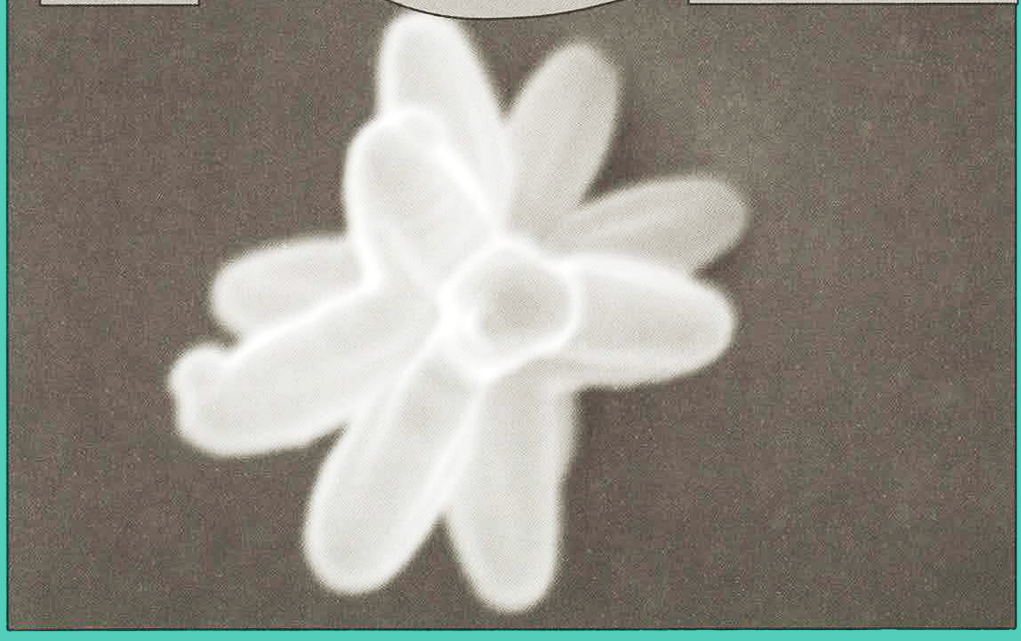
Number 135 *2nd Issue 2004*

ICE



NEWS BULLETIN OF THE INTERNATIONAL GLACIOLOGICAL SOCIETY

ISSN 0019–1043

ICE

NEWS BULLETIN OF THE INTERNATIONAL GLACIOLOGICAL SOCIETY

Number 135 2nd Issue 2004

CONTENTS

COVER PICTURE: Scanning electron micrograph of an unusual ice crystal type found on the surface of bulk ice samples during cryo-SEM. The crystals are an occasional contaminant suspected to form from traces of water vapour close to the beaker of liquid nitrogen in which the samples are transported. Each crystal has an unusual double-headed flower shape – the end faces look like a flower with six petals – probably originating from a hexagonal columnar ice crystal. The crystals are deposited on the surface during SEM insertion when a partial vacuum is applied to the liquid nitrogen.

The crystal shown here was approximately 7 microns diameter across the top face with the 6 petals/arms, and 6.5 microns high. Other similar crystals were observed with diameters and heights up to 18 microns.

(Image reproduced by permission of David C. Mallard)

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

FROM THE EDITOR

Dear IGS member

By the time this reaches you, you should already have received the first issue of Volume 50 of the *Journal of Glaciology*.

To commemorate the 50th volume, the IGS Council, the publications committee and the staff at the IGS office decided to give the *Journal* (and the *Annals*) a new look. We are implementing this in two stages, the result of the first part you will have seen when you received issue 168. The *Journal* has a new cover as well as a new layout of the inside covers.

Second, starting with the last issue of Volume 50, we are changing the inside of the *Journal*, i.e. the way your articles will look in the final publication. This will be the first issue in which we make use of the new templates we have made to more easily import your manuscripts into our typesetting program. It is our belief that these templates will speed up the production considerably. We will be doing our own page makeup and creating a PDF file of your article in which the layout will look like the final publication. We will be sending you this PDF file in place of the regular hard copy proofs you are used to receiving. We will be sending the PDFs to you by e-mail so it is especially important that you keep us informed about your current e-mail address. If you prefer a hard copy of proofs, we will of course mail them to you. But unless instructed to do otherwise, we will use e-mail.

The *Annals* will also acquire this new look. The first *Annals* that will be produced with this new look and using the new templates will be the long overdue *Annals* 39, shortly followed by *Annals* 40, 41 and 42.

These changes in the production procedures will enable us to process articles much faster and we should be able to clear our backlog fairly rapidly as these new methods are implemented.

We hope that you will continue to enjoy the *Journal* and the *Annals* with their new look and that you will be pleased with the planned increased rate of production.

Magnús Már Magnússson
Secretary General

RECENT WORK

ALASKA

(For abbreviations used see page 7)

GLACIERS

New methods for instrumenting subglacial till
(W. Harrison, M. Truffer, K. Echelmeyer, UAF)
We developed a new heavy down-borehole hammer capable of inserting instrument probes into several meters of coarse clast-rich till. The probes contained tilt meters and pressure transducers and used a wireless frequency shift protocol to transmit data to a receiver in the basal ice. A field test on Black Rapids Glacier in spring 2002 was successful and two probes worked intermittently for over one year.

Temporal and spatial distribution of ice deformation
(M. Truffer, K. Echelmeyer, J. Amundson, UAF)
Tilt meters were installed in a transect of boreholes on Black Rapids Glacier to monitor deformation rates and their temporal evolution in response to changing basal conditions. Currently, we are using finite element methods to interpret the results.

Deformation of proglacial moraines at Taku Glacier
(R. Motyka, M. Truffer, E. Kuriger, A. Bucki, UAF)
The advancing Taku Glacier has folded and thrusted moraines up to 200 m in front of the terminus. At the same time it continues to excavate basal sediments, as revealed by repeat radio echo sounding. We used geophysical techniques and excavations to investigate the folding and thrusting of the moraines. Glacier measurements include high resolution GPS and photogrammetry from vertical air photos.

The advance of Hubbard Glacier
(R. Motyka, M. Truffer, UAF)
In collaboration with a variety of agencies we study the continued advance of Hubbard Glacier, and the 2002 closure of Russell Fiord. Repeat bathymetry is used to find sedimentation rates and sediment redistribution during the 2002 outburst flood. Aerial photographs were used to study the development of a subaerial moraine, and bulge features were compared to those observed at Taku Glacier.

Recent behavior of Mendenhall Glacier, southeast Alaska: Response to climatic and subglacial topographic factors
(R. Motyka UAF; E. Boyce, E. Hood, UAS; C. Connor, UAF)
The thinning and retreat of Mendenhall Glacier terminus, a lake-terminating valley glacier in southeast Alaska, is under investigation using a semi-permanent GPS station, velocity markers., and a time-lapse camera. Radar and seismic methods were used to map bedrock topography in the terminus region. Bathymetric surveys of Mendenhall Lake measured depths adjacent to the retreating terminus. Raised thermo-erosional notches along the calving front and backsloping of the terminus suggest that the terminus may have become locally buoyant.

Glacier and firn dynamics of the Mt. Wrangell caldera
(M. Lüthi, M. Truffer, UAF; in collaboration with T. Shiraiwa, ILTS, S. Murayev, and S. Kanomori)
In collaboration with a Japanese-Russian group, we carry out an ice dynamical study around a core site on Mt. Wrangell. In addition to motion measurements, we will monitor borehole deformation and use seismic measurements to determine the depth of the caldera. Radio echo sounding has been unsuccessful.

Airborne Altimetry on Alaska Glaciers
(Keith Echelmeyer, Anthony Arendt, William Harrison, Craig Lingle and Virginia Valentine, UAF)
The surface elevations of more that 100 glaciers in northwestern North America have been measured by airborne altimetry starting in the early 1990s, the data from 2/3 of which have been reduced. Comparison with maps made typically in the mid 1950s indicates that average rate of thickness change of these glaciers was -0.52 m/year. Extrapolation to all glaciers in Alaska gives an estimate of 0.14 +/- 0.04 mm/year contribution to sea level rise during this interval. Repeat profiling of 28 glaciers between the early 1990s and 2001-2002 suggests that the more recent contribution to sea level is about 0.27 +/- 0.10 mm/year. These values are much higher than previously published loss estimates for Alaska Glaciers. More profiling is in progress.

Neotectonics, Glacier Unloading and Post Little Ice age Glacial Rebound in Southern Alaska
(R. Motyka, C. Larsen, K. Echelmeyer, and J. Freymueller, UAF)
Extreme uplift rates and sea level changes in southern Alaska have been documented by Global Positioning System (GPS) surveys, tide gauge measurements and

studies of raised shorelines. Most of the northern southeast Alaska is uplifting faster than 10 mm/yr, with several sites greater than 30 mm/yr. Raised shoreline studies at 27 sites document total sea level change, with a maximum change in sea level of -5.7 m found in Dundas Bay and upper Lynn Canal. The start of the ongoing uplift episode that raised these shorelines has been dated with dendrochronology and found to be coincident with the start of the collapse of the Glacier Bay Icefield, ca. 1750 AD. Since the end of the Little Ice Age, Glacier Bay has lost approximately 2500 km^3 of ice. Rebound modeling, based on this ice loss and late 20th century regional ice loss measured by laser altimetry, shows that glacial isostatic rebound can entirely account for the rapid uplift of southern Alaska over the last ~250 yrs.

The role of margins in ice stream motion
(M. Truffer, M. Lüthi, K. Echelmeyer, UAF)
In this modeling study we used finite element methods to match measured and modeled velocity profiles across the margins of Whillans Ice Stream. Those profiles are characterized by very high gradients, requiring large amounts of flow enhancement. Alternatively, we investigate the role of strain induced damage in weakening the ice.

The continued retreat of Brown Glacier, Heard Island
(M. Truffer, UAF, in collaboration with D. Thost, I. Allison, S. Donoghue, AAD): In this collaborative work we revisited Brown Glacier on Heard Island in the southern Indian Ocean. Volume change rates during the past three years are more than twice the average mass loss rate over the last half century. Weather station data and glacier geometry and speed is used to guide a numerical model

Variegated Glacier Surges
(W.D. Harrison, UAF; O. Eisen, AWI; K.A. Echelmeyer, UAF; C.F. Raymond, UW; M. Truffer and R.J. Motyka, UAF)
Variegated Glacier, which underwent a well-studied surge in 1982-83, has surged twice subsequently, in 1995 and 2004. This makes a total of eight surges since the beginning of the twentieth century. Reconnaissance level information on these surges is being studied to permit comparison with the earlier surges.

The basal velocity field of a temperate valley glacier: An inverse approach
(S. Avdonin, M. Truffer, UAF)
In this new study we will develop and adapt inverse methods to determine basal conditions from surface and geometry measurements on temperate valley glaciers, in an effort to understand the glacier-climate interaction.

Glacier research in National Parks in Alaska
(Guy Adema, NPS)
The national parks in Alaska have organized for monitoring efforts into four networks of parks (central, southwest, southeast, and arctic). We are in the planning stages of glacier monitoring for the central (Denali, Wrangell, and Yukon-Charley) and southwest (Kenai, Katmai, Lake Clark, Aniakchak), holding a formal scoping session last winter. The notes from that meeting will be available soon. The Arctic and Southeast monitoring networks are about two years behind the Central and Southwest Networks. Denali is in its 12th year of monitoring index mass balance and movement sites on the Traleika and Kahiltna Glaciers. The sites are visited twice a year. The East Fork glacier is being monitored by four monitoring stakes, using the USGS Benchark Method. The Muldrow Glacier is being monitored for pre-surge activity, including movement, profiles, and comparative photography. A comprehensive comparative photography project is underway to revisit photo-points of glacier photos from 1902- 1970 across Denali. A remote sensing project is underway to determine volume change of the East Fork glacier. A DEM will be developed from stereo pair of controlled images and is predicted to be accurate to roughly 5m vertically. This can be compared to UAF work and USGS maps. A project to outline all glaciated areas evident on a 2001 LANDSat image is in progress. It will be comparable to 1980's AHAP photography and 1950s USGS photography for glacier change. A project to monitor the movement of human waste in the Ruth Amphitheater and SE Fork of the Kahiltna Glacier, using magnets and monitoring stakes began in 2003 and is expected to continue for at least five years.

Glacier/Climate Studies at Gulkana and Wolverine Glacier
(R. March and D. Trabant, USGS)
Long-term glacier/climate monitoring, begun in 1966, continues at Gulkana and Wolverine Glaciers with measurements of the mass balance, meteorology, glacier-surface altitude, ice motion, terminus position, and runoff. Photogrammetric volume changes have recently been completed from 1974 to1993 and 1999 at Gulkana Glacier and from 1979 to 1995, 1998, and 2002 at Wolverine Glacier. The results agree with and provide verification of the long-term mass balance records (J. of Glaciology, in press). A 30-year data report has recently been released for Wolverine Glacier and is available through our web site at http://ak.water.usgs.gov/glaciology/

Volume change and ice dynamics of McCall Glacier, Alaska
(Matt Nolan, Anthony Arendt, UAF; Bernhard Rabus, MDA; Frank Pattyn, UB)
McCall Glacier continues to lose mass at what seems to be an increasing rate over time. We are now in year two of a five year study to document the rates of mass loss, mass balance, and ice dynamics. The glacier is polythermal, and surface motion cannot be fully accounted for by cold ice deformation in some parts of the glacier. We are studying these flow variations with field work and modeling.

Paleoclimate reconstructions using ice cores from McCall Glacier
(Matt Nolan, UAF, and Shuhei Takahashi, KIT)
Though not an ideal location for paleoclimate reconstructions from ice cores, we believe McCall

Glacier may be our best chance for a climate record for the eastern Brooks Range over the past 150 years or so. We have taken several short cores and are currently analyzing them for climate proxies such as oxygen isotopes, pollen, and chemistry. If these preliminary efforts show promise, we will attempt one or more deep cores in the next several years.

LAKE ICE

Measurement and modelling of the variability of lake ice growth and decay in Alaska

(Martin Jeffries, Kim Morris, and Marc Gould, UAF)

Lake ice characteristics and processes have been studied each winter since 1999-2000 at shallow ponds in the vicinity of Poker Flat Research Range, 50 km northeast of Fairbanks, central Alaska. Observations and measurements include (1) freeze-up, break-up and duration, (2) ice thickness, composition, and temperature, and (3) snow depth, density and temperature. These data have been used to assess the performance of CLIMo - the Canadian Lake Ice Model – a one-dimensional thermodynamic model with unsteady heat conduction and penetrating solar radiation. The model has then been used to (1) determine the consequences for lake ice of the Pacific Decadal Oscillation shift that occurred in the mid-1970s, and (2) predict the effects of future air temperature and precipitation changes on lake ice in central Alaska.

The Alaska Lake Ice and Snow Observatory Network (ALISON): A statewide K-12 and university science education and research partnership

(Martin Jeffries, UAF, and Delena Norris-Tull, UMW)

ALISON is a project that enables teachers and students to practice hands-on science and learn in the local context by participating in a research project. The aim of the research is to document the temporal and spatial variability of ice thickness, the depth and density of the snow on the ice, and the conductive heat flow to the atmosphere at frozen lakes and ponds in the different climate zones of Alaska. Using those abundant and familiar materials, snow and ice, teachers and students are learning about (1) observation and measurement; (2) the SI System and metric units; (3) temperature, heat, energy, thermal resistance, phase change; (4) weight, mass, volume, density; (5) arithmetic, equations, statistics; (6) graphs, data analysis and interpretation, and models; (7) snow, ice and polar environmental change; (8) polar science - that it is interesting, enjoyable and not just a summer activity.

Ice formation and conductive heat flow from frozen lakes in Alaska

(Martin Jeffries, Kim Morris, and Marc Gould, UAF)

Conductive heat flow is the primary means of heat transfer through floating ice and snow in winter, and it dominates the surface energy balance. This much is known for sea ice, but the magnitude and variability of the conductive heat flow through lake ice are much less well known. Using field measurements and numerical modelling, this project aims to quantify the conductive heat flow and total heat loss from lake ice, and how they are partitioned between congelation ice formation by water freezing at the base of the ice cover and snow ice formation by slush freezing at the top of the ice cover. The primary field study sites will be in the vicinity of Poker Flat Research Range, 50 km northeast of Fairbanks, central Alaska. Secondary study sites at Barrow, Nome and Seward will be run by teachers and students participating in ALISON, the Alaska Lake Ice and Snow Observatory network.

Lake Ice Dynamics on Lake El'gygytgyn, Siberia

(Matt Nolan, UAF, and Julie Brigham-Grette, UMA)

We have been studying the lake ice dynamics of Lake El'gygytgyn, Siberia, using SAR, Landsat, modeling, and local weather and lake temperature data for the past four years. Lake ice dynamics is the dominant control on lake biogeochemistry on centennial time-scales, as revealed by paleoclimate reconstruction from sediment cores. We have already constructed a 400,000 year continuous record, the longest in the terrestrial arctic, and hope to reach back a total of 3.6 million years in future coring efforts. Our hope is that by better understanding the modern processes there, we can better reconstruct its history.

