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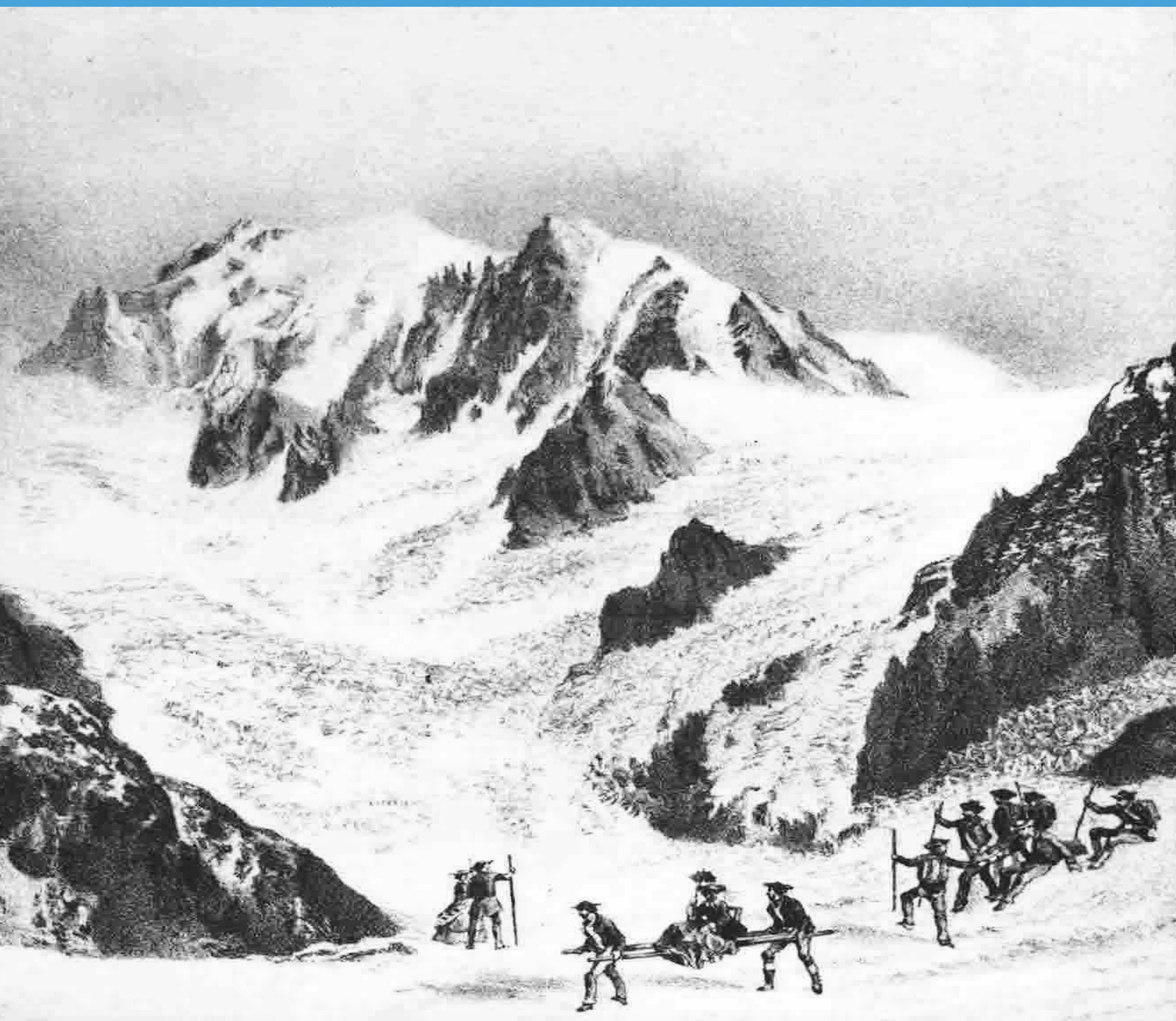
ICE



ICEBERG CONFERENCE

The second conference on the USE OF ICEBERGS will be held in Cambridge, U.K. on 1 — 3 April 1980, and will be organized by the International Glaciological Society. The conference is sponsored by Iceberg Transport International, Ltd., and will be hosted by the Scott Polar Research Institute.

A circular will be published by the Society within the next few months. Enquiries should be addressed to the Secretary General of the Society at the address given on the back cover.

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ICE

NEWS BULLETIN OF THE

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CONTENTS

We are sorry to report the deaths of Robert Haefeli (from Switzerland, an Honorary Member of the Society), Stanislav Baranowski (a Polish glaciologist), Jonathan Job (a pioneer of iceberg towing techniques, from Australia), and Brian Roberts (who played an important role in the early years of the Journal of Glaciology and had great influence on the development of the Society). Obituaries will be published in due course.

COVER PICTURE. Old print of the French Alps. Contributed by Robert Vivian.

RECENT WORK

GERMANY : CANADA

NEIL PENINSULA, ELLESMERE ISLAND

Seven members of the Geography Department of Heidelberg University and the Geodesy Department of Karlsruhe University, Germany, studied the Neil Peninsula/Oobloyah Bay Area, 125 km north of Eureka, Ellesmere Island from 20 June to 8 August 1978. An orthophotomap 1:25 000 was established and it is intended to print the map after the necessary improvements that were made possible by the terrestrial triangulation and photogrammetry. The area was reflown by the Glaciology Division, Ottawa, at the end of the season, thus obtaining the equilibrium line for 1978. The now available photography will allow studies of glacier changes during the last 30 years. The development of push moraines will be studied also.

Morphological mapping of the numerous moraines, raised deltas and shorelines will allow research of glacier fluctuations and rebound. The measurement of mass movement shows unexpectedly high mass movement rates. Origin and development of frozen peat mounds were studied. Ground and rock temperatures were recorded at numerous profiles.

Meteorological records were obtained from two field weather stations, showing much higher temperatures than the surrounding stations in the same year, e.g. maximum temperatures of more than 15° C on several days.

D. Barsch and L. King

NORWAY

MASS BALANCE STUDIES AT SELECTED GLACIERS 1976/77

The Norwegian Water Resources and Electricity Board (NVE) is a government organization. One of the sections within the Hydrology Division, Glaciology Section, has undertaken glaciological investigations at five glaciers in Southern Norway and two glaciers in Northern Norway. In addition the Norwegian Polar Institute (Norsk Polarinstitutt) has investigated three additional glaciers in Southern Norway and two on Spitsbergen. Further, a special study was made in Antarctica, during a Norwegian Expedition to Dronning Maud Land.

The longest observation series are available from the glacier Storbreen in Jotunheimen (observed by Norsk Polarinstitutt) and Nigardsbreen, an outlet glacier from the Jostedalsbreen ice-cap. Complete mass balance studies (including winter balance and summer balance) started at Storbreen in 1948 and on Nigardsbreen in 1962. Similar studies started in Northern Norway in 1970 in the Svartisen area.

Alfotbreen

The total snow depth, as observed in April, ranged from 420 cm to 650 cm, which is much less than normal on this glacier that is situated in an extremely maritime climate. The total accumulation was measured to +2.33 m which is only 66% of the average for the last 15 years.

The summer was generally relatively cool and the summer balance amounted to only 87% of the average for the last 15 years. It amounted to −2.89 m and the mass balance turned out to be negative (−0.56 m), after six consecutive years of positive balance.

Blomsterskardbreen

Unfortunately it was not possible to study both the winter balance and the summer balance but by observing stakes which have survived several years a calculation of the *net* balance for the period October 1975-November 1977 could be done and, based upon a theoretical net balance curve (balance vs. height), it was possible to determine the *net* balance which turned out to be ±0. For the balance year 1975-76 the net balance has been previously calculated to +1.4 m and the balance for the year 1976-77 must then have been −1.4 m which is slightly more than was measured on Bondhusbreen (see below) where it amounted to −1.0 m for the same period.

Bondhusbreen

This glacier is also an outlet glacier from Folgefonni and the investigations made here were requested because the water power station in the area collects subglacial meltwater from an altitude of about 900 m. Relatively simple measurements were started to get information on the mass balance, and data are available from the summer 1976 when 10 stakes were placed between 1100 and 1600 m a.s.l. A map of the glacier at a scale of 1:20 000 is not sufficiently good as a base for these investigations, mainly because it is extremely difficult to define the total drainage basin. However, an area of about 10 sq km has been selected and all measurements are made within that part of the glacier. Only the very steepest and most crevassed part of the tongue is impossible for field observations.

The winter balance, measured on May 11 with snow depth soundings in 120 points above 1200 m a.s.l., gave a specific accumulation of

+1.96 m. The ablation was observed by several visits during the summer and it was found to be −2.96 m, including the lower part of the tongue where the ablation was estimated based upon knowledge from similar glaciers, mainly Nigardsbreen. The net balance turned out to be −1.0 m.

Nigardsbreen

The snow conditions during the winter were unusual and, in general, very little snow fell in Western Norway. The specific winter balance amounted to +1.52 m which is only 66% of the mean for the period 1962-76, and it is the lowest accumulation ever measured on Nigardsbreen since 1962.

The field station at Steinmannen was not manned in 1977 (for the first time since 1962) so that ablation was observed by frequent visits during the summer, in general once a month. The ablation was larger than normal, the specific figure reached −2.29 m which is 122% of the average for the period 1962-76.

The unusually small winter accumulation and the slightly higher ablation than normal resulted, of course, in a negative mass balance. It amounted to −0.77 m and the equilibrium line was situated at 1650 m a.s.l. This year was the first year of negative mass balance since 1972, but on average the glacier has increased its mass by 5.6 m of water equivalent since 1962.

The discharge from the glacier amounted to 132 × $10^6 m^3$ water at the outlet of the lake Nigardsvatn. The largest daily discharge was observed on July 9 when 3.14 × $10^6 m^3$ water passed the automatic gauging station. Most of this water originates from glacier melt.

Hardangerjøkulen

The measurements are undertaken by Norsk Polarinstitutt on Rembesdalsskåki, a west-facing outlet glacier from Hardangerjøkulen. The winter balance amounted to +1.20 m whereas the summer balance was −1.92 m so that the result turned out to be a net mass loss of −0.72 m water equivalent.

Storbreen

Norsk Polarinstitutt has conducted a complete mass balance study (both winter balance and summer balance measurements) on this glacier since 1948, and this is the next longest observation series of this kind in the world. The accumulation was much smaller than normal, the winter balance amounted to only +0.94 m whereas the summer balance was −1.48 m and a total net mass balance of −0.54 m of water equivalent was the result.

Hellstugubreen

This glacier is situated in the relatively continental mountainous area in Southern Norway (Jotunheimen), thus it receives normally much less snow than glaciers farther west. The winter balance was +0.68 m which is only 64% of the average for the last 15 years.

The summer balance turned out to be −1.4 m of water equivalent, which is the same deficit as in 1976. The glacier has now experienced a negative mass balance during twelve consecutive years, and the mass loss during this period amounts to 5.8 m of water equivalent. (Compare Nigardsbreen which has shown a growing tendency.)

Gråsubreen

This is the highest and easternmost situated glacier in Southern Norway and it receives normally the smallest amount of winter accumulation. When the snow survey was made at the beginning of May only 0.51 m of water equivalent had accumulated and all stakes had survived the winter. This accumulation is 73% of the average for the period 1963-76. The ablation was measured twice during the summer but it was then found that several stakes had been destroyed either by tourists or by reindeer. The summer balance turned out to be −0.91 m which is 85% of the average for the years 1963-76.

The net balance was −0.40 m. Similar to Hellstugubreen this glacier experienced its twelfth consecutive year of negative mass balance. The total mass loss in this period amounts to 6.3 m of water equivalent.

Høgtuvbreen

The snow survey was made in the beginning of May when the snow depth was measured in 170 points. The winter balance amounted to +2.2 m which is more than was simultaneously observed at Engabreen, but still the smallest ever observed on Høgtuvbreen since 1971. The winter balance is only 65% of the average for the period 1971-76.

The summer balance was observed by two visits during the summer and it amounted to −2.72 m which is almost equal to the result found for the two last summers, but it is only 83% of the average for the period 1971/76.

The net balance for 1977 turned out to be negative, amounting to −0.52 m.

Engabreen

The accumulation season 1976/77 was one of the driest since the glaciological investigations started, only the winter 1969/70 gave less accumulation. The accumulation had already started at the end of August and the glacier was visited in December and February, whereas the final snow survey was made at the beginning of May. In total 424 snow depth measurements were made along 93 km of profiles. The winter balance amounted to 2.08 m of water equivalent which is only 63% of the average for the last 7 years. The field station near Helgelandsbukken (at 1100 m a.s.l.) was manned from June 15-September 1, so that meteorological measurements and ablation studies could be carried out almost continuously during the melt season. The summer balance amounted to −1.2 m which is the smallest summer balance ever measured at Engabreen—it is only 53% of the average for the last 7 years. In spite of the small winter

accumulation, this cool summer gave a positive net mass balance amounting to +0.88 m. The equilibrium line in 1977 was situated as low as 1000 m a.s.l. Since 1970 the glacier has increased its mass, on an average, by 8.4 m of water equivalent.

Bondhusbreen—subglacial investigations

This outlet glacier was considered as a part of the large hydro-electric power project west of the icecap Folgefonni. The diverting galleries are at altitudes of 850-900 m a.s.l., whereas the glacier penetrates down to about 500 m a.s.l., so a subglacial water intake must be constructed to catch the melt water.

Many problems were encountered in this connection, one being the exact positioning of intake shafts, constructed vertically from the diverting bedrock tunnel up to the ice/bedrock interface. Several such shafts were constructed during the last few years, but only small amounts of water came into them.

Therefore a great number of holes were drilled vertically up from the almost horizontal diverting tunnel to obtain a more detailed picture of the subglacial topography. During the summer 1977 an intensified study was made, the variations in water flow from these holes were carefully observed and a tracer study was performed in the fall. Salt injected in the outlet from the lake Holmavatn was traced at certain points in the tunnel after 12 minutes, giving a subglacial water speed of 0.7 m/s for a horizontal distance of 430 m and a drop of 220 m (i.e. about 27°).

Spitsbergen

Two glaciers have been selected for mass-balance investigations: Austre Brøggerbreen and Midre Lovénbreen. They have been observed by Norsk Polarinstitutt concerning winter and summer balance since 1966.

In 1977 the winter balance amounted to 76 cm and 80 cm, respectively. The summer balance was almost equal for the two glaciers, namely 87 cm and 84 cm, respectively.

The mass balance turned out to be near equilibrium or slightly negative, −11 cm for Austre Brøggerbreen and −4 cm for Midre Lovénbreen.

