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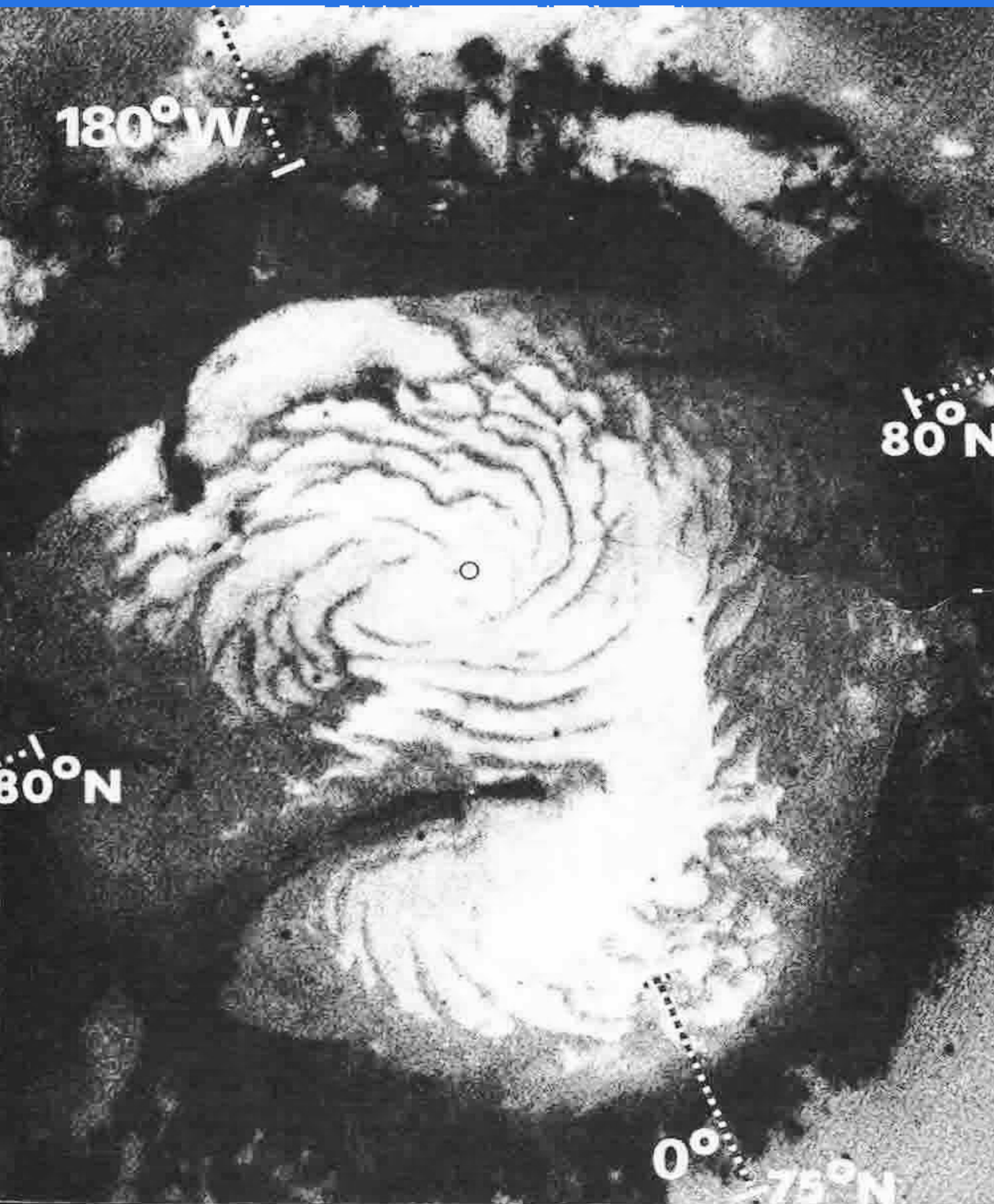

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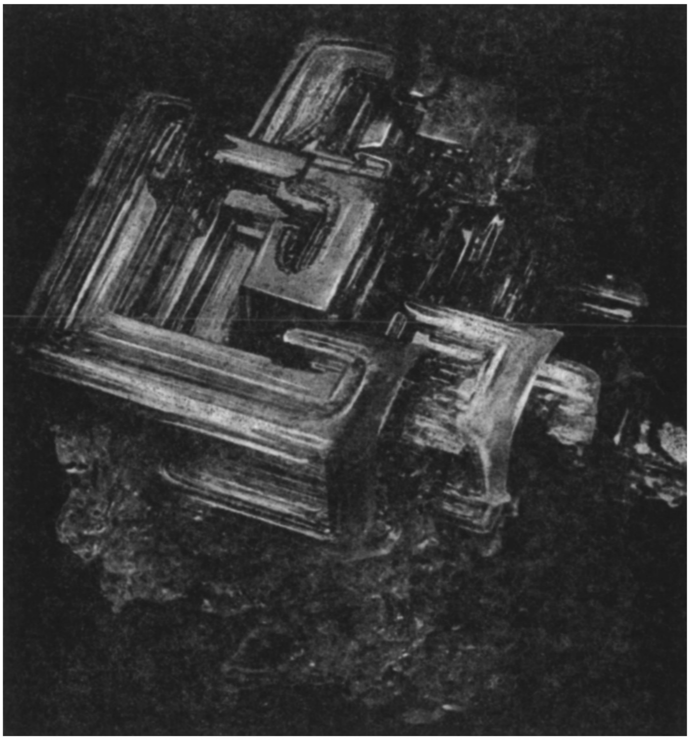


— see pages 12-13 of this issue of ICE.

ICE
NEWS BULLETIN OF THE INTERNATIONAL GLACIOLOGICAL SOCIETY

2nd ISSUE 1973 NUMBER 42

CONTENTS

MISSING JOURNALS? If you have not received your copy of No. 65 Journal of Glaciology, it is because we have not received your money for 1973. When your money arrives, your Journal and a copy of the Proceedings of the 1969 Symposium on the Hydrology of Glaciers (provided you qualify for a free copy—see page 16 of this issue of ICE) will be mailed to you.

SYMPOSIUM ON THE HYDROLOGY OF GLACIERS. The Proceedings of this Symposium, which was organized by the Society in September 1969, have now been published by the International Association of Hydrological Sciences, Publication No. 95.
Please see page 16 of this issue of ICE for details of how to obtain a copy.

We regret to announce the death of Admiral Dr Charles W. Thomas in a road accident in Argentina. Admiral Thomas was a retired Coast Guard, polar explorer and ice breaking expert. During the International Geophysical Year he was task unit commander for Operation Deep Freeze I and II and later was appointed director of Arctic operations for the IGY. Afterwards he directed a study of the Arctic basin for the University of Washington, served with the Museum of Comparative Zoology at Harvard University and was professor of science at Nathaniel Hawthorne College in New Hampshire.

COVER PICTURE. North polar ice cap of Mars: the residual cap at the end of the ablation season. Diameter = approx. 1200 km. Photograph provided by Prof. Robert P. Sharp, Division of Geological Sciences, California Institute of Technology, Pasadena, CA 91109, U.S.A. Professor Sharp will be pleased to receive ideas about the origin and meaning of the roughly helical markings on the cap.

RECENT WORK

AUSTRALIA

ANTARCTICA

Casey

A core drilling programme was carried out during 1973 by the wintering glaciologists Craig Austin and Murray Rich of the Antarctic Division, Department of Science. In autumn a 113m hole was drilled near the coast at Cape Poinsett where a high negative temperature-depth gradient was found, as expected from the high downslope movement rates there. Part of the core has been returned to Melbourne for analysis.

During winter and spring/summer 3 further cores 50-100m deep were obtained closer to Casey in the low accumulation zone and along the summit - Cape Folger line. In this region the expected positive temperature depth gradients were obtained. Almost continuous cores were returned to Melbourne for analysis.

Prince Charles Mountains

Aerial photography together with surface elevation and ice thickness sounding measurements were continued in conjunction with a geology and mapping programme. Several lines across the Lambert Glacier were flown and clear bed echoes were recorded. The 2500m deep section of the Lambert Glacier below its confluence with the Fisher and Mellor Glaciers, observed in a longitudinal profile by A. Foster in 1971-72, was confirmed by Vin. Morgan in a cross profile during the 1972-73 season. Remeasurements of ice movement markers are planned for the 1973-74 summer.

IRIAN JAYA (WEST NEW GUINEA)

A second Carstensz Glaciers Expedition (CGE) was carried out during January and February 1973 with the help of funds from the Australian Research Committee and from Melbourne University's Meteorology Department, and with great logistic and other support from the Indonesian authorities in Irian Jaya, from Freeport Indonesia Inc. and Newmont Pty. Ltd., and from the Royal Australian Air Force. The expedition was led by Dr Jim Peterson (Monash University: geomorphology) and included Ian Allison, (Antarctic Division, Department of Science: glaciology), Ted Anderson (University of New South Wales: surveying), Richard Muggleton (Northcote and Preston Community Hospital: photography), and Judy Peterson (Larnook Teachers College: biology). San Mustamou, an Indonesian mountaineer from "Uncen" (Cenderawasih University) joined the expedition in Jayapura, and two more Indonesian climbers followed it with a filming party from a Melbourne television station, led by Randell Champion, the leader of the first CGE. Jim Peterson and Ted Anderson climbed the Carstensz Pyramid and established a marker from which its height was later accurately determined as 4884 ± 2m — i.e. 74m higher than Mt. Blanc, but more than 300m lower than claimed by Heinrich Harrer after his "Erstbesteigung" in 1962.

This time the expedition had to make its way to the mountains on foot from the north; with 35 native porters, the march took 7 days and a good deal of persuasion. The work accomplished in 5 weeks on the glaciers included coring to 10m depth at 5 points on the centre line of the Meren Glacier, and at 3 points on the Carstensz Glacier; remeasurement of surviving stakes and planting of new stakes specially designed for long-term use in high ablation conditions; resurveying the glacier fronts and movement markers; geomorphological analyses and sampling; and a detailed study of the glacial algae abounding in this region.

The results and records of temperature, humidity, rainfall and run-off obtained by long-term recorders at the Ertsberg Mine and below the Carstensz Glacier are now being evaluated. Both glaciers appear to have retreated by a further 10m or so since the 1972 CGE. A preliminary estimate of the thickness of the Carstensz Glacier is 80m. A contour map of the entire area based on the 1972 survey is nearing completion and another is being constructed from U.S. Air Force photos taken in 1942. A further visit to the area is in the planning stage.

W. F. Budd, U. Radok

ICELAND

BARDARBUNGA EXPEDITION

The main efforts of the Iceland Glaciological Society in 1972 were concentrated on an expedition to Bardarbunga, the highest cupola of Vatnajökull proper (1988 m). This expedition was a joint enterprise of the Science Institute, University of Iceland, and the Iceland Glaciological Society. The expedition was made possible by financial support from the International Atomic Energy Authority in Vienna, and by the transport work and a great part of the drilling work on the glacier being carried out by members of the Iceland Glaciological Society who participated as volunteers. Four scientists took part in the expedition: B. Arnason (chemist), H. Björnsson (glaciologist), S. Steinthorsson (petrographer), and P. Theodorsson (physicist).

