NUMBER 16

DECEMBER 1964

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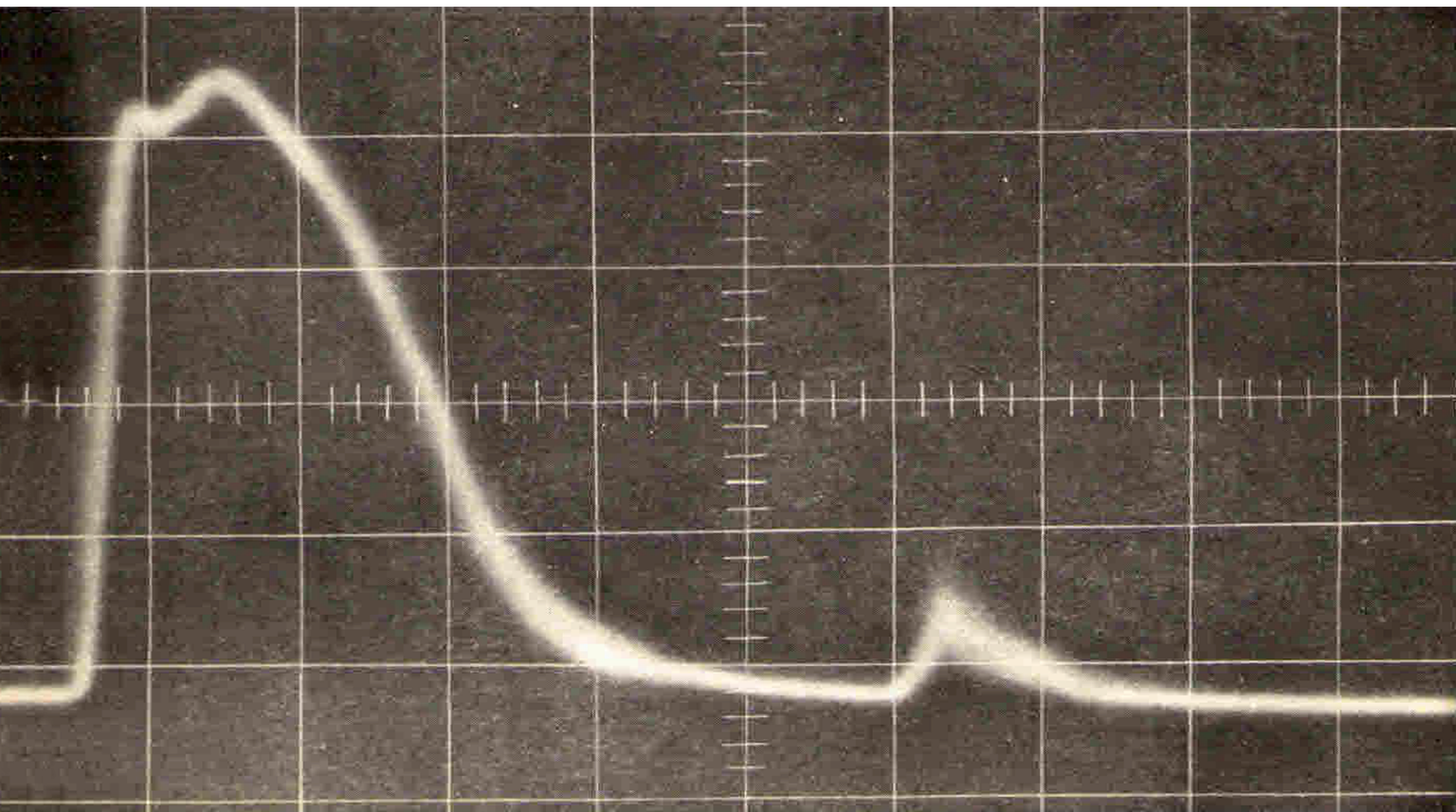


COMMISSION OF SNOW AND ICE

(Int. Association of Scientific Hydrology of the Int. Union of Geodesy and Geophysics)

GLACIER MAPPING

A Symposium will be held in Ottawa, Canada, 20 - 23 September, 1965

Details are given on pages 6 - 7 of this issue of Ice.

If you wish to attend, please complete the form on page 23 and send it to the address given thereon NOT LATER THAN 1st FEBRUARY, 1965.

FINAL DATE FOR BOOKING—1 FEBRUARY 1965

I C E

News Bulletin of the Glaciological Society

DECEMBER 1964 **NUMBER 16**

CONTENTS

Members are reminded that their subscriptions for 1965 (£3 or $9.00 for Ordinary Members, £1 or $3.00 for Junior Members) become due on 1 January. Early payment will ensure that your copies ot the Journal of Glaciology reach you promptly.

DUPLICATE PAPERS. Spare copies of papers donated to the Society's library are available free to members. A list of these duplicates may be obtained from the Glaciological Society Library, Little Dane, Biddenden, Ashford, Kent, England. We shall be pleased to receive spare reprints of articles published by members in other journals, so that we can continue this service to members.

COVER PICTURE. Photograph of an oscilloscope trace which represents the time interval between an initial pulse of electro-magnetic energy and its arrival after reflection from the bottom of a cold polar ice sheet. (See article by S. Evans on page 10)

FIELD WORK

1964 field work will be reported in the April and August issues of Ice. Contributions should be sent as soon as possible to the **Editor, Mrs.** H. Richardson, c/o Scott Polar Research Institute, Lensfield Road, Cambridge, England.

FIELD WORK

JAPAN

HOKKAIDO UNIVERSITY, ALASKAN GLACIER EXPEDITION, 1964. During the summer of 1964, a party of scientists from Hokkaido University, Sapporo, Japan, visited Alaska and the Yukon Territory. Members of this expedition were H. Shimizu, S. Tazawa, and Drs. S. Hashimoto, G. Wakahama, K. Nakamura, and the leader, A. Higashi. The expedition was supported by the Overseas Research Fund of the Ministry of Education of the Japanese Government. This was the second such expedition for many of the members, a previous one having been carried out in 1960 (Ice, no. 7, p. 6-7; Glaciological Notes, no. 5, p. 34).

The expedition spent about five weeks on the Mendenhall Glacier in southeast Alaska, collecting large single crystals from icebergs on Mendenhall Lake and measuring the strain rate tensor on the lower part of the glacier. Three members of the party visited the Antler Glacier, about fifty miles north of the Mendenhall, studying the spectacular ogives on this glacier.

The expedition left Juneau by automobile on July 18th, travelling down the Alaska Highway to Fairbanks and Anchorage. Four of the members visited the Kaskawulsh Glacier in the Yukon Territory, joining the Icefield Ranges Research Project for one week. Aircraft from the I. R. R. P. helped them transport their equipment to the Divide Camp where they made stratigraphical studies of the firn snow. The two other members travelled to Whitehorse during this period, making a general geological survey of the area.

The expedition spent several interesting and profitable days in Fairbanks, visiting their opposite numbers at the University of Alaska and inspecting permafrost and ice wedges in the locality, and then went down to the Gulkana Glacier, where they met Dr. D. M. Ragan and discussed reformation of foliations under the icefall.

The expedition then visited Katmai National Monument and some members made a short reconnaissance flight over Katmai Glacier and the Valley of Ten Thousand Smokes. Unfortunately, bad weather prevented observation of the newly forming glacier in the Mt. Katmai crater. The expedition geologists explored the valley and collected specimens of welded tuff.

The expedition collected one ton of large single crystals of ice which were returned to Hokkaido by the University research vessel, "Oshoro-Maru", and which will be used in solid state studies, and also much other data. Contacts and discussions with other scientists were very real contributions to the success of the expedition.

A. Higashi and Z. Yosida

UNITED KINGDOM

In the summers of 1962 and 1964, six students from the Department of Geography, University of Newcastle upon Tyne worked, by kind permission of Dr. Valter Schytt, at the Stockholm University, Department of Geography's Tarfala Research Station adjacent to Kebnekajse, North Sweden.

