Number 99 *2nd Issue 1992*

ICE

NEWS BULLETIN OF THE INTERNATIONAL GLACIOLOGICAL SOCIETY

INTERNATIONAL GLACIOLOGICAL SOCIETY

The International Glaciological Society is looking for a new Secretary General who would be free to join the Society in Cambridge, England in late 1993.

The job description details will be advertised in ICE and elsewhere within the next few months. The appointment will be confirmed in the spring of 1993.

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ICE

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CONTENTS

COVER PICTURE: Volcan Osorno (2660 m), a volcano on the eastern shore of Largo Llanquihue, Chile. A hotel and ski slope are situated on the western side. Photograph by D. M. Rootes.

DENMARK

For abbreviations, see end of this report

Glaciotectonics

(S. A. S. Pedersen, DGU)

Glaciotectonic studies are being carried out in order to understand the 3-dimensional framework of the uppermost deposits in Denmark. The basis for these studies is the description of the well-exposed coastal cliff sections displaying cross sections through glaciotectonic thrust fault complexes, glaciotectonic duplexes and foreland fold and fault structures situated in various stratigraphic and dynamic settings. In these studies two main deformational regimes are distinguished: (1) the structures due to gravity spreading deformation, and (2) the structures formed by shear along the sole of the glacier.

The project is related to the glaciotectonic subgroup under the INQUA commission on genesis and lithology of Quaternary deposits. The project has reference to the working group preparing a glaciotectonic map of North Europe and North America.

Map of the Quaternary deposits in Denmark 1 : 200 000

(S. A. S. Pedersen, I. Salinas, K. S. Petersen, L. Aa. Rasmussen, DGU)

The map of Quaternary deposits in Denmark, published 1989, is based on a systematic geological mapping supplemented by well data collected in DGU. The map shows the following glacial sediments: sandy and gravelly till; till clayey and fine-sandy; glaciofluvial sand and gravel; glaciolacustrine laminated clay, silt and fine sand; sandur deposits and extramarginal river-valley terraces.

Mapping of glaciogene deposits

(K. S. Petersen, S. A. S. Pedersen, L. Aa. Rasmussen, DGU)

The dynamic features observed during the geological mapping procedure have formed the basis of the Pleistocene stratigraphy following the kinetostratigraphic concept.

Geological mapping of areas in central parts of Jutland has resulted in map sheets from the Viborg area and the Ulfborg area to the west at the North Sea. On the Djursland Peninsula three map sheets are used where the evidence of a continuous upper kinetostratigraphic unit related to the Late Middle Weichselian ice advance can be demonstrated.

Pleistocene palaeoenvironments

(M. Houmakr-Neilsen, GI/UCPH, E. K. Kolstrup, X)

The establishment of a straigraphic model for the Late Pleistocene of southeast Denmark is at present centered on the island of Møn. Here key sections containing Saalian, Eemian and Weichselian sequences are studied in terms of lithology, sedimentary structures, biogenic material, geochemical properties, age determinations and chronology of glaciotectonic deformation.

Time slices of different lengths are described with regard to palaeoenvironments. These range from boreal marine fjord systems during the Eemian over Early- to Mid-Weichselian periglacial environments with heather and shrub vegetation dominated by wind activity and solifluction to glacial conditions with glaciotectonic deformation and till deposition during the Mid- and Late Weichselian.

The project is supported by the Carlsberg Foundation and the Danish Natural Science Research Council and work is still in progress.

DENMARK–NORWAY

Okstindan Glacier project

(N. T. Knudsen, J. t. Møller, GI/AU; W. H. Theakstone, MU)

During 1989–91 mass balance components have been measured on Austre Okstindbreen. Water balance of the glacier's hydrological basin has been determined during ablation periods. Measurements of horizontal ice velocity are measured at about 20 closely distributed stakes at the equilibrium line and in the accumulation and ablation area. The results are presented in an annual report.

The chemical and oxygen isotopic composition of snow and ice on the glacier and glacial river water and liquid precipitation are investigated to gain information on the temporal and spatial variability within and beneath the glacier, as well as processes in the accumulation area. The investigations have been supported by time-series analyses of climatic variables and river discharge.

A portable radio-echo sounder (built in Aarhus) was used during the summer of 1990 and provided detailed information on ice thickness in the ablation area and at the equilibrium line. In 1992 the measurements will continue to obtain information on ice thickness in the accumulation area.

DENMARK–GREENLAND

Weather and climate in Greenland

(P. Frich, DMI)

A relational data base has been operated at the Danish Meteorological Institute since 1986. Data from more than 40 stations in Greenland are added to the database every three hours. Nearly half of the stations are equipped with automatic sensors for air pressure, wind speed, wind direction, air temperature and relative humidity. Data from automatic stations are transferred to the database via ARGOS telecommunication satellites. Most of these unmanned stations were started during the period 1980 to 1984.

Obvservations from 15 stations have been recorded in the database since 1958 (1961). The quality of the data is quite good during the 1960s, rather poor during the 1970s and quite good during the 1980s. Unfortunately, the precipitation data are very difficult to correct. This task is a continuous process which will require both manpower and economic support in the future.

North Atlantic climatological dataset (NACD)

(P. Frich, DMI; B. Aune, DNMI; R. Heino, FMI; G. R. Demarée, KMI; A. F. V. van Engelen, KNMI; L. Keegan, MS; B. Dahlström, SMHI; R. Tabony, UKMO; T. Jonsson, VI)

More than 70 stations in the North Atlantic region (50°–80° N, 60°–40° E) have been selected by the nine national meteorological institutions. Monthly climate data comprising more than 20 climatic elements are being digitized. Most of these stations have observational records which started in the latter half of the 19th century.

Spatial and temporal homogeneity are being tested and corrections applied when necessary. Missing values are interpolated. The purpose is to establish a complete and homgeneous dataset of monthly climatic values.

The North Atlantic Climatological Dataset (NACD) could be used by glaciologists in the study of mass-balance conditions in Greenland, Iceland and Scandinavia. The NACD information on air temperature, precipitation, cloud cover, hours of bright sunshine and wind conditions is relevant when dealing with the response of glaciers to changes in climate.

Hydro-meteorological data base in Greenland

(C. Kern-Hansen, GFU)

Since the late 1970s intensive investigations of hydropower potential have been carried out in Greenland. A major part of these investigations has been a systematic monitoring of runoff and other hydro-meteorological parameters (precipitation, air, lake and rock temperatures, barometric pressure, wind speed and direction, short- and long-wave radiation etc.). This monitoring has been conducted by Greenland Field Investigations, Hydro-Technical Division (formerly a department of Greenland Technical Organization, now a Greenland Home Rule Agency).

Automatic climate stations have been operating on approximately 80 different locations during the last 15 years, and today stations are recording every 3 hours on 40 different locations. All data are stored in a data base operated by Greenland Field Investigations.

Data for permafrost studies in Greenland

(C. Kern-Hansen, GFU)

The design of a hydropower plant with both underground and water-filled tunnels in permafrozen rock has initiated a study of the prevailing subsurface and lake temperatures in an area near Ilulissat/Jakobshavn, West Greenland. During a 3 year period, both water and rock temperature has been recorded every 3 hours by automatic climate stations.

Water temperatures were measured in two natural lakes planned as reservoirs at the margin of the Greenland ice sheet. Water temperatures were measured with a system of floating thermistor strings placed in a 40 m profile at different depths in the lakes. The temperature conditions of the intake water can be divided into a steady period (September–May, temperatures between 0.0 and 0.5°C) and an unsteady period (June–September, temperatures between 0.5 and 2.5°C).

Temperatures in the sub-surface rock were measured with thermistor strings placed at various depths in seven core drillings. The total depth of these drillings varied between 30 and 250 m. The measurements indicate that the temperature is less than 0°C below a depth of 3 m and that the temperature has stabilized at 4°C in a depth of 15 m below the surface. Further down the temperature increases to 0.5°C at a depth of 250 m.

