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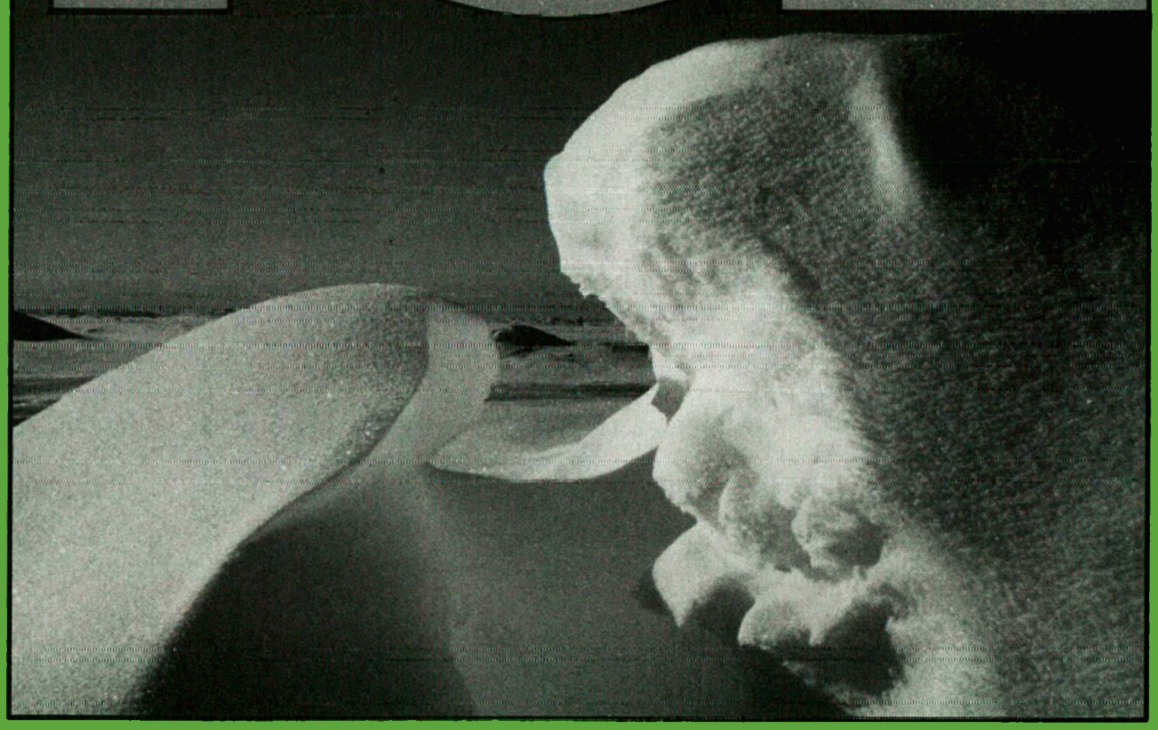

NEWS BULLETIN OF THE INTERNATIONAL GLACIOLOGICAL SOCIETY

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ICE

NEWS BULLETIN OF THE INTERNATIONAL GLACIOLOGICAL SOCIETY

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CONTENTS

COVER PICTURE: Snow sculpture, summer 1996, Eurasian Basin, Arctic Ocean (Photograph by Finlo Cottier).

Scanning electron micrograph of the ice crystal used in headings by kind permission of William P. Wergin, Agricultural Research Service, U.S. Department of Agriculture

RECENT WORK

SWEDEN

(For abbreviations used see page 8)

ALPINE GLACIERS

Glaciometeorological studies on Storglaciären

(R. Hock, MRI-CIRC)

Glacier melt and its climatic forcing at different time-scales is being investigated. A meteorological station was operated on Storglaciären during the 1998 and 1999 melt seasons. The data are used to develop and improve models of glacier melt and discharge at an hourly time-scale using energy-balance and temperature-index methods. Emphasis is placed on parameterization of grid-based computation of radiative-energy fluxes in steeply sided terrain. Energy partitioning and cumulative melt will be related to the synoptic weather; moving from an hourly time-scale to a daily or weekly one, and linking point-scale measurements to larger-scale atmospheric conditions. The research will focus on these links and their potential for operational use in melt forecasting.

Formation of glacial cirques

(P. Holmlund, NG/SU, MRI-CIRC; I. Brown, MRI-CIRC; C. Richardson, NG/SU)

How glacier cirques are formed and the extent to which they can be used as a proxy for past climate are being assessed. The project focuses on some small, glacier-filled, cirques in the Sarek region and the data used are the present climate, glacial morphology and ice thickness. It is hoped to determine what processes have been active in cirque formation and when.

Measurement of temperature distribution in glaciers by radar

(P. Holmlund, R. Pettersson, C. Richardson, NG/SU)

Ten years ago the thickness of the dry (below freezing-point) surface layer of Storglaciären was mapped. At the time this was a new approach and the survey has since been followed by several similar studies especially in Spitsbergen. Such data are useful in the search for suitable ice-coring sites, ice-velocity surveys, ice-sheet modelling in mountainous areas and permafrost studies etc. A regional survey of the temperature regime of Swedish glaciers, which presently includes about 40 glaciers, will be completed, though data are of variable quality and resolution at the different sites. The project will follow-up on temporal changes in the thickness of the cold surface layer of glaciers and estimate changes in sediment load in rivers due to climate change.

Mass-balance-measurement accuracy

(P. Jansson, NG/SU)

Mass-balance data for Storglaciären are an excellent basis for investigating the accuracy of mass-balance measurements. Winter balance has been measured in a regularly spaced, globally identical net for the past 30 years whereas summer balance has been determined from ablation stakes of continually changing distribution. The effects of this and varying evaluation procedures through time can now be checked.

Short-term variations in ice dynamics and hydrology of Storglaciären

(P. Jansson, NG/SU)

The configuration of the en- and subglacial drainage system of Storglaciären is complex. A subglacial drainage system exists beneath the whole glacier. However, a classical tunnel system seems present only beneath the lower half of the ablation area. The upper half seems to have poorly developed subglacial drainage and a more efficient englacial-drainage system. How this englacial system is coupled to the subglacial system and how it is fed from drainage emanating from the accumulation area is poorly understood. Through measurements of water pressure and dye tracing, this problem will be elucidated.

Glacier fluctuations on Mt Kenya

(W. Karlén, NG/SU)

Proglacial lacustrine sediment studies at Mount Kenya have revealed that glaciers on the western side of Mount Kenya fluctuated during the Holocene. A major advance, which reached a maximum position close to 1 km outside the Little Ice Age position of Lewis Glacier, is dated to before 5700 cal yr BP. The glaciers retreated and were small or entirely melted away by 5000 cal yr BP. An advance, which was initiated shortly after 5000 cal yr BP, was briefly interrupted by a small retreat around 3800 BP. Possibly, the glaciers were cold-based from 2800-2300 cal yr BP. After about 2100 cal yr BP the climate became relatively warm, but this warmer climate was interrupted by cold spells around 1200 cal yr BP and during the Little Ice Age.

Internal accumulation firn, Storglaciären

(T. Schneider, C. Richardson, NG/SU)

Melt water in the firn area of temperate glaciers infiltrates into the snow surface and percolates downwards into the firn layer. In porous snow and firn some water is retained against gravity due to capillary and adhesive forces. The water equivalent of the snow cover remaining in the end of summer is calculated from snow depth and density. Accordingly, even the liquid-water content in the snow cover is taken into account. During the following winter the cold wave will penetrate into the firn layer and all liquid water will freeze.

During summer, meltwater again percolates downward and is retained in the pores of the previous year's snow layer. This retained water is not taken into account by mass-balance measurements. The depth of cold-wave penetration on Storglaciären was measured to 15 m below the snow surface in spring 1997. Accumulation during winter 96/97 at the same site was 7.3 m of snow, and at the end of summer 1996 the snow layer of the balance year 1995/96 was 2.7 m thick. Accordingly, immobile water in 5 m of firn below the 1995/96 snow layer refroze during winter 1996/97 and contributed to the glacier's mass balance. Measurements of water content on different glaciers show that the immobile water content of firn is of the order of 0.04. This corresponds to an internal accumulation of 0.2 m w.e. which is ~6% of the winter balance at the same site on Storglaciären. This investigation focuses on the water content in the firn layer measured by capacitance probes, calorimetric methods and radar. In addition, the depth of the cold penetration in the firn is measured by standard thermocouples and radar.

ANTARCTIC GLACIERS

Ice flux along a 500 km grounding-zone profile, Dronning Maud Land

(J.-O. Näslund, NG/SU)

In 1996/97, airborne-radar data on ice thickness/bed topography were collected along 500 km of the grounding zone of the Jelbart and Fimbul Ice Shelves, west-central Dronning Maud Land, East Antarctica (from 6.5° W to 5° E). GPS data on ice-surface altitude and ice velocity were measured along the same profile. Together with data on surface velocity, obtained from multi-temporal satellite images, the field data will be used to calculate the mass flux across the grounding zone. The project aims to quantify the ice flux to the ocean along a significant portion of the ice sheet in an area dominated by sheet flow, but also including minor ice streams such as Schytt Glacier.

Paleo-ice sheet dynamics

(J.-O. Näslund, P. Holmlund, NG/SU; L. Rodhe, SGU)

The use of a numerical ice-sheet model to interpret paleo-ice-sheet dynamics from the geological record is being tested for parts of the Fennoscandian ice sheet. The study area includes several sub-areas in northern Sweden where comparisons are made between the output from an ice-sheet model run at high spatial resolution (sub-km scale) and mapped geological information on former Weichselian ice sheet flow directions. The geological data, on striae orientations and till fabrics, were collected by the Geological Survey of Sweden. The study sites are chosen to represent areas where either the flow of the Weichselian ice sheet displays significant changes in flow direction over time, or where glacial landforms of special interest have been observed. An example of the latter is close to the Gulf of Bothnia where the orientation of drumlins has been observed to change abruptly from a general NW–SE orientation on the inland side to a N–S direction closer to the coast. The result of the comparison between the model output, regarding time-dependant ice-flow directions, and the mapped geological data, on flow directions, are used for a discussion on the dynamical and thermal evolution of the Weichselian ice sheet in northern Sweden.

Ice flux through Heimefront Range, Dronning Maud Land

(V.A. Pohjola, J. Hedfors, ES/UU; SWEDARP members)

The surface-velocity distribution of the outlet glacier Kibergbreen has been constructed by: a) tracing the motion of objects (crevasses) from SPOT-images (taken in 1987 and 1995); and b) using surface-triangulation measurements on aluminium markers during a field party in the austral summer 1989/90. Ice depths are from several radio-echo measurements by the SWEDARP expeditions. Using a simple ice-deformation model, the ice flux through the tributary glacier Bonnevie-Svendsen-breen was calculated. The calculated annual ice flux was of the same magnitude as the annual accumulation estimated from the relatively small catchment for this tributary (55 km^2). Force-budget techniques are being used to get a better estimate of the ice flux through this ice system, which will eventually provide better information on the state of balance of this East Antarctic outlet glacier.

Spatial variability in snow accumulation, Dronning Maud Land

(C. Richardson, P. Holmlund, NG/SU)

Spatial variability of snow accumulation is being mapped in shallow snow layers (<12 m deep) along continuous profiles, using a ground-based snow radar. An extensive dataset of radar profiles has been collected from coastal regions and the polar plateau in Dronning Maud Land; from expeditions in 1991/92, 93/94, 96/97 and 97/98. The relationships between spatial variability in accumulation and other physical parameters, such as altitude, surface slope, exposure, relief and distance to sea have been studied. The radar data are also used to produce detailed 3-D maps of snow layering at core sites in order to assess their representativeness. The radar recordings are calibrated using depth–density curves and datings obtained from firn cores.

Spatial variability in surface snow chemistry: sastrugi studies in Antarctica and northern Sweden

(M. Stenberg, NG/SU)

One problem in snow and ice coring in polar regions is the regional representativeness of samples. After the snow has been deposited, different factors influence how the chemical signal is preserved. For instance, wind may redistribute snow in some areas. This causes micro-variations in the chemical distribution pattern which has to be considered when interpreting ion information stored in the snow. Sastrugi-rich areas may produce level errors in the interpretation of accumulation rates. Data for this study were obtained from geographically different regions. Sastrugi from both hemispheres, around 70° N and S respectively have been investigated. At the first site, in the Tarfala valley, northern Sweden, the work began as a pilot study for further and more extensive studies in Antarctica. The fieldwork in Antarctica was done in connection with pre-site surveys for the SWEDARP 1997/98 expedition to western Dronning Maud Land (DML).

