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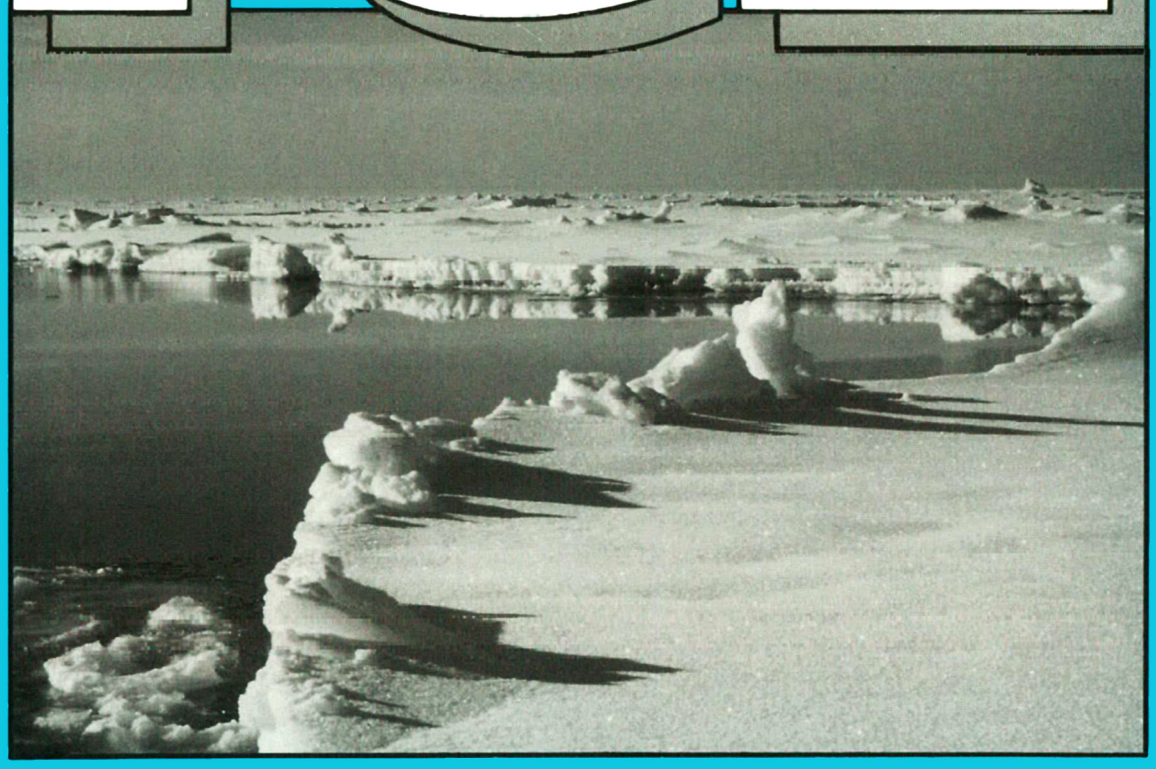

NEWS BULLETIN OF THE INTERNATIONAL GLACIOLOGICAL SOCIETY

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CONTENTS

COVER PICTURE: First-year ice in the Eurasian basin, Arctic Ocean, summer 1996 (Photograph by Finlo Cottier).

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

RECENT WORK

USA (Eastern)

(For abbreviations used see page 6)

Glaciological studies, Pennsylvania State University

(R.B. Alley, ESSC/GEOS/PSU)

Glaciological studies continue on several fronts at Penn State. S. Anandakrishnan is using passive and active seismic techniques to demonstrate the dependence of West Antarctic ice streaming on subglacial geology, to learn the controls on ice-stream motion, and to investigate the seismicity of Antarctica. M.A. Mahaffy is conducting 3-D ice-sheet modeling to study West Antarctic stability, and T.K. Dupont is using reduced-dimension models for the same purpose. In collaboration with D.R. MacAyeal (GEOP/UChic), B.R. Parizek is developing a 2-D ice-sheet model to study Heinrich events and other phenomena. S. Das is conducting a multifaceted study of ice-sheet surface melt focused on the West Antarctic, and M. Spencer is completing a time-dependent model of firn densification. A.M. Agústsdóttir and former Penn Stater P.F. Fawcett (now Univ. of New Mexico) have used GCMs to improve our understanding of the paleoclimatic record in Greenland ice cores and elsewhere, demonstrating that ice-core changes can be explained by the effects of proposed paleoceanographic changes. T.T. Creyts has completed a study of the effects of water-pressure fluctuations on horizontal fracturing as the rate-limiting step in erosion beneath some glaciers. B. Olsson is looking into the possible role of orbitally driven changes in dust affecting climate. D.E. Voigt is completing analyses of the Upstream C firn/shallow-ice core and its record of ice-stream shut-down. R.B. Alley occasionally cuts thin sections of ice cores and thinks about some of these things. T.A. Sowers and his team of dedicated researchers are hard at work on ice-core gases.

GLACIERS

Mass balances, North Cascades

(M.S. Pelto, NichC)

Since 1984, the North Cascade Glacier Climate Project has monitored annual net balance on at least eight North Cascade glaciers and terminus position on 47. The mean annual balance for 1995–97 has been significantly higher than for the rest of the 1984–97. Mean annual balance on the eight glaciers was –0.09 m in 1995, +0.15 m in 1996 and +0.54 m in 1997. From 1984–97, –0.26 m a^{-1} for the 8 North Cascade glaciers is an average loss of 3.6 m of glacier thickness during the last 11 years. This represents a significant loss to glaciers that are less than 50 m thick on average.

Behavior of Glacier Peak glaciers, Washington, since 1900

(M.S. Pelto, NichC; C. Hedlund, ORSU)

The terminus behavior of 15 Glacier Peak (Washington) glaciers of the last century has been determined from photographic and field surveys. From 1850–1945 all the glaciers retreated an average of 1500 m. Those on the peak itself were near to equilibrium in 1946. The ELA then dropped 100 m during the 1950–75 period causing a small advance of 100–400 m on each of the nine glaciers lying directly on Glacier Peak. This lower ELA was not enough to stop the retreat of five of the six glaciers on the north and south subsidiary ridges of Glacier Peak, their retreat for this period averaged 160 m. They have lower slopes and less crevassing than those immediately on Glacier Peak that advanced, and hence a longer response time. For the 1976–95 period the ELA rose 100–120 m. The result has been the retreat of all 15 glaciers, one of them, Milk Lake Glacier, disappearing in 1993. The mean retreat has been 155 m since 1979. The 1.0–1.5°C post LIA warming resulted in extensive long-term glacier retreat with Glacier Peak glaciers reaching equilibrium in 100 years. The glaciers on the subsidiary peaks around Kololo Peak and Milk Lake have each taken at least 150 years to adjust to the post LIA warming and, except for Suiattle Glacier and Milk Lake Glacier, have not yet reached a steady-state. Thus, a pronounced warming of more than 1.0°C will require at least a century for some North Cascade glaciers to fully respond.

Post-surge investigations, Bering Glacier, Alaska

(P.J. Fleisher, SUNY-One)

For the 11th consecutive year the New York based research team of E.H. Muller and M. Lachniet (SyrU), D.H. Cadwell (New York State Geological Survey), P.K. Bailey (CRREL retired), B.B. Tormey (PSU) and many SUNY-Oneonta students, Mark Mucci and Scott Wickham, conducted field work on the eastern sector of Bering piedmont glacier.The primary thrust is documenting post-surge activity including measuring the rates of retreat (backwasting and downwasting), ice-contact lake sedimentation, ice-front subglacial venting of supercooled water, GPS mapping of emerging landforms, and the Holocene foreland stratigraphy in new exposures cut during late-surge outburst flooding. This year we were joined by Y. Merrand and M. Koppes (UWA), and L.E. Hunter (CRREL). Paleoecological investigations of the Bering/Steller foreland are also underway involving D.M. Peteet (LDEO).

