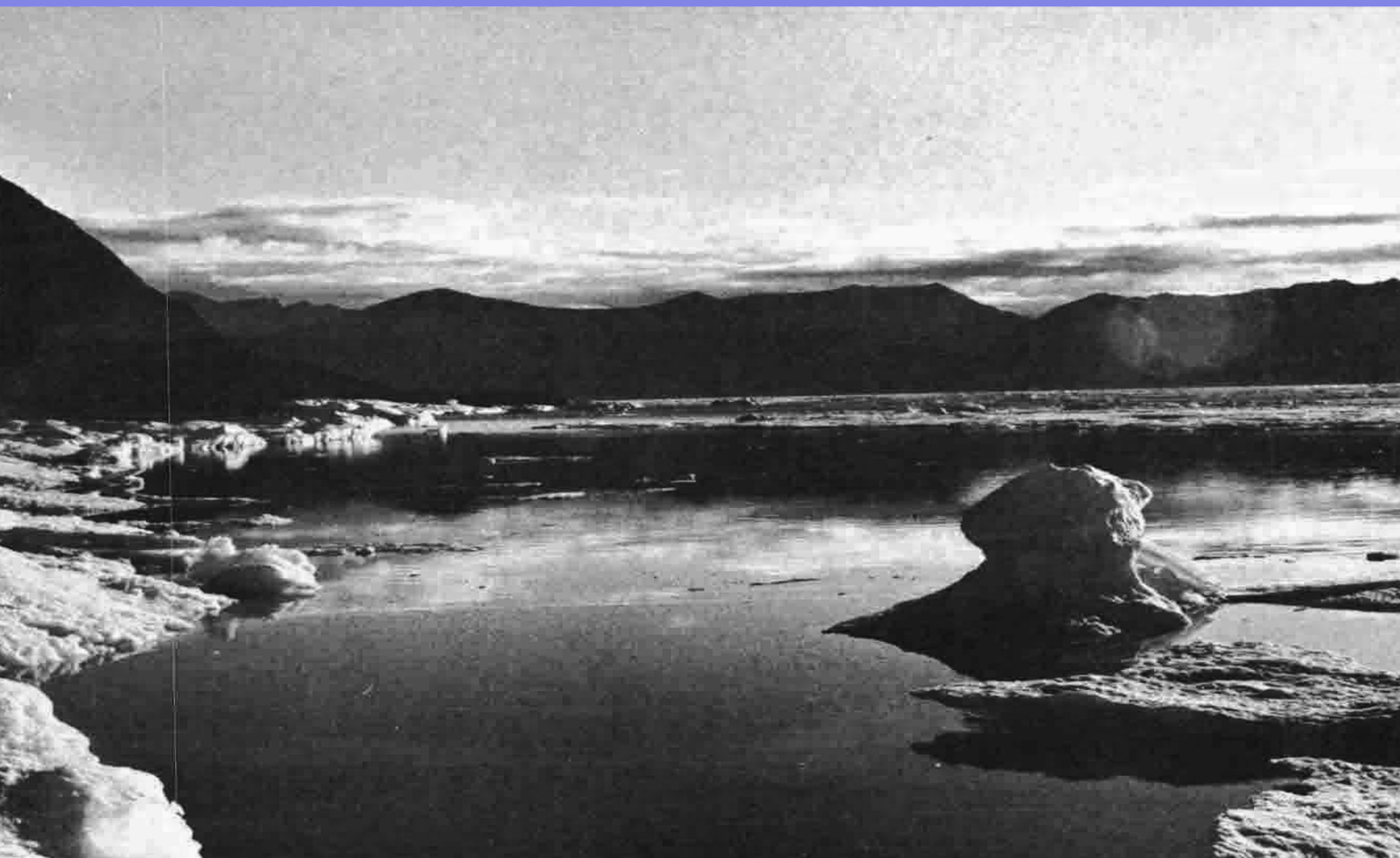
NUMBER 34

DECEMBER 1970

ICE



GLACIOLOGICAL SOCIETY

EVENTS 1971

29 & 30 APRIL: ANNUAL CONFERENCE

The Society's Annual Conference will take place on Thursday and Friday, 29 and 30 April, at the Scott Polar Research Institute, Cambridge, England. Short papers will be presented, giving news and results of recent field and laboratory research.

Full details will be sent to all members later.

On 29 April there will be a Dinner at 7.45 p.m. at the University Centre.

All enquiries from members of the Society who wish to attend the meeting should be addressed to:

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

NORTHEAST NORTH AMERICAN BRANCH

A week-end meeting will be held at the end of February or the beginning of March 1971, near the ski resort of Sutton, P.Q., Canada.

Further details will be sent to members of the Branch in January.

ICE

NEWS BULLETIN OF THE GLACIOLOGICAL SOCIETY

DECEMBER 1970 NUMBER 34

CONTENTS

1971 DUES. Subscription reminders and forms have been sent to all members who do not pay by Bankers' Standing Orders. We shall appreciate prompt payment of your dues, for then we do not have to spend time and money on reminders later in the year.

ANNUAL CONFERENCE. The 1971 two-day conference will be held on April 29 and 30 at the Scott Polar Research Institute, Lensfield Road, Cambridge. A special dinner will be held on the Thursday evening, at 7.45 p.m. at the University Centre. Full details will be sent to members later.

COVER PICTURE. Sea ice in Nathorst Fjord, East Greenland, 20 July 1969. Photograph by Julian Paren.

FIELD WORK

NEW ZEALAND

WAIKATO UNIVERSITY EXPEDITION TO ANTARCTICA, 1969-70

The first Waikato University expedition to Antarctica was carried out as part of the New Zealand programme for the summer season 1969-70. The four-man party consisted of three chemists— A. T. Wilson (leader), C. H. Hendy, J. Johnson—and one geomorphologist—M. J. Selby. The party took an X-ray diffraction machine and a flame photometer with which to analyse samples of salts from the frozen lakes of Ross Island and the Taylor Valley.

The main glaciological work involved drilling through the Canada Glacier so that repeated measurements of the inclination of the drill hole can be made. This is in an attempt to understand how very cold glaciers (−23°C) move. A survey of Deep Lake at Cape Barne on Ross Island was also completed and samples taken from the lake bottom for analysis. By using salt content figures it is hoped to discover the history of the lake.

The main geomorphological work was concerned with the development of slopes in the arid areas of the Taylor, Wright and Victoria dry valleys. Processes appear to be extremely slow and frost action is limited to areas where there is melt water. It appears that by far the most important geomorphic process is saltweathering, which is responsible for breaking up coarsely crystalline rocks and producing large caverns.

M. J. Selby

NORWAY

MASS BALANCE STUDIES

Mass balance studies were carried out and the mass changes during a glaciological year were calculated for nine glaciers in southern Norway: Ålfotbreen, Vesledalsbreen, Tunsbergdalsbreen, Nigardsbreen, Hardangerjøkulen, Hellstugubreen, Vestre and Austre Memurubre and Gråsubreen.

The field measurements were made as in previous years. The winter balance was found by making a large number of snow-depth measurements, normally by sounding, and the snow density was measured at only a few points. As one is seldom able to do the field work exactly at the time of the change from the winter to the summer season, the deviations from the final values were found by making additional measurements or calculations from available meteorological observations. For each glacier maps were made showing the positions of stakes, pits and sounding profiles, and the distribution of the winter balance. The balance at selected dates, and especially the summer balance, was found by fresh measurements of the snow and firn density, in addition to stake observations. On several of the glaciers there are fairly large numbers of stakes. As stakes have a tendency to disappear during the winter season, replacement stakes must be established in the spring. Much work is therefore involved in calculating and checking the balance at each stake. In 1968 a computer program for such calculations and the construction of stake diagrams was worked out.

The mass balance values in 1969 generally decreased from the maritime western areas to the continental eastern areas. The difference in the winter balance on the western and eastern glaciers in 1969 was less than the calculated mean value, which corresponds fairly well to the mean of the years 1963-67. The beginning of the winter season of 1969 varied at different elevations and in different areas, and unusually large local variations in snow accumulation were observed. In spite of this, the distribution patterns of winter balance on the glaciers were similar to those in previous years.

On all the glaciers observed the summer balances had the highest values since these measurements were started in 1962. The mean values of the summer balances varied between 4.83 m of water equivalent on Ålfotbreen and 2.04 m on Gråsubreen, whereas the mean values for the period 1963-67 were 3.36 m and 0.88 m respectively. This is very close to the computed "normal" values. On all glaciers the summer balances were between 1.0 m and 1.5 m of water equivalent larger than the 1963-67 means. This was partly due to unusually high summer temperatures; the mean air temperatures from 1 June to 30 September were 1-2°C higher than the normal at selected meteorological stations in the area.

