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# NEWS BULLETIN OF THE INTERNATIONAL GLACIOLOGICAL SOCIETY



# INTERNATIONAL GLACIOLOGICAL SOCIETY

# SYMPOSIUM ON SNOW AND GLACIER RESEARCH RELATING TO HUMAN LIVING CONDITIONS

LOM, NORWAY, 4 - 9 SEPTEMBER 1988



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See page 13 of this issue of ICE for the FIRST CIRCULAR

# ICE NEWS BULLETIN OF THE INTERNATIONAL GLACIOLOGICAL SOCIETY

#### NUMBER 81

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FIFTIETH ANNIVERSARY OF THE SOCIETY. The next issue of ICE (No. 82, 3rd issue 1986) will be devoted to reports on the celebrations in Cambridge and on the Swiss Tour in September 1986.

COVER PICTURE: Balls of larch needles formed by the action of waves on the shore of the lake at Davos, Switzerland. The balls were iced over. Photograph by E. Wengi, Swiss Federal Institute for Snow and Avalanche Research, 7260 Weissfluhjoch, Davos, Switzerland.

# BELGIUM

#### ANTARCTICA, 1986-1989

A national research program on Antarctica has been set up by the Belgian government for the period 1986-1989. Four glaciological programs have been selected:

a) Interaction between sea ice, katabatic wind formation and Antarctic climate (A.Berger, University of Louvain).

b) Glacier flow in a region of East Antarctica, specially in connection with the damming effect of a mountain range (H. Decleir, University of Ghent).

c) Modelling the evolution of marginal sea ice zones in the Weddell Sea (A.Berlamont, University of Leuven and G.Pichot, North Sea Research Unit).

d) Isotopic composition, 5D and 5<sup>18</sup>O of ice, due to refreezing (R.Souchez, University of Brussels).

# BASAL ICE OF THE GREENLAND ICE SHEET

The objective of a joint University of Aberdeen (UK) and University of Brussels project is to carry out detailed analysis of the chemistry, crystallography, oxygen and hydrogen isotope ratios and debris content of basal ice exposed at the western margin of the Greenland Ice Sheet. After a preliminary investigation in 1984, two sites were visited and studied during the 1985 summer: the margin of the Ice Sheet along the northern part of the Jakobshaven Glacier and along the northern and terminal part of the Russell Glacier.

#### ISOTOPIC EVOLUTION OF WATER AND ICE DURING FREEZING

In collaboration with J.Jouzel (Centre d'Etudes Nucléaires de Saclay, France), R.Souchez (University of Brussels) investigated the peculiar evolution of the isotope composition, both in  $\delta D$  and  $\delta^{18}O$ , of water and ice during freezing in open systems.

Conclusions concerning the isotope composition of basal ice were reported in the Journal of Glaciology (1985) with J.-M. De Groote.

#### ORIGIN OF GROUND ICE MASSES ON VICTORIA ISLAND, CANADA

Applying the results obtained by J.Jouzel and R. Souchez, R.Lorrain (University of Brusels) was able to give isotopic evidence for the occurrence of relic Pleistocene glacier ice on Victoria Island (Arctic and Alpine Research, 1985). Roland Souchez

# **CHINA**

# SNOW AND ICE RESOURCES IN THE OILIAN SHAN

(Xie Zichu, Zeng Qunzhu, Yang Zhenniang et al., Lanzhou Institute of Glaciology and Geocryology, Academia Sinica, Lanzhou, China (LIGG))

Using data from remote sensing and field observations, a predictive model of short-term snowmelt run-off during April-May has been developed with an accuracy of 80-85%. A field station was set up at Binggou, in the basin of the Heihe River, for observations of snowmelt run-off, hydrological and meteorological elements, areas of snow cover and for spectrum measurements. The remote sensing data are also used to monitor the snow and to establish relationships between snow melt run-off and the meteorological elements. The data obtained includes the following: glacier fluctuations in the mid-section of the Qilian Shan; glacier thickness from radio echosounding, ground water recharge using the tritium tracer method, and a dendroclimatological analysis for the last 1000 vears.

#### WATER RESOUCES AND THEIR UTILIZA-TION, URUMQI RIVER, TIAN SHAN

(Shi Yafeng, Qu Yaoguang, Wang Zongtai, Kang Ersi et al., LIGG)

The main objectives are to find the effects of ground water withdrawal for Urumqi City in the piedmont area, the ecological environment of Chaiwopu Lake and its environs and the possibility of channelling water from Heigou River to Chaiwopu Lake. Some insights and new data have been obtained on precipitation in high mountain areas; on the characteristics of run-off distribution from glacier melt along the southern slope of Bogda Peak; and the measurement, calculation and distribution of precipitation in the high mountain areas of the upper Urumqi River. The research work started in 1985 and will be continued in 1986. Research on the allocation and utilization of water among industries, agriculture and population is also planned.

### CHINESE GLACIER INVENTORY

(Shi Yafeng, Wang Zongtai, Liu Chaohai et al., LIGG)

The inventory of glaciers ewas completed in Kunlun Shan and the inland mountain ranges of the Qinghai-Xizang Plateau. It continues in the Karakoram, Mt. Hengduan Shan and the Himalayas.

#### SNOW RESEARCH

(Li Peiji, LIGG)

Daily data on the thickness and density of the snow cover during 1951-1980 from 2300 meteorological stations covering 29 provinces and municipalities directly under the central government and 30 years' data on snowfall and snow cover in most provinces in China have been collected to form the basis for a further study on the distribution of snow water resources and their volume in China.

#### THE GENESIS AND PREDICTION OF JØKULHLAUPS, YARKAND RIVER, SOUTHWEST XINJIANG

(Zhang Xiangsong, You Xiyao et al., LIGG) Exceptionally big floods were formed by the outburst of the ice-dammed lake of Kyagar Glacier, or caused by water release from subglacial and englacial cavities. The flash floods on Yarkand River are closely related to fluctuations of the glaciers on the northern slope of the Karakoram. Field investigations from semi-fixed position will be done in the headwater area of the Shaksgam River in 1986. Special attention will be given to the hydrological characteristics of Kyagar Lake, to the design and testing of instruments for remote sensing, to warning systems and to precipitation problems in high mountain areas.