Vertical profiles of temperature, vapour pressure and wind speed were measured to 2 m with values of short wave and net total radiation reaching the surface of the Storglaciären and the adjacent Tarfala valley. Water discharge and the silt in suspension was measured in meltwater streams issuing from the Storglaciären and in the main stream of the Tarfala valley. From the 1962 data the amount of heat calculated as available at the surface was generally slightly greater than the heat used in causing the ablation measured, so in 1964 radiation penetrating the snow to 10, 20, and 30 cm in depth was measured. A hot wire anemometer was used for wind fluctuations normal to the mean path and drag plates were set in the snow surface for direct calculation of the friction velocity to give greater precision in finding wind velocity as a function of height and atmospheric stability. Great difficulty was experienced with both hot wires and drag places but on a first analysis of results Miss M. E. Grainger finds the turbulence coefficient of momentum transfer at 50 cm height decreases by a factor of 4 from neutral (frequently assumed) to the high stabilities experienced over a melting snow surface.

H. Lister

MEETINGS

GLACIOLOGICAL SOCIETY. The following meetings have recently been held in the United Kingdom:

29 October in Imperial College, London S.W.7.
J. W. Sheard & H. T. Lovenbury - The Glaciological work of the 1963 Imperial College Beerenberg Expedition.
12 November in the Geology Department, Birmingham University
J. F. Nye - Advance and retreat of glaciers.
28 November in the Scott Polar Research Institute, Cambridge
(joint meeting with the Scott Polar Research Institute)
J. T. Andrews - Baffin Island.

INTERNATIONAL GEOGRAPHICAL UNION. Papers of glaciological interest read at the 20th Congress in London, 21-28 July 1964, are as follows.

(a) Section 3b Polar regions

Cailleux, A. (France)
Altitude du continent Antarctique et loi des altitudes de Matschinski.

Grave, N.A. (U.S.S.R.)
The geographical landscapes of the north and the latest and recent tectonic movements.

Blake, W. (Canada)
Studies of the glacial history of Bathurst Island, Arctic Canada.

Ashwell, I.Y. (Canada)
Some notes on the Pleistocene period in Iceland.

Smith, H.T.U. (U.S.A.)
Scabland topography in Victoria Land, Antarctica

Changes in sea-level, particularly in relation to glacial fluctuation

Stephens, N. (U.K.)
Pleistocene shorelines in Ireland.

Andrews, J.T. (Canada)
The pattern of land up-lift in Grant-Suttie Bay, N.E. Foxe basin.

Brown McGregor, J.C. (Canada)
The use of pollen analysis in establishing a stage in the Champlain Sea.

Mistardis, G.G. (Greece)
Investigations into shoreline displacements and sea-level changes during the Middle-Upper Quaternary in the Greek central area.

Fairbridge, R.W. (U.S.A.)
Beach erosion and sea level changes, eustatic and others.

(b) Section 5 Periglacial phenomena

Dylik, J. (Poland)
Main trend in periglacial research since the last International Geographical Congress.

Dylikowa, A. (Poland)
Periglacial terminology.

Salvador, M. F. (Spain)
Differential modelling in Quaternary formations, and the formation of glacis under cold climatic conditions.

Czeppe, Z. (Poland)
Exfoliation in a periglacial climate.

Matschinskii, M. (France)
Les cailloux façonnés et la direction du vent qui les a formées ("vent fossile").

Glacial erosion

Jennings, J. N., et al (Australia)
The problem of snowpatch erosion - an Australian example.

Klimek, K. (Poland)
Magnitude of erosion of the Middle Polish inland ice.

Pippan, Th. (Austria)
Comparative glacial morphological research in the Alpine, Hercynian and Caledonian mountains in Europe.

Klimaszewski, M. (Poland)
Influence of preglacial relief on the course and efficiency of glacial erosion in the Tatra mountains.

Linton, D. L. and Clayton, K. M.
A qualitative scale of the intensity of glacial erosion.

15th ALASKAN SCIENCE CONFERENCE. The conference was held in the University of Alaska, College, 31 August to 4 September 1964, under the auspices of the University and the Arctic Branch of the Alaska Division of the American Association for the Advancement of Science. Papers of particular interest to glaciologists are listed below. Further details may be obtained from L. Keith Miller, Secretary, Alaska Division A.A.A.S., University of Alaska, College, Alaska, U.S.A.

John J. Kelley, Jr.: Carbon dioxide fluctuations in the Arctic atmosphere.
Bruce J. Lieske: Net radiation over fast sea ice during spring breakup at Point Barrow, Alaska.
Lloyd W. Tourville: The uses of meteorological satellites for observations.
Carl S. Benson: Ice fog studies in the Fairbanks area.
Leander A. Stroschein: An automated radiation climatology station at Point Barrow, Alaska.
Maynard M. Miller: Alaskan glacier variations and the implications of recent tectonic activity.
Carl S. Benson: Units – Metric or Medieval.
Troy L. Péwé: The physical environment of Alaska.
S. J. Knight: Studies on the trafficability of snow and muskeg.
Carl S. Benson: Reconnaissance glaciological and volcanological studies: Mt. Wrangell, Alaska.
Maynard M. Miller: Report on the Summer Institute of Geological Sciences, Juneau Icefield, Alaska.
Charles W. Thomas: Late Pleistocene and recent polar climates as inferred by ocean bottom cores.
Gary S. Anderson: A preliminary study on freezing in turbulent streams of interior Alaska.
Ernest W. Marshall: Classification of lake-ice sheets.
Russell A. Paige: Engineering properties of processed snow.
P. V. Sellmann: Near-surface stratigraphy, Barrow, Alaska: core analysis.
Amory H. Waite: Ice depth measurement with electromagnetic waves, Arctic and Antarctic.

GEOLOGICAL SOCIETY OF AMERICA. The following papers of interest to glaciologists were presented at the Annual Meeting held in Miami Beach, Florida, from 19 to 21 November 1964:

Geomorphology

Helen L. Foster and G. William Holmes: Large transitional rock glacier in the Johnson River area, Alaska Range.

H. T. U. Smith: Wind-eroded rock basins in dry valleys of Victoria Land, Antarctica.

Geophysics

Peter E. Fricker: Paleoclimate of the Canadian Arctic Archipelago and some implications on the problem of continental drift.

Ned A. Ostenso, P. V. Sellmann and T. L. Péwé: Bottom topography of Gulkana Glacier, Alaska Range.

Hydrogeology

Robert F. Black and Thomas E. Berg: Saline discharge from Taylor Glacier, Victoria Land, Antarctica.

Marine Geology and Oceanography

Joe S. Creager and Dean A. McManus: Pleistocene drainage pattern on the floor of the Chukchi Sea.

Robert W. Rex: Possible interglacial beach or dune sands from 300 m water depth in the Weddell Sea, Antarctica.

Arthur L. Bloom: Coastal isostatic downwarping by postglacial rise of sea level.

Ernest E. Angino: Trace-element chemistry of Recent Antarctic glacial marine sediments.

Pleistocene

Dwight R. Crandall: Alpine glaciers at Mount Rainier, Washington, during late Pleistocene and Recent time.

Arthur T. Fernald: Late Quaternary chronology, Upper Tanana River valley, eastern Alaska.

Daniel B. Krinsley: Pleistocene geology of the Southwest Yukon Territory, Canada.

Stephen C. Porter: Multiple glaciation of Chagvan Bay area, southwestern Alaska.

Bjørn G. Andersen and G. William Holmes: Fennoscandian moraine in southeastern Norway.

F. L. Doyle: Glacial stagnation in northwestern Illinois.

Cornelia C. Cameron: Mapping continental glacial drifts: An environmental approach.

Hans E. Suess: Natural carbon-14 inventory and its changes over the past 2000 years.

J. Robert Dodd: Paleotemperatures from the California Pleistocene.

Sedimentology

A. Thomas Ovenshine: Glacial interpretation of Precambrian Gowganda Formation, north shore of Lake Huron, Canada.

AMERICAN GEOPHYSICAL UNION. The 4th Western National Meeting will be held at the University of Washington, Seattle from 28 to 30 December 1964. Glaciological papers to be read at this meeting are:

Giovinetto, Robinson and Swithinbank - The regime of the western part of the Ross Ice Shelf drainage system.

Meier - The recent history of advance-retreat and net budget of South Cascade Glacier.

Tangborne - Glacier mass budget measurements by hydrometeorological means.

Post - Influence of the 1964 Good Friday earthquake on Alaskan glaciers.

Benson - Glaciological research at the University of Alaska.

Harrison - Climate and glacier fluctuations.

AMERICAN SOCIETY OF PHOTOGRAMMETRY and the AMERICAN CONGRESS ON SURVEYING AND MAPPING. The annual meetings will be held in Washington, D. C., from 28 March to 2 April 1965. For further information, write to C. E. Palmer, American Society of Photogrammetry, 44 Leesberg Pike, Falls Church, Virginia, U.S.A.