Ice-proximal processes in southern and southeast Alaska

(L.E. Hunter, CRREL)

Investigations include studies of sediment and glacier dynamics in Glacier Bay, with D.E. Lawson and S.R. Bigl (CRREL), and two new studies including sediment monitoring of Tsiu and Vitus Lakes in front of Bering Glacier with B. Hallet (UWA), and of Le Conte Bay near Le Conte Glacier with R. Motyka (UAK-SE) and K. Echelmeyer (UAK-F). The focus is to monitor ice-proximal sediment dynamics and rates of fjord infilling. Particularly, the characterization of sediment yield variations in basins of different rock type (metamorphic in Glacier Bay and granitic at Le Conte Glacier), and the effects of the Bering Glacier surge on lake sedimentation. Studies include bathymetric mapping, sediment trapping and characterization of the ice-proximal basins. Preliminary investigations at Bering and Le Conte Glaciers were initiated in July and October, 1998.

GLACIAL GEOLOGY

Drainage history of Glacial Lake Hitchcock, Connecticut River Valley

(J.F. Brigham-Grette, UMA)

J.F. Brigham-Grette and T. Rittenour are investigating the drainage history of Glacial Lake Hitchcock in the Connecticut River valley. Sediment cores of the varved sequence in the Amherst area and in northern Massachusetts are being correlated with the Antevs varve sequence in collaboration with J. Ridge (TuftsU), who has been working in the northern sector of the glacial lake. Post-lake terraces recording the sequential downcutting and early evolution of the Connecticut River are being dating by Optically Stimulated Luminescence in collaboration with S.L. Forman (UIL-C), and using archeological evidence in collaboration with D. Dincause (UMA).

Pleistocene glaciations, central and outer Chukotka, NE Russia

(J.F. Brigham-Grette, UMA; O. Glushkova, NorthEast Interdisciplinary Scientific Res. Inst., Magadan, Russia)

J.F. Brigham-Grette and O. Glushkova are working on the history of Pleistocene glaciations across central and outer Chukotka, N.E. Russia. This work provides field-based data on the distribution of past ice sheets in this region of W. Beringia. L. Gualtieri (UMA) is finishing her dissertation on aspects of this research. This work disproves the hypothesis of an East Siberian Sea ice sheet or a Beringian ice sheet put forward by T.J. Hughes (UME) and M.G. Grosswald (GEOG/MSU).

SNOW

Snow acoustics

(D.G. Albert, CRREL)

The presence of a snow cover or firn at the Earth's surface produces large changes in the waveforms of horizontally-traveling acoustic pulses in the air. An extensive set of field measurements has been obtained and a computational model that treats the snow/firn as a rigid porous medium has been developed. These efforts show that the acoustic pulse changes are controled primarily by snow-cover depth and snow permeability. The goal is to develop methods of automatically measuring snow conditions and parameters using these acoustic pulse changes.

Sintering in seasonal snow

(S.C. Colbeck, CRREL)

The basic shape of bonds in snow is dictated by the geometrical requirements of grain-boundary grooves and is not a simple concave neck as has long been assumed. In fact, all of the earlier work on the theory of sintering in snow was based on an incorrect assumption about the geometry. A new theory of the growth of bonds in snow is based on observations of their actual shape which is dominated by grain-boundary grooves. The theory describes the growth of the bond by the removal of water molecules from the grain boundary by diffusion due to the stress gradient. 3-D grains are described and the dihedral angle is allowed to increase with time.

Ice-lens development in glacier snowpack and firn

(M.S. Pelto, NichC)

On Juneau Icefield, Alaska, ice lenses and ice layers make up 5–15% of the annual accumulation layer volume in mid-summer. In contrast, ice lenses make up less than 0.1% of the annual accumulation layer volume in mid-summer on North Cascade, Washington glaciers. Ice-lens development is critical in impeding snowpack percolation, ablation and runoff. Ice-lens formation requires cold-dry snow at the beginning of the melt season. Snowpack temperatures in the North Cascades range from 0 to –1°C, vs –3 to –7°C in S. Alaska. Threshold air-temperature conditions that develop ice lenses in the maritime Coast Ranges of the Pacific Northwest are a mean Dec–March temperature below –7 to –8°C, and infrequent (>5) winter melt events. This is the case in the Coast Ranges of S. Alaska and N. British Columbia, but not in the North Cascades of Washington. The transition from cold-dry to the 0°C snowpack that does not allow ice lens development is identifiable using SAR imagery. Thus, areas of internal accumulation and retarded meltwater release can be identified readily.

Modeling seismic wave propagation in firn

(D.G. Albert, CRREL)

This project is investigating seismic wave propagation in firn at the South Pole, where ground-vehicle and station-generated noise interfere with teleseismic signals recorded by the Global Seismic Network sensors. The goal is to determine how far from the station and how deep in the firn new sensors should be emplaced to reduce the noise to acceptable levels. Modeling waves here is complicated by the steep velocity gradient caused by firn densification. This gradient refracts down-going seismic waves towards the surface and "traps" seismic energy in the upper few hundred meters of the firn. Rayleigh wave attenuation with depth below the surface is also an important factor.

Tunneling in firn, South Pole

(M.R. Walsh, CRREL)

A tunneling system was designed and built to machine tunnels in the firn at the U.S. Amundsen–Scott South Pole Station. The electrohydraulically-powered tunneling machine can machine a 2 x 3 m tunnel at depths up to 15 m. Production rates varied from 1–2 m h^{-1}. Machined material was transported to the surface pneumatically. A 125 m long tunnel was machined in 1996 at the station over 10 days. The tunnel temperature is about –40°, providing a stable environment for work, passage, and utilities. The tunnel machined in 1996 is currently in use at the station.

Snow cover monitoring

(R.E. Davis, T. Pangburn, CRREL)

CRREL has partnered with the U.S. Army Corps of Engineers Sacramento District to develop a snow-cover and runoff data-monitoring system suitable for operational water control and management. The software package, CorpsView, provides the basis of this system. CorpsView is a data-visualization tool to improve access to water-control databases, time-series and relational data, GIS coverage, remote-sensing imagery, model input and results. CorpsView uses a menu system and a geographic map through which data can be accessed, analyzed, displayed and plotted.

We have implemented algorithms to map snow recover fractional extent per pixel at about 1 km resolution from NOAA AVHRR. Experience with the water year 1998 showed that complete maps of the southern Sierra Nevada could be compiled about once a week. Methods to estimate snow extent under clouds using relational models have shown promising preliminary results, so that more frequent and spatially complete maps are possible. Recent research has also tested improved methods to interpolate snow water equivalence, which when merged with the snow maps, provide a baseline for time-series comparison. Current bottlenecks in processing include user-interactive georegistration of satellite imagery and cloud masking. Preliminary studies show sensitivity of water equivalent maps to accuracy of georegistration and spatial resolution of the snow extent maps. We are developing design studies based on historical runoff and similar image-based products for spatio-temporal comparison with current situations and forecast analysis. These snow products complement operational products from NOAA National Operational Hydrology Remote Sensing Center, so that design analyses can proceed with alternative data sources. A new version of HEC-HMS, a grid-based runoff routing model, will be tested using melt derived solely from satellite-derived products with the aim to determine requirements for spatially distributed modeling of snow melt.