ENGINEERING GLACIOLOGY

Ice force measurements, Gulf of Bothnia

(L. Fransson, LTU)

Large ice-force panels have been developed to register the pressure from moving sea ice. These panels are now installed at the waterline around the Swedish lighthouse Norstromsgrund in the Gulf of Bothnia. In winter 1998, eight panels, covering half the periphery of the light-house produced high-quality data. The first successful recordings were obtained in February, when relatively thin but hard ice was crushed during a period of southerly winds. The lighthouse is heated and serves as a research station for other sea-ice investigations.

GLACIER HYDROLOGY

Water drainage in firn, Storglaciären

(T. Schneider, S. Frödin, P. Jansson, NG/SU; L. Stearns, CCMN)

The drainage of the firn aquifer on Storglaciären was investigated by tracer tests and water-level measurements. Table salt was injected into the firn aquifer and electrical conductivity (EC) measured in surrounding boreholes. From these measurements, flow velocity in the aquifer was calculated. In addition, EC profiles were measured in different boreholes to determine the depth of the porous firn. To trace water flow from the firn area, two different fluorescent dye tracers, Fluorescein (5 kg) and Rhodamine B (12 kg), were injected into the firn aquifer via a borehole and sprayed onto the firn surface, respectively. Water samples were taken in surrounding boreholes and at the terminus of the glacier about 3 km from the injection site. Measurements of spatial variations of the depth to firn water-table, and observations of water drainage from the aquifer into crevasses, led to the conclusion that crevasses play the main role in draining the firn aquifer if they are connected to the englacial drainage system. The depth of the firn–ice transition was determined from EC profiles in boreholes to be 20–21.5 m below the firn surface. The dye-tracer test showed that dye injected into the firn aquifer reached the terminus of the glacier about 6 days after injection, whereas dye sprayed on the firn surface emerged at the proglacial stream after 10 days. From the time lag of the two dyes, percolation velocity can be estimated to be 0.21 m h^{-1}.

Proglacial suspended-sediment transport

(T. Schneider, P. Jansson, NG/SU)

Proglacial suspended-sediment concentration and water discharge, surface velocity of the glacier and meteorological data will be used to model suspended-sediment transport. Previous investigations showed that it cannot be simulated solely by water-discharge data. It was found that during years of high suspended-sediment transport extremely high precipitation events occurred. However, correlation with precipitation and discharge did not improve the model significantly. The new approach is to include glacier dynamics in modeling suspended-sediment transport in glacierized basins.

Hydrological modelling of a glacierized drainage basin

(T. Schneider, K. Jonson, NG/SU; B. Holst, H. Sanner, SMHI)

Previous applications of the HBV-model, a semi-distributed precipitation–runoff model with a melt routine based on a simple degree-day method, showed it could not simulate the water balance in a glacierized drainage basin, together with the mass balance of the glacier, adequately. A new version of the HBV-model has been used to simulate the water balance in the Tarfala valley and the mass balance of Storglaciären. This includes changes in the snow-distribution routine and the melt routine. In addition,the model is more distributed, which means that the conditions for melting of snow and ice on, and the routing of water through, the glacier can be taken into account.

ICE CORES

Ice coring in polythermal glaciers

(P. Holmlund, R. Pettersson, NG/SU; P. Torssander, IGG/SU)

A drilling campaign at Märmaglaciären in 1997 was very successful and showed that climatic and atmospheric information were well preserved in the ice core. The campaign was carried out as a test for the next year's Nordic pre-site survey for the EPICA deep drillings in DML. The core from Märmaglaciären covers

only 54 annual layers and unfortunately does not include any dateable signal from, e.g., Icelandic volcanic eruptions. However, simple modeling and correlation to dendrochronology suggest that the core covers the period 1790–1840. Considering ice depth, ice-flow velocity and thermal regime at least the last 500 years might be covered on Märmaglaciären. To date, analyses have been made for ECM, sulphur, volcanic ash and organic halogens. The next field campaign is planned for April 2000 in collaboration with the British Antarctic Survey (R. Mulvaney). The aim will be to evaluate climate change and the fallout of anthropogenic pollutants during the last 500 years.

ENSO signal in Antarctic snow: potential for dating snow cores?

(E. Isaksson, NPI; M. Stenberg, W. Karlén, NG/SU; P.A. Mayewski, M.S. Twickler, S.I. Whitlow, CCRC-EOS/UNH; N. Gundestrup, NBI/UCop)

Previously, snow-core data from the Antarctic plateau have shown a MSA/ENSO correlation. Data from snow pits and shallow firn cores from DML suggest that some of the MSA peaks, such as the 1991–93 layer, can be recognized at several sites. Therefore, such MSA peaks might be used as reference horizons for dating purposes, which in turn would provide more information on the interannual variability of snow accumulation from the interior of Antarctica. The distribution of MSA/ENSO peaks provides further information for our understanding of the underlying mechanism for the MSA-ENSO link.

Trace substances in snow and firn near two Antarctica research stations

(M. Stenberg, NG/SU; A. Modig, KVA)

A monitoring program has been initiated by the Swedish Polar Research Secretariat to explore using trace analyses of snow samples to identify anthropogenic influences in the environments of two small research stations in Antarctica. The sampling program started in the 1991/92 field season when surface snow samples and a short firn core were collected near the Swedish station Wasa and the Finnish station Aboa. Surface snow was sampled again in 1993/94, 96/97 and 97/98. Major ions were and will be analysed at Stockholm University.

Snow-layer thickness and chemistry near two drill sites, western Dronning Maud Land

(M. Stenberg, P. Holmlund, NG/SU; M. Hansson, MI/SU; L. Karlöf, NPI)

As a part of the pre-site survey in DML for the EPICA, the spatial variability of snow-layer thickness and snow chemistry were studied at two different ice-core drill sites. The study aimed at quantifying error bars on accumulation rates derived from firn and ice cores. One site is on the polar plateau at Amundsenisen (76° S, 08° W) and the other one is situated in the coastal area at Maudheimvidda (73° S, 13° W). Medium-deep ice cores (100 m) and shallow firn cores (10–20 m) were drilled and snow pits (0.5–2.5 m) were dug at each site. At Amundsenisen a large (16 x 6 m long and 2.5 m deep) snow pit was dug. Snow structures in this large snow pit were mapped using optical surveying equipment and documented by photography. Samples for analyses of nine ions and oxygen isotopes were collected along one depth profile. Density and in-situ electrical-conductivity measurements were made along three depth profiles. Snow-layer variability was studied in two different areas and at two different scales. At a regional scale, measured by snow-radar soundings, the variability was 8% on the polar plateau and 45% in the coastal area. The variability at a microscale in the large snow pit was 9%. The results indicate that ice cores from the polar plateau are more representative for a larger area than ice cores which are drilled in the coastal area. There is no doubt that there are significant error bars on high-resolution accumulation data from firn and ice cores, especially from the coastal area, but averaging over tens of years reduces the error in accumulation estimates.

Climatic and environmental variations in the Svalbard Archipelago

(V.A. Pohjola, ES/UU; Lomonosovfonna ice core project members)

Lomonosovfonna is one of the highest ice fields in Svalbard and may therefore be one of the best sites for ice cores in the Svalbard Archipelago. In April 1997, a 120 m deep ice core was drilled at the ice divide at 1230 m a.s.l. (78°51'53" N, 17°25'30" E) by a Dutch–Norwegian–British–Swedish–Finish team. Temperature measurements in the borehole show that the ice column is below the freezing point (average temperature was –2.8°C, with a standard deviation of ±0.2°C).

Most Arctic ice cores, outside the Greenland ice sheet, are affected by melting and percolation of melt/rain water that refreeze into ice layers beneath the surface. This alters the depositional sequence, and the seasonal/annual information may be severely damaged, or even lost.

This core is not excepted from the effects of percolation/refreezing. Detailed analysis of its ice structures shows that a considerable part of the core consists of solid ice; an effect of infiltrating water. Analyses of the solid-ice facies shows that about 40% of the upper half of the core is affected by infiltrating water, with a higher percentage towards the last decades (about 70%), and down to 20–30% prior to the 1920s. These are relatively high numbers, but smaller than have been registered in most other Arctic ice cores, excluding Greenland.

There is a tendency to enrichment of ions in the solid-ice facies. Some species appear to be more sensitive to vertical movement of percolating water than others. A preliminary estimate of ionic "outwash" is that <50% of ion concentrations of the more sensitive species may have been transposed vertically during percolation events. Some species seem to be resistant to "outwash", and may therefore largely have kept their depositional value, despite percolating water effects.

Using statistical data on the concentrations of chemistry and the water-isotope content in the different ice facies we hope to be able to make an estimate of the original values of the precipitated chemical concentrations and water-isotope ratios.

Seasonal climate and atmospheric variability over Greenland

(V.A. Pohjola, ES/UU; J.F. Bolzan, J.C. Rogers, BPRC)
One problem with using oxygen-isotope data ($\delta^{18}O$) from ice cores as a temperature proxy is the diffusion of vapour within the firn, which alters the $\delta^{18}O$ value with time. A numerical back-diffusion algorithm has been used to reconstruct the undiffused stable-isotope ratio. Good results have been achieved by correlating undiffused $\delta^{18}O$ time-series from nine shallow ice cores, from the summit of the Greenland ice sheet, with coastal temperatures and with the regional atmospheric pressure variability during the 30 year period studied. This control gives confidence in the method, and plans are to extend the study into:

1. A larger spatial coverage of Greenland to determine if the variability of $\delta^{18}O$ at different parts of the ice sheet reveals connections with air-pressure patterns;
2. A time coverage back, and over the Little Ice Age from deeper ice cores that will reveal the changes of; (i) the regional distribution of undiffused $\delta^{18}O$ over a large area of the Greenland ice sheet within this period; (ii) the variability and modes of atmospheric circulation in the spatial distribution of the undiffused $\delta^{18}O$; (iii) the general advection paths over Greenland from gradients in the distribution of seasonal $\delta^{18}O$; (iv) the general position of the Arctic Front, the major air pressure cells and the NAO pattern by combining information in (i)–(iii).

Diffusion of water isotopes in firn

(V.A. Pohjola, F. Westman, ES/UU)
The use of numerically back-diffused water-isotope ratios for high-resolution climatic reconstructions underlines the importance of knowing diffusion rates within the firn/ice pack. There has been work on this issue, but there is a need to study the effect in more detail.

The aim is to study diffusion rates in a laboratory set-up, where ice density, ice temperature, the initial isotope ratio and air pressure can be controlled. A set-up of snow layers of different isotopic composition will take several months to run in order to get measurable values on the diffusion of water isotopes in a low-density ice pack. It is hoped that this empirical approach can establish constraints on the diffusion rate in firn.

LAKE AND SEA ICE

Modelling ice on lakes, estuaries, shelf seas and oceans

(A. Omstedt, SMHI)
The modelling of cold-water bodies including ice has been continued within some different research projects at SMHI. Ljungemyr and others have treated the parameterization of lakes including ice in weather-forecasting models. A similar study for introducing two-way coupled ocean and atmosphere models for the Baltic Sea has been reported by Gustafsson and others. The modelling approach for forecasting ice on lakes, estuaries and shelf seas has been discussed by Omstedt who has also reviewed the important processes to be considered in the modelling of freezing estuaries. The models are now used in different climate studies at SMHI and SWECLIM.

Within the GEWEX/BALTEX project some different studies related to the role of sea ice in the water and heat cycles of the Baltic Sea and Skagerrak system have been published recently. Interannual, seasonal and regional variations of precipitation and evaporation over the Baltic Sea have been analyzed by Omstedt and others and who has modelling the seasonal, and long-term variations of salinity and temperatures in the Baltic proper with Axell.

Svensson and Omstedt have recently published a new model for the formation of frazil ice in the ocean.

PALAEOGLACIOLOGY

Glacial valley systems, northern Swedish mountains: geomorphology and radionuclide age dating

(A.P. Stroeven, QR/SU; D. Fabel, J.M. Harbor, EAS/PU)
Valley evolution in the northern Swedish mountains is being investigated. The initial hypothesis is that "selective linear erosion" of preglacial fluvial precursors by glaciers has dominated valley evolution. This is supported by the fact that the current upland areas, between distinct glacial troughs, bear no or weak imprints of glacial erosion and deposition. The preglacial (Pliocene) landscape surface across the mountain range (and across glacial valleys) is being reconstructing as a reference-surface against which to determine the amount of Pliocene–present glacial erosion. Field sampling strategies are designed to sample exposed (sub-) horizontal bedrock surfaces for radionuclide (^{10}Be, ^{26}Al) age dating to test relative ages of different glacial valley incisions, the minimum age of the preglacial surface, and glacial incision rates during different modes of Fennoscandian glaciation. Initial dating results from PRIME Laboratory, Purdue University, will be available in late spring 1999.