AMERICAN GEOPHYSICAL UNION. The 46th Annual Meeting will be held in Washington, D. C. from 19 to 22 April 1965. Further details are given in the December issue of Transactions of the AGU. Special Announcements section.

COMMISSION OF SNOW AND ICE

(Int. Association of Scientific Hydrology of the Int. Union of Geodesy and Geophysics)

SYMPOSIUM ON GLACIER MAPPING, OTTAWA, SEPTEMBER 1965

FIRST CIRCULAR, NOVEMBER 1964

1. INTRODUCTION

The National Research Council of Canada, in association with the IUGG/IASH Commission of Snow and Ice, is organizing a Symposium on Glacier Mapping to be held in Ottawa in September 1965. The idea of such a Symposium originated at a meeting of the National Research Council's Sub-Committee on Glaciers in October 1963. The Commission of Snow and Ice supported the proposal, and Dr. H. Hoinkes, the President of the Commission, wrote that he considers the Symposium "very important indeed, especially at the beginning of the International Hydrological Decade ... we are badly in need of many more exact glacier maps from all over the world and the Symposium on Glacier Mapping might foster international co-operation in this field." As a result of enquiries in April 1964, further encouraging support has come from a number of glaciologists of various nationalities, distinguished in the field of glacier mapping, who have indicated their willingness to present a paper at the Symposium. All arrangements for the Symposium will be made by the Sub-Committee on Glaciers.

2. PLACE AND DATE

The Symposium will be held from Monday 20th to Wednesday 22nd September 1965 at the National Research Council Laboratories, Montreal Road, Ottawa, which are 10 minutes by car and 20 minutes by 'bus from the centre of town, and which hold good facilities for a meeting with up to 100 participants.

3. ACCOMMODATION

The following is a guide to prices of three types of accommodation in Ottawa; prices do not include meals, for which a minimum of $4 per day should be allowed.

	Room (Canadian dollars)	
	Single	Double
Class "A" (centre of town)	10.00 - 20.00	15.00 - 25.00
Class "B" (centre of town)	4.50 - 5.00	7.00 - 8.50
Motor Hotel (5 mins. walk from National Research Council)	7.00	12.00

4. REGISTRATION

Registration will take place at the National Research Council Laboratories, Montreal Road, between 9 and 10 a.m. on Monday, 20th September. No registration fee is being charged.

5. PAPERS

5.1 Contents. The papers may cover any aspect of glacier mapping, with the emphasis on the solution of particular problems. They are expected to be original in content and critical in treatment.

5.2 Text, diagrams and photographs. The complete paper in English or in French, including short abstracts in English and/or French, diagrams, tables and photographs should not exceed 15 double-spaced typewritten pages. Each page of typescript should contain not more than about 300 words. The number of photographs and large maps (see para 5.6) must be kept to a minimum; the diagrams must be drawn with black lines on white paper or tracing linen, and be suitable for direct reproduction.

5.3 Submission and deadline. Titles and abstracts of papers must be forwarded to the Chairman, Sub-Committee on Glaciers, Liaison Office, National Research Council, 100 Sussex Drive, Ottawa, Ontario, Canada to arrive not later than 1 February, and the papers must be received not later than 1 August 1965. The programme allows for only a limited number of papers, which will be subject to screening.

5.4 Circulation of abstracts. Mimeographed copies of Abstracts will be circulated to participants before the Symposium.

5.5 Delivery. A maximum of 45 minutes will be allowed for the delivery and discussion of each paper, and the delivery itself should not exceed about 30 minutes.

5.6 Publication. Arrangements will be made for the publication of all papers as soon after the Symposium as possible. It will not be possible to reproduce large folding maps, but authors may wish to provide a supply of such maps for distribution with the publication.

6. DISPLAY OF MAPS

In conjunction with the Symposium, it is planned to arrange a display of glacier maps. It is hoped that the display will have a broad historical, geographical and technical scope. Exhibits for this display are invited.

7. RECEPTION BANQUET

On Monday 20 September there will be a Reception and Banquet for participants at the Symposium at a time and place to be arranged.

8. EXCURSION

On 23 September, at the end of the Symposium, an excursion to a point of interest in the Ottawa area may be arranged. While primarily a social occasion, the excursion would provide an opportunity to observe the effects of past glaciation, under the guidance of a geologist familiar with the area.

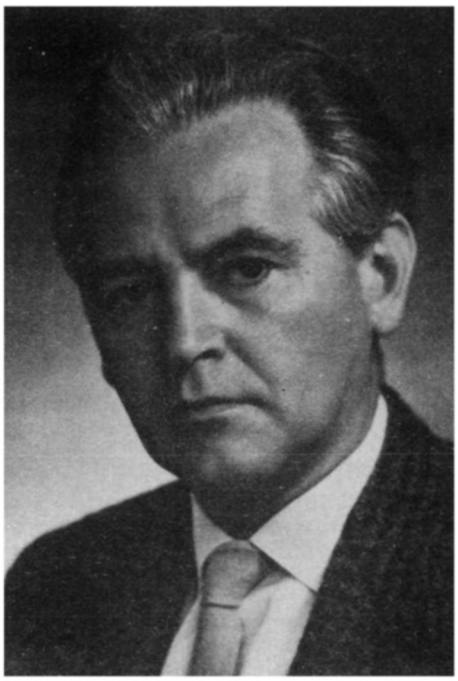
9. WEATHER DATA FOR OTTAWA IN SEPTEMBER

Mean monthly temperature	14.7° C
Mean maximum temperature	20.5° C
Mean minimum temperature	8.9° C
Mean precipitation	76 mm
Mean rainy days	11
Mean sunshine hours	5.9/day

10. CORRESPONDENCE

Intending participants at the Symposium should fill out the form on p.23 and return it to the Chairman, Sub-Committee on Glaciers, Liaison Office, National Research Council, 100 Sussex Drive, Ottawa, Ontario, Canada not later than 1 February 1965. A second Circular will be sent out in March.

G. Hattersley-Smith
Chairman, Sub-Committee on Glaciers
National Research Council, Canada



Herfried Hoinkes

A glaciologist visiting Innsbruck will have many interesting experiences. Some will be memorable and meteorological. As his aeroplane descends rapidly from the chilly Zugspitz into the confined warmth of the Inn valley, ice pellets are sometimes showered by the ventilation system on the laps of the passengers. But the warm welcome of the University's Professor of Meteorology, Herfried Hoinkes, quickly dispells any meteorological fears, for he loses no time in introducing a visitor to the competent weather service of the Innsbruck airport.

Hoinkes was born in 1916 in Bielitz, Austrian Silesia. After education in meteorology and geophysics at Könisberg and Innsbruck universities he took his Ph.D. in 1940. His first work on glaciers was in 1938 as an assistant to Professors Schatz and Vietoris in surveys of the Hintereis and Vernagtferner. A glance at his athletic figure and a face bronzed by the effects of shortwave radiation suggests his years of devotion to sport and work in the high mountains.

During the early years of the war, he took part in the high-mountain research courses organized by Professors Finsterwalder, Troll and Kinzl; he spent the later years as meteorologist in the German Navy Weather Service. When in a reminiscent mood, say, in a quiet corner of a crowded Ötztal hut, he has told many stories of his escapades on the coast of the English Channel and in Paris with the German Navy.

After the war, he returned to Innsbruck to begin with his students a long-term programme of research on the glacial meteorology of the Central Otztal Alps, a programme that still continues today. This work has established and secured his world-wide reputation in heat-budget studies. His former assistants - Norbert Untersteiner and Walter Ambach among others - are now listed among his disciples. In 1949, Hoinkes became a dozent, and in 1956 he was appointed Assistant Professor of Meteorology in Innsbruck University and Director of its Institute of Meteorology and Geophysics.

In 1957, the beginning of the International Geophysical Year, he wintered in Antarctica as a member of the United States "Operation Deepfreeze". Most of the time he spent at Little America V, but he also visited the South Pole and Byrd stations before returning home by way of the mountains of New Zealand and Hawaii. He probably counts that sojourn in the Southern Hemisphere among his most memorable experiences. It has left a ripe flavour of American and New Zealand accents in his speech and given him an excellent command of the English language.

On return to Innsbruck, he became full Professor, and his growing interest in world-wide glacio-meteorological problems led him to contribute to many international conferences. In 1962, he organized at Obergurgl with the Commission of Snow and Ice the Symposium on the Variations of Glaciers, which was attended enthusiastically by glaciologists from many countries.