SEA ICE

Interannual variability of landfast ice extent and coastal lead patterns in the Alaskan Arctic

(H. Eicken, A. Mahoney, L. Shapiro, UAF; A. Graves Gaylord, NT)

The sea ice group at the University of Alaska Fairbanks is conducting an extensive study of nearshore sea ice conditions over most of the Alaskan Arctic, focusing on recurrent patterns of leads and the annual evolution of the landfast ice cover over the last 10 years. Through analysis of Advanced Very High Resolution Radiometer (AVHRR) data, the location, extent and orientation of leads within the sea ice and their temporal variability is being quantified at a 1km scale and examined in conjunction with larger scale atmospheric data. RadarSat Synthetic Aperture Radar (SAR) imagery with 100m resolution is being used to delineate the landfast ice extent as it changes through the seasons and between years. These data identify regions and periods of low variability and elucidate the processes responsible stabilizing and destabilizing landfast ice.

On a smaller scale, a land-based side looking radar is monitoring the landfast sea ice near Barrow and storing images every 5 minutes. These data capture the sudden and short-lived events that make up the gradual evolution of the landfast ice over the year. One full year of data has been collected so far, which appears significantly different to what were considered typical years in the 1970s when a similar radar system was operated at Barrow. Initial formation of landfast ice was approximately 3 weeks later and complete break-up was approximately 3 weeks earlier. The intervening period saw more dynamic events within the landfast ice and fewer days with zero ice motion.

Physical-biological control of primary production in Beaufort and Chukchi Sea ice: Its contribution to shelf-basin interactions in the western Arctic
(H. Eicken, R. Gradinger, H. Merkel, UAF)
This interdisciplinary proposal aims to quantify sea ice primary production in the Chukchi and Beaufort seas. The main working hypotheses are that both light and nutrient supply control biomass formation within the sea ice and the project combines field studies, laboratory experimental work and remote sensing observations. This approach is designed to quantify the ice-related biogeochemical processes and to supply a regional, seasonally varying estimate of carbon accumulation in, and release from, the ice cover. In May/June 2002 and 2004, icebreaker cruises into the Chukchi and Beaufort Sea allowed us to collect the first set of field observations as part of this project. One major, somewhat unexpected finding was the wide distribution of sediment-laden ice in the study area. Significant portions (>25 % areal fraction in the central and eastern Chukchi and western Beaufort Sea) of the first-year ice cover were found to contain sediments in multiple layers. Ice core analysis and ancillary information on ice history obtained from buoy data suggests an origin from shallower waters in the Beaufort Sea.

Measurements and improved parameterizations of the thermal conductivity and heat flow through first-year sea ice
(H. Eicken, M. O. Jeffries, L. Backstrom, P. Cotter, UAF)
In collaboration with colleagues from Victoria University Wellington in New Zealand, we have completed a set of field measurements in McMurdo Sound, Antarctica, and Barrow, Alaska, from which the thermal conductivity of first-year sea ice will be derived as a function of ice microstructure, temperature (and temperature gradients), salinity and other environmental parameters. In order to arrive at in-situ, non-destructive estimates of brine volume and salinity, capacitance probes that provide data from the complex permittivity of sea ice at 50 MHz can be derived have been frozen in. We are currently evaluating data from these and additional laboratory experiments to gauge the applicability of this approach. Field work completed in 2002 and 2003 included the retrieval of thermistor and dielectric probes from McMurdo Sound jointly with New Zealand colleagues, along with a detailed field observational program of ice characterization. Ultimately, this work will also help us to identify the factors responsible for the observed contrasts between sea-ice melt processes in the Arctic (top melt with pond development prevails) and Antarctic pack-ice zone (bottom and lateral melt with lack of surface melt ponds prevails).

SNOW

Snow, Weather and Shrubs: Pathways of Change in Arctic Ecosystems
(Matthew Sturm, Charles Racine, CRREL; Glen Liston, CS; Peter Olsson, UAA)
We are studying the biophysical interactions of snow and shrubs. The background
for this work is that there is accumulating evidence that the tundra regions of Alaska and elsewhere in the Arctic are becoming more shrubby. Shrubs cause snow to accumulate in drifts and this in turn creates a warmer soil thermal regime. The warmer winter soils promote more microbial activity which tends to be favorable for shrub growth. Since the snow lasts 8 to 9 months of the year, the impact can be substantial. We have been
making measurements of shrub biometrics, snow conditions in and around shrubs, and soil temperatures in an effort to understand the interactions better.

Over-snow Traverses in NW Alaska
(Matthew Sturm, Jon Holmgren, Tom Douglas, CRREL; Glen Liston, CS)
In 2002 and 2004 we traversed from Nome to Barrow, Alaska, a distance of 1000 km. Detailed measurements of snow depth distribution, snow stratigraphy, and snow chemistry were collected. We are now in the process of analyzing these to determine how the snow distribution is related to synoptic patterns in NW Alaska. In addition, mercury deposition is keyed to the surface winds and proximity to the coast (and a sea ice cover). We have observed mercury concentrations as high as 180 ng/L as far inland as 70 km.

Validation of AMSR-E Polar Ocean Products
(Matthew Sturm, Don Perovich, Jackie Richter-Menge, Jon Holmgren, CRREL; James Maslanik and Julienne Stroeve, UC; John Heinrichs, Ft. Hays State; Don Cavaliri and Thorsten MArkus, NASA-Goddard)
In 2003 we conducted an extensive field campaign combining on-ice measurements, aerial and satellite measurements at Barrow, Alaska and the ice about 150 km north of the Arctic Coast. This work was done in collaboration with the University of Colorado and researchers from the Goddard Space Flight Center. We are in the process of comparing the ground-based measurements of the ice and snow to those from the aircraft. Combining the observations with models, we will the results to suggest improvements in the algorithms for interpreting the AMSR-E satellite products for sea ice and snow. A follow-on campaign in Barrow is planned for 2006.

Arctic Sea Ice Atlas of the Future
(L. Brigham, USARC in collaboration with J. Walsh, UAF)
The Arctic Climate Impact Assessment (ACIA) has evaluated ongoing and projected changes in the Arctic climate system. Changes in sea ice are of major importance within ACIA, not only for the key roles played by sea ice within the climate system, but also because of potentially significant impacts of sea ice changes for marine navigation, offshore development, marine ecosystems, and coastal erosion. Projected changes of Arctic sea ice coverage through the 21st century in ACIA are based on simulations of five different global climate models (GCMs); alternative futures for Arctic sea ice are provided for three ACIA

time periods: 2010-2030, 2040-2060, and 2070-2090. The ACIA analyses of sea ice have provided the foundation for an initial attempt to construct an 'Arctic sea ice atlas of the future.' Unlike earlier sea ice atlases based on the climatological and observed record, we are constructing a new atlas primarily based on GCM projections of Arctic sea ice that will be designed to provide a strategic look at plausible, changing sea ice conditions in the 21st century. The 'atlas' should be considered a first-order, strategic guide to the future of marine access in the Arctic Ocean.

ABBREVIATIONS

AAD:	Australian Antarctic Division
CRREL:	Cold Regions Research and Engineering Lab
CS:	Colorado State
ITLS:	Institute of Low Temperature Science, Japan
KIT:	Kitami Institute of Technology
MDA:	McDonald Detwiler Associates
NPS:	National Park Service
NT:	Nuna Technologies
UAF:	University of Alaska Fairbanks
UAS:	University of Alaska Southeast
UAA:	University of Alaska Anchorage
UB:	University of Brussels
UC:	University of Colorado
UMA:	University of Massachusetts, Amherst
UMW:	University of Montana – Western
USGS:	United States Geological Survey
USARC:	US Arctic Research Council
UW:	University of Washington

INTERNATIONAL GLACIOLOGICAL SOCIETY

ANNUAL GENERAL MEETING 2004

MINUTES OF THE ANNUAL GENERAL MEETING OF THE
INTERNATIONAL GLACIOLOGICAL SOCIETY

29 July 2004, Hoffman Hall, Portland State University, Portland, Oregon, U.S.A.

The President, Dr Elizabeth Morris, was in the Chair.

56 members from 12 countries were present.

1. The Minutes of the last Annual General Meeting, published in the ICE, 2003, No 1132/133, pp. 9–11, were approved on a motion by R. Bindschadler, seconded by K. Hutter and signed by the President.

2. The President gave the following report for 2003–2004:

Ladies and gentlemen,

The role of the IGS is to serve the glaciological community, and in particular the members of the Society, by stimulating and facilitating research. We do this by organising conferences, publishing the *Journal*, *Annals* and *Ice* and supporting other organisations with a glaciological interest by co-sponsorship of activities. It is my duty to report to you, on behalf of Council, on how we have progressed in these tasks over the last year.

You will recall that at the Milan meeting Council decided on a plan of action to modernise our publishing activities. We decided that it was essential that from now on the *Journal* and *Annals* should be available on the Web and that members would appreciate a service which included on-line submission of papers and on-line tracking of their progress through the system. It was also clear that we could improve the general efficiency of the Office by upgrading our infrastructure. So we embarked on a programme of change.

Of course there was a risk involved. As you know, publication of the *Journal* and *Annals* had fallen behind schedule. The first part of the *Journal* for 2003, that is Number 164 of Volume 49, did not appear until November last year. Likewise *Annals* 35, with papers from the Kangerlussuaq conference on Ice Cores and Climate in 2001, did not appear until 2 years later. It could be argued that last year was not the moment to divert staff energies into a modernisation programme. But of course these delays were symptoms of the underlying problem that Council had identified, and that is why we decided to take action swiftly.

I am very pleased to tell you that because of the enthusiasm and dedication of the Office staff we have been able to carry through the modernisation programme without losing any ground on the publication side. In the steady state we need to be able to produce 4 numbers of the *Journal* and 2 volumes of the *Annals* per year. In the year since the last Council meeting we achieved this by the skin of our teeth! We published Numbers 164 and 165 of Volume 49 in November 2003, Number 166 in February this year and Number 167 is in the post. We also published *Annals* 36, containing selected papers from the meeting in Yakutat, Alaska, U.S.A., on Fast Glacier Flow and *Annals* 37, with selected papers from our International Symposium on Physical and Mechanical Processes in Ice in Relation to Glacier and Ice-Sheet Modelling, held in Chamonix.

So now we have our new infrastructure in place and all we need to do is to step up the production rate for a while. If in the next two years we can publish 10 rather than 8 parts of the *Journal*, plus our normal 4 *Annals* volumes, we will be back on course. I think this is quite possible given the new systems we have in place and the extra staff we have employed on a temporary basis.

What progress have we made with the two key objectives for the year?

First of all, I am pleased to tell you that all new publications now appear on the Web as soon as they are shipped to members. IGS members can access the *Journal* online at ingentaselect.com. Volumes of *Annals* are also available on-line, free of charge to those that attended the associated symposium or have subsequently purchased a printed copy. If your library subscribes to the *Annals* and the *Journal* you can also access the publications free of charge using the library access system. We will be putting back issues (from 1999 onwards) on-line next year.

Secondly, we have made considerable progress with a system for on-line submission of papers. As you know an on-line system designed by Doug MacAyeal and Young-Jin Kin has been used for this symposium and has proved most successful. We intend to look carefully at the system this autumn and, if feasible, develop it so that we can have on-line submission available for both the *Journal* and *Annals* from now on.

Over the past year the Office has taken a close look at the production process and has identified several ways in which it can be improved. These include moving to on-screen rather than paper editing, making full use of the powerful features of our typesetting software 3B2, and doing page makeup within the office. The Production Team have also found time to redesign the appearance of our publications to give a fresh modern look, while keeping some of the traditional features such as size and colour of the covers. The first number of the new-look *Journal* will appear this autumn. The first new-look *Annals* will be the proceedings of this

symposium and should appear just over a year from now.

Jo Jacka, the new Chief Editor, and the Publications Committee led by Christina Hulbe have been thinking hard about how we might improve the editorial side of our publication system. Clearly it will help to have a good tracking system so that we can pounce on reviewers or authors who are not responding in a reasonable length of time. Authors can also help by following the instructions for submission; we are going to get tougher with those who don't! But the fundamental need is for knowledgeable, efficient and fair reviewers. W are deeply grateful to all those of you who have undertaken this task in the past and hope that you will continue in the future.

Before I leave the subject of publications let me just mention that three issues of *Ice* were published last year. We have just published a double issue, 132 and 133, that should be on its way to you at this moment. We are planning to make the publication of *Ice* more regular in the future, but this will require a regular flow of national reports. I would like to encourage all National Correspondents to try to ensure that reports on national activities are provided at regular two-year intervals. The name of your National Correspondent is published in *Ice* and on our web-site, so please contact him if you feel too much time has elapsed since the last time your work was profiled.

What have we in store for next year? We have had a successful meeting here in Portland, with over 50 papers submitted for *Annals* 40. We are expecting final versions of all the accepted papers in Cambridge by mid-September, for publication in 2005. Later this year, we will be receiving papers from the International Symposium on Arctic Glaciology for review, editing and subsequent publication in *Annals* 42. 77 papers have been submitted. We are also planning to produce a special volume of selected papers from the ITASE/ISMASS Expert Group meeting in Bremen with Gordon Hamilton as Chief Scientific Editor. This will be *Annals* 41. Jo Jacka is attending the meeting and will ensure that the standards of the IGS are upheld.

In 2005, we will be back to hosting two meetings: an International Symposium on High-Elevation Glaciers and Climate Records, to be held in Lanzhou, China, in September; and an International Symposium on Sea Ice, to be held in Dunedin, New Zealand in December. We already have commitments for 2006, but anyone wanting to propose a meeting in 2007 or later should contact the Secretary General as soon as possible.

In summary, the activity of IGS remains very high. Given the competition from other journals, we do need to work hard in the next couple of years to ensure that the *Journal* and *Annals* are attractive options for publication of glaciological papers, but with your help I think it can be done.

It only remains for me to thank the Secretary General, Magnús Már Magnússon and Linda Gorman our Membership Secretary, who are both here in Portland, for all their hard work and dedication. On behalf of Council I also thank Christine Butler, the Production Manger and her team – Craig Baxter, Ann Leeding and Ken Moxham, plus the newcomers Joan Keating, Alison Woollatt and Liz Pasteur for their enthusiastic response to the challenging work programme we set them last year.

I will now pass you over to the Treasurer who will report on the financial affairs of the Society.

The Secretary General invited members to discuss the President's report.

M. Jeffries discussed the need for the Society to make an effort to bring in more younger members and the need to change the profile of the disciplines of the Society in an effort to increase the membership base. He asked the members present to consider and bring forward ideas of what the Society could do to keep younger members. Often they join as students but drift away as they finish their studies. An idea was put forward to have a competition for the younger attendees at the Societies symposia. This had been successfully done at the 2000 Sea Ice symposium in Fairbanks, Alaska. He suggested that this should be made a regular feature at IGS symposia. K. Hutter reminded members this used to be done, why it was discontinued was unknown to him.

M. Meier proposed, and K. Hutter seconded, that the President's report be accepted. This was carried unanimously.

3. The Treasurer, Dr J.A. Heap, presented the following reported with the audited Financial Statements for the year ended 31 December 2003.

"The state of the Society's finances is best summarized by considering the changes from 31 December 2002 to 31 December 2003 in the following funds, as shown on page 13 of the accounts:

Seligman Fund: increased from £7143 to £7392 as a consequence of accrued interest of £249;

Contingencies Fund: maintained at the same level of £12,684;

Annals Fund: increased from £60,437 to £78,952 as a result of accrued interest and transfer of funds set against expenditure;

Publications Fund: decreased from £26,090 to £25,443, as a consequence expenditures set against sales, royalties and interest accrual;

Future Volumes: decreased from £44,384 to £33,976 reflecting late payments for *Annals* 37;

Accumulated Fund: decreased from £378,532 to £377,445 consequent upon a loss in that account for the year of £1087, this included a profit of £1900 in the value of investments due to an adjustment to market value (page 12, note 7). There was a substantial increase in expenditure due to the increase in staff and the overlap of the outgoing and incoming SG, income from memberships

remained the same and library sales were up by £5903 and that from page charges was up from last year by £16,681 regaining the level as it was in 2002. In 2002 we also received the £75,500 legacy from Loris Seligman, which of course was not repeated in 2003. We also incurred substantial cost in the year due to the purchase of IT equipment and the refurbishing of the IGS office in Cambridge.

In 2003, the Society published 618 pages in the *Journal of Glaciology* and 716 pages in the *Annals of Glaciology*. In 2002 the figures were 642 for the *Journal* and 1056 for the *Annals*, a year with two issues of the *Annals*. Although we had a decrease in published pages we actually had an increase of £16,681 in page-charge revenue, almost half the total revenue received from members' dues. This indicates how dependent we are on fluctuations in this income and how particularly grateful we must be to all those authors who have been both able and willing to support the Society in this way.

May I, again, make a plea to members of the Society to do all in their power to increase the membership. Although we are continuing to receive new members these are now balanced by those retiring or moving to other fields. Our target is a base of at least 1000 and there is still some way to go. Please encourage your colleagues and students to join. I believe they will find it is extremely good value for money. Also, please ensure that libraries in any institutions over which you have influence either maintain their subscriptions or take one out. "

M. Jeffries asked if it would be possible to show graphically the trend in the various funds over the past few years at future AGMs. He also asked if it would be possible to use the Accumulated fund for the further benefit of the members. The Treasurer responded by explaining the reserves policy of the Society as decided by Council. He called for members to consider the policy and convey their opinion to members of the Council. The Society is not just a publishing house but a professional Society that looks after the interests of its members.

M. Brugman expressed her opinion that the Society provides excellent value for money but suggested that the IGS take steps to ensure that its presence on the web is recognised by whoever cites its publication or refers to data presented in articles in the *Journal* or the *Annals*. This should be done in a way that it would be obvious to whoever looked at the citation that the it originally came from an IGS publication. This would raise the awareness of senior management and make it easier for younger scientists to obtain permission and funding to attend the various functions of the Society.