PERMAFROST AND SNOW AND ICE CLIMATOLOGY

Permafrost in Scandinavia

(P. Holmlund, P. Jansson, NG/SU)
Within the framework of the EU-funded program Permafrost and Climate in Europe (PACE) measurements of the temperature regime of polythermal glaciers and in permafrost are being conducted. Associated with the program are detailed mappings of topography, geomorphology and occurrence of permafrost. The field area is centred on the Tarfala valley and the program which is currently running is planned to be fully operational from the year 2000.

GLACIERS AND CLIMATE

Coupling between Scandinavian glaciers and atmospheric circulation

(V. Pohjola, ES/UU; J.C. Rogers, BPRC; B. Holmgren, MI/UU)

Glaciers in the Scandinavian Mountain Range are advancing while most of the monitored mountain glaciers of the world are retreating. Atmospheric circulation variability is being examined, and changes in air-pressure indices and the mass balance of glaciers bordering the northeastern Atlantic Ocean compared. The mass balance of Scandinavian glaciers is well correlated with the strength of maritime flow in both winter and summer, the presence of high pressure over the Barents Sea being a critical factor in summer. The increased positive mass balance of Scandinavian glaciers is partly due to persistently strong westerly winds over the northeastern Atlantic during post-1980 winters and partly to cold summertime flow which together have helped maintain positive glacier net balance by decreasing ablation since 1980. Daily–weekly ablation and accumulation measurements on one glacier will be used to investigate how well pressure indices reflect actual snow accumulation/melting in a glacier basin.

Reconstructing recent climatic variations from shallow Greenland cores

(V.A. Pohjola, ES/UU; J.F. Bolzan, J.C. Rogers, BPRC)

The stable oxygen-isotope record measured in ice cores contains temperature and other climatic signals, but the interpretation of the temperature signal is complicated by diffusional processes. One effect is to change the amplitude between the summer and winter isotopic extremes, a process which depends on the seasonal accumulation rate (layer thickness) and the firn temperature. A simplified version of the Whillans and Grootes diffusion model has been used to calculate the effects of isotopic diffusion in nine shallow ice cores, which were retrieved in 1987 as a part of a deep-drilling site-selection survey in central Greenland. The reconstructed isotopic seasonal signals were then compared with temperature data from coastal stations, short records from automatic weather stations from the ice core sites and from satellite microwave brightness records in order to tune the diffusion model. The reconstructed isotopic signal has a meaningful correlation with temperature records and the reconstructed spatial isotopic record can be a useful tool in reconstructing past atmospheric circulation patterns over the region.

Tarfala Research Station

The measurements made as part of the Tarfala Research Station routine program involve measurements both in the Tarfala Valley and the Swedish mountains as a whole. These measurements are carried out by the Glaciology Group at the NG/SU (Currently: R. Hock, P. Holmlund, P. Jansson, T. Schneider, P. Klingbjer, J.-O. Näslund, R. Pettersson, C. Rickardsson, M. Stenberg).

The routine program at Tarfala

The 53-year long mass-balance record of Storglaciären forms the basis for glacio-climatic studies in Sweden. The measurement of the mass balance of Storglaciären is carried out by the staff of Tarfala Research Station, situated only 1 km from the glacier. The stake net on the glacier is surveyed every week or every second week throughout the melt season.

Climatic data have been collected continuously since 1965; the automatic weather station was computerized in 1989. In 1995, Tarfala became an official meteorological station following the introduction of a automated synoptic weather station. The hydrological regime is surveyed every year using stream gauges at 3–4 sites in the valley. The objective is to establish a hydrological balance for Storglaciären.

The station is also used for student courses and to host small conferences. Results and general information about the station are published every year in an annual report available through NG/SU.

Glaciers as indicators of climate change

The regional representativity of Storglaciären is studied using other glaciers. These are usually visited twice a year, at the end of the accumulation and ablation periods. The total number of glaciers in the mass-balance program varies. Currently it involves five glaciers: Märmaglaciären, Rabots Glaciär, Riukojietna, Stour Räitaglaciären and Storglaciären. These have been chosen with respect to the E–W climatic gradient in which the western glaciers are influenced by a much more maritime climate compared to the eastern ones.

In addition to the mass-balance program, the frontal positions of 20 glaciers are observed. This full-size program has been run since 1965 and includes, besides surveys of glacier-front positions, photogrammetric surveys and radio-echo soundings in order to improve the time resolution. Automatic computerized weather stations have been placed at glaciers situated some distance from the climate stations used by SMHI.

Submitted by Peter Jansson



ABBREVIATIONS

BPRC	Byrd Polar Research Center, OHSU
CCMN	Carleton College, Northfield, MN 55057, U.S.A.
CCRC-EOS	Climate Change Research Center, Institute for Study of Earth, Oceans and Space, UNH
EAS	Earth and Atmospheric Sciences
EPICA	European Project for deep Ice Coring in Antarctica
ES	Earth Sciences
IGG	Institutionen för Geologi och Geokemi
KVA	Kungliga Vetenskapsakademien (Royal Academy of Sciences), Box 50005, S-104 05 Stockholm, Sweden
LTU	Luleå Tekniska Univ., Väg och Vattenbyggnad, Sweden
MI	Meteorologiska Institutionen
MRI-CIRC	Miljö och Rymdforskningsinstitutet (Environmental and Space Research Institute), Climate Impacts Research Centre, Björkplan 6A, S-981 42 Kiruna, Sweden
NBI	Niels Bohr Inst. for Astronomy, Physics and Geophysics, UCop
NG	Naturgeografiska Institutionen
NPI	Norwegian Polar Inst., Postboks 399, N-9296 Tromsø, Norway
OHSU	Ohio State University, Columbus, OH 43210, U.S.A.
PU	Purdue Univ., West Lafayette, IN 47907-1397, USA
QR	Quaternary Research
SGU	Geological Survey of Sweden, P.O. Box 670, S-751 28 Uppsala, Sweden
SMHI	Sveriges Meteorologiska och Hydrologiska Inst., S-601 76 Norrköping, Sweden
SU	Stockholms Univ., S-106 91 Stockholm, Sweden
SWEDARP	Swedish Antarctic Research Project, Swedish Polar Research Secretariat, Royal Academy of Sciences, S-104 05 Stockholm
UCop	Univ. Copenhagen, DK-2100 Copenhagen Ø, Denmark
UNH	Univ. New Hampshire, Durham, NH 03824-3525, U.S.A.
UU	Uppsala Univ., S-751 05 Uppsala, Sweden

INTERNATIONAL GLACIOLOGICAL SOCIETY

BRENDA VARNEY

We are very sad to have to report the death earlier this year of Brenda Varney. Until last August she worked part-time for the Society setting manuscripts. At that time she left to set up a home-care busines, placing staff in the homes of clients who needed assistance in their homes. Just before Christmas she was diagnosed with ovarian cancer. Our condolences go to her husband Jim.

IGS STAFF CHANGES

Sally Stonehouse has decided to take life a little easier and concentrate in the future on her part-time job at the Scott Polar Research Institute as Manager of the World Data Centre C for Glaciology. She has worked for the Society for many years as part of the team of those setting your manuscripts and has assisted the Secretary General with the production of *ICE*. Her cheerful personality, attention to detail, knowledge of the 3B2 desk-top publishing system and willingness to help out in any emergency have been assets from which the Society has derived much benefit. Her presence will be much missed. We know she will enjoy the extra time she will not have available to spend with her husband Bernard. We wish her every success and happiness in all her future endeavours.

Two part-time typists have now been hired to assist with the Society's desk-top publishing. Joan Keating has taken early retirement, following employment at the university and most recently with a local firm of solicitors, in order to have more time to spend on teaching music. She will probably work for us two mornings a week. Liz Farmer currently works part-time for the MacDonald Institute of Archaeological Research on the production of the Cambridge Archaeological Journal. She will be supplementing this job by working for us two to three afternoons a week.

Some training will obviously be required, as neither are familiar with 3B2, but we do not anticipate any delays in the production of papers for either the *Journal* or the *Annals*.

SCIENCE CITATION INDEX®

The Society has now received confirmation from the Institute for Scientific Information that papers in Annals 26, from the International Symposium on Snow and Avalanches held in Chamonix Mont-Blanc, France, 26 – 30 May 1997, will be included in the Science Citation Index®.

JOURNAL OF GLACIOLOGY

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

R J Braithwaite and Y Zhang
Inter-annual variability of glacier mass balance as a climatic indicator

R J Braithwaite and Y Zhang
Sensitivity of mass balance of five Swiss glaciers to temperature changes assessed by tuning a degree-day model

J Clarke and D McClung
Full-depth avalanche occurrences caused by snow gliding, Coquihalla, British Columbia

Y Durand, G Giraud, E Brun, L Mérindol and E Martin
A computer based system simulating snowpack structures as a tool for regional avalanche forecast

A C Fowler
Breaking the seal at Grímsvötn

G Furdada, P Martínez, P Oller and J M Vilaplana
Slushflows at *El Port del Comte*, northeast Spain

M Gay and J Weiss
Automatic reconstruction of polycrystalline ice microstructure from image analysis: application to the EPICA ice core at Dome Concordia, Antarctica

R W Gillett, T D van Ommen, A V Jackson and G P Ayers
Formaldehyde and peroxide concentrations in Law Dome firn and ice cores

R C A Hindmarsh
On the numerical computation of temperature in an ice sheet

Hou Shugui, Qin Dahe, P A Mayewski, Yang Qinzhao, Ren Jiawen, Li Zhongqin and Xiao Cunde
Climatological significance of $\delta^{18}O$ from precipitation to ice cores: a case study at the head of Ürümqi River, Tien Shan, China

A Kääb and M Funk
Modelling mass balance using photogrammetric and geo-physical data: a pilot study at Griesgletscher, Swiss Alps

R B Kayastha, T Ohata and Y Ageta
A model of glacier mass balance applicable to the Himalayas

C Mätzler
A simple snowpack/cloud reflectance and transmittance model from microwaves to ultraviolet: the ice-lemella pack

I L Meglis, P M Melanson and I J Jordaan
Microstructural change in ice: II. Creep behavior under triaxial stress conditions

P M Melanson, I L Meglis, I J Jordaan and B M Stone
Microstructural change in ice: I. Constant-deformation-rate tests under triaxial stress conditions

J C Moore, A Pälli, F Ludwig, H Blatter, J Jania, B Gadek, P Glowacki, D Mochnacki and E Isaksson
High resolution hydrothermal structure of Hansbreen, Spitsbergen mapped by ground penetrating radar

K J Muggeridge and I J Jordaan
Microstructural change in ice: III. Observations from an iceberg impact zone

J Oerlemans and B K Reichert
Relating glacier mass balance to meteorological data by using a Seasonal Sensitivity Characteristic (SSC)

N Reeh, S N Madsen and J J Mohr
Combining SAR interferometry and the equation of continuity to estimate the three-dimensional glacier surface velocity vector

R Staroszczyk and O Gagliardini
Two orthotropic models for strain-induced anisotropy of polar ice

M Truffer, R J Motyka, W D Harrison, K A Echelmeyer, B Fisk and S Tulaczyk
Subglacial drilling at Black Rapids Glacier, Alaska, U.S.A.: drilling method and sample descriptions

V Zagorodnov, L G Thompson and E Mosley-Thompson
Portable system for intermediate depth ice core drilling

ANNALS OF GLACIOLOGY

The following papers from the Sixth International Symposium on Antarctic Glaciology (ISAG-6) held in Lanzhou, China, 5–9 September 1998 have been accepted for publication in *Annals of Glaciology* Vol. 29, edited by T.H. Jacka:

N Azuma, Y Wang, K Mori, H Narita, T Hondoh, H Shoji and O Watanabe
Textures and fabrics in the Dome F (Antarctica) ice core

A Bondesan, M Meneghel, M C Salvatore and G Orombelli
A model of the glacial retreat of the Upper Rennick Glacier, Victoria Land, Antarctica

QIN DAHE, P A MAYEWSKI, W B LYONS, SUN JUNYING AND HOU SHUGUI
Lead pollution in Antarctic surface snow revealed along the route of the International Trans-Antarctic Expedition

QIN DAHE, P A MAYEWSKI, REN JIAWEN, XIAO CUNDE AND SUN JUNYING
The Weddell Sea region: an important precipitation channel to the interior of the Antarctic ice sheet as revealed by glaciochemical investigation of surface snow along the longest trans-Antarctic route

W RACK, H ROTT, A SIEGEL AND P SKVARCA
The motion field of northern Larsen Ice Shelf, Antarctic Peninsula, derived from satellite imagery