#### GEOTECHNICAL RESEARCH

(Wu Ziwang, Chen Xiaobe, Ding Dewen, Wang Zhonglong et al., LIGG)

The following are objects of special study: the freezing disasters during the rebuilding of the asphalt roadway along the Qinghai-Xizang Highway; plans for the amelioration of drifting snow problems in the Tanggula Shan area along the Qinghai-Xizang Highway; artificial freezing of the coal base both south and north of Huaihe River for well drilling; applied research on engineering foundations in the frost heaving permafrost zone during spring melt; the shallow burying of building foundations in northeast China; laboratory and field testing of a thin-film lining protection against frost heaving along irrigation canals and for preventing infiltration in the Hexi area of Gansu Province.

## **GLACIER MAPPING**

(Chen Jianming, Bu Jueying et al., LIGG) A map of the glaciers on Mount Gongga, at a scale of 1:25 000, has been completed using both terrestrial photogrammetric surveys and aerial photography.

# RESEARCH ON THE ANTARCTIC ICE SHEET

(Xie Zichu, Huang Maohuan, Ren Jiawen, Qin Dahe, Qian Songlin et al., LIGG) The microtexture and fabrics of ice samples from a 400-m ice core from the BHQ boreholes, Law Dome Ice Cap, Antarctica, have been analysed. Co-operative glaciological studies will continue at the Australian Casey Station, as well as research on the physical properties of the ice cap on Nalsen Island near the Chinese Great Wall Station.

# SNOW AND ICE INSTRUMENTATION

(Wang Liangwei, Zhu Guocai et al., LIGG) An interface for data transfer between the remote sensing single-plate instrument (TP-801) and a PC-1500 micro-computer has been built. The design and manufacture of a CMOS single-plate instrument and an automatic water level recorder, using a microcomputer, has been completed.

# PHYSICAL RESEARCH ON GLACIERS AND PERMAFROST

(Huang Maohan, Xu Xiaozu, Zhu Yuanlin et al., LIGG)

The basic theoretical subjects under study are moisture migration and ice formation during freezing, the mechanisms of frost heaving and saline heaving, ice texture and ice creep, etc. It has been proved that there is sliding at the base of Glacier No. 1 in the headwater of Urumqi River, Tian Shan.

## INTERNATIONAL COOPERATIVE RE-SEARCH PROJECTS ON GLACIERS AND PERMAFROST IN CHINA

Eleven memorandums on academic exchanges and reseasch have been signed with U.K., Japan, U.S.A., Switzerland, Canada, Federal Republic of Germany, Poland and Australia. The research projects include: ice-core climatology; hydrology and meteorology; modelling of glaciers and glacial hydrology; remote sensing of ice, snow and permafrost; hydrochemistry of ice and snow; periglacial processes; and high mountain area geomorphology. As an example, Sino-German scientists (Wang Wenying, Zheng Benxing and M.Kuhle et al.) have completed field studies on glacier fluctuations and Quaternary glaciation etc. in the area of Mt. Jolmo Lungma and Mt. Xixiabangma. Sino-American scientists (Wu Xiaolin and L.G.Thompson et al.) obtained a 16-m ice core from a flat summit of Dunde Glacier, Qilian Shan, providing a climatological record for more than 40 years based on isotope and microparticle concentration analysis. This work will continue in 1986.

Zhang Xiansong and Xie Zichu

In 1985, Soviet glaciologists worked in the Caucasus, Central Asia, the Khibiny Mountains, Siberia, the Far East, Kamchatka, the Arctic and in Antarctica.

#### WORLD ATLAS OF SNOW AND ICE RESOURCES

Work on the first volume of the Atlas (maps) was completed under the leadership of the Institute of Geography, USSR Academy of Sciences; that on the second volume, a scientific monograph of about 2000 pages, continues.

The compilation of the Atlas involved the development and testing of a complex systems approach to glaciological mapping. This included a sequence of cause-and-effect maps together with a thematic series which characterized the complex conditions under which glacio-nival systems form and exist at different regional levels, the morphological characteristics of the systems and their regime, the snow and ice resources and their role in run-off formation. As a result of a comparative study of the glaciation of the world, an orderly morphological classification of glaciers was elaborated with three classes sheet, mountain and mountain-sheet glaciations: the latter type having become equal to the other two for the first time.

Analysis of the Atlas data suggests that during the last 25-30 years there has been a trend towards a slowing in the retreat of mountain glaciers, to their stabilization and reactivation against the general background of glacier retreat and mass reduction which has been going on since the late 19th Century. This tendency is particularly prominent in regions with a humid maritime climate (the Alps and west coast of North America), while the rate of glacier retreat has not changed in the dry inner continental regions. Glaciological data do not suggest that natural climate changes are affected by anthropogenic influences. The variability of the major thermal indices at the same altitude (duration of warm period and sums of positive air temperature) seems to be much greater within than between mountain areas. The role of precipitation augmenting in liquid accumulation and in the formation of runoff from glaciers is also specified.

Tashkent University worked out a new variation on the technique for estimating the response of mountain glaciation (not that of an individual glacier) to climatic changes. A new method was also proposed for determining the height of the "reduction firn line" in glacierized regions that avoided previous difficulties in its calculation.

A thermodynamic iceberg model, developed at the Institute of Mechanics, Moscow State

University, describes aspects of the degradation and destruction of floating ice blocks. It was established that the characteristics of the melting of fresh-water ice in salt water are such that the natural hydrodynamics of icebergs differ sharply from the induced ones. An active external influence leads to rapid ablation of ice from the underside and to destruction of the iceberg, especially in low latitudes.