SEDIMENT TRANSPORT STUDIES AT SELECTED NORWEGIAN GLACIERS

Studies of suspended sediments in certain glacier streams have been carried out in Norway since 1967. Before these systematic studies were started by the Norwegian Water Resources and Electricity Board, single studies were performed for shorter periods, mainly for the purpose of collecting data for thesis work by students at the University of Oslo.

The intensified studies started in 1967 to collect data for engineers for their planning of future hydro-electric power stations. Water from high-mountain glacierized basins should be diverted to reservoirs and the content of suspended sediment might cause technical problems (silting-up of reservoirs, increased wear in turbines, etc.) so information on the solid particles in suspension was of great interest for the engineers. Further, the scientific discussion on the rate of glacier erosion in various areas made such investigations highly valuable from a theoretical point of view. A project of cooperation was therefore started between the Norwegian Water Resources and Electricity Board and the Department of Physical Geography at the University of Stockholm so that both aspects of the data collection could be considered.

In 1967 three glaciers were studied during a 6-9 weeks' long field season. Later the number of investigated glacier streams increased up to 1972 when 8 glaciers were studied during 10-16 weeks to obtain an almost complete picture of the total transport of suspended sediment throughout the entire melt season.

During the last few years it became clear that results from 5-6 consecutive field seasons at some selected glacier streams were sufficient for the engineers. Consequently, the sediment transport studies were terminated in 1973 at three of the selected streams and in 1974 at two more locations. At present the studies are continued at Nigardsbreen in Southern Norway and at Engabreen in Northern Norway.

In addition to the suspended sediment it is also of great interest to know the amount of bottom load. This was directly measured at Nigardsbreen in 1969 when a great fence was constructed across the stream. Later the amount of bottom load has been determined annually by repeated surveys of the delta increments which are caused by coarse material deposited by the glacier stream.

Sediment samples are taken normally 3-5 times daily but during periods of rapidly increasing water discharge generally one sample is taken every hour. All water samples are collected in 1-litre plastic bottles, the content is filtered in the field and the filtering paper is sent to the laboratory in Oslo for ashing. To investigate the representativity of single samples a special programme is carried out to compare two, and two samples are taken simultaneously on certain occasions.

Nigardsbreen

The highest peak flood this summer occurred on 9 July when a discharge of 40.5 m^3/sec. was observed at the outlet of the lake. This is not any unusual flow—much higher discharges have been observed during previous years, for example in 1970 when about 56 m^3/sec. was observed on June 25.

Calculations based upon the field data indicate that 7100 metric tons of suspended load were moved into the lake whereas 1850 tons were carried out of the lake, i.e. about 74% was

deposited in the lake. The largest daily transport was observed on 4 August when the glacier stream carried 446 tons at a total water discharge of 2.6 . $10^6 m^3$. The highest sediment concentration was found at 1300 hrs on 10 July when it was 1155 mg/l. This unusually high concentration was caused by a special flood originating from the burst of a local ice dam in front of the glacier. The maximum sediment concentration observed during previous years ranges between 225 and 2000 mg/l. The total transport of suspended material into the lake was found to be in the order of *7700 metric tons.*

The increment on the delta was determined during the fall 1977 when all the previous profiles were accurately surveyed. All calculations were made by S. R. Ekman and his results indicate that an average accumulation of 5.3 cm had taken place from 1976 to 1977. This corresponds to about 1500 m^3 or about 3000 metric tons. The total amount of material corresponds to 0.08 mm of solid rocks removed from the entire glacier bed provided the bedrock density is set at 2.7 g/cm^3.

Engabreen

Investigations have been carried on at the front of Engabreen (38 km^2) since 1969 and results have been published annually in the report series from the Glaciology Section. Water samples are normally taken both at the inlet and at the outlet of the lake Engavatn (1.2 km^2) and the water discharge is continuously recorded on an automatic water level recorder. To obtain data on the amount of coarse material carried by the stream, eight profiles across the delta have been surveyed every 5 m in the last four years.

The discharge from the glacier in 1977 was the lowest ever recorded, only 138 . $10^6 m^3$ which is 79% of the average for the period 1970-77. The glacier front has advanced approx. 20 m from 1976 to 1977 and the front is now in a more advanced position than before 1972.

The maximum daily sediment transport occurred on 3 August when 590 metric tons were carried by the glacier stream. This transport peak was caused by very high temperatures, even during the night the temperature was over 20°C. The daily discharge maximum occurred on 6 August due to a heavy rainfall after a period of high temperatures. The highest peak flood ever recorded, 88 $m^3/sec.$, occurred in 1971 whereas the highest peak flow in 1977 was only 35 $m^3/sec.$

It is calculated that the total transport was 12 800 metric tons of suspended sediment from the glacier of which 87% was left on the lake bottom.

Based upon surveys made along profiles crossing the delta it is supposed that about 8000 metric tons of coarser material were deposited there. Adding this to the amount of suspended sediment the result is that about 19 000 metric tons of solid particles have been discharged from the glacier—the bottom load accounting for 42% of this amount.

An electronic device to monitor variations in turbidity

Experiments have taken place since 1971 to construct a recorder which could be used to monitor variations in sediment concentration between each single sample (about 5 samples per day). The need for such a device became clear in 1969 because "clouds" of sediments seemed to pass the observation point on several occasions, and then the sediment concentration may be much larger than at the time when samples are taken. Consequently, if a straight-line interpolation is made between each sample, a sudden variation in sediment concentration will "disappear" and will not be accounted for. An instrument was therefore constructed to investigate whether single samples were representative for a longer period or not. The recorder which was in use during the summer of 1977 showed useful results in the time period from 8 July to 14 August.

The most troublesome problem connected with this new instrument is the fact that particles of ice may follow the water into the intake pipe and prevent water from flowing continuously between the light source and the sensor.

The energy consumption of 170 mA causes another problem; the battery drain can possibly be compensated by a wind-driven generator—an idea which is planned for next year.

G. Østrem

U.S.S.R.

In 1977 Soviet glaciological expeditions studied the glaciers of the Caucasus, Central Asia, Altay, Polar Urals, the mountains of Central and East Siberia, Kamchatka, Sakhalin, the Arctic and Antarctica.

CAUCASUS

The Institute of Geography, the USSR Academy of Sciences, continued observations of the Marukh and Kolka glaciers under the international programme of glacier variations surveys. Instrumental studies of strain in ice-blocks on the Marukh glacier surface suggest that, together with flowability, stick/slip motion of adjacent overlapping ice layers is quite significant for glacier motion in general. Conditions of run off formation were investigated on the same glacier. Methods evaluating accumulation, precipitation and glacier run-off according to the height of the equilibrium line and snow accumulation on it

permitted mapping of the height of the equilibrium line.

Palaeoglaciological studies aimed at the determination of the extent and chronology of large glacier surges were continued in the central Caucasus. Present-day multidisciplinary field and laboratory methods (radiochronometry, lichenometry, lithology, palynology etc.) were used.

Studies of the Marukh glacier were also performed by the **North Caucasian Hydrometeorological Service.** The complex of glaciometeorological surveys (meteorological and hydrological, observations of snow and ice melting; observations by totalisers) was carried out. Snow surveys were fulfilled on this glacier and on the Khakel, Bezengi, Kelbashi and some other glaciers. The reported year appeared to be unfavourable for glaciers: only 60-80% of the precipitation norm occurred in winter months. There were actually no summer snow falls. The totals of positive temperatures for the ablation period were above the mean perennial norm in the west Caucasus, nearly equalled the norm in the central Caucasus and were a bit below the norm in the east Caucasus. Snow disappeared very quickly and only ice melted in the ablation period.

Annual variations of 26 glacier tongues were estimated on the northern slopes of the west and central Caucasus. 21 of them were found to retreat at a mean annual velocity of 0.1 (the Khakel glacier) -11 m/yr. (the Tseyiskiy glacier). Five glaciers advanced at a rate of 0.1-33.5 m/yr. (the Bol'shoy Asau glacier).

The Laboratory on the Problems of Snow Avalanches, Moscow University, continued investigations of the Dzhankuat mountain-glacier basin, where it fulfilled multidisciplinary studies of water and ice balances of glaciers and water balance of the basin; distribution of snow mantle over glaciers and periglacial areas. A new geodetic network was established. Development of stereo-photogrammetric methods, determining snow cover thickness on mountain slopes, has been accomplished along with a set of experimental and theoretical investigations of its creep, consolidation and destruction. Regularities of snow structure changes in course of its deformation were revealed.

The studies of snow avalanches were continued. In order to determine climatic causes of disastrous avalanching and refine the methods, the laboratory estimated the maximum length of avalanche cones and studied avalanches of extreme dimensions observed in winter 1976-77. A new formula calculating the maximum length of avalanching on the basis of morphometric properties of avalanche catchment areas was deduced. Investigations of climatically-induced rhythm of avalanching throughout historical time were accomplished. Synchronism in fluctuations of humidification and snowiness in the mountains surrounding the European territory of the USSR was established. This should enable long-term forecasts of avalanche danger to be made.

The Alpine Geophysical Institute undertook field studies on the northern slope of the central and west Caucasus. Computer-based system collecting data on snow-avalanches has been created in the El'brus area. Relationship between air humidity, sunshine duration and changes in the temperature of snow sequence was established. Conditions under which unconsolidated horizons occur in the surface and contact zones of snow cover were determined. Unconsolidated horizons induce avalanches on the 3rd to 4th day after snowfall. It was proposed to predict such avalanches by the rate of crystal growth.

Structure and metamorphism of snow was studied; significant symmetrical properties of deep-seated hoarfrost crystals and corresponding types of environmental symmetry were determined. Occurrence of a liquid spherical layer on the spherical ice nucleus and equilibrium conditions of the system's ice-water and ice-water-vapour with curved surface of phase separation were studied. The role of surface tension in the processes of phase equilibrium and phase transition was shown.

Avalanche and mudflow danger was evaluated in alpine areas of the west Caucasus; glacier constituent in the total run-off of the Garauzuez river (Chegem river-basin) was determined.

Kharkov University studied fluctuations of climate and height of the firn line in some areas of the main Caucasus. The height of the firn line was reconstructed for the period since 1700, and was predicted up to 1987. Good curvilinear relations between annual growth of trees and meteorological conditions (the sum of positive temperatures for warm period and the sum of precipitation for summer period) were established, thus permitting reconstruction of these conditions for the whole period of tree growth.

The Transcaucasian Hydrometeorological Institute carried out field studies on the Devdoraky glacier (hydrological observations of the Devdoraky-Tskaly river mouth, meteorological and actinometric observations, measurements of ice velocity, ablation and changes in the surface level) and phototheodolite surveys of the Gergety, Khalde, Tvibery and Kitlod glaciers.

The Azerbaydzhan Hydrometeorological Service continued stationary and route observations of the Yuzhnyy, Yugo-Vostochnyy, Tikhitsar and Murkar glaciers. Ice velocities and ablation, fluctuations of glacier tongues, and water discharge of the Kila and Selda rivers were measured.

CENTRAL ASIA

The Section of Physical Geography of the Academy of Sciences, Kazakhskaya SSR, performed multidisciplinary glaciometeorological

studies of the Zailiyskiy, Kungey, Terskey and Dzhungarskiy Alatau glaciers. Accumulation-ablation of snow and ice, mass-balance of glaciers, changes in ice thickness and glacier fronts as well as ice velocity were observed with the help of measurements along stake profiles, stake fields and strain figures. Stereophotogrammetric and tacheometric surveys and studies of the dynamics of glacier variations in accordance with the 1st and 2nd class programmes were undertaken in the Dzhungarskiy (Shumskiy glacier) and Zailiyskiy Alatau (Tsentral'nyy Tuyuksu, Igly Tuyuksu and Shokal'skiy glaciers). Observations in accordance with the 3rd class programme embraced some other glaciers of these ranges.

Data interpretation permitted establishment of the properties of scalar and vector values and their fields, mapping according to the rate of ice near the surface and mapping the course of dynamic properties for different years. Glacio-meteorological regime, mass-balance and glacier run-off from the Tuyuksu mountain glacier basin for 1965-1976 were clarified. Possible duration of daily insolation of the mountain glacier surface was evaluated and ice ablation on the same surface was calculated on the basis of the main meteorological indices. Large-scale plans of the Krasovskiy and Kartaygan glaciers were prepared.

Complex studies of snow cover, its distribution and time-spatial evolution of predicative features of snow horizons, different in genesis, were fulfilled. The mean perennial position of snow line was evaluated in the Zailiyskiy, Kungey, Terskey and Talasskiy Alatau. Norms of annual and seasonal precipitation in the alpine areas were calculated. Maps of snowiness, general estimation of avalanche danger on the Ketmen and Terskey Alatau ranges were compiled. Avalanche danger in the Chidza river-basin, Dzhungarskiy Alatau, and types of surfaces in representative areas of Dzhungarskiy and Terskey Alatau were mapped. Properties of avalanches in the Zailiyskiy Alatau were clarified for 1960-1975.

Stationary and route studies of water-thermal regime of glacier waters, thermal regime of morainic grounds, structure and dynamics of mudflows were carried out in the Zailiyskiy Alatau river-basins. In cooperation with **the Kazakh Hydrometeorological Service,** hydrometric studies were performed at the foot of the Tuyuksu end moraine, evaluating its capacity for regulation. Tacheometric surveys and water sampling for chemical analyses were carried out at the lakes near the Bogatyr, Kotlyakov and Syuttibulak glaciers.

1977 was remarkable for low humidification and high inflows of heat. Snow accumulation on glaciers and ice-free slopes was small making the seasonal snow line on all the glaciers rise up to the mark, which it seldom reaches. Under these conditions, intense ablation (on large areas of bare ice) brought about extremely negative mass-balance of glaciers, shrinkage of their length and area.

Strong heating of morainic deposits, melt waters and some other agents caused glacial mud-flows in the upper reaches of the Zharcheya river (Issyk river-basin) and Kumbelya River (Bol'shaya Almatinka river-basin) in summer 1977. Avalanche activity was low in winter and spring because of small snow accumulation in the mountains.

The Kirgiz Hydrometeorological Service studied the glaciers of the Kungey and Terskey Alatau and Kirgiz range. Fluctuations of the lower boundaries of glaciers and changes of their surface were observed on the Aksu Zapadniy, Aksu Vostochniy, Dolonata (Kungey Alatau) and Dzhukuchak (Terskey Alatau) glaciers. Mass-balance, accumulation-ablation of snow and ice, variations of the lower boundary, changes in the surface level, position of the firn line and avalanche regime were studied on the Golubin glacier (Kirgiz range).