A member asked if it was possible to have a second type of membership that would allow a member to have electronic, not paper copies of the *Journal*.

The President thought that this would be difficult to organize but that Council should discuss the possibility.

M. Jeffries cited a survey done by Arctic Institute of North America on electronic v. paper publication. The survey indicated that members were happy with both types of publication. The survey also indicated that if paper copies were no longer available it would result in a decline in membership.

A suggestion was put forward from the floor that the membership be categorized by area of expertise rather than country of residence. The SG explained that this information was indeed maintained by the Society.

M. Jeffries proposed, and R. Bindschadler seconded, that the Treasurer's report be accepted. This was carried unanimously.

4. Election of auditors for 2003 accounts.

J. Heap proposed, and M. Jeffries seconded, that Messrs Peters Elworthy and Moore of Cambridge be elected auditors for the 2004 accounts. This was carried unanimously.

5. Elections to Council. After circulation to members of the Society of the Council's suggested list of nominees for 2004–2007, no further nominations were received, and the following members were therefore elected unanimously.

Vice-Presidents:	Atsumu Ohmura
Treasurer	John Heap
Elective Members(4):	Olga Solomina
	Patricia Langhorne
	Vincent Morgan
	Frank Pattyn

These appointments were unanimously approved by the AGM.

6. Other business:

M. Jeffries discussed the importance of the Society and the considerable impact it had on research and researchers. The Society needs to uphold this and thus needs to increase its profile, e.g. by using the IGS web site more to reflect the activities undertaken by its members. The IGS constitution does explicitly state that one of its goals is to facilitate and increase the flow of glaciological ideas and information. He also expressed his opinion that the Society should get involved more in educational issues. One of the goals of the Society is to stimulate interest in and encourage research into the scientific and technical problems of snow and ice in all countries. He also raised the question whether the IGS should be involved in "Education Outreach", e.g. on the web.

J. Heap expanded on the fact that it is easy to create a product but quite often difficult to get people to use it. Any such effort must be prepared thoroughly for it to be of use to members and the general public.

T. Youngberg, of the local organizing committee, pointed out that an "Outreach" effort had in fact been made by inviting local organizations to join the meeting

at a special rate and for specific sessions in an effort to increase the profile of glaciology in the local community.

The AGM was adjourned on a motion from R. Bindschadler, seconded by M. Sharp.

A REPORT FROM THE PORTLAND SYMPOSIUM

An International Symposium on Ice and Water Interactions was held from 26 to 30 July 2004 on the Portland State University campus, in Portland, Oregon, USA. The symposium got off to a convivial start with a pre-symposium tour to local craft breweries, including one with a spectacular view the debris-covered Eliot Glacier on the eastern slopes of Mt Hood.

Figure 1 The craft brewery tour was enjoyed by all

The mountain, a glacierized volcano, was the destination for mid-week field trips. One trip made stops to discuss regional geology while the other made a beeline for the mountain and a vigorous hike up to about 8,300 feet and views of other volcanoes in the Cascade chain.

In a step away from tradition but keeping with the informal Portland lifestyle, organizers scheduled the symposium banquet at the end of the field trip. The banquet was held the Edgefield Inn in Troutdale, a country inn that was once the site of the county asylum. Early arrivers to the Inn were able to stroll about its grounds, which include vineyards and a distillery.

Optional social events were offered throughout the week. More than one quarter of the symposium registrants attended a minor-league baseball game (Portland Beavers v. Albuquerque Isotopes).

Additional events included dinner excursions to the Bridgeport Brewery, an important site in Portland's craft-brew revival, and participants still in town Friday evening made their way by public transport to dinner at the Kennedy School, an elementary school turned brewpub, hotel, and movie theatre. Accompanying persons participated in a Willamette Valley winery tour and a tour of Portland by public transportation.

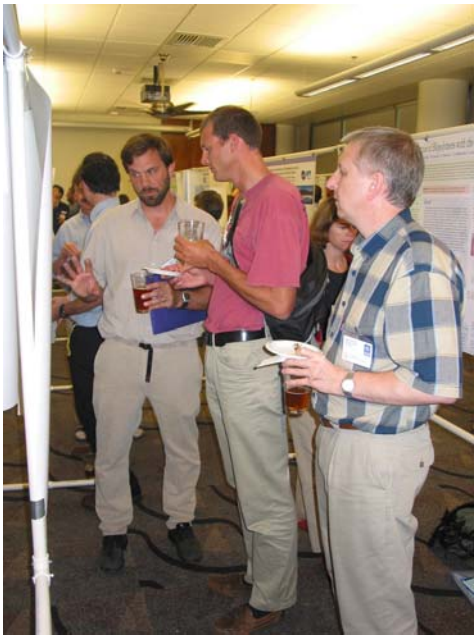


Figure 2 The poster session was a stimulating venue

Tai Chi lessons were offered during each afternoon coffee break. Taught by a member of the Oregon Taoist Society, the lessons were generously underwritten by Doug MacAyeal.

Figure 3 Returning from the Wednesday excursion one of the vehicles needed a tyre replaced

Figure 4 The breaks were used for stimulating discussions and to renew friendships

Society President Liz Morris awarded the Seligman Crystal to Kolumban Hutter during the symposium banquet. Dr. Hutter gave a thought-provoking lecture that combined remembrances of his early days in mathematical glaciology, highlights from his fundamental contributions to the field, and reviews of papers he guesses you have not read. Magnus Magnusson read a touching congratulatory email sent by Dr. Hutter's colleagues and students in Bremerhaven.

Approximately 120 registrants and 12 student volunteers participated in the symposium. The volunteers worked in exchange for admission to the meeting sessions

.

JOURNAL OF GLACIOLOGY

Papers accepted for publication between1 January 2004 and 30 June 2004. The following three papers were either, left out of or merged into one, in the last listing of accepted papers that appeared in ICE 134

Hou Shugui, Jean Jouzel, Jérôme Chappellaz, Qin Dahe, Valérie Masson-Delmotte, Ulrich Von Grafenstein, Amaelle Landais, Nicolas Caillon
Correspondence. Age of Himalayan bottom ice cores

Jerome Weiss
Subcritical crack propagation as a mechanism of crevasse formation and iceberg calving

Shin Sugiyama and G. Hilmar Gudmundsson
Short-term variations in glacier flow controlled by subglacial water pressure at Lauteraargletscher, Bernese Alps, Switzerland

Papers accepted for publication between1 July 2004 and 30 November 2004. Some of these papers have already been published.

Perry Bartelt, Othmar Buser, Martin Kern
Dissipated work, stability and the internal flow structure of granular snow avalanches

I. Kravchenko, D. Besson, J. Meyers
In situ index of refraction measurements of south polar firn with the RICE detector

Mike Craven, Frank Carsey, Alberto Behar, Jaret Matthews, Russell Brand, Alan Elcheikh, Seasne Hall, Adam Treverrow
Borehole imagery of meteoric and marine ice layers in the Amery Ice Shelf

Andrew Fountain, Thomas Neumann, Paul Glenn, Trevor Chinn
Can climate warming induce glacier advance in Taylor Valley, Antarctica

Massimo Frezzotti, Michel Pourchet, Onelio Flora, Stefano Gandolfi, Michel Gay, Stefano Urbini, Christian Vincent, Silvia Becagli, Roberto Gragnani, Marco Proposito, Mirko Severi, Rita Traversi, Roberto Udisti, Michel Fily
Spatial and temporal variability of snow accumulation in east Antarctica from traverse data

Gillet-Chaulet, Gagliardini, Meyssonnier, Montagnat, Castelnau
A user-friendly anisotropic flow law for ice sheet modelling

B. Goodsell, M.J. Hambrey, N.F. Glasser
Debris transport in a temperate valley glacier: Haut Glacier d'Arolla, Vallais, Switzerland

W. Greuell, J. Oerlemans
Validation of AVHRR- and MODIS-derived albedos of snow and ice surfaces by means of helicopter measurements

W. Haeberli, C. Huggel, A Kaab, S. Zgraggen-Oswald
The Kolka-Karmadon rock/ice slide of 20 September 2002 - an extraordinary event of historical dimensions in North Ossetia (Russian Caucasus)

Wilfried J. Hagg, Ludwig N. Braun, Vladimir N. Uvarov, Konstantin G. Makarevich
A comparison of three methods of mass balance determination in the Tuyuksu Glacier Region, Tien Shan

D.H. Elsberg, W.D. Harrison, M.A. Zumberge, J.L. Morack, E.C. Pettit, E.D. Waddington, E. Husmann
Depth- and time-dependent vertical strain rates at Siple Dome, Antarctica

Regine Hock, Bjorn Holmgren

A distributed surface energy balance model for complex topography and its application to Storglaciaren, Sweden

J.V. Johnson, P.R. Prescott and T. Hughes
Relating crevassing to apparent ice stiffness variations in the floating part of Jakobshavns Isbrae

C.L. Hulbe, M.A. Fahnestock
West Antarctic ice stream discharge variability: mechanism, controls, and pattern of grounding line retreat

Matt King
Rigorous GPS data processing strategies for glaciological applications

Anselmo Cagnati, Andrea Crepaz, Giovanni Macelloni, Paolo Pampaloni, Roberto Ranzi, Marco Tedesco, Massimo Tomirotti, Mauro Valt
Study of the snow melting-refreezing cycle using multi-sensor data and snow modelling

Kelly MacGregor, Catherine Riihimaki, Robert Anderson
Spatial and temporal evolution fo rapid basal sliding on Bench Glacier, Alaska

Dirk Notz, J.S. Wettlaufer, M. Grae Worster
A non-destructive method for measuring the salinity and solid fraction of growing sea ice in situ

Frank Pattyn, Bert De Smedt, Roland Souchez
Influence of subglacial Lake Vostok on the regional ice dynamics of the Antarctic ice sheet: a model study

Andrés Rivera, Gino Casassa, Jonathan Bamber and Andreas Kääb
Ice elevation changes of Glaciar Chico, southern Patagonia, using ASTER DEMs, aerial photographs and GPS data

L. Stearns, K. Jezek, C.J. van der Veen
Decadal scale variations in ice flow along Whillans Ice Stream and its tributaries, West Antarctica

Michael R. van den Broeke, Carleen H. Reijmer, Roderik S.W. van de Wal
A study of the surface mass balance in Dronning Maud Land, Antarctica, using automatic weather stations

Karin Weiler, Hubertus Fischer, Diedrich Fritzsche, Urs Ruth, Frank Wilhelms, Heinz Miller
Glaciochemical reconnaissance of a new ice core from Severnaya Zemlya

ANNALS OF GLACIOLOGY, VOLUME 40

The following papers from the International Symposium on Ice and Water interactions: Processes Across the Phase Boundaries held at Portlamd, Oregon, U.S.A 26–30 July 2004 have been accepted for publication in *Annals of Glaciology* Vol. 40, edited by Douglas R. MacAyeal:

R. B. Alley, T.K. Dupont, B.R. Parizek and S. Anandakrishnan
Acess of surface meltwater to beds of subfreezing glaciers: preliminary insights

R.S. Anderson, J. Walder, S.P. Anderson, D. Trabant and A.G. Fountain
The dynamic response of Kennicott Glacier to the Hidden Creek Lake outburst flood

A. Bauder, D.M. Mickelson and S.J. Marshall
Numerical modeling investigations of the subglacial conditions of the southern Laurentide Ice Sheet

G. Diolaiuti, M.P. Kirkbride, C. Smiraglia, D.I. Benn, C. D'Agata and L. Nicholson
Calving processes and lake evolution at Miage Glacier (Mont Blanc, Italian Alps)

C. Bock and H. Eicken
A magnetic resonance study of temperature-dependent microstructural evolution and self-diffusion of water in Arctic first-year sea ice

C.E. Bøggild, R. Forsberg and N. Reeh
Aspects of melt water retention in a transect across the Greenland ice sheet

P. Buzzini, B. Turchetti, G. Diolaiuti, C. D'Agata, A. Martini and C. Smiraglia
Culturable yeasts in melt waters draining from two glaciers in the Italian Alps

E.S. Cutler and B. B. Fitzharris
Surface snow melt at high elevation in the Southern Alps on New Zealand

T.K. Dupont and R.B. Alley
Conditions for the reversal of ice/air surface slope on ice streams and shelves: a model study

A.F. Ebnet, A.G. Fountain and T.H.Nylen
A temperature-index model of stream flow at below freezing temperatures in Taylor Valley, Antarctica

N.S. Eyre, A. Payne, D.J. Baldwin and H. Björnsson
The use of salt injection and conductivity monitoring to infer near margin hydrological conditions on Vestari-Hagafellsjökull, Iceland

U. H. Fischer, A. Braun, A, Bauder and G.E. Flowers
Changes in geometry and subglacial drainage derived from digital elevation models: Unteraargletscher, Switzerland, 1927--1997

A.G. Fountain, R.B. Schlichting, P.Jansson and R.W. Jacobel
Observations of englacial water passages -- a fracture dominated system

T. J. Fudge, J.T. Harper, N.F. Humphrey and W.T. Pfeffer
Timing and pattern of termination of diurnal water pressure fluctuations: Bench Glacier, Alaska

M. Gould and M.O. Jeffries
Temperature variations in lake ice in central Alaska

J.T. Harper, N.F. Humphrey, W.T. Pfeffer, T. Fudge and S.O´Neel
Evolution of subglacial water pressure along a glacier´s length

S. Hashimoto, s. Zhou, M. Nakawo, M. Shimizu and N. Ishikawa
Temporal isotobe changes in wet snow layers in association with mass exchange between snow particles and liquid water in between the particles

I. Howat and S. Tulaczyk
Trends in spring snowpack over a half century of climate warming in California

M.O. Jeffries, K.Morris and C. Duguay
Lake ice growth and decay in central Alaska: observations and computer simulations compared

R. Johnston, A.G. Fountain and T.H. Nylen
The origin of channels on Lower Taylor Glacier, McMurdo Dry Valleys, Antarctica and their implication for water runoff

G. Lappegard and J. Kohler
Determination of basal hydrolic systems based on subglacial high-pressure pump experiments

W.B. Lyons, K.A. Welch, A.E. Carey, D.H. Wall, R.A. Virginia, A.G. Fountain, P.T. Doran, B.M. Csathó and C.M. Tremper
Groundwater Seeps in Taylor Valley Antarctica: An Example of a Subsurface Melt Event

X. Ma, T. Yasunari, T.Ohata and Y. Fukushima
The influence of river ice on spring runoff in the Lena River, Siberia

K.Morris, M.O. Jeffries and C. Duguay
Model simulation of the effects of climate variability and change on lake ice in central Alaska

O.V. Nagornov, Y.V. Konovalov and V. Tehijov
Reconstruction of past temperatiure for arctic glaciers subjected to intese sub-surface melting

J-O. Näslund, P. Jansson, J.L. Fastook, J. Johnson and L. Andersson
Detailed spatially distributed geothermal heat flow data for modeling of basal temperatures and melt water production beneath the Fennoscandian ice sheet

F. Pattyn, M. Nolan, B. Rabus and S. Takahashi
Localized basal motion of a polythermal arctic glacier: McCall Glacier, Alaska, U.S.A.

F. Pattyn, S. De Brabander and A. Huyghe
Basal and thermal control mechanisms of the Ragnhild glaciers, East Antarctica

A. Rempel
Englacial phase changes and intergranular flow above subglacial lakes

M.J. Roberts, F. Pálsson, M.T. Guðmundsson, H. Björnsson and F.S. Tweed
Ice-water interactions during floods from Grænalón glacier-dammed lake, Iceland

G. Royston-Bishop, J.C. Priscu, M. Tranter, B. Christner, M.J. Siegert and V. Lee
Incorporation of particulates into accreted ice above subglacial Lake Vostok, Antarctica

N. Rutter
Impact of subglacial hydrology on the release of water from temporary storage in an Alpine glacier

D. Samyn, A. Svensson, S.J. Fitzimons and R.D. Lorrain
Ice crystal properties of amber ice and strain enhanchement at the base of cold Antarctic glaciers

O. Sergienko and D. MacAyeal
Surface melting on Larsen Ice Shelf, Antarctica

J.M. Shea, F.S. Anslow and S.J. Marshall
Hydrometeorological relationships on the Haig Glacier, Alberta, Canada

S. Sugiyama, R. Naruse and Y.D. Mura'yev
Surface strain anomaly induced by the storage and drainage of englacial water in Koryto Glacier, Kamchatka, Russia

M. Tranter, A.G. Fountain, W.B. Lyons, T.H. Nylen and K.A. Welch
The chemical composition of runoff from Canada Glacier, Antarctica: implications for glacier hydrology during a cool summer

B.H. Vaughn and A.G. Fountain
Stable Isotopes and Electrical Conductivity as Keys to Understanding Water Pathways and Storage in South Cascade Glacier, Washington

J. Walder, D.C. Trabant, M.Cunico, S.P. Anderson, R.S. Anderson, A.G. Fountain and A. Malm
Fault-dominated deformation in an ice dam during annual filling and drainage of a marginal lake

J. Weertman
Slip event propagation direction in transition region of low surface slope

2003 SELIGMAN CRYSTAL AWARD

Kolumban Hutter

28 July 2004, Edgefiled Inn, Troutdale, Oregon U.S.A.

The Society's Council agreed unanimously in 2003 that a Seligman Crystal be awarded to Kolumban Hutter. The Crystal was presented at the International Symposium on Ice and Water Interactions after the following introduction by the IGS President, Liz Morris.

