibretts", p.67-87; T. Fukuoka, "Belastung- und Kniewinkelanderung bei den verschiedenen Schwungarten beim alpinen Skilauf", p.89-97; M. Shimbo, "Friction on snow of ski soles, unwaxed and waxed", p.99-112, Z. Yosida, "Investigations on snow conditioning for the XI Olympic Winter Games, Sapporo, February 3-13, 1972", p.113-25; Z. Yosida, "List of papers on deposited snow and skiing published by the Institute of Low Temperature Science, Hokkaido University, in its publications", p.127-41.]

[Society of Ski Science, *ed.*] [*Scientific study of skiing in Japan. Papers in Japanese. Tokyo, Hitachi, 1971.*] [viii], 187p.

[Published to mark the Winter Olympic Games in Sapporo, February 1972. Contains 21 papers, all in Japanese with English abstracts. These papers are not the same as those listed above.]

G. K. Tushinskiy, *ed. Karty lavinoopasnykh rayonov Sovetskogo Soyuza* [*Maps of avalanche risk regions of the Soviet Union*]. Moscow, Izdatel'stvo Moskovskogo Universiteta, 1971. 27p. 4 maps.

[Four maps of the U.S.S.R., relating relief, climate and distribution of avalanches, accompanied by explanatory booklet.]

G. N. Yakovlev, *ed.* Fiziko-teknicheskiye issledovaniya l'da [Physical and technical studies of ice]. *Trudy Arkticheskogo i Antarkticheskogo Nauchno-Issledovatel'skogo Instituta,* Tom 300, 1971, 218p.

BRANCH NEWS

French Branch

The first meeting of the French Branch will take place in Chamonix 27-29 October 1972. The theme proposed is: "Sites sous glaciares et glaces profondes". People who wish to present a paper on this subject are asked to send the text, or a detailed summary, before 1 October to: International Glaciological Society, Section française, c/o Institut de Géographie alpine, Rue Maurice Gignoux, 38 Grenoble, France.

Two discussion groups will be organized on the following subjects: 1. "Les propriétés cristallographiques et physico-chimiques des glaces profondes". 2. "Observations in situ et érosion sous glaciaire (en rapport avec les problèmes de dynamique glaciaire)." For each theme, a general presentation outlining the main points of each contribution will be made by a rapporteur.

Detailed information about times, accommodation and programme will be sent during August to members of the French Branch and also to those who write to the Branch (address above) indicating their interest in the meeting.

Nordic Branch

The inaugural meeting of the Nordic Branch will take place at the Geographical Institute, Stockholm, 22-24 September 1972. The outline programme is as follows:

Friday 22 September—Lectures and reports about current research projects.

Saturday 23 September—Lectures and reports in the morning. Glacial-geological excursion in the afternoon. Dinner in the cellar at the Geographical Institute.

Sunday 24 September—We hope to arrange a tour of the Stockholm Archipelago for studies of glacial erosion, particularly channels and striae of different ages.

Elections will also take place for a President, Vice-President and Secretary/Treasurer.

Will those people who wish to attend the meeting please send the following details to Dr. V. Schytt, Naturgeografiska Institutionen, Box 6801, 113 86 Stockholm, Sweden, before 1 September:

1. Title of lecture or report and its length.
2. Requirements for projectors.
3. Requirements for room reservations and at what price (those who bring a sleeping bag and air mattress can save hotel prices by sleeping on some floor).
4. Any suggestions for the offices of President, Vice-President and Secretary/Treasurer.

JOURNAL OF GLACIOLOGY

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

Articles—

P. J. Morgan:

A photogrammetric survey of Hoseason Glacier, Kemp Coast, Antarctica.

R. I. Perla:

Generalization of Haefeli's creep angle analysis.

C. F. Raymond:

Inversion of flow measurements for stress and rheological parameters in a valley glacier.

Short Note—

D. P. Adam:

A further note on correlation coefficients derived from cumulative distributors.