EOS investigations of snow cover

(D.K. Hall, A.T.C. Chang and J.L. Foster, NASA/GSFC/G)

Snow and ice research is ongoing in preparation for the launch of the Earth Observing System (EOS) AM-1 spacecraft with the Moderate Resolution Imaging Spectroradiometer (MODIS) in 1999, and the EOS PM-1 spacecraft with the Advanced Microwave Scanning Radiometer (AMSR) in 2000. Both satellites will have polar orbits. Algorithms have been developed to map global snow and sea-ice cover daily using MODIS data at a spatial resolution of 500 m and 1 km, respectively. Ice on large, inland lakes will be mapped at 500 m resolution. Snow extent and depth will be mapped using an algorithm developed for the AMSR data at a spatial resolution of 25 km. Field and aircraft studies have been undertaken to help develop and validate the MODIS and AMSR algorithms in key regions of interest (e.g. central and northern Alaska, the Great Plains and parts of New York and New Hampshire in the United States). The MODIS and AMSR algorithms exhibit their poorest performance in densely-forested areas. Thus it is in these areas that efforts are being concentrated for agorithm development and validation.

High-altitude meteorology and snow geochemistry, Bolivian Andes

(D.R. Hardy, M. Vuille, R.S. Bradley, UMA)

At the summits of two Andean mountains in Bolivia, automated weather stations (AWS) and snowpack analysis are being used to improve the calibration of geochemical variations within tropical ice cores. One station was installed in October 1996 on the ice-capped volcano Sajama (6542 m, 18°06'S, 68°53'W), where a team led by L.G. Thompson (OHSU) recovered two ice cores to bedrock from the summit in June and July, 1997. The other station is located near the summit of Nevado Illimani in the Cordillera Real (6265 m, 16°39'S, 67°47'W), where another drilling campaign is anticipated within the next few years. These satellite-linked AWSs are providing hourly measurements of snow accumulation and ablation, along with snow temperature and a variety of meteorological variables.

The objective is to better understand the atmospheric sources of geochemical variability in the snow. The analysis of station data is closely tied to results of annual snowpack studies carried out near the AWSs.

Individual stratigraphic layers in the snow pits are delineated and sampled in detail (for oxygen-isotope ratios, microparticles and major ions), enabling snowfall episodes to be characterized in terms of precipitation geochemistry. Ultimately, analysis of the prevailing meteorological conditions associated with precipitation events, as measured at the stations, combined with regional airflow derived from satellite imagery, and reconstructed from NCEP global analyses (National Centers for Environmental Protection, NOAA), will enable different airflow patterns to be associated with variations in the geochemistry of the snow. This will then provide valuable insight into the interpretation of down-core geochemical variations within ice cores from the Tropics.

RIVER AND LAKE ICE

River-ice modeling

(M.A. Hopkins, CRREL)
A 3-D river-ice model, based on a new discrete-element technique, is being developed with S.F. Daly. It is closely coupled to a 1-D hydraulic model. The model is being used to simulate river-ice jam formation and river-ice management at locks and dams (see www.crrel.usace.army.mil/ierd/hop1/riv.html).

Ice thrust in reservoirs

(D. Carter, Carter; D.S. Sodhi, CRREL; E. Stander, Carter; O. Caron, T.T. Quach, Hydro-Québec)
A three-year program has been undertaken to measure the magnitude of static ice forces in four reservoirs located respectively in central and northern Quebec. These static forces may be generated by a temperature change or due to other mechanisms such as water-level variations, wind and current friction. Field observations have evidenced two important facts: (1) ice covers have circumferential cracks caused either by water-level variations or thermal contraction; and (2) the static ice forces are, in some instances, sufficient to trigger the instability of the broken ice covers by a mechanism similar to buckling. Noting that an ice cover cannot transmit to a structure a force larger than its own resistance, the upper bound for static forces is then established by determining the in-plane compression force at which a fragmented ice cover collapses. Empirical formulae have been developed for three typical structure shapes: retaining walls, sluice gates, and piers. The formulae correlate well with the field data collected from the four dam sites, and suggest that the maximum ice thrust may be simply defined as a function of ice thickness and contact geometry.

Ice effects on riprap: small-scale tests

(D.S. Sodhi, S. Borland, J.M. Stanley, C.J. Donnelly, CRREL)
Model tests have been conducted to simulate interaction between floating ice sheets and sloping banks protected with riprap stones. Two series of tests simulated ice action against model riprap bank protection when the ice sheet moves perpendicular and at an angle of 45° to the shoreline. The first simulated ice-shoving action, while the second incorporated both shoving and shearing actions of ice in equal proportion. 35 tests were conducted during the first series and 47 tests during the second. The results indicate that the size of maximum stone (D100) should be about 2.5 times the ice thickness to sustain no damage from ice action either perpendicular or at an angle of 45° to the shoreline. The data on riprap failure indicate the likelihood of riprap damage increases with the slope of a riprap-protected bank.

Lake Superior cryosphere

(D. Pilant, H.S. Santeford, A. Agarwal, MTU; R.E. Davis, CRREL)
The Laurentian Great Lakes contain about 20% of Earth's liquid fresh water, are a unique ecosystem and directly influence the lives and industry of some 40 million people. Ice is a major component of the Lakes' hydrologic cycle. Research efforts at the MTU Remote Sensing and Environmental Monitoring Institute focus on remote sensing of Lake Superior ice cover using RADARSAT synthetic aperture radar (SAR), AVHRR and GOES visible and infrared imagery and in-situ observations. The overall goal is to better understand this highly dynamic ice cover and how it affects limnology, ecology, climate and weather. Efforts are focused on interpreting of SAR data with respect to ice types, phenology and dynamics. SAR data are augmented with field observations, aerial reconnaissance and complementary satellite data (AVHRR and GOES). (see http://www.geo.mtu.edu/~anpilant/)

SEA ICE

Granular sea-ice model

(M.A. Hopkins, CRREL)
A granular sea-ice model is being developed that incorporates individual ice floes. Each floe has its own oriented ice-thickness distribution. Pressure ridging between floes is modeled using parameterizations from ridging simulations. The model ice pack is driven by winds, Coriolis and kinematic boundary motions. Thermodynamics are based on an Ebert and Curry model that includes heat storage. The goal is to simulate the ice pack surrounding the SHEBA field experiment (see www.crrel.usace.army.mil/ierd/hop1/seaice.html).

Compression of floating ice fields

(M.A. Hopkins, CRREL)
A study using a new 3-D discrete-element model to simulate a field of circular ice floes compressed in a rectangular channel has been completed with J. Tuhkuri (HUT). The simulations were compared directly with physical experiments in the HUT ice basin. The results show the dependence of compressive forces and thickening on floe characteristics and boundary conditions.

Rafting and ridging of thin ice sheets

(M.A. Hopkins, CRREL)

A study of pressure ridging between two identical sheets of ice has been completed, with J. Tuhkuri and M. Lensu (HUT). The results of computer simulations were compared directly with physical experiments performed in the Helsinki University of Technology ice basin. The results suggest the degree of thickness inhomogeneity in the ice sheets determines whether ridging or rafting occurs when two identical sheets are pushed together.