Kolumban, ladies and gentlemen:

Last year, just before the Davos conference, I was storm-bound in the Arctic at the end of a field season on Agassiz Ice Cap. An enigmatic and highly confidential message came through from the Secretary-General telling me that the Awards Committee had made a recommendation for the Seligman Crystal. To my great joy I found that they had chosen Kolumban Hutter, who I knew had made an outstanding contribution in my own field of snow modelling. So without hesitation I sent back the presidential assent and looked forward to the pleasure of hearing all about Kolumban's snow research tonight.

But of course I had just been thinking about one very small part of Koli's extraordinary contribution to glaciology. In fact, as I found out, the citation recommends the award "in recognition of his fundamental contributions to mathematical glaciology that have helped illuminate the coupled physics that controls ice in the environment and underlies a variety of complex phenomena including thermo-mechanical processes in polythermal glaciers, the flow of water through ice-walled conduits and the dynamics of icy mixtures". I revere Koli for his work on "icy mixtures", but others in quite different fields will also claim him as their own.

In fact given the breadth of his achievements we should probably give him a Seligman Crystal "and bar"!

As I am sure most of you know, Koli is an expert in theoretical mechanics. After a diploma in civil engineering he obtained masters and doctoral degrees in theoretical and applied mechanics from Cornell University. Then in 1972 he took up a position as a mathematician in ETH Zurich, not far from some very fine glaciers. Soon his interest had been caught, and in 1978 he attended a conference in Ottawa where he sought out glaciologists like Andrew Fowler and Leslie Morland who were able to speak the same mathematical language. This was the start of an extraordinarily fruitful connection between the applied mechanics and glaciological worlds.

I can vouch for the impact of Koli's influence at that time. From Koli, via Leslie, I learnt about mixture theory, and found a framework for describing the interactions between ice, water, water vapour and air within a snow cover which transformed my ideas about snowmelt modelling. It was certainly the most important and exciting time of my life as a scientist.

It was the same in other fields of glaciology – he showed us that a wealth of general knowledge about how to model mixtures, porous media and granular flows could be applied to snow and ice and thereby inspired a whole generation.

Over the last 25 years Koli's contribution to science has been awe-inspiring. If my calculations are right, he has supervised 41 PhD students and 17scientists have written their Habilitation theses under his aegis. These include for example Heinz Blatter, Nico Gray and Hilmar Gudmundsson. He has written 17 books, including of course the one we all know "Theoretical Glaciology" and has even made a movie - on diffusion of turbulent jets. He has given dozens of lecture courses, organised conferences, edited journals and written a prodigious number of scientific papers. And yet he has found time to give noble support to the glaciological community. I doubt if anyone else has been Editor-in-Chief for 4 volumes of Annals, Scientific Editor for the Journal and Vice-President of the IGS.

Koli, I am going to be brief because you are the best person to describe your scientific work, and we are all looking forward to hearing you. I will merely say - we have a lot to thank you for.

On behalf of the International Glaciological Society I have the honour to present you with The Seligman Crystal.

President, I am proud that you think me worthy of the Seligman Crystal Award and with you the Awards Committee, the Council and the members of the Society. It is wonderful to receive this honour here at the Banquet of the IGS conference on Ice-Water Interactions, surrounded by so many of the friends and colleagues who have made and are still making glaciology a rewarding undertaking. When last year in Davos (Switzerland) Atsumu Ohmura announced at the Society's meeting that the Seligman Crystal award is to be bestowed on me, I was moved and don't recall whether what I said as my immediate response was to the point, but in my subsequent e-mail to *Garry Clarke* I said that I am immodestly proud and this is still so. Thank you all for this outstanding honour.

In December 1972, when returning from Cornell University with a fresh Ph Degree in Theoretical and Applied Mechanics and a dissertation on the thermodynamic foundations of electro-magneto-mechanical interactions, it was my desire to work in a field of theoretical mechanics and thereby prove that at last I had mastered the step from reproductive to creative scientific work. I started working at VAW (Laboratory of Hydraulics, Hydrology and Glaciology), where I had been working as an industrious hydraulic engineer prior to my graduate education in the US, and was assigned by its director, **Prof. D. Vischer**, to strengthen the Glaciology Section on the mathematical side: in his words: to make VAW a centre of mathematical glaciology. With *Peter Kasser* and **Hans Roethlisberger**, its reputation in applied glaciology, especially hydrology and glacier hydraulics was unquestioned and became even stronger with **Almut Iken´s** expertise in the subsequent years. My knowledge of glaciology at the time of 1972/73 was zero, but Hans Roethlisberger was a wonderful guide. The Seegfrörni of the winter 1962/63 and the ice avalanche of the Alalingletscher in 1965, killing 88 people at Mattmark, were still fresh in his mind. In addition, the possible ice avalanche, endangering the village Randa by an ice mass breaking off from Weissgletscher was preoccupying his mind day and night and permeated many of our learning discussions. Tschoon (spelled John) loaded me with tons of papers on glaciology - *Lliboutry, Nye, Kamb, Weertman* and many others - but very early on, he asked me to become proficient in the Seegfrörni problem.

So, already in December 1972, I plunged into the *Mechanics of Floating Ice Plates.* Probably none of us was aware how marvellous this advice was. My PhD advisor, Prof. *Yih-Hsing Pao*, at Cornell University was a student of *Mindlin* and taught us all subtleties of the derivation of plate equations as rationalised by Mindlin in the fifties, and Tschoon had worked at SIPRE, now CRREL (US Army Cold Regions Research and Engineering Laboratory) and knew personally *A. Assur, D. Nevel, G. Frankenstein, W. Weeks* who all were experts in some way or another on fresh water and sea water ice plates. He also knew the Canadian scene, *L. Gold* and *B. Frederking* at the Division of Building Research of the Canadian Research Council in Ottawa. Tschoon established the contacts. So, in a few months only, a zero-knowledge glaciologist became an expert in a subject of engineering ice mechanics.

The question, I was addressing myself, was: *How do the plate bending rigidities depend on the thermal conditions in the atmosphere.* In a quasistatic situation this led to a linear temperature distribution through the plate and therefore to a variation of Young's modulus and Poisson´s ratio through depth. This dependence is more conspicuous for sea ice than for fresh water ice because of the strong temperature dependence of the size of the brine pockets. With both, Young's modulus and Poisson's ratio depending on depth, the derivation of the plate equations is some what more difficult than otherwise. This brought me ahead of others, e.g. *A. Kerr*, a consultant to CRREL at that time at New York University, now at Delaware, who just had finished his consultancy report on the same topic, treating the Poisson ratio as constant. With variable Poisson ratio the membrane and bending effects were genuinely coupled. This was new, and it allowed quantification of the effect of the variation of the Poisson ratio with temperature in quasistatic and wave propagation problems of floating ice plates. The report, published by VAW as Mitteilung No 8 had the title *"On the fundamental equations of floating ice"* received immediate attraction by the specialists mentioned above. It was soon called *The Green Monster*, probably because it used Cartesian tensor notation on 150 pages, at that time still a horror to glaciologists. The report also contained the corresponding viscoelastic theory including a postulate of thermorheologically simple behaviour, to explain the observational fact that in spring fast moving cars on floating ice pates can escape from breaking into the ice but leaving behind a wake of broken ice. The Green Monster appeared in June 1973, but one month earlier I visited CRREL, the Division of Building Research at the Canadian Research Council in Ottawa and the Third Canadian Congress of Applied Mechanics in Montreal to report on its content. At that time, I had already concluded that in fresh water ice, the temperature dependence of Poisson's ratio in floating ice plates could never be experimentally detected. However, Andrew Assur insisted that for sea ice it had to be taken into account. So I went home to work on sea ice plates in the hope to rescue the labour involved in the generation of the Green monster. In essentially two papers

- On the significance of Poisson's ratio for floating sea ice (Mitt No 11 of VAW, 1974) and

- Floating sea ice plates and the significance of Poisson's ratio on brine content, Proc. Royal Soc. London **343A** (1975): 85-108

it was demonstrated that in static loadings and in harmonic waves of a sea ice plate floating on a constant-depth homogeneous water layer the effect of the non-constancy of the Poisson ratio generated deviations from the constant Poisson ratio results that were equally two small to even having a chance to be measurable. So it turned out that the Green Monster was a dead–born child. It was time to direct the activities to different subjects.

Nevertheless, the ice plate research was tremendously beneficial for me and probably others with whom I became friends through this activity. For one, I submitted the sea ice work as a habilitation thesis for the venia legendi in Mechanics at the Technical University of Vienna with the venia legendi granted by the Austrian Ministry of Science and Education in early 1976. Another contact should emerge from this, but this later. The first surprising contact was established at CAMCAM 73, where a young lady graduate student from the Mathematics Department of Simon Frazor University in Burnaby presented a talk on linear viscoelasticity involving aging effects. We were soon deep into subjects of the Green Monster. Three and a half years later **Mary Williams** (today at Memorial University, St. Johns, New Foundland) submitted a dissertation *"The deformation of viscoelastic materials with environment dependent properties (Oct 1975)* giving strong reference to and extending ideas of the Green Monster. Later, in 1978, I had the good fortune to work together with Mary Williams on a climate impact model of ice shelves, an extension of the Weertman solution; published in two papers, glaciologists do not seem to be aware of. A further contact was established – again by chance – when I delivered an upper level course at the Technical University in Vienna in 1997 with the simple title *"Ice Mechanics"*. It was the precursor to my book *Theoretical Glaciology,* published six years later. This course, offered in block form over two weeks, was attended by **Fritz Legerer** an Austrian Professor of Applied Mechanics at the Memorial University, St. Johns, Newfoundland. He invited me to his Department to hold a series of lectures "On the mechanics of floating ice sheets". This I did in 1977, the lecture notes being published in 1978. In that course, there was a young graduate student from the Scott Polar Institute at Cambridge University, *Vernon Squire* who took up the dynamics of floating ice plates as his topic for the Ph. D. dissertation. He worked on wave interactions of ice sheets with the underlying ocean and became a great expert in the topic since then. If I remember correctly, he even identified the trace of an internal wave beneath the Erebus Ice Tongue in Antarctica by measuring the length changes of an inwar wire between two poles on the surface of the ice tongue. He also investigated the wave stress exercised on the ice sheet at the marginal zone and he wrote with others a book on moving loads on ice plates.

In 1975/76 three incidences occurred in my professional career that were of some importance to me:

(i) I was officially taken away by Prof. Vischer from glaciology and asked to form and head a new group on physical limnology.

(ii) J.F. Nye had submitted a paper to the Journal of Glaciology on Jökulhlaups for which Tschoon was referee; this triggered his new interest in glacier conduit hydraulics, and

(iii) I had worked through Tschoon´s pile of relevant glaciological papers and many more.

As for item (i) I was happy to receive an independent responsibility and afraid, I could not finish or even start the research I felt needed to be done in glaciology, but I soon discovered that with 50 – 70 % physical limnology I could satisfy Prof. Vischer´s demands.

The glacier conduit problem was taken up by Tschoon and myself as a research proposal at the Swiss National Science Foundation and **Ueli Spring** was hired to conduct his PhD dissertation on it. Intellectually, this was an extremely challenging problem: Unsteady pipe flow of a fluid in turbulent motion could be studied, in which the growth rate of the size of the cross section of the pipe was determined by (i) the melting rate of the ice at the pipe wall due to the frictional and turbulent heat in the flow and (ii) the closure rate by the state of stress – primarily the overburden pressure of the overlying ice. This must lead to a hydraulic theory in which the thermal energy balance played a significant role. It definitely had its continuum mechanical intricacies and turned out to be very challenging if one tried, as we did, to derive the governing one-dimensional hydraulic equations from the three-dimensional balance laws of mass, momenta and energy by averaging over the temporally evolving cross section. During the roughly three years until *Ueli Spring* graduated, I felt often lonesome and lost with my thoughts, how this upscalling process could consistently be performed. Tschoon could help on the physical side with his tremendous gut felling of what was right, but with equations he was lost as much as I and Ueli were when chewing them to mold them into new equations that approached the Nye equations in the appropriate specialisation except, of course for the few fallacies we sensed but still were unable to rationalize. Ueli´s thesis was very difficult to publish which we did in two papers, namely

- **Spring, U. and Hutter, K.,** Numerical studies of Jökulhlaups, *Cold Regions Science and Technology,* **4**, (1981); 227 – 244
- **Spring, U. and Hutter, K.,** Conduct of a fluid through its solid phase and its application to intraglacial channel flow. *Int. J. Eng. Sci.,* **20** (1982); 327 – 363

The second deals with the foundation from which the first is nourished, but the order of publication indicates that the careful mathematical layout of the basic equations is far less appreciated than the application. The first submission of the "Conduit of a fluid through its solid phase" – paper was to the Royal Society, London, and it is not difficult to surmise where the rejection may have come from. Moreover, when submitting Ueli´s thesis, which I had thoroughly checked before its submission to the Doctor-father, Prof. Vischer, the latter soon sent it back to me stating in one of the marginalia on page 100 "that he would have started the thesis there". Page 100 contains the governing equations in their most simple form – a slight, but important, generalisation of Nye's equations from 1976, and condensing the two to three years sweat of a PhD student's and his supervisor's efforts. It is likely not a great exaggeration, if I state that no glaciologist ever read the "conduit–paper". Such experiences are the applied mathematician's fate, but rather than to mourn I prefer to express my pride that the Glaciological Society is sufficiently tolerant to give a few theoreticians room to prove that they are useful, and even more so to bestow the Seligman Crystal upon one of them – I do not claim to be the right one.

Real progress in the Jökulhlaup work required numerical expertise in nonlinear parabolic–hyperbolic partial differential equations, not my expertise of that time. Paired with other pressing duties I dropped the topic, reluctantly, but definitely. Much later, in the late nineties *Garry Clarke* took it up again, starting with the equations on page 100 of Ueli´s thesis and demonstrating that we were indeed unable to properly account for their numerical stiffness and were therefore not capturing their true properties that excite him so much. With his exceptional enthusiasm he may well have sufficiently motivated me to try a new start after my retirement in 1 ½ years. Indeed there are still a great number of questions, both from an applied glaciology and a theoretical point of view; here are some:

- How does the conduit geometry evolve in time?
- Does an initially curved and twisted intraglacial channel become straight?
- How does the shape of the cross section change with time?
- What is the role of frazil ice? Can water of the conduit freeze or does suspended ice melt?

but I have not asked *Helgi Björnsson* or *Garry Clarke* whether they pass their scrutiny.

Let me return to problem (iii) stated earlier. By 1975/76 I had worked though Tschoon´s pile of relevant glaciological papers and many more, and I believed to know what some of the burning questions were in glaciology. I was particularly attracted by papers dealing with (1) the transfer of basal undulations to the free surface, by (2) the deviations of the basal shear stress from what I call the *"First Commandment of Glaciology"*, namely that "shear stress at a certain depth equals the weight of the ice column above it times surface slope", and (3) by the kinematic wave theory of Lighthill & Whitham as applied in its linearized version to glaciology by Nye. However, I was equally dissatisfied with what *B. Budd, J. Nye* and *I. Collins* and a few others were doing. The basal shear stress was given in terms of depth integrals of other stress components. The differences of the papers layed essentially in the treatment of the local geometry, and the formulas were identical modulo ad hoc approximations and transformations, but the formulas were hardly constructive. There was no rule which one could follow to systematically improve the parallel-sided slab solution. An exception to this are the four papers by *K. Echelmeyer and B. Kamb* derived from Keith´s thesis.

There was nevertheless a lot to be learnt from such papers. *First*, scrutiny showed that the stresses of the parallel sided slab solution depended on the constitutive assumptions only to the extent that stretching and stress deviator were collinear, but no inferences from a flow law were needed. Only the corrections of these depended on explicit material postulates such as Glen´s flow law. *Second*, the corrections to the first commandment in the Budd-Nye-Collins papers all needed explicit material knowledge, but to call their contribution "longitudinal stress effects" was only telling part of the story. This denotation was likely motivated by Nye´s 1957 paper on extending and compressing flow, attributing the effect of accumulation and ablation to these normal stress effects; shear stresses may in general, equally contribute. Incidentally, this paper pointed even at a possible hidden inconsistency: indeed, its fundamental assumptions are that the strain rates, and consequently the velocity, depend on the downhill coordinate, whilst the stresses do not. This meant a direct clash with the classical *Weertman, Lliboutry, Kamb, Morland, Fowler, Iken, Schweizer* etc. viscous sliding law. No-one seemed to be bothered. However, and *third*, when constructing the temperature profile to the thermo-mechanical version of Nye´s extending and compressing flow problem, as done by Llibroutry (and Weertman), the temperature profile shows all qualitative features of bore hole measured temperature profiles in Greenland and Antarctica, except the inversion close to the surface.

The vertical stretching due to the accumulation–ablation rate is the cause for it. Therefore, by successive elimination, the temperature inversion close to the ice sheet surface was likely due to time–dependent effects and longitudinal stretchings that differ from the vertical ones, as made evident already by *G. Robin*.