The optical characteristics of snow and ice (volumetric absorption, light scattering and reflection, as well as re-evolution of it from the surface) led to a theoretical definition of some new features of the heating of the snow/ice cover. In a number of cases, the temperature maximum (and hence melting) is attained beneath the surface if there is no liquid precipitation. This accounts for some metamorphic features in the upper layers of the snow/ice stratum that are important for the transformation from firn to ice in the accumulation zone of glaciers: certain corrections must be made to estimates of the glacier's energy balance. A theoretical explanation of the role of energy in the melt process of the snow/ice surface, when there is radiational heating from the surface, has been given.

The Central Asian Hydrometeorological Institute has established the first operational data bank on glaciers, mountain snow cover and avalanches.

## GLACIERS - CAUCASUS

The Institute of Geography made mass balance measurements on the Malyi Azau, Garabashi and Terskol glaciers. During the ablation season, regular observations were made on the shifting of the transient snowline, on the structure of the snow pack and its temperature regime, on variations in the regime and on ice formation in the different glaciological zones.

The processes of spalling, transportation and deposition of debris were studied on the Bezenga glacier. This work included dating mudflow (seli) cones in the upper reaches of the Cherek-Bezenga River, determining mudflow rhythms and their dependence on glacial phenomena, a structural tectonic and morainic survey of the Bezenga Glacier, measuring rates of ice deformation and movement and determination of the percentage of fines in glacier ice.

The Vakhushti Institute of Geography carried out glaciological, hydrological and meteorological observations in the basin of the Bubistskali River. Snow and ice melt were studied on the Tbilisa and Buba glaciers. The water balance was determined for the ablation season. Other studies included an investigation of solid run-off, the chemical composition of glacier water and the relationship between glacier cooling and weather types; it increases when the weather is dry and sunny and decreases when it is rainy and cloudy.

## GLACIERS - TIEN SHAN

The Institute of Geography, U.S.S.R. Academy of Sciences, carried out a range of glaciological and geophysical studies on the Davydov and Sary-Tor glaciers in the Ak-Shirak Mountains. These included the influence of glaciers in the upper reaches of the Naryn River on run-off, areal snow surveys on the glaciers, ablation measurements, radio echo-sounding and thermal drilling to the bed. Studies on the Golubin and Medvezhiy glaciers were continued.

The Tien Shan Physico-Geographical Station, Academy of Sciences of the Kirghiz S.S.R., invesigated the Inyl'chik glacier. For the first time, the infilling and drainage of the Mertsbakher fault lake were observed. The theory of an ice dam during the period of maximum infilling, confirmed by the Station's specialists, explains the relatively rapid discharge of the lake: 7-10 times higher than prior to the faulting. Analysis of numerous totalizing rain gauges showed that precipitation depends less on orography than absolute height. The Institute of Geography, Academy of Sciences of the Kazakh S.S.R., summarized data collected over many years on the regime and distribution of precipitation and the snow cover in the mountains of the Zailiysky Alatau. An analysis of run-off mechanisms in the glacierized area permitted determination of values of mean long-term glacier run-off in the Ili River, both the total and individual components.

Leningrad University organized joint meteorological and heat balance studies, as well as temperature and wind profiles of the atmospheric boundary layer over the Central Tyuksu Glacier. Thus, the characteristics of the interaction between the glacier and nearglacier atmospheric layer were defined and the influence of the exterior and interior factors on the processes of air transformation over the glacier surface estimated. The intensity of heat and moisture exchange processes near the glacier surface were analyzed in relation to the mesoscale processes. Measurements of air temperature at seven levels (from 0.12 to 8 m) and continuous recording of wind parameters at 2 m were used to determine the type and variability of temperature profiles in the near-glacier layer of air, depending on meteorological conditions and on the degree of air transfomation over the glacier surface. Based on infrared radiometer measurements of the temperature of the underlying surface during the period of melting under intensive solar radiation, the temperature of the water film on the surface is from 0.2 to 0.5 °C.

Methods for calculating previous altitudes of the firn line from meteorological data were worked out at Kharkov University. Field studies were carried out on Shumsky Glacier in the Dzhungar Alatau. The height of the firn line was estimated from observational data from 1947-1983 and using meteorological data from Sarkand Station, 33 km from the glacier. The difference between the observed and actual value averages 29 m.

# GLACIERS - ALTAI

Tomsk University organized meteorological observations on six glaciers. In 1985, the run-off of the Aktru River, during the ablation season, was lower than the mean for many years. Altai University conducted a hydrochemical analysis of seasonal snow on Gebler Glacier, between 1 950 m and 4 440 m. The level of snow mineralization does not depend on absolute altitude. The increase in Zn and Mg is accounted for by westerly wind transport from industrial regions.

# GLACIERS - KAMCHATKA

The Institute of Voncanology, Far East Branch of the U.S.S.R. Academy of Sciences, continued to study the regime of glaciers n volcanic regions. Aerial surveys in East Kamchatka showed that the snow line was low on the glaciers of the Avacha group of volcanoes and on the East volcanic ridge. The mass balances of the Kozel'sky, Koryto and Grechishkin glaciers, reconstructed from meteorological data, were compared with atmospheric circulation types from the Pacific sector and a long-term forecast was made for the development of glacierization for 1986 to 2015. It is expected that the balance will become more negative and the tongues retreat, due to a considerable decrease in accumulation. The 1980 to 1985 prognosis on the peninsula's glaciers was on the whole justified - for these years the balance was positive.

## FLUCTUATIONS OF GLACIERS

In the Caucasus, the Vakhushti Institute of Geography made repeated phototheodolite surveys of the Adishi, Khonkhito, Laboda, Shkhara and Naumkvan glaciers. Over a 7-year period, Naumkvan Glacier retreated 37 m: all the other glaciers were in a steady state. Moscow University's Laboratory of Aerospace Methods continued similar surveys aimed at understanding the dynamics of Elbrus glaciation over the last 25 years. The rate of glacier recession seems to have decreased in comparison with previous decades. Several glaciers are in a steady state, while some have advanced. The National Research Centre "Priroda" used remote sensing and astronaut observations to study the variation and pulsing of glaciers in the Pamirs, Tien Shan and Karakorum. Maps were compiled of glacier variations in the Central Pamirs and of surging glaciers in the Pamirs and Karakorum.