The sparse winter balance resulted in the early uncovering of firn and glacier ice, which increases the average albedo of the glacier surface. Thus a larger part of the incoming radiation energy was absorbed by the glacier.

This summer balance in 1969 was higher than that of 1968, even though the mean summer temperatures in the two years were approximately the same. This must partly have been due to the exceptional albedo conditions in 1969.

On all glaciers there were fairly large negative net balances, and the glaciers in the northwestern areas showed the largest decreases in mass. On Ålfotbreen and Vesledalsbreen the net balances were close to 2.2 m of water equivalent; in the eastern areas the net balances were approximately 1 m of water equivalent.

On most of the glaciers there were net balances in all areas of the glacier and thus the equilibrium line could not be observed on the glacier itself.

METEOROLOGICAL AND HYDROLOGICAL INVESTIGATIONS

Meteorological observations of cloud cover, air temperature, wind conditions, precipitation and discharge in the glacier river were made on Ålfotbreen, Nigardsbreen, Austre Memurubre and Vesledalsbreen. Except for Austre Memurubre, the air humidity was observed for part of the summer.

The temperature gradient between the glacier area and the meteorological stations in the vicinity has been computed, and also the gradient within the glacier area where measurements were available from more than one place. By postulating the same temperature gradient above a glacier-free and a glacier-covered surface, the observations on Nigardsbreen gave a decrease in temperature on the glacier, and a mean value of 2°C was found. This is in accordance with previous measurements

Daily precipitation was measured at the observation huts. The precipitation was very small in southern Norway in June and August 1969. In July and September, however, the precipitation was far larger than the normal value.

The distribution of summer precipitation was studied and the mean precipitation compared with that at nearby meteorological stations. The results correspond well with what has been found in previous years.

The relative air humidity was generally high on all the glaciers where hygrographs were installed. The daily mean vapour pressure was lower than 6.1 mb, which corresponds to the saturation pressure at 0°C, on only 2 days on Ålfotbreen, on 11 days on Vesledalsbreen and on 9 days on Nigardsbreen during the observation period. This means that condensation of vapour was possible for the greater part of the summer season, and the energy released by condensation has to be taken into account by considering the energy balance on the glacier surface.

SURVEYING AND MOVEMENT STUDIES

The local triangulation network at Hellstugubreen was completed this summer and connected with the Norwegian official triangulation network.

Due to the large net ablation, several old stakes became visible during the summer, and a more complete movement study was possible in certain areas. Triangulation for computing the glacier movement was carried out on Ålfotbreen, Vesledalsbreen, Nigardsbreen and Austre Memurubre. On Ålfotbreen the glacier movement ranges from 18 m in the central parts to about 2 m near the edge of the glacier (on the basis of the 1965-66 triangulations).

On Vesledalsbreen the largest movement was found at the lower part of the glacier, which is also the steepest part. Special measurements on the plateau between Stornose, Klubben and Svartefjell showed glacier movement in accordance with the glacier slope.

On the tongue of Nigardsbreen two new points were established, so that the movement can be determined by resection. The results of the stake triangulation on the tongue show that the summer movement is far larger than the winter movement. This year the movement on the plateau could be calculated for the first time, and the movement here appeared to be fairly small.

The glacier movement on Austre Memurubre was fairly even throughout the basin, except in the area east of the middle moraine, where the ice seems to be quite stagnant.

TWO NEW GLACIER MAPS

Two maps, of Ålfotbreen and Gråsubreen, on a scale of 1:10,000 complete the series of glacier maps that has been produced to cover all the areas where detailed mass-balance measurements are at present being made by the Norwegian Water Resources and Electricity Board. Both areas were covered by vertical air photography in 1968. After some checking work on the ground, the maps were plotted in a Wild B-8 Aviograph. In the cartographic representation the same method was used as for the maps previously published in this series. For Gråsubreen a green screen was placed on the glacier surface to separate it from the areas that were not to be mapped.

The accuracy is assumed to be better than 2 m in relative height determination and better than 5 m in absolute height determination. The error in horizontal determination is less than 5 m.

GLACIER DISCHARGE

In order to study the relative effects of various meteorological parameters on the water discharge in glacier streams, a stepwise regression analysis was applied to five selected glaciers in southern

Norway: Ålfotbreen, Erdalsbreen, Vesledalsbreen, Nigardsbreen and Memurubreen, and for all these glaciers three different tables were compiled. The tables gave (a) information concerning existing observations and the observation sites, (b) a selection of the most interesting correlation coefficients calculated by the computer, and (c) the final regression equations, based upon one, two or three independent variables. In addition to the original meteorological data used in the analysis, a number of "new" variables were generated. They were derived from the standard data by multiplication or by potentiation. Due to delay in water discharge from the glacier, it was necessary to use meteorological data obtained 1, 2 or 3 days *before* the actual water-discharge observation.

Ålfotbreen. Precipitation has a great effect on the discharge in the humid western part of Norway. On account of the large areas of exposed bedrock, the increase in river discharge follows almost immediately after the rain starts to fall. Daily precipitation is therefore the single factor that would be included if a simple formula were to be devised to describe the river discharge from Ålfotbreen.

Wind and air moisture together are the second important factor influencing the discharge. The product of the daily mean wind speed and the air moisture has a high correlation coefficient (0.71). It is extremely interesting that the air temperature is almost insignificant for meltwater production at Ålfotbreen. This statement is valid even for the summer of 1969, when unusually long, dry periods with high air temperatures occurred.

Erdalsbreen seems to be a glacier situated in an area with no pronounced maritime or continental climatic conditions. None of the abundant meteorological data available has a high correlation coefficient with the discharge. Thus, Erdalsbreen forms a definite exception among the glaciers investigated.

Wind and air moisture seem to be relatively important factors, and the air temperature is of small importance, as was the case for Ålfotbreen. However, the correlation coefficients are generally small, and it is difficult to find a good formula to describe variations in water discharge. Using the best-correlated factor, which in this case is the product of the daily mean wind velocity and the water-vapour content of the air (observed on the same day in the firn area), the correlation coefficient is only 0.49, and the residual standard error is as much as 35%. It is difficult to explain why the result is so poor for Erdalsbreen, especially when the discharge from the adjacent Vesledalsbreen glacier seems to be described far better by a similar simple factor.

Vesledalsbreen is the adjacent outlet glacier from Jostedalsbreen, situated only 3 km NW of Erdalsbreen. The glacier is smaller and the elevation range considerably less than for Erdalsbreen. Meteorological observations have been made at the glacier front and in the firn area. Standard meteorological data from Oppstryn were also included in the analysis.

A single generated variable, the product of the daily mean air temperature and the daily mean wind velocity (as measured in the firn area), showed a surprisingly high correlation coefficient with the discharge. The residual standard error was only 24%, using this single, although complex variable. Using three variables, the residual standard error was reduced to 19%. The water-vapour content of the air does not seem to be so important for Vesledalsbreen as for Ålfotbreen and Erdalsbreen.

The calculations showed that the daily mean air temperature in the firn area is very well correlated with similar temperatures observed in Oppstryn. The air temperature is furthermore inversely correlated with the cloud cover, which indicates that high temperatures are mainly generated by radiation. For water-discharge prediction, it would therefore be better to use radiation data. However, air-temperature observations are much easier to make, and the data are generally more easily available. For future run-off predictions, it may be more realistic to use standard meteorological observation data.

Nigardsbreen is a large outlet glacier on the eastern side of the Jostedalsbreen ice cap. A standard meteorological station, Bjørkehaug, is situated only 4 km from the present ice front. During the melting season fairly comprehensive observations were also made in the firn area. Furthermore, air-temperature recordings were made at high altitude on the ice cap in a meteorological screen placed on the glacier.

Daily mean air temperature and the water-vapour content of the air were the most important factors influencing water discharge from the glacier. Using only one single variable, the regression equation gave a very good correlation between the calculated discharge and the discharge actually observed. The residual standard deviation is of the order of 17%, using the air temperature measured the day before in the firn area. If the water-vapour content is included in the formula, the residual standard deviation is reduced to only 13%, and this must be regarded as a very good result. The fact that air moisture is such an important factor proves that considerable condensation must take place on Nigardsbreen. This is in contrast with conditions at glaciers further inland, where condensation is generally regarded as being of little importance.

Memurubreen. Standard meteorological observations are available from a high mountain observatory 30 km due west of the glacier, and from a medium-altitude mountain station 45 km to the south-west. In addition, observations were made during the ablation season at two huts, one below the glacier front and the other on a nunatak in the firn area.