Analysis of the data showed that ablation on the Golubin glacier prevailed over accumulation, and by the end of the ablation period the seasonal snow line lay at 4000 m a.s.l. During the last 5 years this has been typical of the majority of glaciers on the northern slope of the Kirgiz range. In 1977 the Golubin glacier remained stable, Aksu Vostochniy advanced 25 m, and Aksu Zapadniy—45 m. The Dolonata glacier retreated 60 m and Dzhukuchak glacier—25 m (as compared to the surveys of 1966).

The Tien-Shan station of the Kirgiz Academy of Sciences carried out multidisciplinary observations of the Karabatkak glacier (northern slope of Terskey Alatau). Snow surveys, observations of snow cover distribution over the glacier and the basin in general, glaciohydrometeorological studies under the programme of glacier variations surveys were completed. Internal nourishment of the glacier and permanent snow drift were evaluated numerically, and calculations of its mass-balance were improved. Regular measurements of snow accumulations by annual layers (periodicity of observations 10-12 days) showed considerable variability of ablation with elevation. At the level of 3920 m snow ablation made up 583 mm with regard to precipitation, and at the height of 4100 m — only 300 mm, internal accumulation of the under layer also falling with height.

Studies of the Kyzyl-Su glacier (southern slope of Terskey Alatau), situated 10 km away from the Karabatkak glacier, were performed at the same time. Small distance accounts for similarity of synoptic processes, bringing about similar regime of cloudness, humidification and temperature, and thus permitting precise determination of the role of exposure in glacier regime. Despite the 500 m altitudinal difference in position of the glaciers' tongues, melting on

the Kyzyl-Su glacier was only 7% more than that on the Karabatkak glacier.

The Institute of Geography, the USSR Academy of Sciences continued multidisciplinary studies of the Medvezhiy glacier. Special observations of ice velocity and strain rate were carried out. In future they will permit observation of annual and summer movement of kinematic waves along the 6 km tongue of the glacier, and determination of their number and values for prediction of surges. In 1977 the glacier was found to be in the middle of its quiescent stage.

The Interdepartmental Transpamirian Alpine Expedition fulfilled its investigations in July-August. Field observations identified many surging glaciers in the active stage of their surges. Existence of the zone of superimposed ice in the East Pamirs was confirmed, and its duration was determined. Precipitation in the alpine zone was calculated by ecological scales. The expedition discovered local sources of high mineralization of glacier waters. It is assumed that changes in the dimensions of icings on Pamirian rivers have an auto oscillating nature and that subsurface ice of the Karakul occurs in subaqual conditions of shallow waters.

Studies of periglacial icings have been started, with a view to using them for artificial regulation of glacial run-off. The rate of icing melting is approximately the same as that of glacier melting in general, though it is situated lower and in warmer climatic conditions. The share of icing run-off makes up about 2% of the annual run-off. Increase in the run-off due to melting of icings may be achieved by artificial augmentation of icings and consequently prolongation of its existence in the areas where icings are observed during part of the summer.

Palaeoglaciological studies were continued. The complex of analytical data provided a base for outlining the stages of glacioclimatic history of the mountain frame of Fergana. Long-term studies of the regularities of evaporation and its role in heat balance of the present-day glaciers and former glaciation of Central Asian mountains have been accomplished. Application of the palaeobalance method to the studies of natural evolution of the Pamirs showed conclusively that the last glaciation of the mountain system took place in the Upper Pleistocene, and not in the Middle-Pleistocene, as was broadly believed.

Department of Glaciology of the Central Asia Hydrometeorological Institute continued long-term studies of the Abramov glacier. The method and computation programme of long term rows of the total amounts of glacier melting in the Central Asian river-basins were developed. Calculation formulae for prediction of melting constituents with different periods in advance were obtained. A complex of computer programmes calculating morphometric properties of glaciers was worked out and new data on the Alaiy, Turkestan, and Gissar ranges and of the central Pamirs and west Tien-Shan were obtained.

Studies of snow cover and experiments evaluating snow accumulation by aerial gamma-surveys from helicopter were carried out in the river-basins of the western Tien-Shan. This method is found to be most efficient for plateau-like and flattened water-divide surfaces. Initial levels of gamma-field in the mountains by far exceed values typical of plains and thus permit measurement of mountain snow accumulations up to 600 mm. Criteria of the density of reference points, measuring snow mantle (precipitation) in alpine areas, are worked out. They are based on evaluation of errors in plotting the curve of snow accumulation norms versus the height of locality. Recommendations on re-arrangement of snow-survey network in the Karadarya, Naryna and Vakhsha river-basins are given. Field studies of snow-avalanching covered the Bartang river-basin, areas of the Lenin and Communism peaks.

Glaciological Laboratory of the Institute of Geology and Geophysics, Uzbek Academy of Sciences investigated the Abramov glacier. Numerical indices of the influence of the walls of the glacier trough upon temperature, humidity and wind regime in the glacier zone were determined. Circulation regime of glacier-born wind and the effects upon it of orographic structure and the wind in the free atmosphere were revealed. Relationship between morainic mantle, eolian drift and ice substratum was studied together with peculiarities of glacial lithogenesis on the basis of petrographic data. The nature and state of the morainic mantle were found to be qualitative indices of the activity of glaciation. Together with the Central Asia Hydrometeorological Institute the Laboratory measured the surface albedo by the optimum number of points on the total area of the glacier and performed experiments on artificial dusting of the firn zone.

Leningrad University studied the Abramov glacier with the goal of developing new evaluation methods of heat- and moisture-flows in mountain glaciers. Reconstruction of meteorological conditions by the data of weather stations showed a close relationship between cloudiness on the Pamir-Alai glaciers and lower stations. It became possible to calculate global radiation for a long period.

The Tadzhik Hydrometeorological Service continued observations of glaciers in the Obikhingou, Zeravshan, Muksu, and Surkhob river-basins and Ozero Iskanderkul. Levelling of the glacier surface along 6 profiles was fulfilled on the Fedchenko glacier. Ice velocity was determined in three transverse sections and its ablation in a longitudinal cross-section. Meteorological observations and surveys of the glacier tongue were carried out. The Maliy Tanymas, Kosinenko and Uluckbek glaciers were studied.

Aerovisual observations of the alpine area of Tadzhikistan were performed twice in order to reveal sources of glacial mudflows. 24 glaciers capable of generating such mudflows were discovered in six river-basins.

ALTAY

Tomsk University continued long-term glacio-hydroclimatological studies of the Aktru mountain-glacier basin, where 14 actinometric and meteorological stations, 7 hydrometric sections, an experimental observation plot on the Maliy Aktru glacier and the station "Uchitel" were working.

To reveal possible causes of intense glacier run-off in the most continental area of the Altay, comparative stationary-route observations were fulfilled in July-August in the Maashey, Kurkurek, Korumdu and Taldura glacier basins, trending W-E. Analysis of the data made it possible to compare glaciohydroclimatic properties of northern slopes of the highest ranges in the Chuisk area of the Altay.

Relation of the total volumes of the run-off and of its moduli to the dimensions of a glacier was established. Water discharge on the Taldurin glacier, situated in the area of well-pronounced continentality, was found bigger than the doubled discharge of the Aktru, which nearly equalled the norm in 1977. Though agreement between climate, topography and glacierisation favourable for the Bolshoy Taldurin glacier was violated. the glacier remained stable due to abundant nourishment from one of its constituent flows.

It is assumed that the climatic contrasts between glaciers of northern slopes and near-by steppe valleys may cause the growth of precipitation of glaciers, bringing additional amounts of moisture to the valleys and creating a circulation mechanism in glacier basins, shifting the atmospheric boundary between windward and leeward slopes to the lee side.

The Section of Geography of the Kazakh Academy of Sciences continued to study the glaciers of the Berel river-basin. Complex measurements in accordance with the 2nd class programme of glacier variations were undertaken on the Maliy Berel'skiy glacier. Calculations of glaciers' mass-balance in Kazakhskiy Altay were carried out and the radiation balance of the glacial zone of this area was evaluated.

CENTRAL AND EAST SIBERIA

The Institute of Geography of Siberia and the Far East, the USSR Academy of Sciences, fulfilled multidisciplinary glaciohydrometeorological studies of the Chara basin and the alpine zone of the Kodar range. The institute studied occurrence and destruction of snow mantle, icings, lake ice, run-off regime, dynamics of humidification and thawing of soils, levels and thermal regime of drift-dammed and corrie lakes, vegetation on icing-fields and glacial topography.

Analysis of long-term observations of the Minusinsk basin determined dynamics of snow cover in steppe and taiga natural complexes, evaluated the effect of bioclimatic indices of landscape on accumulation and structure of snow, estimated the role of snow evaporation on the ground and in trees in the general balance of snow accumulation. Methods calculating evaporation of a snow ball situated in a forest zone were developed. Methods compiling the maps of maximum snow accumulations, with regard to biometric properties of forest and meadow communities and regularities of temporal and spatial differentiation of the snow mantle were advanced.

The Novosibirsk Institute of Railway Transport investigated regularities of formation, accumulation and caving of snow in the avalanche catchment areas at three stations of the Baykal'skiy and Severo-Muiskiy ranges. Impact of snow upon fences and velocities of snow creep were determined. Snow-drifts and protective measures were studied. The institute went on with snow-avalanche studies in the Kuznetskiy Alatau.

The Department of Glaciology of the Central Asia Hydrometeorological Institute studied snow-avalanching along the Baykal-Amur railway. Relationship between the main avalanche-forming agents (rate of precipitation, air temperature etc.) and the time of avalanching was established. A prediction graph of non-linear discriminant function, determining the time of snow-drift avalanching during snow-falls in Siberia is proposed.

POLAR URALS

The Institute of Geography, the USSR Academy of Sciences, continued studies of the Bol'shaya Khadata mountain-glacier basin. Surveys of the Obruchev and IGAN glacier variations were performed. Since 1975 these glaciers have shrunk considerably, which is mainly caused by warming and lengthening of summer seasons. Methods calculating external load upon a glacier by meteorological parameters were worked out. Calculations (by special computer programme), using results of the Obruchev glacier observations, provided the data on direct solar radiation, with regard to exposure and dip angles of different areas of the glacier. Detailed field observations showed distribution of the ablation layer over this glacier for different weather types.

KAMCHATKA AND SAKHALIN

The Novosibirsk Institute of Railway Transport continued studies of experimental avalanche-protective and snow-retardation constructions, and of static and dynamic loads of snow. Properties of snow cover and parameters of avalanches were determined. In Southern Sakhalin and Kamchatka snow drifts were studied and protective measures were worked out.

THE ARCTIC

The Institute of Geography, the USSR Academy of Sciences, continued field studies of Svalbard glaciers. Comprehensive terrestrial radio-echo-sounding of ice thickness and subglacial topography of the Vöring corrie-glacier was undertaken along with the sounding of 14 glaciers different in type and dimensions. The water-ice balance of three glaciers, used for water-supply of the Soviet mines at Barentsburg and Piramiden, and of the Norwegian mine at Longyearbyen, was studied.

Stratigraphic studies of the age of glacial and sea deposits were continued in conjunction with the Institute of Geology, Estonian Academy of Sciences. Radiocarbon and thermoluminescent datings suggested the Late Pleistocene age of some sections, which is important for clarification of glaciation and transgression chronology over the territory of the archipelago. Studies of the formation mechanism of structural forms of moraines confirmed significance of shear planes for incorporation of till by glaciers, including layers of stratified loose sediments, whose melting out engenders structural forms of morainic topography.

As a result of palaeoglaciological studies of the Arctic the hypothesis of the Late-Würmian Arctic Ice Sheet over the Northern Hemisphere was formulated. Morphometric studies of the ice sheet were completed and environmental impact of surges of "marine" ice sheets was analysed.

The Arctic and Antarctic Institute continued multidisciplinary studies at the "Vavilov Dome" station, Severnaya Zemlya. The institute undertook meteorological and actinometric observations, snow-survey routes, theodolite and radio-echo sounding measurements of velocities in surface ice layers, radio-sounding along glacier profiles; hydrometric, limnological and physico-geographical studies. Glacier sequence was studied in pits. Two boreholes were drilled to the depth of 450 and 459 m with selection of the core.

It is established that conditions most favourable for ablation are created on Severnaya Zemlya glaciers by warm air masses from west Siberia and Kazakhstan. Maximum melting is observed from the middle of July up to the middle of August. The mean melting makes up ⅓ of the annual accumulation. Three-year long observations indicate a positive mass balance for the Vavilov glacier.

ANTARCTICA

Studies under the programme of the International Antarctic Glaciological Project (IAGP) were continued. **The Soviet Antarctic Expedition** traced the two routes: Mirniy-Komsomol'skaya and Mirniy-Pionerskaya-Dome C. Snow surveys along the route and on snow survey polygons, stratigraphic studies of snow-firn sequence in pits, meteorological observations and sampling of surface snow for oxygen-isotope analysis were fulfilled. Barometric levelling, gravimetric and magnetometric measurements were performed on the route Pionerskaya-670 km. Drilling of the Vostok-1 borehole was carried out from a depth of 180 m down to 300 m with continuous selection of core.

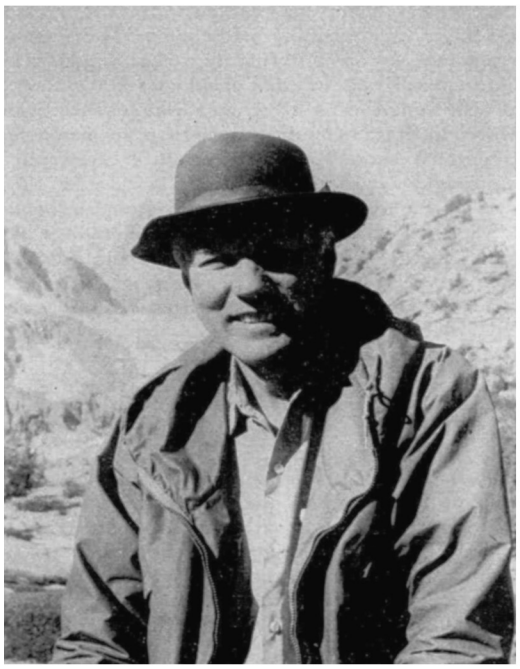
The Institute of Geography, the USSR Academy of Sciences, drilled in conjunction with the Arctic and Antarctic Institute the deepest borehole (810 m) in the marginal zone of Antarctica, studied the core throughout its depth and measured ice temperature. Temperature regime at various depths in the Antarctic ice sheet was studied. Heat-exchange of icebergs with sea water was calculated with due regard to existing projects of their transportation to the countries lacking water. Field studies of the glacial history of the Shackleton Mts. in the Weddell Sea basin were continued.

The Laboratory on the Problems of Snow Avalanches, Moscow University, has accomplished studies of Ross Sea glacial history and determined the velocity and spatial evolution of two mountain glaciers of the McMurdo region (Transantarctic Mts.).