In the Pamirs, the Tadzik Hydrometeorological Service studied 113 glaciers in the Zeravshan, Surkhob and Obikhingou river basins: all observed glaciers are retreating.

The Institute of Geography, Academy of Sciences of the Kazakh S.S.R., working in the Tien Shan, analyzed data on the dynamics of the Tyuksyu, Igly Tyuksyu and Shokalsky (Zailiysky Alatau) glaciers. On these, and the Molodezhnyi and Mametova glaciers, surface changes were also evaluated. An analysis of all the components of exterior masss exchange for 18 years was completed for Shumsky Glacier. Methods were developed for calculating maximum snow reserves on the glacier surface and for making probability forecasts of exterior mass exchange with a 90% precision. Harmonic analysis detected long-term rhythms in Dzhungarsky Alatau at 2, 5, 11 and 24 years.

The Geological and Geophysical Institute, Academy of Sciences of the Uzbek S.S.R., studied variations in the terminus of Imat Glacier for 20 years. It has retreated 60-70 m; more intensively in the last three years.

The Tien Shan Physico-Geographical Station, Academy of Sciences of the Kirgiz S.S.R., continues to observe the contraction of glaciers in the Sary-Dzhaz River basin. The mass balance of the reference Karabatkak Glacier was negative for the last years. Despite the steady recession of the glaciers, the volume of run-off in the glacier-fed rivers has not yet decreased.

In the Altai, Tomsk Unviersity has continued observations on the Aktru Glacier. The velocity of the tongue of Malyi Aktru Glacier dropped by 0.37 m/d as compared to 1984, but that on Levyi Aktru has stayed the same as in the previous balance year. Compared to 1983, all glaciers on the Severo-Chuiskiy and Yuzhno-Chuiskiy ridges retreated 6-18 m. The maximum depths of the Bolshoi Maasheisky and Dzhelo glaciers, on the former ridge, were determined by radio echosounding to be 190 m and 118 m respectively.

Studies by Altai University, in the Altai and Sayan mountains, show that the degradation of glaciers continues, although balances for 1983-84 and 1984-85 were positive. Valley glaciers were retreating 10-15 m/a, while small glaciers were stationary. From 1983-85, Gebler Glacier retreated 25-40 m.

## PALEOGLACIOLOGY

The Institute of Geology, Academy of Sciences of the Estonian S.S.R., together with researchers from Moscow State University and

the PNIIIS of the Gostroi of the U.S.S.R. (Office of State Construction), continued studying paleoclimatic and paleocryolithic regimes of West and North-East Siberia including the Novosibirsk Islands. A relationship was established between  $5^{18}$ O variations and climatic conditions for the formation of permafrost. The relation between the dynamics of Late Holocene glaciation on Spitsbergen and changes in the glacioclimatic conditions governing glacier formation was also studied.

Moscow University's Avalanche and Mudslide Laboratory extracted a core from the upper 90 m of ice on the Dzhantugan Plateau, Central Caucasus. Its analysis permitted the reconstruction of glaciological and climatic conditions for the last 57 years. A method for defining the recurrence of previous avalanches, using the distribution of buried soils in the avalanche cones, was tested in the Khibin Mountains. In comparison with the present, they were in the range of +20% to +25% in the Little Ice Age and -30% to -50% in the Arkhyz interval. Advanced dendrochronological and lichenometric techniques were used in the Central Tien Shan to reconstruct avalanche activity and mudflows (seli) and for determining variations in glacier snout positions for the last 200-300 years. The techniques were improved and the results of a harmonic analysis of former climate fluctuations in Eurasia were used to forecast natural climate fluctuations into the 21st Century. Long-term, quantitative forecasts were made of changes in the avalanche hazard in the Khibin Mountains, in the Elbrus region and in the Central Tien Shan; of changes in the Dzhankuat and Karabatkak glaciers; and of the mudflow hazard in the Central Tien Shan in response to natural and anthropogenic climate changes (after M.I. Budyko). Forecasts were made of periods of glacier advance, activation of avalanches and other dangerous climatological phenomena in the mountains of the U.S.S.R. in reponse to natural climatic changes.

# AVALANCHES AND MUDFLOWS

The Institute of Geography, Academy of Sciences of the Zazakh S.S.R., carried out a variety of snow avalanche observations in the Turgen' River basin, Zailiiskiy Alatau. The orientation of slopes and type of vegetation influence the mode of distribution of the snow cover in winters with abundant snow. In the mountains of the Zailiiskiy Alatau, West Tien Shan, Terskei Alatau and Dzhungarsky Alatau, the following aspects of hazards in avalanche-prone basins were studied: the volume of avalanche cones on valley bottoms; the depth of avalanches; their direction; and the relationship between the dimension and volume of avalanches, etc. Methods for measuring avalanche volumes and run-out distances were improved. The avalanche hazard in different regions of South-East Kazakhstan was estimated.

The Central Asian Institute completed work on methods for estimating the nature of the snow cover, for forecasting different types of avalanches and for determining and mapping their characteristics. The Remote Sensing Complex "Lavina" created an automated information system for emergency prediction of avalanches. Large-scale avalanche-hazard maps of Soviet Central Asia were compiled and guidelines drawn up for forecasting different types of avalanches.

The "Apatit" Industrial Association improved their methods for estimating snow firmness on avalanche-prone slopes using pitting. From experiments with different types of snow in the Khibin Mountains, it was found that snow firmness decreases with an increase in the sample size. Studies suggest that in the Khibin Mountains, as compared to other mountain regions, the physical-mechanical properties of the snow cover have a higher degree of changeability.