MEETINGS

GERMAN SOCIETY OF POLAR RESEARCH

The scientific part of the meeting, held in Bad Harzburg 13-17 April 1972, was concerned with modern methods in polar research. About a hundred participants from 8 countries attended 4 sessions with contributions ranging from space, by dealing with satellite observations of ice and aurora borealis investigations, to the bottom of ice caps, with deep drill cores, radar-, seismic- and geoelectric measurements and heated probes melting down automatically. But also surface observations are still of importance and papers on heat balance, radiation, mass budgets, ice movement and geomorphological problems provided further information on actual polar research, not only on methods.

The topic for the official part was the awarding of the Karl Weyprecht Medal to Dr Fritz Loewe, Melbourne, by the chairman of the Society, Dr Karl Weiken, and the opening lecture by Dr Loewe: "Alfred Wegener's meaning for modern polar research", which gave not only an impression of the famous scientist but also of the personality of Wegener.

An invitation by the mayor of the city, a very impressive public lecture by Dr H. Hoinkes: "Does the ice of the earth increase?", an excursion to the Elm led by Dr W. Hofmann, a second excursion to the Harz mountains, and an evening with folklore performances, taken up with enthusiasm, completed the programme. Thus knowing where to find Bad Harzburg within Germany was not the only profit to those who attended the meeting. This place was chosen in honour of Kurt Ruthe, the Society's executive editor, living there, who served the Society well by taking care of the journal *Polarforschung* for a long period.

The next meeting will be held in Munich, 25-27 April 1973, with "The ice regions of the earth, their climatological and ecological conditions" as the main theme.

ARCTIC AND MOUNTAIN ENVIRONMENTS SYMPOSIUM

The Symposium, held in Michigan State University 22-23 April 1972, was sponsored by the Glaciological and Arctic Sciences Institute, Michigan State University, and the Foundation for Glacier and Environmental Research, Pacific Science Center, Seattle, Washington. Papers included:

W. C. Mahaney: Reinterpretation of neoglacial chronology in the Central Colorado Front Range.

A. M. Tallman: Frost mound and palsa investigations using electrical resistivity.

A. C. Pinchak: Mathematical methods in glaciological research.

G. Cloud: Precision field techniques for measuring glacier strain rates.

G. Warner: Preliminary micro-strain measurements on temperate and polar glaciers.

W. A. Dittrich: Surface velocity analyses on the Vaughan Lewis Glacier, Alaska, 1970-71.

B. W. Prather and H. F. Bennett: Anisotropic effects on seismic velocities of certain Alaska glaciers.

R. Shaw, W. J. Hinze and R. A. Asher: Gravity surveys on the Lemon and Ptarmigan glaciers in 1971.

G. Gloss and L. Knazovicky: A new large-scale terrestrial photogrammetric map of the Taku Glacier, Alaska.

P. Angus-Leypan: Atmospheric refraction effects above glaciers.

M. M. Miller and W. I. Wittman: Sea ice surveillance in the Arctic Ocean and Greenland waters—NAVOCEANO Project Birdseye.

L. R. Miller: West Greenland glacier surveys relating to the provenance of Atlantic bergs.

J. R. Bugh: Ephemeral supraglacial lakes on the Juneau Icefield.

J. Barber: A search for DDT in Alaska ice.

G. Østrem: Sediment transport in glacier streams.

R. Chambers and D. Alt: Multiple refillings of glacial Lake Missoula.

A. C. Pinchak: Observations on glacier meltwater streams on the Gilkey and Vaughan Lewis glaciers, Alaska.

W. M. Lokey, R. Mack, M. M. Miller, B. W. Prather and E. Kiver: Project Crater: Mt. Rainier glacio-volcanological research, 1970-72.