C REIJMER, W GREUELL AND J OERLEMANS
The annual cycle of meteorological variables and the surface energy balance on Berkner Island, Antarctica

REN JIAWEN, QIN DAHE AND I ALLISON
Variations of snow accumulation and temperature over past decades in the Lambert Glacier basin, Antarctica

C RICHARDSON AND P HOLMLUND
Regional and local variability in shallow snow-layer depths from a 500 km continuous radar traverse on the polar plateau, central Dronning Maud Land, East Antarctica

B RIEDEL, U NIXDORF, M HEINERT, A ECKSTALLER AND C MAYER
The response of the Ekström Ice Shelf in the grounding zone to tidal forcing

A N SALAMATIN, V YA LIPENKOV, T HONDOH AND T IKEDA
Simulated features of the air-hydrate formation process in the Antarctic ice sheet at Vostok

J C SIMÕES, U F BREMER, F E AQUINO AND F A FERRON
Morphology and variations of glacial drainage basins in the King George Island ice field, Antarctica

P SKVARCA, W RACK AND H ROTT
34 year satellite time series to monitor characteristics, extent and dynamics of Larsen B Ice Shelf, Antarctic Peninsula

D STEINHAGE, U NIXDORF, U MEYER AND H MILLER
New maps of the ice thickness and subglacial topography in Dronning Maud Land, Antarctica, determined by means of airborne radio-echo sounding

M STENBERG, M HANSSON, P HOLMLUND AND L KARLÖF
Variability in snow layering and snow chemistry in the vicinity of two drill sites in western Dronning Maud Land, Antarctica

SUN JUNYING, REN JIAWEN, QIN DAHE AND WANG XIAOXIANG
Sulfur-containing species in a snowpit in the Lambert Glacier basin, East Antarctica

R UDISTI, C BARBANTE, E CASTELLANO, S VERMIGLI, R TRAVERSI, G CAPODAGLIO AND G PICCARDI
Chemical characterisation of a volcanic event (about 1500 A.D.) at Styx Glacier plateau, northern Victoria Land, Antarctica

R UDISTI, S BECAGLI, E CASTELLANO, R TRAVERSI, S VERMIGLI AND G PICCARDI
Sea spray and marine biogenic seasonal contribution to snow composition at Terra Nova Bay (Antarctica)

T D VAN OMMEN, V I MORGAN, T H JACKA, S WOON AND A ELCHEIKH
Near-surface temperatures in the Dome Summit South (Law Dome, East Antarctica) borehole

W L WANG AND R C WARNER
Modeling of anisotropic ice flow in Law Dome, East Antarctica

WANG NINGLIAN, YAO TANDONG, QIN DAHE, L G THOMPSON, E MOSLEY-THOMPSON, J COLE-DAI, M E DAVIS AND P-N LIN
New evidence for enhanced cosmogenic isotope production rate in the atmosphere ~36 ka BP

WANG YUN AND N AZUMA
A new automatic ice fabric analyzer which uses image-analysis techniques

O WATANABE, K KAMIYAMA, H MOTOYAMA, Y FUJII, H SHOJI AND K SATOW
Studies on palaeoclimate signal, recorded in the ice core from Dome Fuji Station, Antarctica

WOLFF, I BASILE, J-R PETIT AND J SCHWANDER
Comparison of Holocene electrical records from Dome C and Vostok, Antarctica

X WU, W F BUDD AND T H JACKA
Simulations of Southern Hemisphere warming and Antarctic sea-ice changes using global climate models

D YI AND C R BENTLEY
Geoscience laser altimeter system waveform simulation and its applications

INTERNATIONAL SYMPOSIUM ON SNOW, AVALANCHES AND IMPACT OF THE FOREST COVER

Innsbruck, Austria, 22–26 May 2000

CO-SPONSORED BY
Federal Ministry of Agriculture and Forest
Institute for Avalanche and Torrent Research (FBVA)
Governor and Province of Tyrol
Mayor and City of Innsbruck
Congress Innsbruck GmbH
Austrian Cableway Association

SECOND CIRCULAR

The International Glaciological Society will hold an International Symposium on Snow, Avalanches and Impact of the Forest Cover in 2000. The symposium will be held in Bozen Hall, Congress Innsbruck, Innsbruck, Austria, with registration on 21 May, and sessions from May 22–26.

SYMPOSIUM ORGANIZATION
S. Ommanney

LOCAL ARRANGEMENTS COMMITTEE
Horst Schaffhauser (Chairman), Michael Kuhn, Dimitrios Kolymbas, Josef Neuner, Werner Rachoy, Martina Eller, Stefan Kleinlercher

CHIEF SCIENTIFIC EDITOR
Kolumban Hutter

PARTICIPATION
This circular includes forms for registration and accommodation. The registration form and accompanying payment should be returned before 25 February 2000. There will be a £50 surcharge for late registrations. The hotel reservation form should be returned before 14 April 2000. The participant's registration fee covers organization costs, a set of abstracts, the icebreaker, banquet, the mid-week excursion and a copy of the *Annals of Glaciology*. The accompanying person's registration fee includes organization costs, the icebreaker, the mid-week excursion and the banquet. A local programme is being developed and details will be announced later. There is an administration charge for participants who are not members of the International Glaciological Society.

REGISTRATION FEES	UK £
Participant (IGS member)	195
Participant (not IGS member)	225
Student	95
Accompanying person aged 18 or over	45
Late registration surcharge (after 1 March)	50

Refunds on registration fees will be made on a sliding scale, according to date of receipt of notification, up to 8 May 2000. After that date it may be impossible to make any refund. See booking form for methods of making payment. All who pre-register will receive a copy of the third circular and programme prior to the meeting.

THEME
The properties of snow in mountain and polar regions and the processes taking place within the snow cover are critical factors in our ability to model the movement of snow. In addition, management of the vegetation cover can influence the snow cover, its distribution and movement. In most mountain regions, avalanches pose a significant threat to human life and property. Improved scientific knowledge of mountain snow and avalanche dynamics opens up new and powerful prospects for reducing this threat. This Symposium will focus on those aspects of snow science related to understanding the snow cover, its properties and movement.

TOPICS
The suggested topics include:
1. Snow properties and structure
2. Snow-cover distribution
3. Snow drifting/blowing snow
4. Snowmelt and water quality
5. Modelling snow processes
6. Snow ecology
7. Artificial snow ecology
8. Influence of forest and vegetation cover on snow distribution and movement
9. Avalanches
10. Avalanche snow rheology
11. Avalanche dynamics
12. Avalanche control
13. Avalanche risk assessment
14. Model verification
15. Hazard mapping and zoning
16. Slush flows

Sessions will be developed around these themes.

SESSIONS
Oral presentations will be held on four full days and one half-day. There will be ample opportunity for poster displays.

PAPERS

(I) SUBMISSION OF ABSTRACTS
Participants who want to contribute to the Symposium should submit an abstract of their proposed paper. This abstract must contain sufficient detail to enable us to judge the scientific merit and relevance of the pro-posed paper. It should not exceed one page of type-script, on international-size paper A4 (210 x 297 mm). References and illustrations are not required. Place the title and author(s) names and address(es) at the top of the abstract, not on a separate sheet. Indicate at the bottom which specific topic it intends to address, and whether a poster presentation is preferred. When selecting material, authors should bear in mind that the final version of the paper should not exceed 5 printed pages in the *Annals*; extra pages will be charged at the rate of £90 per page. Send abstracts by E-mail, fax or regular mail to: Secretary General, International Glaciological Society, Lensfield Road, Cambridge CB2 1ER, U.K.

LAST DATE FOR RECEIPT OF ABSTRACTS
12 NOVEMBER 1999

(II) SELECTION OF PAPERS
Each abstract will be assessed on its scientific quality and relevance to the topics of the Symposium. Authors whose abstracts are acceptable will be invited to make either an oral or poster presentation at the Symposium. There will be no distinction between oral or poster papers in the *Annals of Glaciology*. First or correspond-ing authors will be advised by mid December of the acceptance or otherwise; other authors will not be informed separately. Authors who have not received notification by the end of December should contact the IGS office in Cambridge. Acceptance of an abstract means that the paper based on it must be submitted to the *Annals of Glaciology* and not to another publication. Note: Abstracts alone will not be published in the *Annals of Glaciology*.

(III) DISTRIBUTION OF ABSTRACTS
A set of the accepted abstracts will be provided to all registered participants upon registration on 21 May 2000.

(IV) SUBMISSION OF PAPERS AND PUBLICATION
Four copies of each paper, doubled-spaced with wide margins, should be sent to the Secretary General, International Glaciological Society, Lensfield Road, Cambridge CB2 1ER, U.K. by 1 March 2000. ALL AUTHORS ARE EXPECTED TO ADHERE TO THIS DEADLINE. Papers should be prepared in accordance with the style instructions sent to authors with the abstract acceptance notification. Papers will be refereed according to the usual standards of the Society before being accepted for publication. Final papers, presented at the Symposium, which have been submitted and accepted by the Editorial Board, following review, will be published in English in the *Annals of Glaciology* (Vol. 32). Final, revised versions of papers, diskettes and original art work must be submitted by 30 June 2000. Speedy publication of the *Annals of Glaciology* will depend upon strict adherence to deadlines.

LAST DATE FOR RECEIPT OF PAPERS
1 MARCH 2000

MID-WEEK EXCURSION

There will be a mid-week excursion into the avalanche catchment areas of the Innsbruck Nordkette mountains to review aspects of avalanche control, hazard map-ping, avalanche dynamics, design criteria and the role of forests.

POST SYMPOSIUM TOUR

Consideration is being given to running a post-sym-posium tour. Anyone interested in participating in such a tour should indicate their interest on the registration form.

ACCOMMODATION

Accommodation is being organized by Congress Innsbruck GmbH. Please complete and return the appropriate reservation form by 14 April 2000.

IMPORTANT DATES:

Abstracts due	**12 November 1999**
Notification of acceptance	15 December 1999
Pre-registration deadline	25 February 2000
Papers due	**1 March 2000**
Deadline for full refund	3 April 2000
Hotel reservation deadline	14 April 2000
Deadline for refund	8 May 2000
Conference starts	21 May 2000
Final revised papers	**30 June 2000**

Please respect the above deadlines

ADDITIONAL INFORMATION

For updates please check the web sites:
http://www.spri.cam.ac.uk/igs/inpages.htm
http://www.magnet.at/

SNOW, AVALANCHES AND IMPACT OF THE FOREST COVER

Innsbruck, Austria, 22–26 May 2000

REGISTRATION FORM

Family Name: _____
First Name: _____
Address: _____
_____
Tel: _____
FAX: _____
E-mail: _____

Accompanied by:
Name: _____ Age (if under 18) _____
Name: _____ Age (if under 18) _____
Name: _____ Age (if under 18) _____

REGISTRATION FEES	£	£
Participant (Member of the IGS)	195	_____
Participant (Not a member of the IGS)	225	_____
Student	95	_____
Accompanying person aged 18 or over	45	_____
Late registration surcharge (after 1 March)	50	_____

I would be interested in participating in a post-symposium tour _____

TOTAL REGISTRATION FEES AND DEPOSITS SENT _____

Payment may be made by cheque, in pounds sterling drawn on a UK bank, payable to

INTERNATIONAL GLACIOLOGICAL SOCIETY

By Access/Eurocard/MasterCard or VISA/Delta

Card No. | | | | | | | | | | | | | | | | Expires | | | | |

Signature: _____

Payment may also be made directly to: National Westminster Bank plc,
account no: 54770084, 56 St. Andrew's Street, Cambridge CB2 3DA, UK.
Mail to: Secretary General, International Glaciological Society, Lensfield Road,Cambridge CB2 1ER, UK

For payments made after 1 March 2000, add surcharge of £50 per person

INTERNATIONAL SYMPOSIUM ON SEA ICE AND ITS INTERACTIONS WITH THE OCEAN, ATMOSPHERE AND BIOSPHERE

Fairbanks, Alaska, U.S.A., 19–23 June 2000

CONTRIBUTING CO-SPONSORS
Arctic Research Consortium of the United States
International Arctic Research Center
U.S. National Aeronautics and Space Administration, Polar Program
U.S. National Science Foundation, Office of Polar Programs

CO-SPONSORS
American Geophysical Union
International Arctic Science Committee
International Commission on Snow and Ice
Japanese Society of Snow and Ice
IAPSO Sea Ice Commission
Scientific Committee on Antarctic Research

SECOND CIRCULAR

The International Glaciological Society will hold a symposium on Sea Ice and its Interactions with the Ocean, Atmosphere and Biosphere in the year 2000. The symposium will be held under the midnight sun at the University of Alaska-Fairbanks, Alaska, U.S.A. Registration will be on 18 June and sessions will be held from 19-23 June 2000.