The Arctic and Antarctic Institute undertook route radar airborne measurements of ice thickness near the Filchner and Ronne ice shelves, and during the flight to the South Pole. Radio-echo sounding permitted discovery and study of a subglacial lake near Molodezhnaya station. Rheological properties of the ice shelf and fast ice in the area of Novolazarevskaya station were determined. Elastic, strain and electric properties of ice as well as internal noises of the glacier in the autumn and winter seasons were investigated.

Studies of melting and liquid run-off from the surface of the Antarctic ice sheet have been accomplished. Principles of predicting dangerous phenomena, connected with outbursts of lakes in the marginal zone of Antarctica were formulated. The position of the edge of the Antarctic ice sheet throughout the period of Antarctic studies was analysed according to cartographic data. The most dynamic areas of the coast were identified. Relation of the variability of coast line to the types of coasts was revealed. The nature of the changes of the Filchner, Brunt, Bellingshausen and Amery Ice Shelves was determined.

V. M. Kotlyakov



RON SHREVE

Ronald L. Shreve was born in Los Angeles on 18 October 1930, and apart from temporary sojourns elsewhere has lived in California ever since, now with his wife and one child.

When he was growing up, his parents and his grandfather, who lived with them, taught him many valuable practical skills as well as a love of the mountains and deserts and an abiding respect for Nature.

In 1945 the family moved from Los Angeles to Bishop Creek, which flows from the rugged 3000 m eastern escarpment of the Sierra Nevada of California. There they lived at an elevation of 2600 m amidst some of the most splendid glacial scenery anywhere.

These surroundings included not only the serrate peaks, U-shaped valleys, great moraines, and pluvial lake remnants left by the glaciers, but also active earthquake faults, hot springs and geysers, recently erupted volcanic cinder cones and lava flows, mines for gold, silver, tungsten, talc, and other valuable minerals, and a remarkable variety of other geological features, all beautifully displayed. Thus was Ron's early interest in Nature influenced toward geology, particularly glaciology and geomorphology.

Nevertheless, when he entered Caltech in 1948, he studied physics rather than geology, and received a B.S. in Physics in 1952. In his second year as an undergraduate he considered changing to geology, but did not do so because the course of study in physics allowed greater scope for his interests in other subjects, such as mathematics and electronics.

He continued on to graduate study in physics at Caltech, but switched to geology the second year. He took practically the whole of the undergraduate geology curriculum that year, including Bob Sharp's course on general geomorphology. This awakened his latent interest in the subject, and in the following years Ron also took his courses on arid-regions geomorphology, glaciology, and glacial geology, and all his seminars, thereby arriving at what was to become a life-long professional specialization.

Sharp taught his courses directly from the original literature, with plenty of field trips to maintain contact with reality, and he emphasized thinking for oneself above all else. In fact, Ron Shreve's interest in the Blackhawk landslide, which became his dissertation topic, originated when camping there during an arid-regions field trip. He found his thinking out of accord with the accepted explanations of how that great mass of limestone fragments, up to three kilometers wide and thirty meters thick, could have moved eight kilometers down the gently sloping alluvial surface on which it rests. But it took him two years to come up with what he thinks is a better explanation, namely the air-cushion hypothesis that he proposed in his Ph.D. dissertation, which he completed under Sharp's supervision in 1958.

Being a student of Sharp was not the apprentice-type relationship so common in doctoral training in science. Although many of his students assisted him on projects, to their great benefit, his research and theirs were completely separate. He was not interested in

mass-producing research nor in making carbon copies of himself. Instead, he encouraged them toward their own diverse problems, approaches, and viewpoints, insisting only on high standards of performance. This has had a deep influence on both the content and the style of Shreve's own research and teaching.

Work in glaciology began when Sharp invited him in 1957 to participate in his project on the lower Blue Glacier, which he was organizing as part of the United States effort in the International Geophysical Year. The offer was accepted, largely because Ron had never been on a real glacier before (the Sierra Nevadan variety with which he was familiar being hardly more than oversized perennial snowbanks). The other members of the field party that year were Clarence Allen, Carl Benson, Barclay Kamb, Mark Meier, and Jim Savage: a notable collection of glaciologists. Their glaciological research seemed to consist largely of making theodolite observations in bad weather and drilling numerous holes in recalcitrant ice, which moved Benson to suggest that the main qualifications for the job were "a strong back and a weak mind!"

Shreve considers that he himself must have qualified, for he continued with the project for eight more years, working mainly on studies of ice deformation and structure at depth in the glacier, initially with Sharp and later with Kamb. Problems with freezing in deep boreholes in this temperate glacier led him to the concept of a water table in such glaciers, and thus to his more recent studies of the movement of water in glaciers and hence of the formation of eskers. This in turn is leading him farther into the domain between glacier physics and glacial geology.

The Blue Glacier studies led indirectly to work on migration of liquid, vapour, and gas inclusions in ice under a temperature gradient, which was motivated in part by questions about the origin and stability of the bubble foliation, basal clear ice, and other features observed in the thermal core drilling. They also stimulated his initial interest in the regelation problem, in connection with its role not only in basal sliding of glaciers but also in possible movement relative to the ice of deformation markers such as pipes and cables. This prompted the remarkable experiments by Lon Drake in 1965 on pressure melting and regelation of ice by round wires, whose many completely unexpected results in turn motivated Ron's work on the theory.

After finishing his Ph.D. in 1958 he took up his present appointment on the faculty at UCLA, but spent the first year on leave as a National Science Foundation Postdoctoral Fellow at the Swiss Federal Institute of Technology in Zürich, where he worked with Peter Kasser and Fritz Müller in the Section of Hydrology and Glaciology of the Laboratory for Hydraulics and Soil Mechanics. There he studied not only glaciological problems but also analysis of water movement in an earth-fill dam that failed after sudden lowering of lake level and on planning for correction of a river that was destructively widening its channel in response to extensive mining of sand and gravel from it at a point upstream.

In the summer of 1959 Ron joined Vaughan Lewis, Bill Ward, John Glen, Cuchlaine King, John Nye, and the other members of the Cambridge Austerdalsbre Expedition during its last field season in Norway. What he saw there brought him back the next summer with Kamb to make a detailed plane-table topographic and geologic map of the structures associated with the famous wave ogives and Forbes bands of that glacier.

In his 20 years at UCLA Shreve has taught many different courses, the most important perhaps being general geology, elements of field geology, theory of stress and deformation, theoretical geomorphology, and his seminar on geomorphology and glaciology. He considers himself fortunate in attracting a series of extremely able, highly stimulating graduate students. With few exceptions, however, they have been more oriented toward rock mechanics, glacier physics, or glacial geology than toward his other major interest, which is the theory of landforms shaped dominantly by running water.

This interest in fluvial geomorphology began, of course, with Sharp's courses, and stimulated a variety of research projects on river and slope mechanics while he was still a graduate student, but it really found its focus in R. E. Horton's "laws" of drainage composition. These empirical "laws" state that the numbers, average lengths, and average drainage areas of the streams of successive "order" in virtually all drainage basins tend to follow closely simple geometric series. This was a challenge he could not resist. It was not until the summer of 1960, however, when he spent a month in Copenhagen with nothing but pencil and paper, that he made significant headway on the problem. At that time he realized the statistical nature of Horton's "laws" and the basic role of network topology, articulated the fundamental hypothesis that channel networks with equal numbers of sources are equally likely, and derived from it the "law" of stream numbers for small networks; but it took four more years to complete the calculations for larger networks and test the predicted statistics against the observed data, inasmuch as the convenient computing power taken for granted today was unavailable then.

Since that time he has extended the theory to Horton's "laws" of lengths and areas, and to mainstream lengths and other basin properties not considered by Horton. He points out that quite a number of other workers have been attracted to the "random-topology model" as

it is generally called, and have made many important contributions to the subject, so that it has now become established as an active and growing research area in its own right.

Meanwhile, beginning around 1971 other lines of thought took him back to some of the other problems of fluvial geomorphology on which he had worked while a graduate student. This was motivated in part by problems raised in a course on statistical geomorphology that he taught at the University of Minnesota in the spring of 1968 and in part by the necessity of preparing for the Crosby Lectures at M.I.T., which he had been invited to give in the spring of 1972 on the subject of theoretical fluvial geomorphology.

In discussing channel networks, hill slopes, and river profiles as closely interrelated, reasonably tractable facets of the central problem of drainage-basin form and evolution, he discovered that, although these three facets are superficially quite dissimilar, inasmuch as they range in character from wholly probabilistic to purely deterministic, they nevertheless have a remarkable degree of underlying mathematical and physical unity. This he has continued to explore as his principal research effort. In addition, he gave a series of lectures on the subject at the University of Minnesota last spring, and during the current academic year is working on it full time while enjoying sabbatical-leave appointment as a Sherman Fairchild Distinguished Scholar at Caltech. Ron reports that he is very excited by the prospects this approach is opening up for defining and solving some longstanding fundamental problems in theoretical fluvial geomorphology.

This attitude certainly shows what an enthusiast and perfectionist he is. Whether teaching in the field or the classroom, or pursuing his own research, or writing, or serving on professional organizations, his expertise is widely acclaimed and welcomed.

INTERNATIONAL GLACIOLOGICAL SOCIETY

ANNUAL GENERAL MEETING 1978

MINUTES OF THE ANNUAL GENERAL MEETING OF THE INTERNATIONAL GLACIOLOGICAL SOCIETY 25 AUGUST IN CARLETON UNIVERSITY, OTTAWA, CANADA

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

1. **The Minutes of the 1977 Annual General Meeting,** published in ICE No. 54, were approved and signed by the Chairman.

2. **The President** gave his report for 1977-78:

Although our Society has held a symposium in 1976, 1977 and this year, we are about to adopt as a regular pattern the organization of our own symposia in the even years and the sponsorship of an international meeting of another organization on a subject of common interest in the years in between. As a rule cosponsorship implies editing and publishing the proceedings of that conference by the Society, with the contribution from the organizing body toward the costs. Nevertheless this means a considerable increase in the administrative and editorial activity of the Society. But it is believed that in serving the glaciological community in such a way, the Society will raise its accomplishment and its prestige.

In 1978, for the first time in its history, the Society has organized a symposium of its own outside its Cambridge Headquarters, and for the second time the Annual General Meeting is not at home. When we hold our meetings in other countries, local groups of members will get an opportunity to participate more closely in our work and the international character of the Society will be emphasized.

Looking back at the 16 months that have elapsed since our last AGM we recognize the considerable impact of the long term programme on the activity of that short period.

While the proceedings of the Symposium on Physics and Chemistry of Ice held in 1977 in Cambridge have reached the stage of being printed, the present Symposium on Dynamics of large ice masses, organized locally by Dr Lorne Gold and his group, is still on the scene . . . very successfully as we all see.

As an exception the Society has cosponsored in this same year a second Symposium: that on Glacier Beds, organized by the Subcommittee on Glaciers of the National Research Council of Canada.

The future programme reaching as far as 1982 has already marked the period I am reporting on. Like sea waves rolling against the shore we see four conferences approaching us:

–1979 the cosponsored conference on "Snow in Motion", organized by the US Forest Service in Fort Collins, Colorado.

–1980 An IGS Symposium on "Processes of glacier erosion and sedimentation", in Geilo, Norway.

–1981 A SCAR Symposium on "Antarctic Glaciology", in Columbus, Ohio.
–1982 A 2nd IGS Symposium on "Applied Glaciology", in Hanover N.H.

For all these events preparations are underway with active local committees at work according to the present need.

For 1980 we have been challenged by a request from Iceberg Transport International Limited (ITI) to organize in Cambridge at their expense a 2nd conference on "Use of Icebergs". The sponsor of this meeting will be ITI, the host will be the Scott Polar Research Institute and the Organizers are ourselves. The role of the Society in this action will be to provide a platform for analyzing all aspects of using icebergs as a fresh water source in a scientific manner. All extra work to be invested in this project by the Society will be covered and the Journal of Glaciology and its editorial staff will not be involved.

Looking at the Journal of Glaciology we realize its growing value to the glaciological community and in particular to our members. In 1974 580 pages were published, in 1977 the output was 1216 pages. This achievement has financial consequences although for the symposia volumes extra funds are sometimes available. Printing has become more expensive due to this growth and to inflation. We try to keep our members' dues as low as possible. But, in order to keep pace with the rising costs, the Council had to increase the membership dues for next year after they had been left untouched for 3 years.

For our editors the growth of the Journal means more work. An expansion of our editorial staff may have to be considered for the future. Certain delays in publishing were caused by various reasons, some having arisen from unique personal circumstances. The Council has decided to check the whole publication policy of the Society and to investigate how the consumer can be served best.

This does not reduce the merits of the editors of the Journal who make a tremendous and unique effort to keep the printing delays low and the standards high. I wish to thank Dr John Glen, Dr Ray Adie, Dr David Homer, Miss Doris Johnson and Mrs Ailsa Macqueen for what they do behind the scene.

The extension of our offices, announced in my last report, has been successfully realized. One room is occupied by Peter Wood, who works as a Visiting Research Fellow on the Society's archives and history. We hope to be able to publish this history for the celebration of the Society's 50th anniversary in 1986.

Our regional branches have been active, some by visiting remote areas. The Western Alpine Branch met in Tarfala, Swedish Lapland in 1977, the Nordic Branch gathered in Iceland this year and the British Branch had a meeting in Manchester.

The membership of the Society stayed stable in numbers with a total of 1050 members.

There is a slow steady flux of people through the Society. On the losing end now and then one of our old members has to leave, who has played an important part in glaciology. As one of these, our Honorary Member Robert Haefeli, Professor of Soil Mechanics at the FIT, Zurich, died in April 1978 in his 80th year of life. He was the leader of the first Weissfluhjoch Research Team 1935 to 1940 and the founder of the present Snow and Avalanche Research Institute. By initiating the discipline of snow mechanics he started a development which swept the world. Robert Haefeli was also the driving force of the International Glaciological Greenland Expeditions 1959 to 1968, named EGIG, and many other glaciological programmes in the Alps. Those who knew this scientist of classical mould will never forget him.

The Council has agreed, upon the recommendation of its Awards Committee, to confer Honorary Membership upon our distinguished member Louis Lliboutry of Grenoble, France. His outstanding and widespread work, including a two-volume handbook on Glaciology, is well known and recognized.

The Council itself is renewed by a steady flux. To the ones whose term is expiring now I say good-bye. These are Ed LaChapelle, one of our Vice-presidents, and Colin Bull, Mike Kuhn, Olaf Løken and Igor Zotikov. The majority of them were able to offer a very intense co-operation for which they are thanked on behalf of the Society. I give thanks to Willy Weeks, who has served on the Council since 1969 and as President 1972-75.