PONAM (Polar North Atlantic Margins; late Cenozoic evolution)

The aim of this geological project is to investigate the climate/ice sheet response mechanism in areas around the Arctic North Atlantic since the Late Cenozoic, and during the last interglacial–glacial cycle in particular.

The ESF (European Science Foundation) project has participation from seven European countries. In 1989 the work began with the marine geological cruise of the German research ship *Polarstern* in the Scoresby Sund fjord coplex, East Greenland, succeeded by marine geological work on the shelves of western Svalbard and eastern Greenland, as well as major Quaternary field work on Jameson Land (1990) and eastern Svalbard (1991). In 1992 there will be 26 Quaternary geologists and students working on last interglacial–glacial sediments in East Greenland.

Holocene oceanography and climate, West Greenland

(G. Jones, WHOI; S. Funder, GMU/CPH)

The intensity of North Atlantic oceanic surface circulation has changed during the Holocene, probably as a result of orbitally induced insolation changes. However, the oceanographic change does not seem to be in phase with atmospheric climate change, as revealed in the ice cores or in the pollen record from lakes.

This project studies the response rate in the oceans, using high-resolution AMS C-14 dating and stable isotope geochemistry of mollusc shells in raised marine deposits through the Holocene hypsithermal period.

Remote sensing of sea ice in the Greenland Sea

(L. T. Pedersen, H. Skriver, H. Zhang, P. Gudmandsen, EMI/TUD)

The Electromagnetics Institute has participated in the international Greenland Sea Project for the last five years. The major objective of the participation has been to develop methods for utilization of remote-sensing data for sea-ice research.

Among the many tools developed are methods for automatic and semi-automatic tracking of ice features in sequential visible or infrared images from the NOAA satellites. The methods have been used to obtain a large dataset of 2600 observations from December 1988 to March 1989. The methods will shortly be applied to the Synthetic Aperture Radar (SAR) data of the European ERS-1 satellite launched July 1991.

Other tools developed include methods for detecting sea-ice concentration from active and passive microwave data. The methods for microwave radiometer data (passive) have been used to study large-scale variations in the daily sea-ice cover of the Greenland Sea during several winters since 1978. Ice maps from passive microwave data are presently being compared with conventional maps from the Danish Meteorological Institute. The methods for SAR data awaits evaluation with data from ERS-1 but have been successfully tested with data from SEASAT and various aircraft data. Studies are carried out of the sea-ice formation in the central Greenland Sea using all types of remote-sensing data including the fine-resolution data of ERS-1 SAR.

Thermal microwave radiation from the Greenland ice sheet

(H. Zang, P. Gudmandsen, L. T. Toudal, EMI/TUD)
An investigation of the thermal microwave radiation from the Greenland ice sheet has been carried out. Brightness temperature data from the NIMBUS-7, SMMR (Scanning Multichannel Microwave RAdiometer) from two periods (November 1978 to October 1980 and January to March 1982), i.e. including two summers and three winters have been analysed for temporal, spatial, spectral and polarization variations. It was found that in the central part of the ice sheet an area exists with very small variations in brightness temperatures through the years. The brightness temperature versus wavelength relationship is a complex function of the position on the ice sheet and there appears to be an inversion of the relationship going from north to south. In the north the radiation is larger at short wavelengths, whereas in the south the radiation is larger at the long wavelengths, with a neutral area in central Greenland.

Danish glaciology within the framework of GRIP

One of the most comprehensive efforts in Danish glaciology is a contribution to the multinational Greenland Ice Core Project (GRIP), a European research project organized under the auspices of the European Science Foundation, and funded by its member organizations in Belgium, Denmark, France, Germany, Iceland, Italy, Switzerland and the United Kingdom and by the CEC.

The goal of GRIP is to retrieve and analyse a deep ice core to bedrock at the summit of the Greenland ice sheet. The field camp, Summit, was built at 72°34′ N, 37°37′ W in 1989 and 1990. Three wooden domes are used as a workshop, drill shelter, mess hall and accommodation for some of the 30 to 50 scientists, technicians and students occupying the camp during field seasons of three months duration.

The Geophysical Institute, University of Copenhagen, is responsible for the logistics organized from Søndre Strømfjord. Heavy cargo is transported by chartered U.S. Airforce Hercules airplanes, light cargo by a Twin Otter airplane put at GRIP disposal by the British Antarctic Survey.

Drilling is accomplished by an updated version of the Danish deep drill, ISTUK. It reached a depth of 770 m in 1990 and in 1991 a depth of 2321 m, where the ice is approximately 40 000 years old. Bedrock is expected to be reached at a depth of 3050 m in late July 1992. The average core production has hitherto been 170 m per week during operation. The core recovery has been better than 99.95%. Disregarding a zone of brittle ice from 700 to 1300 m depth, the core quality has been excellent.

Ice core processing takes place in up to 40 m long subsurface laboratories. It comprises logging, cutting of samples and several analyses that need to be done shortly after retrieval of the ice. The Danish scientific contribution aims at establishing profiles of ^{18}O, acidity, dust, sulphate and nitrate concentrations in addition to down-hole measurements and ice-flow modelling.

Present expansion of the inland ice, south Greenland

(A. Weidick, GGU)
In connection with the work on a West Greenland glacier atlas and glacier inventory, the activity of a c. 1200 km-long segment of the inland ice was investigated for the years 1950 and 1985.

Around 1950 major parts of the ice margin were in a state of thinning and recession and exceptions were mainly confined to restricted highland areas where evidence of advance could be located. Updating of the conditions to 1985 reveals that marginal advances have now spread to parts of the adjoining lowland areas indicating a 'turn of the tide' where the general period of recession since last century to around 1950 is now substituted by a major tendency for advance.

Glacier mapping on Disko Island, central West Greenland

(O. Humlum, GCI/UCPH)
A comprehensive glacier mapping based on aerial photographs obtained in 1985 is currently being carried out. Frontal variations for a number of the local glaciers are studied in the field. During this century, most glaciers have melted substantially back. During the last years an increasing number of glaciers are however beginning to advance. Chamberlin Glacier, close to the Arctic Station in Godhavn town, has advanced about 50 m since 1987. The relation between glaciation, topography and wind regime is presently being analysed, both past and present. Rock glaciers are numerous on Disko Island, and are also studied within this context.

Glaciological studies on Mitdluagkat Glacier near Angmassalik, East Greenland

(O. Humlum, GCI/UCPH)
Since 1988 the mass balance has been measured each year and the glacier margin observed. Since around 1900 the glacier has melted back from a position almost at the sea to the present position 1500 m inland. Mass balance during the last years has generally been positive, especially the year 1990/91 where the ELA was at an elevation of 350 m a.s.l. compared to a normal elevation of 500 m a.s.l. This has resulted in an increase of measured surface velocities and the frontal retreat has stopped. Also sediment transport both with the glacier system and in the proglacial environment is being studied at the Mitdluagkat Glacier area.

Greenland ice sheet, mass-balance and hydraulic measurements

(H. H. Thomsen, O. B. Olesen, GGU)
Mass-balance measurements on the inland ice at Paakitsoq northeast of Jakobshavn continue. Stakes were set up in 1982, starting on an outlet glacier (69°28′ N, 50°12′ W). During the nine years of measurements the stake net has been expanded. The net consists of 15 stakes covering the elevation range from 200 to 1070 m a.s.l. The stakes are visited by helicopter twice a year during May and August.

Hot-water drilling to investigate the glacier hydraulic conditions on the inland ice at Paakitsoq was made in August 1990. Six holes were drilled to the bottom of the ice in the ablation area about 8 km from the ice margin. In three of the holes, located on a local ridge on the ice surface, no draining took place in the boreholes. In the remaining three holes, located in a local depression of the ice surface, the water level dropped several metres when the drill stopped advancing at the bottom of the ice. Water level was recorded in one of the boreholes. The continuous recordings showed a marked diurnal oscillation in water levels with high levels at 20.00–22.00 h and minima at 12.00–13.00 h. Maximum and minimum registrations in the record correspond to a borehole water pressure of 94 and 85% of the ice overburden pressure. This is comparable with measurements made further downstream on the ice in 1988 and 1989.

Englacial temperature measurements at Paakitsoq, West Greenland

(H. H. Thomsen, O. B. Olesen, GGU; H. Blatter, ETH)
Measurements of englacial temperatures continued in 1990 in the ablation zone of the inland ice at Paakitsoq, West Greenland. The work in 1990 was made in collaboration with the Swiss Federal Institute of Technology (ETH) which was conducting energy-balance measurements at the equilibrium line at Paakitsoq. Two thermistor strings were installed to depths of 500 and 600 m respectively. The 500 m string was installed about 23 km from the ice margin at an elevation of 965 m a.s.l. and 600 m string at the Swiss field camp about 38 km from the ice margin at an elevation of about 1050 m a.s.l.

Glaciological investigations at Tasersiaq, West Greenland

(O. B. Olesen, GGU)
After nine years of operation the glaciological station at Tasersiaq, West Greenland, was abandoned in the fall of 1990 due to lack of funds.

During the period summer measurements of climatological and mass-balance parameters were carried out on a continuous basis. Most of the time this involved two climatological stations on land (980 m a.s.l., east and west end of the basin) and two on the Amitsoluq ice cap at 980 and 1350 m a.s.l. Mass balance was measured spring and autumn at a network of 26 stakes while daily readings were taken at a "stake farm" with five stakes near the lower climate station.

Firn temperatures have been measured near several stakes down to 10 and 20 m below surface, while ice temperatures were measured down to 10 m near the lower climate station.

The climate has fortunately varied a great deal during the period with summer mean temperatures (June–August) from –0.2°C in 1983 to 3.6°C in 1990 with 2.0°C as summer mean for the whole period. Ablation for the same years has increased from 4 to 12 times at individual stakes.

Ablation variations on the Greenland ice sheet, West Greenland, 1961–90

(R. J. Braithwaite, O. B.Olesen, H. H. Thomsen, GGU)
Annual ice ablation has been measured at the margin of the ice sheet in West Greenland for different periods at several locations: Nordbogletscher (for 6 years, 1977/78 to 1982/83), Qamanârssûp sermia (10 years, 1977/78 to 1986/87) and at Paakitsup Akuliarusersua (9 years, 1982/83 to present). The measured series at each site were extended over the last 30 years 1961–90 by simulations using climatic data, and the extended data series were compared. The ablation variations at the three locations are remarkably similar with no sign of any trend towards increased ablation in recent years. There was generally low ablation from the mid-1970s to mid-1980s which may explain the recent thickening of the ablation area which has been detected by satellite radar altimetry. Ablation varies substantially from year to year, e.g. with a standard deviation of the order of ± 0.5 m water a^{-1}, and any future monitoring programme must detect trends of increasing ablation against this background of natural variations. Further information will appear in *Journal of Glaciology* during 1992.

The refreezing zone on the Greenland ice sheet, Paakitsoq, West Greenland

(R. J. Braithwaite, GGU)
Under the present climate there is substantial melting in the lower accumulation area of the Greenland ice sheet, but there is little or no runoff because mletwater is refrozen as ice layers within the snow pack. Under a warmer climate, refreezing will not necessarily keep pace with increased melting so that runoff may occur. Current runoff models account for refreezing in snow by assuming that meltwater is refrozen until the snow density reaches some critical threshold. This has drawbacks but few data are available for a more realistic approach. A two-year programme (1991–93) has therefore been started with support from The European Community through EPOCH (European Programme on Climatology and Natural Hazards) to test this simple assumption. Fieldwork in 1991 involved measuring mass balance and snow temperatures in a stake traverse crossing the equilibrium line at Paakitsoq (69°34′ N, 49°18′ W). Close cooperation was established in the field with parties from the Swiss Federal Institute of Technology, Zürich, Switzerland, and from the University of Colorado, Boulder, USA.

Greenland's contribution to sea-level rise under a warmer climate

(R. J. Braithwaite, GGU)
GGU's energy-balance model (see *ICE*, no. 94) has been used to estimate the increased melting that may occur on the Greenland ice sheet as a result of a warmer climate. The resulting rise in world sea level is about 0.4 mm a^{-1} for every 1° temperature rise which falls within the consensus quoted by the Intergovernmental Panel on Climate Change (IPCC) in its 1990 report. However, the GGU figure is an extrapolation based on detailed field data at only two locations in West Greenland, and improved estimates will be made in the future. A simpler degree-day approach is more appropriate for estimating ablation over the whole Greenland ice sheet but has the drawback that its main parameter (the degree-day factor) is empirical. The possible space and time variations of the degree-day factor are now being studied using synthetic ablation series generated by the more physically correct energy-balance model. Field studies of ablation–climate relations are also being planned for remote areas of Greenland, e.g. southeast Greenland in 1993 and north Greenland in 1994.

Annual workshops on the mass and energy balance of the Greenland ice sheet

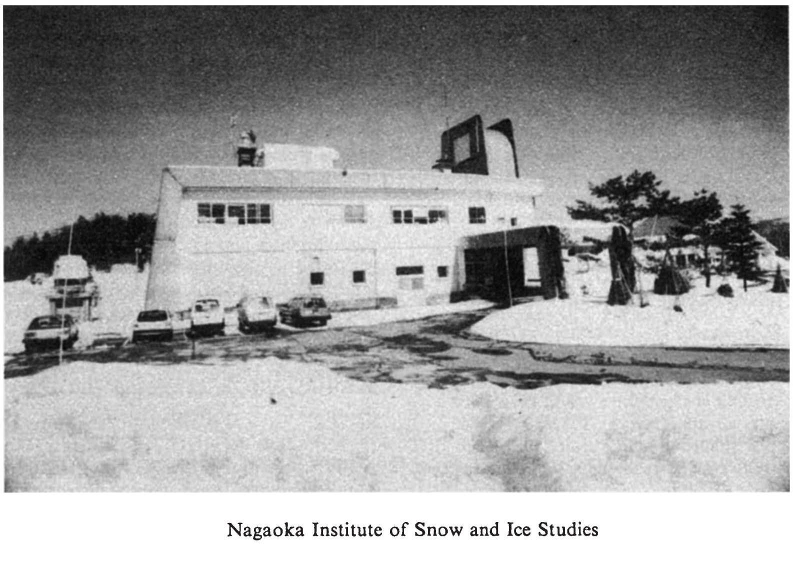
(R. J. Braithwaite, GGU; J. Oerlemans, IMAU; H. Oerter, AWI; A. Ohmura, ETH; N. Reeh, DPC)
Two workshops on the mass and energy balance of the Greenland ice sheet have already taken place, at Copenhagen in 1990 and Zermatt in 1991, and a further

one is planned for Bremerhaven in late 1992. The workshops are quite informal and represent a response to the real need for coordination and exchange between different groups working in Greenland. The workshop concept evolved naturally in the late 1980s in the context of concerns about increased melting of the Greenland ice sheet as a result of global warming. The workshops, with 20–30 participants, have been very active with brand new results and relatively many young researchers. The European emphasis of the workshops so far is entirely accidental, and participation is open to anybody actively interested in the mass and energy balance of the Greenland ice sheet. So far most contributions have come from the ablation area but representatives from the accumulation area will be very welcome in future.

Submitted by H. H. Thomsen

Abbreviations used in the text:

AWI:	Alfred Wegener Institute, Germany
DGU:	Geological Survey of Denmark
DMI:	The Danish Meteorological Institute
DNMI:	The Norwegian Meteorological Institute
DPC:	Danish Polar Center
EMI/TUD:	Electromagnetics Institute, Technical University of Denmark
ETH:	Eidgenössische Technische Hochschule, Switzerland
FMI:	Finnish Meteorological Institute
GCI/UCPH:	Geographical Institute, University of Copenhagen
GFU:	Greenland Field Investigations
GGU:	Geological Survey of Greenland
GI/AU:	Geological Institute, University of Aarhus
GI/UCPH:	Geological Institute, University of Copenhagen
GMU/CPH:	Geological Museum, Copenhagen
GPI/UCPH:	Department of Glaciology, Geophysical Institute, University of Copenhagen
IMAU:	Institute of Meteorology and Oceanography, University of Utrecht, Netherland
KMI:	Koninklijk Meteorologisch Instituut, Belgium
KNMI:	Koninklijk Nederlands Meteorologisch Instituut
MS:	Meteorological Service, Ireland
MU:	Department of Geography, Manchester University
SMHI:	The Swedish Meteorological and Hydrological Institute
UKMO:	Meteorological Office, Edinburgh
VI:	The Icelandic Meteorological Office.
WHOI:	Woods Hole Oceanographic Institution, USA
X:	Private participation



Nagaoka Institute of Snow and Ice Studies

Profile

Prior to the IGS Symposium in Nagaoka in September 1992 on Snow and Snow-related Problems, we present this Profile of the Nagaoka Institute of Snow and Ice Studies.

NAGAOKA INSTITUTE OF SNOW AND ICE STUDIES

Tsutomu Nakamura, Director

The Nagaoka Institute of Snow and Ice Studies (NISIS) is one of the two snow and ice research branches of the National Research Institute for Earth Science and Disaster Prevention (NIED), Science and Technology Agency (STA). Previously known as the National Research Center for Disaster Prevention (NRCDP), it was reorganized and its name changed to NIED on 8 June 1990.

The former name of the NISIS was the Institute of Snow and Ice Studies, founded on 16 December 1964 as a branch of the NRCDP on a small hill in the suburbs of Nagaoka. It was founded at first to solve snow problems in the heaviest snowfall area of Japan, just after the 38-gousetsu winter. (Gousetsu – a heavy snowfall; in the year of the Emperor, Showa 38, i.e. 1963 AD.) The 38-gousetsu killed 238 people, injured 356, destroyed or damaged 10 480 houses, triggered 130 landslides, stopped 19 500 railway transportations, isolated some cities for more than a week, etc. Nagaoka is one of the cities where we have heavy snowfall every winter, for example the average maximum snowcover on the ground is 1.4 m, with a standard deviation of 0.6 m.

The Institute of Snow and Ice Studies consists of three laboratories, and research subjects carried out in the last quarter of a century can be grouped into six categories: (1) surveys of snow damage and disastrous snow phenomena, (2) fundamental studies of snowcover, (3) experimental studies of the mechanical properties of snow and ice, (4) experimental and theoretical research on snow avalanches, as well as outdoor surveys of snow avalanches which cause damage, and statistical research on them by collecting the damage reports from the local newspapers of the last fifty years, (5) engineering research studies on snow removal and transportation, and removal of roof-snow, (6) research on how to measure the properties of snow, and the making of new instruments, such as the snow-depth meter, snow-weight meter and others.

Now we stand at an epoch when we are going to carry out snow and ice research from the global natural-hazard point of view as well as the local snow and ice research one.

Research activities in the three laboratories are as follows:

The first laboratory (Yutaka Yamada, Head, Yasuaki Nohguchi, Senior researcher, and Takashi Ikarashi) carries out fundamental research on snow and ice. The main project of this laboratory is work on snow avalanches. Yamada and Nohguchi are going to derive physical parameters by experiments which affect snow-avalanche motion, and through these analyses they hope to improve the equation of motion in snow-avalanche computer simulations.

They are also interested in the mechanical properties of snow which affect the release of snow avalanches, and plan to measure the failure strength of snow by a shear-test machine. Ikarashi compiles snow-pit observation data every winter and collects published data on damage due to snow and ice phenomena.

The second laboratory (Masayoshi Nakawo, Head, and Masujiro Shimizu). Nakawo and Shimizu are interested in carrying out snow and ice research from a geophysical point of view. Their main research projects are grouped into the following two subjects:

Studies on the role of the cryosphere in global natural hazards: Palaeoclimate/environment is being studied by analysing ice/snow cores from various parts of the world. Core data as well as field data are examined to assess the contribution of the cryosphere to global natural hazards such as sea-level rise and anomalous climate.

Studies on the spatial and temporal variations in falling/deposited snow: Meteorological and snow data are being collected at several observation stations, some of which are located in mountain regions. The results are used, in combination with remote-sensing data, to examine the spatial and temporal variations of falling/deposited snow in Japan, and the variations are analysed to correlate with global climatic change.

The third laboratory (Motonobu Kumagai, Head, and Toshiichi Kobayashi) researches the engineering problems of snow removal and snow transportation. One of the main projects is to find the critical conditions under which snow in granular form or in a snow/ice ball would be transported by the force of air flow. The snow transportation ability of water flow is also examined. The second project is to make a good roof-snow removal machine which works on any roof even in the heavy snowfall conditions which prevail in the warm atmospheric conditions in the Hoku-shin-etsu area of Japan.

Radar observation of snowfall in the southern part of the Echigo Plain was started last winter by Nakamura with Ikarashi and Kobayashi. One of the purposes of this project is to obtain a relation between radar-echo intensity and the amount of snowpack on the ground.

These three laboratories are supported by three administrative staff, K. Kenmotsu, Head, Y. Hayashi and E. Fujii. A further three or four temporary staff are employed every year for data analysis.

Four cold rooms are included in a main building and a small guest room with a garage is available for foreign researchers.

In 1988, the Science and Technology Agency established a new fellowship, the STA Fellowship, which offers chances to young researchers (under 35 years old) from overseas to engage in research at the Nagaoka Institute as well as the Shinjo Branch of Snow and Ice Studies, NIED, located in Yamagata prefecture, and many other national institutions in Japan. Rand Decker, Assistant Professor of the University of Utah, USA, was the first STA Fellow at the Nagaoka Institute and another Fellow is expected to join us soon.

Future meetings (of other organizations)

NAGAOKA INTERNATIONAL SYMPOSIUM ON AVALANCHE CONTROL

"To study, to predict and to prevent avalanches for the development of the 21st century ski resort"
Nagaoka, Japan, 11–12 September 1992
Organized by the Hokushin'etsu Branch of the Japanese Society of Snow and Ice

In mountainous areas above the snowline, occurrence of avalanches is a commonplace. Some of them are disastrous, burying roads, destroying houses and claiming human casualties. To counter avalanches hazards, a number of measures have been undertaken in Japan, including the avoidance of hazardous areas for habitations and the erection of avalanche-preventive fences and structures along roads and inhabited areas.

In Europe and in North America these structural devices alone do not eliminate avalanche disasters. One effective way to minimize such disasters is to set off avalanches deliberately. The prospect of the development of mountainous areas for skiing and other winter sports in Japan highlights the urgent need to widen the scope of avalanche control technology.

The Hokushin'etsu Branch of the Japanese Society of Snow and Ice takes this opportunity to hold an international symposium for the discussion and exchange of scientific and technological views on a wide variety of avalanche control techniques. It is opportune that the International Symposium on Snow and Snow-related Problems of the International Glaciological Society had been planned to be held in Nagaoka from 14–18 September.

Speakers at this Symposium are invited to attend, as are established scholars or practising engineers of international reputation. There will be ample time for discussions and social activities. All those who are interested in or involved with avalanche control are invited to attend this Symposium.

Languages: English, French and Japanese (interpretation available).

Venue: Symposium is to be held at the Nagakoa Industrial Exchange Center. The banquet will be held at the Hotel New Ohtani Nagaoka.

Supporting organizations:

International Glaciological Society
Hokuriku Regional Construction Bureau, Ministry of Construction
Niigata Prefecture
Nagaoka City
Arai City
Foundation of Hokuriku Construction
Foundation of Snow Studies.

Organizing Committee:

Teruyoshi Umemura (Chairman), Nagaoka University of Technology
Tsutomu Nakamura, Nagaoka Institute of Snow and Ice Studies
Norio Hayakawa, Nagaoka Institute of Technology
Jun Wada, Snow Research Centre
Kazuo Fukuyama, Tokyo Club Inc.
Ikno Furukawa, ARGOS Co. Ltd.

Participation:

Registration to the Symposium may be made in writing to the Local Organizing Committee, enclosing the registration fee in full as indicated below. The registration fee covers the symposium text to be handed out at the lecture hall.

Registration (equivalent amount of foreign currency can be accepted):

Members of JSSI and IGS	5,000 yen
Others	50,000 yen
Banquet	10,000 yen

Payment of the fee can be made via international postal money order payable to Norio Hayakawa whose address is given below. He will also make hotel bookings.

Cooperative members of JSSI are qualified to register a certain number of people with a fee for members. For details consult the Local Organizing Committee.

Local Organizing Committee Office:

Norio Hayakawa, Symposium Coordinator,
Nagaoka International Symposium on Avalanche Control, c/o Nagaoka University of Technology, Nagakoa 940-21, Japan (Phone 0258-46-6000, Fax. 0258-47-0019)

Programme

September 1992

11th (Friday) 0900–1000
Opening Ceremony
Keynote Lecture by T. Nakamura (Nagaoka Institute of Snow and Ice Studies)

1000–1215 (Two lectures)
R. L. Brown (Montana State University, USA)
E. Akitaya (Hokkaido University, Japan)

1315–1630 (Three lectures)
G. Brugnot (CEMAGREF, Grenoble, France)
K. Kawada (Toyama University, Japan)
D. M. McClung (University of British Columbia, Canada)

1745 Banquet (a truly memorable extravaganza)

12th (Saturday) 0900–1215 (Three lectures)
H. Gubler (Swiss Federal Institute for Snow and Avalanche Research, Davos, Switzerland)
C. Charlier (CEMAGREF, Grenoble, France)
L. Fitzgerald (Snowbird Ski Resort, Utah, USA)

1330–1630 Panel Discussion
Coordinator: N. Hayakawa, Nagaoka University of Technology.

JOURNAL PAGE CHARGES

A discussion piece

The Society is facing a looming problem with the *Journal of Glaciology*: we are accepting papers at a greater rate than we can afford to print them. Of course the solution is to let the *Journal* grow to accommodate the energy of our contributors while still enforcing a high scientific standard. However, this strategy magnifies a problem that the *Journal* has faced for many years. Authors who honour page charges are in the minority so, under the present system, membership dues and library subscriptions pay the difference. In 1993 we intend to raise the dues, subscription rates and page charges by roughly 10%, but these measures are insufficient to make the problem disappear. The question we must face is how we can increase the *percentage* of authors who honour page charges. The present rate is a mere 45% so there is much room for improvement. Possibilities under consideration include:

1. Set a page limit, say 3–4 pages, above which page charges are mandatory. Several American Geophysical Union publications follow this system.
2. Introduce a fast-lane/slow-lane system. Submissions for which page charges were to be honoured would be placed in a fast-processing queue; the remainder would be published at whatever rate the Society could afford. Several IEEE publications use this system.
3. Set up a page-charge granting system. Authors not able to honour page charges would be required to apply for a page-charge grant from the Society, which would involve a simple statement of the reasons that page charges could not be honoured and a request to IGS for a certain number of uncharged *Journal* pages. Requests might be reviewed by IGS Council or whatever and grant recipients would be listed in *Ice*.

We intend to place specific recommendations before the IGS Council at the September 1992 meeting in Nagaoka and invite your responses now. Please direct these (in written form) to Hilda Richardson at IGS Headquarters.

Garry K. C. Clarke
President

JOURNAL OF GLACIOLOGY

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

R B ALLEY
Flow-law hypotheses for ice-sheet modeling.

A BERGER, H GALLÉE AND C TRICOT
Glaciation and deglaciation mechanisms in a coupled 2-D climate–ice-sheet model.

D B STONE, G K C CLARKE AND E W BLAKE
Subglacial measurement of turbidity and electrical conductivity.

L LLIBOUTRY
Internal melting and ice accretion at the bottom of temperate glaciers.

R J BRAITHWAITE AND O B OLESEN
Seasonal variation of ice ablation at the margin of the Greenland ice sheet and its sensitivity to climate change, Qamanârssûp sermia, West Greenland.

D G VAUGHAN
Relating the occurrence of crevasses to surface strain rates.

H CONWAY AND C F RAYMOND
Snow stability during rain.

R W JACOBEL, A M GADES, D L GOTTSCHLING, S M HODGE AND D L WRIGHT
Interpretation of radar-detected internal layer folding in West Antarctic ice streams.

M LEDROIT, F REMY AND J-F MINSTER
Observations of the Antarctic ice sheet with the SEASAT scatterometer: relation to katabatic wind intensity and direction.

T NAKAZAWA, T MACHIDA, K ESUMI, M TANAKA, Y FUJII, S AOKI AND O WATANABE
Measurements of CO_2 and CH_4 concentrations of air in a polar ice core.

J HEINTZENBERG AND M RUMMUKAINEN
Airborne particles in snow.

G S BOULTON AND K E DOBBIE
Consolidation of sediments by glaciers: relations between sediment geotechnics, soft-bed glacier dynamics and subglacial groundwater flow.

S A LECCE
Flow separation and diurnal variability in the hydrology of Conness Glacier, Serra Nevada, California.

K HUTTER
Thermo-mechanically coupled ice-sheet response. Cold, polythermal, temperate.

Yu Ya MACHERET, M Yu MOSKALEVSKY AND E V VASILENKO
Velocity of radio waves in glaciers as in indicator of their hydrothermal state, structure and regime.

I M WHILLANS AND C J VAN DER VEEN
Patterns of calculated basal drag on Ice Streams B and C, Antarctica.

R E BRAND AND S G WARREN
Solar heating rates and temperature profiles in Antarctic snow and ice.

K HUTTER AND M SIEGEL
Two-dimensional similarity solutions for finite mass granular avalanches with Coulomb- and viscous-type frictional resistance.

J C MOORE
High-resolution dielectric profiling of ice cores.

K GROSFELD AND N BLINDOW
Determination of ice-shelf bottom melting by time-domain reflectometry.

D B STONE AND G K C CLARKE
Estimation of subglacial hydraulic properties from induced changes in basal water pressure: a theoretical framework for borehole response tests.

ANNALS OF GLACIOLOGY

The following papers will be published in Volume 16, *Proceedings of the Symposium on Mountain Glaciology relating to Human Activities*, held at Lanzhou, China, 26–30 August 1991.

AGETA, Y AND T KADOTA
Predictions of changes of glacier mass balance in the Nepal Himalya and Tibetan Plateau: a case study of air temperature increase for three glaciers

BJÖRNSSON, H
Jökulhlaups in Iceland: characteristics, prediction and impact

CAO MEISHENG, MI DESHENG, PU YINBIN AND LIU JINGHAUNG
Application of nonlinear colour enhancement on transparencies for interpretation of glacier surface characteristics

CHANG, A T C, J L FOSTER, D K HALL, D A ROBINSON, LI PEIJI AND CAO MEISHENG
The use of microwave radiometer data for characterizing snow storage in western China

DENNIS, A
Avalanche videos

DING YONGJIAN
Some glacio-micrometeorological features on the north side of Mount Qogir (K2), Karakoram mountains

DING YONGJIAN AND LIU JINGSHI
Glacier lake outburst flood disasters in China

DING YONGJIAN, LI ZHONGQIN, LIU SHIYIN AND YU XINZHI
Glacioclimatological features in the Tanggula mountains, China

DYURGEROV, M B, M G KUNAKHOVITCH, V N MIKHALENKO, A M SOKALSKAYA AND V A KUZMICHENOK
Can the mass balance of the entire glacier area of the Tien Shan be estimated?

DYURGEROV, M B, V N MIKHALENKO, M G KUNAKHOVITCH, S N USHNURTSEV, LIU CHAOHAI, XIE ZICHU, ZHANG WANCHANG AND WANG CHUNZI
Simultaneous monitoring of mass balance fluctuations of and runoff from Tien Shan glaciers

ELDER, K, R KATTELMANN, S N USHNURTSEV, DAQING YANG AND A CHICHAGOV
Differences in mass-balance calculations resulting from alternative sampling and estimation techniques on Glacier No. 1, Tien Shan, China

GREBENETS, V I AND D B FEDOSEYEV
Industrial influence on glacial processes in mountains of circumpolar regions

HASTENRATH, S AND P D KRUSS
The dramatic retreat of Mount Kenya's glaciers between 1963 and 1987: greenhouse forcing

HU RUJI, MA HONG AND WANG GUO
An outline of avalanches in the Tien Shan mountains

HUANG MAOHUAN
The movement mechanisms of Ürümqi Glacier No. 1, Tien Shan mountains, China

JING XIAOPING, HUANG MAOHUAN, CHEN JIANMING AND JIN MINGXIE
Basal deformation of Ürümqi Glacier No. 1, Tien Shan mountains, China

KANG ERSI, YANG DAQING, ZHANG YINSHENG, YANG XINYUAN AND SHI YAFENG
An experimental study of the water and heat balance in the source area of the Ürümqi River in the Tien Shan mountains

KATTELMANN, R AND YANG DAQING
Factors delaying spring runoff in the upper Ürümqi River basin, China

KRIMMEL, R M AND D C TRABANT
The terminus of Hubbard Glacier, Alaska

LAUMANN, T AND B WOLD
Reactions of a calving glacier to large changes in water level

LI SHIJIE AND SHI YAFENG
Glacial and lake fluctuations in the area of the west Kunlun mountains during the last 45 years

LIU CHAOHAI AND HAN TIANDING
Relation between recent glacier variations and climate in the Tien Shan mountains, central Asia

LIU JINSHI
Jökulhlaups in the Kunmalike River, southern Tien Shan mountains, China

MA HONG, LIU ZONGCHAO AND LIU YIFENG
Energy balance of a snow cover and simulation of snowmelt in the western Tien Shan mountains, China

MA HONG, LIU ZONGCHAO AND YANG ZHIAN
Temperature regime studies and mathematical calculations for dry snow covers in the western Tien Shan mountains, China

OHATA, T
An evaluation of scale-dependent effects of atmosphere–glacier interactions on heat supply to glaciers

OHNO, H, T OHATA AND K HIGUCHI
The influence of humidity on the ablation of continental-type glaciers

SEVERSKIY, S I AND I V SEVERSKIY
Influence of local factors on the distribution of snow resources in northern Tien Shan

SU ZHEN, LIU SHIYIN, WANG NINGLIAN AND SHI AIPING
Recent fluctuations of glaciers in the Gongga mountains

TRABANT, D C AND D F MEYER
Flood generation and destruction of "Drift" Glacier by the 1989–90 eruption of Redoubt Volcano, Alaska

WAKE, C P, P A MAYEWSKI, WANG PING, YANG QINZHAO, HAN JIANKANG AND XIE ZICHU
Anthropogenic sulfate and Asian dust signals in snow from Tien Shan, northwest China

WANG YANLONG AND HUANG MAOHUAN
An outline of avalanches in the southeastern Tibet Plateau, China

WANG ZONGTAI AND YANG HUIAN
Characteristics of the distribution of glaciers in China

WEI WENSHOU
Avalanches in the Tien Shan mountains, China

WILLIAMS, M W, K A TONNESSEN, J M MELACK AND YANG DAQING
Sources and spatial variation of the chemical composition of snow in the Tien Shan, China

XIE ZICHU
Progress and prospect for research on mountain glaciers in China

YANG ZHENNIANG AND HU XIAOGANG
Study of glacier meltwater resources in China

YAO TANDONG AND L G THOMPSON
Trends and features of climatic changes in the past 5 years recorded by the Dunde ice core

ZENG QUNZHU, FENG XUEZHI, CHEN XIANZHANG, LAN YOUNGCHAO, WANG JIAN AND LIU YUJIE
Satellite snow-cover monitoring for the prediction of snowmelt runoff in the upper reaches of the Yellow River, China

ZHANG WENJING
Identification of glaciers with surge characteristics on the Tibetan Plateau

ZHANG XIANGSONG
Investigation of glacier bursts of the Yarkant River in Xinjiang, China

INTERNATIONAL SYMPOSIUM ON APPLIED ICE AND SNOW RESEARCH

Rovaniemi, Finland, 18 – 23 April 1993

CO-SPONSORED BY

Ministry of Education, Finland, Arctic Centre, University of Lapland,
Technical Research Centre of Finland, City of Rovaniemi,
City of Kemi, Kemijoki Oy, Finnish Broadcasting Co.

SECOND CIRCULAR
March 1992

SYMPOSIUM ORGANIZATION: H. Richardson

LOCAL ARRANGEMENTS COMMITTEE: E. Palosuo (Chairman)
L Makkonen (Deputy Chairman), E. Kuusisto, M. A. Lange,
M. Leppäranata, J. Lillberg, K. Riska, M. Seppälä

INFORMATION ABOUT THE SYMPOSIUM MAY BE OBTAINED FROM:
Secretary General, International Glaciological Society, Lensfield Road,
Cambridge CB2 1ER, U.K.
Tel: Cambridge (code from outside U.K. -223) 355974 Fax: Cambridge 336543

- -

The Society will hold an international symposium on Applied Snow and Ice Research in Rovaniemi, Finland, in April 1993. Registration will take place on Sunday 18 April and sessions will be from Monday 19 through Friday 23 April. A mid-symposium half-day tour and a post-symposium tour will be arranged.

PARTICIPATION

This circular includes a registration form for registration and accommodation. The form and accompnaying payments should be submitted in accordance with the instructions given on the form
Participants' resigration fees cover organization costs, distribution of reprints of abstracts, Icebreaker, Banquet, half-day tour and a copy of the Proceedings Volume.
Accompanying persons' registration fees include organization costs, Icebreaker, Banquet and half-day tour.
*There is an adminstration charge for participants who are not members of IGS and for all registrations received after 1 January.

Registration fees: due before 1 January 1993	£
Participant (member of IGS)	170
*Participant (not a member of IGS)	190
Accompanying person aged 18 or over (there is no fee for those under 18)	60
Surcharge for late registration (after 1 January 1993)	20

Refunds on registration fees will be made on a sliding scale, according to date of receipt of notification, up to 20 March 1993. After that date it may be impossible to make any refund.

TOPICS

The following topics will be open for discussion:

(a) measurement of ice and snow properties,
(b) modelling of ice growth and decay,
(c) seasonal snow cover,
(d) snow thermodynamics,
(e) fracture and creep of ice,
(f) friction and adhesion of ice and snow,
(g) ice and snow as construction material.

POST-SYMPOSIUM TOUR 24 – 27 April 1993: to Finnish Lapland and the Gulf of Bothnia

IGS SYMPOSIUM ON APPLIED ICE & SNOW RESEARCH

18 – 23 April 1993

REGISTRATION FORM

Mail to: Secretary General, International Glaciological Society, Lensfield Road, Cambridge CB2 1ER, U.K. – to arrive by 1 January 1993. If you send it later, the registration surcharge of £20 should be added for each person. All cheques, etc. should be made payable to

INTERNATIONAL GLACIOLOGICAL SOCIETY

Name of participant (family name) . . . . (initials)

Address . . . .

. . . .

Accompnaied by (indicate if under 18)

Name . . . . Name . . . .

REGISTRATION

* I enclose registration fees as follows:

Participant (member of IGS): £170	. . . .
Participant (not a member of IGS): £190	. . . .
Accompanying person: £60	. . . .
Surcharge for late submission: £20 (after 1 January)	. . . .
TOTAL SUM SENT	. . . .

ACCOMMODATION

I wish to book a *single room/*twin-bedded room at Hotel Lapponia.

TOUR

I wish to book . . . . places on the tour.

** delete as appropriate*

Finland residents — may pay by FIM made out to International Glaciological Society and sent to Suomen Jäätutkimussevra, account no. SYP 214618-102757, with this booking form. A copy of the form must be sent to Cambridge at the same time. ALL other cheques/bank transfers should be sent to the Cambridge address given above in £ sterling. No other currency will be accepted.
We do not accept credit cards.

PLEASE PAY THE BANK OR TRANSFER CHARGES YOURSELF
WE NEED THE FULL FEE FOR EACH PERSON

Glaciological Diary

** IGS Symposia
* Co-sponsored by IGS

1992

2-4 September
International Conference on Arctic Margins, Anchorage, Alaska (1991 International Conference on Arctic Margins, Alaska Geological Society, P.O. Box 101288, Anchorage, Alaska 99510, U.S.A.)

14-18 September
** Symposium on Snow and Snow-related Problems (as part of an International Forum on Snow Areas), Nagaoka, Japan. Co-sponsored by the Japanese Society of Snow and Ice and the City of Nagaoka (Secretary General, IGS, Lensfield Road, Cambridge CB2 1ER, U.K.)

4-8 October
International Snow Science Workshop, Breckenridge, CO, U.S.A. (ISSW'92, P.O. Box 733, Fort Collins, CO80522, U.S.A.)

30 November-3 December
Circumpolar Universities Cooperation Conference, Rovaniemi, Finland (Outi Snellman, International Relations, University of Lapland, P.O. Box 122, SF-96101 Rovaniemi, Finland)

1993

18-23 April
** Symposium on Applied Ice and Snow Research, Rovaniemi, Finland. Co-sponsored by Ministry of Education, Finland, Arctic Centre, University of Lapland, City of Rovaniemi (Secretary General, IGS, Lensfield Road, Cambridge CB2 1ER, U.K.)

6-11 June
ISOPE-93, Third International Offshore and Polar Engineering Conference, Singapore (ISOPE-93, P.O. Box 1107, Golden, CO 80402-1107, U.S.A.)

26 June-1 July
4th Canadian Marine Geotechnical Conference, St John's, Newfoundland, Canada (C-CORE, Memorial University of Newfoundland, St John's, NF, Canada A1B 3X5)

5-9 July
6th International Conference on Permafrost, Beijing, China (Cheng Guodong, Lanzhou Institute of Glaciology and Geocryology, Academia Sinica, Lanzhou 730000, China)

5-11 September
* Fifth International Symposium on Antarctic Glaciology, Cambridge, U.K. (E. M. Morris, Head, Ice and Climate Division, British Antarctic Survey, High Cross, Madingley Road, Cambridge CB3 0ET, U.K.)

20-26 September
International Symposium on Seasonal and Long-term Fluctuations of Nival and Glacial Processes in Mountains at Different Scales of Analysis, Tashkent, Uzbekistan (Dr V.G. Konovalov, Central Asian Regional Research Hydrometeorological Institute, 72, Observatorskaya str., Tashkent, Uzbekistan 700052)

News

OBITUARIES

During the latter half of 1991, two scientists died whose careers were significantly associated with snow and ice research at CRREL. As I had the good fortune to co-author several papers and to work closely with them in the field and laboratory, I have been asked to write a few words about their careers and contributions to glaciology. (Willy Weeks, Geophysical Institute, University of Alaska Fairbanks)

Malcolm Mellor (1933–91)
Malcolm's career was described several years ago in a profile in *ICE* , No. 54, 1977 and more recently in *Cold Regions Science and Technology*, **20**(1), v–vii, a journal that he helped to found and edited until his death. Additional details about his varied activities can be found in these publications. Malcolm was born (May 1933) in Cheshire, England. He studied at Nottingham University and took part in expeditions to both Iceland and Svalbard while obtaining his B.Sc. in Civil Engineering. In 1955 he moved to Australia where he was employed by the Australian Antarctic Division and became the first glaciologist to winter-over at Mawson. In 1959 he received his M.Sc. degree in Meteorology and Physics from Melbourne University and moved to the United States where he was employed by Dartmouth University on a contract with CRREL. In 1961 he switched to direct employment by CRREL, where he remained as a member of its engineering staff until his death. While at CRREL he also found time to obtain a Ph.D. in Engineering from Sheffield University and to receive a D.Sc. in Applied Science from Melbourne University.

His interests ranged across almost every aspect of the engineering mechanics and applied physics of snow, ice and permafrost. He published more than 150 papers on subjects as varied as avalanches, snow and ice mechanics, drifting snow, sea ice, testing techniques, drilling, tunneling, excavating and subsea and ocean engineering. He wrote reviews of great insight on many subjects. In fact, for some years Malcolm was THE monograph writer at CRREL, a task he carried out with singular success.

Malcolm loved to travel. In addition to Iceland and Svalbard, he worked in Alaska, the Rocky Mountains, Labrador, the Yukon, Siberia, Greenland and the Antarctic. He particularly loved the Antarctic. During the last few years, he returned to working in the Antarctic with particular focus on snow and ice engineering problems. He was delighted about this turn of events as it allowed him "to escape from CRREL to do some real work". He and I were together for a brief period during January/February 1991 at McMurdo Station. He told me about his heart problem and was particularly concerned because of his worry that he would not be allowed to do further Antarctic field work. Unfortunately his concern was well justified as he died 3 days before an operation scheduled to correct the problem but only after going canoeing and climbing up a long hill. Malcolm lived life to the fullest and compromise was not in his nature.

He is survived by his wife, Anne, and 2 children. He leaves to glaciology a legacy of work of the highest quality and to his many friends fond recollections of his high standards and his zest for life.

Andrew Assur (1918–1991)

Andrew Assur was born in Pyatigorsk in the Caucasus in June 1918. His father was a high school teacher in Estonia whose school was moved to that location as the result of World War I. At the end of the war the family first moved to Germany, then to Poland and finally to Latvia where Andrew received his Civil Engineering degree in 1941. He then served as part of the civil engineering faculty at the University of Riga until 1944 when he moved to Hamburg ahead of the Russian advance, obtaining work at the German Hydrographic Service (Seewarte). His long-term interest in the bearing capacity of sea and lake ice stem from this time when he was called upon to make bearing capacity estimates for the German military. He moved to the United States in 1951 where he was initially employed by the Library of Congress as a translator/abstractor. In 1953 he joined the staff of CRREL (then (SIPRE) in Wilmette, Illinois and, soon after, was sent to the Canadian Arctic to advise the Air Force on bearing capacity problems encountered during the construction of the DEW line. By the time I first met him in 1955 he had managed to get SIPRE to assign him as a physicist to do research on the "Joint Services Sea Ice project" operating at Hopedale, Labrador during the winter of 1955/56 and at Thule, Greenland during 1956/67. Andrew's considerable experience in the field of ice mechanics contributed immeasurably to the success of this multidisciplinary program. In 1957 he worked with Gunther Frankenstein on IGY Drift Station Alpha in the Central Arctic Ocean, a trip that contributed significantly to his insights into the behavior of pack ice. During the next year his clever solution of problems leading to the deterioration of the ice runway at McMudro Station resulted in his receiving the Navy Distinguished Service Award.