SYMPOSIUM ORGANIZATION
S. Ommanney

LOCAL ARRANGEMENTS COMMITTEE
Martin Jeffries (Chairman), Stephen Ackley, Nancy Bachner, Hajo Eicken, Jerome Johnson, Don Perovich, Matthew Sturm

CHIEF SCIENTIFIC EDITORS
Martin Jeffries and Hajo Eicken

PARTICIPATION
This circular includes forms for registration and accommodation. The registration form and accompanying payment should be returned before 24 March 2000. There will be a £50 surcharge for registrations received after this date. The Campus Housing Request Form should be returned before 1 June 2000. The participant's registration fee covers organization costs, copies of the abstracts, the icebreaker, banquet, breakfast and lunch during the meeting, the mid-week excursion and a copy of the *Annals of Glaciology*. The accompanying person's registration fee includes organization costs, the icebreaker, banquet and mid-week excursion. There is an administration charge for participants who are not members of the International Glaciological Society.

REGISTRATION FEES	**UK£**
Participant (IGS member)	250
Participant (not IGS member)	300
Student	100
Accompanying person aged 18 or over	55
Late fee (after 24 March 2000)	50

Full registration refunds will be made for cancellations received before1 May 2000. Refunds will be made on a sliding scale, according to date of receipt of notification, up to 2 June 2000. After that date it may be impossible to make any refund. See booking form for methods of making payment. All who pre-register will receive a copy of the third circular and programme prior to the meeting.

THEME
The sea-ice cover in the Arctic and Antarctic modifies and transforms the regional atmosphere and ocean, ultimately playing a key role in the global climate. The sea-ice habitat and its interactions with the atmosphere and ocean influence the ecology of the polar oceans. Today we have unprecedented opportunities to combine field measurements, remote sensing and numerical modelling in interdisciplinary approaches to solving physical and biological problems at different scales, from the individual ice floe to the entire ice pack. The aim of this symposium is to promote interdisciplinary discussion of the geophysics of sea ice and its interactions with the ocean, atmosphere and biosphere.

TOPICS
The suggested topics include:
1. Sea ice and climate
2. Sea-ice growth, decay and thickness distribution
3. Sea-ice motion and deformation
4. Variability of regional and global sea-ice covers
5. Ocean–atmosphere heat fluxes, and ice–ocean salt fluxes
6. Surface energy balance
7. The sea-ice habitat and its physical and biological roles
8. Sea ice as a transportation agent

Sessions will be developed around these themes.

SESSIONS
There will be nine half-day sessions to accommodate a combination of oral presentations and posters. There will be no concurrent sessions.

PAPERS

(I) SUBMISSION OF ABSTRACTS
Participants who want to contribute to the Symposium should submit an abstract of their proposed paper. This abstract must contain sufficient detail to enable us to judge the scientific merit and relevance of the proposed paper. It should not exceed one page of typescript, on international-size paper A4 (210 x 297 mm). References and illustrations are not required. Place the title and author(s) names and address(es) at the top of the abstract, not on a separate sheet. Indicate at the bottom which specific topic it intends to address and whether a poster presentation is preferred. When selecting material, authors should bear in mind that the final version of the paper should not exceed 5 printed pages in the Annals; extra pages will be charged at the rate of £90 per page. Send abstracts by E-mail, fax or regular mail to: Secretary General, International Glaciological Society, Lensfield Road, Cambridge CB2 1ER, U.K.

LAST DATE FOR RECEIPT OF ABSTRACTS: 1 NOVEMBER 1999

(II) SELECTION OF PAPERS
Each abstract will be assessed on its scientific quality and relevance to the topics of the Symposium. Authors whose abstracts are acceptable will be invited to make either an oral or poster presentation at the Symposium. There will be no distinction between oral or poster papers in the Annals of Glaciology. First or corresponding authors will be advised by mid December of the acceptance or otherwise; other authors will not be informed separately. Authors who have not received notification by the end of December should contact the IGS office in Cambridge. Acceptance of an abstract means that the paper based on it must be submitted to the Annals of Glaciology and not to another publication. Note: Abstracts alone will not be published in the Annals of Glaciology.

(III) DISTRIBUTION OF ABSTRACTS
A set of the accepted abstracts will be provided to all registered participants upon registration on 18 June 2000.

(IV) SUBMISSION OF PAPERS AND PUBLICATION
Four copies of each paper should be sent to the Secretary General, International Glaciological Society, Lensfield Road, Cambridge CB2 1ER, U.K. by 15 March 2000. ALL AUTHORS ARE EXPECTED TO ADHERE TO THIS DEADLINE. Papers should be prepared in accordance with the style instructions sent to authors with the abstract acceptance notification. Papers will be refereed according to the usual standards of the Society before being accepted for publication. Final papers, presented at the Symposium, which have been submitted and accepted by the Editorial Board, following review, will be published in English in the Annals of Glaciology (Vol. 33). Revisions of papers, diskettes and original art work must be submitted by 15 August 2000. Speedy publication of the Annals of Glaciology will depend upon strict adherence to deadlines.

LAST DATE FOR RECEIPT OF PAPERS: 15 MARCH 2000

STUDENT AWARD
The organisers are proposing to reward excellence in student presentations through a special award. All graduate students (non-members included) are eligible.

MID-WEEK EXCURSION
There will be a half-day excursion on 21 June, the summer solstice, when there will be more than 20 hours of daylight. This will be a visit to the Fort Knox Gold Mine and is available to participants on a first-come first-serve basis (up to 100). The tour will include a visit to the face wall where the blasting and removal takes place plus the core-logging lab and a tour of the entire crushing/milling/leaching. operation. On the way out to the mine a stop off at the Alaska Pipeline Viewing Site (0.5 hrs max.) is planned.

ACCOMPANYING PERSONS' PROGRAMME
An active programme is being developed for accompanying persons. This will involve a half-day and two full-day excursions during the week to sites of scenic, historic and academic interest. There may be an additional charge for some of these. More details will be available on the Symposium Web site in due course and at registration.

ACCOMMODATION
Accommodation will include University dormitories and apartments located within a five-minute walk of the symposium venue, and off-campus hotels, but campus accommodation is recommended for its convenience. Please use the Campus Housing Request Form. See touritst information web site for details of hotels.

TOURIST INFORMATION
The organisers have decided not to arrange any pre- or post symposium tours. However for those wishing to see and do more, Fairbanks is well served by many tour operators.

Further information about Fairbanks and Alaska can be found at the web sites of the Fairbanks Convention and Visitors Bureau (http://www.explorefairbanks.com/fairbanks/html/flash.html) or the Alaska Division of Tourism (http://www.commerce.state.ak.us/tourism/).

TRAVEL ADVISORY
Please plan ahead, and book early!
It is most important that any travel (i.e. airline and hotel) bookings are made early (6 months or more) as the symposium coincides with the tourist season.

ADDITIONAL INFORMATION
For updates please check the web sites:
http://www.gi.alaska.edu/seaicesymposium
http://www.spri.cam.ac.uk/igs/akpages.htm

IMPORTANT DATES

Abstracts due	**1 November 1999**	Deadline for full refund	01 May 2000
Notification of acceptance	15 December 1999	Deadline for refund	02 June 2000
Pre-registration deadline	24 March 2000	Conference starts	18 June 2000
Papers due	**15 March 2000**	**Final revised papers**	**15 August 2000**

Please respect the above deadlines

SEA ICE AND ITS INTERACTIONS WITH THE OCEAN, ATMOSPHERE AND BIOSPHERE

Fairbanks, Alaska, U.S.A., 19–23 June 2000

REGISTRATION FORM

Family Name: _____
First Name: _____
Address: _____
_____
Tel: _____
FAX: _____
E-mail: _____

Accompanied by:
Name: _____ Age (if under 18) _____
Name: _____ Age (if under 18) _____
Name: _____ Age (if under 18) _____

REGISTRATION FEES	£	£
Participant (Member of the IGS)	250	_____
Participant (Not a member of the IGS)	300	_____
Student	100	_____
Accompanying person aged 18 or over	50	_____
Late registration surcharge (after 24 March)	50	_____
TOTAL REGISTRATION FEES AND DEPOSITS SENT		_____

Payment may be made by cheque, in pounds sterling drawn on a UK bank, payable to

INTERNATIONAL GLACIOLOGICAL SOCIETY

By Access/Eurocard/MasterCard or VISA/Delta

Card No. | | | | | | | | | | | | | | | | Expires | | | | |

Signature: _____

Payment may also be made directly to: National Westminster Bank plc,
account no: 54770084, 56 St. Andrew's Street, Cambridge CB2 3DA, UK.
Mail to: Secretary General, International Glaciological Society, Lensfield Road,Cambridge CB2 1ER, UK

For payments made after 24 March 2000, add surcharge of £50 per person

BRITISH BRANCH MEETING 1999

Centre for Glaciology, Institute of Geography and Earth Sciences
University of Wales, Aberystwyth
9–10 September 1999

FIRST CIRCULAR

This year, the annual meeting of the British Branch of the International Glaciological Society will be held at the Centre for Glaciology, Institute of Geography and Earth Sciences, University of Wales, Aberystwyth on Thursday 9th and Friday 10th September 1999. Presentations are invited on all aspects of ice and snow research, in the form of either a short talk or poster. Time allocated for individual talks will be 15 minutes, with 5 minutes for discussion. There will also be a session for shorter talks of 8 minutes (plus 2 minutes for discussion) for less formal presentations (e.g. by new postgraduate students or hot-off-the-press field results). The number of talks will be restricted to ensure there is sufficient time for informal discussion and viewing of posters. Pin-boards will be provided for posters, which will be displayed throughout the meeting.

If you wish to give a talk or poster, please submit an abstract (up to 1 side A4) by e-mail to gbb@aber.ac.uk or post it on a 3.5" diskette with the Registration Form before 31 July 1999. A booklet of abstracts will be distributed at the meeting.

Registration for the meeting, including tea/coffee/biscuits and the booklet of abstracts, is £17 for waged and £9 for unwaged delegates. Late registration (after 31 July 1999) will be £21 waged / £11 unwaged. Bed and breakfast accommodation will be available on Wednesday, Thursday and Friday nights in Rosser and Penbryn Halls; 3 minutes walk from the Centre for Glaciology. Two standards of rooms are available, either en-suite (£28 per night) or with communal bathroom per corridor (£18 per night). A limited amount of floorspace for sleeping bags can be provided for post-graduates if needed. Please indicate if this is required when registering.

The annual dinner will be held at The Royal Pier Tandoori at a cost of £15 plus drinks. A variety of dietary requirements can be catered for (e.g. vegetarian, non-spicy, non-Indian). Again, please indicate these when registering.

If you wish to attend the meeting, please fill out the registration form, available from the Centre for Glaciology Website (http://www.aber.ac.uk/~glawww/) and return it to the Conference Office, University of Wales, Penbryn, Penglais Campus, Aberystwyth, Ceredigion, SY23 3BY, together with a cheque for registration, accommodation and the annual dinner; payable to the University of Wales, Aberystwyth. Please note that late registration costs extra.

Updated details of the meeting will be posted on the web site. In due course, a second circular, including maps and programme, will be circulated to all who have registered.

Limited financial assistance may be available to postgraduate students if all other avenues of funding (e.g. department, university and grant-awarding body) have been exhausted. Request an application form when registering. Refunds will be made at the meeting.

Giles Brown

NEWS

SNOW–VEGETATION INTERACTIONS WORKING GROUP (SVIWG)

A Working Group of the International Commission on Snow and Ice

ICSI working groups on snow chemistry, snow ecology and snow–climate interactions have identified complex feedback relationships between vegetation cover and properties of the snow cover. For instance, vegetation communities are strongly linked to patterns of seasonal-snow accumulation and melt by their influence on mass-, chemical- and energy-exchange processes, and by their sensitivity to snow thermal insulation and spring-time inputs of meltwater, nutrients and latent heat. Many snow models and parameterisations presume stationary plant communities as part of their regional calibrations. It is not clear how sustainable these plant communities are under changing levels of snow-carried stressors, such as pollutants, snow drought or winter storms, nor has the impact of vegetation cover and its management on climate, snow and aquatic resources been fully evaluated.