The main aim of the expedition was to drill a hole, as deep as possible, into the ice on Bardarbunga and sample the cores. Before the expedition a rotary drill for deep coring in temperate ice was designed and constructed at the Science Institute. Its total length is 6 m and its weight 100 kg. The diameter of the core is 90 mm, and its maximum length 2 m. An anti-freeze mixture at the bottom of the hole proved necessary to hinder refreezing of the chips on the cutting bits, but with such a mixture the drill worked satisfactorily.

The expedition started on 25 May, and returned on 12 August and was the longest that hitherto has worked on Vatnajökull.

A 415 m deep hole was drilled and core-recovery was 99%. The cores were stored and transported to Reykjavík in polystyrene foam. Because of a fault in the cable the bottom of the glacier was not reached. The cores will now be examined thoroughly to determine deuterium and tritium profiles, stratigraphy, structure, and texture of the ice, as well as the amount of some chemical elements, and the presence of volcanic ash layers. Although the glacier on Bardarbunga is temperate, the cores show marked seasonal fluctuations in the deuterium and tritium profiles, and every exactly dated ash layer will be an important time marker in the core.

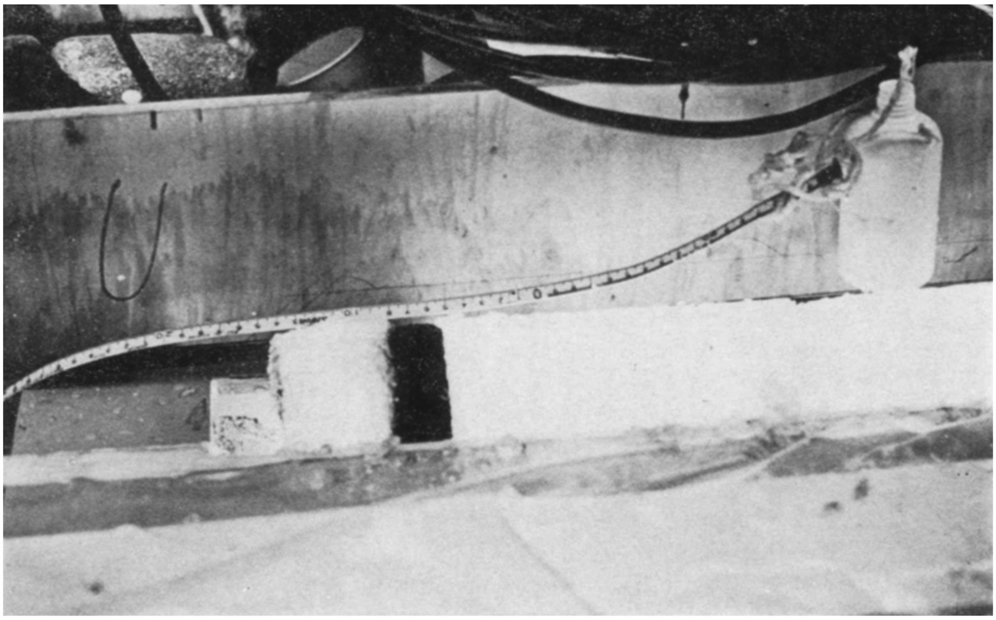
JÖKULHLAUP FROM GRIMSVÖTN

When in 1971 it was decided to build an auto road across Skeidarársandur, the studies of the annual changes in the Grímsvötn area, carried out by the Iceland Glaciological Society since 1953, suddenly became of great practical importance. The reason is that the jökulhlaups from Grímsvötn are likely to destroy shorter or longer stretches of this road, and the Public Roads Administration has thus become interested in any research that might help to predict these floods. Measurements in Grímsvötn in the spring of 1971 indicated that a jökulhlaup was to be expected soon, and the road work on the sandur was consequently postponed until the flood had occurred. The jökulhlaup began in the middle of March 1972, and was studied more thoroughly than any previous jökulhlaups, and while it was going on, scientists were sent to Grímsvötn in helicopters to study the changes there, and measure the sinking of the ice surface of the caldera.

GLACIER SURGES

During 1972 three outlet glaciers in Iceland surged. These were: Hagafellsjökull vestri, a southern outlet of Langjökull; Múlajökull, a southern outlet of Hofsjökull; and Ejabakkajökull, a northern outlet of Vatnajökull. The total advances of these glaciers were measured, and so were the normal longitudinal variations of about the same number of glaciers as in previous years. This work is now led by Sigurjón Rist.

Sigurdur Thorarinsson



Ice core from the drill hole on Bardarbunga. The black layer, 2½ cm thick, is the volcanic ash from the Grimsvötn eruption in April 1934. Its depth beneath the glacier surface was 86.59 cm.

NEW ZEALAND

During 1972-3 glaciological investigations were continued by the water and soil division, Ministry of Works, Christchurch, and included projects carried out in conjunction with the University of Canterbury and the Antarctic and Geophysics divisions of the Department of Scientific and Industrial Research (DSIR).

SEASONAL SNOW

The 1972 winter started early with major snowfalls in May and snowpack continued to accumulate until September, followed by a relatively short melt season. Synoptic meteorological data were used to compute a snow index for selected alpine regions. Snow courses were monitored by Ministry of Works at Lake Tekapo and the Fraser Basin in Central Otago, and by the Forest Service at Craigieburn in the Canterbury foothills.

In the Upper Waitaki Basin, which is being developed as part of a large hydro-electric power project, attempts are being made to estimate the contribution of snowmelt to run-off. Photographic records of snow cover in the drainage basins of Lakes Tekapo and Pukaki were used to prepare maps showing variations in snow cover during the spring melt season.

TASMAN GLACIER

Mass balance measurements were continued at three index sites representing the névé and the upper and lower parts of the glacier tongue. Winter balance values for 1972 are relatively high. At the end of the 1972-3 balance year the residual snowpack at the névé site was considerably greater than in the previous three years and the annual snow line reached an altitude of about 1850 m.

Marker poles were surveyed to determine surface movement across the two transverse profiles where ice depths have been determined by seismic surveys. In conjunction with DSIR, further geophysical investigations were carried out in the terminal area of the glacier using seismic, gravity and resistivity techniques. Ice near the terminus is about 200 m thick and rests on gravels and till up to 750 m in thickness.

IVORY GLACIER

(IHD representative basin)

Mass balance measurements have been continued. The glacier showed negative net balance of 1.6 m for the 1971-72 balance year and 1.8 m for the 1972-73 balance year over a surface area of 0.8 km^2. Snow accumulation during the 1972 winter was greater than in the preceding 3 years but spring snowmelt was correspondingly greater. The 1972-73 summer was characterised by cool, wet conditions in December and hot, dry conditions in January and February.

From mid-January to mid-February a second summer programme of microclimatological studies was carried out at a site on the glacier by staff and students of the geography department, University of Canterbury. Unusually high temperatures and low precipitation again prevented adequate sampling of the more typical cloudy, humid conditions. Improved instrumentation and techniques resulted in a considerable improvement of data quality.

ANTARCTIC

During the 1972-73 summer season, the programme of hydrological and glaciological research was continued in the "Dry Valleys" region of southern Victoria Land.

Mass balance measurements and margin studies were continued on the Jeremy Sykes, Alberich and Heimdall glaciers in the Asgard Range, Wright Valley. Observations were extended to include Meserve Glacier, the Lower Wright Glacier, which is the principal source of meltwater for the Onyx River, and the Packard Glacier in the Victoria Valley. Movement surveys were continued on the Heimdall and Jeremy Sykes glaciers.

Part of the programme involves photographic monitoring of selected glacier termini in the region. Observations were extended to include the Upper Victoria Glacier, the Lower Wright Glacier and five glaciers in the Taylor Valley.

Discharge of the Onyx River was recorded throughout the summer at two locations, one near the terminus of the lower Wright Glacier and one near Lake Vanda, and the level of Lake Vanda was also monitored. In contrast to the high flows of the 1970-71 and 1971-72 summers the Onyx River flow was very low. The highest instantaneous discharge recorded was 1.3 m^3/s and the rise in lake level was 0.05 m compared to 2.41 m and 0.60 m for 1970-71 and 1971-72. Lake levels were recorded at several other lakes in the Dry Valleys at the beginning and end of the summer.

P. W. Anderton
J. K. Fenwick

UNITED KINGDOM

CAMBRIDGE STAUNINGS EXPEDITION 1972

During the four weeks spent by the 12 members of the expedition at Base Camp (mid-July to mid-August) virtually the whole of the main scientific programme was completed, in spite of deteriorating weather in the second half of this period. In fact the summer thaw did not reach its normal extent throughout this season, and for a time the snow morass in and around Base Camp was extremely trying. The scientific results will be published in due course in the full expedition report, but for the purposes of this preliminary report the following summary is given.

Ice depth, radio-echo sounding. A new design sledge was built using light-weight materials, and the central sections of the Roslin Glacier and the Roslin-Dalmore Glacier junction areas were covered by traverses. On the whole the electronic equipment gave very little trouble, and the new sledge withstood the rough conditions very well. All film records were developed in Base Camp as the work proceeded.

Steam probe. A portable steam generator, rigid probe, and 20 metres of flexible hose, were put to most effective use. The probe was used for drilling stake holes, and deep holes for temperature measurements, and was also put through a comprehensive series of tests for optimisation of its design in respect of operating pressure, nozzle design, and probe construction.

Electrical deep probe. This programme was expected to be severely handicapped by lack of fuel for the generator. However, in the event, the four newly designed probes brought out for trial would not, for some reason, penetrate to anywhere near the depth expected.

Survey. The 1970 stake lines were measured and profiles of the glacier surface were drawn up to complement the radio-echo sounding results. All the sledge runs were plane-tabled by two members from Imperial College (financially independent of this expedition but assisting this particular project). A complete plane table map of the Roslin-Dalmore junction area was drawn up.

Heat balance studies. A camp was set up on the glacier surface, and the humidity, sunshine, temperature, wind direction and speed, and ablation were observed every six hours throughout the expedition, to assist in the overall study of this glacier system.

Other items of work were carried out at various times, such as mechanical drilling of new stake holes, radio communications trials, and the ascent of several peaks and survey points including a first ascent of an important station.

D. W. Matthews
K. J. Miller

U.S.A.

SNOW AND ICE RESEARCH AT CRREL

The Cold Regions Research and Engineering Laboratory (CRREL) was established in 1961 by the U.S. Army Corps of Engineers by combining its two predecessors—the Snow, Ice and Permafrost Research Establishment (SIPRE) and the Arctic Construction and Frost Effects Laboratory (ACFEL). While these organizations had concentrated on research and engineering respectively, the formation of CRREL combined their efforts at one location with an exceptional capability for cold regions work. The core of the laboratory houses 24 cold rooms of various sizes with individual temperature control. CRREL has published over 1300 reports in its own series and, in addition, well over 500 articles have been published in professional journals. The library facility contains nearly every item published on any aspect of the cold regions thus simplifying the work of the 125 members of CRREL'S professional staff. This civilian staff is supplemented by a rotating group of 50 military scientists and engineers who work for the continuing projects during their tour of duty at the Laboratory. Some of the current projects are described below.