All this contains physically the correct ingredients but is mathematically unsatisfactory. Rectification was brought by scalings, non-dimensionalising the equations, identifying a typical small parameter and then using perturbation methods. I was using two types of scalings, one appropriate to answer questions how peculiar basal boundary behaviour is transferred to the free surface with undulations having any length scale, but amplitudes small in comparison to the glacier depth. Non-dimensionalising the equations involved no stretching of the coordinates. It answered the questions, probably asked first by *B. Budd*, which basal protuberance wave length would best be transferred to the surface and how one could infer knowledge of basal topography by e.g. Fourier-transforming surface topography. The second scaling made use of a stretching of the coordinates and assumed that the waves would be long in comparison to the glacier depth. The three papers are:

- **Hutter, K.** Time dependent surface elevation of an ice slope. *J. Glaciology*, **25** (1980): 247 – 266
- **Hutter, K.** The effect of longitudinal strain on the shear stress of an ice sheet – In defense of using stretched coordinates. *I. Glaciology,* **27** (1981): 39 – 59
- **Hutter, K.**, **Legerer, F. and Spring, U.** First order stresses and deformations in glaciers and ice sheets. *J. Glaciology*, **27** (1981): 227 – 270

and, restricted to two spatial dimensions, they were able to rectify all the mathematical inconsistencies mentioned above. I faced extreme difficulties to publish these papers in the J. of Glaciology. They were ready for publication in early 1979, I worked through revisions of them in autumn, winter 1979 and again in 1980. The addendum "In defense of using stretched coordinates" was added to the second paper, because I had to defend the stretched coordinates – incidentally routinely used in fluid mechanics – against a stubborn referee, and I wanted to provide the reader with some indirect information of it. In addition, in one of the papers I had a statement stating the inconsistency of Nye´s extending-compressing solution with a viscous sliding law, mentioned above, but I was equally stubborn not to drop the sentence despite *John Glen´s* polite, polished and multivalued sentences indicating it. Later when I became Scientific Editor of the Journal of Glaciology and Chief-Editor of Continuum Mechanics and Thermodynamics, this experience was of great help for me, and I am very thankful to John for the experience.

Much of the above papers were under way, when I attended in August 1978 the IGS conference on *Dynamics of Large Ice Masses* in Ottawa (my first IGS conference) where I met for the first time **L.W. Morland** and *A. Fowler*. I presented talks on the second and third topic and discovered that both Leslie and Andrew applied stretched coordinate scalings to very similar problems, and Lliboutry essentially outlined the second problem. This was a strong wind of competition and it hit me like a sonic boom, but the last 26 years have proved the relations to be constructive, and Leslie and I became close friends.

It is probably fair to say that it was in Ottawa where the *Shallow Ice Approximation* (SIA) was born, and if any one deserves the credit for it, then it is all three. The stretched coordinates and the asymptotics we were using, were all aiming at the same thing, namely to set in evidence an aspect ratio of depth to length scales of a physical variable, in Andrew and my own cases, a geometric measure, in Leslie´s method a stress measure. When finalising my book on *Theoretical Glaciology,* I went through the labor to show by simple transformation that Leslie´s and my scalings were exactly the same, but I kept my version and only switched to Leslie´s variables in the 1986 papers with **S. Yakowitz** and **F. Szidarovsky**, in which very early thermo-mechanically coupled numerical two-dimensional ice sheets were treated.

The two-dimensional regular perturbation method of the Hutter-Legerer-Spring paper was similarly applied by *I. Whillans* and extended to flows over three-dimensional protuberances by *N. Reeh,* but only for a linearly viscous fluid. In a series of similar papers forming his habilitation thesis, *Hilmar Gudmudsson* is analysing, among other things, how bottom features are transmitted to the free surface. This is conceptually a tricky problem, because it bears the potential of an inverse problem; these problems are prone of incorrect inferences. For instance, when deducing properties of the basal velocities from surface information by integrating to depth, one can not avoid the trouble to formulate a postulate about that slip-boundary condition which one believes to be correct and on which the velocities eventually depend. Unlike some others, Hilmar answers these questions correctly.

The perturbation methods used by Andrew, Leslie, myself and others exhibit, unfortunately, their idiosyncrasies. Two sources are responsible for the mathematical singularities: on the one hand the stretching of the coordinates, on the other hand the infinite viscosity of Glen´s flow law at zero stretching. Morland and I (and others) regularize the latter by introducing a *finite viscosity law*. In the weakly non-linear surface wave problem and the problem of the

transfer of bottom protuberances to the free surface the stress-deformation singularity arises at the free surface and at the snout. When using Glen´s flow law *Johnson and Mc Meeking* proved that the surface boundary layer is of the order of the n-th root of their perturbation parameter (the protuberance amplitude), n being the power law exponent in Glen´s flow law. The corrections account exactly for the "longitudinal stress effects" and, if regularised, the perturbation expansion must be pushed far enough that they are included. This has been done by *T. Johannesson* in his 1992 dissertation and the published work emerging from it.

The SIA is the zeroth order solution of a singularly perturbed thermo-mechanically coupled ice flow problem that, obviously, cannot hold close to the ice divide and the margins. A. Fowler looked more deeply into the snouts, especially when they move. They are so-called passive boundary layers and do not influence the far field. On the other hand, ice divides need special attention despite the fact that ice sheet modellers smear over the singularity, where again longitudinal stress effects would come to bear (**Calov**, **Greve**, *Herterich, Huybrechts, Ritz* and many others). The difficulties with ice divides are already transpiring in the 1986-paper by Hutter, *Yakowitz, Szidarovsky*. We looked at the problem in more detail in the 1989 Annals paper, but it was rather misty. The first correct solution was given by **A. Wilchinsky** and *V. Chugunov* by constructing the inner solution, valid in the vicinity of the summit that matched the outer SIA-Solution. A true singularity at a summit, however, only arises, when the no-slip boundary condition applies there at the base *and* Glen´s flow law is used; so, formally, regularity can be re-established by introducing a finite viscosity law and pushing the perturbation method to the order which includes the "longitudinal stress effects". This was done by **A. Mangeney** in her 1996 dissertation and then more carefully again by **D. Baral** et al (2000). This led to the so-called second order shallow ice approximation (SOSIA) which today probably no longer bears any advantages over the solution of the full Stokes problem.

I should not end this paragraph without mentioning **G. Boulton** and **R. Hindmarsh.** I met both of them 1980 at the University of East Anglia in Norwich. Leslie brought me to Norwich as external examiner of his PhD student *I. Johnson* with his ice sheet work and Geoffrey wanted us to numerically model the Fenno-Scandinavian ice sheet. This led to a great collaboration of all of us and, in particular, with Richard, today probably the best expert of the mathematics of ice sheet modelling.

The occupation with glacier and ice sheet flows turned out to be a happy and never ending source of ideas. Apart from what has already been mentioned, at least three other activities ought to be mentioned:

- Dynamics of polythermal ice
- Asymptotic analysis for ice shelves and the development of the shallow shelf approximation,
- Development of anisotropic flow laws for the ice in polar ice sheets.

The *first* concerns the derivation of a mathematical description for the flow and thermal response of polythermal ice masses. Fowler & Larson in 1978/80 published the first model in which the ice interacted with the water. The evolution of the moisture content was described by a diffusion equation (much like temperature in the heat equation), but the diffusivity was eventually dropped. This, and an awkward Stefan condition at the cold-temperate transition surface challenged me to present my own theory,

> **Hutter, K.**, A mathematical model of polythermal glaciers and ice sheets.
> Geophys. Astrophys. Fluid Dyn. **21** (1982): 201-224.

I, later took it up again with **H. Blatter,** and it was perfected by **R. Greve** in his PhD dissertation. In any case, Ralf was a tremendous fortune for me: He applied the SIA to polythermal ice, which is easy, and wrote the software SICOPOLIS for it, which is difficult, that is now used by many numerical modellers, and he helped me supervising the PhD students. The diffusive moisture model, with its diffusive physics only accounting for in the Stefan condition, may be adequate in cold ice sheets with temperate patches at the base. It has tremendous advantages in numerical implementations, because the SIA may easily be imposed on it. In a paper with **H. Blatter** and **M. Funk** it was applied to an artic glacier in Axel Heiberg. However, for mostly temperate glaciers it is too simple. Thus, Fowler (1984), Morland (1992) and I (1993), we all proposed new models for the water flow through a porous ice matrix that are using concepts of soil mechanics and Darcy´s flow law. None of these models has, however, been used under realistic conditions, such as e.g. the SIA.

The second of the above problems deals with ice shelves; they constitute the other type of large shallow ice masses, but the scalings, first presented by L. W. Morland, are different from those for ice sheets. A systematic treatment accounting for meteoric and marine ice and considering melting, freezing and accretion at the ice-ocean interface and employing perturbation theory was given by **Weis,** Greve & Hutter (1999). In this restriction to zeroth order – this is the so-called shallow shelf approximation (SSA) – floating ice shelves are thermo-mechanically coupled slack fluid membranes. At higher order, bending effects come into play, and the second order shallow shelf approximation (SOSSA) discloses that these are operative in boundary regions along the grounding lines and close to other

margins along the coast and at boundaries of ice rises. The results are contained in a still unpublished PhD thesis by **D. Baral,** and **A. Humbert** shows in her unfinished PhD dissertation that observations support this interpretation for the Ross Ice Shelf.

This results points at an interesting parallel: I started my ice research more than 30 years ago with ice plates, and the dependence of Poisson's ratio on temperature implied a coupling of bending by membrane effects; and now the SOSSA tells us a similar behaviour, that membrane effects of ice shelves are influenced at boundaries by bending effects. The first is a regular, the second a singular perturbation problem. The first is conceptually a thick plate with small surface tension the second a thin film with large surface tension but small bending rigidity.

Third, the inadequacy of Glen's flow law was transpired already in connection with the SIA: the SIA fails close to the ice divide because of its infinite viscosity at zero stretching. Regularisation is easily possible by adding a Newtonian contribution to the flow law. On the other hand, climate modellers involved with the flow of large ice sheets through ice ages continue to use Glen's flow law, but incorporate in it an *enhancement factor* to account for the variable softness of the polar ice due to impurities, different orientations of the crystallites, different sizes of the grains, grain growth, polygonisation, recrystallisation, nucleation, annealing, dislocation movement, and so forth. That this is inadequate is known since almost 20 years. At the IGS-conference 1995 in Chamonix **B. Svendsen** and I presented a first attempt to introduce a second order anisotropy tensor into the stress-stretching relationship that was generalising Glen's flow law, and added an orientation distribution function for the evolution of the fabric. This was further perfected by work with **G. Gödert, D. Ktitarev, S. Faria, G. Kremer,** and **L. Placidi** who in his thesis accounts for. the evolution of texture and fabric. I learned tremendously from the direct involvement with *L. W. Morland, P. Duval, J. Meyssonnier, O. Gagliardini* within a project of the European Science Foundation and later, but should not forget the specialists worldwide such as *R. Alley, Azuma, Goto-Azuma, K. van de Veen, I. Whillans, Thorsteinssons, J. Jacka.* The last word is still not said here, and we are still far away from implementing grain size dependent anisotropic flow laws into software of global ice sheet models.

The best thing I probably made in my professional career, when moving in 1987 from VAW at ETH Zürich to the Department of Mechanics at TU Darmstadt was to keep Glaciology as part of my research activity and still maintain the course assignment "Theoretical Glaciology" in the Department of Earth Science at ETH, Zürich. *M. Funk, M. Truffer, H. Gudmundsson, A. Abe-Ouchi, A. Bauder, M. Lüthi,* the *Vieli* family and A. Pralong are just a few of them who still stay in glaciology as their active field of research. Association with these students, with the Institute of Climatology and with the Glaciology Section of VAW helped me to stay a breath with the applied side of glacier and ice sheet dynamics; I acknowledge tremendous interactions with *A. Ohmura* on climatology, *H. Röthlisberger, M. Funk, A. Iken* on glacier flow and *H. Blatter* on both. Darmstadt allowed me to feel more freely in theoretical research; the students and post docs involved in ice research were mentioned. I had many more students and post docs also in my other fields of specialisation, not mentioned, from whom I learned tremendously and who also helped the Darmstadt unit on *Geophysical and Environmental Mechanics* to flourish. Without all of them I would have achieved far less than I did.

I also owe a wealth of gratitude to my family, my wife Barbara and Bettina & Katja, who cooperated to live without me, and Barbara still maintains to live with me. Neither do I wish to finish without mentioning the late *Hilda Richardson, Simon* and *Margreth Ommaney* with whom I had and still have outstanding relationships. They made me – the crazy theoretician, as some say and still believe – feel at home in the IGS, and I conjecture, that they all played their role that I am standing here now. Thank you all.

CORRECTIONS AND ERRATA

In *Journal of Glaciology*, vol. 49, issue 167, the reference list of the correspondence by Hannah and others had some serious mistakes. We would like to publish the corrected list here in ICE for the benefit of our members. We will also be publishing an Erratum in the next issue of the *Journal*.

Balnois, E., K.J. Wilkinson, J.R. Lead and J. Buffle. 1999. Atomic force microscopy of human substances: effects of pH and ionic strength. *Environ. Sci. and Technol.,* **33**(21), 3911–3917. (doi:10.1021/es990365n.)

Buffle, J., K.J. Wilkinson, S. Stoll, M. Filella and J. Zhang. 1998. A generalized description of aquatic colloidal interactions: the three colloidal component approach. *Environ. Sci. and Technol.,* **32**(19), 2887–2899. (doi:10.1021/es980217h.)

Carvalho, R.A., M.C. Benfield and P.H. Santschi. 1999. Comparative bioaccumulation studies of colloidally complex and free ionic heavy metals in juvenile brown shrimp *Penaeus aztecus* (Crustacea: Decapoda: Penaeidae). *Limnol. Oceanogr.,* **44**(2), 403–414.

Fenn, C.R. and B. Gomez. 1989. Particle size analysis of the sediment suspended in a proglacial stream: Glacier de Tsidjiore Nouve, Switzerland. *Hydrol. Processes,* **3**, 123–135.

Gurnell, A.M., D. Hannah and D. Lawler. 1996. Suspended sediment yield from glacier basins. *IAHS Publication 236,* (Symposium at Exeter 1996 --- *Erosion and Sediment Yield: Global and Regional Perspectives*), 97–104.

Hannah, D.M., B.P.G. Smith, A.M. Gurnell and G.R. McGregor. 2000. An approach to hydrograph classification. *Hydrol. Processes,* **14**(2), 317–338.

Lead, J.R., W. Davison, J. Hamilton-Taylor and J. Buffle. 1997. Characterising colloidal material in natural waters. *Aquat. Geochem.,* **3**(3), 219–232.

Lead, J.R., J. Hamilton-Taylor, W. Davison and M. Harper. 1999. Trace metal sorption by natural particles and coarse colloids. *Geochim. Cosmochim. Acta,* **63**(11–12), 1661–1670.

Muirhead, D. and J.R. Lead. 2003. Measurement of the size and structure of natural aquatic colloids in an urbanized watershed by atomic force microscopy. *Hydrobiologia,* **494**(1-3), 65–69.

Richards, G. and R.D. Moore. 2003. Suspended sediment dynamics in a steep, glacier-fed mountain stream, Place Creek, Canada. *Hydrol. Processes,* **17**(9), 1733–1753.

Santschi, P.H., E. Balnois, K.J. Wilkinson, J. Zhang and J. Buffle. 1998. Fibrillar polysaccharides in marine macromolecular organic matter as imaged by atomic force microscopy and transmission electron microscopy. *Limnol. Oceanogr.,* **43**(5), 896–908.

Smith, B.P.G., D.M. Hannah, A.M. Gurnell and G.E. Petts. 2001. A hydrogeomorphological context for ecological research on alpine glacial rivers. *Freshwater Biol.,* **46**(12), 1579–1596.

Tipping, E., C. Woof and D. Cooke. 1981. Iron oxide in a seasonally anoxic lake. *Geochim. Cosmochim. Acta,* **45**, 1411–1419.

Woodward, J.C., P.R. Porter, A.T. Lowe, D.E. Walling and A.J. Evans. 2002. Composite suspended sediment particles and flocculation in glacial meltwaters: preliminary evidence from Alpine and Himalayan basins. *Hydrol. Processes,* **16**(9), 1735–1744. (doi:10.1002/hyp.360.)

INTERNATIONAL SYMPOSIUM ON HIGH-ELEVATION GLACIERS AND CLIMATE RECORDS

Lanzhou, China
5–9 September, 2005

CO-SPONSORED BY
National Natural Science Foundation of China
Chinese Academy of Sciences
China Meteorological Administration

SECOND CIRCULAR

The International Glaciological Society will hold an International Symposium on High-Elevation Glaciers And Climate Records in 2005. The symposium will be held in Lanzhou, China, with registration on 4 September and sessions from 5–9 September 2005.

SYMPOSIUM ORGANIZATION

Magnús Már Magnússon (International Glaciological Society)

LOCAL ARRANGEMENTS COMMITTEE

Qin Dahe (Chairman), Shi Yafeng, Li Jijun, Yao Tandong, Ren Jiawen

SCIENCE STEERING AND EDITORIAL COMMITTEE

Lonnie Thompson and Ellen Mosley-Thompson (co Chief Editors), Vladimir Mikhalenko, Margit Schwikowski, Valdimir Aizen, Ren Jiawen , Michael Bender, Lewis Owen, L. DeWayne Cecil, Wang Ninglian, Raymond Bradley, Tracy A. Mashiotta, Mary E. Davis, Henry Brecher, Mathias Vuille

INFORMATION ABOUT THE SYMPOSIUM MAY BE OBTAINED FROM:

International Glaciological Society, Scott Polar Research Institute,
Lensfield Rd, Cambridge CB2 1ER, UK.
Tel: +[44] (0)1223 355 974 Fax: +[44] (0)1223 354 931
Email: igsoc@igsoc.org
Web: http://www.igsoc.org/symposia/ http://www.itpcas.ac.cn/igschina

PARTICIPATION

This circular includes forms for registration and instructions for arranging accommodation. These can also be found on the symposium website. The registration form and accompanying payment should be returned by 11 June 2005. There is a surcharge for late registration. The participants registration fee includes organization costs, a set of abstracts, the icebreaker function, coffee breaks, the banquet, the mid-week excursion and a copy of the *Annals of Glaciology*.