For the academic year 1963-64, in addition to his regular duties Hoinkes became Dean of the Faculty of Philosophy, an arduous post involving responsibilities to many professors. After spending most of his day in his majestic office administering his faculty, he returned in the evening and at weekends to his studies and tasks at the Institute.

A visitor to his old and overcrowded Institute is welcomed by a busy hive of research students, and then, on entering the inner sanctum of their much-admired Professor, he notices the walls lined with a splendid collection of books on earth sciences and the desk loaded with correspondence. Here certainly is the scene of much hard work, but it is also one, at least occasionally, of informal entertainment in which family, students, and friends join.

Hoinkes married Trude, a fine skier and mountaineer, during his period of service in the German Navy. They spend many holidays with their two sons, Christian and George, in the Ötztal mountains.

Everyone who knows Hoinkes soon discovers that he is a delightful companion with an engaging love of fun. That characteristic twinkle heralds spirited repartee in expected and in many unexpected situations. His abilities as organizer and leader have gained him many honours. He is a member of the Geophysical Commission of the Austrian Academy of Sciences and of the Glaciological Commission of the Bavarian Academy of Sciences. In 1963 at the Berkeley Assembly of the I. U. G. G. he was elected President of the Commission of Snow and Ice, and in 1964 he was elected Vice-President of the Glaciological Society.

THE INTERNATIONAL HYDROLOGICAL DECADE

In 1962, the General Conference of UNESCO authorized the Director-General to 'provide' for the preparation of a long-term programme of international co-operation in scientific hydrology whose operational aspect shall begin in 1965, based upon the conceptual framework of an International Hydrological Decade, and relating to UNESCO's contribution to the United Nations Development Decade', and to 'convene for that purpose during 1964 an intergovernmental meeting of experts to be preceded by a preparatory meeting in the first half of 1963'.

The preparatory meeting was held in Paris in May 1963, and the final meeting in April 1964. The latter meeting was attended by our members Dr. J. T. Wilson and Ing. P. Kasser and its report (UNESCO/NS/188) was issued in June 1964. It contains the final programme for the Decade, prescribes methods for its implementation and prepares the decisions to be taken by the General Conference of UNESCO in October 1964.

The International Hydrological Decade will be concerned primarily with water in the land areas of the globe, attention being given to oceanic waters only in relation to specific problems in land areas. Similarly, the programme will not be concerned with meteorology as such, but only with those aspects closely related to the land phase of the hydrological cycle.

The programme planned for the Decade includes seven basic components:

1. Appraisal of the state of our knowledge of the hydrology of the world and identification of the principal gaps in that knowledge.
2. Standardization of the instruments, observations, techniques and terminologies used for the collection, compilation and reporting of data.
3. Establishment of basic networks and improvement of existing networks, to provide fundamental data on hydrological systems varying in size from small watersheds to the world as a whole.

4. Research on hydrological systems in selected geological, geographical, topographical and climatic environments, constituting what may be called 'representative basins'.
5. Research on specific hydrological problems whose urgency and special nature call for a considerable effort at international level.
6. Theoretical and practical training in hydrology and related subjects.
7. Systematic exchanges of information.

As regards arrangements for the successful organization of the work, the general administrative and co-ordinating machinery, which has already been installed, has a three-fold basis: national committees, a Co-ordinating Council and the support of scientists in general.

The Co-ordinating Council is a body on which a fairly large number of States are represented, on as wide a geographical basis as possible, and in which all the organizations in the United Nations system, collaborating in the execution of the programme, can participate effectively. The Secretariat of the Council, which will also be that of the Decade, will focus national and international action and provide over-all liaison.

The outline of the scientific programme pays particular attention to snow and ice masses as primary observation items in water balance studies.

The various countries are currently preparing their national programmes for submission to the UNESCO Secretariat as a list of projects classified in one of the following categories:-

1. Collection of basic data
2. Inventories and water balances
3. Research
4. Education and training
5. Exchange of information

Within these categories the programme mentions the following topics of special interest to glaciologists.

1. Establishment of meridional and latitudinal chains of observations on glaciers, mapping of permafrost areas and a study of the water balance of Antarctic icefields.
2. Each country is requested to assemble inventories of available data on snow, ice and glacier masses, and to study the water resources of Antarctica on an international scale.
3. Under 'Research' there is a special section headed:
   Snow, ice, periglacial, glaciers and ice caps
   The basic research problems common to these topics are the physical processes of accumulation, formation, metamorphosis, and melting. The dispersion of snow and ice around the world in a variety of climatological and topographic settings provides an excellent opportunity for comparative studies. Specific topics are:

   (a) comparison of energy results among snow fields and ice in various locations;
   (b) transformation and melting of snow and ice by thermal and mechanical means;
   (c) formation, break-up and movement of river and lake ice;
   (d) dynamics of glacier movement;
   (e) formation and melting of pergelisol and temporarily frozen soil;
   (f) instruments for measuring volume and state of snow and ice;
   (g) long-term hydrologic balance of glaciers and ice-caps;
   (h) erosion and sedimentation caused by glaciers;
   (i) discharge in ice and snow through a transverse section of a glacier;
   (j) circulation of water in the interior of a glacier.

RADIO ECHO-SOUNDING

The V.H.F. radar apparatus developed at the Scott Polar Research Institute for sounding polar ice sheets has now been used in several field trials. Mark I was used by M.E.R. Walford, British Antarctic Survey, on the Brunt Ice Shelf at Halley Bay. He obtained strong echoes (up to 50 dB above receiver noise) from many small isolated areas of the bottom surface of the ice shelf but no detectable signal from intervening areas up to 1 km across.

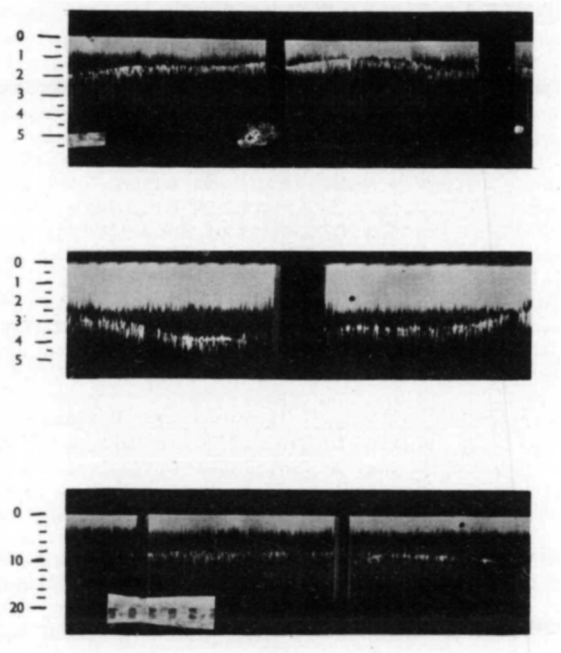
This is unlike the results of Waite (U.S. Army Electronics Research and Development Laboratories) who worked with higher frequency equipment on the Ross Ice Shelf where he obtained virtually continuous echoes. The S.P.R.I. Mark II apparatus was first tried in north-west Greenland in April 1963 up to a distance of 40 km from the edge of the ice cap near the U.S. Army Research Support Group Headquarters at Camp Tuto. The maximum thickness penetrated was about 500 metres and the results encouraged further development of the apparatus for much more extensive trials in north-west Greenland during June to August 1964. On a combined traverse with the U.S. Army Cold Regions Research and Engineering Laboratories, the U.S. Army Electronics Research and Development Laboratories, the Geophysical and Polar Research Center of the University of Wisconsin, and the Scott Polar Research Institute, a profile of the bottom surface of the ice sheet was obtained on a continuous photographic recorder over 97 per cent of the distance. The journey covered the flagged trail 200 km from Camp Tuto (76° 25' N, 68° 28' W, elevation 480 metres) to Camp Century (77° 11' N, 61° 09' W, elevation 1900 metres) then to distances 60 km south and 80 km north-west of Century along routes surveyed for strain-rate measurements by Mock in 1962. The greatest ice thickness encountered this year was 1500 metres.

