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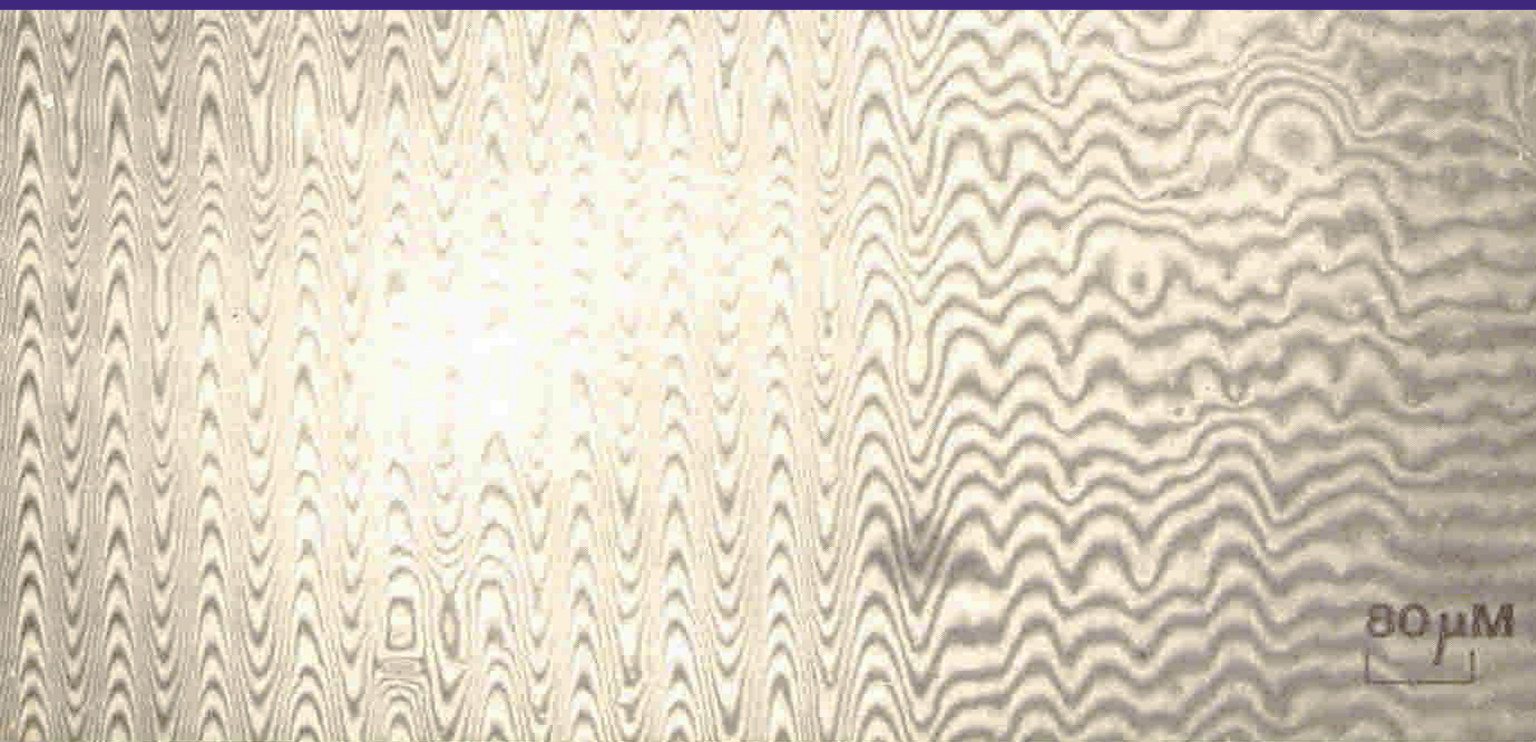
ICE



GLACIOLOGICAL SOCIETY

1970 ANNUAL GENERAL MEETING & CONFERENCE

The Society's Annual General Meeting will take place on Thursday 7 May at 6.30 p.m. at the University Centre, Cambridge, England, and will be followed by a dinner at 7.45 p.m.

Details of the conference programme for 7 and 8 May are given on page 11 of this issue of ICE.

ICE

NEWS BULLETIN OF THE GLACIOLOGICAL SOCIETY

APRIL 1970 NUMBER 32

CONTENTS

ANNUAL GENERAL MEETING 1970. As announced in the previous issue of ICE, this will be held on Thursday 7 May in the University Centre, Cambridge, England, at 6.30 p.m. It will be followed at 7.45 p.m. by the Society's Annual Dinner. Tickets may be obtained from the Secretary, price £1. 18s. (U.S.$4.50), wines included.

1970 DUES. Have you paid? NO DUES BY JUNE—NO JUNE JOURNAL.

FREE TO MEMBERS. We are able to offer once again to members of the Society reprints and reports which we have received in duplicate. A list of these duplicates has been compiled and is available upon application to the Secretary. If you are interested, please apply soon. We shall not begin the actual distribution of duplicates immediately: we shall allow a lapse of time sufficient to give those members who live at the other side of the world equal opportunity with those who work near to the Society's library. The offer is restricted to members of the Glaciological Society.

COVER PICTURE. Laser Interferogram of a series of finely spaced grooves on the surface of a single ice crystal. These interferograms are now being used in surface self-diffusion studies of ice. Photograph by T. M. Tobin and K. Itagaki (U.S. Army CRREL).

FIELD WORK

FRANCE

CNRS GLACIOLOGICAL LABORATORY

If we include M. Lorius' team from Paris, which will remain in Grenoble until the autumn of 1970, the staff of this laboratory consists of 17 research workers, 4 engineers, and 14 technicians. A building with 2500m² floor space is planned within the university precincts of Grenoble-St Martin d'Hères, and construction work on it should begin in 1970.

In 1969, 5 micrometeorological stations measuring airground heat transfer were in operation at Clos de l'Ours (1000m), Plan de l'Aiguille (2250m), the alpine garden at Lautaret (2100m), Lac d'Arsine (2500m), and St Sorlin Glacier (2730m).

About 100 ablation stakes have been set up and readings taken from them on the Mer de Glace, St Sorlin Glacier and Glacier Blanc. Elsewhere speeds have been determined by ground photographic survey. The Arsine Glacier has been completely surveyed at a scale of 1:2000. The thickness of Glacier Blanc has been measured by seismic sounding, and of Arsine and St Sorlin Glaciers by gravimetry.