Special thanks are addressed to Dr Gordon Robin, the Director of the Scott Polar Research Institute, where our Headquarters are located, for allowing us to be there.

At the annual dinner yesterday evening we had the opportunity to celebrate the 25 years of activity with the Society of our Secretary General, Mrs Hilda Richardson. I wish to thank her and her small staff, in particular Mrs Beverley Baker, for their efficient work. Under these conditions it was a pleasure to be the President of this Society.

3. **The Treasurer's** Report and accounts for 1977 were presented by Dr C. Swithinbank:

"I must first apologise for not being able to come to Ottawa personally and to thank Dr Swithinbank for presenting this report on my behalf. The statement of accounts for the year ended 31 December 1977 shows that we ended the year with a surplus of just over £2,000 which was reduced to £553 upon the transfer of £1,500 to the Contingencies Fund. The previous year the surplus was just over £5,000 before transferring £1,000 to the Contingencies Fund.

Moreover in 1977 we received £22,000 income from page charges whilst for 1978 our income from this source appears to be about £14,000. This might possibly be further increased by another £2,000 from the symposium volume. To make matters worse the number of pages in 1978 will be substantially more, and hence production costs substantially higher, than in the original budget estimate. It is encouraging to see the volume of papers and interest in the Journal increasing, but the optimum size of the Journal should be discussed when increased growth could cause serious financial problems.

The outlook for the future then is not too encouraging and it seems inevitable that subscription rates will have to be increased to keep pace with inflation. At the Council meeting on 14 September 1977 held in Cambridge, Council recognized the possible need to increase subscription rates more frequently than in the past. The last increase occurred after an interval of five years—previous increases followed a seven-year cycle. In the present financial climate a three-year cycle seems inevitable.

If nothing is done, we shall end 1979 with a deficit of about £5,000. If members' subscriptions are increased by 50% we would just about break even. If library subscriptions were also increased, our income would grow sufficiently to see us through the next three or four years. It should be pointed out that, in spite of inflation, the number of pages published has increased by about 50% since the last rise in subscription rates, so that members will still be getting a very good bargain.

Inflation and rising costs have made it difficult for Learned Societies. However, we must accept it as a present way of life and try and plan for the future as wisely as we can. If the Society is to continue its activities on the same scale as in the past, a rise in subscription rates is unavoidable."

(signed) J. A. Jacobs

Dr Swithinbank reported that the Council, at its meeting three days ago, had accepted the Treasurer's proposals. The 1979 rates will be £15 for Ordinary Members and £6 for Junior Members (under the age of 25). Rates for Libraries have also been increased.

4. **Election of auditors for the 1978 accounts:** Dr C. W. Swithinbank proposed and Dr Lorne Gold seconded that Messrs Peters, Elworthy and Moore, of Cambridge, be elected auditors for the 1978 accounts. This was carried unanimously.

5. **Elections to the Council 1978-81:** 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	L. W. Gold
Vice-Presidents	O. Orheim
	C. Swithinbank
Elective Members	H. Björnsson
	G. K. C. Clarke
	G. Golubev
	P. Schwerdtfeger

In accepting election as President, Dr Gold said he felt honoured at the confidence placed in him—a recognition of the growing strength of glaciological research in Canada. He expressed his gratitude to those Canadians who have worked in glaciology and for the Society over the last 25 years, mentioning particularly Elton Pounder, Phil Langleben and Bernard Michel.

In thanking Dr de Quervain for his work over the past three years, he warned his Canadian colleagues that he would be seeking their help in the next three years. Several meetings had already been arranged, which should continue to give the Society opportunities for making inter-disciplinary contacts, a role to which it was eminently suited.

1978 ANNUAL DINNER

The Society's 1978 Annual Dinner took place in Ottawa, Canada, on 24 August, during the week of the Symposium on Dynamics of large ice masses. The President, Dr Marcel de Quervain, welcomed over 100 members and guests, and in particular those participants of the Symposium who were not members of our Society. He gave a special welcome to our Honorary Member, Dr Robert F. Legget, who had re-arranged his tight travelling programme so that he could be present. The President also welcomed Dr and Mrs Ken Thorence, who were representing Carleton University, where the Symposium was being held, and Mrs and Mr Stauton who kindly introduced the Society to the Ottawa Hunt Club, and thanked them for the privilege of using the Club for this occasion.

After the Dinner, Dr L. W. Gold introduced Dr R. F. Legget by recounting not only how much his own career in snow and ice owed to him, but also how far Dr Legget's influence had spread beyond the Division of Building Research. He had played a significant role in the development of snow and ice research in Canada and he had, moreover, taken a very early interest in the affairs of the Society. As a strong supporter and as an Honorary Member, it was fitting that Dr Legget be asked to propose a toast to the Society.

Dr Legget, in an entertaining and interesting speech, recalled his long connections with snow

and ice work and the early days of the Society. He referred in particular to his meetings with Gerald Seligman and to the stimulus that these gave to his own growing interest in glaciology. Then he painted a vivid verbal picture of his visit to the laboratory on the Weissfluhjoch in Switzerland and of his meetings with Marcel de Quervain, now the Director of that laboratory and President of the Society. He returned finally to the Canadian scene, by recalling the influence that Marcel had had on research into snow and ice in Canada, and then proposed a toast to the Society, linked with the names of the President and the Secretary General.

In reply, Dr de Quervain said:

"As Dr Gold has pointed out in his introduction, the present activity in the field of snow and ice research in Canada and the high level contributions achieved in this country have been largely inspired and promoted by Dr Legget. Referring to his first visit at the Weissfluhjoch above Davos in 1947 and to my subsequent activity in Canada, Dr Legget has drawn a large circle of 30 years diameter, so to say, which is closing now with our present meeting. But too many personal matters and souvenirs are located in this circle to speak about here. Robert Legget has made a few allusions to our delightful co-operation. I wish to thank him for his stimulation and guidance over all these years, and now in particular for his brilliant and profound toast given to our Society.

"Sometimes it worries me that we have to deal with a material and with related processes which are hostile to life. Certainly there is a rigid beauty in snow crystals and lots of glamour in skiing, but whenever we have to do applied work we are confronted with nasty problems, dangers and catastrophes like snow blizzards, ice jams, avalanches.

"One may wonder how it is that people working with these cold, hostile materials snow and ice are so warm blooded and as a rule so nice to handle?

"My answer is speculative, but I have no other one to offer: Snow and ice are found in marginal zones of life, in the polar regions, in the mountains. Marginal zones as such are often distinguished to produce major quality. Best wines do not grow in the warmest climate but near the borders of wine areas. In addition if people enter snow and ice zones they have to form teams, they have to rely on each other rather than to fight, and the hostile surroundings create a spirit of co-operation. I see the Glaciological Society as a sort of a large team formed by a majority of members who know this expedition feeling and transfer it to the home work and to the life of the Society.

"In Canada, our present host country with its immense unsettled zones dominated by snow and ice, this spirit is particularly met with. We have experienced it in the oganization of these symposia and in the daily life of this country. I wish to propose a toast to Canada which has received us so well.

"Now we have the privilege to enjoy a celebration which is probably unique.

"Mrs Hilda Richardson, the Secretary General of the Society, is about to complete her 25th year of service to the Society. As an ex-student of Professor Vaughan Lewis at the University of Cambridge she was appointed in 1953 by Sir Vivian Fuchs and Dr Colin Bertram, two of the leading men of the Society which was at that time still the 'British Glaciological Society'.

"Looking back on these 25 years one notices an enormous development of this organization. On the way to becoming the international community of glaciologists of the world, in other words, of scientists and engineers interested in any form of snow and ice, the Society has burst at the seams twice. Hilda Richardson was and still is a driving force in this zoom to international reputation. Behind this achievement there is more than just professional skill and efficiency. I think it is the identification of her person with the Society, which in her eyes, and in ours too, is not merely an organization but a living organism of people linked together by common interests and friendship. Hilda Richardson has served and guided at the same time the ever changing Council and the series of Presidents. She was and is the string that holds together this agglomeration.

"We congratulate you, Hilda, on the occasion of this milestone and, above all we thank you for your devotion and achievement.

"As a souvenir for this day I wish to offer you a little present from the Society. It is an old engraving (acquatinta) showing the upper Grindelwald Glacier about 150 years ago. The glacier was down in the valley at that time, then it shrunk in the middle of this century, but now it is advancing again, hopefully symbolizing the development of the Society. The picture shows in addition an avalanche that had rushed down the Wetterhorn cliff, thus covering at least two of our many subjects."

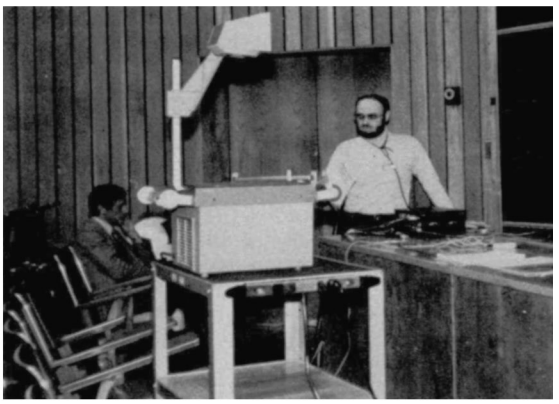
Mrs Richardson thanked the President for his kind words and for the beautiful gift. She agreed wholeheartedly with his remarks about the friendliness of glaciologists, and spoke about the privilege of having served with all the Presidents of the Society—each of whom had contributed in his own unique way to its development: Gerald Seligman, Vivian Fuchs, John Nye, Valter Schytt, Willy Weeks and Marcel de Quervain.

The evening ended with the presentation of a glass goblet, engraved with the Cambridge University coat-of-arms, to Lorne Gold and his wife, Joan, by Hilda Richardson—as a "thank you" for undertaking the local organization of the Symposium this year, a task that up to now has been done by the Headquarters staff in Cambridge.

SYMPOSIUM ON DYNAMICS OF LARGE ICE MASSES
Ottawa, 1978

Participants ←

and one of the authors of papers →



and some of the helpers ←

1978 ANNUAL DINNER

Lorne Gold (Chairman, Local Organizing Committee) ↑

Marcel de Quervain (President) ↑

and families

Lorne Gold chats to Hilda Richardson (Sec. Gen.) ↓ ↓

Simon Ommanney (Symposium Local Organizing Committee) ←

The President replies to the toast to the Society, proposed by Robert Legget (far left) ←

BRANCH NEWS

NORDIC BRANCH

The fifth meeting of the Nordic Branch was held at Kirkjubæjarklaustur, South East Iceland from 18-24 June 1978. The meeting was attended by 36 Society members and "family members" from Denmark, Finland, Norway and Sweden and 3 from the U.S.A. Altogether 14 Icelanders participated in some or all of the activities. The time was divided about half and half between excursions and technical sessions.

Prof. Sigurdur Thorarinsson, an Honorary Member of the Society, guided the group on excursions through extensive lava fields, between active volcanoes, across vast sandur areas, the playgrounds of catastrophic jökulhlaups, and to some of the most interesting geological and historical places in Iceland. Through his excellent guidance, the participants got a unique description of the Icelanders' thousand years of struggle against ice and fire. Among the places visited the following can be mentioned: Reykjavik, Geysir, Gullfoss, Skógasandur, Myrdalssandur, Sólheimajökull (advancing for the present), Eldhraun (the Laki lava), Eldgjálava, Skeidarársandur, Skaftafell National Park, Öræfajökull and its glacier outlets (skriðjöklar), Breidamerkurjökull, Jökulsárlón, Hoffellsjökull, Höfn and Thingvellir. Sigurdur Thorarinsson wrote a guide for the whole excursion. The weather was beautiful with brilliant sunshine during the whole week.

In the technical sessions the participants presented many interesting papers and progress reports, described and discussed informally their current glaciological interests and activities. Altogether 25 papers were presented with the following authors and contents:

Sigurdur Thorarinsson: Catastrophes of ice and fire which have hit the district Skaftafellssysla in historical times.

Helgi Björnsson: The various types of jökulhlaups in Iceland—their sources, triggering and hydrodynamics.

Claus U. Hammer: Past volcanism revealed by Greenland ice sheet impurities.

Sigurdur Steinthórsson: Tephra layers in a drill core from the Vatnajökull ice cap.

Bragi Árnason: The age and flow velocity of thermal groundwater in Northern Iceland. Preliminary results.

Ingvar Gjessing: The chemical composition of snow—a measure of air pollution?

Sigfus Johnsen: Remarks on some problems in the dynamics of large ice masses.

Sören Overgaard: Radio-echo sounding of the Greenland ice sheet.

Helgi Björnsson, Marteinn Sverrisson and Ævar Jóhannesson: An equipment for radio-echo sounding of temperate glaciers in Iceland.

Helgi Björnsson: Results of radio-echo soundings of the ice caps Vatnajökull and Myrdalsjökull.

Carsten Rygner: The fixing of geographical positions by use of navigation satellites.

Rögnvaldur Ólafsson: A fully electronic data logging system for recording geophysical data.

Björn Holmgren: Glacial-meteorological studies in Tarfala, Sweden.

Valter Schytt: Variations of the mass balances of Storglaciären and Hintereisferner.

Jörgen Nilsson: Periodic variations in the horizontal gradient of the mean annual air temperature in Sweden.

Haukur Tómasson: Transport of sediments in glacier rivers in Iceland.

Inga Kaldal: Moraines north of Hofsjökull, central Iceland.

Eggert Lárusson: Distribution of cirques in North-West Iceland.

Eiliv Larsen: Former cirque glaciation in outer Nordfjord, Western Norway.

Richard Cameron: Interesting forms on the Greenland Ice Sheet.

Wibjörn Karlén: Preliminary results from studies of pro-glacial lacustrine sediments.

Tvis Knudsen: Short term variations of glacier margins measured by terrestrial photogrammetry. A survey of Austre Okstindbreen and Corneliussens Bre, Okstindan, Norway.

Edvigs Kanavin: Ice problems in water-courses.

Oddur Sigurdsson: A show of three-dimensional slides of glaciers in Iceland.

Sigurdur Thorarinsson: A lesson in the pronunciation of Icelandic place-names.

The meeting was financially supported by the Nordic Cultural Fund.

Professor Valter Schytt offered to host the next meeting in Sweden in August 1979.

Helgi Björnsson

BRITISH BRANCH

The 1979 meeting will be held on Friday 30 March in the Geography Department, University of Newcastle upon Tyne. It is hoped that the meeting will be followed by a week-end in the Lake District. Further details may be obtained from the Branch Secretary, David Collins, School of Geography, University of Manchester, Manchester M13 9PL.