As in 1968, the air temperature is by far the most predominant factor determining the water discharge from the glacier. The best-correlated daily temperature proved to be that from Varden, Filefjell, with a correlation coefficient as high as 0·84. Further investigation showed that a slightly higher correlation could be obtained when the temperature was potentiated. The expression $t^{1.6}$ proved to give the best correlation and, when this single factor was included in the regression equation, the residual standard deviation turned out to be 25%. If wind velocity was also included in the formula, the residual standard deviation was reduced to 20%, and this must be regarded as a fairly good result.

G. Østrem

POLAND

POLISH SPITSBERGEN 1970 EXPEDITION

During the summer 1970, from 28 June to 12 September, a 6-person Polish Expedition was working in the Hornsund region of Vestspitsbergen. The expedition was organized by the Geographical Institute of Wroclaw University and led by Dr Stanislaw Baranowski. The other members were: Dr A. Szponar, B. Glowicki, A. Martini, M. Górski and J. Romer. The expedition was transported by the High Marine School's ship s/t "Jan Turlejski" (Gdynia). The Polish Station in Hornsund, Isbjörnhamna, built in 1957, was used as a base.

The expedition's work concentrated on the glaciological and geomorphological problems in the area of two neighbouring glaciers: Werenskioldbreen—with its snout on the land, and Hansbreen—ending in the fiord. The following investigations were among those carried out:

1. Elements of radiation and heat balance of periglacial tundra based on continuous records.
2. Local climate of Werenskioldbreen.
3. Ablation on Werenskioldbreen and ablation water discharge.
4. Movement of ice and its strain rate on Werenskioldbreen and Hansbreen.
5. Ice temperature at 8 m depth on Werenskioldbreen and Hansbreen.
6. Natural tremors of Hansbreen based on microseismographic records at two sites on the glacier.
7. Deformation and ablation of ice under the medial moraine of Werenskioldbreen.
8. Changes in the thickness of Werenskioldbreen and the position of its snout during the last 12 years.
9. Ground moraine of the "fluted moraine" type in front of Werenskioldbreen, with laboratory analysis of moraine samples.
10. Features of syphoning outflows, and "geysir" type water spouts at Werenskioldbreen.
11. Ice ablation under the lateral moraine of Hansbreen.
12. Geomorphology and geology of the marginal zone of Ariebreen (a small valley glacier between Werenskioldbreen and Hansbreen).
13. Mechanical and chemical weathering of different rock types near the expedition's base in Hornsund, with laboratory analysis of samples.
14. Geomorphology of block covers of mountain ridges near the base.
15. Present-day geomorphological processes on periglacial tundra near the base (frost-heaving, solifluction and denudation) based on sites established 12 years ago.
16. Total ozone amount in the atmosphere, from direct and diffuse solar radiation.

Details of some of the work are given below.

Measurements of **ablation** on Werenskioldbreen were based on 30 ablation stakes installed in different parts of the glacier. The stakes were measured at least once a week, some of them every one or two days, in order to establish the relation between ablation and meteorological factors such as solar radiation, temperature and humidity. In the firn region snow density measurements were also made. The flow of the only river that emerges from the glacier was measured by a limnigraph placed where the transverse profile of the river bed did not change much.

Ice movement was measured on Werenskioldbreen along two profiles between points established on the rock on both sides of the glacier tongue. The lower profile was situated roughly 0.5 km and the upper one 2.5 km up from the glacier snout. Each profile comprised 7 stakes, with one set in the middle of the medial moraine. Measurements were repeated every 10 to 15 days.

The **strain rate** was measured at 5 sites, with groups of 4 stakes placed at 50 m around a movement stake. Two groups were installed on the lower movement profile, and three groups were installed on the upper movement profile.

Movement and strain rate at Hansbreen were measured only at two sites on the profile between Fugleberget and Fannytopen (about one kilometer from the glacier front), close to the places where microseismographic records were obtained.

In addition to strain rate measurements at Werenskioldbreen those groups of stakes near the medial moraine were used to measure the **ablation and deformation of ice under the morainic cover** during the ablation season.

In order to check the reaction of the glacier to artificial cover, two sheets of straw blankets 4–5 cm thick were installed on Werenskioldbreen. One of them, 14 m long and 3 m wide, was placed in the dead part of the glacier, some 150 m from its snout, and another, 17 m long and 5 m wide, was put close to the upper movement profile some 120 m south of the natural medial moraine of the glacier. In the middle of the sheets ablation stakes were set and their height was measured both in relation to the ice surface underneath and to the nearby stakes in pure ice. Unfortunately these artificial pieces of medial moraine were only installed at the end of the 1970 summer season, and the effects will not be seen at least until the end of the 1971 summer.

Ice temperature on Werenskioldbreen was measured, with resistance thermometers and a Wheatstone's bridge, in 3 places: 0.3 km, 2.5 km and 4.5 km from the glacier snout, the last point being situated close to the firn line. The holes were drilled down to 8 m at the end of the summer, when there was little ablation and melt water could not affect the temperature measurements.

On Hansbreen, temperature at 8 m depth was measured in the central part of the glacier.

Changes in the position and thickness of the snout of Werenskioldbreen in the last 12 years were evaluated, using the following measurements and comparing them with those made for the Lipert 1958 map (1:5000):

a) the position of 30 points, such as stones, painted red, in front of the glacier close to its actual snout;
b) the position and height of 16 movement and ablation stakes in the lower section of the glacier;
c) a new longitudinal profile of 20 sites, measured by theodolite, from the glacier snout to the Deilegga ridge at the head of the glacier;
b) photographs taken from the same summits round the glacier in different seasons: 1957, 1958, 1959, 1960, 1962 and 1970.

Stanislaw Baranowski

UNITED KINGDOM

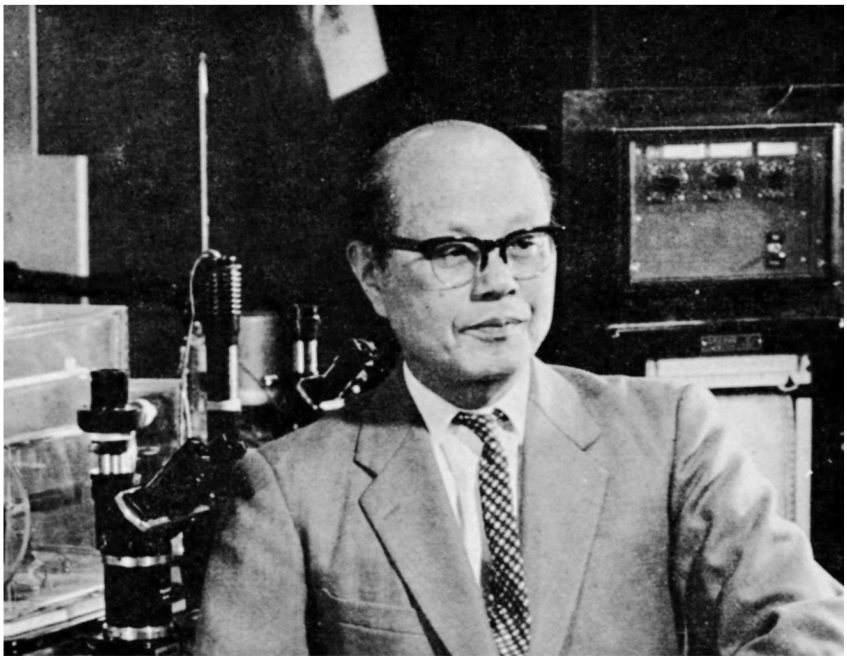
CAMBRIDGE STAUNINGS EXPEDITION 1970

This expedition of ten men operated in the Roslin Glacier area of the Staunings Alps of East Greenlond during the period July–September. Projects included the determination of valley glacier depths, mapping by plane tabling and theodolite, oxygen-isotope analysis of ice samples, temperature-depth profiles, glacier flow rates and ablation measurements, and meteorology

Glacier depth profiles were found by radio-echo techniques. A modified radar altimeter and ancillary equipment including oscilloscopes and cameras were mounted on a sledge which was man-hauled over the length of the glacier.

Temperature profiles were determined from 9 m holes of 6 cm diameter. Mapping to a scale of 1:50,000 by plane tabling faciliated the exact positioning of sledge runs as well as producing a new map of the area. Time did not permit many peaks to be climbed but Hird, Dalmore Junior and Junction Peak were ascended. The exact location and computed heights of these peaks will be given in subsequent publications.