It is now felt that the complex cumulative impacts of a changing environment have created a global need for focused studies of snow–vegetation interactions at several scales: plant, plant community, landscape, biome and global. These interactions have produced quasi-stable relationships between vegetation cover, snow accumulation, snow avalanche, energy exchange, nutrient availability and snow melt in certain high-latitude and altitude biomes. The relationships sustain the biodiversity of these environments and have important implications for climate feedbacks, snow disasters and impacts on downstream aquatic systems. A threat to existing snow–vegetation interactions is perceived however, due to:

Global atmospheric change which involves changes in
- atmospheric deposition of chemicals and
- seasonal regimes of precipitation, wind and temperature

Global forest-cover change due to
- forest harvesting/burning,
- acidic precipitation and
- agricultural expansion

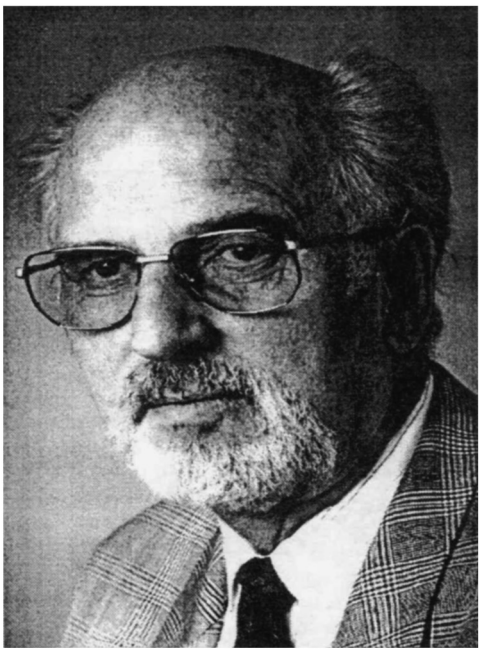
The ICSI Working Group on Snow–Vegetation Interactions (SVIWG) will address issues of recognized international importance relating to the above: deforestation, climate change, deposition of long-range pollutants, land management and the role of the snow–vegetation system in transmitting impacts. Experts and interested scientists from countries with various snow–vegetation problems will be brought together in meetings to:
- Better define the snow–vegetation interaction in various biomes,
- Examine the relationship between global atmospheric change and this interaction, and
- Examine the role of vegetation cover, its change and management on snow phenomena and hydrology.

The working group will identify and promote a co-ordinated approach to research questions that can be addressed in various snowy regions of the world. The SVIWG will link to IBP initiatives (ITEX - International Tundra Experiment), to WCRP studies (GEWEX - Global Energy and Water Cycling Experiment) and IGBP studies (BAHC - Biospheric Aspects of the Hydrological Cycle). The group will also correspond with the International Boreal Forest Research Association and other ecological groups. The SVIWG can potentially gain funding for meetings between delegates from NATO states and Co-operative Partner states in eastern Europe and Asia, ensuring broad participation from snowy countries. It will also propose symposia or workshops under the auspices of IAHS.

J.W. Pomeroy and D.A. Walker
(John.Pomeroy@ec.gc.ca)

OBITUARIES

Hans Oeschger (1927–1998)



Hans Oeschger, an early member of our society and recipient of the Seligman Crystal, passed away after a long illness on Christmas morning, 1998. He was one of a new breed of glaciologists and a respected pioneer in terrestrial environmental research. Although his research covered a wide spectrum of Earth-system sciences, he considered his participation and contributions in ice-core sciences to be some of the most challenging and exciting of his entire career.

Hans was born in 1927 in the village of Ottenbach, near Zürich. He studied experimental physics at the ETH in Zürich for his diploma and thereafter joined Professor F. G. Houtermans at the University of Bern, where he finished his doctoral thesis by inventing and building an instrument to measure ultra-low radio-activity using a proportional counter. Subsequently, he established the first ^{14}C-dating laboratory in Switzerland. In 1959, he spent a year with Hans Suess at Scripps, La Jolla, California, to set up his ^{14}C-measuring system and to investigate other naturally occurring radioisotopes. In 1962, together with André Renaud of Lausanne, he measured the first tritium concentrations in glacier-ice samples from Jungfraujoch. Later that year, at the IGS meeting in Obergurgl, Austria, Renaud introduced one of us (C.L.) to Hans, and so began a long-term collaboration in ice-core research.

Hans was quick to recognize the enormous potential of ice sheets as an archive for past environmental processes and climate history. The main goals of his first polar expeditions to Greenland in 1964 and 1965, and Antarctica in 1969 and 1970, were to ^{14}C date the glacier ice at the edge of the Greenland ice sheet and with depth in the borehole at Byrd Station. He was also convinced that the air bubbles could reveal much more than just the age of the surrounding ice. In the late 1960s and early 1970s, when wide environmental concern was mounting over the apparent increase in atmospheric CO_2, as measured by David Keeling at Mauna Loa, Hans started to establish methods to reconstruct the atmospheric CO_2 concentration further back in time by ice-core analyses. With ice cores from Siple Station (Antarctica), it was possible to determine the pre-industrial concentration of 280 ppmv. This value was later confirmed by other laboratories with various ice cores. Perhaps the most important finding was the significant increase in the CO_2 concentration with the climatic transition from the cold Wisconsinan ice age to the warm Holocene period. This correlation represented the first physical evidence to show a connective relationship between climate and the

most important greenhouse gas in the atmosphere, a theme significantly associated with Oeschger's research.

In 1971, Hans and his laboratory, along with his U.S. and Danish collaborators, immersed themselves in a joint effort to investigate a major part of the Greenland ice sheet. The multi-disciplinary field and laboratory program (GISP) continued for the next eleven years, and successfully concluded with the recovery of the third polar ice core to reach bedrock at Dye 3, Greenland, at 2037 m, in August 1981.

Hans hosted the first IGS symposium on ice-core analyses in Bern in 1987. The meeting coincided with his 60th birthday, which was celebrated at the symposium banquet. Hans also co-convened the Dahlem conference on *Paleoenvironmental Records in Glaciers and Ice Sheets*, held in Berlin, Germany in 1988. The first formal results of the entire GISP operation were presented at the AGU Symposium in Philadelphia, Pennsylvania in 1982. Hans co-edited the proceedings volume and presented a landmark paper on his systems-analysis concept.

The results of the GISP program demonstrated the need to obtain still another deep ice core from an environmentally colder region, less disturbed by ice flow, to answer unexplained questions about the ice-sheet composition and behaviour, not available at Dye 3. A new consortium of seven participating European countries, led by H. Oeschger, W. Dansgaard and C. Lorius, started a new deep drilling at the centre of the Greenland ice sheet in 1989. The Greenland Ice Core Project (GRIP) reached bedrock in July 1992 at a depth of 3029 m.

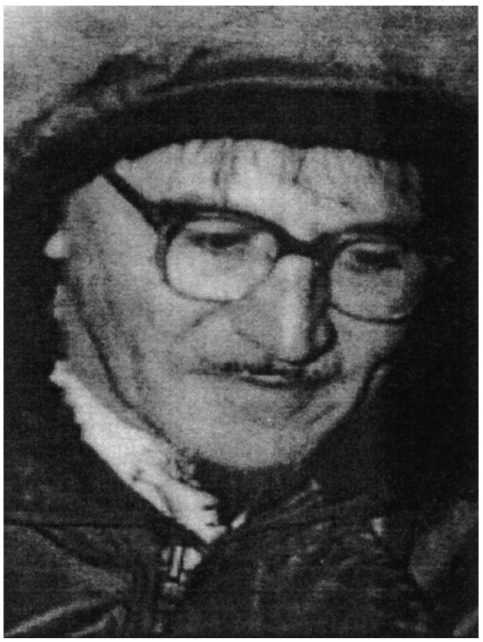
After Hans reached the mandatory retirement age in 1992 and was given emeritus status at the University of Bern. But he still continued his research interests and, in addition, co-directed the IGBP core office of past global change (PAGES). During his directorship, Hans travelled extensively, attending program activities and lecturing on the results and value of ice-core research.

Hans received many awards and honours in recognition of his scientific accomplishments. Besides the Seligman Crystal in 1989, he received the Harold C. Urey medal from the European Association for Geochemistry in 1987 and the Marcel Benoist Prize in 1991. Hans became a honorary member of the Swiss Academy of Science and a foreign member of the U.S. National Academy of Science. He was then awarded the Tyler Prize for Environmental Achievement in 1996 and the Revelle Medal of the American Geophysical Union in 1997.

Hans was a kindly man; cultured, articulate and diplomatic, with a great sense of humour and a contagious, silent laugh. In his spare time, Hans enjoyed opera, playing the violin, discussing the current sociological and political situations around the world, gourmet food and telling jokes, but was modest and unassuming. He will be greatly missed, but long remembered as a topnotch scientist, a respected teacher, an inspiring and visionary colleague and a true friend.

Chester C. Langway and Bernhard Stauffer

Henri Bader (1907–1998)



Henri Bader died in a hospital in Miami, Florida, on 6 December 1998, at the age of nearly 92. He was extremely ill with emphysema and had a virulant intestinal infection. Visiting him in March 1997, one of us (H.R.) found him frail and forgetful, but still vividly interested in what was going on in glacier research. He also proudly placed our order in forceful Spanish when we joined him at his favourite restaurant. He told us that one had to master Spanish to get around on Miami streets. After Adèle became an invalid, they moved into a home where Adèle still lives in the care of a nurse. During the better days of Henri's retirement, the Baders lived in an eleventh-floor apartment overlooking Biscayne Bay. From their balcony, they enjoyed a unique view over the Bay and made good use of the pool within the guarded compound. Doormen would take your car for parking and only admit visitors to the Baders after checking with them. Henri spent much time at his computer, still enjoying his mathematical skills. When the devastating hurricane Andrew struck Miami on 24 August, 1992, most of the Baders' windows were smashed and their furniture and carpets covered in broken glass and water. Many of their highly valued belongings were destroyed, including Henri's computer. The couple survived in a side room behind a reinforced window. Because the elevator was out-of-order for days and the water pump did not work without electricity, Adèle and Henri had to survive on stored food and water; climbing up and down stairs from the eleventh floor to get fresh supplies would have been too strenuous for them.

From Dr Bader's curriculum vitae, as annexed to his Ph.D. thesis, we learn that he was born on 15 January, 1907 in Brugg (Canton of Aargau, Switzerland) and finished high school in the fall of 1926, in Winthur

(Canton of Zürich). He studied earth sciences in Zürich at the University and at the Swiss Federal Institute of Technology (ETH). His Ph.D. thesis, entitled *Beitrag zur Kenntnis der Gesteine und Minerallagerstätten des Binntals* (Contribution to the knowledge of the rocks and mineral deposits of Binntal), was carried out under the leadership of Professor Paul Niggli, holder of a joint professorship at the University of Zürich and ETH and head of its Institute of Mineralogy and Petrology. A detailed account of Henri Bader's career can be found in his "Profile" in *ICE* (No. 13, 1963, 4–5). His attendance at schools in Geneva (three years of French), Manchester and Derby (five years of English), before his higher education in the German part of Switzerland, might account for his facility in switching from one language to another, but without an innate talent he would hardly have mastered this so well.

Henri Bader began his research on snow and ice in 1935 at the Weissfluhjoch experimental station with the Snow and Avalanche Research Commission of Switzerland. With the first chapter of the fundamental work *Der Schnee und seine Metamophose*, entitled (in translation) *Mineralogical and Structural Characterization of Snow and its Metamorphism*, he established himself in the field of snow science at an early stage. Rumours go that Bader was too eager to start working at Weissfluhjoch to get equipped properly beforehand; consequently, he wore his cutaway both in the laboratory and field to keep warm.

In 1938, Henri Bader married Adèle who had relatives in Argentina. The young couple left for South America, first for some prospecting in Argentina. Henri used to hint that he held a claim that would have been worth a fortune if not located in a hopelessly remote place! After working as a mineralogist and lecturing in Bogotà, Colombia, he became superintendent of a mine in Curaçao from May 1941 to May 1945. In the summer of 1945, the Baders moved to the United States where Henri became Associate Research Specialist at Rutgers University, New Brunswick, New Jersey, and Assistant Director of the Bureau of Mineral Research. The following is taken from his profile in *ICE*.

While at Rutgers, Dr. Bader brought to the attention of the U.S. Government the lack of knowledge in snow and ice mechanics in the U.S.A. As a result the War Department General Staff sent him to Europe in the spring of 1947 to review and evaluate snow and ice research accomplished up to that time in England, France, Switzerland and Germany. His report formed the basis of a conference on snow and ice at the Pentagon on 12 August 1947 which stressed the need for such basic research and its Corps of Engineers was assigned the task of initiating the Snow, Ice and Permafrost Research Establishment, which was located first in St. Paul, Minnesota. Research on snow and ice was conducted by contract with the University of Minnesota. In September 1949, Bader left Rutgers University and accepted the position of Research Associate, Institute of Technology, University of Minnesota to work under this Army contract. By June 1951, a laboratory was ready in Wilmette, Illinois, and the Snow, Ice and Permafrost Research Establishment became an operating laboratory on its own as part of the U.S. Army Corps of Engineers, with Bader as Supervisory Physical Science Administrator. He soon became the Acting Scientific Director and the Chief of the Snow and Ice Basic Research Branch and in 1953 was made Chief Scientist.