A 72m electric core sample has been made across the whole of St Sorlin Glacier, and a variety of studies has been made on the cores.

Several members of the Laboratory attended the Glaciological Society Symposium on the Hydrology of Glaciers, in Cambridge, England, September 1969.

GERMANY

GLACIER COURSE 1969

The "Rudolfshütte" (Hohe Tauern) was the place for the "Glacier Course 1969". This was the 17th such course and it continued a tradition started in 1913 by Professor S. Finsterwalder. There were 90 participants. Under the direction of Professor W. Hofmann, Braunschweig, Professor H. Hoinkes, Innsbruck, and Professor Kinzl, Innsbruck, the programme included lively instruction in glaciological theory and practical fieldwork on glaciers. Unfortunately weather conditions were such that theoretical instruction predominated: there was ample time available for lectures on nearly the whole subject of physical glaciology, including extended attempts by Professor Hoinkes to kill all the 90 participants with mass balance terms, heat budget theory and glacier response to changes of the climate. Professor Kinzl took care of the geographical aspects and Professor Hofmann did his best to enable the participants to survey and map glaciers within the few days of the course.

Many other subjects were covered in the lectures. One subject of remarkable topicality was omitted—glacier hydrology, although the IHD and a demonstration right in front of the hut of the use of glacier run-off for hydroenergy should have encouraged us to deal with this subject. Reports of glaciological activities by working groups and institutions completed the indoor programme. The severely restricted field work was remarkable for one point: in surveying the points necessary for the terrestrial photogrammetry of the glaciers in the vicinity of the "Rudolfshütte" and for the velocity measurements, the WILD-Distomat was used for the first time: it provided distance measurements of high accuracy by means of a modulated beam of infrared light. Needless to add for those who are familiar with glaciological fieldwork—science was not the only thing we spent our time with.

INTERNATIONAL GLACIOLOGICAL EXPEDITION TO GREENLAND (EGIG)

In the final campaign of EGIG in the summer of 1968, Germany took part in the scientific programme with two working groups.

1. Levelling A (field leader: H. Seckel)

The group had to repeat the levelling between the west coast of Greenland and the central part of the ice cap using the same methods as in 1959, i.e. geometric levelling with sights in the range of about 100 m along a 462 km route, and on the identical profile as in 1959, to make the values comparable. The results will show changes in altitude within the nine-year interval.

At first, the positions of the EGIG markers of 1959 had to be reconstructed by adding the extrapolated displacement vector to the 1968 position of the markers. The displacement was derived from the 1967 resurveying by the geodesy group. The group also resurveyed deformation patterns and took gravity measurements. Parallel measurement of a barometric altitude profile completed the programme.

2. Temperature measurements in deep ice (field leader: Dr K. Philberth)

This group, working for the first time on the ice cap, was stationed at the EGIG former wintering-over station, "Jarl-Joset". With thermal probes developed by K. Philberth, attempts were made to take temperature measurements at different depths. In addition to this programme, meteorological observations were continued at the station for two further months.

O. Reinwarth

ICELAND

The main work of the Iceland Glaciological Society in 1969, besides the routine measurements of the longitudinal variations of Icelandic glaciers, was carried out by a Vatnajökull expedition which was a joint effort of the Society and the Division of Physics of the Science Institute, University of Iceland. The expedition left Reykjavík 24 May and returned 14 days later. There were 9 members and the main leader was Carl Eiriksson, engineer. This expedition was a direct continuation of the 1968 expedition and its task was threefold: 1) To sample precipitation from the two previous years at as many places as possible in order to measure its content of deuterium and tritium. This work was led by the chemist Bragi Árnason. 2) To collect an ice core by drilling on Vatnajökull's highest cupola, Bárdarbunga (nearly 2000 m above sea level). The group working on Bárdarbunga was led by the physicist Páll Theodórsson. They succeeded in getting a continuous core down to 106 m depth. Two volcanic ash layers were found in the core, the upper one from Grímsvötn 1934, the lower one probably Katla 1918. The oldest ice in the core was from the year 1915. 3) To study changes in the Grímsvötn depression. The ice-firn level had risen about 15 m since the previous spring and a glacier burst (jökulhlaup) may occur in 1970.

Since 1967 detailed deuterium measurements have been carried out on ice and snow from Icelandic glaciers. It has already been found that isotopic exchange between ice and water takes place in temperate glaciers. This exchange causes homogenization of deuterium in snow during the summer thaws, together with a general increase in deuterium concentration. Ice in a temperate glacier is therefore more homogeneous and has a higher deuterium concentration than the precipitation on the glacier.

This study leads to the development of a method for estimating the run-off ratio. This ratio, together with measurements of the amount of retained precipitation in previous annual layers, gives the total amount of yearly precipitation on temperate glaciers. In cases where such estimates have been made the results are in good agreement with available data obtained independently. At an altitude of 2000 m deuterium measurements show that the yearly precipitation is totally accumulated. Therefore at this altitude the deuterium concentration of an ice core collected by drilling through the ice cap may reflect the past climatic changes in a similar way as the ^{18}O does on polar glaciers. Results obtained show that small variations in the mean annual temperature are reflected in variations of the deuterium concentration of the ice core.

As layers of volcanic ash from recorded eruptions can easily be detected in the ice, dating of the ice core is relatively simple and accurate. No information is available about the deepest ice layers in Icelandic glaciers but they are expected to be at least several hundred years old.

In 1969 S. Thorarinsson was elected president of Iceland Glaciological Society.

S. Thorarinsson

ITALY

There were relatively abundant falls of snow over the whole of the Italian Alps during the 1968-69 winter season and the glaciers kept their snow cover until late in the summer. The residual snow was slow to disperse and it was only at the end of September that the higher mountain regions became completely free of old snow. The overall removal of snow was low, since summer temperatures were generally below mean values. As a result of these conditions there was an increase in the percentage of advancing glaciers by comparison with other years.