Sea ice topography (W. D. Hibler, S. J. Mock)

This project is in the process of sampling about 1500 miles of processed laser profile data representing the Arctic Basin geographically and seasonally. The statistical analysis is generally in two categories, ridge statistics and spectral roughness. Ridge height and spacing distributions are being fitted to theoretical distribution models with good agreement. Given this fit the regional ridging can be well described by the two parameters: μ, ridge frequency (ridges per kilometer) and h, mean ridge height. The variation in these parameters as a function of geographical location and season is being studied.

The spectral roughness study is oriented toward characterizing different ice types by different spectral signatures. Also portions of the roughness spectra that have been shown by Banke and Smith at Bedford to correlate well with wind stress drag are being catalogued as a function of location and season.

Tensile strength of ice under combined stresses (F. D. Haynes)

An investigation was conducted to determine the effect of a compressive stress on the tensile strength of bubbly polycrystalline ice. One hundred and thirty-two tests were made in an apparatus of unique design. A cylindrical dumb-bell specimen was stressed in axial tension and radial and tangential compression by a hydraulic system which minimized bending stresses.

Compression-tension ratios ranging from 0.21 to 3.155 were used for the tests. Tensile strength was found to decrease with an increase in the ratio. At the ratio of 3.155 the tensile strength was about one-third the uniaxial value. The test results support the evidence that the Brazil test underestimates the tensile strength for ice. The Brazil test is the diametral compression of a circular disc which fails in tension and is commonly used to determine the tensile strength of rocks. The results also indicate that the Brazil test value for ice can be no greater than one-third the uniaxial tensile strength.

A comparison of the experimental results with a few prominent biaxial failure theories indicates a lower tensile strength than predicted by any theory. However, the best approximation to the results is the Coulomb-Mohr criterion.

Water flow through snow (S. C. Colbeck)

The program of research on wet snow is continuing at CRREL with emphasis on water flow through snow and the metamorphism of wet snow-packs. The one-dimensional theory of water flow through snow has been extended to include the effects of capillarity. This analysis shows that although the wave fronts propagating through snow are not strongly influenced by capillarity, considerable distortion of the waves of water moving through snow lysimeters could result from the end effects at the snow-air interface. This distortion could significantly alter much of the information obtained from lysimeters hence a detailed study of the movement of water through these devices is needed.

An analysis of the propagation of water through layered snowpacks and snowpacks containing ice layers has been made. A method for predicting the flow of water through unsaturated layers of different textures was developed. The flow of water through semi-permeable ice layers and the flow to drains in ice layers was analyzed in order to predict the effect of these layers on delaying water run-off from snowpacks. The results show that once ice layers begin to decompose during spring run-off, their effects are quite small. During the onset of run-off, the mode of flow around an ice layer changes from the two-dimensional flow of water toward discrete drains to direct seepage through each layer. Even at angles of a few degrees, the tilting of an ice layer greatly enhances the tendency for two-dimensional flow to drains and the significance of the thickness and permeability of the layer is greatly reduced.

A method of predicting water movement over impermeable layers was developed in order to predict the run-off from snowpacks overlying frozen ground or ice. This technique considers two regions of flow — an unsaturated layer through which water is conducted from the surface and a saturated layer overlying the impermeable base. The mode of flow in the unsaturated layer, which has been described in previous work, is coupled with the flow through the saturated layer to predict the run-off from knowledge of the surface fluxes. While flow through the unsaturated layer is slowed by the small permeability to the water phase, flow through the saturated layer is characteristically rapid even for small angles of slope. The wave speed through the saturated layer is characteristically two orders of magnitude greater than that through the unsaturated layer thus the diurnal character of meltwater waves propagating vertically through a snow cover are preserved in the discharge from the saturated layer.

The metamorphism of wet snow has been described in terms of the thermodynamics of the pendular and funicular regimes of saturation. In the pendular regime (low saturations), the equilibrium temperature of the three phases of water is controlled primarily by the capillary pressure (difference between the air and water pressures). Thus at low saturations where capillary pressure is large, the effect of grain size is small and grain growth is slow. The bond strength between particles is quite large, however, and the strength of the snow matrix increases as saturation decreases. In the funicular regime, the equilibrium temperature is determined by the sizes of the ice particles and air bubbles. For any given water saturation the local temperature gradients are determined by the particle sizes. The result is heat flow to the smaller particles and rapid metamorphism which increases the size of the larger particles as the smaller ones disappear. Bond strengths tend to be low in the funicular regime since overburden pressure causes melting at the grain contacts. This melting induces rapid densification as the grain centers move closer together adopting a shape more suitable for close packing.

The use of microwaves to detect the liquid water content and density of wet snow has been investigated in the laboratory by Capt. Bruce Sweeny. First the effects of temperature, packing density, grain size and water content were determined for mixtures of glass beads and water in order to establish a theoretical basis for explaining the observations made on wet snow. For this purpose, samples of wet snow of known composition were produced under careful capillary and thermal control in a cold laboratory. The measurements of the dielectric constants with the microwave device were not as accurate as similar measurements made on glass beads and the age-old problem of sampling wet snow without causing a thermal disturbance persists. The results are encouraging, however; work is continuing with the microwave equipment. Once perfected, these techniques will have the capability of making remote measurements of liquid and solid volume in a snowpack.

Electrolytic conductivity of seasonal snow (B. Brockett, J. R. Hicks, T. Jenkins, M. Kumai, R. P. Murrmann, C. Slaughter)

The winter of 1972-1973 was relatively mild and the seasonal snow cover melted away early in the central Alaska and New Hampshire areas. During the winter, the effects of air pollution on the electrolytic conductivity of snow were studied. The pollutants consisted of soluble and insoluble substances, some of which were active as nuclei of snow crystals and ice fogs. During the stage of snow crystal growth and precipitation, the atmospheric pollutants were washed out by snow crystals and were contained in the snow cover. In the Connecticut Valley area, New Hampshire, fresh snow samples were collected in each snowfall. The electrolytic conductivity of snow samples was measured at 25°C by an electrolytic bridge. In these measurements, the electrolytic conductivity ranged from 3.61 to 52.71 μmho cm^{-1} and the mean value was calculated to be 14.9 μmho cm^{-1}. The results showed that lower electrolytic conductivity was obtained from snowfalls originating in a northern (arctic) air mass and was also obtained for a higher amount of snow precipitation.

The electrolytic conductivity of snow cores in New Hampshire was measured 1 March 1973; the average electrolytic conductivity was 18.7 μmho cm^{-1}, which is 3.8 μmho cm^{-1} greater than that found in newly fallen snow. It is concluded that this increase in conductivity over a three-month period was due to 1) dry fallout of various combustion products and 2) sand and salts spread on the highway to melt the snow and ice cover in order to prevent automobile skidding.

The electrolytic conductivity of a mountain stream was also measured this winter at Mt. Ascutney. The measurements obtained showed that 13% of the soluble substances in the perennial stream water came from the snow cover.

From 26 March to 7 April 1973, measurements of atmospheric nuclei and the electrolytic conductivity of snow were made to estimate contamination in winter caused by human activity in the Fairbanks and Fort Wainwright area, central Alaska. In these measurements, the depth of snow cover was between 21 and 52cm, and the density ranged from 0.1 to 0.25 g cm^{-3}. The snow structure was coarse grain near the surface and depth hoar was developed to 0.4 — 1.0 cm diameter near the bottom of the snow cover. The electrolytic conductivity of snow cores ranged from 4.4 to 43.5 μmho cm^{-1} at 25°C. The highest conductivity was measured for samples collected near the electric power plant at Fort Wainwright. This is because of the great amount of local coal with high sulfur content consumed at the electric power plant during the long, severe winter. However, the lowest value in this series of measurements was 3.0 μmho cm^{-1} for a sample collected at the Caribou Creek Valley, an area uncontaminated by human activities, 30 miles north of the Fairbanks. This value is similar to values at the South Pole (1.8 — 3.0 μmho cm^{-1}) found by Gow. Specimens of snow meltwater were shipped from Fairbanks to CRREL for detailed analysis after which a report will be written.

An open-pit mine at the edge of the Greenland Ice Cap (S. C. Colbeck and S. J. Mock)

American and Danish mining companies are investigating the possibility of developing a mineral resource lying at the edge of the ice cap in southwestern Greenland. The ore body, which is about 90 percent covered by ice at depths up to 200 m, forms a high ridge of rock which currently diverts the ice flow to either side of the deposit. Once development begins the flow of ice into this area will increase as the surface slope is increased and the elevation of the glacier margin is lowered. At the final stage of development $172 \cdot 10^6$ m^3 of ice will have to be removed in order to uncover the deposit and to excavate a quasi-stable profile. An additional $7.9 \cdot 10^6$ m^3 per year of ice will have to be removed in order to keep the glacier from thickening and advancing into the open-pit mine.

Much additional information must be gathered before the glaciological aspects of this feasibility study are completed. One major problem with the development of this mineral resource is that the ice temperature reaches the pressure-melting point about 200 m below the surface — this is about equal to depth of the proposed pit. A field program scheduled for the summer of 1973 will drill through the ice in several locations in order to make temperature measurements, water pressure measurements and fabric analysis. In addition, a research program on surface-albedo modification will be done and the existing survey network will be extended to cover a much larger area of the glacier.

When the development of the deposit begins, one of the largest glaciological experiments ever conducted will be underway. Unlike most glacier flow studies, the geometry will be imposed on the glacier by direct excavation, this providing the opportunity to observe the change in the flow regime of a mass of ice undergoing a significant change in size and shape. Access to the basal layers and the underlying bedrock will provide a unique opportunity to examine glacier erosion and structure on large scale.

Sintering in polar snowpack (A. J. Gow)

The variation of density, grain structure and bulk strength as dependent on age and temperature is being investigated for polar snowpacks. These studies show that density increased linearly as the logarithm of the age of the snow and that the mean crystal size and the unconfined compressive strength both increase linearly with the age. Thin section examinations of the changes occurring in the pore-crystal relationship during sintering show that the snow to ice transformation is entirely analogous with the full scale isothermal sintering of powder compacts.

Recrystallization and compressibility of ice (A. J. Gow)

Tests on the recrystallization of ice samples pressurized at 200 bars and at atmospheric pressure were conducted. A variety of polycrystalline ice types were tested including deformed specimens and bubbly ice samples. The most rapid recrystallization was observed in deformed specimens composed of strongly oriented crystals. Recrystallization in this kind of ice resulted in very large increases in the mean size of crystals (up to 40-fold increases in crystal cross-section of samples annealed for one month) and substantial deorientation of the original preferred structure of crystals. The effect of pressure was mainly to retard the growth of crystals and to speed elimination of air bubbles.

Pressure chamber investigations of the linear compressibility of pure, pore-free monocrystalline ice were completed. Measurements of compressibility in directions parallel and normal to the crystallographic c-axis indicated that compressibilities varied by less than 10% in the two directions. The mean compressibility at -10°C was 3.7 Mb^{-1} over the pressure range 0-310 bars. This work has now been extended to bubbly polycrystalline ice in order to determine the effect of porosity on the compressibility of ice.