JOURNAL OF GLACIOLOGY

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

V. L. Tsurikov:
The formation and composition of the gas content of sea ice.

J. Ehlers and H.-J. Stephen:
Forms at the base of till strata as indicators of glacier movement.

O. Haida, H. Suga and S. Seki:
Enthalpy relaxation phenomenon of heavy ice.

R. W. Taylor:
Instruments and methods: Flexural wave studies on the basis of single-sensor recording.

G. Boulton, E. Morris, A. Armstrong and A. Thomas:
Direct measurement of stress at the base of a glacier.

C. Boned, B. Lagourette and M. Clausse:
Dielectric behaviour of ice microcrystals: a study versus temperature.

N. F. Drozdovskaya:
Using linear discriminant analysis to classify snowfall situations into avalanching and non-avalanching ones.

SHORT NOTES

H. Brady and B. McKelvey:
The interpretation of a Tertiary tillite at Mount Feather, Southern Victoria Land, Antarctica.

P. W. F. Gribbon:
Cryoconite holes on Sermikavsak, West Greenland.

H. Gubler:
Acoustic emission as an indicator of stability decrease in fracture zones of avalanches.

R. J. Evans and R. Reid Parmeter:
Gravitational stresses in floating ice sheets.

M. Matsuda:
Instruments and methods: Determination of a-axis orientation of polycrystalline ice.

FUTURE MEETINGS WITH WHICH THE SOCIETY IS ASSOCIATED

Members will be interested in the following diary of events with which we are associated. Our level of activity is growing apace.

1979

in Fort Collins, Colorado, U.S.A.—
Symposium on avalanches and blowing snow 12-17 August. Organized by Colorado State University. Sponsored by the Mountain Snow and Avalanche Research Project of the Rocky Mountain Forest and Range Experiment Station, U.S. Forest Service and the International Glaciological Society.
Proceedings will be published in the *Journal of Glaciology.*

1980

in Cambridge, U.K.—
Conference on Use of icebergs. 1-3 April. Organized by International Glaciological Society. Hosted by Scott Polar Research Institute. Sponsored by Iceberg Transport International Limited.

1980

in Geilo, Norway—
Symposium on Processes of glacier erosion and sedimentation 25-29 August. Organized by International Glaciological Society.
Proceedings will be published in the *Journal of Glaciology.*

1981

in Columbus, Ohio, U.S.A.—
Third Symposium on Antarctic Glaciology. August. Organized by Scientific Committee on Antarctic Research, Working Group on Glaciology and Ohio State University, Institute of Polar Studies. Sponsored by Scientific Committee on Antarctic Research, International Commission on Snow and Ice and International Glaciological Society.
Proceedings will be published in the *Journal of Glaciology.*

1982

in Hanover, New Hampshire, U.S.A.—
Second Symposium on Applied Glaciology (date to be decided). Organized by International Glaciological Society. Hosted by Cold Regions Research and Engineering Laboratory.
Proceedings will be published in the *Journal of Glaciology.*

RECENT MEETINGS (of other organisations)

1978 REGIONAL TRAINING SEMINAR ON ICE, SNOW & AVALANCHES

In the last 11 years Unesco has sponsored training courses in snow and ice hydrology, the first two at the Tarfala Research Station in Northern Sweden in 1967 and 1970 where participants from a great number of nations were present, the instructors being Scandinavian experts in glaciology and related topics.

The IHD Panel on snow and ice (Unesco/IAHS) recommends that similar courses should be continued, preferably in other regions with glaciers and perennial snow fields, and invited UNDP to support such activities (Resolution 25—Snow and Ice Investigations).

The first Regional Training Course was then held in Latin America in November/December 1971 with 18 participants from 4 South American countries. The instructors were 3 European experts in the field of glaciology, snow and ice physics, and snow hydrology.

The second similar activity, initiated by SASE and UNESCO, was the course in India, 13-29 March 1978.

Preparations

A preparatory Workshop was arranged in Manali, Himachal Pradesh, Northern India, in April 1977, where representatives from Unesco, the Indian IHP, various Indian authorities and a number of Indian scientific experts were present.

Drs B. Salm (Switzerland) and G. Østrem (Norway) had been invited by Unesco to participate in this Preparatory Workshop to give their opinion on the planned Training Seminar in 1978. After various consultations in Manali and in Delhi, they submitted a comprehensive report, dated 3 May 1977, containing all agreements concerning the main syllabus, the relative time allocations for various subjects, and a list of equipment and facilities required. The report contained also a list of proposed foreign lecturers for the planned Training Seminar.

Participants

Unesco has invited participants from various countries in the region. The following countries were represented: Afghanistan (2), Iran (1), Nepal (2), Pakistan (1), and India (20). Most of these 26 participants had a relevant theoretical background. However, due to the fact that many of the subjects dealt with in the Seminar have not become study areas in this region, many of the participants were new to this type of study.

This, in one way, made the Seminar difficult to perform, but—in another way—it also demonstrated that this kind of educational activity is needed in the region, because the urgency of solving hydrological and glaciological problems is quite obvious.

At the beginning of the course, all participants were divided in two groups, one for snow and ice hydrology (Group H) and one for avalanches (Group A).

Although some theoretical lectures were given for all participants (Group H and A together), this relative strict division in separate groups was unknown to many participants and came as a surprise to them. However, they were given opportunity to change from one group to another at the beginning of the Seminar.

For future activities we will emphasize the need for the National Commissions to provide the participants whom they have nominated with the relevant information provided by Unesco.

The total number of participants in each group was almost equal (12 H, 14 A), an ideal size for the conduct of exercises, etc.

Instructors

The Indian instructors co-operated to give lectures on such topics which were thought to be of general interest for both groups (for example: climatology of the Himalaya, meteorological aspects, use of remote sensing, isotope techniques, etc.).

Many of these lectures were of excellent quality and gave valuable information. We feel, however, that a better co-ordination between the instructors should have been made in advance, to avoid unnecessary (and sometimes confusing) overlapping, and to secure a logical, pedagogical succession of the lectures given.

As it turned out at the Seminar, some basic and elementary lectures were given after more sophisticated ones—thus causing pedagogical problems and a number of unnecessary questions in the beginning.

The foreign instructors were, according to the agreement made in 1977, Drs B. Salm and G. Østrem as Chief Instructors for the two groups respectively, and they also acted as co-ordinators for programme details.

Further, according to the list of desired additional instructors from abroad (given in the above-mentioned report of 3 May 1977), Unesco had invited Dr Ron Perla (Canmore, Canada) for the Avalanche Group and Dr Kotlyakov (Moscow) for the Hydrology Group. When it became clear that Dr Kotlyakov could not come, the Soviet National Commission decided to send Prof. K. Losev as a replacement. This was *not* in accordance with the agreement made in 1977, where it was clearly stated that foreign lecturers should be selected according to a given priority list *or* after consultation with the Chief Instructors.

Prof. Losev was unable to assist within the Hydrology Group, but gave some contributions

to the Avalanche Group. Consequently a heavy educational load was placed on Dr Østrem who had the entire responsibility for all lectures and exercises in the Hydrology Group—with only a few exceptions.

Prof. Fritz Müller (Switzerland) participated during the last week of the Seminar, giving some lectures to both groups together and particular instructions and exercises in the Hydrology Group, thus releasing Østrem from parts of his responsibility.

Course Content

The general syllabus and time allotments as agreed to in 1977 were followed with only minor deviations. About 2/3 of the total time was devoted to practical exercises (indoor and outdoor) and most of the training was given separately for the two groups. Some of the planned exercises took, however, more time than foreseen so some others had to be cancelled. Only 3 days (19-21 March) were allocated for common lectures, although some single common lectures were given later in the course. 13 participants gave short presentations dealing with their own work, and these talks were given for both groups together. These presentations were much appreciated.

At the end of the Seminar, all participants were requested to fill in a questionnaire to give the organizers an idea of their appreciation and/or criticism of the course content.

Practical Arrangements

Based upon discussions during the Preparatory Workshop in 1977, and the above-mentioned report dated 3 May 1977, SASE had made great efforts to provide adequate technical and educational facilities. Lecture rooms, catering and local transportation were all up to the standards expected. Frequent electricity failures were quickly compensated by SASE's generators, and all possible assistance was given where required by the SASE staff.

A minor problem was created by failure of the slide projectors, so a manual shift of slides proved necessary for most of the lectures. This detail should, however, not cast any shadow on all the detailed and well planned preparations made under the directionship of Lt. Col. K. C. Agrawal and Lt. Col. Lalji D. Singh.

Experiences

Concerning the preparations for this Seminar it is obvious that the Preparatory Workshop one year in advance was absolutely necessary. Without this we feel that the fulfilment of the Seminar would have been extremely difficult or almost impossible.

Although the lecturers supplemented each other remarkably well, co-ordination between them could have been better ahead of time. A meeting should have been arranged between Indian lecturers as soon as the financial background for the Seminar was granted, to avoid situations as described above.

For future courses it is recommended that *all* lecturers prepare titles and abstracts of proposed lectures well in advance so that the chief instructors can propose alterations and ensure sufficient coordination between them.

Even more important is the definite need for at least one two-day meeting between Chief Instructors and foreign lecturers well in advance (as was the case prior to the Regional Training Course in 1971). This is an absolute condition for future arrangements—detailed planning and discussions of this kind cannot be done by mail alone.

The distance and communication difficulties between overseas instructors focuses on a possible priority for a selection of all experts from one area, either North America or Europe only, simply for practical (and economical) reasons.

In addition to equipment and instruments acquired locally, it will aways be necessary to bring specialized items from abroad, and provisions must be made for this. The same relates to literature. Some common books and reprints should be acquired as hand-outs, while larger books and/or items out of print should be made available for consultation during the course—preferable in more than one single copy. Selected bibliographies and lists of information sources are recommended for distribution to participants.

Finally, it cannot be sufficiently stressed that good projector facilities are vital. Several projectors must be available (also for the case of breakdown), both for slides, 16 mm films and viewgraphs ("overhead projectors"). Both glass-mounted and cardboard-mounted slides must be accommodated in the projectors. Otherwise major parts of given talks can be completely spoiled. Also a good quality blackboard and coloured chalks are not to be forgotten in this connection.

Future Arrangements

Participants at this Seminar have indicated that there is a need for similar arrangements in the future. Most of them are of the opinion that their home country/institution will send several suitable representatives if another Training Seminar is arranged in the Region.

Thus, it seems to us that this Seminar has planted a seed which should be given possibilities to grow in the future. So we recommend that this Seminar be followed by a series of courses in the same general field, but one can discuss whether snow and ice hydrology should be combined with avalanche courses.

The location for such courses must be carefully selected, taking into account the need of short distances to snow-covered areas and suitable indoor training facilities. Advance inspection of the site and the intended lecture facilities must be made by the Chief Instructors.

To facilitate the best possible selection of suitable trainees, notice about a planned course

should be given well in advance, at least six months, preferably one year before its start.

Finally, it is stressed that for courses dealing with snow cover it is vital for all participants to be able to move around in the snow, having suitable clothing. Therefore skis and/or snow shoes, wind protecting clothes, gloves, etc. must be made available (as was arranged by SASE at this Seminar). Further, trainees with some general mountaineering experience should be given priority, if possible.

Acknowledgements

A special thanks should be conveyed to UNEP World Glacier Inventory Project because their support made it possible for Prof. Fritz Müller to participate as one of the foreign instructors. This enabled him also to establish contacts for the World Glacier Inventory.

The undersigned are grateful for all the assistance given and the good co-operation obtained with Unesco during all stages of preparation for this Seminar and we are willing to continue this co-operation if future similar courses are planned.

Davos and Oslo, 10 April 1978

Gunnar Østrem

Bruno Salm

(Report to Unesco)

1978 FIELD TRAINING COURSE ON PEYTO GLACIER

The following diary of activities gives an insight into this course, conducted by the Department of Geography of Carleton University, Ottawa, Canada.

Sunday 30 July

Arrival in Calgary. Participants reported at the reception desk in Kananaski's Hall (student's residence at Calgary University). An introductory lecture on glacier classification was given at 1900 hours in a lecture room at Geography Department.

Monday 31 July

Lectures were given from 0900 hours: glacier types, ice avalanches (by Dr. Ron Perla, Canmore), methods of water discharge measurements. In the afternoon: Exercise on calculation methods for the current metre.

After supper an evening lecture was given on glacier mass balance. All participants were thereafter invited for a beer at a nearby restaurant.

Tuesday 1 August

Start from Calgary University in a rented 12-seat van. Some equipment went in a Government truck (Glaciology Division—Gordon Young). Halt in Banff to purchase fresh food, and in Lake Louise to see the lake and the area.

Walk from Peyto Lookout to the glacier (almost four hours with heavy packs).

After dinner two evening lectures were given by Gordon Young on "Glaciological activities at Peyto Glacier" and by David Collins on "Present investigations by the British Group 1978".

Wednesday 2 August

A tour of the station was conducted in the morning by "Peter"; the performance of various meteorological instruments were discussed. Then a trip was made onto the glacier tongue to see how a stake was re-drilled. Then all participants were allowed to practise ice-drilling and several stakes were inserted in the glacier for daily observations of ice melt during the course. An instruction was given in roping techniques—knots and walking rules.

The afternoon's exercise was related to accumulation measurements, particularly to snow pit studies, as an introduction to next day's field work.

David Collins gave the evening lecture, "Intraglacial drainage, various theories".

Thursday 3 August

The entire day, which was sunny and pleasant, was devoted to accumulation studies. The whole party went up to an area of heavy snow cover—crossing some crevasses where ropes were used. Three pits were dug by participants who also made several snow thickness measurements (sounding profiles).

The data collected were processed after dinner in the camp and results compared between the three working groups. No evening lecture was given.

Friday 4 August

The morning lecture was an introduction to Ice Crystallography, after which all participants went onto the glacier to obtain ice samples for crystallographic studies. Three various samples were taken: ice with typically large crystals, ice with small crystals (both taken by a coring auger), and a large block (approximately 30 x 30 x 30 cm).

Thin sections were made of the two first mentioned samples, and they were examined between crossed polaroids. Some samples were photographed by participants. The ice block was used to demonstrate the existence of interstitial water by application of ink on the top of the block. The demonstration was successful due to clear sunshine.

After lunch the exercise "Equilibrium line and the glaciation level" was executed. Participants rotated between tables where 13 various maps were examined.

A lecture on "The salt dilution method" was given before supper. The evening lecture was given by Mr Battacharya concerning his own work on glaciers in India.

Saturday 5 August

The entire day was devoted to salt dilution experiments in the Cauldron Creek and to sediment sampling in Peyto River. After a complete demonstration, the participants, divided in two groups, repeated the measurements. Sediment sampling and filtering exercises were also made by all participants. Lunch was taken in the field, under excellent weather conditions —sunny and warm.