SUMMARY

Retreating glaciers	56	(43%)
Advancing glaciers	29	(22.4%)
Uncertain, snow-covered, stationary glaciers	45	(34.6%)

Western Alps	33	retreating	16
		advancing	13
		uncertain, snow-covered, stationary	4
Central Alps	81	retreating	32
		advancing	14
		uncertain, snow-covered, stationary	35
Eastern Alps	15	retreating	8
		advancing	1
		uncertain, snow-covered, stationary	6
Appennines	1	1 advancing	
Total =	130		

M. Vanni

VARIATIONS OF ITALIAN GLACIERS

Years 1968 (1967-68) — 1969 (1968-1969)

(in metres)

WESTERN ALPS

Reg. No.	GLACIER	Years (1967-1968)	(1968-1969)
1	Clapier	−0.90	+6
2	Peirabroc	−1.0	+5
3	Maledia	−1.3	+9
4	Murayon	−0.5	+4.50
5	Ciafraion	st	+4
6	Gelas	n	−?
34	Lamet	?	−?
40	Bessanese	−3	−6
43	Ciamarella	st	−2
61	Capra	−8	−5
103	Valleille	n (1952)	−92
109	Coupè di Money	n	−?
110	Money	n	−?
111	Grand Croux	n	−?
116	Lauson	n (1952)	−98
117	Tuf	n (1952)	−44
121	Traio	n (1952)	−10
122	Grivoletta	n	sn
130	Gran Paradiso	n	sn
131	Moncorvè	−47.2	+7.1
132	Monciair	−12	+9.60
133	Breuil	−10 (1964)	−2
72	Noaschetta	−1 (1964)	−3
155	Torrent	−7.8	st
		1968	**1969**
147	Soches Centelina	−10	+3.50
144	Lavassey	−18	+4.30
200	Arguarey	n	st
202	Breuil	n	−?
204	Chavannes	sn	−?
209	Lex Blanche	st	+?
221	Toula	+5	+20
234	Triolet	n	+?
235	Prè de Bar	+10	+15

CENTRAL ALPS

244	Mon Gelè	−4	−?
260	Grandes Murailles	+6.5	+8
259	Tza de Tzan	−17	?
257	Col Collon	−6	−20
255	d'Oren Nord	−?	−?
265	Solatset	st	st
272	Roisette (Cian)	+2.50	+3.50
281	Montabel	−12	?
282	Cherillon	st	st
284	Tyndall	st	st
285	Cervino	st	st
286	Forca	−10	st
289	Valtournanche	−5	−150
290	Gran Sometta	+?	+?
298	Piccolo Verra	st	st
299	Castore	−2	+2
297	Grande Verra	−4	−2
304	Lys	−22	+7.6
306	Indren Occ. le	sn	sn
308	Netscho	−2.7	+1.40
324	Nordend	+3	+5
325	Belvedere	?	−2
363	Basodino	sn	sn
361	Siedel	sn	st
354	Gemelli di Ban	sn	−?
355	Costone	sn	st
356	Hohsand Merid.	−74	−27.50
357	Hohsand Sett.	n	staz.
360	Blindenhorn	st	st
365	Pizzo Ferrè	−9 (dal 1965)	+?
371	Sud Suretta	−3	?
372	Orsareigls	−6	−?
408	Preda Rossa	st	st
409	Corna Rossa	staz.	staz.
439	Fellaria Occ. le	n	−17 (dal 1959)
443	Pizzo Scalino	n	+15 (dal 1958)
467	Val Lia	−21	?
468	Cordonnè Orientale	−3	−3
469	Cordonnè Occ. le	−1	−1
471	Verva Maggiore	st	st
473	Dosdè Orientale	−10	−22
996	Val Nera Occ. le	−1	−3
995	Val Nera Orientale	sn	sn
991	Mine	sn	sn
483	Vitelli	st	−26
511	Tresero Sett. le	st	−1
512	Dosegù	+10	−9
516	Sforzellina	+6.5	−2
517	Lago Bianco	−2	−6.5
518	Cavia	?	?
567	Gleno	n	+?
566	Trobio	n	?
549	Porola	−5	+1
550	Scais	−20	−14
577	Pisgana Occ. le	−13	+6
581	Venerocolo	st	+2
583	Centrale d'Avio	sn (1967)	+53
502	Gr. Zebrù	n	sn
503	Cedech	+29 (dal 1961)	sn
506	Rosole Merid.	+30	−5
507	Forni	−20	−23
632	Carè Alto Or. le	sn	sn
633	Niscli	st	−26
634	Lares	−2	−11
639	Mandron	−12	−4.6
640	Nardis. Occ. le	−12 (dal 1966)	−4.5
644	Amola	−5.3	−12.2
646	Cornisello Mer. le	−22 (dal 1966)	?
678	Presanella	st	−1
649	Vallesinella	st	sn
650	Tuckett	sn	sn
652	Brentei	+2	sn
653	Sfulmini	st	sn
655	Crozzon	sn	sn
657	Lagol	st	sn
655	Pra Fiorì	st	sn
659	XII Apostoli	−4 (dal 1958)	st
762	Solda	−3.5	−22.5
733	Lunga	n (1967)	−60.50
732	Cevedale	n	+42 (dal 1967)
731	Forcola	n	−67 (dal 1967)

EASTERN ALPS

889	Quaira Bianca	n	+4
893	Gran Pilastro	n	−25
902	Neves Or. le	n	−20
937	Cristallo	sn	−?
963	Cresta Bianca	n	−?
973	Sorapis Or. le	sn	−?
974	Sorapis Centr.	−20	−?
975	Sorapis Occ. le	n	−?
979	Minore di Montasio	sn	sn
980	Or. le di Montasio	sn	sn
981	Occ. le di Montasio	sn	sn
982	Restreleng	−1	sn
983	Ursic	sn	sn
984	Canin Occ. le	sn	−3
985	Canin Or. le	sn	sn

APPENNINES

1006	Calderone	n	+1.4

M. Vanni

JAPAN

ANTARCTICA

Japanese glaciological activities in Antarctica begin with dull sounds of packed sea ice broken by an ice-breaker, *Fuji*. *Fuji* approaches Showa Base in the beginning of January every year, carrying a big load of freight and the new wintering members of the expedition. A new project, "Glaciological survey of Enderby Land", was started in 1969. The main purpose of this project is to measure, by the use of a strain grid, magnitudes and directions of the principal strains within the ice cap at many places along a route linking the following four sites: 71° S, 43° E; 72° S, 43° E; 72° S, 36° E and 71° S, 37° E. H. Ando (leader), Y. Naruse (glaciology), M. Yoshida (geology), K. Omoto (geography) and others left Showa Base 1 November 1969 and returned on 29 February 1970. They made a square grid of four stakes 1 km apart at each of the five points selected on the line from 71° S, 43° E to 72° S, 43° E. In the same manner they also made 162 triangular grids with sides 3 km long along the line connecting 72° S, 43° E and 72° S, 36° E. Measurements of these grids will be repeated from year to year. During the above trip, the expedition observed annual accumulation along longitude 43° E by measuring the depression of the snow stakes which had been set up in 1968. The observed values of accumulation were 26.3 cm at 69° S, 10.1 cm at 69° S ∽ 70° S, and 8.5 cm at 70° S ∽ 71° S. At the above mentioned 5 sites where the square grids were made, they carried out seismic sounding, 10 m core sampling, pit studies (2 m depth), and temperature measurements of snow at 10 m depth. On the way back to Showa Base, they found an area (500 m x 200 m) near 69° 35′S, 43° 20′E, covered with thick moraines. They also set four land marks along Shirase Glacier to measure its flow velocity.