G. Østrem: Height of glaciation level in northwestern Canada and part of Alaska.

G. Wakahama: Melt-water permeation below the snow-line of Mendenhall Glacier, Juneau Icefield.

R. A. Asher: Formation and drainage of an ice-dammed lake, Lemon Glacier, Alaska.

C. Zenone and M. M. Miller: Glacio-hydrology and the jökulhlaup phenomena in Alaskan glaciers.

E. M. Little: Experiments in the reduction of roughness on snowfields and neves using chemical spreads.

A. C. Pinchak and W. M. Lokey: Avalanche research: Part I—Factors affecting development of airborne avalanches on Mt. McKinley, Alaska, by A. C. Pinchak; Part II—Seasonal and meteorological factors affecting serac avalanches in the Vaughan Lewis icefall, Alaska, by A. C. Pinchak and W. M. Lokey.

J. H. Anderson, M. M. Miller and A. Tallman: Glaciological and palynological interpretation of Holocene climatic environments on the continental flank of the northern boundary range.

GLACIOLOGICAL DIARY

1972

30 June-15 July
Field Course in glaciology and glacier hydrology, Peyto Glacier, Banff National Park. (Dr G. Østrem, Carleton University, Ottawa, Ontario, Canada.)

10-17 August
International Geographical Union, 22nd Congress, Montreal, Canada. (Secretariat, 22nd International Geographical Congress, P.O. Box 1972, Ottawa, Canada.)

14-18 August
Symposium on the Physics and chemistry of ice. Royal Society of Canada. (M. K. Ward, National Research Council of Canada, Montreal Road, Ottawa 7, Canada.)

15-17 August
Twenty-third Annual Alaska Science Conference and Observance of the Twenty-fifth Anniversary of the Naval Arctic Research Laboratory (NARL), University of Alaska. AAAS (Alaska Division). (Dr Gordon Scott Harrison, Chairman, Alaska Science Conference, Institute for Social, Economic and Government Research, University of Alaska, Fairbanks, AK 99701, USA.)

21-30 August
International Geological Congress, 24th Session, Montreal, Canada. (Secretary-General, 24th International Geological Congress, 601 Booth Street, Ottawa 4, Canada.)

6-20 September
Symposia on the Role of snow and ice in hydrology. Banff, School of Fine Arts, Banff, Alberta, Canada. (Dr I. C. Brown, Secretary, Canadian National Committee for IHD, No 8 Building, Carling Avenue, Ottawa 1, Canada.)

10-17 September
Glacier Course, Rudolfshütte (Weisssee), Hohe Tauern (2315m). H. Heuberger, W. Hofmann, H. Hoinkes. (Dr W. Hofmann, Institute for Photogrammetry and Topography, University of Karlsruhe, D-75 Karlsruhe 1, Englerstrasse 7, Postfach 6380, Germany.)

11-13 September
Symposium in hydrology, Colorado State University, Fort Collins, CO 80521, USA. ASCE; Section of Hydrology, AGU; IAHS; Unesco; U.S.N.C.; IHD; and Colorado State University. (Water Resources Meetings, Office of Conferences and Institutes, Room 178, Student Center, Colorado State University, Fort Collins, CO 80521, USA.)

14-16 September
Conference on transfer of water resources knowledge, Colorado State University, Fort Collins, CO 80521, USA. (Details as above for 11-13 September.)

26-29 September
Symposium on ice and its action on hydraulic structures, I.A.H.R. Leningrad, USSR. (Mr B. P. Lebedev, committee for USSR participation in international power conferences, Sovmek, 11 Gorky Street, Moscow K-9, USSR.)

2-6 October
Symposium on the Remote sensing of the environment, University of Michigan, (Univ. of Michigan Extension Service, Conference Dept., Ann Arbor, MI 48104, USA).

18-25 October
Radiocarbon Conference (Royal Society of New Zealand. (Mr G. W. Markham, Royal Society of New Zealand, P.O. Box 196, Wellington, New Zealand.)

1973

25-27 April
Annual Meeting of the German Society of Polar Research, Munich: "The ice regions of the earth, their climatological and ecological conditions".