Sample records are shown in the following figure: some features of this technique and the records which it produces will be new to glaciologists and some will require care for interpretation. Firstly, it is obvious that a continuous profile, rather than spot seismic soundings, will be of immeasurable help towards our understanding of the factors governing the surface form and flow of the ice sheet. However, there is no guarantee that the echoes are received from vertically below the apparatus; several aerials with different directional properties have been tried. Mark I was mounted externally on a Bombardier Muskeg vehicle and used separate transmitting and receiving aerials, each 2 metres long protruding horizontally on either side of the vehicle about 1 metre above the snow surface. In air, these aerials receive equally in all directions in a plane perpendicular to their length. Within the snow, the range of high sensitivity is restricted by an uncertain amount, probably up to 45° from the vertical. Mark II at first used a steel wire rope 12 metres long, with suitable phase-shifters inserted at intervals, and dragged on the snow surface behind the vehicle. This system, though convenient mechanically, fails to take advantage of the directivity which may be gained by refraction in the snow, and conventional balanced-feed half-wave aerials, about 4 metres long, were found to be more effective, providing they can be supported at least 2 metres above the snow surface. At present, this is the most inconvenient feature of the apparatus: it is dictated by the increased absorbtion which occurs at higher frequencies. With these aerials echoes may be detected up to 35° from the vertical within the snow; beyond this range the sensitivity falls abruptly. However, users must always reckon with the possibility of receiving echoes from targets in air or on the snow surface at some horizontal distance. The chief safeguard has been found by experience to be provided by the continuous record and the variation in range of persistent echoes as the observing vehicle moves.

Some simple situations may be imagined. Over a smooth horizontal reflecting surface a single echo of constant strength is received from a direction perpendicular to the surface. Over a small, isolated target the range is seen to change along a hyperbolic locus as the vehicle moves in a straight horizontal line. However, the minimum range will not be in the vertical direction unless the vehicle passes directly over the target. Over a rough extended surface, the most usual situation, the first echo occurs from the perpendicular to the average surface but echoes with longer time delays are received from facets or irregularities at some distance from the perpendicular point. For a very rough surface they may be resolved in range from the nearest echo, or in particular cases there may be one, or two, separate echoes from a hillside at a large angle to the vertical but perpendicular to the line of sight from the observing vehicle.

The bottom echoes are readily recognised by their slow change in range on the film even if they are intermittent. In addition, there is a large number of overlapping echoes from the body of the snow close to the surface. We suppose that this effect is the result of annual layering; even after successive compaction with increasing depth, echoes of this type have been received from depths as great as 300 metres. When observing the bottom echo, the nearby echoes from discontinuities in the snow structure can be troublesome but in their own right they will be a new and most interesting field of study. Persistent echoes from the body of the snow at depths of the order of 500 metres were observed over a wide area in the vicinity of Camp Century and it is supposed that they are related to climatic change at the time the snow at this depth was laid down.

FIGURE 1



Continuous records showing radio echoes from the bottom of the Greenland ice sheet.

Each example represents approximately 2 km of horizontal distance along the traverse. The echo delay time is measured from the top of the broad white band, caused by clutter echoes, to the top of the broken trace caused by the ice-rock interface. The scale of microseconds at the left has an arbitrary zero and in example (a) the bottom echo starts at 2 microseconds (approximately 160 metres depth), in (b) at 2.5 microseconds (200 metres), and in (c) at 8 microseconds (650 metres).

In (a) and (b), where the ice is shallow and the bottom irregular, note the width of the echo caused by reflections from the non-perpendicular direction. The zero of the vertical time scale appears as a straight line on the film whatever the variation in surface profile which must be determined separately from barometric observations.

At the present state of development the apparatus requires a 12 volt power supply. The transmitter and receiver are independent of one another and each is contained in a robust metal box weighing 6 kgm. The receiver contains calibrated attenuators with which the echo strength may be measured directly in dB over receiver noise. It is necessary to adjust the attenuators manually so that the echo of interest is within a suitable range of amplitude for measurement and recording. A commercial oscilloscope weighing 6 kgm and running from a 12 volt supply is used as a monitor on which "A-scope" presentation (shown on the front cover of this issue of Ice, and briefly described on page 1) is normally employed. A second oscilloscope is used with an intensity modulated display, and a recording camera (3 kgm) with a slowly moving film produces a record of the type shown in the figure The film transport is driven electrically from a bicycle wheel odometer so that distances along the traverse may be measured directly on the film. The total load on the power supply is about 5 amps. The complete apparatus is expected to cost about £2500 to duplicate commercially and further details may be obtained from the Scott Polar Research Institute, Cambridge, England.

McGILL SUB-ARCTIC RESEARCH LABORATORY.

On 1st October 1964 the McGill Laboratory at Schefferville, formerly Knob Lake, in central Labrador-Ungava (54° 48' N, 66° 49' W, 512 m a.s.l.), completed ten years of continuous operation. The Laboratory is a first order meteorological observing station, run throughout the year by graduate students and a member of staff from McGill University. During their year of residence, the students, usually Master's candidates, work as meteorological observers, take one course towards their degree, prepare thesis field programmes and maintain a number of permanent research projects set up by the Laboratory. Reports of this work appear in the journals and in the McGill Sub-Arctic Research Papers, of which twenty have been published or are in preparation.

The theses submitted by students working from the Laboratory have included work in geomorphology, climate, vegetation and economic geography. The largest single field of interest has been the deglaciation of the Labrador-Ungava Peninsula. The main permanent research programmes involve measurements of snow, lake ice and permafrost.

For a number of years the Laboratory staff has been making measurements from a network of thermocouple profiles of up to 61 m depth, located on ridge tops which rise some 152 m above the townsite. The sporadic permafrost of the area is of considerable economic importance in the iron mining operation upon which the town depends. A major report covering the first years of this work is in press.

Measurements of lake ice thickness have been made in the vicinity of Schefferville since 1954. During the 1963-64 winter, bi-weekly measurements were made at three sites on each of two lakes and a detailed survey, involving 300 drillings, was made of one of the lakes to examine late season areal variations in snow and ice cover. Accurate bathymetrical maps were made of the lakes involved in the ice survey and weekly measurements of temperature were made from a profile of thermocouples in one of the lakes. The reports and papers resulting from the season's work will be appearing shortly. During the 1964-65 winter the survey is to be intensified and extended to include measurements from a larger area, possibly from the whole of the Labrador-Ungava Peninsula.

The programme of snow measurements has received less attention than the ice survey over the years. During the 1963-64 season, daily measurements of depth and frequent measurements of density were made at stakes in a mile long snow course which encompassed many vegetation types. A series of detailed pit profiles was made in one section of the snow course at intervals throughout the winter and a time-profile plot has been prepared. Towards the end of the winter a survey of the whole area around the snow course was made to place the winter's daily stake measurements in perspective. Reports of this work will appear shortly. During the 1964-65 winter, the pit studies will be further refined and more frequent surveys around the snow course will be made, using a snow sampler, in an effort to follow the development of the end-of-season snow distribution. The snow survey work will be extended to cover a drainage basin of some 77 sq km as a basis for a run-off study.

At the present time, half of the lecture course being given at the Laboratory as part of the McGill Master's programme concerns snow. It consists of an introduction to the physical characteristics and metamorphism of snow on the ground. This half course is a development of part of the Glaciology course being presented at McGill by Dr. Fritz Muller. The Laboratory is very interested in receiving applications from students with good honours degrees in any appropriate subject who wish to undertake graduate research in glaciology.

W. P. Adams
(Director, McGill Sub-Arctic Research Laboratory)

NEWS

ARTIFICIAL GLACIERS. News about the creation of artificial glaciers was given in Ice no. 14, April 1964, p. 27. Further evidence has now come from Patrick Fagan. He reports that in the autumn of 1961, while just west of the major peaks of the Karakoram, Pakistan, he noticed that large numbers of local coolies arrived each day to take away ice in their Bergen-shaped panniers. They said they were going to 'plant' a new glacier above the village of Dasso, a few miles down the Braldu valley from the snout of the Biafo, as their water supply was threatened by the retreat of nearby glaciers. A week or two after their

last visit I went to inspect this new glacier on the north side of the Braldu valley and about nine thousand feet above Dasso, which lies at 10,000 ft above sea level. It lay in a small east-west corrie, three-quarters of a mile in length and surrounded by walls 1,000 ft high. The glacier formed a thickish stream in the middle of the corrie, and was protected from the sun by the steep southern rim.