De-ice of radio navigation equipment (S. F. Ackley, M. Frank and K. Itagaki)

Field experiments on radome deicing were conducted on top of Mt. Washington in New Hampshire during the past two winters under the sponsorship of the Federal Aviation Agency. As a result of these experiments, a low-cost, low-power mechanical deicing system was developed. This consisted of a pulsed, air-inflatable radome cover and a commercial ice detector which is capable of automatic operation in a remote site. This represents a considerable improvement over the electro-thermal systems currently in use which have a high power requirement at times when only stand-by power generators are available.

Participation in the AIDJEX Program (S. F. Ackley, G. Cox, W. D. Hibler, A. Kovacs and W. F. Weeks)

As part of the 1972 AIDJEX Pilot Study, a series of mesoscale strain measurements were carried out in the Beaufort Sea. A laser was used to determine distances to 11 targets that were positioned around the base camp within a circle with a radius of about 13 km. Measurements were made at intervals of 3 hours or less over a 30-day period. Net area changes as large as 3% and divergence and shear rates as large as 0.12% and 0.10% per hour were observed. In the principal axis coordinate system, deformation events typically exhibited a much larger compression (or extension) along one axis than the other. The magnitude of the fluctuations in the strain field was found to scale inversely with the square root of the average length of the strain lines. Also there was a significant coherence in the divergence rates as determined from different sized arrays at approximately 2 cycles per day. Work comparing these results to the predictions of a linear drift theory and to observations obtained by sequential photographic overflights is currently in progress. Other programs carried out at the same time investigated the morphology of pressure ridges and the salinity distribution in multiyear ice.

Brine drainage in sea ice (G. F. N. Cox, W. F. Weeks)

The brine drainage mechanisms responsible for the variation of sea ice salinity with time are being studied in cooperation with Dartmouth College and the Canadian Polar Continental Shelf Project. The study involves a controlled laboratory simulation of the growth and evolution of a sea ice sheet. The initial solution is tagged with radioactive sodium (22) so that both the concentration and movement of the brine within the ice can be remotely followed using a scintillation detector. Since the quantity of radioisotope is proportional to the amount of entrapped salt, the salinity of the ice can be determined at any specified time or position without destroying the sample. Thermistors are inserted into the freezing chamber so that temperature profiles can also be measured. From the sequential temperature and salinity profiles, brine volume profiles can be calculated and studied as a function of initial solution salinity, temperature gradient, and time.

The work also involves a study of: partitioning of salts at the ice-water interface; correlations between the ice microstructure and brine drainage; and the development of a theoretical brine drainage model.

Results to date have indicated that brine expulsion is the dominant brine drainage mechanism during the early stages of ice growth and, as growth continues, gravity drainage becomes more important. The partitioning of salts at the interface can also be described by the Burton, Prim and Slichter equation for growth velocities greater than 10^{-7} m/sec. Unlike previous investigations, brine drainage has been taken into consideration.

Optical properties of sea ice (R. H. Berger, H. Davis, J. W. Lane, R. H. Munis)

The transmission of light through sea ice is being studied in order to explain the anomalous penetration of solar radiation through as much as 10 m of sea ice. Samples of sea ice were made by freezing sea water and the transmission of a HeNe laser beam through each sample was measured with a photodiode. The transmission of the laser beam was determined as a function of the salinity of each sample. The effect of salinity and temperature history were tested by freezing samples of sea ice at different temperatures and then taking the measurements at a common temperature. The effect of air bubbles on the optical properties were investigated by preparing samples with a minimum of air content and making replicas of their surfaces for bubble size and concentration determinations. The effects of wave lengths between 4000 and 8000 A° are being investigated for standardized samples of different salinities prepared at different temperatures.

Floating ice covers (G. Ashton, G. Frankenstein, D. Nevel, R. Perham)

A variety of research projects is being conducted on the properties of floating ice covers. The accumulation of ice fragments to form ice jams is being studied both theoretically and experimentally. The similitude requirements for the entrainment of individual blocks have been defined and special attention is now given to the study of the rotation and entrainment of individual blocks at high rates of flow.

The forces exerted on piles by moving ice fields are being measured in a large scale model. The effects of cross-sectional geometry and slope are being given special attention in these experiments. The forces exerted on an ice boom on the St. Lawrence River have been measured throughout the past winter. These data will provide some basic information needed for the improved design of these facilities.

Snow loads on buildings (G. Hine, R. Redfield, W. Tobiasson, H. Ulda)

The effect of snow loads on structures is being evaluated for the State of Alaska. The available information on snow depth and density is being compiled and a statistical analysis of the maximum snow depth is being done. Where information on water equivalent is available, the "conversion densities" are being constructed on a regional basis. Factors for correlating the snow load on roofs with the snow on the ground are being developed. The effects of geometric, aerodynamic and thermal properties of roofs are being considered in this analysis.

The annual performance survey of the Dye sites in Greenland will be increased this year in order to measure the secondary stresses induced in these structures by the deformation of the ice cap.

Internal friction of single-crystal ice (K. Itagaki, P. E. Stallman)

The objectives of this work are to increase our understanding of internal friction in ice and to correlate mechanical phenomena with electrical relaxation. The interpretation of the experimental results at -78°C is difficult because there is only a slight shift in the two relaxation peaks when subject to X-irradiation. There are three distinct results observed at a constant temperature:

1) The decrement decreases roughly as the inverse of the elapsed time.
2) The decrement increases as the square of the elapsed time up to a limit of 3 to 14 percent of the pre-irradiation value.
3) The decrement increases as the square of the elapsed time until a limit of 1 to 10 percent of the pre-irradiation value (elapsed time was 15 to 30 minutes) and then it decreased as the inverse of the elapsed time.

Any of these results can be achieved by choosing the proper starting position on the peak. The first and third results fit the theory of Simpson and Sosin while the second was treated in a recent CRREL research report by VanDevender and Itagaki.

Recent investigations of the peaks at temperatures between -80 and -120°C has revealed the existence of some new peaks skewed to the higher temperature. These peaks vary in number (usually 1 to 3), amplitude and their temperature of occurrence. However, they are reproducible under a variety of conditions including a change in apparatus, X-irradiation, and various annealing situations. Initially it is being concluded that they are caused by a transition from hexagonal to cubic ice during cooling. During the subsequent warming, the absorbing energy shows up in the internal friction measurement. More experiments are underway to test this conclusion.

A piece of single-crystal ice is being subjected to a tensial stress in a low temperature freezer. The sample is being observed through polarized light in order to detect any significant changes which, if present, will be examined by X-ray patterns. A strong AC field is being used to produce dislocation motion in order to avoid fracturing the ice.

S. C. Colbeck, Jr.

QUATERNARY—TERTIARY PROBLEMS IN ANTARCTICA: DRY VALLEY DRILLING PROJECT—1973-74

The Dry Valley Drilling Project, sponsored by the United States, New Zealand and Japan, has drilled the first deep holes in Antarctica to 201 and 179 m in permafrost volcanics at McMurdo Station on Ross Island. One of the holes will be deepened in September in order to retrieve older sequences of flows, pyroclastics, and perhaps intercalated Tertiary marine sediments and glacial deposits. In October a hole will be drilled through 3 m of lake ice on Lake Vanda in order to collect 50 to 100 m of glacial, marine and lake sediment. The lake is 70 m deep at the drill site. The site was chosen to trace the development of Wright Valley from a fjord environment to the polar desert of today. In November a 60 m hole to basement will be drilled on the shore of Don Juan Pond, a 30 cm deep, calcium chloride brine lake containing 416,500 ppm total dissolved solids.

Other sites planned for the 1973-74 season are a deep hole at Lake Vida ($>$ 300 m of permafrost), shallow holes on the shores of Lake Bonney, and Lake Fryxell, and a 300 m hole at New Harbor. These holes will aid in the reconstruction of the history of Victoria and Taylor Dry Valleys.

Collection of the geologic materials for scientific purposes consists of standard wireline coring techniques, as modified for operations in polar climates and drilled in a manner compatible with environmental restraints in the Dry Valleys. Information regarding distribution of samples may be obtained through the Office of Polar Programs, National Science Foundation, Washington, D.C. 20550, U.S.A.

M. G. Mudrey, Jr.

UNIVERSITY OF MINNESOTA

During the 1972 field season, a party of three from the University of Minnesota spent two months on the Barnes ice cap. Pole lines established for movement and mass balance studies were resurveyed, as was a continuous series of 67 strain nets in the wall of a 125-m ice tunnel. An 8-m vertical shaft was excavated to the bed of the glacier near the margin to study deformation of superimposed ice. Fabric diagrams were prepared from ice from the shaft and from ice collected elsewhere along the margin. The studies indicate that a wedge of deformed superimposed ice exists along the margin. Ice-cored moraines (also called shear moraines) occur at the glacier surface along the contact between this superimposed ice and glacial ice which has overridden the superimposed ice.

Studies of deformation processes in dirty ice and of the near-surface temperature distribution in the saturation zone of a polar glacier are presently in progress at Minnesota.

UNIVERSITY OF NORTH DAKOTA

A thesis was recently completed by Richard Scattolini. It is an investigation of "Black magnetic spherules from the glacial and sea ice of Fletcher's Ice Island (T-3)". The ice was collected over two seasons (1968, 1970) while the student was employed by N.A.R.L. and the U.S.G.S. geothermal studies programme. Scattolini's measurements of the sizes and number of these spherules were eventually extrapolated for the entire earth's surface; the results were found to be very similar to those of other researchers for other sediments and ice. Because the sea ice was young (1970-1959) it was supposed that contamination would be significantly greater than for the older (ca 1800 A.D.) glacier ice. But the numerical results from each ice type were surprisingly similar. How such particles become trapped below the 0.6 m depth is yet to be explained for the sea ice. The publication of the results is in progress.

J. R. Reid

ELTON POUNDER

Elton Pounder was born in Montreal, Québec, in January 1916, son of a minister in the United Church of Canada. His schooling revealed an aptitude for mathematics and physics, and these were the subjects he chose for university courses. He obtained his first degree at McGill University (a B.Sc. Honours) in these subjects at the remarkably early age of 18 and a Ph.D in physics three years later, in 1937. From 1937-39 he worked as an engineer for the Bell Telephone Company of Canada and then saw service as a navigator in the Royal Canadian Air Force during the 1939-45 war, rising to the rank of Wing Commander and earning the Air Force Cross. He remained on the RCAF Active Reserve, in the McGill University Squadron, from 1945 to 1960.

Professional appointments after the war were with the Physics Department in McGill University, first as Assistant Professor 1945-48, then as Associate Professor 1948-58, and finally as Professor in 1959, a post that he still holds. Nuclear physics was his main interest at first, and for a number of years he was associated with the radiation laboratory at the University. He took part in the design and construction of the McGill Cyclotron and nuclear physics experiments. He was also a member of the group that developed the radar system of the Mid-Canada Line.

About 1955 Elton Pounder's interests shifted to ice physics, and, on the suggestion of Trevor Harwood and Geoffrey Hattersley-Smith of the Defence Research Board, to sea ice research in particular. He started the Ice Research Project and has been Director of it since that date. This group now consists of fourteen persons, including four professors, one research associate, one engineer, two technicians, and five graduate students. The emphasis is primarily on the distribution, properties and movement of ice covers and on laboratory studies of the electrical behaviour of sea ice. Elton's major activity has been the direction of a programme of research in drift ice in the Gulf of St. Lawrence, initiated in 1967. This programme has some notable firsts including placing observers adrift on the ice in rubber rafts and freezing a ship into the ice cover, the latter certainly a first for ice observations in the Gulf. This work has naturally extended to AIDJEX, with the Pilot Projects in the Beaufort Sea.