OTHER EXPEDITIONS

Kyoto University sent an expedition (C. Nakajima, leader) to Patagonia, South America, from December 1968 to February 1970. They observed the glaciological climate and old terrestrial magnetism in this region. Okuhira (Nagoya University) joined the Mt. Makalu (Himalaya range) Climbing Party sponsored by Nippon Sangakukai and investigated the glaciers around Mt. Everest. A Japanese Everest skiing expedition will take place in May 1970. In this expedition, it is planned to ski from South Summit (8000 m) to Western Khumbu (5000 m), passing the South Col and the steep south wall of Mt. Everest. A preliminary expedition party surveyed this ski route in September 1969. Fujino (Institute of Low Temperature Science, Hokkaido University) joined this party to investigate the characteristics of the snow and ice along this route.

JAPAN

Studies of snow and ice for XI Olympic Winter Games. Two years ago, the Institute of Low Temperature Science was requested by the Organizing Committee of XI Olympic Winter Games (Sapporo 1972) to solve a number of technical problems concerning the behaviour of snow and ice and its effect on various sports. Since then the scientists of the Institute have been studying hardness and density of snow in order to discover the best conditions for the slalom and downhill races; the studies included experiments in methods of hardening soft snow or melting snow. The Institute suggested to the Olympic Committee that snow should be hardened by compression in such a way that the values of the apparent density and hardness of compressed snow exceed 0.5 g/cm^3 and 10 kg/cm^2 for slalom or giant slalom racing. To achieve this, the snow should be repeatedly compressed from the beginning of the winter season. For the skating events, it was found, by measuring precisely the surface temperature of ice, that most skaters ran at their highest speeds when the surface temperature of ice lay in the range of -2 ∽ -3°C. The scientists are studying the sliding speed of a skate as a function of the surface temperature of ice, and methods of preventing the occurrence on the ice surface of frost formation, which reduces skating speeds.

Avalanches. Aerial observations of crack formation on the snow surface of mountain slopes was made by M. Shoda (Shiozawa Laboratory, National Railways). Crack formation may be considered to be an early warning of the initiation of an avalanche. He analysed the correlation between crack formation and geographical topography, using aerial photographs (x5000 magnification). These results may be useful for avalanche warnings and for the planning of highway construction in mountainous regions. Research on artificial avalanches was carried out by the Highway Construction Agency and the Avalanche Observatory of the Institute of Low Temperature Science, Hokkaido University.

Sea ice. A branch laboratory of the Institute of Low Temperature Science was established at Monbetsu in 1965 to observe drifting sea ice which comes down from the north along the Okhotsk Sea coast of Hokkaido Island. Three radars (5540 MHZ) installed along the Okhotsk Sea coast monitored drifting sea ice approaching from about 70 km offshore. The time-lapse film of the radar image showed the existence of a circular motion in the sea ice near Shiretoko Peninsula.

Perennial snow. A perennial snow patch is regarded as a mini-glacier which changes in

response to environmental changes. A research group in the Institute of Low Temperature Science has been studying a perennial snow patch at Mt. Daisetsu in Hokkaido. By spraying sawdust on the snow surface in the beginning of the winter season, they found that old snow could survive at least 5 years in this snow patch, and that grain growth occurred with age. Another group, from the Water Research Laboratory, Nagoya University, studied the mass balance of the perennial snow patch, "Hamaguri-Yuki", Nagano Prefecture. They made a distribution map of the perennial snow patches in the central mountain ranges of Japan, using aerial photography.

LABORATORY WORK

IX Japanese Antarctic Expedition Party obtained core samples of snow (from 10 m depth) every 100 km along the traverse from Showa Base to the South Pole, and brought them back to Japan. Y. Endo, a member of this party, has been analysing stratigraphy, density and hardness profiles, grain size and microscopic texture of the core samples at the Institute of Low Temperature Science. Some experiments on the deformation of polycrystalline ice were made by Kizaki and Tanaka, Geology Department of Hokkaido University, in order to examine the fabric pattern of deformed ice. A cylindrical sample of ice was compressed uniaxially under stresses of 50 ∽ 100 kg/cm^2 and at a temperature range of -2 ∽ -20°C. Fabric patterns on the schmidt net indicated that double girdles of c-axis projection appeared around the compressive axis at the lower temperature, but they changed to smaller single girdles with increasing temperature and decreasing strain rate. If a cubic sample of ice is compressed, ice expands laterally against the compressive axis. When lateral expansion was allowed only in one direction, three maxima of c-axis projection were observed in the fabric pattern which was similar to that obtained from the ice sheet near Mawson Base, Antarctica.

D. Kuroiwa

UNITED KINGDOM

UNIVERSITY OF LEICESTER ARCTIC NORWAY EXPEDITION, 1969

Part of this Expedition was concerned with the glaciology of Strupbreen, the largest valley glacier in north Norway. It was a preliminary study, carried out at the request of the Norsk Polarinstitutt.

1) Velocity studies. These were taken on three lines of stakes across the glacier, with the uppermost near the firn line. The stakes were measured at 5-day intervals by resection to fixed bedrock stations specially set up for the purpose.