Registration fees	**UK£**
Participant (IGS member)	270
Participant (not IGS member)	320
Student or retired IGS member	100
Accompanying person over 18	80
Late registration surcharge (after 11 June 05)	50
Post-symposium tour (estimate)	250

Registration refunds will be made according to date of notification. Cancellations made before 18 July 2005 will receive a full refund. Cancellations between 19 July and 20 August 2005 will be eligible for a partial refund. After 20 August it may not be possible to make any refund.

THEME

High-elevation glaciers are widely distributed in the world, not only at low and middle latitudes but also in the polar regions. Even on the ice sheets in polar regions, some ice cores have been drilled at quite high elevation. Snow cover is another important process in high-elevation regions. Glacial variations, snow cover and glacial records are very important in the study of climatic changes, water resources and disasters in high-elevation regions. This symposium will focus on glacier variations, processes and their consequences, snow cover and related processes, and climate records from glaciers.

TOPICS

The suggested topics include:

1. Climate and environment records from ice cores
2. Glacier variations
3. Glacial deposits and climate change
4. Interaction between snow/ice and atmosphere
5. Glacier physics
6. Glacio-hydrological processes
7. Glacier mass balance and modelling
8. Snow cover and related processes

SESSIONS AND POSTERS

Oral presentations will be held on four full days and one half-day. There will also be a poster session. The size of poster presentations is A0 (90cm x 120cm)

PUBLICATION

Selected papers from the symposium will be published by the Society in the *Annals of Glaciology*. All papers (including those based on posters) will be refereed and edited according to the Society's regular standards before being accepted for publication.

PAPERS

(1) SUBMISSION OF ABSTRACTS

Participants who want to contribute to the Symposium should submit an abstract of their proposed presentation. This abstract must contain sufficient detail for its scientific merit and relevance to the symposium theme to be judged by the Editorial Board. A web site will be available at the beginning of 2005 where authors can upload their abstract and all the relevant contact information. The abstract itself should not exceed 400 words. References and illustrations should not be included.

You will be required to enter all your details with the submission and in particular to state whether you intend to submit a paper for publication in the *Annals of Glaciology***.** We will only solicit referees for abstracts that have explicitly stated that they intend to submit a paper. Referees are a scarce commodity and we do not want to trouble them unnecessarily.

Those unable to submit their abstract via the internet can submit electronic files on a CD or diskette to the IGS office where a member of staff will upload them onto the web site.

LAST DATE FOR RECEIPT OF ABSTRACTS: 28 FEBRUARY 2005

Final versions of papers accepted for publication should not exceed five printed pages in the *Annals of Glaciology.* Extra pages will be charged at the rate of UK £90 per page. Papers with colour figures will accrue page charges, at the colour rate of UK £150 for ALL pages. Honouring page charges (also £90 per page) for the first five pages is encouraged.

(2) SELECTION OF ABSTRACTS

Each abstract will be assessed on its scientific quality and relevance to the Symposium theme. Authors whose abstracts are accepted will be invited to make either an oral or poster presentation at the Symposium and to submit a paper for publication in the *Annals of Glaciology* (included in the ISI Science Citation Index®). First or corresponding authors will be advised by 2 May 2005 of the acceptance or otherwise; other authors will not be informed separately. Authors who have not received notification by that date should contact the IGS office in Cambridge in case their abstract was not received. Acceptance of an abstract means that the paper based on it should be submitted to the *Annals of Glaciology* and not to another publication. Note: abstracts alone will not be published in the *Annals of Glaciology*.

(3) DISTRIBUTION OF ABSTRACTS

A set of the accepted abstracts will be provided to participants upon registration on 4 September 2005.

(4) SUBMISSION OF PAPERS AND PUBLICATION

Manuscripts should be submitted electronically onto the IGS Symposium website (also linked via the Symposium website,

www.itpcas.ac.cn/igschina). Papers should be prepared in accordance with the instructions sent to authors with the abstract acceptance notification and must be submitted as pdf's (portable document format). Authors who submit in other electronic formats will be asked to re-submit as pdf. Authors who are unable to upload their paper onto the IGS web site can submit a copy of their manuscript, doubled-spaced with wide margins, on a CD or diskette, to the Secretary General, International Glaciological Society, Scott Polar Research Institute, Lensfield Road, Cambridge CB2 1ER, U.K. Their manuscripts will be uploaded onto the Symposium website by IGS staff. All manuscripts should be submitted by **4 July 2005**. ALL AUTHORS ARE EXPECTED TO ADHERE TO THIS DEADLINE. Papers will be refereed according to the usual standards of the Society before being accepted for publication. Final papers, based on presentations 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. 43). Final, revised versions of papers, CD´s and original art work must be submitted by **17 October 2005**. Timely publication of the *Annals of Glaciology* will depend upon strict adherence to deadlines.

LAST DATE FOR RECEIPT OF PAPERS: 4 July 2005

LAST DATE FOR RECEIPT OF REVISED PAPERS: 17 October 2005

EXCURSIONS

MID–WEEK FIELD TRIP:
A half day (afternoon) will be spent sightseeing on Nanshan Mountain, a mountain to the south of Lanzhou city.
BANQUET to be held on Thursday evening in the Ningwozhuang Hotel.

POST-SYMPOSIUM TOUR:
The route is from Lanzhou to Dunhuang (the most famous site for ancient cave painting art) in the vGobi Desert via several sightseeing sites along the route, such as a mountain glacier, Great Wall etc., and then back to Lanzhou. Five days are needed.
Approximate cost is £135 per person, including breakfasts and lunches and travel. Hotel and park tickets are not included.

ACCOMPANYING PERSONS PROGRAMME

The accompanying persons registration fee includes the icebreaker, the banquet, the mid-week field trip and the services of the accompanying persons coordinator. The coordinator will be able to assist accompanying persons to make further arrangements through the local tourist office.

LOCATION AND WEATHER

Lanzhou, located in central China, is the capital of the Gansu province and has a population of about 5,000,000. The Yellow River flows across the city and there is the oldest bridge on the Yellow River in the city. The Nanshan Mount and Beishan Mountain are located in the south and north of the city. Lanzhou has a rather dry climate and the weather in early September is comfortable. You may need a jacket, sun block, a sun hat and some comfortable walking shoes for the excursion. Further information will be available at http://www.itpcas.ac.cn/igschina.

TRAVEL AND ACCOMMODATION

Information will be available at http://www.itpcas.ac.cn/igschina.

Officially issued invitation letters will be sent to all the registered participants by the local organizing committee. Further information will be available at http://www.itpcas.ac.cn/igschina.

Please note that China has strict laws regarding entering the country with agricultural products. Visitors will be asked to declare food and animal products.

IMPORTANT DATES

Abstracts due	28 Feb. 05
Notification of acceptance	2 May 05
Pre-registration deadline	11 June 05
Papers due	4 July 05
Deadline for full refund	18 July 05
Deadline for partial refund	20 August 05
Registration	4 Sept. 05
Conference starts	5 Sept. 05
Post-symposium tour starts	10 Sept. 05
Final revised papers due	17 Oct. 05

INTERNATIONAL GLACIOLOGICAL SOCIETY
SYMPOSIUM ON HIGH-ELEVATION GLACIERS AND CLIMATE RECORDS
Lanzhou, China, 5–9 September 2005

REGISTRATION FORM

Family Name: _____

First Name: _____

Address: _____

_____

Tel: _____ Fax: _____ E-mail: _____

Accompanied by:

Name: _____ Age (if under 21) ____

Name: _____ Age (if under 21) ____

REGISTRATION FEES	£	£
Participant (member of the IGS)	270	___
Participant (not a member of the IGS)	320	___
Student or retired IGS member	100	___
Accompanying person aged 21 or over	80	___
Late registration surcharge (after 24 April)	50	___
Post-symposium tour (estimate)	135	___
TOTAL REGISTRATION FEES		____

ACCOMMODATION

The symposium will be held in Ningwozhuang Hotel. It is a three star hotel and the most famous in Lanzhou. It is located in a garden and has three buildings with different price levels.
In VIP building, two types of rooms: twin bed room – 60 USD; set of two rooms – 110 USD
In North building: twin bed room – 40 USD; set of two rooms – 100 USD
In South building: twin bed room – 30 USD; set of two rooms – 80 USD
These are special discount prices for the symposium guests.

Payment of registration fee, in pounds sterling drawn on a UK bank, may be made by cheque to:

INTERNATIONAL GLACIOLOGICAL SOCIETY

or by Access/Eurocard/MasterCard or VISA/Delta

Card No.																Expires				

Security | | | | code (the last three digits on the signature strip on the back of the card)

Name of card holder as shown on card:_____

Signature: _____

Payment may also be made to: National Westminster Bank plc, Sort code: 52-10-46. Account no: 54770084, 56 St. Andrew's Street, Cambridge CB2 3DA, UK

ALL BANK OR TRANSFER CHARGES MUST BE INCLUDED

Mail or fax to: Secretary General, International Glaciological Society, Scott Polar Research Institute, Lensfield Road, Cambridge CB2 1ER, UK

If payment made after 11 June 2005, add £50 for each person

PLEASE RETURN AS SOON AS POSSIBLE TO: Secretary General, Scott Polar Research Institute, Lensfield Road, Cambridge, CB2 1ER, UK Tel: +44 (0)1223 355 974 Fax: +44 (0)1223 354 931 E-mail: igsoc@igsoc.org

INTERNATIONAL SYMPOSIUM ON SEA ICE

Dunedin, New Zealand
5–9 December 2005

CO-SPONSORED BY
University of Otago
Royal Society of New Zealand
ISOTRACE Ltd
National Institute of Water and Atmospheric Research
Department of Conservation

SECOND CIRCULAR

The International Glaciological Society will hold an International Symposium on Sea Ice in 2005. The symposium will be held in Dunedin, New Zealand, with registration on 4 December and sessions from 5–9 December 2005.

SYMPOSIUM ORGANIZATION

Magnús Már Magnússon (International Glaciological Society)

LOCAL ARRANGEMENTS COMMITTEE

Vernon Squire and Pat Langhorne (co-Chairs), Sean Fitzsimons, Russell Frew, Blair Fitzharris, Harry Keys, Tim Haskell, Mike Williams, Trish Knox, Sandy Wilson, Jo Fielding

SCIENCE STEERING AND EDITORIAL COMMITTEE

Pat Langhorne and Vernon Squire (Chief scientific editors), Martin O. Jeffries, Ian Allison, Gerhard Dieckmann, Hajo Eicken, Jean-Louis Tison, Tony Worby, Enrico Zambianchi, Christian H. Fritsen, Matti Lepparanta, Donald Perovich, Kunio Shirasawa, Stan Jacobs, Mike Williams, Adrian Jenkins, Stein Sandven, Joey Comiso, Jamie Morison, Alexander Makshtas, Michelle Johnston, Stephen Jones, Ruth Preller, Stephen Ackley

INFORMATION ABOUT THE SYMPOSIUM MAY BE OBTAINED FROM:

International Glaciological Society, Scott Polar Research Institute,
Lensfield Rd, Cambridge CB2 1ER, UK.
Tel: +[44] (0)1223 355 974 Fax: +[44] (0)1223 354 931
Email: igsoc@igsoc.org
Web: http://www.igsoc.org/symposia/ http://www.physics.otago.ac.nz/research/ice/igs/

PARTICIPATION

This circular includes forms for registration and instructions for arranging accommodation. These can also be found on the symposium website. The registration form and accompanying payment should be returned by 10 Sept 2005. There is a surcharge for late registration. The participants registration fee includes organisation costs, a set of abstracts, the icebreaker function, coffee breaks, the banquet, the mid-week excursion and a copy of the *Annals of Glaciology*.

Registration fees	**UK£**	
Participant (IGS member)	270	
Participant (not IGS member)	320	
Student or retired IGS member	100	
Accompanying person over 18	80	
Late registration surcharge (after 10 Sept 05)	50	
Post-symposium tour (estimate)	270	or NZ$700

Registration refunds will be made according to date of notification. Cancellations made before 17 October 2005 will receive a full refund. Cancellations between 17 October and 19 November 2005 will be eligible for a partial refund. After 19 November it may not be possible to make any refund.

THEME

The sea-ice of the Arctic and Antarctic Seas exerts a major impact on the regional oceans and atmosphere, concomitantly affecting global climate and modifying the global oceans. It also strongly influences the ecology of the polar oceans. Through remote sensing, fieldwork and modelling, often with a multidisciplinary flavour, scientists are well placed to make significant progress over the next two decades in our understanding of this vital constituent of the geosphere and biosphere at all scales. Succeeding the very successful 'International Symposium on Sea Ice and its Interactions', held in Fairbanks Alaska during June 2000, the overarching goal 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 and decay
3. Sea-ice morphology, motion and deformation
4. Large scale sea-ice processes
5. Atmosphere-ice-ocean interactions
6. Interactions between sea-ice and ice shelves
7. Sea-ice ecology and habitat
8. Sea-ice modelling

SESSIONS AND POSTERS

Oral presentations will be held on four full days and one half-day. There will also be a poster session. The size of poster presentations will be given on the website.

PUBLICATION

Selected papers from the symposium will be published by the Society in the *Annals of Glaciology*. All papers (including those based on posters) will be refereed and edited according to the Society's regular standards before being accepted for publication.

PAPERS

(1) SUBMISSION OF ABSTRACTS

Participants who want to contribute to the Symposium should submit an abstract of their proposed presentation. This abstract must contain sufficient detail for its scientific merit and relevance to the symposium theme to be judged by the Editorial Board. A web site will be available at the beginning of 2005 where authors can upload their abstract and all the relevant contact information. The abstract itself should not exceed 400 words. References and illustrations should not be included.

You will be required to enter all your details with the submission and in particular to state whether you intend to submit a paper for publication in the *Annals of Glaciology*. We will only solicit referees for abstracts that have explicitly stated that they intend to submit a paper. Referees are a scarce commodity and we do not want to trouble them unnecessarily.

Those unable to submit their abstract via the internet can submit electronic files on a CD or diskette to the IGS office where a member of staff will upload them onto the web site.

LAST DATE FOR RECEIPT OF ABSTRACTS: 30 MAY 2005

Final versions of papers accepted for publication should not exceed five printed pages in the *Annals of Glaciology*. Extra pages will be charged at the rate of UK £90 per page. Papers with colour figures will accrue page charges, at the colour rate of UK £150 for all pages. Honouring page charges (also £90 per page) for the first five pages in encouraged.

(2) SELECTION OF ABSTRACTS

Each abstract will be assessed on its scientific quality and relevance to the Symposium theme. Authors whose abstracts are accepted will be invited to make either an oral or poster presentation at the Symposium and submit a paper for publication in the *Annals of Glaciology* (included in the ISI Science Citation Index®). First or corresponding authors will be advised by 1 August 2005 of the acceptance or otherwise; other authors will not be informed separately. Authors who have not received notification by that date should contact the IGS office in Cambridge in case their abstract was not received. Acceptance of an abstract means that the paper based on it should be submitted to the *Annals of Glaciology* and not to another publication. Note: abstracts alone will not be published in the *Annals of Glaciology*.

(3) DISTRIBUTION OF ABSTRACTS

A set of the accepted abstracts will be provided to participants upon registration on 4 December 2005.

(4) SUBMISSION OF PAPERS AND PUBLICATION

Manuscripts should be submitted electronically onto the IGS Symposium website (also linked via the Symposium website). Papers should be prepared in accordance with the instructions sent to authors with the abstract acceptance notification and must be submitted as pdf's (portable document format). Authors who submit in other electronic formats will be asked to re-submit as pdf. Authors who are unable to upload their paper onto the IGS website can submit a copy of their manuscripts, double-spaced with wide margins, on a CD or diskette, to the Secretary General, International Glaciological Society, Scott Polar Research Institute, Lensfield Road, Cambridge CB2 1ER, UK. Their manuscripts will be uploaded onto the Symposium website by IGS staff. All manuscripts should be submitted by **3 October 2005**. ALL AUTHORS ARE EXPECTED TO ADHERE TO THIS DEADLINE. Papers will be refereed according to the usual standards of the Society before being accepted for publication. Final papers, based on presentations 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. 44). Final, revised versions of papers, diskettes and original art work must be submitted by **16 January 2006**. Timely publication of the *Annals of Glaciology* will depend upon strict adherence to deadlines.

LAST DATE FOR RECEIPT OF PAPERS: 3 October 2005

LAST DATE FOR RECEIPT OF REVISED PAPERS: 16 January 2006

EXCURSIONS

MID–WEEK FIELD TRIP:

Option 1: Excursion along Otago Peninsula. The Otago Peninsula is the only mainland nesting site of the Royal Albatross. The tour will include a visit to the albatross colony, a short boat trip to the mouth of the Otago Harbour, and a visit to a yellow-eyed penguin colony.

Option 2: Excursion to Central Otago. This group will head north up the coast by bus to view the Moeraki boulders. The tour will then travel inland to the goldfields of Central Otago to Pukerangi where they will board the Taieri Gorge railway to return to Dunedin by train through the spectacular Taieri gorge.

BANQUET to be held on Thursday evening in the ballroom of Larnach Castle on the Otago Peninsula. Larnach Castle was built in 1871 as home to a local businessman.