In addition to spear-heading Canadian sea ice studies, he has encouraged individuals in his group to study the characteristics of freezing saline solutions, including their electric and dielectric properties; and the energy exchange at sea ice surfaces, this work being done primarily by Phil Langleben.

Elton's contributions to professional and community life also arise from his service on many committees, national and international. In the glaciological world his efforts have been largely related to sea ice and oceanography, but he has also served as Vice-President and President (1969-71) of the Northeast North American Branch of the International Glaciological Society and is now a member of the Council of the Society. It is probably through his membership of the Working Group of Ice in Navigable Waters, of the Canadian Committee on Oceanography, that he has been most effective in encouraging the development of sea ice investigations; this group provided him with the opportunity to influence and provide sound advice to others working in sea ice and to integrate the work of his group with theirs. He has also done a lion's share as a member and, in many cases, as chairman of numerous committees at McGill, and has represented the University on committees of the Ministry of Education of Québec.

As a private citizen he was elected to the School Board of the City of Westmount, where he lives with his wife and son and daughter, and is also Trustee and a Governor of nearby colleges. His main relaxations from this busy life are the enjoyment of Mozart's music, especially for the piano, and the contrasting excitements of science fiction and the ski races at the Society's local Branch meetings. Though his performance now on skis cannot rival that of some of his fellow members, he is considered by them to be one of the stronger and sounder members of the glaciological community, and has undeniably played a leading role in the development of sea ice research in Canada.

INTERNATIONAL GLACIOLOGICAL SOCIETY

RESEARCH AND EDUCATION FUND

Avalanche, flood and drought; disruption of water and power supplies; unusable roads, runways and shipping lanes . . . such are the hazards of ice and snow. Research by glaciologists in many parts of the world helps to minimize destruction. The tremendous natural wealth of the polar regions can only be exploited if we learn to live with and to use this important part of our environment.

Glaciological research calls for training and experience and involves considerable expense. The Research and Education Fund of the International Glaciological Society aims to maintain high standards and to ensure continuity. The Fund will help, irrespective of nationality, promising research that may not be supported by the big grant-giving organizations. It will particularly encourage research by students and young glaciologists with new ideas. Since there are no university graduates in glaciology, scientists with good research potential must be selected and introduced to the subject. Because the International Glaciological Society is the focal point for glaciologists throughout the world, it is in a unique position to help with training where it is most needed.

When funds have been collected, notices will appear in ICE from time to time inviting applications. Until then, no applications can be considered.

We hope that members will help this worthy Fund by making a donation, however small, and by asking organizations and firms for donations. The brochures that were sent to members with the previous issue of ICE were for your own use; if more are required, please write to the Secretary.

Cheques/drafts should be made payable to:

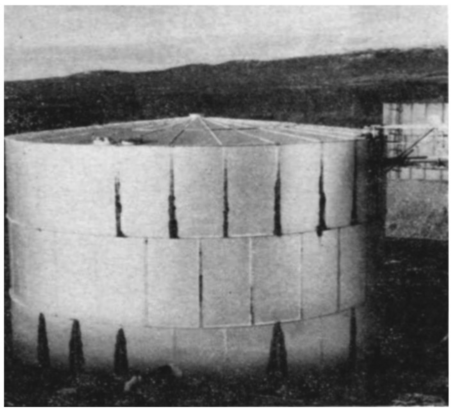
International Glaciological Society—Research and sent *either* direct to the Society, Cambridge CB2 1ER, England, *or* to our Bank, National Westminster Bank Ltd., (Account No. 54770092), 67 St. Andrews Street, Cambridge CB2 3BZ, England *or* by Post Office GIRO Account No. 240 4052.

Inside front cover photograph: *Depth hoar crystals examined under a microscope help glaciologists to unravel the cause of avalanches and to evolve defence systems.*

Ships which force a passage through ice-covered seas have to be modified or specially designed.

© Charles Swithinbank

Research into freezing processes is needed to develop structures that can withstand very low temperatures, unlike this storage tank, with oil seeping through warped joints.



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ANNUAL GENERAL MEETING 1973

MINUTES OF THE ANNUAL GENERAL MEETING OF THE INTERNATIONAL GLACIOLOGICAL SOCIETY

1 MAY 1973 AT THE SCOTT POLAR RESEARCH INSTITUTE CAMBRIDGE, ENGLAND

The President, Dr Wilford F. Weeks, was in the Chair.

1. **The Minutes of the 1972 Annual General Meeting,** published in ICE, No. 39, 2nd issue 1972, were approved, and signed by the Chairman.
2. **The President** gave his report for 1972-73:

This is my first opportunity to report to you on the state of our Society. As you know, the Society's founder, Gerald Seligman, died in February of this year. Our debt to this man is immeasurable. In 1936 he, recognizing the need to foster increased activity and high standards in the study of glaciology, was instrumental in forming the Association for the Study of Snow and Ice and he served as its first president. In 1947 he took the initiative in transforming this association into the British Glaciological Society and in starting the Journal of Glaciology. As the result of his leadership, the Society grew internationally until in 1962, its world-wide service to all those interested in snow and ice was recognized by dropping the word British from its title. During this same time period, important changes were made in our Constitution, allowing all members to take part in the nominating and voting procedures. Although Dr Seligman retired as President in 1963, he continued to serve as the Senior Editor of the Journal of Glaciology until 1968 and he followed the progress of both the Society and his beloved subject until his death. In recognition of his contributions, both as an investigator and as the Society's Founder, the Council in 1963 named our highest award, the Seligman Crystal, in his honour and he was, indeed, its first recipient.

It is my pleasure to announce now that Dr Seligman has, in his will, seen fit to leave the Society a legacy of £1000. Tomorrow, the Council will consider how to best utilize this to further glaciology.

In January 1972 the Society formalized its international role by becoming the International Glaciological Society: reflecting the fact that our membership is scattered throughout the world, that the Council is also widely scattered and that the great majority of our business is conducted via correspondence. The efficiency of our Secretary and her staff, and of our Treasurer, is attested by the fact that the Society's long-distance telephone bills are very low indeed. Letter writing hardly replaces direct conversation but it is clear that our current system is not only working, but working well.

The growing number of branches of the Society also proves to our increasingly international nature. Two new branches, those in the Nordic countries and the Western Alpine countries, had exciting inaugural meetings last fall. The informal exchange of ideas has always been the "hallmark" of our branches. In short, glaciologists attend branch meetings to find out "what's really happening". Based on my impressions of recent meetings, the answer is clearly "a great deal". The Society's Annual Conference also attests to the success of such meetings in that it has continually grown both in attendance and in scope.

The initial responses to the Advance Notice on our forthcoming meeting on "Remote sensing in glaciology" have been particularly promising in that we have heard both from glaciologists and from people working in a variety of new areas, in particular those related to the developmental aspects of the problem. We feel that special symposia such as this one will, by stressing the interrelationship of glaciology to a wide variety of other disciplines, help to broaden our membership and to stimulate a wide spectrum of quality papers for the Journal. The increase in the depth of our Society should also serve to ensure our future independence.

Our membership now numbers 992, and in addition 667 libraries buy our Journal. Our office now houses Hilda Richardson, our most executive of Executive Secretaries, and her full time assistant, Beverley Langford. In addition we have the part time help of Ailsa Proudman in handling the Society's library. We again would like to express our thanks to Gordon Robin, Director of the Scott Polar Research Institute, for tolerating us with such good humour.

Our Journal continues to maintain its high standards under the guidance of our hard-working editors. How they manage to accomplish all this work, in view of their other activities, never fails to amaze me but they do. However, if the Society continues to expand its published output via Symposia and Monographs and an expanded Journal, we will clearly have to give them more help by expanding our editorial services. The resolution of these questions will be considered very carefully by your Editors and the Council.

Financially these are not easy times for learned societies. I am, however, pleased to report that although we are hardly prepared to declare a dividend, we are so far weathering the waves of increased costs.

Finally it is my pleasure to conclude with two announcements. First, the Council announces that Honorary Memberships have been conferred on Robert P. Sharp of the California Institute of Technology, to Sigurdur Thorarinsson of the University of Iceland and to Zyungo Yoshida of the Institute of Low Temperature Science, Hokkaido University, for their eminent contributions to the objects of the Society. I am sure that you will all be pleased with these selections.

We all know that glaciology has been enriched by the efforts of investigators with a wide variety of backgrounds. Indeed much of the strength of our subject and our Society springs from the varied backgrounds and approaches of people interested in problems related to the study of snow and ice. As an example of such an enrichment, I am pleased to announce secondly that the Council has decided to award its highest honour, the Seligman Crystal, to Dr S. Evans of the University of Cambridge. It was Stan who, when he realized that a window did indeed exist that would allow radiowaves to see through glacier ice, set out to do something about it. This he did by surmounting the technical barriers related to the development of suitable instrumentation that would do the job not only in the laboratory but in the field as well. By this pioneering work he set the stage for the exciting Scott Polar Research Institute—NSF radio echo sounding programme carried out under the direction of Gordon Robin. He also was highly influential in the excellent radio echo programme of the British Antarctic Survey and in inspiring the fine programme carried out in Greenland by Preben Gudmandsen and his associates. In addition, Stan's work has ultimately led to the work of John Nye and the Bristol group on the use of radio echo techniques to measure ice motion and thickness changes.

Although the formal presentation of the Crystal will be made in 1974 during our Symposium on remote sensing in glaciology, the Council thought that you would be most pleased by the award and should know of it. That concludes my report to you.

3. **The Treasurer,** Dr J. A. Heap, gave his report: Expenditure in the year was almost exactly as we had anticipated. For income, two items are always difficult to estimate: page charges and sales of back issues of the Journal. In 1972, page charges were slightly lower than estimated, but sales of back issues were considerably lower. This largely accounts for the deficit of £636, instead of an anticipated profit.

   Owing to the present controls on prices in Britain, it may prove necessary for us to make more frequent, though smaller, increases in our charges to members and to libraries; in this way we shall be able to continue publishing the Journal at its present size.
4. **Election of auditors for the 1973 accounts:** Dr J. W. Glen proposed and Dr M. de Quervain seconded that Messrs Peters, Elworthy and Moore, of Cambridge, be elected auditors for the 1973 accounts. This was carried unanimously.
5. **Elections to the Council 1973-76:** 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:

Vice-President	A. Higashi
Treasurer	J. A. Heap
Elective Members	B. Kamb
	D. Kuroiwa
	H. Oeschger
	O. Reinwarth

The President thanked the retiring Council members for their years of service: J. W. Glen, L. Gold, R. P. Goldthwait, Miss C. King, and H. Röthlisberger.

ANNUAL CONFERENCE 1973

Eighty members of the Society, from 15 countries, gathered in Cambridge during the first week of May to hear about the latest research projects and to join in discussions. The following are some of the contributions. (For further information, please write to the authors.)