2-4 May
Annual Conference of International Glaciological Society, Cambridge, England. (Part of the Conference will be devoted to discussion of sea ice research.) (Mrs H. Richardson, Secretary, IGS, Cambridge CB2 1ER, England.)

16-28 July
Conference on Permafrost, USSR Academy of Sciences, Yakutsk. (Institut Merzlotovedeniya, Yakutsk, USSR.)

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

1974

April
Symposium on Snow mechanics, Grindelwald, Switzerland. (Int. Commission on Snow & Ice, IAHS, Dr F. Müller, Secretary, Geog. Inst. der ETH, Sonneggstrasse 5, Zürich 8006, Switzerland.) (It is intended that the meeting will deal with the basic physics of this subject.)

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

1976

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

NEWS

AWARDS

The Massey Medal of the Royal Canadian Geographical Society is awarded 'for outstanding personal achievement in the exploration, development or description of the geography of Canada'. This year, for the first time since its introduction in 1959, the medal has been awarded to a woman — **Isobel Moira Dunbar,** a geographer with the Canadian Defence Research Board.

Born in Edinburgh, Miss Dunbar took a master's degree in geography at Oxford University. In 1947 she went to Canada and joined the Defence Research Board's Arctic Section. An expert in Arctic geography and sea ice, Miss Dunbar has travelled widely north of the Arctic Circle. Her research has produced important findings on the climatology of ice distribution and the interpretation of ice in photographs. She was joint author, with Brigadier General K. R. Greenaway, of the book "Arctic Canada from the Air" and has written many papers on sea ice.

W. F. Budd was awarded in April 1972 the Edgeworth David Medal of the Royal Society of New South Wales, Australia, for the best work done by an Australian scientist under 35 years of age.

NEW GEOLOGIC MAPS OF ANTARCTICA

The systematic geologic study of Antarctica began less than eighty years ago, and twenty years ago large areas of this remote continent were still unexplored. Except for the limited work of parties striving to reach the South Pole, geologic observations were confined to scattered localities along the coast. Today, after the impetus of the International Geophysical Year, few areas of extensive rock exposure remain unvisited by geologists.

In 1963 the American Geographical Society, under contract with the National Science Foundation, began work on the Antarctic Map Folio Series — a loose-leaf atlas of about twenty folios on a variety of subjects. The preparation of Folio 12, Geologic Maps of Antarctica, began in 1964 and it was published in August 1970. The detailed information in Folio 12 made possible the compilation of a 1:5,000,000 Geologic Map of Antarctica, which was published in March 1972.

Work on Folio 12 began with the selection of appropriate areas for portrayal at a scale of 1:1,000,000; two of these areas were later enlarged to 1:500,000. The resulting series of eighteen regional maps represents the direct contribution of twenty-five geologists from eight countries.

These regional maps served as the basis for the preparation of several maps portraying specific geologic features for the entire Antarctic continent at a scale of 1:10,000,000. The maps include: 1) fossil localities, 2) radiometric age localities, 3) geology, 4) tectonics and 5) geomorphic features. A tectonic reconstruction of Gondwanaland is shown on a separate sheet at a scale of about 1:33,000,000.

There has long been a need for a geologic map of Antarctica at a scale of 1:5,000,000 to facilitate comparisons between continents. Geologic maps at this scale already exist for all continents except Antarctica. Although they were published at 1:10,000,000 scale, the maps of the entire continent in Folio 12 were originally compiled on the scale of 1:5,000,000 to permit the subsequent preparation of a complete geologic map on this scale by combining the data on the individual maps. In addition, a great deal of new information on Antarctic geology has appeared since 1969. The new map is thus a synthesis of the material in Folio 12 revised to take account of more recent discoveries up to May 1971. The 1:5,000,000 Geologic Map of Antarctica is printed in colour and measures 41 inches by 48 inches. It includes geology, structural data, fossil and age determination localities, bathymetric and ice sheet surface contours, an explanation, and references to new data sources not cited in Folio 12.