Medium-scale indentation tests on sea ice at various speeds

(D.S. Sodhi, CRREL; T. Takeuchi, Shimizu Corp., Tokyo, Japan; N. Nakazawa, Forest Works Inc., Tokyo; S. Akagawa, Shimizu Corp., Tokyo; H. Saeki, Hokkaido University, Sapporo, Japan)

As part of a five-year program involving laboratory and field tests in Japan, medium-scale indentation tests were conducted on sea ice in the harbor of Lake Notoro, Hokkaido, by pushing a segmented indentor against the edge of a floating ice sheet. Measurements on each 10-cm wide segment included forces in three directions and the moment about a horizontal line parallel to the indentor face. During the tests in 1998, four pressure-sensing panels were installed on the face of the segmented indentor to measure interfacial pressure during indentation tests at three speeds. Data on the actual contact area and the magnitude of interfacial pressures from the pressure-sensing panels were obtained . A "line-like" contact was observed both during high-speed (3 and 30 mm s^{-2}) indentation tests, and a gradually enlarging contact area attributable to creep deformation of the ice during low-speed (0.3 mm s^{-2}) tests. Using the results of a brittle flaking model from the literature, the apparent fracture toughness of the ice was estimated from data on interfacial pressure and the width of the contact area. A theoretical model, taking creep and fracture properties into account, has been developed to estimate the speed at which the transition from ductile to brittle failure of ice takes place during ice–structure interaction.

Arctic ice mapping

(W.B. Krabill, R.H. Thomas, NASA/GSFC/W)

The Arctic Ice Mapping (AIM) program is developing and refining a combination of airborne Global Positioning System (GPS) positioning and laser-ranging technology to an accuracy better than 10 cm, to survey the elevation (topographic height) of polar glacier surfaces at the sub-decimeter level. Subsequent surveys will yield the net gain or loss of ice volume over wide areas. Knowledge of the ice budget in polar glaciers provides an indirect measure of sea-level changes and a clear indication of trends in world climate.

For the 1998 Greenland field season deployment, 12 data-collection flights were planned. The primary purpose was to re-survey flight lines accomplished during the 1993 field season. This data set characterizes the major regions and drainage basins in the southern half of Greenland. A similar re-survey of the northern half will follow in 1999. The resultant data will provide the most detailed and accurate measurement of ice-sheet mass balance stability/change ever collected on a semi-decadal time scale.

A new version of the Airborne Topographic Mapper, designated ATM-2, has been developed from spare parts of the operational ATM. This additional facility allows the project to experiment with various enhancements while maintaining a consistent operational capability. ATM-2 was operated with a new, smaller scan mirror spinning at 20-Hz and 15 deg off-nadir, as compared to 10-Hz and 10 deg off-nadir for ATM-1. This provides more uniform coverage of the 5-kHz ranging data that are now routinely collected with both systems. Both systems were operated simultaneously in the 1997 field season, and will also be operated together in 1998 and 1999. (See http://aol.wff.nasa.gov/aoltm.html.)

Glacier velocities can be obtained from repeat flight lines of the ATM over rapidly flowing glaciers. Cross-correlation analysis is conducted on the two data sets, and high-fidelity, unambiguous velocity vectors are determined over crevassed surfaces.

Submitted by L.E. Hunter

ABBREVIATIONS

Carter	Carter Consultants, 1281 avenue Bishop, Ste-Foy, Quebec G1W 3E4, Canada
CRREL	Cold Regions Research and Engineering Laboratory, 72 Lyme Road, Hanover, NH 03755-1290, USA
GEOG	Geography
GEOS	Geosciences
GEOP	Geophysics
HUT	Helsinki University of Technology, P.O. Box 5300, FIN-02015 HUT Espoo, Finland
LDEO	Lamont-Doherty Earth Observ., Columbia University, Palisades, NY 10964, USA
MSU	Moscow State University, 119899 Moscow, Russia
MTU	Michigan Technological University, Houghton, MI 49931, USA
NASA/GSFC	National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, MD 20771, USA
NASA/GSFC/W	NASA/GSFC/Wallops Flight Facility, Wallops Island, VA 23337, USA
NichC	Nichols College, Dudley, MA 01570, USA
OHSU	The Ohio State University, Columbus, OH 43210-1002, USA

ORSU Oregon State University, Corvallis, OR 97331-5506, USA
PSU The Pennsylvania State University, University Park, PA 16802, USA
SUNY-One State University of New York, Oneonta, NY 13820, USA
SUNY-S State University of New York, Syracuse, NY 13210, USA
SyrU Syracuse University, Syracuse, NY 13244-1070, USA
TuftsU Tufts University, Medford, MA 02155, USA
UAK-F University of Alaska Fairbanks, Fairbanks, Alaska AK 99775-7320, USA
UAK-SE University of Alaska Southeast, Juneau, AK 99801, USA
UChic University of Chicago, 5734 South Ellis Avenue, Chicago, IL 60637, USA
UIL-C University of Illinois, Chicago, IL 60607-7059, USA
UMA University of Massachusetts, Amherst, MA 01003-0026, USA
UME Univ. of Maine, Orono, ME 04469, USA
UWA University of Washington, Seattle, WA 98195-1360, USA

GLACIOLOGY RESEARCH IN THE OFFICE OF POLAR PROGRAMS UNITED STATES NATIONAL SCIENCE FOUNDATION

The United States National Science Foundation (NSF) is an independent U.S. government agency responsible for promoting science and engineering through programs that invest over $ 3.3 billion per year in research and education projects in science and engineering. The Office of Polar Programs (OPP) at NSF is composed of two science sections — the Arctic Sciences Section and the Antarctic Sciences Section, each comprised of specific research programs. A third section, the Polar Research Support Section (PRSS) provides laboratory, operational and logistics support to the Antarctic science programs.

Glaciological research in the Office of Polar Programs is supported in the Antarctic Glaciology Program (AG), the Arctic Natural Sciences Program (ANS) and in the Arctic System Science Program (ARCSS). There is also some overlap between the Antarctic Glaciology Program and the Antarctic Geology and Geophysics Program (AGG), especially in the area of glacial geology research and geophysical studies of the glacier/sediment/rock interface. The AG program normally reviews and funds the more recent time periods (Pliocene to Recent) whereas the AGG program supports the older glacial geological studies (Pliocene and older). There is also some overlap with the Antarctic Oceans and Climate Studies (AOCS) Program in the area of air–snow exchange studies, atmospheric modeling of precipitation and weather patterns which influence the ice sheet and the atmospheric chemistry near the snow/ice surface which affects the chemical composition of snow pit and ice core samples.

The primary focus of the AG program is a major inititative to study the West Antarctic Ice Sheet (WAIS). The WAIS program is a multidisciplinary research program designed to advance an understanding of the WAIS, its current state, internal dynamics, interactions and history with an overarching goal of developing predictive models for the future behavior of the WAIS. The current research programs include an on-going study of the Siple Coast ice streams, drilling of shallow and deep ice cores at sites in West Antarctica (deep drilling is now underway at Siple Dome — an elongate dome of ice between Ice Streams C and D). In addition to studies of ice-sheet dynamics and paleoclimate studies from ice cores, the program supports numerous projects related to developing a better understanding of processes which take place at the glacier /ice-sheet surface, including snow accumulation, diagenetic processes, air–snow exchange etc. Numerical ice-sheet modeling and atmospheric modeling of the phenomena responsible for bringing precipitation to the ice sheet are also important aspects of the AG program.