Dr Bader's early snow research was of a mineralogical and petrological nature. When confronted with the military importance of snow and ice, however, the importance of a better understanding of the mechanical properties was obvious to him. Early SIPRE reports originating at Rutgers and Minnesota, with Bader's participation, consist of a review of the physical and mechanical properties of snow, ice and permafrost and of various engineering aspects of these materials. Field and laboratory studies were also started at that time. These investigations then expanded into the multifaceted SIPRE research program after the laboratory was established in Wilmette, Illinois, in 1951. Without delay, with Bader participating, SIPRE became active on the Greenland ice cap, based out of Thule Air Force Base. An agreement between the Library of Congress and SIPRE was reached to survey existing and current literature in the field of snow, ice and permafrost worldwide. The respective abstracts came out in print, two volumes per year, as SIPRE Report 12 *Annotated Bibliography on Snow, Ice and Permafrost*, beginning in the second half of 1951. The SIPRE (now CRREL) bibliography has proven to be invaluable to researchers involved in studies of the varied aspects of glaciology and its publication continues to this day.

Bader insisted that SIPRE devote itself to basic research. His leadership was crucial because the Corps of Engineers was inclined to deal with problems in an ad hoc manner. When the name changed from SIPRE to CRREL Bader insisted that Research be in the name. Originally it was going to be CREL (Cold Regions Engineering Laboratory). Bader insisted on the extra "R" so that no one could dispute the research function in the future.

After Dr Bader became Chief Scientist, his engagement in cold-region's research is less obvious from his list of publications than in the versatility of research carried out under his direction. Subjects as varied as over-snow trafficability, crevasse detection, blasting in ice and permafrost, ice tunnelling, trenching in snow for sub-surface operations, snow and ice deformation and strength, accumulation distribution across Greenland, patterned ground and the bearing capacity of floating ice, among various other matters of practical or scientific nature, were treated either at SIPRE or by contract with other agencies or private enterprises. Probably the greatest international recognition was won by the pioneering achievements of deep-core drilling on the Greenland ice sheet.

From the beginning, Henri Bader was baffled by the regular increase of density with depth on the high polar ice caps, and his mathematical mind would not rest until he was able to formulate this regularity in mathematical terms. Based on early observations from Wegener's Greenland Expedition of 1930–31, he referred to the depth–density relationship as Sorge's

law and wrote three SIPRE reports on the subject, working out the essential parameters that control densification with time and load.

Dr Bader's sharp mind was felt when he came to one's work place to discuss individual projects. He would listen to the explanations of the scientist involved, ask a few questions, and immediately identify some weak point in the study. Although some individuals felt threatened by Bader's insightful comments, most scientists were encouraged to solve the problem to Bader's and their own satisfaction. Discussions with Dr. Bader were invariably stimulating. His devotion to finding solutions motivated those working under him and helped form a unique team spirit at SIPRE, from which lifetime friendships formed. There was generally great freedom at SIPRE, at least in basic research, in the choice of subjects to investigate, but one had to be able to justify what was done and why.

In 1960, Dr Bader resigned from SIPRE and moved to Miami, Florida as Research Professor at the University of Miami, under government contract and grant. He managed to stay in an advisory position to the government, yet escaped the frictions over priorities between military command, administration and science that hampered SIPRE's future. His service was obviously esteemed at high levels of the U.S. Government, since he had the honour — as a first naturalized American — to be appointed Scientific Attaché to the U.S. Ambassador, first in Bonn, Germany in 1963, and two or three years later in Bern, Switzerland. In the U.S.A., Henri Bader served for many years on the Panel of Glaciology of the Committee on Polar Research of the U.S. Academy of Sciences. When the Instituto Argentino de Nivología y Glaciología (INAGLIA) was set up in Argentina in 1974, Dr Henri Bader was called in as a consultant.

Dr Henri Bader was awarded the Seligman Crystal in September 1967. He was the second recipient, the first was the Founder of the Society, Gerald Seligman. Bader's multiple contributions as an initiator, educator, researcher, adviser and scientific director of a world-renowned research organization were therewith adequately and well-deservedly honoured.

Marcel de Quervain and Hans Röthlisberger

FUTURE MEETINGS (of other organizations)

VENING MEINESZ CONFERENCE ON GLOBAL AND REGIONAL SEA-LEVEL CHANGES AND THE HYDROLOGICAL CYCLE

Loiri-Porto San Paolo, Sardinia, Italy, 4–7 October 1999

This conference will provide a forum for a discussion of the present state of knowledge of sea-level variability in relation to the hydrological cycle both at global and regional scales, and help identify and investigate the problem areas and key parameters for improving our understanding of the physical phenomena and their interaction.

On 7 October a Workshop on Monitoring of Sea Level will be held. Scientific Committee: C.R. Bentley (Madison, USA), A. Cazenave (Toulouse, France), H.-P. Plag (Honefoss, Norway), D. Sahagian (Durham, USA), H. Savenije (Delft, The Netherlands), S. Zerbini (Bologna, Italy).

For further information see:

http://www.copernicus.org/EGS/conference/vmc1/cover.htm

INTERNATIONAL WORKSHOP ON DEBRIS COVERED GLACIERS

University of Washington, Seattle, Washington, U.S.A., 13–15 September, 2000

Sponsored by the International Commission on Snow and Ice

BACKGROUND AND SCOPE

Shrinkage of glaciers has contributed to rising sea level over the last century. Whether the rate of shrinkage could accelerate is of global concern. Glaciers are also of local interest for human water use and potential hydrologic hazards. To address these issues requires accurate measurements of glacier mass balances worldwide and better understanding of their mass and energy exchange. Much of our understanding to date has been gained from relatively clean glaciers, largely free of debris cover. However, debris-covered glaciers comprise a significant fraction of the global population of glaciers and are particularly common in the Himalayas, Andes, Alaska and on stratovolcanoes worldwide.

Despite their relatively common occurrence, debris-covered glaciers have not been well-studied, in part because we do not have practical methods to measure or predict the melting rate of the ice under the debris. This

fundamental variable is crucial for mass-balance calculations, response to climatic variations, and for water runoff. Moreover, the perimeter of debris-covered glaciers can be difficult to determine from ground-based and satellite observations. From a hydrological perspective, debris-covered glaciers commonly develop supraglacial lakes that can release disastrous floods.

In addition to issues directly concerning debris-covered glaciers, rock glaciers may be an end-member in the spectrum of glaciers, possibly originating from debris-covered glaciers. Current debate on the origin of rock glaciers and their possible genetic connection to debris-covered glaciers highlights fundamental issues regarding debris transport and energy balances.

With these issues in mind, the workshop is organized around 5 themes and aims to synthesize our current understanding about debris-covered glaciers and rock glaciers. By drawing on experiences from different regions of the world we hope to highlight the underlying physical processes controlling the nature of debris-covered and rock glaciers.

WORKSHOP THEMES

1. Distribution and setting of debris-covered glaciers.
2. Mass and energy balances of debris-covers.
3. Debris origin and transport processes in debris-covered and rock glaciers.
4. Supra-glacial lakes, formation and outburst.
5. Climatic variations and the response of debris-covered and rock glaciers.

Further details can be obtained from: http://snowman.ihas.nagoya-u.ac.jp/Research/DebrisWS/1stcclr.html

1999 AGU FALL MEETING, HYDROLOGY SECTION SESSIONS

13– 17 December 1999, San Francisco, California, U.S.A.

Four Hydrology Section sessions at the 1999 AGU Fall Meeting are being co-sponsored by the AGU Snow, Ice, and Permafrost Committee and will be of interest to IGS members. Abstracts are due on September 2 (by mail) or September 9 (Web submission, the encouraged medium). For general meeting details see http://www.agu.org/meetings/fm99call.html.

FANS, FLOWS, AND GLACIERS: A SPECIAL SESSION IN HONOR OF ROGER LeB. HOOKE

During his productive career, Roger Hooke has studied an unusually broad range of geomorphic processes. His work has contributed fundamentally to understanding alluvial-fan and river sedimentation, mass wasting, glacier flow, water flow through glaciers, glacial erosion and sedimentation, and links between tectonic and geomorphic change. In his honor, we solicit contributions on these and other geomorphic processes. Approaches can vary from laboratory experiments to basin-scale models.

Conveners: Neal Iverson, Dept. of Geological Sciences, Iowa State Univ., Ames, IA 50011, USA (Tel [1](515) 294-8048; Fax [1](515)294-6049; niverson @iastate.edu)

Gary Parker, St. Anthony Falls Hydraulics Lab, Univ. of Minnesota, Minneapolis, MN 55414, USA (Tel [1](612)627-4010; Fax [1](612)627-4609; parke002 @tc.umn.edu)

James Pizzuto, Dept. of Geology, Univ. of Delaware, Newark, DE 19716, USA (Tel [1](302)831-2710; Fax [1](302)831-4158; pizzuto@udel.edu)

MONITORING, MEASURING, AND MODELING SNOW PROCESSES (poster only)

The storage and modulated release of water from seasonal snowpacks are major components of hydrologic systems in many parts of the world, particularly in the Western portions of the United States and Canada. In these regions, the seasonal snowcover is a critical component of the annual water cycle, controlling soil moisture, streamflow, and the development and stability of terrestrial and aquatic ecosystems. This session will address a broad range of topics that are important to understanding this important resource. We are soliciting poster presentations on all aspects of monitoring, measuring, and modeling snow processes, with emphasis on the following specific topics:

- snow measurement and monitoring techniques and instruments
- investigations into physical properties of snow: linking microscale properties to macroscale processes
- snowcover modeling in vegetated and complex terrain
- remote sensing of snowcover properties and extent.

Conveners: Danny Marks, USDA-ARS, Northwest Watershed Research Center, 800 Park Blvd, Suite 105, Boise, ID 83712, USA (Tel [1](208)422-0721; Fax [1](208)334-1502; danny@quercus.ars.pn.usbr.gov)

Robert E. Davis, U.S. Army Engineer Research and Development Center, Cold Regions Research and Engineering Laboratory, 72 Lyme Road, Hanover, NH 03755-1290, USA (Tel [1](603) 646-4219, Fax [1](603)646-4397; bert@crrel.usace. army.mil)

GLACIERS AND ICE SHEETS

We solicit contributions to the annual Glaciers and Ice Sheets session at the AGU Fall Meeting. The Fall Meeting offers an increasingly international and leading-edge forum to present recent progress and innovation in snow and ice studies. The Glaciers and Ice Sheets session is broad in scope and will embrace observational, theoretical, numerical, and techological studies, with emphasis on applications to contemporary glacial systems. We particularly encourage submissions pertaining to ice dynamics, the subglacial environment, surface processes, and new techniques and methods to monitor glacial activity. Both oral and poster presentations are welcome.

Conveners: Mark A. Fahnestock, Department of Meteorology, University of Maryland, College Park, MD 20742, USA. (Tel [1](301)405-5384; Fax [1](301)405-8468; mark@atmos.umd.edu)
Shawn J. Marshall Earth and Ocean Sciences, University of British Columbia, 129-2219 Main Mall, Vancouver, British Columbia V6T 1Z4, Canada (Tel [1](604)822-3063; Fax [1](604) 822-6047, marshall@eos.ubc.ca)

PROXY CLIMATE RECORDS FROM ALPINE GLACIERS AND ICE CAPS

We solicit contributions in the area of proxy-climate records, that are derived from alpine glaciers and ice caps ("small glaciers"), on any time-scale, from any part of the world. For example, we would consider mass-balance records that have been examined on annual to decadal time-scales, glacier-moraine records that have been dated on the century to millennial time-scales, glaciolacustrine records that have been dated on annual to millennial time-scales, and, of course, ice-core studies, other than those from the Antarctic and Greenland ice sheets which have been well addressed at past AGU meetings. Our purpose is to develop a more geographically widespread database on climatic change on a variety of time-scales. Both oral and poster presentations are welcome.

Conveners: P. Thompson Davis, Dept. of Natural Sciences, Bentley College, Waltham, MA 02452-4705, USA. (Tel [1](781)891-3479; Fax [1](781)891-2838; pdavis@bentley.edu)
Gerald Osborn, Dept. of Geology and Geophysics, University of Calgary, Calgary, Alberta T2N 1N4, Canada (Tel [1](403)220-6448; Fax [1](403) 284-0074; osborn@geo.ucalgary.ca)
Douglas H. Clark, Dept. of Geology, Western Washington University, Bellingham, WA 98225-9080, USA (Tel [1](360)650-7939; Fax [1](360)650-7302, dhclark@cc.wwu.edu)

Contact DH Clark from July 15 to August 30.