K. J. Miller



DAISUKE KUROIWA

Daisuke Kuroiwa was born on 5 September 1916 on the island of Shikoku in southern Japan, where snow rarely falls. At school and at the Tokyo Butsuri Gakko College his interest in physics developed, and he majored in physics at college. In 1940 he took a job at the Electricity Laboratory of the Ministry of Communication and joined a study group on the development of electron microscopes. This became one of the most important wartime research projects in Japan and gave Kuroiwa the material for a book on the subject. In those days, no scientific information on electron microscopes came from overseas, apart from a few bibliographies brought in by Japanese Navy submarines.

In 1943, the Institute of Low Temperature Science was founded at Hokkaido University under the leadership of Professor Ukichiro Nakaya, and Kuroiwa moved to Sapporo to work as a member of this Institute. Professor Nakaya was the leading scientist in two wartime research projects: artificial fog dispersal on airfields and anti- and de-icing on airplanes. As the eastern parts of Hokkaido Island are covered with thick sea fogs in summer, work on artificial fog dispersal was important. Kuroiwa began to study the condensation nuclei of sea fogs with electron microscopes developed in Japan. In winter, he very often climbed Mt. Niseko (1300 m) where an observatory for studying icing had been built. He was actively engaged with Dr Z. Yosida in finding how to prevent icing on aircraft wings and propellers. Just as they began to obtain excellent results, the war came to an end and the projects stopped. Since then, Japanese scientists have encountered great difficulties in getting support for research. In spite of this, Kuroiwa did not give up his research on condensation nuclei, and in 1955 he was awarded a prize by the Japanese Meteorological Society for this work.

In the Institute of Low Temperature Science, several major research projects concentrated on snow and ice. Dr Yosida was leader of the research group studying deposited snow. Kuroiwa studied the dielectric properties of snow and ice and received his doctorate from Hokkaido University in 1953. Thereafter, he widened his studies to include such subjects as ice sintering, internal friction, metamorphism of snow, and etching of ice.

In 1960 he went to the U.S.A. to join the Snow, Ice and Permafrost Research Establishment of the US Army (SIPRE), and worked with many scientists on snow and ice problems. He lived for one year with his family at Evanston near Chicago, and then transferred to New Hampshire to work at the new building of the Cold Regions Research and Engineering Laboratory (CRREL), the new name for SIPRE. During his time in the U.S.A., he attended a conference at the Massachusetts Institute of Technology and presented a paper on "Studies of ice etching and dislocation etch pits". He also visited Greenland, where he, from a small island in the Far East, was fascinated by the vast expanse of the ice sheet. After returning to the Institute of Low Temperature Science, as a full professor, he undertook to compile and organize the data

collected by the late Professor Nakaya in Greenland. This was published as CRREL Research Report No. 89. He has published over 20 other papers in English, as well as nearly 50 papers in Japanese.

His present interest is the physical processes of transformation from snow to ice, but he is not unconcerned about glacio-geology. After the Symposium on the Hydrology of Glaciers organized by the Glaciological Society in Cambridge in 1969, he joined the excursion to Norway. When he visited Nigardsbreen, he took samples of sand and silt discharged from this glacier and is now investigating these materials with a scanning electron microscope. In 1967, he was awarded a prize from the Japanese Society of Snow and Ice. He is at present a member of the National Committee of Hydrology in Japan and is President of the Hokkaido Branch of the Japanese Society of Snow and Ice. Kuroiwa has become, through his studies on snow, glacier ice and laboratory ice, a bridge between ice physicists and glaciologists. His work on the internal friction of ice is generally considered to be his finest contribution.

He is a quiet, friendly person, easy to talk to and always helpful. Foreign participants at the 1966 Physics of Ice Symposium in Sapporo, which marked the 25th Anniversary of the founding of the Institute of Low Temperature Science, remember his pleasant home and the warm welcome from his charming family and large poodle.

PROFILES IN ICE

No. 5, Jan. 1960	Richard Finsterwalder
No. 6, July 1960	Gerald Seligman
No. 7, Jan. 1961	Robert P. Sharp
No. 8, July 1961	Robert Haefeli
No. 9, Jan. 1962	Hans W: son Ahlmann
No. 10, July 1962	Petr A. Shumskiy
No. 11, Jan. 1963	W. H. Ward
No. 12, July 1963	Valter Schytt
No. 13, Dec. 1963	Henri Bader
No. 14, Apr. 1964	Sir Vivian Fuchs
No. 15, Aug. 1964	Marcel de Quervain
No. 16, Dec. 1964	Herfried Hoinkes
No. 17, Apr. 1965	Fritz Loewe
No. 18, Aug. 1965	Geoff Hattersley-Smith
No. 19, Dec. 1965	Bert Crary
No. 20, Apr. 1966	Z. Yosida
No. 21, Aug. 1966	John Nye
No. 22, Dec. 1966	W. O. Field
No. 23, Apr. 1967	L. Lliboutry
No. 24, Aug, 1967	Max Perutz
No. 25, Dec. 1967	J. Eythórsson
No. 26, Apr. 1968	Mark F. Meier
No. 27, Aug. 1968	Uwe Radok
No. 28, Dec. 1968	John Glen
No. 29, Apr. 1969	Manfredo Vanni
No. 30, Aug. 1969	Peter Kasser
No. 31, Dec. 1969	Akira Higashi
No. 32, Apr. 1970	Brian Roberts
No. 33, Aug. 1970	Sigurður Thorarinsson
No. 34, Dec. 1970	D. Kuroiwa

ICELAND 1970

GLACIOLOGICAL SOCIETY

AND

ICELANDIC GLACIOLOGICAL SOCIETY

DIARY OF THE MEETING

The joint meeting between our society and the Icelandic Glaciological Society began in the morning of 19 June 1970 with a bus ride to Thingvellir, the seat of the old Icelandic Parliament from 930 to 1798. Whether the historic or the tectonic interest dominated was entirely due to the individual—the area is broken up by long open cracks, and faulting activity is still active: in 1789 the floor of the valley sank 0.5 m.

The Icelandic Ministry of Education served us an excellent lunch, and the meeting thus had a very pleasant start.

On a winding road over a low shield volcano the bus went eastwards and only the poor visibility prevented us from seeing Hekla, which later the same day had a few new eruptions with considerable lava production.

A short stop was made at Skálholt, bishops' seat and cultural centre of Iceland from 1056 until 1796. Passing one historical place after the other, all well known from the Saga literature, we proceeded east as far as Skógar, which is situated on a narrow sandur between Myrdsjökull and the sea, and set up our headquarters in a comfortable boarding school.

20 June: Over the Skógarsandur to Solheimajökull. Giant boulders spread over the sandur bore witness of an extraordinary jöokulhlaup, which Sigurður Thorarinsson could date back to about 1200-1300 years ago by means of his tephro-chronology. He knew the age of an ash layer in the contact between the sandur masses and the soil outside. Solheimajökull was an impressive sight in spite of its large retreat during the last decades. The kettle topography, the large detached ice masses, the numerous and large dirt cones and the thick till layers in the steep shear planes offered much of interest and caused vivid discussion.

21 June: Southeasterly winds in the morning caused low ceiling and drizzling rain on the south coast, and Thorarinsson, knowing his local climatology, thought that the föhn winds north of the Eyjafjallajökull volcano would give good weather in the Thórsmörk district. And he was right. The Gigjökull (crater glacier) was an impressive sight, particularly the very large end moraines, the outer ones probably about 2500 years old.

Along the sides of the main valley most of the rivers had cut very deep canyons in the ''móberg'', a rock formed by subglacial volcanic eruption, and we followed the deep canyon Stakkholtsgjá to its upper end, where the little river had a vertical fall of nearly 150 m.

On 15 January 1967 a rock mass of about 1.5×10^5 m^3 slid down from the steep Innstihaus (a móberg ridge) on to the Steinholts glacier. A marginal lake was swept empty by the rock slide and boulders up to 80 m^6 were deposited 5 km from the scar in Innstihaus. The slide also caused a flood of Markarfljót, a flood which reached a maximum discharge of 2100 m^3/s—certainly a remarkable figure for the month of January.

A swim in a hot spring near Skógar closed the day.

22 June: Papers session until 5 in the afternoon and a short trip to the southernmost farm in Iceland. Rain and large breaking waves made the party rather wet. Two interesting papers after dinner kept us busy until after 11 p.m.

23 June: A more than 300 km-long excursion over lava fields and sandurs.

Thorarinsson took us first to Hjörleifshöfdi, a rock rising over the Myrdalssandur like a rocky island in the ocean. And this vast sandur can literally turn into an ocean, or rather a 35-40 km-wide torrent, in only a few days. Katla, the subglacial volcano under Myrdalsjökull, has had two recorded eruptions per century since 1580 and the accompanying jökulhlaups have been tremendous, their maximum discharge exceeding that of the River Amazon—but for only a day or less. The morphological effects are as tremendous, and the shoreline can move one or more km because of one single flood.