In addition to the work in West Antarctica, a number of smaller projects in East Antarctica have been supported by the AG program. These projects include studies of the glaciers and glacial deposits in the Dry Valleys of East Antarctica and studies of volcanic ash layers in the blue-ice areas along the front of the Transantarctic Mountains. The AG program, in conjunction with the AGG program,supports the Support Office for Aerogeophysical Research in Antarctica (SOAR), a facility that provides high-precision laser altimetry, gravity, magnetics and navigational data sets from an instrumented Twin Otter aircraft. The function of SOAR is to facilitate aerogeophysical research over ice-covered, continental Antarctica and to help in developing an understanding of the dynamic behavior of the ice sheet and the lithosphere beneath it. Satellite remote sensing continues to play a major role in the ice dynamics studies of the Antarctic ice sheet. A joint research announcement between NSF and NASA was recently released for "Investigations of Antarctic Ice Using Satellite Data". The motivation for this joint announcement was the recent synthetic aperture mapping mission of the Antarctic continent, using the Canadian RADARSAT satellite. This is the first high-resolution synthetic aperture radar dataset of the entire Antarctic continent and provides an unprecedented look at the Antarctic continent. The data obtained will be useful for research in a number of disciplines, including studies of Antarctic sea ice, the West and East Antarctic ice sheets and the geology of the continent. The data also provide a baseline against which future changes over this

remote region can be measured. Finally, deep ice-core drilling was completed this year at Vostok Station as part of an international collaboration between the United States, Russia and France. The core, which reached a depth of 3623 m, is being studied by numerous investigators from the United States, France and Russia and has led to important advances in understanding past climate and environmental changes over several glacial–interglacial cycles.

A new program is the U.S. component of the International Trans-Antarctic Scientific Expedition (ITASE). The aim of the ITASE program is to determine the spatial variability of Antarctic climate (e.g. accumulation rate, air temperature, atmospheric circulation) and the environmental variability of parameters such as sea ice, oceanographic productivity, and anthropogenic impacts over the last 200 years. Planning is currently underway for the first of four traverses to take place during the 1999/2000 austral summer field season. ITASE will produce continental scale "environmental maps" to help elucidate the transfer functions between components of the atmosphere and the snow/ice, validate atmospheric models, and interpolate spatial time-series by satellite remote sensing. ITASE is formally accepted at the international level by both PAGES (IGBP) and GLOCHANT (SCAR).

The Arctic Natural Sciences (ANS) Program is a multidisciplinary program in OPP which supports research in glaciology in addition to other disciplines such as atmospheric sciences, biological sciences, earth sciences and oceanography. The ANS program supports single investigator projects and does not encourage large scientific initiatives. Glaciological projects in the Arctic have included studies of numerous glaciers in Alaska and studies of processes which occur in snow-covered regions of the Northern Hemisphere. An example of research supported by ANS is a study which focuses on the dynamics of the Le Conte Glacier in southeastern Alaska. This glacier has been stable for 33 years, but rapidly began to calve and retreat in December 1994. Scientists are studying the whole glacier by measuring a variety of parameters along the entire length of the glacier. Another example of research in glaciology/glacial geology supported by the ANS Program is a study of the Fireweed Rock Glacier in the Wrangell Mountains, Alaska in which the entire snout recently calved catastrophically. Scientific interest in rock glaciers has increased in recent years because of the geotechnical problems and natural hazards they pose, their potential for archiving past and present geologic conditions in alpine environments, their significance in the hydologic cycle and their role as a debris-transport mechanism. Scientists are also developing a record of Holocene climatic change through the analysis of microparticles, major ions, and physical stratigraphy on a 300 m ice core and snow pits from the Devon Ice Cap in the Canadian Arctic Archipelago. The results should provide important information on the timing and cause of climate change during the Holocene and the regionalization of that change. Future ice-coring programs are anticipated in the circum-Arctic region in collaboration with scientists from other countries. Guidance for the collection of future ice cores is available from the Ice-Core Circum-Arctic Paleoclimate Program (ICAPP) and other programs coordinated through PAGES/IGBP. Another study will help to determine the mass balance of the Greenland ice sheet by developing simple, realistic numerical models for ice-sheet response to environmental forcing, describing the pattern of flow in northwest Greenland and determining scenarios of past climate evolution consistent with the measured mass balance.

The Arctic System Science (ARCSS) Program supports ongoing analyses of the GISP2 ice core (completed in 1993) through the NSF Earth System History program. To facilitate an interpretation of the record of atmospheric chemistry contained in the GISP2 ice core, ARCSS supported a pilot winter-over sampling program in 1997/98 at Summit. The winter-over project collected atmospheric and snow samples for analysis of chemical species that can be measured in the ice core and used to determine the history of atmospheric chemistry for the past 100,000+ years. Four researchers successfully weathered the Summit winter in a new facility installed in 1997 and collected a nearly continuous set of samples that are now being analyzed. (http://www.hwr.arizona.edu/~Alpine/Summit/titlepg.html). The success of the winter-over project will be assessed in the coming months and the possible continuation of a long-term winter sampling program at Summit is under discussion by U.S. and European researchers.

For more information please contact the following Program Managers in the Office of Polar Programs:

Julie Palais – Antarctic Glaciology Program
Tel [1](703)306-1033; jpalais@nsf.gov
Jane Dionne –Arctic Natural Sciences
Tel [1](703)3061029; jdionne@nsf.gov
Mike Ledbetter –Arctic System Science
Tel [1](703)306-1029; mledbett@nsf.gov

Submitted by Julie Palais

INTERNATIONAL GLACIOLOGICAL SOCIETY

ANNUAL GENERAL MEETING 1998

MINUTES OF THE ANNUAL GENERAL MEETING OF THE INTERNATIONAL GLACIOLOGICAL SOCIETY

19 August 1998 in the Folkets Hus (Kiruna Conference Centre), Kiruna, Sweden

The President, Dr Norikazu Maeno, was in the Chair. 38 members from 12 countries were present.

1. The Minutes of the last Annual General Meeting, published in the *ICE*, 1997, No. 115, p.23–25, were approved on a motion by D. Sugden, seconded by C.B. Ritz and signed by the President.

2. The President gave the following report for 1997–98:

Since my last report to you in Hobart in July 1997 there have been a number of significant staff changes in Cambridge. In August, Brenda Varney left; she was one of those who set copy for our publications. David Rootes resigned at the end of 1997 to pursue other activities, after a two month absence in Antarctica. Following this, in August 1998, David Garbett was hired as an editorial assistant to the Secretary General to help with the publication side of the Society's operations. He comes from the Centre for Glaciology in Aberystwyth and has worked both at the Scott Polar Research Institute and the British Antarctic Survey.

Three issues of the *Journal of Glaciology* have been printed since Hobart. *Annals of Glaciology* 25, papers from the Victoria meeting and *Annals of Glaciology* 26, papers from the Chamonix meeting, have now been published. All 115 accepted papers from the Hobart meeting, *Annals of Glaciology* 27, have been copy-edited and set, following receipt of the last papers in April. It is expected that the layout of the more than 700 pages will have been completed by the end of September and will be printed shortly afterwards.

Our new *Journal of Glaciology* editorial team, of Will Harrison, Matthew Sturm and Monica Court, is functioning well and has put in place procedures that should benefit all authors. All remaining papers submitted before January 1998 are still being handled by Doug MacAyeal who will see them through to completion. R.A. Bindschadler, D. Dahl-Jensen, N.R. Iverson, R. Naruse and J.B. Johnson joined the Editorial Board earlier this year. Council has now approved the appointment of J. Walder and M. Lange and the re-appointment of M.J. Hambrey, R. LeB. Hooke and P. Schwerdtfeger. By the beginning of August 1998, 55 manuscripts had been received by the editor's office. Of these, 47 are in the process of review or revision and 6 have been accepted for publication.

The changes to the style of the *Journal of Glaciology* and *Annals of Glaciology*, discussed previously, have now been implemented fully. They have resulted in a higher number of words per page, allowing more papers to be published in the Journal each year, for the same cost to the Society and better value for the five pages offered to *Annals* authors. Concerns about the quality of reproduction have been addressed by changing the type of paper used and the scanning resolution. The latest issue of the *Journal of Glaciology* exemplifies these changes.

We are actively pursuing the problem of the status of the *Annals of Glaciology* with respect to the Science Citation Index, an issue of great concern to all of us.