J. F. Nye—New uses of radio echoes from ice sheets.

G. de Q. Robin—Internal reflections from impurity layers in polar ice sheets.

W. J. Fitzgerald & J. G. Paren—Di-electric properties of Antarctic ice.

C. W. M. Swithinbank—Glaciology of the Antarctic Peninsula (GAP Project).

R. H. Rutford—Ross Ice Shelf Project (RISP).

G. Weller & J. Zwalley—Glaciological and climatological research in the polar regions conducted by the Office of Polar Programs of the U.S. National Science Foundation.

W. F. Weeks—Disposal of Antarctic waste.

D. A. Peel—Chemistry of Antarctic snow.

J. F. Nye—Mechanics of sea ice.

P. C. Clarke—Variations in the extent of sea ice north of Britain.

E. Palosuo—Pressure ridges in the Baltic.

W. F. Weeks—Recent sea ice work. **And**—Towing of icebergs.

G. Norton & K. J. Pascoe—History of "Habbakuk" project and possible developments in the use of ice as a commercial proposition in engineering.

D. Collins—Geochemical evidence for subglacial erosion by temperate glaciers.

W. Ambach—A paradox of the radiation balance of snow surfaces with high albedo.

W. J. Fitzgerald—Elastic and inelastic gamma ray scattering from ice crystals at low temperatures.

R. G. Oakberg—Variational methods in glacier mechanics.

D. R. Homer—Creep tests on ice biocrystals.

R. LeB. Hooke—Shear in a glacier margin.

H. Röthlisberger—Potential ice avalanche on the Weisshorn, Switzerland.

R. P. Goldthwait—Mechanics and field occurence of glacial striations and their meaning.

G. S. Boulton—Origin of drumlins.

R. Vivian—film of ice motion in the snout of the Glacier d'Argentière.

PROCEEDINGS OF THE 1969 SYMPOSIUM ON THE HYDROLOGY OF GLACIERS

The Society organized this Symposium in Cambridge in September 1969. By special arrangement with the co-sponsors, the Commission of Snow and Ice of the International Association of Scientific Hydrology (International Union of Geodesy and Geophysics), publication of the proceedings was undertaken by the Association. The Society's Editors prepared the abstracts and papers, and then handed over the work to the Association. Unforeseen problems arose and as a result the publication date had to be postponed several times. Dr G. Kovacs, Secretary General of the Association (now renamed the International Association of Hydrological Sciences) has put in much time and effort getting the volume to press in Hungary and supervising the final stages of publication. We are grateful to him.

The publication arrangement was such that the Society was allowed to buy copies at a special price, in recognition of the fact that it was solely responsible for the organization of the Symposium. These copies are bound in buff covers and overprinted "For members of the Glaciological Society". They are not for re-sale. Owing to the delay in publication, not all those people who were members in 1970 are still with us, and many others have joined since 1970. Free copies of the Proceedings will be sent to those members still with us (and fully paid up) who were members in 1970; members who have joined since 1970 may obtain a copy (first come, first served) from a small pile of mail-battered volumes in the Secretary's office on payment of 50 pence to cover postage, packing and handling. Write to the Secretary if you are interested. Non-battered copies may be obtained from the stock held by the Association, for sale at US$10.00 and bound in the Association's red covers. Please write to Mr. R. E. Oltman, Treasurer of I.A.H.S., c/o American Geophysical Union, 1707L Street NW, Washington, D.C. 20036, U.S.A.

Libraries, and scientists who are not members of the Society, should also write to Mr. Oltman.

BRANCH NEWS

NORDIC BRANCH

The second meeting of the Nordic Branch of the International Glaciological Society was held in Narssarssuaq, South West Greenland, from 8-18 June 1973. In spite of the relatively high travel expenses 48 members participated, accompanied by 16 family members. A great part of the time was devoted to outdoor activities, which was much appreciated by all. Except for the first two days the weather was marvellous with blue sky and steady sunshine. The only environmental drawback was the mosquitoes!

Local transportation was by air, by boat or on foot, and in the course of our ten days' stay we gained many impressions from this part of Greenland—of glaciers and sea ice, physical geography and morphology, the old Nordic culture, the present situation of the Greenlanders, etc. Excursions by helicopter and on foot to an advancing glacier and an aeroplane reconnaissance of the sea along the coast of southern part of Greenland were perhaps the highlights of our stay. Most participants not familiar with the countryside were very impressed by the ice on land, in the fjords and in the ocean. But cultural trips to the former Norse settlements of Brattahlid and Gardar were also very interesting; here we could observe the stone foundations of buildings erected by the Vikings nearly 1000 years ago. There is no doubt that Eirik Raude (Eric the Red) chose the site of the first Viking settlement with great care—Brattahlid lies on a green and fertile hillside. Perhaps the naming of Greenland was not a salesman's trick after all.

Narssarssuaq, on the opposite side of the fjord, was a less colourful area with grey stone buildings placed on a wide sandur. Buildings and an airstrip were established by the U.S. during World War II, but now the base serves no military purposes and is instead used as the headquarters for the Danish sea ice reconnaissance around Greenland.

The more serious part of the meeting, the presentation and discussion of papers, was conducted mostly in the evenings. Altogether 22 lectures were presented with the following authors and contents:

Bragi Arnason:
Deep drilling in a temperate glacier in Iceland.

Grete Buchman:
History of the Norsemen.

Grete Buchman:
The Norsemen in modern science.

Jens Fabricius:
The ice in the oceans around Greenland.

Jens Fabricius:
The ice reconnaissance centre in Narssarssuaq.

Børge Fristrip:
Greenland today.

Åke Hillefors:
Needle ice (pipkrake) formation in Halland.

Christian Hjort:
Weichsel chronology in central East Greenland.

Edvigs V. Kanavin:
Formation and quality of various types of fresh ice.

Olav Liestøl:
A new theory for "surges".

Jan Mangerud:
Late Weichsel glacier variations in Western Norway.

Valter Schytt:
Changes in snow density through the spring and summer season on Storglaciären.

Charles Swithinbank:
Viewpoints on subglacial morphology.

Arve M. Tvede:
Climate and glacier variations on Folgefonni.

Hans H. Valeur:
Polar ice variations off the west coast of Greenland 1900-1972.

Henrik Østerholm:
Glacial geology in Nordaustlandet.

Gunnar Østrem:
Sediment transportation in Norwegian glacier streams.

Gunnar Østrem:
Elevation of the snow line in Western Canada.

Gunnar Østrem:
Presentation of "Atlas over breer i Nord-Skandinavia".

In between the organized activities there were times available for hikes and excursions in the vicinity of Narssarssuaq, and this was greatly appreciated by both the long distance and short distance hikers.

Our Danish colleagues did a very good job with these many arrangements, and the great expectations of the participants were fulfilled. We suspect that nearly all the Danish glaciologists were in some way involved with the preparations for the meeting. We especially remember Jens Fabricius, who made it possible for us to take part in the ice reconnaissance and helicopter flights, Børge Fristrup, with his all-encompassing knowledge of conditions in Greenland, and the hiker of the group, Anker Weidick, who provided information on the local Quartenary geology, and the most important of them all, our leader, Willi Dansgaard, who with unflagging energy did his utmost at all times to make our stay in Greenland as rewarding as possible. On the last day of the meeting the officers for next year were elected. This is a Norwegian group, consisting of Olav Orheim, President, Olav Liestøl, Vice-President, and Randi Pytte Asvall, Secretary/Treasurer.

Our farewell to Greenland was as successful as the rest of our visit. Leaving Narssarssuaq we flew over the inland ice in cloudfree conditions, giving us yet one more unforgettable view of this magnificent region.

1974 meeting

The 3rd meeting of the Branch will be held near Jostedalsbreen in West Norway, 26-30 August 1974.

The plans include a 2-day excursion to Nigardsbreen and Austerdalsbreen, followed by 3 days of lectures, Annual Meeting and excursion in Fjaerland. This is a classic area for glacier studies in Norway, and is described in an extensive literature. References to this and detailed descriptions of the area will be given in an excursion guide that will be distributed to participants well before the meeting.

Cost for 6 days from evening 25 August to morning 31 August is about N. Kr. 500 per adult. One could save on this by camping. This is an area of many tourists, and limited accommodation, especially in Jostedalen. If the number of participants exceeds 50 there are also problems in placing the whole group in one hotel. It is necessary to reserve hotel space by this autumn, therefore please write to Dr O. Orheim immediately if you are interested. However, please note that members of the Nordic Branch will be given priority, and very few spare places may be available for other members of the Society.

Olav Orheim,
Norsk Polarinstitutt,
Rolfstangveien 12,
Postboks 158, 1330 Oslo Lufthavn,
Norway.

JOURNAL OF GLACIOLOGY

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

S. C. Colbeck:
Capillary effects on water percolation in homogenous snow.

H. Weertman:
Stability of junction of an ice sheet and an ice shelf.

J. O. Curtis & F. W. Smith:
Material property and boundary condition effects on stresses in avalanche snow packs.

G. Wendler & G. Weller:
A heat balance study on McCall Glacier, Brooks Range, Alaska. A contribution to the International Hydrological Decade.

W. H. Mathews:
Surface profiles of the Laurentide ice sheet in its marginal areas.

A. C. de la Casinière:
Heat exchange over a melting snow surface.

D. W. Strangway et al:
Instruments and methods: Radio-frequency interferometry—a new technique for studying glaciers.

G. F. N. Cox & W. F. Weeks:
Salinity variations in sea ice.

G. Holdsworth:
Erebus Glacier tongue, McMurdo Sound, Antarctica.

C. P. Gravenor:
The Yarmouth drumlin field, Nova Scotia, Canada.

W. Ambach:
The influence of cloudiness on the net radiation balance of a snow surface with high albedo.

B. Arnason, H. Björnsson & P. Theodórsson:
Mechanical drill for deep coring in temperate ice.

SHORT NOTES

Heinz Kohnen:
A note on the temperature dependence of seismic waves in ice.

C. F. Raymond:
The local distribution of stress near a point of zero shear stress in a rectilinear flow field.

K. Philberth & B. Federer:
The temperature gradient in the upper part of cold ice sheets.

THE LIBRARY

BOOKS RECEIVED

*Amundsen, Roald. *The South Pole. An account of the Norwegian Antarctic Expedition in the "Fram", 1910-1912. Translated from the Norwegian, by A. G. Chater. Vols. 1 and 2,* London, John Murray, 1912. xxxv, 392p.; x, 449p.

Bonham, V., *comp. Readers' guide to books on geography. 2nd edition.* Shrewsbury, Shropshire, Library Association County Libraries Group, 1973. 52p. (New Series No. 29.)
[List of books on all aspects of geography, pure and applied. Also lists of periodicals and of societies and institutions.]

Dolov, M. A. *and* Khalkechev, V. A. Fizika snega i dinamika snezhnykh lavin [The physics of snow and dynamics of snow avalanches]. *Vysokogornyy Geofizicheskiy Institut. Trudy,* Vyp. 23, 1972, 327p.

Knazovicky, Ladislav. *Západné Tatry. Stúdia o prirodnych pomeroch Západnych Tatier so zvláštnym zretel'om na rekonštrukciu porastov v oblasti hornej hranice lesa a protilavinové opatrenia.* Bratislava, Vydavatel'stvo Slovenskej Akadémie Vied, 1970. [213]p.