Upon return to the camp, all participants processed their figures obtained during the field exercise, and results were compared.

After dinner one short lecture was given on "Sediment Transport in Glacier Streams", and then Björn Wold showed pictures from his visit to Antarctica—a show which was most appreciated.

Sunday 6 August

A morning lecture was given on "Glacier Mapping". Then the exercise "Sediment Transport Calculations" was executed. The weather had deteriorated slightly and some rain fell during the afternoon, when participants had been promised "a half day off". They used this time for writing-up their notes, reading, washing clothes, etc.

The evening lecture was given by Björn Wold who told about activities on Spitzbergen, and showed slides from his two winters there.

Monday 7 August

The entire day was used for an excursion to Athabasca Glacier. Breakfast was taken early, start from the camp at 0815, arrival at the Lookout about 1000, where a letter was found on the car. It invited us to pay a visit to Hilda Creek, just south of the Athabasca Glacier, to see installations for bedload measurements made by the University of Illinois (Chicago). This detour from our planned route was much appreciated.

Lunch was taken near the Athabasca Chalet (packed lunches from the camp) and visits were made to the Athabasca Centre, to the glacier snout and to the look-out. One of the Centre's guides went with us on these trips, giving us some interesting information.

Back at Peyto Lookout at 1800 from where some fresh food was taken up to the camp, arriving there about 2000. Due to the long day and a late supper (at 2100) no evening lecture was given.

Tuesday 8 August

The breakfast was served later than normal due to a good, quiet night's sleep(!). Although the weather was excellent—sun, no clouds and little wind—it was decided to perform mainly indoor exercises.

Before lunch the exercise "Construction of isohydrates" was executed, after lunch the "Sildvik Project" was made, partly outside the lecture tent (in the sun).

The evening lecture "Glacier Hydrology" was partly an introduction to later exercises, partly a general lecture on the subject.

Wednesday 9 August

The whole day was devoted to river observations, so pack lunches were brought together with equipment for current meter measurements. Participants were divided in two parties, one using the current meter, the other making temperature observations in Peyto River and Cauldron Creek (for relative discharge determinations). After lunch the parties shifted.

Back in camp the two parties processed their figures and discussed their results.

The evening lecture "River gauging stations" accentuated various instruments, good and bad location of staff gauges, etc., with examples (shown on slides).

Thursday 10 August

The entire morning was used for indoor activities: exercises on the "Unit Hydrograph" and "Various Rating Curves" were executed before lunch, whereas a lecture on glacier movement was given after lunch. There the group made a trip onto the glacier where arrangements were made to demonstrate various field methods for velocity observations. Upon return the exercise "The Double Mass Curve" was completed.

The evening lecture focused on various snowlines and the use of remote sensing in snow and ice investigations.

Friday 11 August

Rain showers all day; so no outdoor activities were performed. A number of indoor exercises were carried out: complete mass balance calculations for Ram River Glacier 1966 and/or 1971 (before lunch), Principles of a "Stake Diagram" with plotting of data obtained during the course, as well as a "melt/energy" plot from the same data, and finally the calculation of snow melt water from satellite data.

After a short coffee break, the written examination was executed, with participants distributed in the tents and in the cabin.

The last evening was used for a joint lecture (by Wold and Østrem) on "Subglacial Observations in Norway" and a social event (tea, coffee, etc.) during which a souvenir—a "Glacier Egg" was given to all participants.

Saturday 12 August

Rain and fog were the mountains' greetings where the group walked out from the camp at 0715 in the morning, reaching Peyto Lookout about 2 hours later. One student returned to the camp (continued summer job for the Glaciology Division), the rest started for Calgary at 0940, with a considerable amount of equipment in the van.

Short stop for coffee in Canmore, arrival in Calgary about 1330. Then participants travelled in various directions, and the course had come to a successful end, without any mishap or injury.

Gunnar Østrem

FUTURE MEETINGS (of other organisations)

INTERNATIONAL COMMISSION ON SNOW AND ICE

(A) SYMPOSIUM ON SEA LEVEL, ICE SHEETS, AND CLIMATIC CHANGE

(IAHS - IAMAP - IAPSO - IASPEI - ICGC)

Canberra, during IUGG General Assembly, 3-15 December 1979

FIRST CIRCULAR

Origin and Purpose

The cryosphere has received more than its fair share of recent speculations about the climatic past and future. The purpose of this symposium is to review processes and effects *other than those of climate* which could produce changes in sea level and in the large ice sheets; and thereby to define a residue of features which presumably do have climatic causes or effects.

The time scales addressed range from 10^2 to 10^7 years. A parallel symposium on Ice, Weather, and Climate will consider the shorter-lived forms of ice (snow, sea ice, mountain glaciers) and the associated meteorological factors. The two symposia will be combined if the number of papers offered permits this to be done.

Date and Place of the Symposium

The Symposium on Sea Level, Ice Sheets, and Climatic Change forms part of the programme of the 17th General Assembly of the International Union of Geodesy and Geophysics which will be held at Canberra, Australia, from 2 to 15 December 1979. This symposium is scheduled for the afternoon of Friday 7 December and for as much as needed of Saturday 8 December.

Organization

The first session (Friday afternoon) will deal with current views on non-climatic explanations of historical sea level changes. The second session (Saturday morning) will deal with intrinsic ice sheet variability and with the glaciological interpretation of ice core data. The final session (Saturday afternoon) will attempt to establish a body of sea level and ice sheet facts which cannot be understood at present without invoking climatic change.

If no parallel symposium on Ice, Weather, and Climate, proves feasible or necessary the relevant themes will be discussed in separate sessions on Friday 7 December (for details see separate Circular).

Each session will start with an invited review lecture. Contributed papers will next be summarized by their authors and discussed. Following glaciological tradition, the only working language of the symposium will be English.

Abstracts

Abstracts not exceeding 200 words in length should be sent to each of the following addresses:

i) Uwe Radok, Convenor, ISSICC, c/o CIRES, University of Colorado, Boulder, CO 80309, USA;

ii) International Association of Hydrological Sciences, Assistant Editor, Institute of Hydrology, WALLINGFORD, Oxon, OX10 8BB, United Kingdom;

iii) The National Committee of the author's Association.

THE DEADLINE FOR ABSTRACTS IS 31 OCTOBER 1978.

Papers

Only original papers will be accepted; authors must present their own summaries and take part in the discussion at Canberra. Authors of accepted papers will be notified by 15 December and informed of editorial requirements to enable the symposium proceedings to be pre-published. The complete and final manuscripts must reach the Editor by 15 March 1979. Late papers may be published in the Hydrological Sciences Bulletin.

The papers should be written in English, but will be accepted in other languages if accompanied by an English translation. Manuscripts, including abstract, illustrations, and photographs, should not exceed 16 pages. Typing should be double-spaced on one side of A4 paper. Illustrations should be of a quality suitable for reproduction.

Further Details

An information note giving details of the organization of the General Assembly, excursions, and hotels and reservations, can be obtained by writing to the Symposium Organizing Committee at the following address:

Organizing Committee for the 17th IUGG General Assembly
Australian Academy of Sciences
P.O. Box 783
CANBERRA CITY, A.C.T. 2601
Australia

(B) SYMPOSIUM ON ICE, WEATHER, AND CLIMATE

Origin and Purpose

Various short-lived forms of ice are important clements of the climate system. The purpose of this symposium is to review current ideas and new results on the associated weather processes and their ensemble averages, the local and regional climatic fluctuations. Examples are the anticyclogenetic effects of new snow covers, the interactions of synoptic systems with the sea ice edge and with ice packs of different concentrations, and the meso-scale meteorology of changes in the mass balance of mountain glaciers.

The time scales to be addressed range from a few days to a few years. The longer time scales will be considered in a parallel symposium on Sea Level, Ice Sheets, and Climatic Change. The two symposia will be combined if the number of papers offered permit this to be done.

Date and Place of the Symposium

The Symposium on Ice, Weather, and Climate forms part of the programme of the 17th General Assembly of the International Union of Geodesy and Geophysics which will be held at Canberra, Australia, from 2 to 15 December 1979. This symposium is tentatively scheduled for Friday 7 December.

Organization

The morning session will deal with snow and sea ice, while the afternoon session will consider mountain glaciers and sum up the conclusions reached. Each topic will be introduced by an invited review lecture. Contributed papers will next be summarized by their authors and discussed. Following glaciological tradition, the only working language of the symposium will be English.

Abstracts

Abstracts not exceeding 200 words in length should be sent to each of the following addresses:

i) Ian Allison, Convenor, ISIWAC, c/o Glaciology Section, Antarctic Division, Department of Science, University of Melbourne, Parkville Vic. 3052, Australia;

ii) International Association of Hydrological Sciences, Assistant Editor, Institute of Hydrology, WALLINGFORD, Oxon, OX10 8BB, United Kingdom;

iii) Uwe Radok, Convenor, ISSICC, c/o CIRES, University of Colorado, Boulder, CO 80309, USA.

THE DEADLINE FOR ABSTRACTS IS 31 OCTOBER 1978.

Papers

Only original papers will be accepted; authors must present their own summaries and take part in the discussion at Canberra. Authors of accepted papers will be notified by 15 December and informed of editorial requirements to enable the symposium proceedings to be pre-published. The complete and final manuscripts must reach the Editor by 15 March 1979. Late papers may be published in the Hydrological Sciences Bulletin.

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Further Details

An information note giving details of the organization of the General Assembly, excursions, and hotels and reservations, can be obtained by writing to the Symposium Organizing Committee at the following address:

Organizing Committee for the 17th IUGG General Assembly
Australian Academy of Sciences
P.O. Box 783
CANBERRA CITY, A.C.T. 2601
Australia.

IAMAP Int. Ass. Meteorology and Atmospheric Physics
IAPSO Int. Ass. Physical Sciences of the Ocean
IASPEI Int. Ass. Seismology and Physics of the Earth's Interior
ICGC Inter-Union Commission on Geochemistry.

IUTAM SYMPOSIUM ON THE PHYSICS AND MECHANICS OF ICE

Copenhagen, 6-10 August 1979

INTRODUCTORY NOTE

Place
Technical University of Denmark, Copenhagen, Denmark.

Time
6-10 August, 1979.

Main subjects
(1) Physical and mechanical properties of ice.

(2) Mechanical models for calculating ice forces on structures.

(3) Applied mathematics as a tool used in ice mechanics.

Examples of some subjects
Basic ice properties. Strength of ice. Testing of ice. Model ice. Melting and freezing process of ice. Permeability and creep of ice at melting point. Ice sheet dynamics. Failure process in ice. Sliding laws of temperate glaciers. Ice forces on structures. Thrust of freshwater ice against piles and dams. Characteristics of icebergs. Sea ice strength due to a cyclic load. Theory of floating ice sheets. Bearing capacity of ice.

Purpose
The main purpose of the symposium is to exchange the latest achievements within the field of ice science by bringing together different categories of scientists with engineers working on the application of the basic knowledge.

Emphasis is given to the union of ice research, applied mathematics and theoretical mechanics.

Scientific Committee
Dr. L. W. Gold (Canada), Professor S. S. Grigorian (USSR), Professor L. Lliboutry (France), Dr. M. Mellor (USA), Professor J. F. Nye (UK), Dr. J. Schwarz (Germany FR), Professor T. Tabata (Japan), Professor P. Tryde (Denmark, chairman).

Co-Sponsors
International Association for Hydraulic Research (IAHR), International Commission on Snow and Ice, The Geological Survey of Greenland (Ministry for Greenland), Geophysical Isotope Laboratory (University of Copenhagen), Greenland Technical Organisation (Ministry for Greenland), Danish Hydraulic Institute (Danish Academy of Technical Sciences).

Danish Organizing Committee
Professor W. Dansgaard (University of Copenhagen), Assoc. Professor S. J. Johnsen (University of Copenhagen), Assoc. Professor N. Reeh (University of Copenhagen), Assoc. Professor P. Tryde (Technical University of Denmark).

Secretariat (and further information)
P. Tryde, Institute of Hydrodynamics and Hydraulic Engineering, Technical University of Denmark, Building 115, DK-2800 Lyngby / Denmark.
Telephone: +45 2 88 42 00 ext. 5028
Telegrams: Hydroeng, Lyngby
Telex: 37529 DTHDIA DK.

GLACIOLOGICAL DIARY

1979

2–4 March
Northeast North American Branch IGS, meeting in Kingfield, Maine, USA. (R. H. Thomas, Institute for Quaternary Studies, Boardman Hall, University of Maine, Orono, ME 04773, U.S.A.)

30 March
British Branch of IGS, Newcastle upon Tyne. (D. Collins, School of Geography, University of Manchester, Manchester M13 9PL.)

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

11–15 June
William T. Pecora Memorial Symposium: Satellite hydrology. Sioux Falls, S. Dakota, USA. (D. R. Wiesnet, NOAA/NESS, S-33, Washington, D.C. 20233, USA.)

6–10 August
Symposium on the Physics and mechanics of ice. IUTAM. Copenhagen. (P. Tryde, Institute of Hydrodynamics and Hydraulic Engineering, Technical University of Denmark, Building 115, DK-2800 Lyngby, Denmark. (See p. 26 of this issue of ICE.)

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

7–8 December
Symposia on Sea level, ice sheets and climatic change, and on Ice, weather and climate. Canberra, Australia. International Commission on Snow and Ice, during General Assembly of I.U.G.G. (3-15 December). (U. Radok, c/o CIRES, University of Colorado, Boulder, CO 80309, U.S.A.) (See pp. 24-25 of this issue of ICE)

1980

1–3 April
Conference on Iceberg Utilization. Cambridge, U.K. Organized by International Glaciological Society, hosted by Scott Polar Research Institute, sponsored by Iceberg Transport International. (Mrs H. Richardson, International Glaciological Society, Lensfield Road, Cambridge CB2 1ER, England.)

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

1981

Last week July
International Association of Hydraulic Research—Ice Symposium. Quebec City. (B. Michel, Département Génie Civil, Université Laval, Québec 10, P.Q., G1K 7P4, Canada.)

31 August–4 September
Third International Symposium on Antarctic Glaciology. Columbus, Ohio, USA. Scientific Committee on Antarctic Research of ICSU. Co-sponsored by International Commission of Snow and Ice and International Glaciological Society. (Dr C. B. B. Bull, Office of the Dean, College of Mathematics & Physical Sciences, Ohio State University, 164 West 17th Avenue, Columbus, Ohio 43210, USA.)