Two issues of *ICE* have been published. After discussions with the printer we have moved to same-size camera-ready copy generated in Cambridge. The new procedure has resulted in significant cost and time savings. Council has decided to revert to three mailings of *ICE* per year.

For the meeting here in Kiruna, the Cambridge office has worked closely with the local organizers and with the editorial board. I must say that the support received from the local group, under the direction of Per Holmlund and Peter Jansson, has been magnificent and much appreciated. Our thanks to all of them for helping make this meeting a success. I would also like to express appreciation to Johan Kleman and his editorial board for all their hard work.

Next month we will be working closely with Jo Jacka on various editorial aspects of the Sixth International Symposium on Antarctic Glaciology, being held in Lanzhou. Plans are well in hand for subsequent IGS meetings and you will find the details in *ICE*.

As mentioned in the recent issue of *ICE*, the IGS Web page will henceforth be managed from Cambridge. Our thanks to Tina Hulbe for developing and hosting this over the past few years. The site is being further developed and checked and will be made available soon.

This year saw the retirement of Mr David Shepherd, of Peters Elworthy and Moore, who has been guiding the preparation of our annual accounts for a number of years. To him we extend thanks and best wishes for a happy retirement. We look forward to working with Mr Tony Dewey in the future.

Once again we are fortunate to have our Treasurer with us. He will be presenting the accounts and reporting on the state of our finances. Council has approved a slight increase in the rates for 1999 to £52. This has been held well below the expected rate of inflation because of our

concerns about the impact of the strong pound on non-UK members.

Last night, I had the pleasure of presenting the Seligman Crystal to Dr Sigfús J. Johnsen. Today I have the further pleasure of announcing that Council has unanimously approved the award of the Richardson Medal to Dr Garry K.C. Clarke.

Garry Clarke has provided outstanding service to the Society in a number of areas. In the early years of the development of the desk-top publishing system, 3B2, now used by the Society, he spent much time and effort working with the software developers to incorporate T_EX into the package so it would meet the needs of the Society's authors. As President, he saw the Society through some very difficult times, and it was his persuasive skills that enabled a solution to be found to the financial difficulties then troubling the Society. He sought to expand our publication programme and has been the prime mover in putting together material that we hope to publish as our first source book in glaciology. Finally, it is perhaps fitting that the person who conceived, funded, helped design and implement this important addition to the Society's awards should now be recognized through it for everything he has done to help the Society flourish and grow.

On behalf of you all, I would like to express my thanks to our headquarters' staff: to Simon Ommanney, our Secretary General; his assistant Linda Gorman; and those others who help maintain the quality of our publications and service to members — Ray Adie, Ken Moxham and Sylva Gethin, our copy editors, and Sally Stonehouse who processes your manuscripts. To the members of our three committees, Nominations, Publications and Awards, to Will Harrison our Chief Scientific Editor, and to Matthew Sturm the Assistant Chief Editor and the members of their Editorial Board, we also express our warmest thanks.

H. Röthlisberger proposed and C.B. Ritz seconded that the President's report be accepted. This was carried unanimously.

3. The Treasurer, Dr J.A. Heap, presented the following report with the audited Financial Statements for the year ended 31 December 1997.

"The state of the Society's finances is best summarised by considering the changes from 31 December 1996 to 31 December 1997 in the following funds, as shown on page 13 of the accounts:

Seligman Fund: increased from £2164 to £2245, as a consequence of interest accrual;

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

Annals Fund: increased from £56,424 to £60,837;

Publications Fund: increased from £13,198 to £13,744, as a consequence of sales, royalties and interest accrual;

Future Volumes: increased from £12,706 to £41,801 reflecting principally advanced income received with respect to *Annals* 26 and *Annals* 27;

Accumulated Fund: increased from £36,327 to £58,266 (page 6) consequent upon a profit in that account for the year of £19,724 plus a gain of £2,215 in the value of investments due to an adjustment to market value (page 12, note 7).

In 1997 the Society published 606 pages in the *Journal of Glaciology* and 895 pages in the *Annals of Glaciology*. In 1996 the figures were 596 for the *Journal* and 674 for the *Annals*, a year with two issues of the *Annals*.

As I noted in my report for 1997, the Society's publications are still very much dependent on the provision of page charges, the revenue exceeds that derived from the total of members' dues. I wish to register the Society's warm thanks to all those authors who have been both able and ready 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 Junior memberships have increased, there has been a disturbing decline in Full memberships. If the Society is to survive and continue to serve the science, we need to increase our membership base to at least 1000. If you know of colleagues or students who are not members, please encourage them to join. I believe they will find it is extremely good value for money. Also, please ensure that libraries in any institutions in which you have influence either maintain their subscriptions or take one out."

A.P. Stroeven proposed and P. Holmlund seconded that the Treasurer's report be accepted. This was carried unanimously.

4. Election of auditors for the 1998 accounts. J.A. Heap proposed and P.T. Davis seconded that Messrs Peters, Elworthy and Moore of Cambridge be elected auditors for the 1998 accounts. This was carried unanimously.

5. Election to the Council 1998–2001. After circulation to all members of the Society of the Council's suggested list of nominees, no further nominations were received, and the following people were therefore elected unanimously:

Treasurer:	John A. Heap
Elective Members:	Sridhar Anandakrishnan
	Heinz Blatter
	Yoshiyuki Fujii
	Eric Wolff

The President thanked those members who had served on the previous Council and were now retiring: Eizi Akitaya, Almut Iken, Liz Morris and Ed Waddington.

The AGM was adjourned on a motion from J.A. Heap, seconded by A.J. Payne.

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

Innsbruck, Austria, 22–26 May 2000

CO-SPONSORED BY

Federal Ministry of Agriculture and Forest
Institute for Avalanche and Torrent Research (FBVA)
Governor and Province of Tyrol
Mayor and City of Innsbruck
Congress Innsbruck GmbH

FIRST CIRCULAR

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

SYMPOSIUM ORGANIZATION
Simon Ommanney (Secretary General, International Glaciological Society)

CHIEF SCIENTIFIC EDITOR
to be appointed

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

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

This Symposium will focus on those aspects of snow science related to understanding the snow cover, its properties and movement.

TOPICS
The suggested topics include:

- snow properties and structure
- snow-cover distribution
- snow drifting/blowing snow
- snowmelt and water quality
- modelling snow processes
- artificial snow ecology
- avalanche risk assessment
- avalanche snow rheology
- hazard mapping and zoning
- influence of forest and vegetation cover on snow distribution and movement
- avalanches
- avalanche dynamics
- avalanche control
- model verification
- snow ecology
- slush flows

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

PUBLICATION
The Proceedings of the symposium will be published by the Society in the *Annals of Glaciology*. All papers (including poster papers) will be refereed and edited according to the Society's regular standards before being accepted for publication.

ACCOMMODATION
Details will be given in the Second Circular. A full range of hotel and hostel accommodation will be available.

EXCURSIONS
There will be a mid-week excursion to an avalanche catchment in the Innsbruck Nordkette mountains and consideration is being given to a post-symposium tour to the Sellrain mountains (Haggen) and Arlberg region. Details will be provided in the Second Circular.