Lewis, Richard S. *and* Smith, Philip M., *ed. Frozen future. A prophetic report from Antarctica.* New York, Quadrangle, [c1973]. [xx], 455p. $12.50.
[Collection of articles from the *Bulletin of the Atomic Scientists* and the *Antarctic Journal of the United States.* To be reviewed.]

Miller, M. M. *Taku Glacier evaluation study.* Alaska, Dept. of Highways; U.S. Dept. of Commerce, Bureau of Public Roads, 1963. [xiv], [362]p.
[Evaluation of factors controlling glacier's regime in order to understand its present anomalous and future behaviour.]

Reifsnyder, William E. *Hut hopping in the Austrian Alps. A Sierra Club totebook.* San Francisco; New York, Sierra Club, [c1973]. [224]p., illus. 15.5cm. $3.95.
[Compact comprehensive guide to walking and climbing holidays in Austria, including section on "The Stubai Alps: a week in glacier country".]

*Scott, Robert F. *The voyage of the* 'Discovery'. *Vols. 1 and 2.* London, Smith, Elder, 1905. [xx], 556p.; xii, 508p.

Washburn, A. L. *Periglacial processes and environments.* London, Edward Arnold, [c1973]. viii, 320p.
[To be reviewed.]

Annual summary of information on natural disasters. *Number 6: 1971.* Paris, Unesco, 1973. 82p.
[Includes chapter on avalanches, p. 73-82.]

* Both of these expedition accounts were presented to the Society by Miss D. M. Hutchinson, daughter of the late Professor A. Hutchinson, Master of Pembroke College, Cambridge, and Professor of Mineralogy in the University of Cambridge.

REQUEST FOR INFORMATION

INTERNATIONAL COMPARISON OF SEA ICE THICKNESS REMOTE SENSING DEVICES

Measurements of ice thickness are of considerable importance and interest to a number of countries. In Canada alone three complementary ice thickness measuring devices are under test and development. The Canada Centre for Remote Sensing of DEMR is therefore considering the possibility of arranging a field comparison and trial of these devices. We would much appreciate the views of Members of the International Glaciological Society on the need for such an exercise. Members with views, or information on candidate devices, are requested to fill out the following form and return it to:

Canada Centre for Remote Sensing,
Department of Energy, Mines and Resources,
Attn: J. MacDowall,
2464 Sheffield Road,
Ottawa, Canada,
K1A 0E4.

	Yes	No
1. Is a comparison of sea-ice thickness devices worthwhile?	☐	☐
2. Would you be able to participate if such a comparison was held in Canada?	☐	☐

3. Which devices are you aware of and should be considered:

Name of device ....

Physical principle of operation and operating frequency

....

Name and address of developer:

....

....

....

FUTURE MEETINGS (of other organizations)

SYMPOSIUM ON BEAUFORT SEA COASTAL AND SHELF RESEACH

(Sir Francis Drake Hotel, San Francisco, California, 7-10 January 1974)

The following note has been received from the Arctic Institute of North America:

Until recently most North American arctic investigations have dealt with either the deep Arctic Basin or the onshore environment. This is unfortunate for three reasons: (1) many unique and interesting environmental events involving natural phenomena occur here; (2) this zone may well witness considerable, if not great, environmental stress stemming from the present localization of resource development and exploitation; and, (3) the oil industry and related service industries are trying to develop technologies for exploration and production in the seasonally ice covered coastal zone. Consequently, the contents and processes of the shelf and coastal zone should be studied, comprehended, and the knowledge made available as soon as possible.

In view of the new and potential future surge in interest and activity, a symposium has been convened by the Arctic Institute of North America to establish our present state of knowledge. The scope of the meeting will encompass scientific aspects of environmental research as well as aspects of an applied nature. Broadly, the areas of interest are:

Atmospherics (including sea ice distribution and behaviour)
Biology
Geology (including glacial geology and permafrost studies)
Oceanography (including glaciology)

Further information from Mr. John E. Sater, Arctic Institute of North America, 1619 New Hampshire Avenue, NW., Washington, DC 20009, USA.

GLACIOLOGICAL DIARY

1973

2-6 December
Symposium on Advanced concepts and techniques in the study of snow and ice resources. Monterey, California, USA. (Dr H. S. Santeford, Jr., US National Committee for the IHD, National Academy of Sciences, 2101 Constitution Avenue, Washington DC 20418, USA.)

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

1974

7-10 January
Symposium on Beaufort Sea Coastal and Shelf Research, San Francisco, USA. The Arctic Institute of North America. (Mr John E. Sater, The Arctic Institute of North America, 1619 New Hampshire Avenue, NW, Washington, DC 20009, USA.) (See page 19 of this issue of ICE.)

14-25 January
Symposium on the Meteorology of the polar regions. Melbourne, Australia, IAMAP. (Dr S. Orvig, Dept. of Meteorology, McGill University, Burnside Hall, P.O. Box 6070, Montreal 101, Quebec, Canada.)

15-17 January
Symposium on River and Ice. Budapest, Hungary. Hungarian Committee of International Association for Hydraulic Research, and Inland Navigation Section of the Permanent International Association of Navigation Congresses. (Dr Z. G. Hankó, Secretary, Local Organizing Committee, IAHR/PIANC Symposium, Budapest 1974, VITUKI, Rákóczi út- 41, Budapest VIII, Hungary.)

1-5 April
Symposium on Snow Mechanics. Grindelwald, Switzerland. (Int. Commission of Snow and Ice, IAHS, Dr F. Müller, Secretary, Geog. Inst. der ETH, Sonneggstrasse 5, Zürich 8006, Switzerland.)

15-19 April
Symposium on Remote Sensing of Environment, The University of Michigan, USA. (Mr Jerald J. Cook, The Center for Remote Sensing Information and Analysis, Willow Run Laboratories, Environmental Research Institute of Michigan, P.O. Box 618, Ann Arbor, MI 48107, USA.)

20-24 April
1st Symposium on the Geological action of drift ice, Québec, Canada. (Jean-Claude Dionne, Environment Canada, C.P. 3800, Sainte-Foy, Québec, Canada.)

9-12 September
Celebration of Tercentenary of Scientific Hydrology and Symposia to mark end of I.H.D.: Effects of man on the interface of the hydrological cycle with the physical environment. Flash floods—measurement and warning, (Director, Division of Hydrology Unesco, 7 place de Fonternoy, 75700 Paris, France.)

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

1975

8-10 April
Symposium on the thermal regime of glaciers and ice caps. National Research Council of Canada, Simon Fraser University, Vancouver, Canada. (Dr R. B. Sagar, Dept. of Geography, Simon Fraser University, Burnaby, B.C., Canada.)
Symposium on Isotopes and impurities in snow and ice, International Commission of Snow and Ice. Grenoble, France, during the 1975 General Assembly of IUGG. (Dr Fritz Müller, Secretary ICSI, Geog. Inst. der ETH, Sonneggstrasse 5, Zurich 8006, Switzerland.)

18-20 August
International Symposium on the Geochemistry of Natural Waters. Canada Centre for Inland Waters, Burlington, Ontario, Canada. Sponsors: Working Group on Geochemistry and Cosmochemistry, the International Association of Hydrological Sciences and Canada Centre for Inland Waters. (Mary E. Thompson, Chairman, Canada Centre for Inland Waters, Burlington, Ontario, Canada.)

18-21 August
International Association of Hydraulic Research Committee on Ice Problems and US Army Cold Regions Research and Engineering Laboratory—Symposium to include ice management and engineering as related to extended season navigation of inland waterways, ice jam control, and effects of sea ice on marine structures.

1976

15-25 August
The 25th International Geological Congress, Sydney, Australia. (Secretary-General, 25th International Geological Congress, P.O. Box 1892, Canberra City, ACT 2601, Australia.)

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

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

REVIEWS

PRICE, R. J., 1973: Glacial and Fluvioglacial Landforms. Geomorphology Texts, 5. Oliver & Boyd, Edinburgh.

The number of new textbooks in earth sciences has increased in a remarkable and surprising way during the last few years; it may be hoped that this reflects more a widening of interest in the field than a competition situation between different publishing companies

A recent example is given by R. J. Price with his book **Glacial and Fluvioglacial Landforms** (242 p, 93 figures). Dr Price, a Lecturer in the Department of Geography, University of Glasgow, lays much stress on the processes behind the landforms, as is clear already from the division of chapters, with headings such as "Glacier ice and meltwater", "Glacial erosion and transportation", "Fluvioglacial erosion", etc. Other headings point to the actual thinking in terms of models. The text is clear and written in a pedagogic way, the drawings are illustrative, and the photographs are both well chosen and well reproduced.

The book has an Anglo-Saxon approach, evident in both the historical review and the choice of landforms considered. A Scandinavian reader notices that the Nordic contribution to the development of glacial geomorphology more or less seems to start with Mannerfelt 1945. There is no mention of the comprehensive Swedish activity in Svalbard, and to some extent in Iceland also, in the nineteenth century. It was this activity which formed the background to the wellfounded hypothesis of a vast Scandinavian Ice Sheet, in Sweden proposed first by Sven Nilsson in the 1840's, then by A. Erdmann, H. von Post and especially by the great Otto Torell around 1860. Axel Hamberg, who made use of photogrammetry in glaciology and glacial geomorphology before 1900 and demonstrated the importance of regelation at roches moutounnées in 1926, is not mentioned. The glacial-lake era in Scandinavia started in Scandinavia long before Kendall's work in Britain; however, it had the same tendency to absorb too much scientific interest for a long time and to build up erroneous conceptions. Tanner discussed, in a series of voluminous and well-illustrated reports, glacial landforms such as eskers, fluvioglacial channels including lateral drainage channels, end moraines, etc., in an advanced way during the early decades of this century, Gerard De Geer, with an enormous influence on the development of Quaternary geology, is mentioned rather briefly, etc.

Dr Price has personal experience of the processes associated with glaciation from Sweden, Switzerland, and especially from the Casement Glacier, Glacier Bay, Alaska and the Breidamerkurjökull area of southern Iceland. This is naturally a strength, and the author has made valuable contributions to our knowledge of the mode of formation of eskers and end moraines. His demonstration, utilizing aerial photogrammetry, of the englacial deposition of glacifluvial sediments, including eskers, is both convincing and elegant. It may be mentioned, however, that the idea of englacial tunnels is far from new; for example for Iceland it was advocated strongly by E. M. Todtmann in 1960 and earlier. An interesting result is represented by a long series of moraine ridges formed by squeezing along the margin of Fjallsjökull; the same type of ridges were demonstrated by the reviewer in a 1952 paper, when much less newly deglacierized land existed. The same kind of formation was proposed by the reviewer for the so-called De Geer moraines in 1957.

This reminds the reader what is said in the preface: "This book is strongly influenced by my own field experience, and because that experience has been limited to a small sample of the many complex glacial and fluvioglacial environments that exist, the contents of this book represent a biased approach to the study of glacial and fluvioglacial processes." There are definite gaps in the book, a main one being the nearly total absence of an analysis of the landform processes acting when a glacier ends in either deep or shallow water; such a glacier is often characterised by rapid movement up to the ice front. Most of the people in the five Nordic countries live below the highest shoreline; they are acquainted with features formed under such conditions. The indefinite form of the title of the book therefore seems motivated.