For the first time in the U.S.S.R., the Kazakh Hydrometeorological Service (UGKS) has begun to compile monthly operational maps of snow cover distribution and depth in the mountains of the Zailiiskiy Alatau, compared with long-term means. An automatic system for remotely sensing snow reserves in the mountains was tested.

The Novosibirsk Institute of Railway Transport studied the conditions under which the snow cover forms in avalanche locations and the interaction of the snow cover with protective devices. Small-scale simulation of snow drift on different structures, in particular the blocking of stockades and effects in areas of gas deposits in the Tyumen' north, were also investigated. Recommendations were made on the nominal parameters of snow avalanches in the Baikal ridge area crossed by the Baikal-Amur railway, and for a variety of avalanche protection measures. Other recommendations were made for protecting the Novyi Urengoi-Yamburg section against snow and for creating a snow-free railway bed in Kazakhstan and Sakhalin,

#### ROCK GLACIERS, UNDERGROUND ICE AND ICINGS

The Institute of Permafrost, Siberian Branch, U.S.S.R. Academy of Sciences, compiled a map of the distribution and density of rock glaciers in the northern Tien Shan. A sharp increase was noted, from 25 to 90 cm/a, in the velocity of one of the largest rock glaciers. It is first proof of the previous assumption that rock glaciers have surges of a pulsating character.

The Vakhushti Institute of Geography studied modern rock glaciers on the north slope of the Sugansky ridge in Dagestan and on the Egrass and Kodor ridges. The presentday rock glaciers formed during the Fernau stage and reached maximum development early in the 19th Century. The traces of ancient rock glaciers can be distinguished by the steps overlapping each other.

The Institute of Permafrost, Siberian Branch, U.S.S.R. Academy of Sciences, found that rocks beneath the tongues of even comparatively large glaciers  $(5-6 \text{ km}^2)$  of the Inner Tien Shan are in a frozen state; talik massives and subglacial melting are absent. Under one of the glaciers in the Akshiirak Massif, the temperature of the rock bed was  $-3.7 \,^{\circ}\text{C}$ .

The Institute of Permafrost also continued to study the "Ledyanaya Gora" deposit in the lower reaches of the Yanisei. The work included surveying of thermokarst and the installation of bench marks for observing rates of thermokarst development. It continued experiments on the simulation of ice formation during the freezing of glaciolacustrine clays. An unlimited growth of ice lenses is possible under continuous freezing with a certain combination of the physicalmechanical properties of a thawed ground, of the levels of the water-bearing horizon and of the temperature regime.

Characteristics of the distribution and development of three genetic types of blanket underground ice were revealed in the mountain regions of Soviet Central Asia: segregation, injection and buried glacier. The properties of each type were determined for diagnostic purposes. The structure of buried ice seems to change, depending on the time and the external conditions. Quantitative indices of these changes permit the subdivision of buried glacier ice according to age.

The Mountain Institute, Cola Branch, Academy of Sciences of the U.S.S.R., worked out recommendations on tailing design for open-cast mining in the Trans-Baikal region. Data on the distribution of perenially frozen rocks were based on a study that included glacioclimatic conditions.

The Institute of Geography, Siberian Branch, Academy of Sciences of the U.S.S.R., suggested a way of evaluating icing hazards at different stages in the surveying and designing of roads, as well as techniques for defining the main characteristics of different types of icings. Methods for forecasting icing formation, when natural conditions are disturbed in the process of engineering construction, were also developed.

The State Hydrological Institute worked out a way of evaluating the operational ground water resources of the cryolithozone, with a view to regulating icings.

The Institute of Geography, U.S.S.R., Academy of Sciences, studied the dynamics of cave ice in the Perm' Oblast and in the Bashkir A.S.S.R. Twenty caves were examined, in which climatic observations were made and snow-ice formations studied. Most caves were of the cold sack-like cavity type, with congelation and sublimation ice and large areas occupied by icings.

## LAKE AND RIVER ICE

The Institute of Geography, Siberian Branch, Academy of Sciences of the U.S.S.R., has estimated the total reserves of ice forming annually in the basins of the rivers of South-East Siberia: the volume of ice is  $14.7 \text{ km}^3$ on the rivers,  $12.6 \text{ km}^3$  on the lakes and water reservoirs and  $1.2 \text{ km}^3$  in glaciers.

The State Hydrological Institute carried out investigations on the Neva, Volga, Dnestr and Dnieper rivers and on Ladoga Lake. The processes in the formation and destruction of the ice cover, and the formation of ice jams and blockings were studied. Data on the ice characteristics of the rivers in the Extreme North and the Far East were generalized and systematized. Specific features in the development of ice on canals used year-round were revealed, and the processes of freezing and ice breaking on rivers were classified.

## ARCTIC REGIONS

The Arctic and Antarctic Institute continued observations in the accumulation zone of the Vavilov Ice Dome, Severnaya Zemlya. Specific features of the internal accumulation in the glacier's upper horizons were studied in a bore hole, made in the spring of 1984. New data were obtained on the periglacial zone of Severnaya Zemlya, illustrating the role of terrestrial glaciation and of buried glacier ice in the formation of the relief, the hydrographic network, bottom deposits in near-glacier reservoirs and other processes in those areas where there are glaciers of blanket and mountain-blanket type.

Following studies on the Kotel'nyi Island (Novosibirsk Islands), it was established that there were no significant bodies of blanket ice. Polygonalveiny ice of several ages is common on the island: different kinds belong both to syngenetic and epigentic formations. Deposits of the "edoma" complex are of the Upper and Middle Pleistocene age.

Leningrad University studied the character of snow cover bedding and the isotope-oxygen and matter composition of ice on the Vavilov Dome. New geophysical methods for studying snow-firn strata and a lightweight radioisotope density gauge were tested.