1982

23–27 August
Second Symposium on Applied Glaciology, Hanover, New Hampshire, USA. Organized by International Glaciological Society, hosted by Cold Regions Research and Engineering Laboratory. (Mrs H. Richardson, International Glaciological Society, Lensfield Road, Cambridge CB2 1ER, England.)

REVIEW

A. H. Perry and J. M. Walker. The Ocean-Atmosphere System. Longman, New York and London 160 pp (1967). $10.50 (paperback, large format), $17.50 (hardbound).

In "The Ocean-Atmosphere System" Perry and Walker treat interactions between the atmosphere and the oceans and the interdependence of atmospheric and oceanic circulations. The book is aimed at upper level undergraduates and beginning graduate students and attempts to fill the void between introductory texts and specialized monographs such as those of Roll and Kraus. To effectively carry this out is a tall order requiring an encyclopedic knowledge of this very broad and complex subject. Some idea of the coverage can be gained from the chapter headings: The nature and characteristics of the ocean-atmosphere system, oceanic macro-circulations, the action of wind on the sea, ocean-atmosphere heat exchange, thermal behavior of the ocean-atmosphere system and climatic responses, and international projects and numerical models. To expand further under "The action of wind on the sea" one finds sections dealing with the generation and growth of waves, wave forecasting, wave spectra, swell propagation, breaking waves, the meteorological significance of breaking waves, contamination of the sea-surface, the origin of drift currents, Ekman's idealized theory of wind driven currents, turbulence in the upper ocean, some further aspects of Ekman's assumptions, upwelling and surges, and all this in 22 pages. Even considering the fact that the pages are large, that is what I call compact. The book is loaded with facts, figures, and quotes; so much so that at times it becomes overwhelming. If you don't understand baroclinicity, the Coriolis force, wave spectra and vorticity before you read the book, you still won't when you are finished. However, if you do, you will accrue all sorts of tid-bits regarding how things are all over the world ocean plus a very good up-to-date reference list on most everything oceanic and atmospheric. Where could you use this book? Definitely as supplementary reading in a wide variety of ocean

and atmosphere courses. However, not as an initial source of fundamental geophysical understanding.

Why am I reviewing this book in the first place? (I am never windy and dislike making waves.) Because the book is unusual in that it recognizes the geophysical importance of ice in sea and attempts to put this into proper perspective. How do the authors fare on this score? Not great but far better than most (excepting Sverdrup who had indeed seen a few floes in his time). When you are done with Perry and Walker you will have an idea of where the ice is, how it grows and decays. Also you will know that a number of investigators ranging from Badgley to Wittmann (they missed Zubov, for shame) have seriously worried about sea ice; and where to find their papers.

My impression upon finishing the book was that I had picked up all sorts of interesting facts and figures about the winds and the waves. I had also been subjected to quite a bit about sea ice that was OK but not quite like I would say it. I would guess that a wave man would find the wind and ice parts interesting but the waves not quite the way he would have phrased it. This just goes to show that you can't keep everyone happy and also that the authors have been quite successful in achieving the avowed purpose of the text.

The figures are very well done, the printing is easy to read, and the price is quite reasonable. Besides if you buy the book you can find out as a bonus what FGGE and LEPOR stand for. That alone is worth the price of admission (for years I thought that LEPOR was catching).

It's a worthwhile and useful book. I'd recommend it.

W. F. Weeks

NEWS

AWARD

In 1977 Dr. J. F. Nye was elected a Foreign Member of the Royal Swedish Acadamy of Sciences.

PUBLICATIONS

COLD REGIONS SCIENCE AND TECHNOLOGY

EDITOR: Malcolm Mellor, Cold Regions Research & Engineering Laboratory, Hanover, N.H., U.S.A.

PUBLISHER: Elsevier Scientific Publishing Company, P.O. Box 211, Amsterdam, The Netherlands.

Cold Regions Science and Technology is an international journal dealing with the scientific and technical problems of cold environments, including both natural and artificial environments. The primary concern is with problems related to the freezing of water, and especially with the many forms of ice, snow and frozen ground. The journal is intended to serve a wide range of specialists, providing a medium for interdisciplinary communication and a convenient source of reference.

EDITERRA EDITORS' HANDBOOK

The Editerra *Editors' Handbook* is intended to provide editors of earth-science journals with a guide to the various activities involved in editing. It is hoped that editors will find the Handbook of use in solving problems and indicating what is considered good practice by other editors. It will also be of use to editors in other disciplines who need advice in dealing with earth-science matters, and, since editors have no reason to hide their activities from authors, publishers, printers and readers, it will help others who have to deal with editors to understand some of the processes which happen to papers during the editing stage of the publication chain.

Since Editerra (European Association of Earth Science Editors) was founded in 1968 a handbook has been regarded as a natural means by which the discussions of problems which editors encounter might be codified for the benefit of all editors. A considerable body of material has been prepared with a view to its incorporation in the Handbook, but naturally some sections of the work have advanced more rapidly than others, and it has become apparent that to wait until all subjects were ready for publication would mean a very long delay for the material prepared first.

It therefore seemed natural that those parts already prepared should be issued, and that the best format for the Handbook would be separate sections which could be issued separately when they were approved. In this way it is also

possible to revise individual sections in the light of experience or to bring them into line with new decisions of standardizing bodies without having to produce a complete new edition of the whole work. Thus it is that the Editerra Handbook is being published in this form. Initially there will be only a few sections, but as time proceeds more will be added until eventually the Handbook contains sections on all matters which Editerra feels should be incorporated.

These sections are arranged in the handbook in four main subdivisions as follows:

A. PUBLISHING AND PRINTING
B. EDITING
C. STANDARDS AND STYLE
D. EARTH-SCIENCE NOMENCLATURE AND TERMINOLOGY.

EDITERRA EDITORS' HANDBOOK
is available from Geo Abstracts Ltd, University of East Anglia, Norwich NR4 7TJ, England.

Price £3.90 or U.S. $7.80, plus postage. A standing order can be placed for further parts, which will cost £0.60, $1.20.

At present an introduction and four sections have been issued:

Indexing and retrieval. Making information flow.—G. H. BROWN.

Editorial processing of manuscripts and proofs. —J. W. GLEN.

Rock nomenclature; petrography and geochemistry—P. A. SABINE.

Stratigraphic nomenclature—ANDERS MARTINSSON (containing an amended version of "Beneficial regulation of procedure in editing stratigraphy" by N. F. HUGHES).

GLACIOLOGISTS AND ANTARCTIC PLACE-NAMES

Five new satellite photomaps of the Antarctic Peninsula have recently been published in the British Antarctic Survey 250P Series, showing parts of Adelaide Island, Alexander Island, Graham Land and Palmer Land. One of these maps, entitled "Arrowsmith Peninsula, Adelaide Island—Graham Land" (Sheet SQ 19–20/14 (Ext), Edition 1–DOS 1978), covers the area between lats. 67°–68°S, longs. 66°–69°30'W, where the names of forty-one glaciologists from various countries are grouped. The names were officially approved in 1960 and were included in the list of "glaciological" names prepared by the late Dr Brian Roberts (ICE No. 9, January 1962, pp. 10–18, including map pp. 12–13). This map sheet, togther with the others, is on sale from Edward Stanford Ltd., 12/14 Long Acre, London WC2E 9LP, U.K., price 30p.

G. Hattersley-Smith

SYMPOSIUM ON THE DYNAMICS OF TEMPERATE GLACIERS

The Proceedings of this Symposium, held 6–9 September 1977 during the meeting of the European Geographical Union, have been published by Zeitschrift für Gletscherkunde und Glazialgeologie. Details may be obtained from Universitätsverlag Wagner, Postfach 219, A–6010 Innsbruck, Austria.

GRADUATE DIPLOMA IN NORTHERN STUDIES

McGill University

Recent years have witnessed a considerable growth of interest in the Canadian North, and an increasing number of professional persons have become involved in its development and in providing services to northern communities. In response to the present need for special training in this area, McGill University has developed a course of study encompassing a range of basic knowledge and technical information that may be required by anyone who must deal with northern problems. McGill, which has a long standing involvement in northern work, offers this program through its Centre for Northern Studies and Research.

The Diploma Program is primarily intended to meet the needs of persons employed in work that is directly related to northern Canada. Candidates for the program will usually belong to one of the following categories:

1. Government employees concerned with the administration of northern communities or dealing with aspects of policy formulation or planning that affects Canada's north.
2. Persons in industries that have a direct involvement in northern development.
3. Consultants who serve as advisers to industry, government and native peoples' associations on matters concerning the north.
4. Educators who are teaching in northern communities.
5. Recent university graduates who aspire to any of the above professional positions or who wish to pursue graduate work in related areas.

6. Graduate students now registered in degree programs related to northern studies.

The Diploma Program will normally require the full-time participation of the students enrolled in it for the duration of one academic year (September - April) at McGill. Because the candidates will have differing academic histories and ambitions, each student will be assigned to a supervisor within his or her field of specialization.

The program is comprised of several components so arranged that the requirements for the Diploma can be fulfilled over the course of one academic year. The central core of the program consists of five intensive courses, given in sequence, each including 24-48 hours of formal instruction.

197-602A Northern Land Masses:
Continental structure and formation of the polar basin; Geomorphology and glaciology – soils and permafrost; Mineral resources – oil and gas potential and exploitation; Effects of permafrost on construction-buildings, roads and pipelines.

197-603A Physical Environment of the North:
The weather – causes and variability; The seas – bathymetry, watermasses and currents; Sea Ice – characteristics and coverage, effects on shipping; Icebergs and ice islands; Climatic change.

197-604A Northern Ecology and Renewable Resources:
Structure and function of northern ecosystems; Plant and animal distributions, seasonality, migrations; Fish and fisheries – present and potential exploitation; Marine and terrestrial mammals – game management and the fur industry; Principles and practice of environmental impact assessment case studies.

197-605B Peoples of the North and Northern Administration:
Origins and dispersion – demography; Initial contacts with Europeans – the fur trade; Cultural history – religion, art and folklore; The modern phase – political development, native organizations and employment; Political geography – historical background, defence; Government structures – international comparisons, Canadian territorial, provincial and federal roles; The law – native land claims, exploration and resource development; Education and health – educational programs and medical services.

197-606B The Northern Economy and Modern Technology:
Transportation – roads and pipelines, air and sea transport; Communications – the impact of satellite communication systems; Town planning and settlement patterns – waste disposal, energy supplies and the quality of northern life; Tourism and recreation.

In addition, the Northern Studies Seminars I (197-590A) and II (197-591B) are incorporated within the program and, after consultation with a supervisor, each student is required to prepare and submit research papers in his or her specialty.

The Centre for Northern Studies and Research encourages, promotes, undertakes and co-ordinates northern research and training programs with McGill University. It is particularly interested in developing interdisciplinary aspects of research and in assisting in the interchange of information among persons engaged in northern studies and research.

The Centre maintains a Northern Information Unit, which includes a specialized library, bibliographic and reference service, maps, photographs and other sources of information. It provides facilities for field training and research at the McGill Subarctic Research Station in Schefferville, Quebec.

Membership on the Northern Studies Council is at present held by some 60 academic staff at McGill, most of whom are active in research within the natural and social sciences. The Centre draws upon Council members for participation in its teaching program.

Admission Requirements

The Graduate Diploma in Northern Studies is offered through the Faculty of Graduate Studies and Research. Applicants must hold a B.A. or B.Sc. degree with a concentration of courses relevant to one of the subject areas in the diploma program and equivalent to a major. Other experience, including work, may be taken into consideration in lieu of the required concentration of undergraduate course work.

Completed applications which reach the Centre on or before February 15, 1979 will be given preference.

Applications may be obtained by writing to:
Centre for Northern Studies and Research
1020 Pine Avenue West
Montreal, PQ H3A 1A2, Canada

NEW MEMBERS

Calderwood, Bonnie J., 14-700 Coronation Avenue, Ottawa, Ontario K1G 0M6, Canada.

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Prowse, T. D., Geography Department, University of Canterbury, Christchurch, New Zealand.

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Villeneuve, P., 316 Boul. St. Joseph Est, Montreal, P.Q., Canada.

Fluctuations of Glaciers 1970 - 1975 (Vol. III)

269 pages + 12 separate folded maps in a hard case
Published jointly by the International Association of Hydrological Sciences and UNESCO, 1977
$26 (US)

Compiled for the Permanent Service on the Fluctuation of Glaciers (PSFG) by Fritz Müller, ETH, Zurich, as a contribution to the International Hydrological Programme of UNESCO, this volume continues the series *Fluctuations of Glaciers 1959–1965* (Vol. I) published in 1967 and *Fluctuations of Glaciers 1965–1970* (Vol. II) published in 1973. The data were obtained from National Correspondents and Collaborators of PSFG as well as individual glaciologists who completed standard forms on (1) general information, (2) variations in the positions of glacier fronts, (3) mass balance results, and (4) changes in area, volume and thickness, for glaciers in Canada, USA, Peru, Chile, Argentina, Iceland, Norway, Sweden, GFR, France, Switzerland, Austria, Italy, USSR, Uganda, Kenya, Japan, Nepal, Indonesia, New Zealand and Antarctica. As a first step towards the development of a data bank of information on glacier fluctuations many of the data are presented in the form of computer generated tables. Such tables in this and in future volumes of this series will make it easier to portray the worldwide reaction of glaciers to climatic change. Information not suitable for computerization, such as important comments and sources of data, is covered in the separate chapter devoted to each of the four categories of data. Each glacier is identified with a name and a PSFG number with a prefix to denote the country concerned, and an alphabetical index at the end of the book makes it easy to locate the tabulated data on any glacier. The detailed descriptions in this volume will be invaluable not only to glaciologists but also to many earth scientists working in related fields.

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357 pages + 7 separate folded maps in a hard case
$21 (US)

Fluctuations of Glaciers 1959 - 1965 (Vol. I)

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$6 (US)

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INTERNATIONAL GLACIOLOGICAL SOCIETY

Lensfield Road, Cambridge CB2 1ER, England

DETAILS OF MEMBERSHIP

Membership is open to all individuals who have scientific, practical or general interest in any aspect of snow and ice study. Payment covers purchase of the Journal of Glaciology and Ice. Forms for enrolment can be obtained from the Secretary General. No proposer or seconder is required. Annual payments 1979:

Private members	Sterling: £15.00
Junior members	Sterling: £ 6.00 (under 25)
Institutions, libraries	Sterling: £20.00 for Volume 22 (Nos. 86, 87, 88) £20.00 for Volume 23 (Number 89) £25.00 for Volume 24 (Number 90)

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

ICE

Editor: Hilda Richardson

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

Annual cost for libraries, etc, and for individuals who are not members of the Society: Sterling £3.00

Foister & Jagg Ltd., Abbey Walk, Cambridge