FURTHER INFORMATION
If you wish to attend the symposium please return the attached form as soon as possible. The Second Circular will give information about accommodation, the general programme, and preparation of abstracts and final papers. Copies of the Second Circular will be sent to those who return the attached reply form. Members of the International Glaciological Society will automatically receive one. Further information will be posted on the IGS Web site:

http://www.spri.cam.ac.uk/igs/home.htm

PLEASE RETURN FORM IMMEDIATELY TO:
Secretary General, International Glaciological Society,
Lensfield Road, Cambridge CB2 1ER, U.K.
Tel: [44](1223)355974; Fax: [44](1223)336543
E-mail: Int_Glaciol_Soc@compuserve.com

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

Innsbruck, Austria
22–26 May 2000

Family Name: _____

First Name(s): _____

Office Address: _____

_____

Tel: _____ FAX: _____

E-mail: _____

I hope to participate ☐

I expect to submit an abstract ☐

My abstract will be on to the following topic(s):

_____

I hope to join the post-symposium tour ☐

I am interested in an accompanying persons programme ☐

SIXTH IGS NORDIC BRANCH MEETING

The Stockholm University Department of Physical Geography hosted the 6th IGS Nordic Branch Meeting, 6–7 November 1998. The meeting was attended by 40 persons from Denmark, Finland, Norway, Sweden, Estonia, and Switzerland. As usual talks were given on a broad set of topics reflecting the width of glaciology in the Nordic countries. The traditional subjects of ice-core studies, from both Antarctica and Svalbard, and mass balance were covered in several talks. Other talks covered applications of hydrological models to run-off on Greenland, Ice Age ground-water formation in Estonia, snow distribution in Finland, ground-penetrating radar measurements of ice depth and temperature on Spitsbergen, ice velocity from SAR interferometry, and subglacial experiments at the Engabreen subglacial observatory. The latter showing very promising results on the relationship between water pressure and sliding. A refreshing talk on the interpretation of image data from the ice-covered Jovian moon, Europa, was also presented with an evaluation of the use of GPR in investigating the internal structure of the surface layer of the moon.

The discussions during the talks and the breaks were very fruitful and, again, manifested the importance of this form of regional meeting. During the final discussion, the need for networking between the participating countries, both in terms of research but also in terms of promoting glaciological education was emphasized. This is likely to lead to a strengthening of exchange between the participating countries.

The next Nordic Branch meeting will be arranged in Finland in the fall of 1999.

Peter Jansson

QUATERNARY SCIENCE REVIEWS

The journal *Quaternary Science Reviews* is now available to members of the IGS at a special rate for their personal use only. For 1999 this rate is 235 Dutch Guilders (approximately £75). For more information about *QSR* please see:

http://www.elsevier.nl/locate/quascirev

For a free sample copy or to take out a subscription to *QSR* please contact Peter A. Henn, Senior Publishing Editor, Earth Sciences, Elsevier Science Ltd., The Boulevard, Langford Lane, Kidlington, Oxford OX5 1GB, U.K. (Tel [44](1865)843-327; Fax [44] (1865) 843-960; p.henn@elsevier.co.uk)

IGS WEB SITE

http://www.spri.cam.ac.uk/igs/home.htm

As announced in the last issue of ICE, the IGS Web site has been re-established in Cambridge with assistance from the Scott Polar Research Institute and is available for members to use. It includes background information on the International Glaciological Society, committees and the constitution, membership rates and an application form, your national correspondents, contents of recent issues of the *Journal of Glaciology* and the *Annals of Glaciology*. It also includes circulars for forthcoming meetings, links to local home pages for these meetings, and a calendar of forthcoming meetings of other organizations. Efforts are underway to provide better navigation tools. Comments and suggestions for improvement are welcomed.

JOURNAL OF GLACIOLOGY

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

P BARTELT, B SALM AND U GRUBER
Calculating dense snow avalanche runout using a Voellmy-fluid model with active/passive longitudinal straining

M DELMOTTE, D RAYNAUD, V MORGAN AND J JOUZEL
Climatic and glaciological information inferred from air-content measurements of a Law Dome (East Antarctica) ice core

U H FISCHER, G K C CLARKE AND H BLATTER
Evidence for temporally-varying "sticky spots" at the base of Trapridge Glacier

R R FORSTER, E RIGNOT, B L ISACKS AND K C JEZEK
Interferometric radar observations of glaciers Europa and Penguin, Hielo Patagónico Sur, Chile

L W GOLD
Statistical characteristics for the strain dependent density and the spatial position for deformation induced cracks in columnar-grain ice

M O JEFFRIES, T ZHANG, K FREY AND N KOZLENKO
Conductive heat flux through the snow cover on lakes and tundra in late winter on the Alaskan North Slope

I JOUGHIN, M FAHNESTOCK, R KWOK, P GOGINENI AND C ALLEN
Ice flow of Humboldt, Petermann, and Ryder Glaciers, North Greenland

C J KEYLOCK, D M MCCLUNG AND M M MAGNÚSSON
Avalanche risk mapping by simulation

J KRÜGER AND J S ABER
Correspondence. Formation of supraglacial sediment accumulations on Kötlujökull, Iceland

G E LISTON, J.-G WINTHER, O BRULAND, H ELVEHØY AND K SAND
Below-surface ice-melt on the coastal Antarctic ice sheet

T SCHNEIDER
Water movement in the firn of Storglaciären

A K SINGH
An investigation on the thermal conductivity of snow

T THORSTEINSSON, E D WADDINGTON AND K TAYLOR
Strain rate enhancement at Dye 3, Greenland

M R VAN DEN BROEKE, J.-G WINTHER, E ISAKSSON, J F PINGLOT, L KARLÖF, T EIKEN AND L CONRADS
Climate variables along a traverse line in Dronning Maud Land, East Antarctica

A WELLS
Correspondence. Whirled patterns in thawing snow

80TH BIRTHDAY CELEBRATIONS FOR ACADEMICIAN SHI YAFENG 10 SEPTEMBER 1998, LANZHOU, CHINA

The following is the text of an address by the Secretary General on the occasion of the celebration of the 80th birthday of Academician Shi Yafeng, Honorary Member of the International Glaciological Society.

I feel it is a very great privilege to have been invited here today to celebrate the 40th Anniversary of the Institute of Glaciology and Geocryology with you and to have been given the opportunity to help you honour Academician Shi Yafeng on his 80th birthday.

My friendship with him and indeed with his successor as Director of this Institute, Professor Xie Zichu, goes back to 1978. This was a time of great importance for China as doors swung open to the outside world. But it was equally important for us as we had a chance to appreciate the quality of your science and your scientists.

What I had not realized until this week was the significant role played in this by Fritz Müller who was my professor and mentor. Following our work together on developing the specifications for the world inventory, published as a Unesco report, it was Professor Müller who approached the Chinese government to solicit their cooperation in this venture. This led to Chinese participation in the glacier inventory workshop in Switzerland and our first encounter.

However, it was not until I was able to visit Lanzhou in 1984, as a participant in an International Glaciological Society symposium, that I was able to appreciate the enormous role played by Professor Shi in Chinese glaciology and see the fruits of his labours, often in the face of extreme adversity. At that time I was impressed to see the work you had undertaken on the glacier inventory of China and the start of a remote sensing capability that has now become such an essential part of much of what we do. You had already had an Institute for more than 25 years, whereas in Canada, my own

organization was just about to start building a hydrology institute for us in Saskatoon.

As I understand it, it was Professor Shi's expertise and leadership skills that led to a successful expedition to the Qilian Shan that so clearly demonstrated the importance of the mountain snow and ice resources to water supply in the province that he was able to convince the authorities to establish your institute.

It was not until after the initial contact in 1978 that we became aware of more aspects of his work. However he had published a paper in English on the Mount Jolmo Lungma area in Scientia Sinica in 1975, followed by one on the Batura Glacier in 1979. But most western glaciologists would probably not have become aware of his work until the first paper he published in the *Journal of Glaciology* on snow cover in China and the avalanche phenomena of Batura Glacier in Pakistan: the latter being a fruitful area for many other studies. His many other English language papers have now been reproduced and bound by the Institute.