The Institute of Geography, U.S.S.R. Academy of Sciences, continued research on Severo-Vostochnaya Zemlya. A 204-m core hole was drilled successfully. The following work was done on the West Spitsbergen Island: measurement of mass balance on three standard glaciers, repeated photo-theodolite surveys of the near-frontal part of another three glaciers and a survey of the Böring and Boger glaciers to determine their velocity. Hydrological and hydrochemical observations on glacier rivers and studies of stage moraines and sea terraces continued. Tests in Spitsbergen showed the effectiveness of a special type of internal radiolocation device, of a hyperbolic form, for studying the inner structure and the hydrothermal regime of glaciers. The use of a multichannel installation for a comprehensive ice-core study (optical density, electric conductivity of ice, shearing strength, etc.) provided abundant information on the stratigraphy, in particular, the seasonal variations. Based on the core, it was concluded that during the last 100 years the type of alimentation of large glaciers in Spitsbergen changed from cold to warm firn. It was also shown that in the Holocene the glaciers of the archipelago could advance both when the temperature was falling due to predominance of a positive mass balance, and when the temperature began to rise, due to changes of the type of alimentation from cold to warm firn and to the warming of the ice layer.

## ANTARCTICA

The Arctic and Antarctic Institute, together with French scientists from the Laboratoire de Glaciologie in Grenoble, selected samples for an isotope-chemical analysis of the core from the 2083 m deep Vostok borehole. A detailed study of the ice structure in the core was made, including determination of the boundary where mechanisms of ice compression in the vertical section of the glacier changed; a mathematical description of the process of ice compression at depths from 105 to 650 m; and definition of the dependance of the distribution of ice density along the section on the initial parameters of the structure at the boundary between firn and ice (105 m), which, in turn, are a function of the conditions of ice-formation, i.e. of climate. The degree to which metamorphic processes were responsible for changes in the ice structure was determined from a steoreometric description of the structure of ice aggregates: a climatic effect was distinguished.

The formation of natural and man-made firn for use as ice hawsers was studied in the region of Molodeznaya. The vertical structure and the heat regime of firn were studied and the impact of sea water on ice fronts was observed. Experiments were made on the accretion of an ice mass from sea water. The regime of some lakes of East Antarctica was studied: data being obtained on their levels, depths, thermal regime, salinity and ice regime.

The work also included studies of variations in the ice cover in space and time, density, location of the ice edge, dates of the advance of the main development phases and of the destruction of the ice sheet of the Southern Ocean during 1956-1982. It was determined that the seasonal and annual changes in the principal ice regime elements is of a regional character.

The Institute of Geology, Academy of Sciences of the Estonian S.S.R., together with the Institute of Geography, U.S.S.R. Academy of Sciences, studied a core from the Ross Ice Shelf. A marked change was noted on the isotope-oxygen curves, which could probably be related to the boundary of the Pleistocene and Holocene. The data suggest that the basal layers of the Ice Shelf are formed by overfreezing of sea water and that the lakes in the Shirmakher Oasis are mainly fed by meltwater from nearby glaciers, while the share of atmospheric nourishment is insignificant.

V.M. Kotlyakov and M.Yu. Gnedovskaya

# UNITED KINGDOM

## ANTARCTICA

#### ICE AND CLIMATE

The International Glaciology of the Antarctic Peninsula programme aims to make chemical and physical studies on ice cores to connect records from the interior of Antarctica with those from low latitudes. Dr R.Mulvaney has analysed the upper 50 m of an 82 m ice core recovered from a site on the Palmer Land plateau  $(74^{\circ}01'S, 70^{\circ}38'W)$ . Analytical work has focussed on the major inorganic anions. Strong seasonal variations have been observed in sulphate concentrations which can be used to complement the stable isotope record as a means of dating the ice. These cycles possibly result from the oxidation during the summer of sulphurous gases derived from biological activity in the oceans.

A new 200-metre electromechanical drill was used in January 1986 to collect a 133 m core from Dolleman Island. The team included Dr D.A.Peel, Dr R.Mulvaney, and B.Davison (chemists), J.C.Moore (Physicist), and S.Cooper (drilling engineer). Preliminary results indicate that the record extends back to about 1770 AD and includes the effects of several major volcanic eruptions including Krakatoa in 1883. Planned studies on the ice core will extend the climatic records available for the region to before the earliest instrumental readings.

The upper 40 m of the ice core was measured for its dielectric response at the time of drilling. J.C.Moore is investigating the use of a.c. measurements as a stratigraphic indicator in the expectation that the electrical structure will follow seasonal chemical cycles. In addition, the experiments provide needed values of the variability of dielectric response in the search for the origin of internal layering which is so well portrayed on radioecho sounding records.

#### CHEMISTRY OF SNOW AND ICE

The validity of simple theories relating the chemical composition of the atmospheric aerosol with that of snowfall has been demonstrated by A.L.Dick's analyses of heavy metals and major trace elements in snow and air samples collected simultaneously on Gipps Ice Rise, E.W.Wolff has measured heavy metal concentrations in recent snow and has confirmed much lower values than have been reported by any other research group. Airborne concentrations are close to those predicted from theoretical models. He analysed duplicate samples of the aerosol using different methods whilst on a two-month visit to the California Institute of Technology. These show good agreement with the values obtained in Cambridge and add confidence to the interpretation of the concentration of atmospheric aerosol.

#### **GLACIER FLUCTUATIONS**

Surface profiles established ten or more years ago by optical levelling across a number of glaciers in the Antarctic Peninsula were remeasured by N.A.Richardson. Consideration in relation to the annual net snow accumulation of around 500 mm, there was no significant change in surface level. Glacier flow is evidently in close balance with present climate despite the general warming trend in the region over the last 30 years.