About 90 km east of Skógar we crossed the Lakagígar lava flow, the biggest lava flow formed on earth in historical time. The eruption started on 8 June 1783 and went for 8 months. 50 per cent of Iceland's cattle, 76 per cent of the horses, 77 per cent of the sheep and about 20 per cent of the total population were killed.

From Lógmagnúpur, the eastermost point reached during the excursion, we had a beautiful view over Skeidarárjökull and Skeidarársandur.

Skeidarársandur is the largest one (1000 km^2) of these big outwash plains around Vatnajökull, and is the site of two main, very well known, jökulhaups. Graenalón, a large (18 km^2) ice-dammed lake, can release 1.5 km^3 of water and give a maximum run-off of about 5000 m^3/s. The very large floods, however, are caused by the subglacial eruptions of Grimsvötn, a big depression in the centre of Vatnajökull. Big bursts have occurred with about 10 years interval and each time about 7 km^3 of water has been drained. The maximum discharge may reach 40 to 50 000 m^3/s. During the last decades the bursts have come twice as often and thus been smaller.

24 June: Skógar—Hekla—Jökulheimar. A fascinating day with a bus ride through a dark desert.

The eruption which started on Hekla on 5 May 1970 produced about 30.10^6 m^3 of tephra (airborne volcanic material), and the previously whitish desert turned dark-brown overnight. The maximum ash thickness along the road was 18cm. After the first explosive phase the lava flow started and was still going on in front of us. The total area of the new lava was more than 10 km^2.

We could see big, red lava blocks being thrown hundreds of metres into the air, we could see movement even in lava fields a few weeks old, and we could toast our lunch sandwiches along the margins of the lava flows.

Late in the afternoon we reached Jökulheimar, the field station belonging to the Icelandic Glaciological Society. It is situated about one km from the margin of Vatnajökull and offers a very good starting point for expeditions to the interior of the ice cap.

The day ended with a grand dinner party given by the Icelandic Glaciological Society.

25 June: The day started (00^h) with the grand party given by the Icelandic Glaciological Society.

After a few hours' sleep a walk on and along the snout of Vatnajökull brought the participants back to proper glaciology again, but we had a long journey in front of us and started from Jökulheimar before lunch.

On the way back we could of course not resist Hekla, and got the bus driver to take us almost to the base of the now active volcano crater. Just a short walk over a warm lava field brought us to within the reach of the heavy lava bombing. It was a fantastic experience—perhaps not scientifically very useful for those of us who were not vulcanologists—but still extremely interesting and dramatic. Geomorphology *in statu nascendi*.

Nothing can compete with a volcanic eruption,

but, nevertheless, the journey back to Reykjavík also had its highlights. We saw the new, very modern hydropower plant at Búrfell and were invited for an excellent dinner by the company. And between 10 p.m. and 1 a.m. Sigurður Thorarinsson kept us awake, and happy, with songs in half a dozen languages.

26 June: After a few hours' sleep, most of us left Reykjavík for Glasgow as the first stop. We were all tired and nearly worn out. We had had a lovely walk in Iceland, we had seen much, heard much and learnt much. A week with 15 hours a day of excursion or paper sessions can give you enough to think about for a long time. Sigurður Thorarinsson had been a superb organiser and leader, and earned our most sincere thanks for all his efforts. And, finally, we were delighted to meet and work with so many local experts.

V. Schytt

Members from 11 countries attended the meeting.

They saw an active volcano—

—and glaciers—

took many photographs . . . . . and had a party.
(Photographs contributed by several members.)

The following is a summary of the papers and lectures given at the meeting. It is expected that some of the papers will be published in the Journal of Glaciology.

S. Thorarinsson opened with a general survey of the problem of Icelandic glaciology, reminding us that in Iceland glaciology and volcanology are inseparable. Iceland is situated on the world-wide system of mid-ocean rifts, the results of vulcanism dominate the landscape, and vulcanism near or beneath glaciers leads to particular problems. The discussion centred on one of these. The Grimsvötn depression in the ice cap of Vatnajökull is formed by subglacial melting and the stored water is released rather regularly, about every 5 years. It appears at the edge of the ice cap as a flood, or jökulhlaup of up to 7 x 10^9 m^3 of water. The discharge rises exponentially with time, reaching a maximum of up to 5 x 10^4 m^3 s^{-1}, and then falls very abruptly. This behaviour (with lower total volumes, and maximum discharges) is typical of jökulhaups occurring in the last few decades in Iceland. It was suggested in the discussion that after the initial formation of the outflow channel by the Glen mechanism, the dominant process was enlargement of the channel by frictional heating; its closing by plastic deformation would perhaps not be very significant during the rather short time (approx. 10 days) of the flood.

R. J. Price: "The development and destruction of a sandur between 1961 and 1965, associated with the drainage of an ice-dammed lake at Breidamerkurjökull, Iceland". Comparison of maps made photogrammetrically in 1961 and 1965 showed in detail the changes in altitude of the sandur surface in the area 500m x 300m chosen for study. A lowering, as expected, was measured and attributed to the melting of buried ice; but there were also some increases in altitude, presumably due to a melt-water stream that was adding sediment to the surface.

G. Gudmundsson and G. Sigbjarnarson: "Analysis of run-off and meteorological observations". Methods of power spectrum analysis have been used to test the coherency in different frequency bands between temperature, precipitation, wind, humidity and cloud cover at Jökulheimar (western margin of Vatnajökull) on the one hand, and the flow of a river some distance away. Some significant coherency was found, but a large proportion of the river run-off cannot be explained by linear relationships with the meteorological series.

A series of three related papers dealt with isotope studies. (1) **P. Theodórsson:** "Tritium in glaciers in Iceland". In order to date geothermal ground water by its tritium content, it is necessary to know the mean natural concentration of tritium in precipitation (produced by cosmic rays) before the disturbance of the natural concentration by thermonuclear tests. Samples from boreholes in Vatnajökull can give this information. The detailed analysis of the ice cores raises the question of the isotopic exchange between the firn and the summer meltwater that percolates through it. The same problem arises in deuterium studies. (2) **B. Arnason:** "Deuterium measurements applied to studies on the formation and nature of glaciers". A marked homogenization takes place within a single annual layer, so that initial fluctuations in deuterium concentration become smoothed out. However, the concentration in the lower layers is systematically different from the mean concentration of the upper layers. There was discussion of whether this implies that horizontal meltwater percolation must be taken into account in addition to vertical percolation. The method was applied to estimate the ratio of precipitation retained in the upper snow layers to the amount running off as water. At 2000 m, where the yearly precipitation is all retained as snow, variations in deuterium concentration reflect variations in mean annual temperature. (3) **T. Búason:** "Theoretical model of isotope fractionation between ice and water in melting snow column with continuous rain and percolation". This paper reported a laboratory experiment in which melt water was allowed to percolate through a snow column, while the changing deuterium concentration in the water draining from the bottom of the column was measured. A theoretical model has been developed which has been applied both to this experiment and also to the process of deuterium and tritium fractionation in natural snow layers where there is vertical percolation of water. The percolating water has an isotopic composition different from the value that would be attained if it were allowed to remain in contact for a long time with the surrounding ice. The differential equations of the theory describe the changing isotopic composition of the water and the ice as a function of position and time; this is governed by the flow process itself and also by the isotopic exchange brought about by the departure from equilibrium. The differential equations have been solved for a number of different initial conditions and boundary values.

W. Dansgaard, S. J. Johnsen & H. B. Clausen: "Climatic trends depicted and predicted by stable isotope analysis of a deep ice core". This important paper dealt with the climatic trends revealed by analysis of the $^{18}O/^{16}O$ ratio in the 1400 m long surface-to-bottom core from Camp Century, Greenland. Dating is initially based on a simple theoretical model involving a constant accumulation rate and a progressive thinning of the layers by plastic deformation. The record extends back for about 100,000 years. The power spectrum of the oscillations in S-values (relative $^{18}O/^{16}O$ ratio) shows significant peaks, one of which, at a period of about 400 years, is believed to correspond to the similar periodicity found in ^{14}C concentration in tree rings. This identification makes it possible to correct the

initial depth versus age scale, the correction being made in such a way that the ^{18}O period agrees exactly with the ^{14}C period. The reason for this peak is thought to be solar activity. The resulting δ versus age curve shows a wealth of detail that may be correlated, incident by incident, with the geological record. The section of the core representing the last 800 years has been specially studied. Harmonic analysis reveals 2 dominant peaks corresponding to periods of 78 years and 180 years. If these two frequencies were the only ones present a δ-curve would result which is a smoothed version of the one actually measured. Extrapolation of this smoothed curve into the future gives the prediction that the present cool conditions will continue for about 2 decades; the trend will then reverse so that a climatic optimum is reached at about 2015 A.D.