Folio 12 may be ordered from the American Geographical Society, Broadway at 156th Street, New York 10032, USA, for $12.00. The 1:5,000,000 Geologic Map of Antarctica is available from the same source for $6.00 per copy, plus $1.00 for postage and handling.

C. Craddock

REGIONAL TRAINING COURSE IN CHILE ON THE HYDROLOGY OF SNOW AND ICE

The International Conference on the Practical and Scientific Results of the International Hydrological Decade and on International Co-operation in Hydrology (Paris, December 1969) recommended that Unesco consider the organization of regional training activities on snow and ice in regions with continental glaciers and ice fields and invited UNDP to support such activities (Resolution 25—Snow and Ice Investigations). Pursuant to this resolution, Unesco negotiated with those countries having perennial ice and snow masses, both in South America and in Asia, with regard to the subjects with which a training course should deal, the appropriate level and the best way in which to organize the course. Subsequently an agreement was reached to organize a course in South America in 1971. (A decision has not yet been reached regarding a course to be held in Asia, and negotiations are still going on with UNDP for financing such a course.)

Eighteen participants from Argentina, Bolivia, Chile and Peru attended the 1971 course in South America. Most of them were either civil engineers or geologists, while a few of them were meteorologists, chemists and agricultural engineers. Only one of them could be regarded as a specialist in glaciology. Most of them held an academic degree. The lecturers taking part in the course were W. Ambach (Austria), L. Lliboutry (France) and G. Østrem (Sweden). They met in Paris in June 1971 to establish their programme for the course and co-ordinate their activities.

Lectures were held in the period 15 November-1 December 1971, in Santiago, Chile, and concentrated on: generalities of snow, ice and glacier hydrology, physical properties of snow and ice, glacier mass balances, glacier hydrology, heat balances, glacier dynamics and morphological effects of glaciers. During the lecture period, short excursions were organized to visit the snow laboratory of Farellones, the largest water power station in Chile, Central Rapel, and the gauging station El Yeso where nearby experiments with various snow samplers were undertaken. Participants were also given the opportunity of visiting Valparaiso. At the end of the lecture period, the three lecturers set an examination for the participants and issued a certificate of attendance. No official marks were given for this examination although a record was kept by the professors of the achievements of each participant.

The period of theoretical lectures was followed by a period of field work outside Santiago near Laguna Negra where a camp was set up for the participants and lecturers, the lectures being given under canvas. Under the supervision of G. Østrem, assisted by Marangunic and B. Morales (L. Lliboutry and W. Ambach having left), practical exercises were held from 4-8 December. The course split up into three groups of five or six trainees. Exercises were held in hydrology, glaciology (high mountain practices, glacial geology and glacier hydrology), heat balance, snow hydrology and snow sampling.

After the field work period an excursion was arranged to glaciers and places of interest in Argentina. Two glaciers, a sulphur mine that was partly located under a glacier, irrigation schemes and hydrological projects were visited.

The course was closed in San Juan on 18 December, and all participants left for their home countries on the following day.

In the official Unesco report from the course, it is stated that the course has served the purpose of teaching hydrology of snow and ice and of developing a model course for future use in other regions. The general feeling was that the course had been very successful, proving useful for the participants' practical work. However, the variety of backgrounds of the participants (civil engineers, geologists, etc.) meant that some participants were lacking knowledge in certain fields and that others had to cover ground that they already knew. The differences in level and background were regarded as the main difficulty and it was recommended that the participants of such a course in the future should ideally be all of the same profession.

G. Østrem

NEW INSTITUTE IN ARGENTINA

At a meeting held on 12-13 May 1972 at the University of Cuyo, Mendoza, the Instituto Argentino de Nivología y Glaciología was formally established. The Institute belongs to the Consejo Nacional de Investigaciones Científicas y Técnicas (the National Research Council) and will be located at the foot of the high Andes in the city of Mendoza.