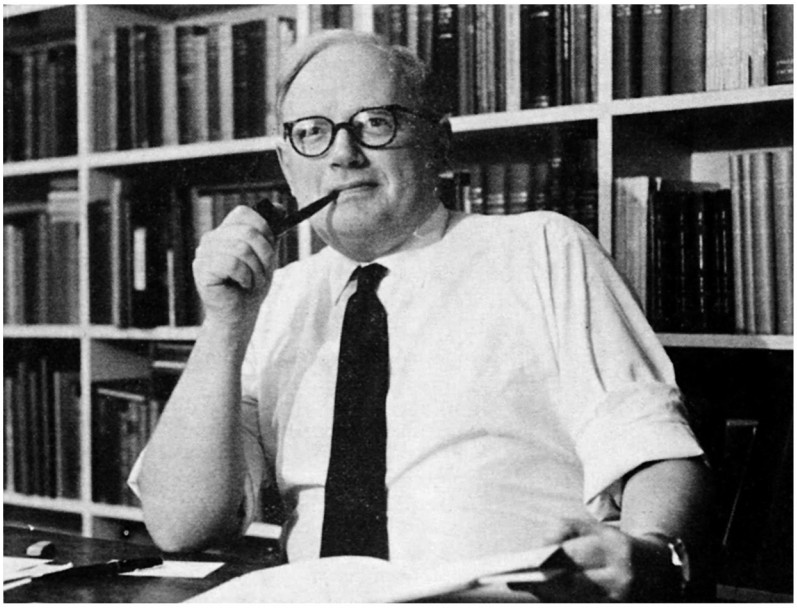
2) **Glaciometeorology.** Some direct measurements of ablation were carried out. Net ablation was measured from a stream gauging point. Two meteorological stations were set up, one near the snout and one near the firn line. Some solar radiation readings were taken at the upper station.

3) **Ice-dammed lake.** Observations on the level of the lake were carried out. A jökulhlaup was witnessed and discharge and lake levels were metered at this time almost continuously.

Most of the readings were for a period from 13 July to 25 August.

Before the Expedition left, the centre stake on each traverse line was drilled in as far as possible (7.5 m) and the snout position surveyed. No return Leicester expedition is planned but other parties visiting the area in the near future could gather much information by continuing the observations taken in 1969.

W. B. Whalley



BRIAN ROBERTS

Many glaciologists who have visited the Scott Polar Research Institute in Cambridge will have met Brian Roberts. If they have stayed for more than the briefest visit and have spent some time delving into the Institute's vast collection of polar and glaciological literature, they will almost certainly have been helped along in their searches by this large, friendly and cheerful man with a stimulating knowledge of the early days of their science. It is most unlikely that they will have any idea of how much they owe to Brian Roberts. To compress the range and depth of his contributions to polar work, glaciology and ornithology, to name only the major fields in which he has been active, is to attempt the almost impossible. Scientists usually achieve fame by original contributions to knowledge in their chosen field. Very few devote their lives to building the essential infrastructure of some part of science. Brian Roberts has applied all his talents to these tasks in the field of polar research.

He has been responsible for organizing the library of the Scott Polar Research Institute; for applying to polar work and glaciology the benefits of the Universal Decimal Classification which have so eased the problems of information retrieval in those subjects; for helping to bring order out of chaos in glaciological terminology; for listing all expeditions to the Antarctic and to the sub-Antarctic islands—a boon to anyone interested in Antarctic history; for developing consistent policies to control the entirely haphazard naming of Antarctic features; for exhaustive work in the bibliography of Antarctic ornithology; for fighting long and difficult political battles in Whitehall aimed at ensuring freedom of scientific investigations in the Antarctic by people who wish to go there. In amongst these tasks he has always found time to encourage and guide the countless young people who have visited the Scott Polar Research Institute intent upon leading an expedition to some part of the polar regions.

In 1932, aged 20 and while still an undergraduate at Cambridge University, he led his first expedition, to Vatnajökull, Iceland. The expedition's attempts to apply the new techniques of seismic sounding to the ice cap were, he says, a dismal but instructive failure. The expedition is notable for the fact that it introduced to practical glaciology two people who, in different ways, were to play important parts in the development of British glaciology: Launcelot Fleming, who later became part-time Director of the Scott Polar Research Institute, who helped Gerald Seligman with the first few issues of the *Journal of Glaciology*, and who is now Bishop of Norwich; and the late Vaughan Lewis, who was to become

a lecturer in the Geography Department of Cambridge University and the enthusiastic tutor and mentor of many glaciologists now working in several countries.

In 1933, Roberts organized the Cambridge University Expedition to Iceland and East Greenland. They were transported to Greenland by J. B. Charcot in *Pourquoi Pas?* In 1934, after graduating in geography, archaeology and anthropology, he joined the British Graham Land Expedition, with Colin Bertram, who was to become part-time Director of the Scott Polar Research Institute after Launcelot Fleming, and Alfred Stephenson, now Professor of Surveying at Imperial College of Science and Technology, London University, who has been responsible for training British Antarctic Survey surveyors for many years. The expedition spent three years in the Antarctic exploring a large part of the Antarctic Peninsula. Roberts devoted his energy to many scientific tasks but concentrated on Antarctic biology.

On his return to Cambridge in 1937, he began work on a Ph.D. thesis on "The biology of some Antarctic birds" and obtained his degree in 1940. During the war-time years he worked for the War Office Intelligence Department (1940-41), then for Admiralty Naval Intelligence Department (1941-43).

In 1936, Gerald Seligman and a group of skiing and mountaineering scientists had founded the Association for the Study of Snow and Ice. In 1945, the Association was revived, its name changed to the British Glaciological Society and, in 1947, it published Volume 1, Number 1 of the *Journal of Glaciology*, with Roberts as one of the four joint editors. His work on the early issues was an important influence on the *Journal*'s editorial policy and its form. The problems he encountered in preparing the index to Volume 1 stimulated his efforts to secure greater international agreement on snow and ice terminology and eventually led, with the co-operation of others, to the publication of glossaries and finally to the *Illustrated Glossary of Snow and Ice.*

As an initial editor of the *Journal of Glaciology* he was specially interested in trying to define the interests of the Society: should we be concerned with such peripheral subjects as Pleistocene stratigraphy? Perhaps not, he suggested. In more specific terms, should the Society concern itself chiefly with "pure research" on the physical properties of snow, ice and permafrost, or should it also embrace the practical engineering applications such as control of snow drifting and avalanches, the economics of snow clearance, or the problems of building in permafrost areas? Some of these questions are still to be decided, but the problems led to Roberts' work, with John Glen, to develop the Universal Decimal Classification schedules relating to these subjects. The schedules have been internationally accepted as a practical classification system by the Fédération International de Documentation for the organization of factual information on snow, ice and frozen soil studies. While there still exist many legitimate differences of opinion about the "subject matter" of glaciology, Roberts has worked consistently to define more closely what those interests might, or might not, embrace.