O. Orheim: "Effects of recent volcanic activity on the glaciers of Deception Island, South Shetland Islands, Antarctica". The main known volcanic eruptions in Antarctica in recent years have been in Deception Island. Mr. Orheim described the effects of the eruptions in December, 1967 and February, 1969. The latter took place beneath the ice and was accompanied by large jökulhlaups and mud flows. Fissures extending 200 m to bedrock were formed in the accumulation area of the ice cap.

G. Sigbjarnarson: "On the recession of Vatnajökull". The run-off measured in Icelandic rivers seems to have been greater than the precipitation, and by measurements of glacier recession Dr Sigbjarnarson has tried to discover to what extent the additional run-off is due to the shrinking of the volume of the glaciers. It seems that glacier recession partially explains the additional run-off.

Professor Thorarinsson showed the very impressive film of the Surtsey eruption and J. F. Nye gave a lecture on developments in glacier mechanics during the last 20 years.

Those attending the meeting came from a very wide range of disciplines; the largest group were physical geographers, but it was also notable that the proportion of physicists, including those engaged in isotope work, was unusually high for a glaciological meeting. The participants could not fail to be impressed by the close relationships between glaciation and vulcanism, for the evidence was all around them, as ash layers, of known dates, and as the imposing effects of jökulhlaups. But, so far as the papers sessions are concerned, what will be most remembered will be Prof Dansgaard's presentation of the extraordinary successful Copenhagen work on the Camp Century core. We saw the geological record of the last 100,000 years presented as a single continuous observational curve and we saw it extrapolated into the future by a technique that appears to be much more powerful than mere trend-guessing from the past few decades, for it uses the data from the past 800 years.

The isotope papers, taken collectively, raised the question of what is the appropriate model to explain the isotopic redistribution that is observed in snow and firn. It was clear from the discussion that there are still unsolved problems here, possibly connected with the horizontal percolation of the meltwater. It seems likely that isotope studies such as these will greatly improve our knowledge of the details of the snow-ice transition—as well as answering the other questions that first prompted the use of the technique.

J. F. Nye

MEETINGS

THE GLACIOLOGICAL SOCIETY

BRITAIN

15 OCTOBER 1970, University of East Anglia, Norwich, Department of Environmental Sciences—"Ice sheet surges and the geological record" by J. T. Hollin.

9 NOVEMBER 1970, Bristol University, joint meeting with the Physics & Geophysics Colloquim of the H. H. Wills Physics Laboratory—"Radio echo sounding" by S. Evans.

14 NOVEMBER 1970, Cambridge, joint meeting with the Scott Polar Research Institute—"Radio echo sounding in Antarctica" by S. Evans.

26 NOVEMBER 1970, Birmingham University, joint meeting with the Lapworth Society—"Radio echo sounding in Antarctica" by S. Evans.

THE FIRST ITALIAN GLACIOLOGICAL MEETING

(Bormio, October 1970)

The First Glaciological Meeting called by the Italian Glaciological Committee was held at Bormio from 9 to 11 October 1970. The Meeting was attended by about forty participants, who stayed as welcome guests at the quarters of the Stelvio National Park which encompasses nearly all the Ortles-Cevedale Group in the Central Alps.

The sessions were presided over by Prof Ardito Desio and on the opening day were mainly concerned with the problems of training glaciological operators who are responsible for the observations on over 100 of the 838 Italian glaciers.

The following day's schedule was crowded with scientific information. Mass balance researches, conducted in co-operation with ENEL by the Geography Department of Padova University on the Caresèr glacier (Ortles-Cevedale Group), were illustrated by Dr G. Zanon. For this glacier the first two observation years (1966-67 and 1967-68) yielded calculations of a water equivalent balance of −390 and of +260 mm respectively. Dr G. Belloni, from the Geology Department of Milan University, then dealt with the hydrologic balance of a small glacier. He explained the results of observations on condensation and ablation done in the 1970 summer around the north-eastern and the north-western glaciers of S. Giacomo (Ortles-Cevedale Group). He also showed data on precipitation and on flows from the glaciers themselves.

Prof G. Aliverti, of the Navy's University Department of Naples, dwelt in her turn on the "surging glacier" concept, based on the most recent studies. She gave the results of personal observations conducted on the Lys glacier (Mt Rosa) and expressed the hope that researches on this phenomenon may be extended to the Italian Alps. Prof Desio recalled the example of the Kutiah glacier, in the Karakoram, which, as he observed personally in 1953, had recorded a 12 km advance in two months.

The final contribution came from Prof M. V. Cerutti of Turin who illustrated the recent variations of some glaciers on the southern slope of Mt Blanc. In contrast with the behaviour of most of the Italian glaciers, these have been showing a positive advance for some time now.

The last day was set aside for a glaciological excursion to the Val Cedêc, which is one of the valleys radiating westwards in the Ortles-Cevedale Group.

At the end of the meeting, the hope was expressed that, as this first gathering of glaciologists in Italy had been such a promising one, other meetings be held regularly in the future.

G. Zanon

FUTURE MEETINGS

SEA ICE CONFERENCE, ICELAND 1971

This international conference will be held in Reykjavík, Iceland, 10—13 May 1971. The sponsor is the National Research Council of Iceland and the co-sponsor is the Bauer Scientific Trust, Washington, D.C., U.S.A.

The registration fee of US$30.00 includes admittance to the technical meetings. The preliminary programme is as follows:

A. Regional Studies
   1. East Greenland Ocean area
      a. Ocean currents and their seasonal variations.
      b. Sea ice budget.
      c. Mechanism of sea ice formation and decay.
      d. Distribution and drift of large icebergs (as a possible indicator of glacier variations).
      e. Scientific evaluation of historical records on ice and climate.
   2. Baffin Bay and Smith's Sound
      a. Formation and decay of ice in relation to atmospheric conditions.
      b. Ice budget.
      c. Icebergs.
   3. Canadian Archipelago, and ice regions off the Canadian and Alaskan coasts.
   4. Eurasian coastal regions.
   5. Central Arctic ice.
   6. Other regions.

B. Observational Techniques, Planning and Reporting.
   1. Measurements of ocean currents under ice.
   2. Problems relating to determination of friction between ice and water (e.g. as induced by waves and tides).
   3. Deformation of the ice field and internal stresses within the ice field.
   4. Numerical methods of ice prediction and their adaptation to different regional conditions.

C. General

1. Short term (seasonal, annual) fluctuations of the quantity of ice and its relations to meteorological and oceanographic conditions.
2. Relationship between average ice conditions and climate.
3. Problems of navigation (shipping) in ice covered regions.

The organizers hope to arrange a flight over the drifting sea ice, if meteorological conditions permit, at a cost of approximately $50.00. During the first part of May, the sea ice is usually not far from the north-west coast of Iceland.

Titles and abstracts of contributed papers, for which 20 minutes will be allowed for presentation, should be sent to the Secretary of the Conference before 1 February 1971.

Details of the conference may be obtained from the Secretary, Mr Thorbjörn Karlsson, The National Research Council, Atvinnudeild Háskólans, Reykjavík, Iceland.

XV ASSEMBLY OF IUGG

Moscow, USSR, 2–13 August 1971

The following notes are extracted from a circular issued to British scientists by The Royal Society on 29 October 1970. Details of the scientific programme for the Assembly have been extracted from various different sources.

Practically all the symposia are being convened jointly by two or more Associations of IUGG, one Association having the primary responsibility in each case. It should be noted that conveners of symposia may select speakers or issue a call for papers, or both. Intending participants wishing to contribute to a particular symposium should establish, by contacting the symposium convener, whether or not subscribed papers would be entertained for selection.