On my return to Dasso I spoke with the headman, and he told me that they had decided to try this experiment after the failure of their crops the previous year. Two experts were brought from Skardu and they selected the site and supervised the work. The initial fees were twenty Rupees and 40 lb of wheat flour (for chapattis) from each of the twenty landowners of the village. Three years later each will contribute a further 80 lb of flour if the operation is successful.

The ice carried up to the corrie by the villagers is placed about four feet deep in the ground and mixed in the proportion of two portions of 'female' ice to one of 'male'. My inquiry as to the difference drew the interesting reply that 'female' ice is much wetter than 'male'. This was the reason for going all the way to the Biafo ('female' glacier) when there were many nearer small glaciers, but these were all 'male'. This ice is mixed together and laid in sandwich-like layers with two-thirds its weight of a mixture of straw and charcoa. On top of each ice layer leather bottles full of some special kind of water were placed, together with a bed of thorns: the latter prick the bottles and a steady seepage of water takes place. On top of the final ice layer about thirty "tengos" - earthenware jars - are placed full of the same kind of special water. These break when the water freezes and again a steady seepage takes place on thawing. Two or three layers of ice and the straw charcoal mixture are laid, and then the top surface is treated with a mixture of ground nuts and camphor.

The villagers hope the ice will fertilise, establish a cold area, however small, and thus delay the melting rate in the spring, when the snow surface is again treated with straw and charcoal. They will continue to do this for six to eight years, and after that they hope that the glacier will be self-supporting, as the half-dozen or so glaciers in Baltistan are claimed to be. At least the people will then not be forced to move elsewhere to find more plentiful water.

CENTRAL ASIAN GLACIERS AND WATER SUPPLY. The main practical importance of snow and glaciers in Soviet Central Asia is their effect on water supply to the arid regions nearby, and there have been two recent mentions in the Soviet press and radio (26 September, 21 October 1964) of ways in which this might be controlled. One refers to the conclusion reached by N. N. Pal'gov and a group of Kazakh glaciologists that the artificial melting of glaciers is not a satisfactory long-term solution; a better method would be the tapping of glacial lakes, for instance by syphoning. The construction of glacier-fed reservoirs might even prove cheaper than the artificial stimulation of melting. The other point mentioned was that study is to be undertaken of the possibility of producing avalanches artificially with the same end in view. This work will be done at the avalanche station at Varzob, in the Alay mountains to the west of the Pamirs where an avalanche warning system has been functioning successfully, and by two similar stations to be set up in the Pamirs.

SUMMER TOLL OF 200 LIVES IN THE ALPS. The conditions in the Swiss, French, and Italian Alps were particularly dangerous during the summer of 1964. Winter and Spring snowfalls were much below average and temperatures in July and August were high: snow covering rocks and glaciers therefore melted quickly. Temperatures were above freezing point up to the 9,000 ft level. As a result, snow bridges over crevasses often collapsed under the weight of climbers, and stones and rocks, now held as usual by snow, fell down upon or came away under the weight of the climber. An avalanche killed 14 Chamonix guides and instructors when they trod on a layer of fairly new snow which had not frozen to the snow underlayer.

65% of the deaths have been attributed to the unsuitable conditions of the mountains and to freakish weather conditions, and the remainder to want of experience.

ALASKAN COASTAL GLACIERS. W. O. Field reports that in September 1964 he visited the glaciers he had previously studied, primarily to see if the earthquake of March 1964 had had any immediate effects on the glacier termini, and to establish ground control for determining any changes which may occur in future. So far as could be seen, none of the termini has been affected to date. However, there have been some big slides on the glaciers which will probably have their effects on regimen and eventually on the variations of the termini. There have also been changes of level of a few feet, both up and down, which may eventually change the status of some termini.

WESTERN CORDILLERA, U.S A. A.E. Harrison reports that the 1964 season has been most unusual. There was as much or more snow at Mt. Baker on 25 July 1964 as on 25 July 1892, when the 1906 advance presumably began. There was more snow at Mt. Rainier in August 1964 than in 1954 or 1955 - two years of exceptional growth. The entrance to the Paradise Ice Caves was still covered by eight feet of snow on 15 September 1964. One notable change occurred at the Nisqually Glacier. The active front, which had been advancing around a body of relict ice instead of merging with it, has now incorporated the small remaining mass of stagnant ice and is moving into the empty canyon as a single front. At Mt. Baker, the front of the Coleman Glacier began moving forward again during the winter, probably sliding and/or moving along shear planes, and advanced about 15 meters. The advance at Mt. Baker has continued during the summer.

Despite complaints of a dry year in California, the Sierra Nevada glaciers and the ones on Mt. Shasta appeared to be quite healthy, probably as a result of a cool summer. Snowbanks below the California cirques were less extensive than usual. Qualitatively, the 1964 season in this country appears to have been as good or better as a budget year than any during the past century, with the probable exception of 1916.

MAP OF THE ALETSCH GLACIER. Within fairly easy reach of the Jungfraujoch Alpine Scientific Station, the Great Aletsch Glacier is the largest in Europe: 22.8 km long and 800 m deep at the Konkordiaplatz. As a contribution by Swiss scientists to the International Geophysical Year, the Glacier Commission of the Swiss Society for the Advancement of Science, the Section for Hydrology and Glaciology of the Laboratory for Hydraulic Research and Soil Mechanics at the Swiss Federal Institute of Technology, and Topographical Survey of Switzerland have produced a map on the scale 1:10,000 by means of aerial photogrammetry. It is the first accurate mapping of the glaciological details covering the whole glacier area, and provides a clear idea of the movements of this great ice stream. It will form a basis for comparison for future research work.

By means of aerial photogrammetry it was possible to map in detail every crevasse, crack, moraine, ice-block, cleft, break, rock-step, crater, and hill with an accuracy of 1 to 2 m. In printing the map, ten plates were used. Large as well as small features of the glacier have been emphasized by means of relief representation by shading, thus showing the constant structural change of the sluggish ice bulk on its way down the valley.

Special research led to the determination of the earlier stages of the glacier, namely the periods of 1850, 1600 and the Daun stage of the Würm ice age, all of them defined in the map. The first single sheets, nos. 2 and 3, were issued in 1961 and 1962. The now complete set of five sheets is an accurate basis for future glacier investigation; it will not only serve the glaciologist, but also the meteorologist, the geologist, the geomorphologist, the natural scientist and the engineer. Each set is accompanied by a description in English and German of the surveying, the cartographic interpretation, and the latest glaciological research results.

Prices

Sheet nos. 1, 2 and 3	Swiss francs 6.- per sheet
Sheet nos. 4a and 4b	Swiss francs 3.- per sheet
Complete set of five sheets	Swiss francs 21.60
	Postage extra

Please place your orders with the Topographical Survey of Switzerland, 3084 Wablern, Switzerland.

PUBLICATIONS

The American Geophysical Union announces the establishment of a new journal: Water Resources Research. The journal will cover those sciences which relate to water resources and will enable the AGU to fulfill its long established role as a forum in this field. Publication will begin in 1965 and an invitation is extended for original scientific contributions that present results of basic or applied research or that offer an examination of the principles governing water planning and development. The emphasis will be upon the sciences of water rather than upon water engineering or water projects. Papers on the physical, chemical or biological sciences should be sent to W. B. Langbein, U.S. Geological Survey, Washington,

D.C., 20036, U.S.A. Subscription rates are $3.00 per annum for members of the AGU, $6.00 per annum for non-members. Orders for subscriptions should be addressed to the American Geophysical Union, Suite 506, 1145 19th Street, N.W., Washington, D.C., 20036, U.S.A

Volumes 1 and 2 of "Arctic", which have been long out of print, are now available. They have been reprinted by the Johnson Reprint Corporation by arrangement with the original publisher, the Arctic Institute of North America. The cost per volume, paper bound, is $15.00. Orders and enquiries should be addressed to the Johnson Reprint Corporation, 111 Fifth Avenue, New York, N.Y., 10003, U.S.A.

Members of the Department of Geography, Glasgow University, are currently working on two large scale maps of Breidamerjurjokull, Iceland. The base maps will be prepared from air photographs taken in 1947 and 1962, and the present condition of the glacier will be mapped from observations to be taken in the summer of 1965. The wastage of ice and the morphological changes that have taken place since 1947 between the glacier and the coast will be plotted on the maps. The leader of the project of Dr. R.J. Price.. Further news will appear in the Field Work section of a subsequent issue of Ice.

ANNUAL GENERAL MEETING

Minutes of the Annual General Meeting held at 7 p.m. on 25 July 1964
at the Imperial College of Science and Technology, London S.W.7.