Gunnar Hoppe

Frozen Future: A prophetic report from Antarctica, Eds. R. S. Lewis and P. M. Smith. New York, Quadrangle Books, Inc., 1973, 455p.

During recent years there has been a noticeable trend in the Earth Sciences for the production of collections of previously published papers. It would seem that such additions, or rather repetitions, of scientific material to an already exponentially increasing flow of reports and original discussions must be viewed with caution. Reprinted collections may well be worthwhile if they bring together important, if not 'classic', contributions in a particular field, especially if the original sources are obscure. Usually, however, they contain outdated material and suffer from editorial bias and pruning in the interests of economy.

FROZEN FUTURE, sadly, contains neither major scientific contributions nor material not easily obtained elsewhere. Eighteen articles, comprising the first three-quarters of the book, have already been published together as a broad-fronted review of Antarctic activities and achievements in the **Bulletin of Atomic Scientists** in 1970, whilst the remaining fourteen articles are reproduced from various editions of the **Antarctic Journal of the United States.** One report has appeared in both these periodicals!

All articles except one curious anomaly (the paper by G. H. Denton and colleagues on Late Cenozoic history of McMurdo Sound area) are low-key, review-type reports intended primarily for non-specialist reading. A brief introduction to scientific (especially U.S.) involvement in Antarctica leads to a useful discussion by European, Soviet and American writers of the role of the Antarctic Treaty and its practical and political implications.

A condensed review of the more important areas of scientific investigation (earth, upper atmosphere and life sciences) constitutes just under a quarter of the volume. Contributions in glaciology are provided by an outline of deep core drilling in both Greenland and Antarctica by C. C. Langway and B. L. Hansen, the inter-relationships between global climate and ice cover by J. O. Fletcher, glaciological aspects of Antarctic meteorology by M. J. Rubin and a report on the glacial history of the McMurdo Sound region by Denton and colleagues. A short relevant discussion of Antarctic geology is given by C. Craddock. The scientific articles suffer mainly from divergent styles, lack of consistency in illustration and units of measurement (S.I. units have not been used). Textural errors present in the original publications have not been corrected.

The problems of science management and the development of scientific and logistic support organizations are outlined in four articles, and future developments in science and economic exploitation of Antarctica are concisely and dispassionately considered. Brief reports of scientific personnel exchanges at U.S., Soviet and Japanese bases make light, enjoyable reading. An important section of 40 pages is devoted to serious discussion of problems and effective control of environmental pollution in Antarctica. Little attention is paid, however, to methods of pollutant detection and continuous base-line monitoring.

My major criticism is not of the articles constituting this volume, which in their original contexts were timely and useful reports. Their reproduction in this book, however, gives the impression of a hastily compiled work with a faint smack of environmental and ecological gimmickry. Such dustcover statements as "Forty million years of Earth's history buried in the ice . . . and a new human civilization to be born. Here is our planet's last continent and last chance" are not only bad science and sensational but do little to commend this book to the serious reader.

David J. Drewry

NEWS

AWARDS

Dr Robert P. Sharp has been elected to the U.S. National Academy of Sciences in recognition of his outstanding research in "glacier flow mechanics and the analysis of natural processes at work in the desert, particularly those involving sand dunes".

QUATERNARY RESEARCH CENTER, UNIVERSITY OF WASHINGTON, U.S.A.

The Society cabled a message of congratulations and good wishes to the Center for the opening of its new building in the second week of May, 1973.

BEAR GLACIER SURGE, U.S.S.R.

A huge lake dammed up by the advancing Bear Glacier broke through its ice barrier on 20 June 1973. A flash flood resulted causing heavy damage but apparently no casualties. The raging torrent carried boulders and ice through the Vanch Valley, destroying electric lines and highways. The flood had been predicted for the past two months, ever since the Bear Glacier began advancing at the head of the Vanch Valley.

Damage was kept to a minimum by dismantling bridges, constructing protective dikes, and evacuating people and livestock. (The Valley has a population of 10,000.)

(Report from the Smithsonian Institute Center for Short-Lived Phenomena, from information provided by Dr L. D. Dolgushin, Institute of Geography, Moscow, USSR.)

NEW QUARTERLY MAGAZINE

The U.S. National Science Foundation has sent us the following notice:

Information on the U.S. Federal arctic research effort will be available in a new quarterly publication, the **Arctic Bulletin,** the first issue of which was published in August 1973. The National Science Foundation is the lead agency for the extension of arctic research, and it manages and funds a research program in the Arctic. The Foundation publishes the **Bulletin** for the Interagency Arctic Research Co-ordinating Committee (IARCC) which is comprised of 12 Federal agencies and departments conducting arctic research. IARCC, chaired by Dr Thomas O. Jones, Deputy Assistant Director, National and International Programs, NSF, co-ordinates all unclassified Federal research in the Arctic.

The **Arctic Bulletin** discusses national and international research plans, activities, and accomplishments. It will report current and planned government-sponsored research in the Arctic; summarize preliminary research results of U.S., co-operative, and foreign projects; report technological or managerial innovations in arctic research; provide a historical record of U.S. arctic research; and afford a forum to discuss and evaluate the national arctic program.

Copies of the **Arctic Bulletin** are available from the Office of Polar Programs, National Science Foundation, 1800 G. Street, Washington, DC 20550, USA.

ROSS ICE SHELF PROJECT

The Ross Ice Shelf Project evolved from the belief expressed by scientists from several countries that many scientific opportunities would emerge if a hole were drilled through the Ross Ice Shelf to sample the ice, examine the underlying water column and biome, and drill into the bottom sediments. In 1970 the U.S. National Academy of Sciences Committee on Polar Research established an ad hoc panel to consider the feasibility and to assess the scientific goals of such an effort. The recommendations of this panel led to the establishment of a RISP Steering Group under the Committee on Polar Research, and ultimately to the establishment of a management office at the University of Nebraska-Lincoln. The Steering Group and the Management Office have been actively working on the development of a science plan for RISP. Scientists from a variety of scientific disciplines (geophysics, glaciology, geology, marine biology, oceanography, engineering, meteorology) have participated in the development of this science plan and have expressed an interest in participating in the project.

The aims of the Ross Ice Shelf Project are to investigate the physical, chemical, biological, and geological conditions in the shelf ice, in the water mass beneath the ice, and in the soft sediments and bottom bedrock. Specifically, the project will attempt to elucidate the present dynamics and past history of the Ross Ice Shelf, the relationship between the waters beneath the shelf and the open Ross Sea, to determine the nature of the fauna and flora beneath the Ross Ice Shelf, and to help with the understanding and interpretation of both the past and present climatic conditions in Antarctica.

During the 1973-74 field season three co-ordinated field programs are planned. A base camp will be established at 82.5°S, 166°W, the site tentatively selected to be the drill site for the following year. At the base camp, oceanography measurements will be made, and recording tidal gravimeters will be used to investigate the tidal motion of the ice shelf. Routine meteorological observations will be taken at the base station and in the field.

During the occupation of the temporary base camp the glaciological and geological parties will occupy 80 and 90 sites on the Ross Ice Shelf using a Twin Otter for transportation. These stations will be about 50 kilometers apart, roughly on a rectangular grid system. The geophysical program will consist of seismic refraction and reflection shooting, radio echo sounding, electrical resistivity profiling, and gravity recording at each station.

The geophysical program will result in a survey of ice thickness, water depth beneath the ice, and depth to basement rock, information which will be useful in final drill site selection. The work will also yield considerable information on the physical properties of the ice shelf; depth-density curves down to the firn-ice boundary, anisotropy within the ice shelf, information on the electrical conductivity of ice and possibly on the existence of a frozen-on layer of bottom ice. Apart from measurements of ice thickness, the radio echo sounding will also provide information on reflectivity of the ice-water interface and on the presence of internal reflectors similar to those found on inland ice sheets. Most of this work is of considerable interest to the glaciologists, and the surface glaciology program is designed to supplement the results from the geophysics program.

The glaciological work will include the planting of strain rosettes at most of the geophysics stations, for studies in surface strain rates, snow accumulation rates, and ice velocity. Shallow holes will be drilled for 10 m temperature and core collection, for subsequent laboratory investigations.

Upon completion of the work from the base camp on the ice shelf, the remainder of the season will be spent operating a similar program out of Williams Field. It is intended that approximately 100 stations be occupied during the 1973-74 season and another 100 during the 1974-75 season giving a complete coverage of the Ross Ice Shelf with stations about 50 km apart. The 1975-76 season will be devoted to remeasurements of strain rosettes and position fixes.

During 1973-74 the planning will continue on the development and acquisition of a drilling system suitable for penetration through the Ross Ice Shelf and into the sub-sea sediments. The initial drilling is planned to start during the 1974-75 field season in Antarctica.

If there are any members of the scientific community who are interested in learning more about the Ross Ice Shelf Project they are urged to contact Dr Robert Rutland, Director, Ross Ice Shelf Project Management Office, University of Nebraska-Lincoln, 135 Bancroft Hall, Lincoln, NB 68508, U.S.A.

NEW MEMBERS

Badré, Denis, CTGREF, BP 114, 38402 St. Martin d'Hères, Grenoble, France.

Baker, Robert W., 520-2nd Avenue SE., Apt. 106, Minneapolis, MN 55414, USA.

Bjelm, Leif, Borlunda 6, 24100 Eslöv, Sweden.

Bon Mardion, Gilbert, no. 1 les Primevères, 38320 Poisat, France.

Boutard, Susanne, Borlunda 6, 24100 Eslöv, Sweden.

Hass, Miss Norma, Box 344, Bancroft, Ontario, Canada.

Huntley, David F., Stevenson College, University of California at Santa Cruz, Santa Cruz, CA 95064, USA.

Keevil, Benjamin, 33 Clarey Avenue, Ottawa, Ontario, Canada.

Kry, Dr Peter R., Eidg. Institut für Schnee- und Lawinenforschung, 7260 Weissfluhjoch, Davos, Switzerland.

Maire, Richard, 73 Boulevard du Righi, 06100 Nice, France.

Marliave, Guy de, ANENA, 46 Avenue F. Viallet, 38 Grenoble, France.

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Matthews, J. A., Department of Geography, University of Edinburgh, High School Yards, Edinburgh, Scotland.

Moiroud, André, Biologie Végétale Bât 405, 43 Bd. du 11 Novembre 1918, 69 Villeurbanne, France.

Oguro, Mitsugu, Department of Applied Physics, Faculty of Engineering, Hokkaido University, Sapporo, Japan.

Pecchio, G., Via Passalacqua 14, 10122 Torino, Italy.

Sangay, André, 39 bis rue du Baradat, 65 Vic-Bigorre, France.

Shoji, Hitoshi, Solid State Physics Group 1, Department of Applied Physics, Faculty of Engineering, Hokkaido University, Sapporo, Japan.

Tewksbury, Dave, 17 Adams Lane, Wayland, MA 01778, USA.

INTERNATIONAL GLACIOLOGICAL SOCIETY

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. No proposer or seconder is required. Annual payments 1973:

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

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

ICE

Editor: Mrs Hilda Richardson

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