POST-SYMPOSIUM TOUR: SOUTH ISLAND OF NEW ZEALAND

THREE DAY TOUR: LEADER - BLAIR FITZHARRIS

Approximate cost is NZ$700 or UK£270 per person, including breakfasts and lunches, luxury bus travel and accommodation on twin share basis.

10 December: The field trip will begin from Dunedin after the Symposium. The main themes on the first day will be gold, tourism and hydro electricity development, land use change and new viticulture. We travel up the Clutha Valley through the historic heartland of Otago to arrive in Queenstown. This is a very scenic place in glaciated terrain and the adventure capital of New Zealand (see the movie *The Lord of the Rings*). Accommodation arranged in Queenstown.

11 December: Mountains, inter-montane basins and lakes of the South Island. Travel from Queenstown over two mountain passes to the McKenzie Country and the Mount Cook Region. Weather permitting, there will be a side trip to Mount Cook and the Tasman Glacier. Accommodation arranged in Twizel.

12 December: Lakes, foothills and plains. Travel from Twizel to Lake Tekapo through the foothills to the Canterbury Plains, across spectacular braided rivers and on to Christchurch. Accommodation arranged in Christchurch.

13 December: Participants will be able to leave for world-wide destinations from Christchurch International Airport. For those with late flights there will be a half day tour of Christchurch and part of Banks Peninsula.

ACCOMPANYING PERSONS PROGRAMME

The accompanying persons registration fee includes the icebreaker, the banquet, the mid-week field trip and the services of the accompanying persons coordinator. The coordinator will be able to assist accompanying persons to make further arrangements through the local tourist office. Tourist information is available at http://www.visit-dunedin.co.nz/.

LOCATION AND WEATHER

Dunedin is home to New Zealand's oldest university and has a population of about 120,000. Situated on the south-east coast of New Zealand's South Island, it is the capital of the spectacular province of Otago. The nearby Otago Peninsula is a sanctuary for wildlife, principally seals, penguins and Royal Albatross. Dunedin has a mild maritime climate and the weather is notoriously unpredictable. December is early summer so make sure you pack a warm jersey, a raincoat, sun block, a sun hat and some comfortable walking shoes for the Wednesday field trip. Further information is available at http://www.cityofdunedin.com.

TRAVEL AND ACCOMMODATION

Citizens of the US, Canada, Japan and many European nations do not need a visa to enter New Zealand. If in doubt ask a travel agent or consult the Immigration New Zealand website www.immigration.govt.nz for information on visitor visas.

Please note that New Zealand has strict laws regarding entering the country with agricultural products. Visitors will be asked to declare the following: food of any kind, animal products (e.g. skins, honey, salami), or plant products (e.g. flowers, pot pourri). Camping and hiking gear will be checked to ensure it is clean. Take care to check your luggage – forgetting an apple can cost you an instant fine of NZ$200!!

A choice of accommodation is offered on the attached sheet. Pencil bookings have been made for conference participants at a range of accommodation. Participants must book their own accommodation and must settle directly with this accommodation on departure. Accommodation will be booked on a first-come first-served basis but pencil bookings will be surrendered if bookings are not made by September. Delegates are cautioned that December is the high tourist season, on top of which university graduations are held during the weekends on either side of the conference. Space in the city's hotels and motels will be at a premium. Further information is available below.

IMPORTANT DATES

Abstracts due	30 May 05
Notification of acceptance	1 Aug 05
Pre-registration due	10 Sept 05
Papers due	3 Oct 05
Deadline for full refund	17 Oct 05
Deadline for partial refund	19 Nov 05
Registration	4 Dec 05
Conference starts	5 Dec 05
Post-symposium tour starts	10 Dec 05
Final revised papers due	16 Jan 06

ACCOMMODATION

St Margaret's College

Location: 2 mins walking distance from conference venue
Accommodation type: Single rooms available with shared bathroom. A smaller number of double rooms are also available.

Approximate price: NZ$55 bed and breakfast per person

Email: stmargarets.college@smc.ac.nz

Website: www.smc.ac.nz
Address: Saint Margaret's College, 333 Leith Street, Dunedin, New Zealand
Phone: +64 3 479-5543
Fax: +64 3479-5541

Booking instructions: Please quote "IGS Sea Ice Symposium" when booking

Commodore Motel/ Apartments/ Rental Cars

Location: 10 mins walking distance from conference venue
Accommodation type: Range of one and two bedroom units, studio units and suites. Self-catering is a possibility.

Approximate price: NA

Email: enquiries@dunedin-motel.co.nz

Website: www.dunedin-motel.co.nz
Address: 932 Cumberland Street, Dunedin, New Zealand
Phone: +64 3 477 7766
Fax: +64 3 477 7750

Booking instructions: Please quote "IGS Sea Ice Symposium" when booking

Cargills Motor Lodge

Location: 5 mins walking distance from conference venue
Accommodation type: Three star hotel

Approximate price: NZ$110–NZ$136

Email: cargills@es.co.nz

Website: www.cargills.co.nz
Address: Flag Cargills Hotel, 678 George Street, Dunedin, New Zealand

Phone: +64 3 477 7983
Fax: +61 2 9999 4332

Booking instructions: Please quote reservation number 64083 when booking

Hyland House

Location: 10 mins walking distance from conference venue
Accommodation type: ensuite rooms for the "discerning traveller"

Approximate price: NZ$130–NZ$300

Email: stay@hylandhouse.co.nz

Website: www.hylandhouse.co.nz
Address: 1003-1011 George Street, Dunedin, New Zealand
Phone: +64 3 473 1122 **Fax:** +64 3 473 6066

Booking instructions: Please quote "IGS Sea Ice Symposium" when booking

Alhambra Oaks Motor Lodge

Location: 5 mins walking distance from conference venue
Accommodation type: 1 & 2 bedroom studio, family units also available

Approximate price: large studio for 2 persons NZ$132–$140 per night, small studio NZ$115 per night

Email: info@alhambraoaks.co.nz

Website: www.alhambraoaks.co.nz
Address: 588 Great King St, Dunedin, New Zealand

Phone: +64 3 477 7735
Fax: +64 3 477 7745

Booking instructions: Please quote "IGS Sea Ice Symposium" when booking

Abbey Lodge

Location: 5 mins walking distance from conference venue
Accommodation type: Rooms for one to three people. Meals available. Please discuss with Abbey Lodge.
Approximate price: NZ$135 per night for 2 people, NZ$20 per head for an additional person (This is a non-commissionable rate. If booking through a travel agent the commissionable rate is NZ$198)
Address: 900 Cumberland St, Dunedin, New Zealand
Website: www.abbeylodge.co.nz
Email: reservations@abbeylodge.co.nz
Address: 900 Cumberland St., Dunedin, New Zealand
Phone: +64 3 477 5380
Fax: +64 3 477 8715
Booking instructions: Please quote reservation number #21783 when booking

Alternative accommodation is available, ranging from campsites, from NZ$11 per person per night, to four star accommodation at NZ$250 per person per night. Campers please note that Leith Valley Touring Camp is the nearest and is approximately 25 mins walk to the conference venue

Dunedin Visitor Centre has an excellent website with accommodation listed according to the facilities required. Their contact details are:
Website: http://www.dunedinnz.com/tourism/
Address: Dunedin Visitors Centre, 48 The Octagon, Dunedin
Phone: +64 3 474 3300
Fax: +64 3 474 3311
Email: visitor.centre@dcc.govt.nz

Alternative accommodation can also be found on the following websites:
http://www.jasons.co.nz/destinations/dunedin/
http://www.wotif.com
http://www.yellowpages.co.nz/

INTERNATIONAL GLACIOLOGICAL SOCIETY
SYMPOSIUM ON SEA ICE
Dunedin, New Zealand, 5–9 December 2005

REGISTRATION FORM

Family Name: _____

First Name: _____

Address: _____

_____

Tel: _____ Fax: _____ E-mail: _____

Accompanied by:

Name: _____ Age (if under 21) ____

Name: _____ Age (if under 21) ____

REGISTRATION FEES		£	£
Participant (member of the IGS)		270	___
Participant (not a member of the IGS)		320	___
Student or retired IGS member		100	___
Accompanying person aged 21 or over		80	___
Late registration surcharge (after 10 September)		50	___
Post-symposium tour (estimate)	NZ$700 or	270	___
TOTAL REGISTRATION FEES			____

ACCOMMODATION

A choice of accommodation is offered on the attached sheet. Pencil bookings have been made for conference participants at a range of accommodation. Participants must book their own accommodation and must settle directly with the accommodation on departure. Accommodation will be booked on a first-come first-served basis but pencil bookings will be surrendered if bookings are not made by September. Delegates are cautioned that this is the high tourist season, on top of which university graduations are held during the weekends on either side of the conference. Space in the city's hotels and motels will be at a premium. Further information is available on the website.

Payment of registration fee, in pounds sterling drawn on a UK bank, may be made by cheque to:

INTERNATIONAL GLACIOLOGICAL SOCIETY

or by Access/Eurocard/MasterCard or VISA/Delta

Card No.																Expires				

Security code | | | | (the last three digits on the signature strip on the back of the card)

Name of card holder as shown on card:_____

Signature: _____

Payment may also be made to: National Westminster Bank plc, Account no: 54770084, 56 St. Andrew's Street, Cambridge CB2 3DA, UK (ANY BANK OR TRANSFER CHARGES MUST BE INCLUDED).

Mail or fax to: Secretary General, International Glaciological Society, Scott Polar Research Institute, Lensfield Road, Cambridge CB2 1ER, UK

If payment made after 10 September 2005, add £50 for each person

PLEASE RETURN AS SOON AS POSSIBLE TO:

Secretary General, Scott Polar Research Institute, Lensfield Road, Cambridge, CB2 1ER, UK

Tel: +44 (0)1223 355 974 Fax: +44 (0)1223 354 931

E-mail: igsoc@igsoc.org Web: http://www.igsoc.org

OBITUARY

Gordon deQuetteville Robin (1927 to 2004)

Gordon Robin, who received the Society's highest award – the Seligman Crystal – in 1986, died on 21 September in Cambridge after a short illness.

Gordon Robin will be remembered warmly by his friends and glaciological colleagues as a pioneer in the remote sensing of ice sheets and ice shelves, in the study of deep ice temperatures and in some of the earliest investigation of the interaction between waves and sea ice. He will also be remembered for his exceptional dedication to promoting international collaboration amongst scientists in Antarctica. As the longest-serving Director of the Scott Polar Research Institute, Cambridge University he built the SPRI into a leading centre internationally.

Gordon deQuettville Robin was born in Melbourne Australia in 1927 and educated at Wesley College and University of Melbourne, gaining a bachelors degree in Physics in 1939 and a Masters in 1942. He volunteered for service in the RANVR and was commissioned as Sub-Lieutenant. After a tour around Australia he moved to the UK, spent a month on Motor Torpedo Boats, then volunteered for the submarine service. Promoted Lieutenant and posted to the Pacific Theatre he joined *HMS Stygian* and was involved in the support of the last midget submarine operation of World War II.

After WWII Robin moved to Birmingham University as a research student of Professor Sir Mark Oliphant studying nuclear physics, but in 1946, at two weeks' notice, he accepted a post with the Falkland Island Dependencies Survey in the South Orkney Islands, having harboured a deep desire to visit Antarctica. He was base commander at Signy Island where he undertook a synoptic meteorological survey and mapped the island by plane-table.

Back in Birmingham Robin was to receive an invitation which changed the course of his life. He was invited to join the Norwegian-British-Swedish Antarctic Expedition as third in command and undertake a programme of seismic sounding. Travelling in two "weasel" tracked vehicles with three other companions (one of whom was Charles Swithinbank) in the summer of 1951–52 he traversed 620km of ice shelf and onto the main ice sheet to latitude 74.3S at an elevation of 2710m above sea level. Despite early problems with detecting bottom echoes due to surface noise from collapsing depth hoar layers, Robin's tenacious experimentation resulted in a technique which produced the first systematic and detailed profile of the ice sheet. The methodology provided the basis for the oversnow seismic work of the International Geophysical Year and later traverses. His Antarctic work also resulted in another "classic" publication – the first study of the distribution of temperatures in ice sheets, published in the Journal of Glaciology in 1955.

In 1958 Robin took up the post which he occupied with considerable distinction for the rest of his career – Directorship of the Scott Polar Research Institute. With his experience in seismic sounding it was unsurprising that when Dr Stan Evans, an ionospheric physicist, joined the SPRI a year later a powerful innovative partnership was created to develop radio echo sounding (RES). In the 1960s Gordon Robin and Stan Evans constructed and trialled new equipment and ran successful RES campaigns in Antarctica, Greenland and the Canadian Arctic. These reached their apotheosis in the collaborative airborne RES programme in Antarctic supported by the US Science Foundation using US Navy long-range aircraft (mostly C-130s) and with the Technical University of Denmark, which ran for a dozen years from 1967 to 1979. Robin's pioneering research using RES formed the most important part of his career; he created an internationally recognised team that pushed back the frontiers of glaciology tackling a range of important questions. These included the identification and definition of the ice streams flowing into the Ross Ice Shelf; discovery of Lake Vostok (and a topic which occupied him in retirement); internal layering; the flow and bottom conditions of shelves; the investigation of large-scale ice dynamics and basal processes.

Two other important aspects to Robin's remarkable scientific contribution to glaciology must be recorded – his early interest in sea ice and observing ice from space.

The first of these was his study, conducted from the *RRS John Biscoe* in 1959–60 in the Weddell Sea, on the propagation of ocean waves and swell into fields of loose pack ice. His paper in 1963 was the first observational analysis on ocean wave decay in the

marginal ice zone and laid the foundation for all later work. Whilst Robin's focus shifted to RES investigations he nevertheless encouraged sea ice work at the SPRI, establishing a group in the early 1970s and playing a central negotiating role in enabling SPRI staff to join Royal Navy nuclear submarine voyages to the Arctic to undertake sonar investigation of sea ice thickness and distribution.

The second contribution was Robin's early recognition of the possibilities of using radar altimeters for profiling the surface of ice sheets from space. In 1963, only a few years after the launch of Sputnik, Robin presented a paper in Canada on "Mapping the Antarctic ice sheet by satellite altimetry", in which the major factors for future successful satellite programmes were enunciated – choice of radio frequency, orbit height and geoid determination, error analysis for returns at non-vertical incidence, and orbit repeat to obtain appropriate aerial coverage. His ideas were quickly taken up at NASA, in particular by Jay Zwally, and the satellite era in active radar remote sensing of the polar ice sheets opened.

Gordon Robin served the cause of international science throughout his life and as Secretary and later President of the Scientific Committee for Antarctic Research fostered, indeed was a key progenitor of, the collaborative framework which allowed unfettered science to be sustained in the Antarctic even in the depths of the Cold War. For that alone we all owe him a considerable debt of gratitude.

Gordon Robin was a mild mannered, self-effacing but determined individual who encouraged only the highest standards of academic scholarship. For those of us privileged to have been his students, colleagues and friends we shall recall him and his personal qualities of support with great affection.

David J. Drewry

(Note: A full appreciation of the life and work of Gordon Robin was published in 2003 in The Polar Record (Cambridge University Press) Volume 39, number 208, pages 61-78)

COVER PHOTOGRAPHS FOR ICE

We are looking for interesting photographs to use on the cover of ICE and if they are particularly good, for the cover of the *Journal*. Please look around in your photo collection and send us a sample. Please keep in mind that the cover of ICE is fairly small and thus the photograph can only contain a limited amount of detail. It is also printed in black and white.