The President, Sir Vivian Fuchs, was in the Chair.

1. The Minutes of the 1963 Annual General Meeting, published in Ice no. 12, July 1963, were approved, and signed by the President.

2. The President made his report for 1963 - 64:

This is the first year since 1936 in which the President's Report has not been delivered by Gerald Seligman, and it is with some diffidence that I now speak about the Society's affairs.

The expansion of the Society has continued during the last year - there are now 678 private members and 469 subscribers to the Journal. In fact more new members joined during 1963 than in any previous year, and over the last seven years there has been an increase of 45% in the total circulation of the Journal. In private membership the rate of expansion continues to increase, as was shown in the graph in "Ice" for December 1963. Yet there is still scope for increasing our numbers by attracting workers in many disciplines. Needless to say, the field is one in which geographers naturally find interest - but glaciology needs physicists, meteorologists, geologists, chemists, engineers and hydrologists. If members can bring in one or two such people each year the strength and efficiency of the Society would be assured.

While our membership is one indication of growing interest in glaciology, a major one is the number of articles submitted to the Journal. In 1958, for example, we published 178 pages, but by 1963 the figure had risen to 453 pages - two and a half times as many. Our news bulletin "Ice" has also grown in the past year, for it now publishes all available field reports, many of which formerly appeared in "Glaciological Notes" (a publication of IGY World Data Center A, Glaciology, New York). "Ice" also prints the notices of the Commission of Snow and Ice (International Association of Scientific Hydrology).

The increased revenue from the growing membership has only been able to supply a part of the money required for the expansion of the Society, especially during the last two years. The greater part has come from organizations which have supported the Journal, either by a direct grant - United States National Science Foundation - or indirectly with page charges.

It has been said in other Societies that the page charge system is a bad thing because it could limit the publication of good papers. This depends on how the principle is applied,

and I do not consider that this can happen in our own case. We do not levy a charge on all papers but ask for a voluntary contribution when the paper has been accepted by the Editors, and when in fact it is being set by the printers. Therefore, you can see that there is no connexion between the scientific quality of a paper and its possible financial backing. Once it has been accepted on its merits, a paper is published whether page charges are forthcoming or not.

The purpose of a scientific journal is to produce the results of research, but such publication is very expensive. If one believes that scientific journals are better managed by their parent societies than by a commercial firm, some financial help is needed. It is not practical to raise members' subscriptions to meet the bulk of such expenditure, and direct grants are only designed to aid a society in particular circumstances. On the other hand, page charges paid by those organizations which have budgeted for this support are an effective means of using research money to promulgate the final results of the research.

In our own case the page charges and direct grants have already enabled us to publish more material without passing on the cost to members. You will shortly be hearing about our 1963 financial situation from the Treasurer so I will not go into details. The money has also been used to expand the Society with the intention of making it unnecessary to rely on outside direct grants. For many years we relied on voluntary part-time help, and to a large extent we still do. You have only to compare the names on the covers of the early numbers of the Journal with those on the last issue to see how loyal people have been. In particular we are grateful to our Editors, Gerald Seligman, John Glen, Ray Adie and Doris Johnson, who perform an invaluable and prodigious task with such painstaking care. In addition I would like to thank all those who have helped to referee papers for the Journal, and also those who have prepared the Abstracts in French and German. These, together with the many people who have given advice to the Editors and to the Secretary, are too numerous to name. Finally I offer our very special thanks to the Director of the Scott Polar Research Institute who allows us accommodation for the Secretariat in spite of the Institute's acute congestion.

The changed status of the Society under the new Constitution has meant that voluntary help has had to be supplemented by paid assistance. During the last year the Secretary has worked full time, and several part-time assistants have been employed to help both the Secretary and the Editors. Some equipment has been bought for the administrative office and for the Editors, so we do not have to rely so completely on the generosity of the institutions where they work.

We have also been able to pay the travelling expenses of the Secretary and Dr. Glen who went to the Congress of the International Union of Geodesy and Geophysics in California last summer. There they did good work in promoting the interests of the Society. During the Congress a Council Meeting was held. The discussions regarding the Society and the Journal were particularly useful since a number of people who cannot normally attend were able to offer very welcome critical advice which is seldom forthcoming by letter.

All the extra expenditure on administration and on the Journal has been made possible by the direct grants and the page charges. At the same time it has been possible to maintain the annual subscription at the same rate as in 1958 when only 178 pages of the Journal were published and when the administration was on a voluntary basis with a part-time Secretary. It was the welcome assistance from the National Science Foundation in 1962 and 1963 which has enabled us to "change into higher gear". I am also glad to tell you that the Foundation has again provided support for us this year. However, such grants are not meant to provide permanent feather-bedding, and we must now seek to stand on our own feet. To maintain our present status and be able to visualise future expansion the Council has decided (as you know from the Circular of 21st May) that a part of the increased expenditure should be borne by our members and subscribers. The Treasurer will say more about this in his Report.

Finally, I would like to say that now that the Society has international responsibilities and is growing into a bigger, and perhaps more professional, organization it is most important that those of us concerned with the everyday work should be aware of the feelings and needs of glaciologists. In consumer parlance the Journal is a "good buy" but those receiving it should not be merely subscribers to a scientific journal. They should remember that they are the Society which publishes it, and that they should feel some corporate cohesion. We should know each other and be able to discuss freely glaciological matters. Our national Correspondents help by getting new members and by sending news and reports, for which we are most grateful. Another way of strengthening the Society could be

by the formation of branches which would bring liaison between members and the central organization. The 1964 List of Members shows those countries in which a useful nucleus of members already exists.

We shall welcome ideas from members on how the Society can best help glaciology - through the Journal, the news bulletin, meetings and symposia, through local branches, or by any other service which will help glaciology and this Society.

3. The deputy Treasurer, Dr. T. E. Armstrong, presented the accounts for 1963 on behalf of the Treasurer, Dr. G. C. L. Bertram.

I must start by expressing my personal sorrow at not being present tonight, the result of a very long standing family commitment. I am further sorry as this is the last occasion of service to the Society in this capacity, as I now retire from the Treasurership after eight years in office. I hold that officers of Societies and Institutions should not go on too long, and that the rules should always incorporate clear instructions for termination. Individuals whose help is still sought by a Society can be re-elected after a decent interval. Rules for the regular termination of office are the safeguards of an essential freedom for societies such as ours.

Your Council, on 7 May 1964, had before it the Audited Accounts for 1963 and passed them as fit for your formal approval tonight. You will not wish for much detail now: it will perhaps suffice to say that Income at £7,784 exceeded Expenditure by some £519, and that the Contingencies Fund has now been enabled to grow to £2000.

The annual subscription for members rises from £2 to £3 in January 1965 and for libraries from £4 to £6. Due notice of these increases has already been given.

Recent years for this Society have been years of great evolution, in size, in financial status and in scientific importance and recognition. The Society's finances are today healthy - thanks to a variety of factors. Pre-eminent are the sustained effort and enthusiasm over the years of your Presidents, Council, and Secretariat. There has been great growth in the Journal of Glaciology, so that the printing of each issue has had to be raised now to 1550. There has been growth to 453 pages a year - and that growth has to be paid for. There has been a gratifying, indeed surprising, income from the sale of completed volumes to the newer libraries. There is the system of page charges, about which the President has spoken in his Report.

Most grateful thanks must be tendered to the British Royal Society and the United States National Science Foundation in succession, for their wise and essential subsidization of the Society's efforts, in publication in particular, over the last decade. A further $2,200 has just been promised from N. S. F. for 1964. So, by nourishing a child, may it be brought to be self-supporting - though, I will certainly not dissent from the realization that, in young adult life, further occasional gifts from rich uncles may remain highly stimulating and acceptable! This welcome subsidization has been connected with the fact that, by the nature of things, membership fees and journal subscriptions must rise by occasional steps, while costs rise continuously. If a retiring Treasurer may advise his successor, here is the chief point. "Dispute with the Society's Council, made up of perhaps too kindly people who wish to postpone the raising of subscriptions. Don't put off the evil day: few subscriptions in fact are lost through necessary increases."

Thus I believe that you can properly be assured that the Society's finances are in a healthy state; prospects are good; but there will long remain need for vigilance.