He served on the Committee of the Society for many years, retiring in 1962 after the Society had adopted its present Constitution. Throughout his period of service he encouraged those changes in the Society's structure which would enable it better to fulfil its growing international role.

His concern with achieving acceptance of underlying policies and principles in the Society was a reflection of what he has always striven for in the two main parts of his career: in the Foreign Office and in the Scott Polar Research Institute. 1n 1943, as a result of a directive from Winston Churchill, he was closely concerned with the initiation and organization of Operation "Tabarin" to maintain British sovereignty in the Falkland Islands Dependencies. Apart from the Argentine station in the South Orkney Islands, Operation "Tabarin" was the start of the first permanent occupation of stations in the Antarctic. It later developed into the Falkland Islands Dependencies Survey and later still into the British Antarctic Survey. In 1944, he was appointed to a post in the Foreign Office in connexion with British polar interests, and he has since divided his time between Whitehall and the Scott Polar Research Institute.

For the last 26 years Brian Roberts has watched British policy in the Antarctic develop from purely "Imperial" beginnings when what mattered was the number of British in the Antarctic as opposed to the number of Argentines and Chileans. To one who had himself reaped a reward from Antarctic research and had seen the limitless possibilities for useful work, the missed opportunities for scientific programmes in the early days of the British Antarctic "presence" was a major frustration. His long years of work to enlighten this dead-end policy were crowned in 1967 when governmental responsibility for the administration of the British Antarctic Survey passed from the Colonial Office and Commonwealth Office to the Department of Education and Science. Underlying this change was a government decision that the scientific work of the Survey was sufficient to warrant its continued support.

Arguments about Antarctic sovereignty also frustrated one of his major beliefs about Antarctic scientific work—that unless results could be freely exchanged between nations their value was enormously reduced. The answer to

this began to appear in 1949 with the organization of the first international expedition to the Antarctic. Roberts was responsible for arranging British Government support for the Norwegian-British-Swedish Expedition (1949-52). Such co-operation was later revived during the International Geophysical Year (1957-58) when scientists of twelve nations arranged to overcome national barriers and co-operate. Brian Roberts was adviser to the British Delegation to the Antarctic Conference which drafted and signed the Antarctic Treaty in Washington in December 1959, ensuring that this co-operation continued. Since then his main aim in successive Consultative Meetings held under the Antarctic Treaty has been that scientists should be able to continue their researches untrammeled by political interference.

In the other half of his job, at the Scott Polar Research Institute, where Gordon Robin is now the Director, he has devoted himself primarily to the information services of the Institute comprised of the library and the *Polar Record,* of which he has been an editorial adviser since 1937. Anyone who has used the library will know what a magnificent research tool he has built up with painstaking care since 1945. In 1959, Cambridge University appointed Roberts a Research Associate, a post especially created to permit him to continue his work in the Foreign Office and in SPRI. In 1965, the Ford Foundation gave a munificent grant toward an extension to the Institute—a new building to accommodate the burgeoning results of the international agreement and co-operation that Roberts had struggled for so many years to keep open. He worked lovingly on the detail of its construction and the design of its facilities.

Two full-time jobs in two cities might seem enough to occupy one man—but in 1965 he was elected to an Extraordinary Fellowship at Churchill College, Cambridge. His work has been rewarded with the Polar Medal (1940), the Back Grant of the Royal Geographical Society (1949) and in the Birthday Honours of 1969 he was appointed a Companion of the Order of St Michael and St George (CMG).

Brian is not, however, a withered diplomatic bibliophile—he leads a very full and enthusiastic social life, that would daunt many a weaker person. Throughout the world he has friends who are glad to welcome him and to make his arrival a ready excuse for a convivial and sometimes uproarious gathering.

MEETINGS

THE GLACIOLOGICAL SOCIETY

BRITAIN

"Gondwanaland ice surges and Carboniferous coal cyclothems" by John Hollin (Princeton University)

KEELE — 4 February, Dept. of Geology, University.

MANCHESTER — 5 February, Dept. of Geology, University.

LONDON — 9 February, University College.

OXFORD — 12 February, Dept. of Geology, University.

"Glacier and ice sheet surges" by J. T. Hollin (Princeton University)

ABERDEEN — 18 February, Dept. of Geography, University.

DUNDEE — 19 February, Dept. of Geography, University.

GERMAN SOCIETY OF POLAR RESEARCH

The meeting took place in Münster/Westfalia from 9-11 April 1969, and its main theme was "Variations of glaciers and ice caps". 150 scientists, representing 11 countries, were present. There were 4 sessions, and papers were presented on the behaviour of glaciers in several areas, including Greenland and Antarctica. Some papers could not be regarded as contributions to the main theme.

At the beginning of the opening session, the chairman of the society, Dr K. Weiken, spoke in memory of Dr B. Brockamp, President of the Society's scientific advisory board, who died at Osnabrück, 20 December 1968. He summarized the merits of Professor Brockamp's contributions to polar research in general and to the German Society of Polar Research in particular. Dr Thyssen, who had worked with Professor Brockamp, gave a review of his rich scientific work, which was mainly devoted to geophysical problems in the field of polar research. In the opening lecture, entitled "We live in an ice age", Professor Hoinkes explained the wide range of glaciological problems in the present and in the past. A public lecture was given by Professor Hofmann on the subject of glacier research throughout the world.

The programme of the meeting was completed by a reception in the historic town hall by the Mayor of the city, and by an excursion to some of the famous Westfalian castles, surrounded by water. Unfortunately, water was not only an object of sightseeing—heavy rain fell during the whole trip.

O. Reinwarth

SNOW AND ICE CONFERENCE, CANADA

Ice engineering and avalanche problems were the main topics of discussion at a conference held at the University of Calgary, Calgary, Alberta, 23 and 24 October 1969. This was the sixth conference on Snow and Ice to be sponsored by the Snow and Ice Subcommittee of the Associate Committee on Geotechnical Research, National Research Council of Canada. The meeting was particularly timely because of the current expansion of oil activities in northern Canada and of mining development in the mountainous areas of Canada. Widespread interest in these developments, and in the attendant snow and ice engineering problems, was evidenced by the attendance at the conference of about 150 engineers and scientists from Canada and the United States.