#### GEORGE VI ICE SHELF

Thermistor chains were installed by S.Cooper in six boreholes in George VI Ice Shelf to study heat flow from the underlying sea water and the temperature structure of the ice shelf. These showed that as ice flows towards the ice front it becomes warmer and ultimately its summer temperature exceeds the freezing point of fully saline sea water. A hole drilled through the ice shelf close to the ice front was unfrozen a year later, and ice cores drilled from depths below sea level were saline. At the upper surface it appears that heat liberated by the freezing of melt water maintains the ice at temperatures close to  $0^{\circ}$ C. Dr J.G.Paren, Dr J.R.Potter and M.Pedley have continued the analysis of oceanographic data. Three topics have dominated the year's work: (a) whether or not freezing can occur at the bottom of the ice shelf; (b) tidal dissipation by ice shelves and non-linear tides; (c) the ocean circulation under George VI Ice Shelf.

#### RUTFORD ICE STREAM

Fast flowing ice streams that drain the West Antarctic ice sheet serve to control the stability of the ice sheet/ice shelf system. A group under Dr C.S.M.Doake is studying Rutford Ice Stream in an attempt to understand how ice can move rapidly over its bed. New ice thickness measurements by radio-echo sounding show that the glacier is more than 2500 m thick close to its margin with Ellsworth Mountains; the glacier bed is between 1500 m and 2000 m below sea level. Measurements by R.M.Frolich and D.G. Vaughan have shown that surface velocities increase progressively downstream, from around 300 m a <sup>-1</sup> at the upstream limit of measurements to  $400 \text{ m a}^{-1}$  near the grounding line. Because it is unlikely that these velocities can be sustained by internal deformation alone, the data suggest that basal sliding makes a significant contribution to the total movement.. There is no indication of an abrupt step in the bed that could be associated with the onset of sliding. Thus the evidence suggests that the transition from deformation flow to sliding flow must occur more than 120 km upstream from the grounding line.

## RONNE ICE SHELF

A.Jenkins started a new programme on Ronne Ice Shelf to study a flowline from Rutford Ice Stream to the ice front. Ice velocities measured by Doppler satellite, ice strains, and 10 m temperatures are being obtained for use in a flowline model to describe the ice shelf regime, the basal melting component and the back stress. Further information on the influence of grounded ice on ice shelf flow has come from a completed study by A.M. Smith of the Doake Ice Rumples between Korff and Henry ice rises.

## BEDROCK TOPOGRAPHY OF ANTARCTICA

D.R.Mantripp has continued to analyse data from airborne radio-echo surveys and has produced a map of Palmer Land showing bedrock contours at 250 m intervals. Extensive areas below sea level occur on the western side of the peninsula and steep scarps bordering deep valleys appear to cut across to the east coast in several places. The map is a necessary prerequisite for selection of a future deep drilling site, where ice around 1000 m thick is required on as flat a base as possible. Charles Swithinbank

# ELECTRICAL STUDIES ON GLACIERS

Impulse radio-echo data from Storglaciaren were analysed by an aperature synthesis technique. Individual targets emerged using this procedure, each characterized by a polarization echo-scattering matrix. We can infer for each target something of its orientation, size, shape and whether it is water- or air-filled.

Preliminary work was also carried out on Storglaciaren to assess whether water channels in a glacier can act as dielectric waveguides at radio-frequencies. The possibility exists of using this property to establish the connectivity etc. of such channels. Initial results are promising.

M.E.R. Walford and M.I. Kennett

#### OKSFJORDJOKUL - NORWAY

A reconnaisance of this ice cap  $(70^{\circ}N)$ provided useful comparisons with current work in the Lyngen Peninsula  $(69^{\circ}N)$  where plateau glaciers are both cold (1600 m) and wet based (<1600 m). The Oksfjordjokul cap  $(40 \text{ km}^2 \text{ at } 900 \text{ m a.s.l.})$  is wet-based. Ice limits of the eastern portion were mapped together with surface and ice depth soundings along selected profiles. Comparisons can be made with photographs taken in the last century; these show that although some areas have undergone considerable change others seem remarkably stable. Sampling of basal ice for isotope analysis and sediments was accomplished at one outlet and to a depth of 5 m from the summit ice dome.

J.G. Paren

#### JOURNAL OF GLACIOLOGY

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

- R.W. Lee:
- A procedure for testing cored ice under uniaxial tension.
- M. Sturm, C. Benson & P. MacKeith: Effects of the 1966-68 eruptions of Mount Redoubt in the flow of Drift Glacier, Alaska, USA.
- J.F. Nye:
- Isotropic points on glaciers.
- E.D. Waddington:
- Wave ogives.
- D. Fisk:
- Method of measuring liquid water mass fraction of snow by alcohol solution.
- J.H. Cragin:
- Chemical fractionation of brine in the McMurdo Ice Shelf, Antarctica.
- J.S. Walder:
- Motion of sub-freezing ice past particles, with applications to wire regelation and frozen soils.
- A.C. Hansen & R.L. Brown: The granular structure of snow: an internalstate variable approach.
- R.B. Alley:
  - Three-dimensional coordination number from two-dimensional measurements: a new method.

- H. Conway, J. Abrahamson & R. Young: A field test to asssess snow-slope stability.
- D.A. Yuen, M.R. Saari & G. Schubert: Explosive growth of shear-heating instabilities in the down-slope creep of ice sheets.
- L. Reynaud, M. Vallon & A. Letreguilly: Mass-balance measurements: problems and two new methods of determining variations.
- G.S. Boulton & U. Spring: Isotopic fractionation at the base of polar and sub-polar glaciers.
- E.W. Wolff & C.S.M. Doake: Implications of the form of the flow law for vertical velocity and age-depth profiles in polar ice.
- J.S. Walder:
- Hydraulics of subglacial cavities.
- J.S. Gardner:
- Recent fluctuations of Rakhiot Glacier, Nanga Parbat, Punjab Himalaya, Pakistan. D.V. Thiel:
- A preliminary assessment of glacial ice profiling using VLF surface-impedance measurements.
- D.F.E. Stolle & F.A. Mirza:
- Finite-element simulation of the thermal regime of the Erebus Glacier tongue, Antarctica.
- R.J. Rogerson, M.E. Olsen & D. Branson: Midial moraines and surface melt on glaciers of the Tornget Mountains, northern Labrador, Canada.