GLACIOLOGICAL DIARY

** IGS sponsored * IGS co-sponsored

2005

13–15 January 2005
Workshop on the mass budget of Arctic glaciers, Pontresina, Switzerland
Working Group on Arctic Glaciology of IASC (International Arctic Science Committee)
Johannes Oerlemans, IMAU, Faculty of Physics and Astronomy, Utrecht University
email: j.oerlemans@phys.uu.nl

24–25 February 2005
9th Alpine Glaciological Meeting, Milano, Italy
Claudio Smiraglia, claudio.smiraglia@unimi.it and Guglielmina Diolaiuti
guglielmina.diolaiuti@unimi.it
Web: http://users.unimi.it/glaciol/

3–9 April 2005
VIIth IAHS Scientific Assembly, Foz do Iguaçu, Brazil
1) Symposium on Contribution from Glaciers and Snow Cover to Runoff from Mountains in Different Climates
2) Workshop on Andean Glaciology
see http://www.cig.ensmp.fr/~iahs/

11–15 April 2005
Cryosphere - The "Frozen" Frontier of Climate Science: Theory, Observations, and Practical Applications
China Meteorological Administration, Beijing, China
see http://clic.npolar.no/meetings/first/

24–29 April 2005
European Geosciences Union General Assemply, Vienna, Austria. 26 sessions dealing with the various aspects of the cryospheric Sciences.
Alan Rempel (rempel@esag.harvard.edu)
see
http://www.copernicus.org/EGU/ga/egu05/programme_overview.html

2–11 August 2005
IAMAS General Assembly. Beijing, China
Web: http://www.iamas.org/

Workshop on Glacier Mass Balance and its Coupling to Atmospheric Circulation
Principal Convener: Prof. Peter Jansson, University of Stockholm, Sweden; Secretary of ICSI. E-mail: peter.jansson@natgeo.su.se

Workshop on Mountain Snow and Ice Cover
Principal Convener: Paul Foehn, Swiss Federal Institute for Snow and Avalanche Research SLF, e-mail: foehn@slf.ch

Workshop on Modeling Forest Snow Processes
Principal Convener: Richard Essery, Centre for Glaciology, Institute of Geography and Earth Sciences, University of Wales, Aberystwyth
e-mail: rie@aber.ac.uk

23–27 August 2005
* Conference on Glacial Sedimentary Processes and Products, Aberystwyth, UK
Centre for Glaciology, Institute of Geography and Earth Sciences, University of Wales, Aberystwyth SY23 3DB, UK
Email: Michael Hambrey mjh@aber.ac.uk, Neil Glasser nfg@aber.ac.uk, Bryn Hubbard byh@aber.ac.uk

1–10 September 2005
The 11th International Conference and Field Trip on Landslides (CFL), Norway
Email: icfl05@ivt.ntnu.no
Web: www.ivt.ntnu.no/ICFL05

5–9 September 2005
** International Symposium on High-elevation Glaciers and Climate Records, Lanzhou, People's Republic of China
Secretary General, International Glaciological Society, Lensfield Road, Cambridge CB2 1ER, UK
Web: http://www.igsoc.org/symposia/

13–24 September 2005
5th Karthaus Summer Shool on Ice Sheets and Glaciers in the Climate System. Karthaus, northern Italy.
Contact: Johannes Oerlemans
e-mail: j.oerlemans@phys.uu.nl
Web:http://www.phys.uu.nl/%7Ewwwimau/education/summer_school/

10–14 October 2005
Third International Conference on the Oceanography of the Ross Sea, Antarctica, Venice, Italy
Jane Frankenfield Zanin, CNR-ISMAR (Istituto di Scienze Marine), San Polo 1364, 30125 Venezia, Italy
Email: jane.frankenfield@ve.ismar.cnr.it

5–9 December 2005
** International Symposium on Sea Ice, New Zealand
Secretary General, International Glaciological Society, Lensfield Road, Cambridge CB2 1ER, UK
Web: http://www.igsoc.org/symposia/

2006

June 2006
** International Symposium on Terrestrial and extraterrestrial glacier volcano/geothermal interactions. Reykjavík, Iceland
Secretary General, International Glaciological Society, Lensfield Road, Cambridge CB2 1ER, UK
Web: http://www.igsoc.org/symposia/

August 2006
* International Symposium on Cryospheric Indicators of Global Climate Change.
A joint CliC/IGS/ICSI Symposium
Secretary General, International Glaciological Society, Lensfield Road, Cambridge CB2 1ER, UK
Web: http://www.igsoc.org/symposia/

BOOKS RECEIVED

Cecil L. DeWayne, Jaromy R. Green and Lonnie G. Thompson *eds.* 2004. *Earth Paleoenvironments: Records preserved in Mid- and Low Latitude Glaciers.* Volume 9. Kluwer Academic Publishers. xxxiii+250 pp. (ISBN 1-4020-2145-3 (hardback), £ 56 (US$ 88, EUR€ 80); ISBN 1-4020-2146-1 (e-book))

Michael Hambrey and Jürg Alean, 2004. *Glaciers.* Second edition. Cambridge University Press. xvi+376 pp. (ISBN 0-521-82808-2 (hardback), £35 (US$ 60)).

RECENT MEETINGS (of other organizations)

Arctic Marine Transport Workshop

During the past five decades the Arctic sea ice cover has been undergoing an unprecedented transformation. Observations indicate sea ice thinning, a reduction in extent (in all seasons), and a reduction in the area of multi-year ice in the Central Arctic Ocean. These observations and sea ice model projections show increasing ice-free areas in the Arctic coastal seas, and suggest plausible improvements in marine access throughout the Arctic Ocean during the 21st century. This has led to renewed interest in the potential for greater use of the Arctic Ocean for marine shipping.

With this backround in mind, sixty-five Arctic marine specialists from eleven nations convened at the Scott Polar Research Institute, University of Cambridge, UK, 28-30 September 2004 to discuss the future of Arctic marine transport (AMT). The workshop - sponsored by the Circumpolar Infrastructure Task Force (CITF) of the Arctic Council, the International Arctic Science Committee (IASC), and the U.S. Arctic Research Commission (USARC)- was timed to preceed the November 2004 release of the four-year Arctic Climate Impact Assessment (ACIA). ACIA identified as one key finding the strong possibility of increases in Arctic marine access in response to the continuing retreat of Arctic sea ice. A pre-workshop survey revealed a diverse set of issues and questions among the specialists - emerging sea routes; infrastructure needs; complex international relations; impacts and protecion of the Arctic marine environment; and, the need for comprehensive Arctic shipping rules.

A key task of the workshop was to generate a research agenda for the sponsors regarding AMT and identify significant issues related to the theme of changing marine access in the Arctic Ocean. Five topical sessions chosen by the organizing committee (representatives from Canada, Finland, Russia and USA) were: 1 - Historical considerations; 2 - Arctic climate/sea ice considerations; 3 - Development and shipping economics; 4 - Technological considerations; and, 5 - International cooperation and marine environmental safety. For each session, four to six key presentations were made followed by a panel discussion

of experts. A simultaneous record of the major points (issues and research agenda items) was taken during the panel and open floor discussions for the five sessions. During the sixth session presentations were given on the ACIA, the Arctic Council's Arctic Marine Strategic Plan, and the future of Arctic development. A final, facilitated roundtable discussion was held where participants were asked to briefly summarize one key issue resulting from the workshop and their professional experience. Nearly one third of the issues related to sea ice and climate, and a further twenty per cent focused on economics and development.

Included in the resulting workshop research agenda are:

- expanded studies to understand sea ice thickness and extent changes,
- improvement in the resolution of global climate models to resolve the complex geographies of the Canadian and Russian Arctic regions,
- examination of the economic needs and demands for trans-Arctic shipping,
- risk assessments and environmental impact assessments for AMT,
- international trade cost-benefit analyses for Arctic routes and destinations,
- development of operational guidelines/design considerations for exhaust emmission and ballast water exchange,
- determination of the range of impacts the law of the sea on AMT,
- determination of the range of impacts of AMT on Arctic indigenous communities,
- study on the core issues of conflict: international status of waters, delimitation of the continetal shelf, maritime boundaries, Arctic indigenous residents, resource development, and political governance.

The workshop honored the memory and fifty years of service to the Arctic community of Dr. Terence Armstrong (1920-1996) of the Scott Polar Research Institute. Dr. Armstrong made seminal contributions to understanding sea ice and Arctic marine transport, particularly in knowledge of the Northern Sea Route in the Russian North. The workshop report was presented to the Senior Arctic Official's of the Arctic Council at the November 2004 meetings in Iceland and to the IASC Board. The workshop final report will be available in early 2005 on the web sites of USARC (www.arctic.gov) and the Arctic Council.

NOTES FROM THE PRODUCTION TEAM

PRESENTATION OF FINAL ACCEPTED ILLUSTRATIONS

When submitting final, accepted electronic illustrations to your papers via email (to either journal@igsoc.org or annals@igsoc.org) or the ftp site (site location and password information available on request), would you remember to send them as print quality individual and separate files in one of the following formats: eps, pdf, ps, tiff or psd? If your figures were created in a format other than those just listed, please provide the figure in its original format as well. As a general rule, and if you have a choice, please bear in mind that vector formats (eg. eps) are easier for us to process than bitmapped (eg. tiff, jpeg) formats. It's helpful if you give your individual figure files names that reflect the number assigned to the paper and the number of the figure (for example, "05J299_Fig1" or "43A250_Fig2")

PROOFS VIA E-MAIL – KEEP US INFORMED OF YOUR MOVEMENTS

Soon, we will be sending authors pdf page proofs of their papers for checking via email. This will have the double advantage of giving authors a better impression of what their published paper is going to look like and speeding up the proof correction stage. It only works though if we have your up-to-date email address. Could we ask that you add us to the list of friends and relatives you inform when you change your e-contact details?

Craig Baxter
Production Department

NEW MEMBERS

Mr. Oliver Browne, Department of Meteorology, University of Reading, P.O. Box 243, Reading, RG6 6BB, U.K.
Tel [44](118) 378-5419
o.j.h.browne@rdg.ac.uk

Mr. Matthew J. Burke, 10 Redburn Close, Houghton-le-Spring, Tyne & Wear, DH4 5DR, U.K.
Tel [44](191) 584-2920;
john.burke@unn.ac.uk

Prof. Giancarlo Dalla Fontana, Dipartimento Territorio e Sistemi Agro-Forestali, AGRIPOLIS, Viale dell'Università, 16, I-35020 Legnaro (PD), Italy
Tel [49](049) 827-2676; Fax [49](049) 827-2686
giancarlo.dallafontna@unipd.it

Tobias Ellenrieder, Neidhartstrasse 27, D-86159 Augsberg, Germany
Tel [49](821) 597-7650
t.ellenrieder@gmx.de

Miss Lesley A. Foster, 21 Mowbray Road, Northallerton, North Yorkshire, DL6 1QT, U.K.
Tel [44](1609) 778-177
lesley.foster@um.ac.uk

Dr. Jonathan M. Gregory, Department of Meteorology, University of Reading, P.O. Box 243, Reading, RG6 6BB U.K.
Tel [44](118) 378-7376
j.m.gregory@reading.ac.uk

Miss Anna Hughes, Department of Geography, University of Sheffield, Winter Street, Sheffield, S10 2TN, U.K.
a.hughes@sheffield.ac.uk

Mr. Young-Jin Kim, Dept. of Geophysical Sciences, University of Chicago, Hinds, Room 429,5734 South Ellis Avenue, Chicago, IL 60637, U.S.A.
Tel [1](773) 493-5659
youngjin@uchicago.edu

Katherine C. Leonard, Oceanography 107e, Lamont-Doherty Earth Observatory, 61 Route 9W, Palisades, NY 10964, U.S.A.
Tel [1](845) 365-8841; Fax [1](845) 365-8179
kleonard@ldeo.columbia.edu

Dr. Gwendolyn L. Vieli, Bristol Glaciology Centre, University of Bristol, School of Geographical Sciences, Bristol, BS8 1SS, U.K.
Tel [44](117) 928-9855; Fax [44](117) 928-7878
g.leysinger-vieli@bristol.ac.uk

Faezeh Maghami Nick,
Inst. for Marine & Atmospheric Res., Utrecht University, Princetonplein 5, NL-3584 Utrecht CC, The Netherlands
Tel [31](30) 253-2984; Fax [31](30) 254-3163
f.m.nick@phys.uu.nl

Miss Victoria Parry, 2F2, 201 Dalkeith Road, Edinburgh, EH16 5DS, U.K.
Tel [44](7979) 595-304;

Miss Kathryn C. Rose, School of Geography, University of Southampton, Southampton, Hants., SO17 1BJ, U.K.
Tel [44](23) 8059-8906
k.c.rose@soton.ac.uk

Miss Inger Seierstad, Bartholins Gade 15, St.T.H., DK-1356 Copenhagen, Denmark
Tel [45](35) 32 05 88; Fax [45](35) 36 53 57
inger@gfy.ku.dk

Ian Skilling, Dept. of Geology & Planetary Sciences, University of Pittsburgh, 200 SRCC Building, Pittsburgh, PA 15260, U.S.A.
Tel [1](412) 624-5873; Fax [1](412) 624-3914
skilling@pitt.edu

Dr. Olga N. Solomina, Institute of Geography RAS, Russian Academy of Sciences, Staromonetny-29, 109017 IGRAN Moscow, Russia
Tel [1](303) 492-5488; Tel [7](095) 939-01-21
solomina@gol.ru

Helena Sykes, 382 Wakefield Road, Dalton, Huddersfield, HD5 8DYU.K.
Tel [44](113) 343-6638; Fax [44](113) 343-3308
geo3hjs@leeds.ac.uk

Dr. Tonie Van Dam, 19 rue Josy Welter, L-7256 Walfedange, Luxembourg
Tel [352](33) 14-87; Fax [352](33) 14-87-88
tvd@ecgs.lu


IGS

INTERNATIONAL GLACIOLOGICAL SOCIETY

SECRETARY GENERAL M.M. Magnússon

COUNCIL MEMBERS

			Concurrent service on Council, from:
PRESIDENT	E.M. Morris	2002–2005	2000
VICE-PRESIDENTS	R.B. Alley	2002–2005	2002
	E. Brun	2002–2006	2002
	A. Ohmura	2004–2007	2001
IMMEDIATE PAST PRESIDENT	R.A. Bindschadler	2002–2005	1997
TREASURER	J.A. Heap	2001–2004	1980
ELECTIVE MEMBERS	*J.O. Hagen	2002–2006	2002
	*N.R. Iverson	2002–2005	2002
	*P. Langhorn	2004–2007	2004
	*S.J. Marshall	2002–2005	2002
	*J. Meyssonnier	2002–2005	2002
	*V. Morgan	2004–2007	2004
	*F. Pattyn	2004–2007	2004
	*A.J. Payne	2003–2006	2003
	*O. Solomina	2004–2007	2004
	*J.A. Richter-Menge	2002–2005	2002
	*Yao Tandong	2003–2006	2003
	*S.G. Warren	2003–2006	2003

*first term of service on the Council

IGS COMMITTEES

AWARDS	P. Langhorne (Chairman)
NOMINATIONS	R.A. Bindschadler (Chairman)
PUBLICATIONS	C.L. Hulbe (Chairman)

CORRESPONDENTS

AUSTRALIA	T.H. Jacka	JAPAN (Honshu)	K. Nishimura
AUSTRIA	Friedrich Obleitner	NETHERLANDS	J. Oerlemans
BELGIUM	J.-L. Tison	NEW ZEALAND	P. Langhorne
CANADA	C.S.L. Ommanney	NORWAY	J.C. Kohler
CHILE	G. Casassa and Andrés Rivera	POLAND	J. Jania
		RUSSIA	V.N. Mikhalenko
CHINA	Yao Tandong	SWEDEN	V.A. Pohjola
DENMARK	C. Mayer	SWITZERLAND	W.J. Ammann
FINLAND	M. Leppäranta	UK	B.P. Hubbard
FRANCE	C. Ritz	USA (Eastern)	D.C. Finnegan
GERMANY	H. Oerter	USA (Western)	H.B. Conway and E.D. Waddington
ICELAND	T. Thorsteinsson		
ITALY	C. Smiraglia	USA (Alaska)	M.A. Nolan
JAPAN (Hokkaido)	T. Shiraiwa		

SELIGMAN CRYSTAL

1963 G. Seligman	1986 G. de Q. Robin	2000 S.C. Colbeck
1967 H. Bader	1989 H. Oeschger	2001 G.S. Boulton
1969 J.F. Nye	1989 W.F. Weeks	2001 G.K.C. Clarke
1972 J.W. Glen	1990 C.R. Bentley	2003 K. Hutter
1972 B.L. Hansen	1990 A. Higashi	
1974 S. Evans	1992 H. Röthlisberger	
1976 W. Dansgaard	1993 L. Lliboutry	
1977 W.B. Kamb	1995 A.J. Gow	
1982 M. de Quervain	1996 W.F. Budd	
1983 W.O. Field	1997 S.J. Johnsen	
1983 J. Weertman	1998 C. Lorius	
1985 M.F. Meier	1999 C.F. Raymond	

HONORARY MEMBERS

V.M. Kotlyakov	U. Radok
L. Lliboutry	R.P. Sharp
M.F. Meier	Shi Yafeng
G. Østrem	C.W.M. Swithinbank
W.S.B. Paterson	G. Wakahama
M. de Quervain	A.L. Washburn

RICHARDSON MEDAL

1993 H. Richardson	1999 J.A. Heap
1997 D.R. MacAyeal	2003 C.S.L. Ommanney
1998 G.K.C. Clarke	

The Society is registered as a charity in the United Kingdom
with the Charity Commissioners – No. 231043

INTERNATIONAL GLACIOLOGICAL SOCIETY

Scott Polar Research Institute, Lensfield Road
Cambridge CB2 1ER, England

DETAILS OF MEMBERSHIP

Membership is open to all individuals who have a scientific, practical or general interest in any aspect of snow and ice. Payment covers purchase of the *Journal of Glaciology* and *ICE*. Forms for enrolment can be obtained from the Secretary General or from http://www.igsoc.org/forms/application.html. No proposer or seconder is required.

ANNUAL PAYMENTS 2004

Ordinary members	Sterling	£62.00	
Supporting members	Sterling	£200.00	
Contributing members	Sterling	£100.00	
Retired members	Sterling	£20.00	
Student members (under 30)	Sterling	£31.00	
Institutions, libraries	Sterling	£240.00	for JGlac. Volume 50 (Nos. 168, 169, 170, 171)

Annals of Glaciology — prices vary according to size of volume. For further information, apply to the Secretary General.

Note: Payments in currencies other than £ sterling should be calculated at the exchange rate in force at the time of payment. Then add sufficient money to cover the bank charges (currently £10.50). The Society needs the full payment, so that the extra £10.50 to cover bank charges should be paid by you. Payment may also be made by Access/Eurocard/ MasterCard or VISA/Delta.

ICE

Editor: M.M. Magnússon (Secretary General)

This news bulletin is issued to members of the International Glaciological Society and is published three times a year. Contributions should be sent to your National Correspondent or to the Secretary General, International Glaciological Society, Scott Polar Research Institute, Lensfield Road, Cambridge CB2 1ER, England.

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

Sterling £27.00

All enquiries about the International Glaciological Society should be addressed to:
Secretary General, International Glaciological Society, Scott Polar Research Institute,
Lensfield Road, Cambridge CB2 1ER, England
Tel: +44 (1223) 355 974 Fax: +44 (1223) 354 931
E-mail: igsoc@igsoc.org
Web: http://www.igsoc.org/