The following organizations will give financial support to the Institute: Consejo Nacional de Investigaciones Científicas y Técnicas, Universidad Nacional de Cuyo, Universidad Nacional del Sur, Secretaria de Recursos Hídricos, Provincia de San Juan, Provincia de Mendoza, Agua y Energía Electrica. After the appointment of a Director the first staff appointments will be made.

Research will be undertaken along the following lines: glacial meteorology and climatology, physics and chemistry of snow and ice, glacier balance, snow avalanches, other factors (physical, meteorological, biological, ecological and geological) which influence the water resources.

A. Corte

NEW MEMBERS

Borrel, Gilles, Ecole Primaire de Liabbaye, F-74190, Le Fayet, France.
Bravard, Yves, Le Barnave, Parc St. Mury, 38 Meylan, France.
Caillemer, André, 10 avenue Emile Acollas, Paris 70, France.
Constantin, Bernard, Chalet Bermina, les Câches, St Roch, 74 Sallanches, France.
Day, Arthur R., 3100 Midvale Avenue, Philadelphia, PA 19129, USA.
Decleir, Dr H., Dr W. Maststraat 71, B-9030, Wondelgem, Belgium.
Deveau, Jean, 8 rue Casimir Brénier, 38 Grenoble, France.
Dittrich, William A, Joint Institute for Laboratory Astrophysics, University of Colorado, Boulder, CO 80302, USA.
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INTERNATIONAL GLACIOLOGICAL SOCIETY

SYMPOSIUM ON REMOTE SENSING IN GLACIOLOGY

Cambridge, England
16—20 September 1974

Advance Notice

A symposium on remote sensing in glaciology will be held in Cambridge, England, in 1974. Registration will take place on Sunday 15 September and sessions will be held from Monday 16 to Friday 20 September in the University Chemical Laboratory, Lensfield Road. The Society's office is next door to the Laboratory, in the Scott Polar Research Institute.

TOPICS

The Symposium will be concerned with the application of remote sensing by radiation to the measurement of glaciological parameters. It will include discussion of topics such as:

radio echo sounding
active and passive microwave
infrared techniques
and laser profilometry

of glaciers, ice sheets, snow, ice and ground ice.

The Symposium will **not** be concerned with conventional photographic techniques.

PAPERS

Details about the submission of summaries and final papers will be given in circulars to be published in 1972 and 1973.

PUBLICATION

Papers presented at the Symposium will be refereed according to the usual standards of the Journal of Glaciology before being accepted for publication in the Proceedings of the Symposium. The Proceedings will be published by the International Glaciological Society.

FURTHER INFORMATION

You are invited to attend this Symposium and to return the attached form as soon as possible. The First Circular will give information about accommodation, general programme and preparation of summaries.

Requests for copies of the First Circular and enquiries about the Symposium should be addressed to:

The Secretary, International Glaciological Society, Cambridge CB2 1ER, England.

INTERNATIONAL GLACIOLOGICAL SOCIETY SYMPOSIUM ON REMOTE SENSING IN GLACIOLOGY 1974

Family name .....

First name ..... Title .....

Address .....

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I hope to participate in the Symposium, 1974 — ☐

I expect to submit a summary of a proposed paper — ☐*

*without obligation

TO BE SENT AS SOON AS POSSIBLE TO:

The Secretary, International Glaciological Society, Cambridge CB2 1ER, England.

INTERNATIONAL GLACIOLOGICAL SOCIETY

Cambridge CB2 1ER, England

DETAILS OF MEMBERSHIP

Membership is open to all who have scientific, practical or general interest in any aspect of snow and ice study. Members receive the Journal of Glaciology free. Forms for enrolment may be obtained from the Secretary. No proposer or seconder is required. Annual subscription rates 1972 :

Private members	Sterling :	£5.00
Junior members (under 25)	Sterling :	£2.00
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I C E

Editor : Mrs Hilda Richardson

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