#### WESTERN ALPINE BRANCH MEETING

29 August - 1 September 1985, Grand Paradis, Italy

Some 51 participants attended the annual Branch meeting. They met at Port Valsavaranche where a banquet, featuring many local delicacies, took place. Friday morning was taken up with the climb to the Victor Emmanuel refuge and a talk about the National Park and its problems. The afternoon involved a visit to the Glacier de Moncorvé, an encounter with some ibex and the ascent to the Col de Grand Paradis. Several groups attempted la Trasendaz (3 609 m) while others planned to climb la Ciarforon (3 640 m). The highlight of the meeting was on Saturday when all the participants reached the top of Grand Paradis (4 061 m) and enjoyed a maginificent day. Unfortunately bad weather and snow prevented further excursions on Sunday so everyone descended to the valley

planning to meet again in a year's time.

The A.G.M. of the Section took place on Saturday evening. The invaluable support of l'Association nationale pour l'étude de la neige et des avalanches (A.N.E.N.A.), in distributing notices and providing an administrative base, was acknowledged. A decision was made to establish a 30 F membership fee to help defray expenses. Sincere thanks were extended to A.M.Faidutti for organizing the meeting. J.P.Thiay was elected President, F.Valla Vice-President and G.Bocquet Secretary/Treasurer. The next meeting will be to the glaciers of the Massif de la Maladeta, 28-31 August 1986. Plans are also underway for a possible trip to Greenland in 1987.

G.Bocquet

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#### BRITISH BRANCH MEETING

11 - 12 September 1986, Cambridge

The Annual Conference of the British Branch took place in Homerton College, Cambridge on 11-12 September 1986. Dr Julian Dowdeswell of the Scott Polar Research Institute and the British Branch's Secretary/ Treasurer organized the meeting. International visitors from the I.G.S. Remote Sensing Symposium enlivened the meeting - as did the Society's 50th Anniversary Celebrations on the 10th September.

The Annual Conference covered many aspects of research in glaciology, and individual scientists can be contacted for further details of their work. The following 30 papaers were presented:

SURGING GLACIERS

- A.C. Fowler (Oxford):
- A theory of glacier surge.
- W. Lawson, M.J. Hambrey & M.J. Sharp (Geography, Cambridge):

Structure of a surge-type glacier.

- C. Gemmel (Oxford) & M.J. Sharp:
- Debris load of a surge-type glacier. M. J. Sharp & C. Gemmel:
- Basal ice layer of a surge-type glacier.
- **GEOMORPHOLOGY**
- J. Hart (University of East Anglia): Some examples of subglacial deformation structures.
- R. Hindmarsh (Geology, Edinburgh): Observations and theory of small scale sediment deformation beneath glaciers.
- G.S. Boulton (Geology, Edinburgh): Imlications of large scale sediment deformation for subglacial sedimentation and ice sheet behaviour.
- D.E.Sugden (Aberdeen) & A. Hall (Geography, Edinburgh):
- Evidence for limited ice sheet erosion in north-east Scotland.
- J.M. Reynolds (Plymouth Polytechnic):
- Geophysical detection of buried channels in Plymouth Sound.

A. Dugmore (Aberdeen):

Modelling Holocene glacier fluctuations in Iceland.

ICE PHYSICS

- J.F. Nye (Bristol):
- Isotropic points on glaciers.

R. Souchez (Brussels):

- $\delta D \delta^{18} 0$  relationships in basal ice.
- M. Ohtomo, S. Ahmad & R.W. Whitworth (Birmingham):
- A technique for the growth of high quality single crystals of ice.
- S. Ahmad, M. Ohtomo & R.W. Whitworth: The study of dislocation glide in ice by synchrotron radiation X-ray topography.

ICE CHEMISTRY

- E. Wolff (BAS, Cambridge): The location of impurities in Antarctic snow.
- A.L. Dick (BAS, Cambridge): Particulate material in Antarctic air and snow.
- R. Mulvaney (BAS, Cambridge):
- The anionic content of Antarctic snow.
- P. Brimblecombe, S. Clegg, T. Davies, D.
- Shooter & M. Tranter (University of East Anglia:
- Loss of solutes from melting laboratory ice.
- C.E. Vincent, T. Davies, P. Brimblecombe &
- M. Tranter (University of East Anglia):
- Ionic distribution in snow and ice cores from the Folgifonni Glacier, Norway.

REMOTE SENSING

- J.A. Dowdeswell (Scott Polar, Cambridge): The saturation of Landsat MSS detectors
- over large ice masses.
- J.L. Bamber (Scott Polar, Cambridge): Interpretation of internal reflecting horizons in Spitsbergen glaciers.
- M.R. Walford (Bristol):
- Recent radio-glaciological research.
- M. Kennett (Bristol):

Radio echo-sounding for water: a synthetic aperture experiment.

GLACIER WASTAGE

- E.M. Morris (Inst. Hydrology, Oxford):
- Problems in snow thermodynamics.
- G. Kaser (Innsbruck): Daily variations of evaporation on an Alpine glacier in relation to the glacier wind system.
- D.N. Collins (Manchester): Characteristics of the meltwater hydrology of the Hunza Karakoram.

ANTARCTIC ICE SHEET

- J.G. Paren & S. Cooper (BAS, Cambridge): Further temperature measurements on George VI Ice Shelf.
- D. Mantripp (BAS, Cambridge): Ice thickness map of northern Palmer Land, Antarctica.
- A. Jenkins (BAS, Cambridge):
- A flowline on Ronne Ice Shelf, Antarctica. L.G. Watts (Scott Polar, Cambridge):
- Some preliminary finite element modelling of the Antarctic Ice Sheet.

The 1987 Branch Meeting will be held in Edinburgh in September. Professor G.S. Boulton and Dr D.E. Sugden have agreed to organize the meeting. Further details will be circulated later.

J.G. