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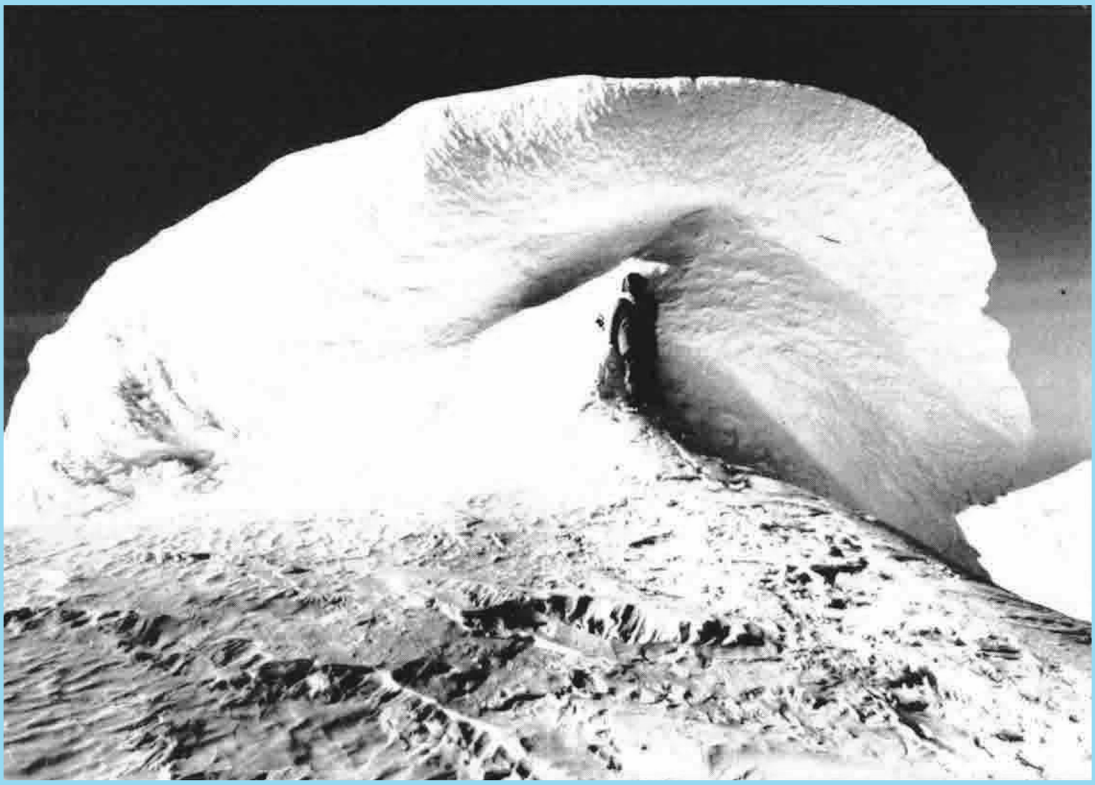

ICE News No. 87 **2nd Issue 1988**

Please find attached pages 1 & 2, 19 & 20, which were omitted from ICE News Number 87, 2nd issue 1988.

The cover of this issue was also incorrectly printed with No 86 instead of No 87.

Both of these errors occurred during the printing of the journal for which Chameleon Press Limited accepts sole responsibility.

We apologise unreservedly to both The International Glaciological Society and to all who receive ICE News.

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ICE

NEWS BULLETIN OF THE INTERNATIONAL GLACIOLOGICAL SOCIETY

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CONTENTS

COVER PICTURE: Windsculptured rime formation near the summit of Mt Morning (2723 m), South Victoria Land, Antarctica. Photograph by Harry Keys, Department of Conservation, P.O. Box 10420 Wellington, New Zealand.

RECENT WORK

POLAND

BIOMASS SIBEX-2 PROJECT

At the turn of 1986 the third BIOMASS SIBEX-2 expedition was organized under the leadership of Professor Rakusa-Suszczewski by the Institute of Ecology, Polish Academy of Sciences, in co-operation with the Sea Fishing Institute as a result of an international programme. The study area comprised test grounds in the zone of convergence around the South Shetland Islands and in the Bransfield Strait.

KING GEORGE ISLAND SURVEY

The 9th expedition organized by the Institute of Ecology, Polish Academy of Sciences, to the Antarctic Arctowski Station on King George Island (under the leadership of Mr Wojciechowski) carried out the programme of biological and geophysical research in Admiralty Bay. A Polish-Soviet oceano-biological symposium was held as part of the expedition programme when the Soviet research ship *Academic Kurchatov* arrived. Polish-Argentinian joint research was conducted near Marambio Station on Seymour Island.

The 10th expedition organized by the Institute of Ecology, Polish Academy of Sciences, (under the leadership of Professor Kołakowski) to the Antarctic Arctowski Station conducted biological-marine research in 1986, especially the study of krill throughout an annual cycle in terms of its exploitation, processing and complete utilization. During the Antarctic summer at the beginning of 1986 geological/tectonics and palaeontological studies were carried out on King George Island under Dr Gaździcki.

SPITSBERGEN EXPEDITIONS

The 8th expedition organized by the Institute of Geophysics, Polish Academy of Sciences to the Polar Station at Hornsund, Spitsbergen, under Mr Szymański and, after his earlier return to Poland because of illness, by Mr Misztal, an engineer, carried out geophysical and glaciological studies (undertaken by Professor Jahn's team). In the summer of 1986 ecological research into the energy balance of the Fugleberget catchment near the Hornsund Station (under Professor Grodzińska) and geological studies of Mesozoic phosphate-bearing formations (Dr Krajewski) were continued.

The 9th expedition organized by the Institute of Geophysics, Polish Academy of Sciences, to the Polar Station in Hornsund, Spitsbergen, worked from August 1986 and wintered over under Mr Gregorczyk. Its members conducted stationary geophysical research, including studies of the upper atmosphere.

The 12th polar expedition (4 people) was organized by the Geographical Institute of Wrocław University under Professor Jahn. They stayed at the Baranowski Research Station located on the Werenskiöld Glacier moraine and conducted research during July to September. The research programme concentrated on permafrost and present-day geomorphological processes operating in the periglacial environment. The study of permafrost dealt with the following topics: (1) dynamics of changes in the active layer thickness against natural conditions, (2) vertical ground movements and cryostatic stresses, (3) thermal properties of the active layer and permafrost top. The study of present-day processes was concerned with aeolian processes, including dust storms. The devices installed will allow this programme to be continued in future. The study was also made of periglacial structures and forms, with special reference to clay islands encountered at the tundra surface.

The 8th glaciological expedition organized by the Silesian University spent the period from 11 June 1986 to 16 October 1986 in Spitsbergen. Its main research object was the Werenskiöld Glacier basin (Wedel Jarlsberg Land). The aim of research was to determine water and denudation balance in the modelled glaciated area where glaciers terminate on land. Special attention was given to the hydrological balance of the glacier foreland, determining the physical–chemical properties of subglacial and englacial waters and determining the ways of water circulation in the glacier. Some caves and avens were also explored in the Werenskiöld Glacier. The exploration brought about a plan of the Kvisla Cave 600 m long and a channel part (430 m) connecting an aven 70 m deep, located at the medial moraine, with a spring-type water outflow track. Photogrammetric activities started in 1982 were continued. They involved photogrammetric recording of the frontal part of the Hans Glacier, its foreland and lateral moraine, as well as recording of surface movements in this glacier. The frontal parts of the Torell and Werenskiöld glaciers were recorded too. Some recordings were also made in the Fugleberget catchment area. They were necessary for the needs of cyclic observations of slope processes and snow cover measurements.

The 7th Jagiellonian University Spitsbergen expedition (3 members: Krawczyk, historical geographer, Kuczek, geography student, Ziaja, physical geographer and expedition leader) was sent to Sörkappland in July and August 1986. The research programme worked out and supervised by Professor Czeppe included: (1) the mapping of geocomplexes in the mountain

massifs of Hilmarfjellet, Karentoppen, Wiederfjellet (the southern part) and in coastal plains Björnbeinflyene and Oslokflyene, (2) study of various Quaternary deposit outcrops, (3) compilation of the list of seasonal settlement remains on the sea-facing Hornsund side and near Hilmarfjellet.

RESEARCH TOPICS OF THE EXPEDITION SPITSBERGEN '87

(Wojciech Stankowski, Quaternary Research Institute of Adam Mickiewicz University, Poznań)

Geomorphological, hydrological, geochemical and palaeo-geographical research was conducted in an area between Billefjorden and Austfjorden. Six members of the expedition that lasted from 24 June till 4 August carried out control photo-interpretative mapping of a marginal system of lateral ice streams Mittag-Lefflerbreen at the base of Trikolorfjellet and Odellfjellet and around Alandvatnet. The main emphasis was put on glacial and fluvioglacial morphogenesis within the context of relief details of marine origin and the morphological role of lake basins. A wide-ranging programme of hydrochemical research carried out around Hoglandvatnet and Alandvatnet was completed.

Control photo-interpretation was carried out in Ebbadalen in order to delimit a geocomplex. Detailed geomorphological and sedimentological studies of Ragnarbreen and Nordenskjoldbreen marginal zones were also made.

Hydrological studies were included in the research programme in Ebbaelva around Petuniabukta, within Putuniabukta and in a small catchment of a lake occupying marine terraces. The groups of lakes and marches over raised marine terraces were subjected to hydrochemical study.

A network of geodetic points was fixed on the eastern fringe of Petuniabukta and geodetic measurements were made of raised marine beaches. Radiometric dating allowed determination of the age of a marine terrace about 10 m high. The 14-C date of 6080 ± 70 yr B.P. (Gd-5246) was available for marine shells found in marine sediments. At the base of the terrace there are tills containing marine shells radiocarbon-dated to 8770 ± 90 yr B.P. (Gd 5247). Beneath the tills there is a poorly developed organic series related the the weathering of gypsum rock surface; the 14-C age of the organic layer is 11940 ± 200 yr B.P. (Gd-2772). The dating was made in the C-14 Laboratory of the Institute of Physics, Silesian Polytechnic in Gliwice, Poland.

THE POLISH POLAR CLUB

In 1986 the 13th Scientific Symposium of the Polar Club was held in Gdansk and attended by foreign visitors, including Oda Rogne, the head of the Norsk Polarinstitutt in Oslo.

The 14th Scientific Symposium of the Polish Polar Club affiliated to the Polish Geographical Society was held in Lublin on 7-9 May 1987. The current problems of Polish research in the Arctic and Antarctic regions were discussed during plenary sessions and special sessions on biological, as well as geological and geomorphological, glaciological, hydrological and meteorological topics. Altogether 33 papers were presented by the Polish participants and invited guests from Norway, Spain, Sweden and the Soviet Union. A poster sesion and business meetings of the Committee on Polar Research (PAS) and the Polish Permafrost Group were organized as accompanying events.

N. COPERNICUS MEDAL FOR T. GJELSVIK

During a formal session held in the Branch Office of the Polish Academy of Sciences in Kraków in May 1986, Dr Tore Gjelsvik, formerly head of the Norsk Polarinstitutt for many years, received the N. Copernicus Medal.

S. Kozarski

USA - ALASKA

GLACIER STUDIES

EKLUTNA GLACIER, ALASKA

(Tim Brabets, U.S. Geological Survey, Anchorage)

Eklutna Lake, located 40 km northeast of Anchorage, is fed primarily by Eklutna Glacier. East Fork Eklutna Creek (100 km^2, 10% glacierized) and West Fork Eklutna Creek (65 km^2, 50% glacierized) are the main inflow streams. Beginning in 1988, water from the lake will be used by Anchorage for public water supply. Since 1985 the the U.S. Geological Survey has conducted a study of the Eklutna basin to determine how melting of snow and glacier ice affect runoff; and sediment transport, sedimentation rates, and the effects of this sediment on water quality in Eklutna Lake.

During the study, streamflow, air temperature, suspended sediment, bedload, and precipitation measurements have been made on the two streams. Ice and snow balance and climatological data have been collected on Eklutna Glacier. Bathymetric and light transmissivity profiles have been taken on Eklutna Lake. Efforts are now being directed toward analyzing and interpreting these data for a final report.

PATTERNS OF MOTION AND STREAM DISCHARGE: FELS AND BLACK RAPIDS GLACIERS

(W.D. Harrison, M. Sturm and K. Echelmeyer,

Geophysical Institute, University of Alaska, Fairbanks)

The seasonal and shorter period variation in the motion of a glacier and its relation to stream discharge provide information about the internal plumbing of a glacier, but the acquisition of year-round data with fine time resolution has not been achieved so far. We are developing automated techniques to measure velocity, strain and seismicity year-round, and to measure stream discharge characteristics in summer. Velocity is measured over one day intervals by automatic photography, with control and finer spatial resolution provided by periodic surveys. Photography is also used to monitor lake and pothole drainings, and stream behavior. The vertical component of surface strain is measured with wire strain meters, usually at a resolution of two parts per million and at intervals of one hour or less; average seismicity over the same interval is also measured. Stream stage is monitored by sonic ranger, and water turbidity, electrical conductivity, and temperature are monitored by instruments on board a small floating platform tethered in the stream.

These measurements on Fels and Black Rapids glaciers in the central Alaska Range began in 1986. Some of the notable preliminary results can be stated briefly. Much smaller surface vertical strain rates occur than are accounted for by existing theory. We found evidence for inhomogeneous motion of the ice. The two glaciers have seasonal variations in speed that are quite different. Short period motion events last several days or less. Diurnal variations in strain rate and seismicity are sometimes modulate the short period events. Some events are simultaneous on both glaciers; there is a correlation between some motion, stream turbidity, and electrical conductivity events.

GLACIER FLUCTUATIONS IN SOUTHERN COASTAL ALASKA

(William O. Field, Great Barrington, Massachusetts)

In June 1987, assisted by John Field of Tufts University and for part of the time by Suzanne Brown, U.S. Geological Survey, Tacoma, I continued the long-term project of observations of the fluctuation of glacier termini along the southern coast of Alaska. The project was initiated in 1926, and since 1940 has been carried forward as part of the glacier study program of the American Geographical Society of New York. This was the twentieth visit to Alaska for this project.

Observations consisted of photography, mostly from fixed-wing aircraft, and at previously established photo stations at seven glaciers accessed by helicopter. The approximate changes in the positions of sixty termini relative to previous observations were recorded, as well as changes in the characteristics of the visible lower parts of each glacier. Of these, fifty had been first photographed as part of this project in the early period, 1926–41.

Preliminary results after the field work indicate that of the sixty glaciers examined, twelve are now more advanced than when last observed by our parties in the 1970s and early 1980s. In Glacier Bay National Park, the rapid deglaciation of the southern areas of the whole of the Muir Inlet complex on the east, and Geikie, Charpentier and Hugh Miller inlets on the west, where névés are at relatively low altitudes, is continuing. In the northern inlets of the Bay, where accumulation areas are at higher altitudes, the glaciers tend to be either relatively stable, advancing slowly, or oscillating back and forth. Rendu Glacier in Glacier Bay was the only glacier seen to be surging. It is the recorded fifth surge for that glacier in this century. Sherman Glacier, in the Chugach Mountains near Cordova, on which a third of the ablation area was covered by the debris of a landslide during the earthquake of March 27, 1964, is continuing to advance. Up until 1964 the terminus had receded in the previous fifty-four years at an average annual rate of about 22 m. The retreat ended in 1964, the terminus stabilized, and has advanced appreciably in the last decade. This is due in large part to the load of rock debris and the ice conserved by its insulating effect.

McCALL GLACIER, ALASKA

(C. Benson, G. Weller, G. Wendler, Geophysical Institute, University of Alaska, Fairbanks)

Studies of the McCall Glacier in the Brooks Range of northern Alaska resumed in the summer of 1987, after a fifteen year period of no observations. A cross-section profile of the glacier was resurveyed and the data are being analyzed to determine changes in ice mass since 1969. About ten accumulation/ablation stakes near the equilibrium line survived, and showed that the mass balance has remained negative and increased slightly during the period.

SURGE OF PETERS GLACIER, ALASKA

(Keith Echelmeyer, Geophysical Institute, University of Alaska, Fairbanks)

In cooperation with the National Park Service a study was made of the 1986-87 surge of Peters Glacier, Denali National Park, Alaska. This glacier flows northward from the slopes of North America's highest mountain, Mt McKinley, and is one of several surge-type glaciers in this region. The surge apparently started in the winter of 1985-86 and ended in late winter of 1987. The surge front propagated at speeds of up to 100 m per day. In many respects the characteristics of this surge were similar to those observed on Variegated Glacier, Alaska, during its recent surge, and thus similar mechanisms are postulated.

GLACIER FLOW INSTABILITIES OBSERVED IN ALASKA

(L.R. Mayo, U.S. Geological Survey, Fairbanks)

An increase in activity of pulsing and surging glaciers was noted during air photo reconnaissance flights in 1986 and 1987 in southern Alaska. Notable events ranged from relatively short duration speed increases that produced marginal shearing, small amounts of ice drawdown, and some increases in crevassing, such as at the Valerie Glacier tributary of Hubbard Glacier, which might have gone unnoticed except the event was responsible in part for the closure of Russell Fiord and the formation of a 195 km^2 new glacier-dammed lake. Highly energetic surges also took place, such as at the Marvine tributary of Malaspina Glacier, which caused a large amount of ice drawdown in the upper parts of the glacier and a significant advance of the eastern margin of Malaspina Glacier into Malaspina Lake. This advance has almost filled the 70 km^2 lake with ice.

Between 50 and 100 glaciers were observed with either pulsing (small speed increase) or surging (large speed increase) flow behavior. No precisely defined method is available at this time to distinguish safely between the weaker and stronger flow instabilities, and both pulses and surges probably represent a continuum of activity produced by the same physical processes at the glacier bed, but with a wide range of effects on glacier flow. The relatively large number of glaciers observed to be pulsing and surging in the past two years is approximately an order of magnitude higher than is normally observed each year in Alaska, and suggests that such flow instabilities can take place in swarms over large areas, affecting some (but not all) potentially unstable glaciers.

UNIVERSITY OF ALASKA STUDIES ON BLOWING SNOW IN ANTARCTICA

BLOWING SNOW MEASUREMENT IN ANTARCTICA

(G. Wendler and G. Mimken, Geophysical Institute, University of Alaska, Fairbanks)

As part of a large USA–French Experiment in Eastern Antarctica (IAGO), the amount of blowing snow was measured with a photo-electric device. The device, which measures both the frequency and size distribution of blowing snow particles, has substantial advantages over traditional snow traps that makes it easier to relate wind speed variations to the blowing snow flux, namely:

1. Little or no disturbance of the wind field.
2. Short time resolution about two orders of magnitude better than traditionally-used devices.

Knowing the annual wind speed distribution from AWS (automatic weather stations) which report over the ARGOS system, the annual transport of snow was estimated to around 5 10^3 kg m^{-1} yr^{-1}, a value important for the mass balance of Antarctica.

UNIVERSITY OF ALASKA STUDIES ON ARCTIC SEA ICE

ARCTIC SEA ICE AND GENERAL CIRCULATION

(Y. Nagashima and G. Wendler, Geophysical Institute, University of Alaska, Fairbanks)

The sea ice conditions in the Arctic were related to the 700 mb level maps. It was found that sea ice conditions have two opposing effects on the zonal circulation intensity, depending on the season. Heavier than normal ice in winter causes stronger than normal circulation in subsequent months, whereas heavier than normal ice in the summer–fall causes weaker zonal circulation in subsequent months. Analyzing the two sectors, the Atlantic and the Pacific ones separately, a negative correlation was found, which means a heavier ice year in the Atlantic Ocean is normally associated with a light one in the Pacific Ocean and vice versa.

UNIVERSITY OF ALASKA WORK IN GREENLAND

DYNAMICS OF JAKOBSHAVN ICE STREAM, GREENLAND

(Keith Echelmeyer and Will Harrison, Geophysical Institute, University of Alaska, Fairbanks)

Jakobshavn Glacier is a fast-moving outlet glacier draining a significant part of the Greenland Ice Sheet. This glacier extends nearly 100 km into the ice sheet as a well-defined ice stream. The lower glacier moves at speeds of over 7 km yr^{-1} below the grounding zone, with a gradual decrease in speed inland into the ice sheet, and moves at these high speeds continuously. Such high speeds are comparable to average velocities observed on surge-type glaciers during periods of peak surge activity, when basal sliding has been shown to be the dominant flow mechanism. An important question is whether or not the high speeds on Jakobshavn Glacier are due to a large sliding contribution or some other mechanism such as anomalously high deformation rate near the base. If it is sliding, what causes these high slip rates? If there is a basal zone of favorably-oriented ice (and therefore a weak layer) then ice deformation under the large stresses may account for the fast motion in the ice stream, rather than basal sliding or deformation of basal debris as has been proposed for the Antarctic streams.

A major field program was undertaken on Jakobshavn Glacier during 1984-87 to address these and other questions relating to ice stream dynamics. Measurements included spatial and temporal variations of the surface velocity field, mass balance, ice temperature, seismic activity, calving rate and terminus position, ice fabric analysis, and ice

thickness.

Surface velocity throughout the year shows no seasonal variation. Production of large amounts of meltwater at the surface in the ablation zone (lower 75 km of ice stream) does not appear to influence the speed directly. Calculations show that basal shear stresses along the ice stream are large. At and below the grounding zone, short-interval (one-half to one hour) surveys show that the velocity varies harmonically by as much as 35% with the level of the tide in the fiord. The phasing, maximum speed during falling tide, shows that basal sliding is occurring at the grounding zone and that this sliding is directly affected by subglacial water.

Observations of ice temperature strongly show the effects of meltwater refreezing in the percolation zone. These and other interesting results from the extensive field program give further insight into the dynamics of this fast ice stream.

Reports collected by L.R. Mayo

USA - EASTERN REGION

ICE STUDIES AT THE GEOPHYSICAL FLUID DYNAMICS LABORATORY / NOAA ENVIRONMENTAL RESEARCH LABORATORIES, PRINCETON, NJ

COUPLED ICE-OCEAN MODEL

(L.H. Kantha, G.L. Mellor, M. Steele, GFDL/NOAA/ERL, Princeton, NJ)

The equations and a numerical model have been developed for the interaction of ice and the underlying ocean wherein the ice velocity of interfacial stress was assumed known. This has been upgraded to an ice model forced by winds and atmospheric heat fluxes. The prognostic ice variables are ice thickness, concentration and ice temperature. The ice model and the ocean model are now completely coupled. The latter includes the second moment turbulence closure submodel.

A one-dimensional version has been applied to the seasonal variation in the central Arctic. Included are studies on the effects on ice divergence and on the sensitivity of an empirical parameter in the equation for ice concentration. A two-dimensional version has been applied to the marginal zone and compared to data in the Bering Sea. During that year, considerable attention has been directed to the molecular sublayer within the ice–ocean interface. Its correct parameterization is important and, for example, governs the ratio of frazil-ice to congelate-ice freezing rates.

Various marginal ice zone mechanisms have been explored including ice banding which can be created numerically through the stabilizing effect of melt water and consequent reduction of the ice–ocean interfacial drag.

The entire model will be extended to three dimensions (the ocean part is already three-dimensional) and the new coupled ice–ocean model will be applied to a simulation of the Greenland-Iceland-Norwegian Sea.

ICE AGE CLIMATE

(A.J. Broccoli, I.M. Held, S. Manabe, P. Phillipps, GFDL/NOAA/ERL, Princeton, NJ)

Using a coupled atmosphere mixed layer ocean model, experiments have been conducted that attempt to simulate the last glacial maximum (LGM). The expansion of continental ice produces much of the Northern Hemisphere cooling, but has only a very minor influence on Southern Hemisphere temperature. Most of the cooling in the Southern Hemisphere results from the reduction of CO_2. Changes in land albedo have only a small effect on global temperature, although they have a substantial local influence in some low latitude locations.

The role of reduced CO_2 in maintaining an ice age climate is particularly interesting given the difficulties in reconciling the simultaneity of glacial periods in both hemispheres with the Milankovitch forcing of Pleistocene climate fluctuations. Mechanisms have been proposed by which Northern Hemisphere glaciation would trigger a reduction in atmospheric CO_2. Such a mechanism may represent a way in which a Northern Hemisphere climatic signal could be transmitted into the Southern Hemisphere.

The results from this modeling study confirm the finding that the introduction of expanded continental ice to the model does little to cool the Southern Hemisphere. In addition, a reduction of atmospheric CO_2 to the levels estimated for the LGM produces substantial Southern Hemisphere cooling. This supports the hypothesis that glacial-interglacial variations in CO_2 concentration may provide a linkage between the two hemispheres.

ICE AGE MODELING

(I.M. Held, P. Phillipps, GFDL/NOAA/ERL, Princeton, NJ)

A very efficient two-layer grid-point primitive equation model on the sphere has been constructed at GFDL in collaboration with M.J. Suarez of the NASA Goddard Laboratory for Atmospheres (GLA) for the purpose of studying the climatic response to orbital parameter variations and thus testing the Milankovitch theory of ice ages. Over the past year the atmosphere has been coupled to an oceanic mixed layer and sea ice model and has been thoroughly tested. The model's very fast execution time allows a large number of calculations with seasonal forcing to be run to equilibrium. Identical versions of the model

are now running at GFDL and GLA.

The sensitivity of both annual mean and seasonal versions of the model to changes in solar constant is under investigation. The range of solar constants over which the permanent snow cover exists (without growing to cover the earth or melting back to the pole) in the annual mean model has been found to be sensitive to the radiative formulation. A formulation has been chosen that allows the model to form permanent ice caps without being perilously close to the large icecap instability.

The sensitivity of the two-layer model to variations in solar constant, obliquity, and the relative position of the perihelion and the solstices will be studied. The dependence of the results on the radiation formulation will also be studied.

ICE AGE STATIONARY WAVES

(I.M. Held, K.H. Cook, GFDL/NOAA/ERL, Princeton, NJ)

The Lawrentide ice sheet in North America undoubtedly has a very large effect on stationary waves in the atmosphere. The distortion of the flow was important for the maintenance of the ice age climate, but also provides a stringent test of the robustness of a stationary wave model. Using a linear baroclinic model, GFDL has simulated the topographically forced ice age stationary waves produced in a full GCM.

The results are very encouraging. Stationary waves of the correct amplitude are produced, but only if the zonal mean state about which the model is linearized is taken from the ice age climate. If the basic state is chosen from a model of the present day climate, the stationary waves produced by the Laurentide ice sheet are much too large. The key factor is the increase in low-level temperature gradient in the ice age climate. The reason why this should result in smaller stationary waves is under investigation.

MULTIPLE EQUILIBRIA

(S. Manabe and R. Stouffer, GFDL/NOAA/ERL, Princeton, NJ)

During the past year, two experiments were conducted using a coupled global atmosphere–ocean model which incorporated realistic topography and annual mean insolation. The atmospheric component of the model is a spectral general circulation model with rhomboidal truncation at 15 wavenumbers (R15). The oceanic component is a grid point general circulation model with a grid spacing of 4° of latitude. In these experiments, the model was time-integrated to a stable equilibrium from two different sets of initial conditions under an identical boundary condition. When the equilibrium climates of these two experiments were compared, it was found that they were different, especially in the region of the North Atlantic Ocean. One had a thermohaline circulation similar to today's observed climate in which the surface waters in the Atlantic Ocean flow northward to high latitudes where they sink and flow southward in the middle levels of the ocean. In the other experiment, this circulation does not exist.

Because of the difference in residence time of surface water, both surface temperature and salinity are quite different between the two experiments in the high latitudes of the North Atlantic Ocean, where the ocean surface is cooled strongly and is diluted due to the excess of precipitation and runoff over evaporation. For example, the difference in surface temperature reaches 8 °C and that of surface salinity exceeds 4‰ in the North Atlantic Ocean of the model. This increased surface salinity accounts for the increased density that leads to the overturning in this region. Over the rest of the globe the surface temperature difference is much smaller.

These results show that, under identical boundary conditions, at least two equilibria are possible in coupled atmosphere–ocean models. Therefore, one has to keep this possibility in mind when interpreting the results from sensitivity studies using such models.

The present results may be compared to paleoclimatic evidence (compiled by Broecker and others, *Nature*, 1985). During the Younger Dryas period, the thermohaline circulation in the North Atlantic Ocean shut off abruptly, causing large regional climatic effects. In the North Atlantic, there are sites where there is evidence of abrupt warm to cold to warm temperature change in the climatic record. The North Atlantic region is also the area of largest temperature sensitivity in the model, with maximum sensitivity corresponding to the region of maximum temperature variability in the paleoclimatic evidence. Both in the climatic record and in the model results, the North Atlantic is marked by very large differences in sea ice margin. The fact that this pattern is produced by contrasting climates from models in which one has the thermohaline circulation in the North Atlantic and one which does not have this circulation seems to support the speculation by Broecker and others.

HYDRAULICS OF HANGING ICE DAMS

(P.D. Yapa, Civil/Environmental Engineering, Clarkson College of Technology, Potsdam, NY)

Objectives: (1) to develop an understanding of the mechanisms of formation of fragment ice dams; (2) to determine the hydraulic resistance of fragment ice dams of the Upper St Lawrence River; (3) to construct a combined ice progression/flow condition predictive model for the Upper St Lawrence River.

Rationale: By developing information on how and why hanging ice dams occur and investigating alternatives for minimizing their formation, a more efficient flow regulation plan could be developed by operators of hydroelectric plants located on these rivers. This would benefit power companies, shipping interests, and riparian landowners.

Accomplishments: Field survey in winter 1984 determined the profile of a hanging ice dam, which formed near the leading edge of cover ice as it progressed upstream of power dam in St Lawrence River. Such dams form in the section of the river where the channel is deepest. One-dimensional model developed to simulate formation of surface ice cover and undersurface ice. Preliminary model developed to predict river flow rate.

ICE DISSIPATION IN NATURAL WATERBODIES

(A. Wake, Civil Engineering, State University of New York at Buffalo, Buffalo, NY)

Objectives: (1) to develop a simplified practical method for estimating ice-melt rate at the air/ice interface in natural waterbodies; (2) to develop analytical methods for estimating ice-melt rate at the ice/water interface and develop a practical method of estimating this rate based on the analytical work; (3) to implement these improved methods for estimating ice-melt rates through application to existing ice forecasting models.

Rationale: The findings from this study should result in a definite improvement in our ability to forecast ice conditions in natural waterbodies; more specifically, ice melt due to environmental heat exchange.

Accomplishments: Numerical simulator developed for hydrothermal analysis at the ice–water interface. Simulator is a 2-D finite element model in the X-Z plane consisting of the momentum and heat transport process with a nonlinear expression of the equation of state. Experimental set up to verify model is being prepared. Air–ice thermodynamics experiments of ice surface melt under controlled ambient parameters will start in summer 1985.

AN ASSESSMENT OF THE IMPORTANCE OF MARINE ICE IN THE ESTUARINE ENVIRONMENT

(T.C. Loder, UNH, Earth Sciences, Ocean Process Analysis Lab, Durham, NH, and P.A. Mayewski, UNH, Earth Sciences, Ocean Process Analysis Lab, Glacier Research Group, Durham, NH)

Objectives: (1) to determine the potential for erosion and transport of sediment by ice in temperate estuaries; (2) to determine the role of ice in modulating the residence time and effect of pollutant input to a temperate estuary; (3) to characterize the effect of ice on biological processes in a temperate estuary; (4) to develop a detailed understanding of the physical, chemical and gross biological components of sea ice in a readily accessible area outside of the polar latitudes to implement existing sea ice studies.

Methodology: Semi-weekly sampling of specific estuarine sites will include the collection of ice cores and water samples, during the freezing seasons, to provide samples for the analysis of: stratigraphy, density, temperature, Cl^-, SO_4^{2-}, Br^-, NO_2^-, NO_3^-, F^-, PO_4^{3-}, Na^+, K^+, Ca^{2+}, Mg^{2+}, SiO_4^{4+}, NH_4^{3+}, chlorophyll-a and phaeopigment. Facilities at UNH, the Cold Regions Research and Engineering Laboratory (U.S. Army Corps of Engineering, Hanover, NH), and USGS (Denver) will be utilized.

Rationale: Despite the fact that ice covers portions of the New England coastal areas for as much as 20-35% of the year, little information concerning the physical, chemical and biological characteristics of these ice masses and their effects on coastal sites, such as Great Bay, NH/ME is available. In addition to providing a data base for local assessment, this ice study will also be extremely valuable to the general study of sea ice in temperate estuaries.

Accomplishments: During the 1985-86 freezing season semi-weekly visits to several sites on Great Bay were conducted in order to obtain samples for physical, chemical and biological analyses. These analyses are currently in progress. Weekly maps portraying ice extent (compiled using auto, air and ship observations) are currently being completed. D. Meese and T. Gow (CRREL) collected several ice cores from coastal Alaska in order to sample these in the same way as the Great Bay samples as an attempt to further verify the similarities between estuarine ice in NH and "true" ice in the Arctic. Funds for this addition to the Sea Grant study were supplied solely by CRREL.

UNDER-ICE ECOLOGY PILOT PROGRAM

(S.J. Bolsenga, NOAA, ERL, Ann Arbor, MI)

An under-ice ecology pilot program on Traverse Bay near Lake Michigan was successfully completed. The study consisted of a pre-ice cruise, an under-ice phase, and a post-ice cruise. The prupose of the study was to obtain a better understanding of phytoplankton, zooplankton, and benthic macroinvertebrate population dynamics under winter conditions. Preliminary findings include: (1) the amount of radiation through the ice increased from the two months prior to ice cover to the two months during ice cover; this is due to anincrease in incoming radiation during February and March as compared to December and January and also higher than expected transmittance values during the ice covered period due to a greater than expected amount of clear ice, and less snowcover on the ice than expected; (2) biological data indicated that organisms were thriving under the ice; (3) before ice formation concentration of particulate matter and chlorophyll were low and uniformly distributed with depth; (4) after ice cover formed the conentration of particulate matter was roughly twice as high through the water column, with most of the particulate matter concentrated in the upper 64 m of the water column; (5) zooplankton feeding was low before the ice covered period and high both during and after the ice covered period.

SPECTRAL TRANSMITTANCE OF FRESHWATER ICE AND SNOW

(S.J. Bolsenga, NOAA, ERL, Ann Arbor, MI)

In a joint Great Lakes Environmental Research Laboratory / Ohio State University program, an underwater spectroradiometer was configured to obtain information on the spectral transmittance of the various types of ice in the Great Lakes. Data were collected through a wide variety of ice types. Although the data is not completely analyzed, it appears to represent an important contribution to the field of under-ice biology. For example, small amounts of radiation were observed to penetrate to 10–12 m even on overcast days and in relatively turbid waters. Also, spectral shifts in the intensity of radiation were observed at various depths and radiation transmittance directly under various ice types does not appear to vary widely in spectral composition, but only in intensity.

ICE ENGINEERING STATISTICS

(S.J. Bolsenga, NOAA, ERL, Ann Arbor, MI)

Statistics relating to the formation, growth, and decay of nearshore ice were developed from a long-term data base archived at the Great Lakes Environmental Research Laboratory. These include average freezeup dates and ranges, average maximum thickness dates and ranges, average maximum thickness amounts and ranges, average breakup dates and ranges, growth and dissipation rates, duration of cover, and average white and total ice amounts and ranges.

UNDER-ICE ROUGHNESS

(S.J. Bolsenga, NOAA, ERL, Ann Arbor, MI)

The Great Lakes Environmental Research Laboratory is currently proposing to use an unmanned submersible vehicle through the NOAA's Office of Undersea Research; National Undersea Research Program, University of Connecticut, Avery Point to examine under-ice roughness. Investigations will include ice which exhibits a smooth surface, ice which shows surface evidence of rafting and ridging, ridging near the icefoot, and ice showing surface evidence of forces against structures. During the first year, field trips are planned to Traverse Bay (Lake Michigan), Whitefish Bay (Lake Superior) and the Bass Islands (Lake Erie) – all of these sites are known to have extensive ridging which generally reccurs on a yearly basis.

SPECTRAL REFLECTANCE OF GREAT LAKES ICE COVER

(G.A. Leshkevich, NOAA, ERl, Ann Arbor, MI)

A cooperative project with NASA/Goddard Space Flight Center involves making ground based spectral reflectance measurements of snow and freshwater ice types using a shere-scanning spectroradiometer. The objectives are to collect spectral reflectance data in the AVHRR and other satellite bandpasses. The data will be used to extend the library of signatures for different Great Lakes ice types to be used for satellite albedo interpretation and ice classification, as well as for the analysis of diurnal variation in reflectance, and reflectance modeling efforts. During the first field season spectral measurements were made over snow, refrozen slush-covered ice, and clear ice in Landsat TM bands 3, 4, and 5, centered at 662, 826, and 1658 nm respectively.

SATELLITE INTERPRETATION OF GREAT LAKES ICE COVER

(G.A. Leshkevich, NOAA, ERL, Ann Arbor, MI)

NOAA/AVHRR and other digital satellite data are being used with measured ground truth data to identify and map Great Lakes ice types, and for deriving lake-wide ice albedos needed for surface energy balance studies. Initial analysis has shown that different ice types can be identified in an ice cover based on their spectral signatures but that a more comprehensive library of spectral signatures characterizing major Great Lakes ice types is needed.

OPERATIONAL ICE FORECASTS

(R.A. Assel, NOAA, ERL, Ann Arbor, MI)

The Great Lakes Environmental Research Laboratory provides support to the National Weather Service (NWS) by development of operational ice forecasting techniques and by transfer of data and technology. In 1987 computer programs and air temperature files were transferred to the NWS for analysis of freezing degree-days and thawing degree-days. Work is currently under way to develop empirically-based freezeup, ice thickness, and breakup forecasts for four bay and harbor sites on the Great Lakes.

IMPACT OF CLIMATIC CHANGE ON GREAT LAKES ICE CYCLES

(R.A. Assel, NOAA, ERL, Ann Arbor, MI)

A program was initiated to develop methods to analyze the effects of climatic change on Great Lakes ice cycles. This work is part of an Environmental Protection Agency study to evaluate the potential impacts of climatic change on the Great Lakes. Lakes Erie and Superior represent the extremes in climate, water mass, and lake depth for the Great Lakes and so they were chosen for this initial analysis. Each lake was divided into basins representative of different heat storage capacity. Basin mean ice concentration, air temperature, and freezing and thawing degree-days were calculated for three basins of Lake Erie and two basins of Lake Superior over the 20-winter period 1960-79. Empirical models to simulate basin mean ice concentration are under development and evaluation.

These reports have been collected by A. Fountain

USA - WESTERN REGION

ATMOSPHERIC ICE

ORIGIN OF ICE CLOUDS
(P.V. Hobbs, Atmos. Sci., UW, Seattle, WA)
Recent airborne studies of clouds, by the Cloud and Aerosol Research Group at the University of Washington, have shown that high concentrations of ice particles, greatly in excess of those expected from ice nucleus measurements, appear near the tops of clouds when temperatures are $\leq -4\,^{\circ}C$ and droplets are present with diameters $\geq 20\ \mu m$ (*Journal of Atmospheric Science*, 42: 2523-49 (1985)). We are preparing to mount a new series of field studies to investigate the mechanism(s) for production of these high concentrations of ice particles.

ERRATUM
ICE **85**, p. 11, under *IMD ICE TANK*, should have read " ... and the ice properties are now consistently uniform ..." rather than not.

INTERNATIONAL GLACIOLOGICAL SOCIETY

JOURNAL OF GLACIOLOGY

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

M S PELTO:
The annual balance of North Cascade glaciers, Washington, U.S.A., measured and predicted using an activity-index method.

R J BRAITHWAITE AND O B OLESEN:
Effect of glaciers on annual run-off, Johan Dahl Land, south Greenland.

V P YEPIFANOV AND V P KUZ'MENKO:
Acoustic emission methods applied to avalanche-formation studies.

D F E STOLLE:
A one-dimensional finite-element model for two-dimensional glacier flow.

P HOLMLUND:
Internal geometry and evolution of moulins, Storglaciären, Sweden.

D K PEROVICH AND A HIRAI:
Microcomputer-based image processing system.

I M WHILLANS AND J F BOLZAN:
A method for computing shallow ice-core depths.

J E GORDON, W G DARLING, W B WHALLEY AND A F GELLATLY:
δD-$\delta^{18}O$ relationships and the thermal history of basal ice near the margins of two glaciers in Lyngen, north Norway.

LIU YUN-GANG, ZHANG YUN-HUI, LI GUI-QUN, XIAO LUN AND XIE ZI-CHU:
Analysis of trace elements in the BHQ ice core, Law Dome, Antarctica.

K L YOUNG AND A G LEWKOWICZ:
Measurement of outflow from a snowbank with basal ice.

M R DRINKWATER AND G B CROCKER:
Modelling changes in the dielectric and scattering properties of young snow-covered sea ice at GHz frequencies.

R B ALLEY:
Concerning the deposition and diagenesis of strata in polar firn.

J C F WALKER AND E D WADDINGTON:
Descent of glaciers: some early speculations on glacier flow and ice physics.

BRITISH BRANCH ANNUAL CONFERENCE

15-16 September 1988, University of Manchester

The Annual Conference of the British Branch of the International Glaciological Society will be held on Thursday 15 and Friday 16 September 1988, at the University of Manchester.

The meeting will commence at 11.00 on Thursday 15 September, with coffee from 10.30, permitting arrival from most parts of the UK that morning. The Annual Dinner will be held in the evening. Further presentations will be given on Friday 16 September, before the Annual General Meeting of the Branch, which should end in time to allow those who wish to leave to catch trains to most major centres. There will be an excursion on Saturday 17 September to the Lake District, subject to demand.

It is hoped that presentations of both completed work and work in progress will be made, and there will be a display space for posters. Accommodation will be available at Ellis Llwyd Jones Hall, bed and breakfast, at an inclusive cost per night of £13.00. Informal accommodation for those in possession of sleeping bags can also be provided free of charge. The registration fee of £7.50 includes coffee and tea and distribution of abstracts.

The meeting has been timed to allow participation in both the British Branch conference and the Society's International meeting in Lom, Norway. The British Branch welcomes participants and visitors from outside the United Kingdom. Offers of papers to and further particulars from: Dr David Collins, Department of Geography, University of Manchester, Manchester, M13 9PL, UK.

SYMPOSIUM ON ICE-OCEAN DYNAMICS AND MECHANICS

26 – 31 August 1990

Dartmouth College, Hanover, N.H., U.S.A.

FIRST CIRCULAR

The Society will hold a symposium on Ice-Ocean Dynamics and Mechanics in Hanover, N.H., USA in 1990. Registration will take place on Sunday 26 August and sessions will be from Monday 27 August to Friday 31 August in Dartmouth College.

TOPICS

The symposium will be concerned with understanding the dynamics and mechanics of the ice-ocean system.

The main themes will be:

(1) Micromechanical and microphysical processes in ice.

(2) Ice constitutive relationships, including the large-scale aggregate behaviour of sea ice.

(3) Numerical, analytical and observational investigations of ice-ocean dynamics.

There will be additional discussion of the following topics as relevant to the main themes: Physical and thermodynamic ice properties relevant to ice dynamics.

Air-sea energy exchange in the presence of floating ice.

Properties and behaviour of ice shelves.

PAPERS

Details about submission of summaries and final papers will be given in the Second Circular, to be published in May 1989. Dates for submissions are firm ones and must be adhered to.

PUBLICATION

The proceedings of the symposium will be published by the Society in the *Annals of Glaciology*. Papers will be refereed and edited according to the Society's usual standards before being accepted for publication.

SESSIONS

Sessions will be held on four full days and one half-day. An excursion will be held during the week.

ACCOMMODATION

Accommodation will be available in various price categories: details will be given in the Second Circular.

FURTHER INFORMATION

You are invited to attend the symposium. Please return the attached form as soon as possible. The Second Circular will give information about accommodation, general programme, preparation of summaries and final papers. Requests for copies of the Second Circular* should be addressed to the Secretary General, International Glaciological Society, Lensfield Road, Cambridge CB2 1ER, England.

*Note: Members of the International Glaciological Society will automatically receive a copy.

SYMPOSIUM ORGANIZATION

H. Richardson (Secretary General, I.G.S.)

LOCAL ARRANGEMENTS COMMITTEE

E.M. Schulson (Chairman)

A.J. Gow W.D. Hibler III

CHIEF EDITOR

K. Hutter

INTERNATIONAL GLACIOLOGICAL SOCIETY
SYMPOSIUM ON ICE-OCEAN DYNAMICS
AND MECHANICS 1990

Family Name .....

First Name .....

Address .....

.....

*I hope to participate in the symposium in 1990 [ ]

*I expect to submit a summary of a proposed paper [ ]

Theme number .....

**without obligation*

TO BE SENT AS SOON AS POSSIBLE TO:

Secretary General, International Glaciological Society, Lensfield Road, Cambridge CB2 1ER, England.

PROFILE

NORWEGIAN POLAR RESEARCH INSTITUTE (NPI)
NORWEGIAN WATER RESOURCES AND ENERGY ADMINISTRATION (NVE)
NORWEGIAN GEOTECHNICAL INSTITUTE (NGI)

Norway is one of the northernmost inhabited countries in the world, situated between latitudes 58° and 72°N. In addition, the islands of Svalbard, 77–81°N, belong to Norway. Life in Norway has thus for centuries been a struggle against problems caused by snow and ice, but the struggle also created a curiosity about how best to take advantage of the snow conditions and severe climate.

In the middle of the 19th century, interest in the economic development of the mountainous areas and the Arctic and Antarctic grew remarkably. This economic interest, combined with the curiosity of explorers and scientists, was the first push to more systematic and long-lasting research on snow and glaciers.

The topics selected for snow and glacier research in modern Norway are both a heritage of the pioneering age and a reflection of our close relationship with severe winter problems. Most research projects are concentrated on improving the safety and mobility of residents, and on the economic development of mountainous and Arctic areas. Thus, the title of the Lom Symposium, "Snow and glacier research relating to human living conditions", reflects the main objective of Norwegian research in snow science and glaciology.

There are three agencies having the main responsibility for snow and glacier research in Norway:

Norwegian Polar Research Institute (NPI).
Norwegian Water Resources and Energy Administration (NVE).
Norwegian Geotechnical Institute (NGI).

In addition, the Universities of Oslo, Bergen and Trondheim do some research, and provide the education for people later involved in research.

Norwegian Polar Research Institute (NPI)

This is the oldest of these three agencies. It was founded in 1906 to increase scientific research in Svalbard. Today, the Institute is Norway's central institute for scientific research in Svalbard, Jan Mayen, the polar seas, and the Norwegian stations in the Antarctic. The Institute is situated in Oslo, but operates a research station in Ny-Ålesund, Svalbard — at 79°N. The main sciences represented by the staff of 55 persons are biology, geophysics, geology and cartography.

The geophysical section concentrates its glaciological research on the mass balance of glaciers in Svalbard, Antarctica and Norway. The world's second long-lasting record of glacier variations is obtained from Storbren, central Norway. In recent years, remote sensing in glaciology has been a major task. Remote sensing is used for detecting the boundaries of the snow cover and glaciers, as well as for interpreting the temperature and physical properties of the glacier surface. It is also used for regular mapping of the glaciers on Svalbard.

Another important research topic in the geophysical section is the study of sea ice. This topic has been stimulated in recent years by the oil exploitation in the Barents Sea. The section also has the repsonsiblity for iceberg statistics in the Antarctic.

Norwegian Water Resources and Energy Administration (NVE)

This is the governmental agency responsible for energy matters and the administration of water resources. The glaciology section at NVE belongs to the Hydrology Department, and the section was founded in 1962.

Its first task was glacier mass-balance measurements, but later sediment transport investigations in glacierized river basins became important. The object of the investigations has mostly been to improve the water power production in glacierized areas. However, in recent years environmental problems have assumed an increasing importance. The most important areas of work are:

- the development of a national network for measuring material transport in rivers,
- glacier mass-balance investigations,
- glacier dynamics related to ice avalanches and the creation of reservoirs at glacier fronts,
- location of water divides under ice caps,
- location of subglacial river channels,
- development of snow-measuring techniques,
- setting up of a subglacial laboratory under 180 m of ice at Engabreen, northern Norway.

Norwegian Geotechnical Institute (NGI)

Snow and avalanche research at the Institute began in 1973, and the avalanche section now employs 9 scientists. NGI operates as a private consulting firm, but also receives governmental funding for the research activity. The section is responsible for both research and consulting on snow avalanches and drifting snow. The research is approximately 30% of the total workload. The section runs its own research

station in Gråsdalen, western Norway, and most of the field work is done in this area.

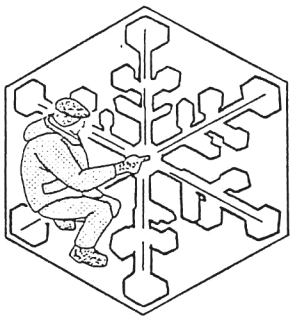
The main research projects are:

- evaluating the relationship between climatic and snow conditions and the avalanche hazard,
- measuring snow creep forces on constructions erected on slopes,
- measuring avalanche speeds and impact pressures on constructions exposed to avalanches,
- studying release mechanism for slush flows,
- release mechanism and run-out distances for debris flows,
- calculating run-out distances of avalanches based on topographical parameters.

The main agencies which consult NGI are the National Fund for National Disaster Assistance, the State Power Board, local communities, the Department of Highways and the Norwegian State Railways.

Harald Norem

The Editor is pleased to include this profile in ICE 87 because these three organizations are responsible for the local arrangements for the IGS Symposium in Lom in September 1988.



GLACIOLOGICAL DIARY

** IGS Symposia
* Co-sponsored by IGS

1988

4-8 July
Sixth International Congress on Protection of habitat from floods, debris flows and avalanches, Graz, Styria, Austria. (INTERPRAEVENT 1988, Postfach 43, A-8010 Graz, Austria)

25 July - 5 August
Glaciology and glacier hydrology – field training course, Place Glacier, coastal mountains of British Columbia. To be given by Dr Gunnar Østrem from the Norwegian Water Resources and Energy Administration, presented in association with the National Hydrology Research Institute, Saskatoon, Saskatchewan and Simon Fraser University, British Columbia. (Freddie Frankling, Geotechnical Science Laboratories, Dept. of Geography, Carleton University, Ottawa, Ontario, Canada K1S 5B6)

2-5 August
Fifth International Conference on Permafrost, Trondheim, Norway. (VICOP, Norwegian Road Research Lab., P.O. Box 6390 Etterstad, N–0604 Oslo 6, Norway.)

2 August
(in conjunction with the above conference) Workshop on Permafrost data and information. (R.G. Barry, Director, WDC-A for Glaciology, Boulder, Colorado, U.S.A.)

23-27 August
Ninth IAHR International Symposium on Ice Problems, Hokkaido University, Sapporo, Japan. (Hiroshi Saeki, Department of Civil Engineering, Hokkaido University, Kita-13, Nishi-8, Kita-ku, Sapporo 060, Japan)

4-9 September
** Symposium on Snow and glacier research relating to human living conditions. Lom, Norway. (Secretary General, IGS, Lensfield Road, Cambridge CB2 1ER, UK)

13-16 September
Eighth International Conference on Geoscience and remote sensing, Edinburgh, Scotland. (Dr J.A.T. Young, Department of Geography, University of Edinburgh, Drummond Street, Edinburgh EH8 9XP, Scotland, UK)

12-15 October
International Snow Science Workshop, Whistler, Canada. (I.S.S.W. '88 Committee, P.O. Box 67, Whistler, B.C., Canada V0N 1B0)

12-15 October
Workshop on Ice core drilling, Grenoble, France. (Mrs D. Beaudoing, Laboratoire de Glaciologie et Géophysique de l'Environnement, B.P. 96, 38402 St Martin d'Hères Cedex, France)

24-26 October
Fiftieth Anniversary Scientific Meeting of the Japanese Society of Snow and Ice, Tokyo, Japan. (Dr Kou Kusunoki, Committee for 1988 Meeting, Japanese Society of Snow and Ice, 308 Bancho Heim, 1-2, Nibancho, Chiyoda-ku, Tokyo 102, Japan)

5-9 December
* American Geophysical Union 1988 Fall Meeting jointly with the American Society of Limnology and Oceanography Winter Meeting: sessions on snow, ice, and permafrost, San Francisco, California, U.S.A. American Geophysical Union, 2000 Florida Avenue, NW, Washington, DC 20009, U.S.A.)

1989

13-17 March
Fourteenth General Assembly of the European Geophysical Society, Barcelona, Spain. (E.G.S. Office, c/o MPI für Aeronomie, D-3411 Katlenburg-Lindau, Federal Republic of Germany)

16-17 March
* Meeting on Glacimarine environments: processes and sediments, London, UK. (Marine Studies Group of the Geological Society of London. J.A. Dowdeswell, Department of Geography, University College of Wales, Llandinam Building, Aberystwyth, Dyfed SY23 3DB, U.K.)

19-23 March
OHMAE Europe 1989 – Eighth International Conference on Offshore mechanics and Arctic engineering, The Hague. Ice mechanics: (Dr Nirmal K. Sinha, Chairman, Ice Mechanics Committee, Offshore Mechanics and Arctic Engineering (OHMAE/ASME), Institute for Research in Construction, National Research Council of Canada, Ottawa, Ontario, Canada K1A 0R6)

20-23 March
Fifth Conference of the European Union of Geosciences, Strasbourg, France. (Jan Høst, Geological Survey of Norway, P.O. Box 3006 – Lade, N – 7002 Trondheim, Norway)

May
6th Symposium on Glacitectonics, Zielona Góra, Poland (Jerzy Kotowski, Komitetu Organizacyjnego VI Sympozjum Glacitektoniki, Wydzial Budownictwa i Inzynierii Sanitarnej, Wyzsza Szkola Inzynierska, ul. Podgórna 50, 65-246 Zielona Góra, Poland)

12-14 April
QRA Discussion meeting on Environmental change in Iceland: past and present, Aberdeen, Scotland. (Judith Maizels, Dept. of Geography, University of Aberdeen, AB9 2UF, UK)

10-19 May
3rd IAHS Scientific Assembly (Symposium S5: Stochastic processes and time series analysis in glaciology) Baltimore, Maryland, U.S.A. (A. Ivan Johnson, Chairman, Third IAHS Scientific Assembly Organizing Committee, 7474 Upham Court, Arvada, CO 80003, U.S.A.)

9-19 July
28th International Geological Congress, Washington, D.C., U.S.A. (B.B. Hanshaw, Secretary General, 28th International Geological Congress, P.O. Box 1001, Herndon, VA 22070-1001, U.S.A.)

21-25 August
23rd IAHR Biennial Congress, Ottawa, Ontario, Canada. (T.M. Dick, NWRI, CCIW, P.O.Box 5050, 867 Lakeshore Road, Burlington, Ontario, L7R 4A6, Canada)

21-25 August
** Symposium on Ice and Climate, Seattle, Washington, U.S.A. (Secretary General, IGS, Lensfield Road, Cambridge CB2 1ER, UK)

4-8 December
American Geophysical Union Fall Meeting, San Francisco, California, U.S.A. (A.G.U. Meetings, 2000 Florida Avenue, N.W., Washington, DC 20009, U.S.A.)

1990

12-15 June
International Symposium on Water Resources Systems Application, Winnipeg, Canada. (S.P. Simonovic, Civil Engineering Department, The University of Manitoba, Winnipeg, Manitoba, Canada, R3T 2N2)

August

** Symposium on Ice–Ocean Dynamics and Mechanics, Hanover, N.H., U.S.A. (Secretary General, IGS, Lensfield Road, Cambridge CB2 1ER, UK) Co-sponsored by the American Geophysical Union and the American Meteorological Society.

1991

11-24 August
20th General Assembly of the International Union of Geodesy and Geophysics, Vienna, Austria.

NEWS

ICE CORE WORKING GROUP

The role of the ICWG is to:

1. Foster and facilitate communications within the U.S. ice coring community.
2. Develop a strategy for U.S. ice core research based on views solicited from this community and on the long-range research objectives identified by the International Council of Scientific Unions (ICSU) in the "International Geosphere-Biosphere Program (IGBP): A Study in Global Change".
3. Play an advocacy role on behalf of the U.S. ice coring community at large and represent this community's interests and needs to funding agencies and the public.
4. Provide recommendations to U.S. funding agencies in decisions affecting the direction of ice core research.
5. Establish and promote links with the National Academy of Sciences and programs such as the Global Geosciences Initiative (GGI) that have climatological and/or glaciological interests.
6. Provide a forum for the involvement of U.S. scientists who are not directly involved in ice core research.
7. Represent U.S. ice core researchers in international forums and actively participate in the scientific and logistic planning related to international ice coring programs.
8. Promote links with and participation by other disciplines in studies related to ice core research.

The scientific impetus of the ICWG is to develop a framework within which the research community will:

1. Maintain ice core research in the mainstream of scientific thought as a tool for solving compelling scientific problems well into the twenty-first century.
2. Obtain information on physical and chemical processes controlling deposition onto any polar or high altitude/low-to-middle latitude ice mass which can potentially provide an environmental record.
3. Obtain high resolution time-series of environmental parameters over decades, centuries, and/or millenia at crucial geographical locations around the globe.
4. Obtain long time-series over the last one hundred thousand years or more at the most scientifically suitable sites in Greenland and Antarctica.
5. Measure ice properties and geophysical parameters contributing to an understanding of the dynamics of ice sheets past and present.
6. Interpret ice core-derived environmental data, and compare these data with records from marine and terrestrial sources in order to expand the temporal and spatial applicability of environmental data in general.
7. Apply data retrieved from ice core research for understanding climate processes and advancement of climate models.
8. Advance technologies and methodologies necessary to achieve the foregoing objectives.

ICE CORE WORKING GROUP (ICWG) MEMBERS AND ALTERNATES

Atmospheric Chemistry and Meteorology
Randy Borys (ICWG) and Cliff Davidson (Alternate).

Climatological Research
Thomas Crowley (ICWG) and Richard G. Fairbanks (Alternate).

Geophysics
Steve Hodge (ICWG), C.F. Raymond (Alternate) and John Bolzan (Alternate).

Ice Chemistry
Paul A. Mayewski (ICWG) Chairman, and Robert Finkel (Alternate).

Particles
Lonnie Thompson (ICWG) and Julie Palais (Alternate).

Physical Properties
Tony Gow (ICWG) and Hitoshi Shoji (Alternate).

Stable Isotopes
Pieter Grootes (ICWG) and James White (Alternate).

Trace Gas Chemistry
Reinhold Rasmussen (ICWG) and M.A.K. Khalil (Alternate).

Further information may be obtained from
Paul A. Mayewski (ICWG), Chairman
University of New Hampshire
Institute for the Study of Earth,
Oceans and Space
Science and Engineering Research Building
Durham, NH 03824, U.S.A.

MEETING ON SNOW, ICE AND WATER OF ALPINE GLACIERS, ETH, ZÜRICH, 26 JANUARY 1988

The meeting was held on the occasion of the 65th birthday of Prof. Hans Röthlisberger, to mark his retirement. The lectures and some additional contributions will be published by ETH.

Session I: Climate and glacier fluctuations

L. Reynaud:
Alpine glacier fluctuations and climatic changes over the last century.

W. Ambach:
Instabilities of the equilibrium line altitude in Greenland by climatic warming.

M. Kuhn:
Consequences of a long range warming.

A. Ohmura:
Role of glaciers in a climatic change for snow and ice.

B. Stauffer:
Air inclusions in glacier ice.

B. Kasser and H. Siegenthaler:
On the effect of a change in size of a glacier on runoff and mass balance.

M. Aellen and M. Funk:
Mass balance of Griesgletscher from 1961 till 1986: comparison of different methods.

W. Haeberli and J. Schweizer:
Rhonegletscher 1850: consideration of glacier dynamics for a historical stage.

Session II: Glaciers and water

A. Iken:
Adaptation of the hot-water-drilling for drilling to great depth.

H. Oerter and O. Reinwarth:
Observations concerning flood discharge from an Alpine glacier (Vernagtferner, Oetztaler Alps).

H. Lang:
On some peculiarities of glacial runoff.

D. Collins:
Suspended sediment delivery to melt-waters beneath an Alpine glacier.

Session III: Stability of snow and ice on steep mountain sides

J. Alean and W. Schmid:
Ice avalanches from Fletschhorngletscher.

J. Schweizer:
Numerical analysis of a hanging glacier on the Lyskamm (Valais Alps).

H. Gubler:
Aspects of spontaneous snow slab release.

B. Salm:
Shear-crack propagation in the snow cover.

F. Hermann and T. Scheiwiller:
Experiments on the deposition by laboratory powder snow avalanches.

K. Hutter, Ch. Plüss and N. Maneo:
Some implications deduced from laboratory experiments for granular avalanches.

PUBLICATIONS

The Correspondent for USA (Western)* has sent us the following notice about a delightful book by Wendell V. Tangborn, a member of IGS.

Glaciers, by Wendell V. Tangborn, illustrated by Marc Simont. 1988 Revised edition. New York, Harper and Row.

The brevity of *Glaciers* is deceptive. Packed into the book's 71 sentences (the shortest is 2 words) are discourses on the spatial and temporal variability of climate as it relates to glaciers and ice sheets, global distribution of ice masses, and glacial geology. Other topics more briefly mentioned are glacier dynamics and hydrology, and the iceberg rafting of debris. Only an author long familiar with his subject could transform the facts into the eloquent, concise prose found in this book.

Glaciers is beautifully illustrated with watercolor scenes that clearly aid the text. The delightful drawings and the absence of equations indicate that Tangborn is directing the book toward pictorial rather than mathematical thinkers. Some experts may criticize the omission of basic equations used in glaciology, such as the flow law, but the book has been carefully crafted for a specific audience, and I doubt such material will be missed.

Ordinarily, I find it unfair to describe one author's work in relation to another's, unless the connection between the two is unambiguous. However, the most succinct way to describe *Glaciers* is to call it Paterson's *Physics of Glaciers* for the 4–8 year old set. Tangborn's book is part of the *Let's-read-and-find-out* Science Series published by Crowell for young learners.

* Andrew Fountain

* *Western Region correspondent, new address: U.S. Geological Survey, Box 25046, MS 412, Denver Federal Center, Denver, CO 80225, U.S.A.*

New publications of the U.S. Geological Survey

Professional Paper 1386-B, *Satellite image atlas of glaciers of the world*, edited by Richard S. Williams, Jr, and Jane G. Ferrigno, 1987. The chapter *Antarctica* by Charles Swithinbank, with sections on The "dry valleys" of Victoria Land, by Trevor J. Chinn, and Landsat images of Antarctica, by Richard S. Williams, Jr, and Jane G. Ferrigno, is the first in a series of eleven to be released.

AWARDS

American Geophysical Union has awarded the James B. Macelwane Medal in recognition of significant contributions to the geophysical sciences by a young scientist (less than 36 years old) to Douglas R. MacAyeal (University of Chicago, Chicago, IL) for studies of the dynamics of the Ross Ice Shelf, which have involved collecting copious field measurements, determining oceanographic processes beneath ice shelves, and developing dynamical models. His work has contributed to knowledge of changing sea level and climatic change.

DATA PROTECTION

Pursuant to the provisions of the U.K. Data Protection Act 1984 s.33(3), we are required to inform our members that following the acquisition of a word processor we are now holding a mailing list on computer disc. The information held by us is required only for the purpose of distributing or recording the distribution of articles of information to members and consists only of their names, addresses and other particulars necessary for effecting such distribution. If any member objects to the information being held as mentioned he should notify the Secretary of the Society before 1 September 1988.

EXCLUSION CLAUSE

While care is taken to provide accurate accounts and information in this Newslatter, the editor is not qualified in law or accountancy, and neither she nor the International Glaciological Society undertakes any liability for omissions or errors.

RECENT MEETING (of other organizations)

NORTHWEST GLACIOLOGISTS MEETING, DEC 3–4 1987, TACOMA, WA

The annual meeting of the Northwest Glaciologists was held on December 3–4 1987 at the University of Puget Sound under the sponsorship of the Ice and Climate Project, U.S. Geological Survey. Ed Josberger (ICP-USGS) chaired the meeting, which consisted of 41 papers. Ed held an icebreaker at his home the first night of the meeting and those who could follow an excellent map during the dark and rainy night over suspect terrain were treated to fine wines and cheeses in cozy wood-paneled rooms.

The end of the meeting was marked by a proposal to include Boulder, CO, in the traditional rotation of NG sites. In addition, a suggestion was made to shift the meeting days from Thursday/Friday to Friday/Saturday, or Saturday/Sunday, to accomodate those with academic schedules. Both ideas have been tabled for further discussion.

Papers were presented under the subjects:

Columbia Glacier, Alaska
Storglaciären, Sweden
Hydrology
Snow
Glacier flow
Climate
Basal processes

A full list of papers may be obtained from Andrew Fountain, at his new address: U.S. Geological Survey, Box 25046, MS 412, Denver Federal Center, Denver, CO 80225, U.S.A.

REVIEW

The Polar Shelf: the saga of Canada's Arctic scientists, by Michael Foster and Carol Marino. 1986. Toronto, NC Press.

The Polar Continental Shelf Project, or PCSP, was set up by the Government of Canada in 1958 to conduct scientific research and strengthen Canada's sovereignty in the Far North. Starting off as a self-contained unit tasked mainly with oceanographic and hydrographic work, it has over the years concentrated less on in-house projects, developing instead into a superb logistic support organization, supporting scientists from other government departments, from universities and other agencies, and providing a coordinating communication system which keeps in touch with all parties operating in the High Arctic. This is most valuable service, without which many successful programs could not have been undertaken. Nevertheless, the sub-title of the book – the saga of Canada's Arctic scientists – is slightly misleading, giving as it does the impression that all Canadian scientific work in the Arctic is part of the Polar Shelf Program. This is untrue, though all benefit to at least some extent from its presence.

The book is essentially a picture book on the history and work of the Polar Shelf, not perhaps glossy enough to qualify for full Coffee Table status, but a very nicely produced and attractive volume, and certainly not a serious detailed account. The authors are photographers and writers rather than active participants in the work of the project, though one of them is described on the dust jacket as having "first-hand experience in the North with Polar Shelf".

Perhaps sensibly then, the text consists of a minimum of narrative combined with many direct quotations from those who have had a part in the project, from Fred Roots, the first director, and George Hobson, the second and continuing director, to such important but frequently unheard-from expedition members as pilots, technicians, and cooks. This adds a liveliness and authenticity which might otherwise be missing. Some of the quotations are woven into the narrative, others scattered around in apparently uncoordinated places and a variety of type-faces, which makes for an interesting presentation but occasionally seems disjointed and in danger of becoming confusing to the general reader. And it is presumably for an interested but outside audience that the book is intended, since it is totally non-technical and by no means complete in its coverage of the work undertaken. Nor is there much mention of the results of research. The readers who will enjoy it are those who were involved in arctic research in the period covered, whether or not under the Polar Shelf shield. For them it is a delightful and nostalgic record of familiar people and places.

The pictures are largely black and white photographs taken by expedition members, with an increasing use of colour towards the end of the book. Why this should be is something of a mystery, as colour film was certainly as widespread in 1958 as it is now. There is nothing wrong with black and white photography, of course, but much of this is of such high contrast that a lot of detail is lost. In some cases the contrast is very effective, but it is so overdone that one suspects poor reproduction. It is hard to believe that so many expedition members over-exposed their film.

There are one or two unfortunate errors. Bernier's hut at Winter Harbour is attributed to Parry, and Bernier himself is elsewhere referred to as an early explorer, which is stretching it a bit. The Mer de Glace Agassiz is consistently referred to as the Mer de Glace Agassiz Ice Cap. As a bilingual country Canada's street signs may often read "Rue Main Street", but the user is expected to choose one or the other, not both. Another puzzler is a photo of "Hell Gate on Sverdrup Island". In talking about ice islands, on one of which Polar Shelf has established a station, the authors state that they originate only from the Ward Hunt Ice Shelf or from Disraeli, Milne or Yelverton fiords. This not only leaves out Ayles Fiord, Markham Bay and M'Clintock Inlet, but also Phillips Inlet, which on the same page Fred Roots is quoted as being the source of the island of the U.S. station ARLIS II. Finally, the "range of hills" on ARLIS II was not one of the corrugations characteristic of ice islands, but a ridge of morain material from the coast (of Phillips Inlet).

In spite of these quibbles the book remains a good if popular account of the work of Polar Shelf and will be enjoyed by many readers.

Moira Dunbar

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ICE

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