IAMAP-LED SYMPOSIA

Energy fluxes over polar surfaces (with IASH, IAPSO and the Scientific Committee on Antarctic Research)
3–5 August inclusive
Convener: Professor S. Orvig,
McGill University,
Montreal 110, P.Q., Canada
Deadline for abstracts: 15 February 1971

Air-sea interaction (with IASH, IAPSO and the Scientific Committee on Oceanic Research)
6–9 August
Convener: Professor H. Charnock,
Department of Oceanography,
The University,
Southampton, SO9 5NH.
Deadline for abstracts: 15 February 1971

IASH-LED SYMPOSIUM

Snow and ice in mountainous regions (with IAMP)
9–13 August inclusive
Convener: Professor V. M. Kotlyakov,
Institute of Geography,
Academy of Sciences,
Moscow, U.S.S.R.
Deadline for abstracts: 15 February 1971

BRITISH GEOMORPHOLOGICAL RESEARCH GROUP

(The Geomorphological Study Group of the Institute of British Geographers)

A SYMPOSIUM ON THE GEOMORPHOLOGY OF POLAR REGIONS

The symposium, which is being organised by Dr R. J. Price and Dr D. E. Sugden, is to be held in Aberdeen University in conjunction with the conference of the Institute of British Geographers in early January 1972. It will be based on a series of papers concerned with the geomorphology of Polar regions. Papers concerned with current processes, landform analysis, Quaternary chronology, changing sea levels and glaciology will be particularly welcome.

It is hoped that a volume of papers and accompanying discussions will be published after the meeting.

All interested in contributing to the symposium are asked to submit abstracts of papers by 1 January 1971, and completed papers by 1 May 1971. Authors of papers accepted for presentation at the symposium will be notified and asked to supply 100 copies of their paper for distribution beforehand.

Abstracts, papers and any correspondence should be addressed to:— Dr D. E. Sugden, Department of Geography, University of Aberdeen, St Mary's High Street, Aberdeen, AB9 2UF, Scotland.

SYMPOSIUM ON THE PHYSICS AND CHEMISTRY OF ICE, CANADA 1972

This international symposium will be held in Ottawa, Canada, 14–18 August 1972, and is sponsored by the Royal Society of Canada. The symposium will emphasize the fundamental physics and chemistry of ice in all its phases, including the clathrate hydrates. The symposium follows earlier ones in Erlenbach (1962) and München (1968).

Those people interested in receiving the second circular, which will give detailed information about the symposium, should write to the Executive Secretary of the symposium: Mr M. K. Ward, c/o National Research Council of Canada, Montreal Road, Ottawa 7, Ontario, Canada.

GLACIOLOGICAL DIARY

1971

12-16 April
Annual Meeting of the American Geophysical Union, Sheraton Park Hotel, Washington, D.C. (AGU, 2100 Pennsylvania Ave., N.W., Wash., D.C. 20037, U.S.A.)

14-16 April
Annual meeting of German Society of Polar Research: Modern methods in polar research. (Deutsche Gesellschaft für Polarforschung, 44 Münster/Westf., Steinfurter Strasse 107, Institut für Geophysik der Universität.)

10-13 May
Sea Ice Conference, Reykjavík, Iceland. National Research Council, Iceland. (Mr Thorbjörn Karlsson, National Research Council, Reykjavik, Iceland.) (See p. 14 of this issue of ICE.)

5-9 July
Conference on Crystal Growth, Marseille, France. (Secretariat ICCG-3, Faculté des Sciences, Marseille St. Jérôme, 13-Marseille-13e, France.)

28 July–14 August
XVth General Assembly of IUGG, Moscow, U.S.S.R. (See p. 15 of this issue of ICE.)
Joint symposia planned:
(a) Energy fluxes over polar surfaces. Organized by Commission on Polar Meteorology of IAMAP. (Prof. S. Orvig, Department of Meteorology, McGill University, Montreal 2, P.Q., Canada.)
(b) Air-sea interactions with floating ice. Organised by IAMAP. (Prof. H. Charnock, Dept. of Oceanography, The University, Southampton, England.)
(c) Interdisciplinary studies of snow and ice in mountain regions. Organized by CSI, local convener V. Kotlyakov, Moscow. (Dr W. H. Ward, 147 Rickmansworth Road, Watford, Herts., England.)

18-27 August
Pacific Science Association, congress, Canberra, Australia. (Australian Academy of Science, Gordon St., Canberra, A.C.T., Australia.)

1972

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.) (See p. 16 of this issue of ICE.)

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

7-14 September
Symposium on snow and ice, hydrology and forecasting. 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.)

Mid October
Radiocarbon Conference. Royal Society of New Zealand. (Dr T. A. Rafter, Institute of Nuclear Sciences, Private Bag, Lower Hutt, New Zealand.)

1973

(date not fixed)
International Union for Quaternary Research, congress, New Zealand. (Dr E. A. Francis, Dept. of Geology, Univ. of Newcastle upon Tyne, England.)

1975

(date not fixed)
International Union of Geodesy and Geophysics, general assembly, France. (Prof. G. D. Garland, Geophysics Lab., Univ. of Toronto, Toronto 5, Canada.)

COMMISSION OF SNOW AND ICE

REPORT OF A MEETING OF OFFICERS OF THE COMMISSION WITH UNESCO-IHD SECRETARIAT, PARIS, 4–6 MAY 1970

The following items are extracts from the minutes of the meeting, which was chaired by the President of the Commission, Dr Mark F. Meier. (The complete minutes may be obtained from the Secretary of the Commission—Dr W. H. Ward, 147 Rickmansworth Road, Watford, Herts., England.)

a) **Unesco/WMO International Glossary of Hydrology (Second draft, 1969)**

The list of terms contained some 80 terms related to snow and ice which were considered to be an unbalanced selection. The total number of snow and ice terms should be of the order 80-100 and account should be taken of the terms used in the IHD Technical Papers on snow and ice, and of the fact that it is a glossary for hydrologists. Comments will be referred back to Unesco/WMO.

b) **Reports on catastrophic avalanches during winter 1970**

Verbal presentations with illustrations of avalanche incidents during the recent winter were given as follows:

(i) Swiss Alps (Walensee and Reckingen) by M. de Quervain.

(ii) French Alps (Val d'Isère, St Gervais) by L. de Crécy.

(iii) Iran by André Roch (a pilot study mission supported by Unesco).

The unusual build-up of snow during the winter appeared to be responsible for the general incidence of avalanches in the Alps. Though there had been many avalanches, a large number of people had been killed in a small number of incidents. Other points which emerged in discussion were: siting of buildings needed much more consideration; there had been, in the past, clearing of forest for alpine grazing at high altitudes; roads should be closed officially during avalanche emergencies—traffic convoys are very vulnerable.

c) **Resolution 25 of the IHD Mid-Decade Conference on Regional seminars on snow and ice**

It was agreed that training programmes on snow and ice problems were very desirable in the Middle East and in Latin America and that the programmes should be adapted to meet regional problems. To implement the resolution it was agreed that the Unesco/IHD Secretariat would write to ICSI requesting an outline programme for a training course to be held in one of the South American countries. Unesco would then seek the interest of these countries and ICSI would simultaneously seek the interest of individuals known to them.

d) **Permanent Service on the Fluctuations of Glaciers**

Ing. P. Kasser reported that he now had correspondents in 11 countries and was receiving data from several additional areas, including some information from Antarctica.

e) **Technical Secretariats for IHD snow and ice projects**

ICSI officers again reaffirmed their belief that the support of Technical Secretariats is essential to the success of the IHD projects in snow and ice. Only in this way can the various reports from different nations be put into a consistent framework and analyzed as a co-ordinated, world-wide study.

The glacier inventory project has advanced to the point where a full time secretariat will be needed for the 4-year period 1972-75. This would involve a part-time Director, a full-time technician and a modern data analysis centre with access to a computer. This secretariat might cost from $15,000 to $25,000 per year, depending on location and other factors. A special technical secretariat for the permafrost inventory does not appear to be justified at this time because the limited amount of data could probably be handled by the glacier inventory secretariat. Analysis of the seasonal snow cover also cannot be attempted immediately, but the Commission noted with interest that the WMO-World Weather Watch was to involve snow and ice studies during its operational phase 1972-75, and that additional snow cover data will be available from new satellites. A technical secretariat for the project on Combined Heat, Ice and Water Balances at Selected Glacier Basins will be needed at a later date.

f) **Arrangements for Symposium on Interdisciplinary studies of snow and ice in mountain regions—Moscow 1971**

The officers expressed concern that the Symposium on Energy fluxes over polar surfaces in which the Commission is very interested was scheduled early in the week before the Symposium on Interdisciplinary studies of snow and ice in mountain regions. It was felt that very few people could afford to spend so long in Moscow to attend virtually two parts of the same Symposium. In order to make the two Symposia a really cooperative effort between IAMAP and the Commission it was suggested that all papers dealing with energy fluxes from both Symposia and of interest to glaciologists should be presented in one joint meeting on August 12 and 13. It was agreed by the Commission's officers together with the Secretary of IASH that this

suggestion should be presented to the Secretary of IUGG for discussion with the Commission on Polar Meteorology and with IAMAP.