SCALING LAWS IN ICE MECHANICS AND ICE DYNAMICS

June 13–16, 2000 Fairbanks, Alaska, U.S.A.

The International Union of Theoretical and Applied Mechanics is convening a symposium on scaling laws just before the IGS meeting in Fairbanks next year. Details of the meeting including a Preliminary Information Request, an outline of the objectives and its present organizational details are available from the meeting web site.

http://www.clarkson.edu/~yub/iutam_ice.html

GLACIOLOGICAL DIARY

** IGS sponsored * IGS co-sponsored

1999

3–11 August 1999
Magnitude and Frequency in the Glacial and Glaciofluvial Sedimentary Record of Modern and Ancient Glaciers, XV INQUA International Congress, Durban, South Africa
A.J. Russell, Department of Geography, Keele Univer-sity, Keele, Staffs ST5 5BG, UK (Tel [44](1782)584- 303; Fax [44](1782)715-261; a.j.russell@keele.ac.uk; www.inqua.geoscience.org.za)

6 August 1999
Glacier Deforming Bed Processes, XV INQUA International Congress, Durban, South Africa
J. Rose, Department of Geography, Royal Holloway and Bedford New College, Egham, Surrey TW20 0EX, UK (Tel [44](1784)443-807; Fax [44](1784) 443-836; j.rose@rmbnc.ac.uk) and J.K. Hart, Department of Geography, University of Southampton, Southampton, Hants S09 5NH, UK (Tel [44](1703) 594-615; Fax [44](1703)593-729; jhart@soton.ac.uk)

14–15 August 1999
Satellite Measurements and Monitoring of Glaciers and Ice Sheets, Zürich, Switzerland
J.S. Kargel, U.S. Geological Survey, 2255 North Gemini, Flagstaff, AZ 86001, USA (Tel [1](602) 556-7034; Fax [1](602)556-7014; jkargel@flagmail.wr.usgs.gov)

16–20 August 1999
** International Symposium on the Verification of Cryospheric Models, Zürich, Switzerland
Secretary General, International Glaciological Society, Lensfield Road, Cambridge CB2 1ER, UK (www.spri.cam.ac.uk/igs/zpages.htm)

22–25 August, 1999
* 6th International Symposium on Thermal Engineering and Sciences for Cold Regions, Darmstadt, Germany
Y.Wang, Institut für Mechanik, Technische Universität Darmstadt, Hochschulstrasse 1, D-64289 Darmstadt, Germany (Tel [49](6151)163196; Fax [49](6151)164-120; wang@mechanik.tu-darmstadt.de; www.mechanik.tu-darmstadt.de/ag3/ISTESCR99)

23–27 August 1999
POAC 99, 15th International Conference on Port and Ocean Engineering under Arctic Conditions, Espoo, Finland
K.A. Riska, Ship Laboratory, Helsinki University of Technology, P.O. Box 4100, FIN-02150 HUT, Finland (Tel [358](9)451-3498; Fax [358](9)451-3493; kaj.riska@hut.fi; info@tsgcongress.fi)

7–8 September 1999
* International Conference on the Deformation of Glacial Materials, London, England
B.P. Hubbard, Centre for Glaciology, University of Wales, Aberystwyth SY23 3DB, Ceredigion, Wales, UK (Tel [44](1970)622-783; Fax [44](1970)622-780; byh@aber.ac.uk; www.gaber.ac.uk/~byh/dgm99.html)

9–10 September 1999
** IGS British Branch Meeting 1999, Centre for Glaciology, Institute of Geography and Earth Sciences, University of Wales, Aberystwyth, Wales
G.H. Brown, Centre for Glaciology, University of Wales, Aberystwyth, Ceredigion, Dyfed SY23 3DB, Wales, UK (Tel [44](1970)622-784; Fax [44](1970) 622-780; gbb@aber.ac.uk; www.aber.ac.uk/~glawww/)

9–12 September 1999
Alpine Glaciers and Climate Change, 8th Italian Glaciological Meeting, Bormio, Italy
Dipartimento di Scienze dell'Ambiente e del Territorio, Università Milano, via Emanueli 15, I-20126 Milano, Italy (Fax [39](2)64-47-44-00; glacialp@alpha.disat.unimi.it; www.disat.unimi.it/glacialp)

17–22 September 1999
European Research Conference on Polar Regions and Quaternary Climate, Giens, near Toulouse, France
Office of European Research Conferences (EURESCO), 1 quai Lezay-Marnésia, F-67080 Strasbourg Cedex, France (Fax: [33](3)88-36-69-87; euresco@esf.org; www.esf.org/euresco)

27–30 September 1999
Fifth International Ice Drilling Technology Workshop, University of Nebraska, Lincoln, Nebraska, USA
PICO, P.O. Box 830850, University of Nebraska-Lincoln, Lincoln, NE 68583-0850, USA (Tel [1](402)472-9833; Fax [1](402)472-9832; sirg-pico@unlinfo.unl.edu)

4–7 October 1999
Vening Meinesz Conference on Global and Regional Sea-Level Changes and the Hydrological Cycle, Loiri-Porto San Paolo, Sardinia, Italy
EGS Office, Max-Planck-Str. 13, D-37191 Katlenburg-Lindau, Germany (Tel [49]5556-1440; Fax [49]5556-4709; egs@copernicus.org; www.copernicus.org/EGS/conference/vmc1/cover.htm)

13–17 December 1999
AGU Fall Meeting, San Francisco, California, USA
www.agu.org/meetings/fm99call.html

Fans, Flows, and Glaciers: a Special Session in Honor of Roger LeB. Hooke
N.R. Iverson, Department of Geological Sciences, Iowa State University, Ames, IA 50011-3210, USA (Tel [1](515)294-8048; Fax [1](515)294-6049; niverson@iastate.edu or Gary Parker (parke002 @tc.umn.edu) or James Pizzuto (pizzuto@udel.edu)

Monitoring, Measuring, and Modeling Snow Processes (poster only)
D. Marks, USDA-ARS, Northwest Watershed Res. Center, 800 Park Blvd, Suite 105, Boise, ID 83712, USA (Tel [1](208)422-0721; Fax [1](208)334-1502; danny@quercus.ars.pn.usbr.gov) or R.E. Davis (bert @crrel.usace.army.mil)

Glaciers and Ice Sheets
M.A. Fahnestock, Department of Meteorology, Univer-sity of Maryland, College Park, MD 20742, USA (Tel [1](301)405-5384; Fax [1](301)405-8468; mark @atmos.umd.edu) or S.J. Marshall (marshall@eos. ubc.ca)

Proxy Climate Records from Alpine Glaciers & Ice Caps
P.T. Davis, Department of Natural Sciences, Bentley College, Waltham, ME 02154-4705, USA (Tel [1](617)891-3479; Fax [1](617)891-2838; pdavis @bentley.edu) or G.D. Osborn (osborn@geo.ucalgary.ca) or D.H. Clark (dhclark@cc.wwu.edu)

2000

3–7 April 2000
European Geophysical Society General Assembly, Firenze, Italy
L.N. Braun, Kommission für Glaziologie, Bayerische Akademie der Wissenschaften, Marstallplatz 8, D-80539 München, Germany (Tel [49](89)23031-195; Fax [49] (89)230-31-100; ludwig.braun@lrz.badw-muenchen.de)

22–26 May 2000
** International Symposium on Snow, Avalanches and Impact of the Forest Cover, Innsbruck, Austria
Secretary General, International Glaciological Society, Lensfield Road, Cambridge CB2 1ER, UK (www.spri.cam.ac.uk/igs/inpages.htm)

28 May – 2 June 2000
ISOPE-2000, 10th International Offshore and Polar Engineering Conference and Exhibition, Seattle, Washington, USA
ISOPE-98, P.O. Box 1107, Golden, CO 80402-1107, USA (Tel [1](303)273-3673; Fax: [1](303)420-3760; meetings@isope.org)

5–8 June 2000
Ninth International Workshop on Atmospheric Icing of Structures (IWAIS), Chester, England
Paul Bagg, EA Technology Ltd, Capenhurst, Chester CH1 6ES, UK (Tel [44](151)347-2467; Fax [44] (151)347-2178; events@eatl.co.uk; www.eatl.co.uk)

13–16 June 2000
IUTAM Symposium on Scaling in Sea Ice Mechanics and Sea Ice Dynamics, Fairbanks, Alaska, USA
J.P. Dempsey, Department of Engineering, University of Cambridge, Cambridge CB2 1PZ, UK (Tel [44](1223) 332-642; Fax [44](1223)339-713; jpd23@eng.cam. ac.uk; www.clarkson.edu/~yub/iutam_ice.html)

18–23 June 2000
** International Symposium on Sea Ice and its Interactions with the Ocean, Atmosphere and Biosphere, Fairbanks, Alaska, USA
Secretary General, International Glaciological Society, Lensfield Road, Cambridge CB2 1ER, UK (www.spri.cam.ac.uk/igs/akpages.htm)

19–22 June 2000
4th International Conference on Snow Engineering, Trondheim, Norway
SEVU-Congress Department, Norwegian University of Science and Technology (Tel [47]73-59-52-47; Fax [47]73-59-51-50; snoweng@sevu.ntnu.no; www.ntnu.no/sevu/)

26–30 June 2000
Interpraevent 2000, Durable Protection from Floodings, Debris Flow and Avalanches, Villach, Austria
Interpraevent 2000, Postfach 117, A-9020 Klagenfurt, Austria (Tel [43](463)536-31818; Fax [43](463)536-31828; interpraevent@ktn.gv.at; www.ktn.gv.at/akl/ abt18/interpraevent.htm)

17–19 July 2000
The Extremes of the Extremes: International Symposium on Extraordinary Floods, Reykjavík, Iceland
Extremes2000 Conference Secretariat, Helga P. Finnsdóttir, National Energy Authority, Grensásvegi 9, IS-108 Reykjavík, Iceland (extremes2000@os.is; www.os.is/vatnam/extremes2000): Iceland Conferences, Bryndís E. Jóhannsdóttir, Lágmúli 4, IS-108 Reykjavík, Iceland (Tel [354]562-3300; Fax [354]562-3345; congrex@itb.is; bryndis@itb.is)

13–15 September 2000
International Workshop on Debris-Covered Glaciers, University of Washington, Seattle, Washington, USA
M. Nakawo, Institute for Hydrospheric-Atmospheric Sciences, Nagoya University, Furo-cho Chikusa-ku, Nagoya 464-8601, Japan (Tel [81](52)789-3477; Fax [81](52)789-3436; nakawo@ihas.nagoya-u.ac.jp; snowman.ihas.nagoya-u.ac.jp/Research/DebrisWS/1stcclr.html)

2001

23–27 July 2001
Physics and Chemistry of Ice, University of Kent, Canterbury, England
J. Dore and V. Nield (Fax [44](1227)827558; pcice @ukc.ac.uk; kiwi.ukc.ac.uk/physics/events.html)

to be announced, 2001
** Remote Sensing in Glaciology, Washington DC, USA
Secretary General, International Glaciological Society, Lensfield Road, Cambridge CB2 1ER, UK (www.spri.cam.ac.uk/igs/sympigs.htm)

August 2001
** Ice Cores and Climate, Kangerlussuag, Greenland
Secretary General, International Glaciological Society, Lensfield Road, Cambridge CB2 1ER, UK (www.spri.cam.ac.uk/igs/sympigs.htm)

23–28 August 2001
5th International Conference on Geomorphology, Chuo University, Tokyo, Japan
K. Kashiwaya, Department of Earth Sciences, Kanazawa University, Kakuma, Kanazawa 920-1192, Japan (kashi@kenroku.kanazawa-u.ac.jp; wwwsoc.nacsis.ac. jp/jgu/)

BOOKS RECEIVED

Głowacki, P. 1997. *Polish Polar Studies, 24th Polar Symposium. 40th anniversary of the Polish polar station Hornsund -- Spitsbergen 77°00' N 15°33' E.* Warszawa, Polish Academy of Sciences. Institute of Geophysics.

Głowacki, P. and J. Bednarek. 1998. *Polish Polar Studies, 25th International Polar Symposium. The 100th anniversary of Prof. Henryk Arctowski's and Prof. Antoni Boleslaw Dobrowolski's participation in the Belgica expedition to the Antarctic in 1887--1889.* Warszawa, Polish Academy of Sciences. Institute of Geophysics.

Knight, P.G. 1999. *Glaciers.* Cheltenham, U.K., Stanley Thornes (Publishers) Ltd. (ISBN 0-7487-4000-7 paperback £27.50)

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Assisted by D.J. Garbett

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