Papers on the classification of river and lake ice and the process of failure in ice were presented on the morning of the first day. These presentations were of special interest because of current related activity within UNESCO and the International Association for Hydraulic Research. Papers on specific engineering problems, such as the break-up of river ice, the analyses of forces on structures and behaviour of ice under loads, were presented in the afternoon. The session closed with the showing of an interesting film on the historic voyage of the S.S. *Manhattan* through the Arctic ice fields, and a film on model studies of the behaviour of a large tanker in ice.

The second day of the conference was devoted to papers and discussion of problems due to avalanches, avalanche control and avalanche

hazard forecasting. This meeting provided the first formal opportunity for those concerned with avalanche research in Canada and the United States to discuss their work. It was brought out clearly at the meeting that greater attention must be given in the future to training individuals in avalanche hazard evaluation and forecasting because of the growing economic development and recreational activity in the mountain regions of Canada and the United States. The conference was followed by a field trip to see the avalanche defence system for the Trans-Canada Highway at Rogers Pass, B.C. It is hoped that this conference in Calgary will mark the beginning of regular meetings bringing together those concerned with avalanche problems in America.

The Proceedings of the conference will be published in the Technical Memorandum series of the Associate Committee on Geotechnical Research. Requests for copies of the proceedings should be sent to the Secretary, Associate Committee on Geotechnical Research, National Research Council of Canada, Ottawa 7, Ontario.

G. P. Williams

FUTURE MEETINGS

THE GLACIOLOGICAL SOCIETY

ANNUAL GENERAL MEETING AND CONFERENCE 1970

The 1970 Annual General Meeting and Conference will take place in Cambridge, England, on 7 and 8 May. The programme is as follows:

Thursday, 7 May:

Scott Polar Research Institute

1100—1615 (with break for lunch)—Presentation of papers.

University Centre

1830—business meeting, with election of new Council members.

1945—dinner.

Friday, 8 May:

Scott Polar Research Institute

0930—1615 (with break for lunch)—Presentation of papers and "Think Session".

The list of papers to be presented will be circulated to members.

Tickets for the dinner on 7 May may be obtained from the Secretary of the Glaciological Society, Cambridge CB2 1ER, England, price **£1.18s./US$4.50**. Last date for booking: 1 MAY.

EXCURSION IN ICELAND

Please note that the excursion planned to take place in June 1970 immediately following the Joint Meeting with the Icelandic Glaciological Society has had to be cancelled. The Joint Meeting is not affected by this cancellation, and will take place as announced from 19-25 June 1970.

21st AAAS ALASKA SCIENCE CONFERENCE

The 21st Alaska Science Conference will take place 16-19 August 1970 at the University of Alaska, College, and will consist in part of technical sessions at which contributed papers in the physical, biological and social sciences will be presented. There will be general sessions wherein the American Association for the Advancement of Science, Alaska Public Health Association, American Meteorological Society and Canadian Meteorological Society participants will meet together, and there will be separate sessions involving the meeting of the Alaska Public Health Association and the Symposium on Polar Meteorology. Special panel discussions or other sessions may be arranged.

SYMPOSIUM ON POLAR METEOROLGY

The American Meteorological Society will sponsor a Symposium on polar meteorology as part of the meeting of the Alaska Division of the American Association for the Advancement of Science. The meeting will be held on the campus of the University of Alaska, College, Alaska, 16-19 August 1970. The Canadian Meteorological Society and the Arctic Institute of North America are cooperating with the AMS in arranging the sessions on Polar Meteorology.

Papers are invited on meteorology and climatology of the polar regions. Informative abstracts should be sent before 15 April 1970 to Dr Gerd Wendler, University of Alaska, Geophysical Institute, College, Alaska 99701.

Further information about the meeting may be obtained from:

AAAS Symposium Secretary,
Geophysical Institute,
College,
Alaska 99701, U.S.A.

GLACIOLOGICAL DIARY

1970

5—7 April
10th Annual North American Snow Conference, Boston, Mass., USA. (General Chairman, North American Snow Conference, APWA, 1313 E. 60th Street, Chicago, Ill. 60637, USA.)

8—10 April
Symposium on snow and ice control on roads and runways. Hanover, New Hampshire, USA.

20—23 April
American Geophysical Union, annual meeting, Washington, D.C. (AGU, 2100 Pennsylvania Ave. NW, Washington, D.C. 20037, USA.)

18—25 June
Icelandic Glaciological Society and Glaciological Society, joint meeting.

15—23 July
Symposium on the world water balance. Reading, England. (Unesco/IASH.) (Professor R. G. Sutcliffe, Department of Geophysics, University of Reading, Building No. 2, Earley Gate, Whiteknights Park, Reading, RG6 2AU, England.)

26 July—12 August
Glaciological Training Course (Unesco). Kebnekaise, Sweden. (Dr V. Schytt, Dept. of Physical Geography, Box 6801, 113 86 Stockholm, Sweden.)

7—15 August
SCAR Geology, Oslo, Norway. (Dr R. J. Adie, Geology Department, Birmingham University, P.O. Box 363, Birmingham 15, England.)

7—10 September
Iceland IAHR, Reykjavík, Iceland. (Mr S. Freysteinsson, Chairman of the Organizing Committee, IAHR Ice Symposium 1970, Verkfraedistofa, Sigurdur Thoroddsen Sf, Armula 4, Reykjavík, Iceland.)

14—25 September
"The Ocean World", joint oceanographic conference, Tokyo, Japan. (Prof. K. Yoshida, Secretary, Japanese Organizing Committee for IAPSO, Science Council of Japan, Ueno Park, Tokyo 110, Japan.)

11—13 November
Geological Society of America, annual meeting, Milwaukee. (GSA headquarters, Box 1719, Boulder, Colo. 80302, USA.)

1971

5—9 July

International Conference on Crystal Growth, Marseille, France. (Secretariat ICCG-3, Faculté des Sciences, Marseille St. Jérome, 13-Marseille-13e, France.)

28 July—14 August

XVth General Assembly of IUGG, Moscow, USSR. Joint symposia planned:

(a) Interdisciplinary studies of snow and ice in mountain regions. Organized by CSI, local convener V. Kotlyakov, Moscow; co-sponsored by IAMAP. A first circular will be issued shortly. (Dr W. H. Ward, 147 Rickmansworth Road, Watford, Herts., England.)