I would like to end this report about the Society's finances by paying a tribute to Gerald Seligman, our Founder. It seems a long time now since the activities in the 1930's of the 'Association for the Study of Snow & Ice.' He, so to speak, laid a good egg. Special mention too I would make of our President, Sir Vivian Fuchs, who, if I may say so, leads our Society so skilfully in this very recent transition from original British insularity to internationalism. My years as Treasurer have been happy ones.

The meeting passed unanimously a vote of thanks to Dr. Bertram for his work during the past eight years.

4. Election of auditors for the 1964 accounts.

Dr. J. W. Glen proposed and Dr. W. H. Ward seconded that Messrs Peters, Elworthy and Moore, of Cambridge, be re-elected auditors, for the 1964 accounts. This was carried unanimously.

5. Elections to the Council, 1964 - 67.

After circulation to all members of the Council's list of nominations, no further nominations in accordance with the Constitution had been received. The following people were elected unanimously:

		Proposer	Seconder
Vice-Presidents (2)	H. C. Hoinkes	G. Manley	W. H. Ward
	W. H. Ward	M. F. Meier	J. W. Glen
Treasurer	T. E. Armstrong	G. C. L. Bertram	D. M. Johnson
Elective members (3)	H. Bader	V. Schytt	V. E. Fuchs
	F. Muller	M. F. Meier	T. E. Armstrong
	J. W. Sheard	W. H. Ward	C. A. M. King

6. Appointment to the Post of Founder.

Under Rule 10 of the Constitution, the Council of the Society recommended that Dr. Gerald Seligman's name be put to the Annual General Meeting for appointment to this Post. The appointment was confirmed unanimously.

7. Formation of a branch of the Society in Britain.

The Council proposed, under Rule 3 of the Constitution, that a branch of the Society be formed in Britain; British members of the Society would become members of the branch and British members of the Society's Council would form its Committee. The branch would not be a charge on the Society's funds.

Since the Society's Constitution was changed in 1962, it has proved difficult in Britain for the Council to appoint representatives to serve on British national scientific committees: a society which has an international constitution and an international council is not entitled to appoint representatives to national bodies. A national branch of the Society would, however, be entitled to do so.

The President asked members present at the meeting for their comments on the proposal, and reported that the circular sent to British members of the Society in February had met with a favourable response. Members from Britain, Canada, Poland and the U.S.A. joined in the discussion, and a letter from a member in the U.S.A. was read. Some details of the proposal were clarified. It was emphasised that other countries may also find that the formation of a branch will overcome local difficulties: for example, transfer of subscriptions from eastern Europe to the Society's office in Britain may be easier for local branches than it is now for individual members.

The Council's proposal was carried unanimously.

THE SOCIETY'S LIBRARY

Works received for the Society's library since August 1964.

We thank the following authors or donors of papers and pamphlets and regret that it is impossible to acknowledge them individually. The glaciological works, with their complete reference, will be listed in the "Glaciological Literature" at the end of the Journal of Glaciology and bound in the Society's collection of glaciological papers.

Aliverti, G.
Bloch, M.R.
Case, J.B.
Dylik, J.
Field, W.O.
de Gomery, G. de Gerlach (2 items)
Havens, J.M.
Kick, W.
Little, E.M.
Miller, M.M. (2 items)
Ogasahara, K.
Østrem, G.
Reid, J.R.
Robin, G. de Q.
Shôda, M.
Svensson, H.
Tricart, J. (2 items)
Washburn, A.L. (2 items)
Yosida, Z.

Antarctic Division, Department of External Affairs, Melbourne, Australia.
Arctic Bibliography Project (Director), Washington, D.C., U.S.A.
Arktisk Institut, Charlottenlund, Denmark.
Association Internationale d'Hydrologie Scientifique.
Boreal Institute, University of Alberta, Canada.
British Antarctic Survey (2 items).
U.S.Army, Cold Regions Research and Engineering Laboratory (12 items).
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Geophysical & Polar Research Center University of Wisconsin, U.S.A.

REVIEWS

L.B. LEOPOLD, M.G. WOLMAN AND J.P. MILLER. FLUVIAL PROCESSES IN GEOMORPHOLOGY. San Francisco and London, W.H. Freeman and Co., 1964. xiii, 522 p., illus. 57s.

This book covers a rather wider field than the title suggests. It is divided into three sections. The short introductory section, 'The evolving landscape', shows how field evidence can be interpreted to indicate the processes operating to produce a specific type of landform association in the field, and to elucidate the stages through which the landscape has passed. Part II, which occupies the major part of the book, is concerned with 'Process and form'. The effect of climate is considered and this leads on to a brief discussion of weathering, followed by the most important part of the book - an account of fluvial processes. This is based on theoretical considerations, model studies and field observations. It gives the most up-to-date and comprehensive study in this field that is available in a textbook. A shorter chapter is then devoted to hill-slopes. In the third section, 'The

effects of time', methods of dating are first considered, followed by an account of drainage pattern evolution and the development of other fluvial features and hill-slopes.

The book as a whole is clearly written and very well illustrated with diagrams and photographs; it also contains useful references after each chapter. The data are treated quantitatively as far as possible, but mathematics are only used where this approach clarifies the explanation and puts it on a sounder scientific basis. There is relatively little material of direct glaciological interest, but the book does provide a very valuable account of modern knowledge concerning rivers and fluvial processes in particular.

C. A. M. King

SIR ARNOLD LUNN. THE SWISS AND THEIR MOUNTAINS, A STUDY OF THE INFLUENCE OF MOUNTAINS ON MAN. London, George Allen & Unwin, Ltd., 1963. 167 p., illus.

The books of Sir Arnold Lunn stand up in the plains of literature like the mountains he here describes - bold, intractable, rocky and unlovely in many aspects, but grand in the larger scale - and always through them blows the freshening air of independence. How many, I wonder, actually enjoy reading Sir Arnold's excellent books and how many, I wonder, actually enjoy climbing those splendid mountains. Hard work I have always found them both, but at the end there is the grateful feeling that one has accomplished something worthwhile.

It is not true, as many persons seem to believe, that the Swiss, their mountains, and all forms of alpine sport sprang full-blown from the fertile mind of Sir Arnold Lunn. But no one has longer nor more effectively presented the Swiss and the glories of their mountains to the world, and few foreigners can have had a greater influence on the Swiss. Everyone, therefore, with personal or professional interest in Switzerland will do well to attend his remarks.

Sir Arnold provides here a little political history, a little speculative sociology, a little affectionate and not-so-affectionate biography, a little subjective art criticism, a very little geology and geography, and a lot of lively reminiscence. Few readers will find the book equally absorbing in all its parts. Those who welcome controversy over first ascents are unlikely to study with the same enthusiasm Sir Arnold's views on the evolution of artistic feeling among the Swiss kleinmeister. But everyone should find amusing and instructive the brief biographies of mountaineers and of scientists who came from Switzerland or made it their special study. The author well conveys his friendly admiration for "the first of the true mountaineers", an eccentric and stubborn Benedictine whose political ideas brought him to prison. He evidently feels less warmly toward de Saussure, but he most engagingly describes that busy, imprudent man of science, Louis Agassiz, whose true genius, we are made to understand, lay in his being a helpee, a person able to charm everyone in sight into giving up their own work to assist him in his.

Sir Arnold prepared this volume in tribute to the Swiss Alpine Club, which celebrated its centenary in September, 1963. The value and beauty of the book are enhanced by the inclusion, in colour, of many works by Swiss mountain artists. No one but Sir Arnold could have made a unity of such diverse materials as he brings together in these pages. Indeed, no one else would have tried.

Alan Cooke

BOOKS RECEIVED

PAUL-EMILE VICTOR. Man and the conquest of the Poles. Translation by Scott Sullivan. New York, Simon and Schuster, 1963, 320 p., illus., 21 cm. $6.95.

LOUIS DUFOUR AND RAYMOND DEFAY. Thermodynamics of Clouds. New York and London, Academic Press (International Geophysics Series, Vol. 6), 1963, 255 p., 24 cm.

Soviet Antarctic Expedition Information Bulletin. Volume II. Amsterdam, London, New York, Elsevier Publishing Company, 1964, 318 p., illus., 23 cm. £4.0s.0d.

JOSE L. LORENZO. Los Glaciares de Mexico. (2nd Edition) Mexico, D.F., Universidad Nacional Autonoma de Mexico, Monografias del Instituto de Geofisca/1, 1964, 124 p., illus., maps, 23 cm. (English transcription by James V. Papworth, p. 97-124).

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ICE

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