The gradual recognition of Assur's many talents led to his assignment to more managerial roles; first as the Chief of the Applied Research Branch in 1961 and then as Chief Scientist of CRREl in 1963, a position that he occupied for over 26 years until his retirement in December 1989. However, he hated paper work and loved the excitement of field operations and would use any excuse to spend time in the polar regions. During 19969–70 he was instrumental in both designing and carrying out the highly successful sea-ice test program associated with the two attempts of the tanker SS *Manhattan* to transit the Northwest Passage. Although he was not a prolific author (37 papers), his papers have had a major influence on the development of sea- and lake-ice mechanics. Particularly important was his 1958 publication on the "Composition of sea ice and its tensile strength" which resulted in the sea-ice phase diagram which has been used by all succeeding authors who have analyzed sea-ice property variations in terms of brine volume changes. Also important was his 1966 work on the "Flexural and other properties of sea ice sheets" which pioneered methods for treating vertical variations in the elastic modulus.

When I examine Andrew's career, I see several major contributions in addition to his published work. He had a significant effect on almost every major project that CRREL undertook. His ability to generate analytical approaches to complex scientific and engineering problems was amazing. He always went right to the heart of the matter and started to make immediate progress. He was totally opposed to what he referred to as junk research. At many government laboratories, there has been over time a trend toward more and more administrative control over projects. Andrew maintained continuous vigilance to keep productive scientists removed from such pressure. These were lonely battles in that the individual investigators usually were unaware of Andrew's protection.

Andrew was serving as the principal technical advisor to the Assistant Chief of Engineers when in 1972 the Corps of Engineers started to participate in scientific exchanges with the Soviet Union. His fluency in Russian and his technical credentials were definitely factors in the gradual thawing of relations between the Corps and the Soviets. One thing that continually irritated him was the artificial barriers erected to hinder effective scientific exchange between CRREL and Soviet scientists working in related fields. However, it was a rare barrier that Andrew could not find a way around, over or under. Later, in the 1980s, Andrew made similar positive contributions to improve exchanges with Chinese scientists. To realize how difficult this was, one must recall that CRREL is a part of the Corps of Engineers which is a part of the US Army, an organization that in times past has been more than a little suspicious of Soviet motives. Andrew's efforts toward improved international relations rewarded him with several trips to the Soviet Union. These trips were his particular love.

During the last few years of his life Andrew was not in good health, with a continuing heart problem. Although he retired for medical reasons at the end of 1989, his retirement was really a joke in that he seemed to spend even more time at the office. Prior to his retirement it was a common opinion among the CRREL staff that he would never retire but would die "in the saddle". To some extent this view became true, for on 2 December 1991 he collapsed and died on the floor of the CRREL executive office.

He is survived by his wife Sophia and his four daughters. He left his fifth child, the CRREL research staff, in good condition and capable of taking care of itself.

ARCTIC ARCHIPELAGOS AND ISLANDS OFF EURASIA

Compiled by R. K. Headland

These lands in the Arctic Ocean include a diverse range of archipelagos and separate islands. Some basic statistics about them follow. The positions given are approximately the middle point for smaller islands and their limits for larger ones and groups. The other statistics are from the best sources available to the author: not all are equally reliable. Discoveries and winterings are the first recorded; there may have been previous ones for some islands. Names are given in the forms recommended by the Union Géographique International with, where the name has varied through double transliteration, the original form and, in other cases, an English translation. Islands only a short distance off the continental mainland are not included. In easterly order the islands are:

Svalbard ('Cold Coast') 76°30'–80°48' N, 10–34° E
Four main islands and about 100 lesser ones.
Area 62 800 km^2, 1717 m altitude, 60% glacierized.
Possibly discovered 1194 by Icelanders, confirmed 1596 by a Dutch whaling voyage (William Barents).
First wintering 1630; permanent mining settlement established 1906, currently three operate, four scientific stations established.
Norwegian territory under the Spitsbergen Treaty of 1920.

Bjørnøya (Bear Island) 74°36' N, 19° E
One isolated island.
Area 178 km^2, 536 m, unglacierized.
Discovered 1596 by a Dutch whaling voyage (Willem Barents).
First wintering 1852–53; meteorological station established 1923.
Norwegian territory under the Spitsbergen Treaty of 1920.

Frantsa-Iosifa, Zemlya (Franz Joseph Land) 79°44'–81°56' N, 37–65°30' E
A group of 191 islands.
Area 12 334 km^2, 606 m altitude, 85% glacierized.
Discovered in 1873 by an Austrian expedition (Julius Payer aboard *Tegethoff*).
First wintering 1873–74; polar station established 1929, currently 5 operate.
Russian territory (Commonwealth of Independent States).

Novaya Zemlya ('New Land') 70°40'–77° N, 51°–69° E
Two main islands, several small ones.
Area 81 280 km^2, 1547 m altitude, 27% glacierized.
Known to Russian sealers from the 13th century.
First wintering 1596–97; polar station established 1900, currently 4 operate.
Russian territory (Commonwealth of Independent States).

Vize, Ostrov (Vize Island) 79°30' N, 78° E
One isolated island.
Area 289 km^2, 30 m altitude, unglacierized.
Discovered in 1930 by a Soviet Union expedition (V. I. Voronin aboard *Sedov*).
First wintering 1945–46; polar station established 1945.
Russian Territory (Commonwealth of Independent States).

Ushakova, Ostrov (Ushakov Island) 79°25' N, 80°48' E
Area 328 km^2, 294 m altitude, 45% glacierized.
Discovered in 1935 by a Soviet Union expedition (G. A. Ushakov aboard *Sadko*).
First wintering 1954–55; polar station established 1954.
Russian territory (Commonwealth of Independent States).

Severnaya Zemlya ('Northern Land') 77°50'–81°15' N, 90°–108° E
Four main islands and several smaller ones.
Area 36 766 km^2, 965 m altitude, 50% glacierized.
Discovered in 1913 by a Russian expedition (B. A. Vilkitskiy aboard *Vaigach*).
First wintering 1930–31; polar station established 1943, currently 3 operate.
Russian territory (Commonwealth of Independent States).

Novo Sibirskiye Ostrova (New Siberian Islands) 73°–77° N, 133–158°30' E
Three groups of islands (Ostrova Lyakhovskiye (southern group: 3), Ostrova Anzhu (main group: 3), Ostrova De-Longa (minor group: 5)) with some small offliers.
Area 35 797 km^2, 426 m altitude, 50% glacierized.
Southern and central portions discovered in 1770 and 1773 by Russian mercantile voyages (I. Lyakhov); remainder discovered in 1881 (United States) and 1913 (Russia).
First wintering 1901–02; polar station established 1933, currently 4 operate.
Russian territory (Commonwealth of Independent States).

Vrangelya, Ostrov (Wrangel Island) 71°20' N, 178° E–177° W
One island.
Area 7940 km^2, 1097 m altitude, unglacierized.
Existence surmised in 1824 (Russian expedition), sighted in 1849 (British expedition), first landing in 1881 (United States expedition).
First wintering 1912–13; polar station established 1926, currently 3 operate. National Park since 1976.
Russian territory (Commonwealth of Independent States).

Geral'd, Ostrov (Herald Island) 71°23′ N, 175°40′ W
One small isolated island (65 km E of O. Vrangelya). Area 11 km^2, 250 m altitude, unglacierized. Discovered in 1849 by a British expedition (H. Kellett aboard *Herald*).
No wintering recorded, unoccupied. National Park since 1976.
Russian territory (Commonwealth of Independent States).

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ICE

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