(b) Air-sea interactions with floating ice. Organized by IAMAP; co-sponsored by CSI, IAPSO, SCAR. (Secretary, IAMAP, Dr R. E. Munn, Meteorological Office, 315 Bloor Street West, Toronto 5, Ont., Canada.)

(c) Energy fluxes over polar surfaces. Organized by Commission on Polar Meteorology of IAMAP; co-sponsored by CSI, IAPSO, SCAR. (Prof. S. Orvig, Department of Meteorology, McGill University, Montreal 2, P.Q., Canada.)

18—27 August

Pacific Science Association, congress, Canberra, Australia. (Geography Chairman: Akira Watanabe, Dept. of Geography, Ochanomizu Univ., Bunkyo-ku, Tokyo, Japan. Meteorology Chairman: J. F. Gabites, Director, Met. Service, P.O. Box 722 Wellington, New Zealand. Solid Earth Sciences Chairman: W. H. Mathews, Dept. of Geography, Univ. of British Columbia, Vancouver 8, B.C., Canada.)

1972

(early August)

International Geological Union Congress
International Geographical Union Congress — Both in Montreal, Canada, on successive weeks.
(Secretariat, 22nd International Geographical Congress, P.O. Box 1972, Ottawa, Canada.)

7—14 September

International Symposium on snow and ice, hydrology and forecasting. Banff School of Fine Arts, Banff, Alberta, Canada. (Dr I. C. Brown, Secretary, Canadian National Committee for IHD, No. 8 Building, Carling Avenue, Ottawa 1, Canada.)

1973

(date not fixed)

International Union for Quaternary Research, congress, New Zealand. (Dr E. A. Francis, Dept. of Geology, Univ. of Newcastle upon Tyne, Newcastle upon Tyne, England.)

1975

(date not fixed)

International Union of Geodesy and Geophysics, general assembly, France. (Prof. G. D. Garland, Geophysics Lab., Univ. of Toronto, Toronto 5, Canada.)

THE CRUISE OF THE S.S. *MANHATTAN*, 1969

When the *S.S. Manhattan* sailed north from the east coast of the United States in late August 1969, it was the first attempt by a commercial vessel to traverse the Northwest Passage across the Canadian Arctic Archipelago to the Arctic Ocean. The purpose of the trip was to gain technical data that would permit a realistic evaluation of the possibility of year-around icebreaking tanker trade between the major oil discovery at Prudhoe Bay on the north slope of Alaska and the east coast of the United States and Canada. Correlations between the icebreaking ability of model ships and the limited data available on the performance of actual icebreakers suggested that such a ship was possible. However, the extrapolations necessary to predict the characteristics of the design tanker were so large that it was very difficult to appraise their adequacy. To obtain intermediate data points and operational experience with a large ship in ice, the Marine Department of the Humble Oil and Refining Company in cooperation with Atlantic Richfield and the BP Oil Corporation leased the 145,000 ton *Manhattan*. Extensive modifications were made to the ship in preparing for the voyage: a new icebreaking bow was added, bringing the length of the ship up to 330 m, an "icebelt" was placed around the outside of the hull, the hull was internally strengthened, and the propellers and rudders were modified.

On the voyage the *Manhattan* was joined by the Canadian Department of Transport icebreaker *John A. MacDonald* and the U.S. Coast Guard icebreaker *Northwind*. Although the westward portion of the trip was heavily reported in the press, very little testing was accomplished during it. It was marked by the *Northwind* turning back in Viscount Melville Sound (engine trouble), a helicopter crashing through a melt pond, and the *Manhattan* becoming stuck in the heavy ice of McClure Strait. After the *John A. MacDonald* finally freed the tanker, the two ships completed the passage through Prince of Wales Strait arriving off Prudhoe Bay on 17 September and then proceeding on to Barrow, Alaska, The U.S. Coast Guard breaker *Staten Island* and the new Canadian breaker *Louis S. St-Laurent* accompanied the *Manhattan* and the *John A. MacDonald* on the return through the Passage. When the ships returned to Viscount Melville Sound they remained west of Resolute Bay for three weeks, completing a series of tests of the icebreaking capabilities of the *Manhattan*. In these tests a "reasonably" homogeneous area of ice was selected and the steady state breaking velocity was determined where the ice resistance was just balanced by the thrust. At the completion of each test, ice thicknesses, temperatures and salinities as well as strength and Young's modulus were measured along the test track to characterize the state of the ice.

The Glaciological Society was well represented on the cruise. Society members in the CRREL group supervising the ice testing program were A. Assur, S. DenHartog, G. Frankenstein and W. Weeks. A. Poulin from CRREL performed infrared studies of the ice from the *Staten Island*, M. Dunbar of the Canadian Defence Research Board was an observer abroad the *John A. MacDonald*, and C. Swithinbank of the British Antarctic Survey and Scott Polar Research Institute was an observer for BP aboard the *Manhattan*.

Although the tests are still being analysed, there is one primary deficiency in the results caused by the variety of ice that was available for testing. In the early fall there are two main ice types in the Northwest Passage: young ice less than 50 cm thick which is ideal for testing and multiyear ice up to 4 m thick that shows wide variations in both thickness and in physical properties. Ice of intermediate thickness is very rare, having been either melted or deformed into pressure ridges. The test results, therefore, give a few well defined points on the thin ice end of the graph and a large scatter on the thick ice end. The "filling out" of the curve so that a confident extrapolation of the characteristics of the design tanker is possible will require either a winter or a spring cruise, when homogeneous cold ice of intermediate thickness is available. This cruise will take place in April and May (Baffin Bay and Lancaster Sound).

Although the technical problems are challenging, it is my impression that large icebreaking tankers that will be able to transit safely the Northwest Passage on a year-around basis can be built. Such ships may even be able to make routine runs north of Greenland to Europe during the summer. Whether or not it is economically feasible at present to do this is another matter. Sooner or later, the dream of the Northwest Passage as an operational sea route will become a reality. I would guess that it will be sooner.

W. F. Weeks

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THE GLACIOLOGICAL SOCIETY

c/o Scott Polar Research Institute, Lensfield Road, Cambridge, England

President: Dr V. Schytt

Secretary: Mrs. H. Richardson

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

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I C E

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