I need not dwell on his scientific achievements because I am sure that all of you, who know them so much better than I do, will make sure that none are forgotten. I know that publication of results from some of his earlier work was considerably delayed due to circumstances at the time which made it impossible to compile the reports. Because of my own interests, I am principally aware of his work on glacier variations, glacier inventory, the distribution of glaciers and the effects of climate change, but his versatility has led him into studies of ground ice, the Qinghai-Xizang Plateau, Quaternary glaciation, and remote sensing, among others things.

When I was here in 1984 we looked to the future, to the success and growth of glaciology in China and to international cooperation. That we now see such an active international component, with Chinese scientists working in others parts of the world and foreign scientists working here, is an indication of how successful Prof. Shi has been in reaching out to the international community. That we now see here in Lanzhou the State Key Laboratory of Frozen Soil and Engineering and the brand new Laboratory of Ice Core and Cold Regions Environment is an enormous testament to the foresight, leadership and ability of one man. Others may have helped but without him I suspect far less would have been achieved.

It was in recognition of the pivotal role Academician Shi has played in Chinese glaciology, and in bringing Chinese glaciology and glaciologists to the rest of us, that the International Glaciological Society chose to award him Honorary Membership.

It is my very great pleasure and honour to be here as a representative of that Society and as a friend to say thank you for all you have done and may you have long life and many achievements still to come. As a small birthday present I would like to give you a copy of our latest *Annals of Glaciology*. Appropriately, it deals with snow and avalanches, the subject of your first paper in the *Journal*.

GLACIOLOGICAL DIARY

** IGS sponsored * IGS co-sponsored

1999

19–22 April
64th Western Snow Conference, South Lake Tahoe, California, USA
R. Kattlemann, Sierra Nevada Aquatic Research Lab., Star Route 1, P.O. Box 198, Mammoth Lakes, CA 93546, USA (Tel [1](619)935-4903; Fax [1](619)935-4867; rick@icess.ucsb.edu; http://snobear.colorado.edu/WSC/WSC.html)

20–23 April
International Conference on Monitoring the Cryosphere, Pushchino, Moscow region, Russia
Consolidated Scientific Council on Earth Cryology, Russian Acad. of Sciences, Fersman Str. 11/2, Apt. 68, 117312 Moscow, Russia (kriozem@glas.apc.org)

20–22 April 1999
* EISMINT/EPICA Symposium on Ice Sheet Modelling and Deep Ice Drilling, EGS General Assembly, Den Haag, The Netherlands
C.S.M. Doake, British Antarctic Survey, High Cross, Cambridge CB3 OET, UK (Tel [44](1223) 251-488; Fax [44](1223)362- 616; csmd@ bas. ac.uk; A. Richter: EGS@linax1.dnet.gwdg.de

21–26 May
European Research Conference on Palaeoclimate Modelling and Analysis, Albufeira, Portugal
EURESCO, 1 quai Lezay-Marnésia, F-67080 Strasbourg Cedex, France (Tel [33](3)88-76-71-35; Fax [33](3)88-36-69-87; euresco@esf.org; http://www.esf.org/euresco

30 May – 4 June
ISOPE-99, 9th International Offshore and Polar Engineering Conference, Brest, France
ISOPE-99, P.O. Box 1107, Golden, CO 80402-1107, USA (Tel [1](303)420-8114; Fax [1](303)420-3760; http://www.ifremer.fr/isope99/)

2–4 June
56th Eastern Snow Conference, Fredericton, New Brunswick, Canada
D.K. Hall, Code 974, NASA/Goddard Space Flight Center, Greenbelt, MD 20771, USA (Tel [1](301) 614-5771; Fax [1](301)614-5808; dhall@glacier.gsfc.nasa.gov; http://www.tor.ec.gc.ca/CRYSYS/esc/)

11–16 July
OMAE '99, St. John's, Newfoundland, Canada
J. Myrick-Harris, Conference Office, Hatcher House, Memorial University of Newfoundland, St. John's, Nfld, Canada (Tel [1](709)737-7922; Fax [1](709)737-3520; jharris@morgan.ucs.mun.ca; http://www.mun.ca/ccore/omae99/)

18–23 July
5th International Conference on Mars, Pasadena, California
A.L. Albee, Graduate Office, Mail Code 02-31, California Institute of Technology, Pasadena, CA 91125, USA (Tel [1](626)395-6367; Fax [1](626)577-9246; 5thMars99@caltech.edu)

19–30 July
XXII General Assembly of the International Union of Geodesy and Geophysics, Birmingham, UK (http://www.bham.ac.uk/IUGG99/)
Interactions Between the Cryosphere, Climate and Greenhouse Gases
M. Tranter, Department of Geography, University of Bristol, Bristol BS8 1SS, UK (Tel [44](117) 928-8307; Fax [44](117)928-7878; tranter@bris. ac.uk; http://www.wlu.ca/~wwwiahs/index.html)
Hydrology of Ice-covered Rivers
M.G. Ferrick, CRREL, 72 Lyme Road, Hanover, NH 03755-1290, USA (Tel [1](603)646-4287; Fax [1](603)646-4785: mferrick@crrel.usace.army.mil)
Ice Sheets, Oceans, and the Earth's Shape: Modern Perspectives on Sea-level Change
C.R Bentley, Geophysical and Polar Research Center, University of Wisconsin, Madison, WI 53706, USA (Tel [1](608)262-1922; Fax [1](608)262-0693; bentley@geology.wisc.edu

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

16–20 August
** International Symposium on the Verification of Cryospheric Models, Zürich, Switzerland
Secretary General, International Glaciological Society, Lensfield Road, Cambridge, CB2 1ER, UK (http://www.geo.umnw.ethz.ch/igs-symposium)

22–25 August,
* 6th International Symposium on Thermal Engineering and Sciences for Cold Regions, Darmstadt, Germany
Y.Wang, Institut für Mechanik, Technische Universität Darmstadt, Hochschulstrasse 1, D-64289 Darmstadt, Germany (Tel [49](6151)63196; Fax [49](6151)164120; wang@mechanik.tu-darmstadt.de; www.mechanik.tu-darmstadt.de/ag3/ISTESCR99)

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

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

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

17–22 September
European Research Conference on Polar Regions and Quaternary Climate: Towards High-Resolution Records of the Last Cliamtic Cycle — The Antarctic Perspective, Giens, near Toulouse, France
EURESCO, 1 quai Lezay-Marnésia, F-67080 Strasbourg Cedex, France (Fax [33](3)88-36-69-87; euresco@esf.org; http://www.esf.org/euresco

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

2000

22–26 May
** International Symposium on Snow and Avalanches, Innsbruck, Austria
Secretary General, International Glaciological Society, Lensfield Road, Cambridge, CB2 1ER, UK

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

18–23 June
** International Symposium on Sea Ice and its Interactions with the Ocean, Atmosphere and Biosphere, Fairbanks, Alaska, USA
Secretary General, International Glaciological Society, Lensfield Road, Cambridge, CB2 1ER, UK (http://www.gi.alaska.edu/seaicesymposium)

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

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

2001

23–27 July 2001
Physics and Chemistry of Ice, University of Kent, Canterbury, UK
John Dore and Vicky Nield
(Fax [44](1227)827-558; pcice@ukc.ac.uk; http://kiwi.ukc.ac.uk/physics/events.html)

2001

** Remote Sensing in Glaciology, Washington, DC
Secretary General, International Glaciological Society, Lensfield Road, Cambridge, CB2 1ER, UK

August
** Ice Cores and Climate, Kangerlussuag, Greenland
Secretary General, International Glaciological Society, Lensfield Road, Cambridge, CB2 1ER, UK

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Lensfield Road, Cambridge CB2 1ER, England

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