Deadlines for abstracts and papers submissions were agreed. It was noted with great pleasure that an excursion to the Caucasus was planned immediately following the Moscow meeting.

g) **Interim statutes for the Commission**

Dr de Quervain presented his proposals for statutes, which he had circulated earlier to officers. After a detailed discussion it was agreed that the President, the Secretary and Dr Schytt, in coordination with the IASH Committee on Reorganisation, should prepare a new draft for presentation at the Moscow Assembly.

h) **Nomination of new officers for the Commission**

A tentative slate of new officers was prepared and the President agreed to approach the nominees to see whether they would be willing to serve.

i) **Unesco Annual Summary of Natural Disasters: Report from Working Group on Avalanche Classification**

The recommendations of this group, under the chairmanship of Dr de Quervain, were accepted. (A summary of their report appears at the end of these notes on the minutes). The good progress made by the group towards the preparation of an avalanche classification was noted.

Inclusion of glacier surges and outburst floods in Unesco Annual Summary of Natural Disasters

Dr F. Müller consulted 13 specialists and all thought that it was desirable to include glacier surges and outburst floods in the Unesco summary. On consultation with Unesco and the Avalanche Working Group, he reported that these incidents might be incorporated in the same type of reporting system as avalanches. The Commission requested Dr Müller to work further with his specialists, in cooperation with Dr de Quervain, to recommend specific procedures for reporting within two months.

j) WMO interest in sea ice

The WMO representative reported the interest of WMO in sea ice measurements. The Commission's officers recognised the value of the cooperation of WMO in any sea ice programme and agreed to submit a copy of the manuscript 'Guide to World Inventory of Sea, Lake, and River Ice' to WMO for information and comment.

REPORT OF MEETING OF WORKING GROUP ON AVALANCHE CLASSIFICATION WITH UNESCO DEPARTMENT OF ENVIRONMENT, SCIENCE AND NATURAL RESOURCES RESEARCH, PARIS 4/6 MAY 1970

1. **Avalanches as Natural Disasters**

The ICSI Working Group were invited by Unesco to consider the desirability of including information on avalanche incidents and disasters in the Unesco Annual Summary of Natural Disasters. This proposal was accepted unanimously and the meeting proceeded to define the type of information to be included and the ways in which it should be collected and summarised.

Disastrous avalanches were defined as those which affect human life and property to an extraordinary extent. The Summary should include primarily the scientific aspects of such disastrous events, but should also include statistical information in condensed form on less severe incidents.

A reporting system and future cooperation between Unesco and the Working Group was agreed as follows:

(a) Unesco will invite through Governmental channels appropriate organizations (e.g. Forest Services, IHD-Committees, Mountain Rescue Organizations) to nominate a national correspondent in each country where avalanche hazards may occur.

(b) The national correspondents will submit to Unesco an annual report on disastrous and less severe avalanches. The report should contain a general assessment of the avalanche situation, a short description of the disastrous events and statistical information on the general avalanche activity.

(c) The Working Group undertook to prepare the necessary questionnaire forms to be used in reporting incidents.

(d) The information collected by Unesco will be handed over to an avalanche specialist for analysis and for the preparation of the Annual Summary.

(f) The Working Group undertook to prepare a list of avalanche specialists (or centres of avalanche knowledge) who might be willing to prepare the Summary.

(g) Where disasters occur in countries where there is no avalanche reporting organization, or in other special circumstances, Unesco may send experts on a short mission to report on the incidents. The Working Group will prepare a list of suitable experts who might be willing to act. An example of such a mission was the visit of Mr A. Roch to the avalanche on the Haraz Road (Iran) in 1970. Mr Roch was invited to prepare general instructions for the use of mission experts.

(h) The question of including glacier surges and outburst floods in the Annual Summary was discussed with Dr F. Müller. For the reporting system it was thought that the same basic organization might serve, but that the specialists needed

for preparing the Summary and for special missions would generally be different people. The Working Group agreed to keep in close contact with Dr Müller.

(i) The documents mentioned above should be submitted to Unesco by 1 July, 1970 with a view to including avalanche and glacier surge disasters in the Annual Summary for 1970. The text for this should be ready by July 1971.

2. **Avalanche Classification**

The Working Group discussed drafts for a morphological and genetic classification of avalanches, including written comments which had been exchanged in the year before the meeting. The need for creating classifications for general use by trained observers in avalanche survey and forecasting was unanimously accepted. Nevertheless, the classifications should be suitable for scientific refinement.

The basic scheme of the morphological classification was agreed. It was emphasized that it should be kept as simple as possible and certain subdivisions of former drafts should be left out or marked as optional.

Good progress had been achieved with the genetic classification insofar as the dominant genetic factors were generally recognized. Although many quantitative relations exist between the genetic elements and avalanche occurrence, the genetic classification should be specified as empirical. Further studies were necessary to find the best method of presentation. Furthermore, the extent to which terrain conditions should be included in the one or the other classification was not yet agreed.

A proposal to illustrate the avalanche classification with a collection of photographs of avalanche features was unanimously accepted. The best avalanche pictures from all over the world should serve this purpose.

Only a short discussion was devoted to the problem of an avalanche code. The general view pointed to a code based on numbers, although certain advantages of a code with mixed letters and numbers were recognized.

It was planned to circulate revised drafts with certain alternative proposals in order to resolve outstanding questions during 1970. A final version of the morphological classification and at least an advanced draft of the genetic classification would be presented at the IUGG meeting in Moscow in 1971.

M. de Quervain
Chairman of Working Group
on Avalanche Classification
6 June 1970

NEWS

ESTABLISHMENT OF NEW POLAR RESEARCH CENTRE, TOKYO

In conjunction with the progress of polar research in Japan and especially with the planning and execution of the Japanese Antarctic Research Expedition (JARE), a new Polar Research Centre was officially established in the National Science Museum, Ueno Park, Tokyo, on 17 April 1970.

This new organization will ensure close cooperation between the National Science Museum and the Japanese Antarctic Research Expedition (JARE), whose secretariat is in the Ministry of Education. The new Centre will also carry out studies in such fields as upper atmosphere physics, meteorology, earth sciences, biological sciences and logistics in polar regions.

Masayoshi Murayama has been appointed as the Director, also holding the position of Chief of the Department of Administration. Kou Kusunoki is Chief of the Department of Polar Research and Information.

AWARDS AND ELECTIONS

Dr Fritz Loewe was given an honorary degree by the Ohio State University in September 1970. The degree of Doctor of Science was conferred by the President of the University, who said that Dr Loewe was an outstanding scholar of global meteorology and glaciology whose atmospheric studies and polar explorations have advanced man's knowledge of the environment.

Dr Gordon Robin, Director of the Scott Polar Research Institute, has been elected President of the Scientific Committee on Antarctic Research.

USSR Academy of Sciences elected the following people in November 1970:

Academician	—K. K. Markov (geography)
Corresponding Member	—V. V. Bogorodskiy (geography)
	A. P. Kapitsa (geography)

WORLD DATA CENTER A GLACIOLOGY

The Center has been transferred from the American Geographical Society in New York to the US Geological Survey Office in Tacoma, Washington.

REVIEW

Münchner Anden-Kundfahrt 1967, Verlauf, wissenschaftliche und bergsteigerische Ergebnisse. Herausgegeben von der Akademischen Sektion München des Deutschen Alpenvereins, München 1969, 65 pp. 12 plates, map. DM 8.—

In 1967 a group of mountaineers and scientists, members of the Akademische Sektion München of the Deutscher Alpenverein, went to Peru, to pay a visit to the Yarumario-group in the Cordillera Central, east of Lima. The well produced brochure includes a chapter on the geology of the area by A.v. Hillebrandt and P. Mirwald, with two geological profiles. Climatological and glaciological observations were carried out by Chr. Jahl, P. Mirwald and E. Rübel over a period of 39 days. Snow line was found between 5000 and 5200 metres, depending on exposure. Surface velocity was measured in one profile on Pachancote-glacier (Plate 3), with a maximum displacement of numbered stones of 285 cm over a period of 26 days. About 22 km^2 or 25 per cent of the area shown in the sketch-map 1:60,000 were found to be glacierized, but systems of old moraines indicate larger extent of glaciers in the past.

H. Hoinkes

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THE GLACIOLOGICAL SOCIETY

Cambridge CB2 1ER, England

President: Dr V. Schytt

Secretary: Mrs. H. Richardson

DETAILS OF MEMBERSHIP

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

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(under 25)	U.S. dollars:	$3.00
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	U.S. dollars:	$16.00

(The dollar rates include Bank conversion charges)

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

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I C E

Editor: Mrs. H. Richardson

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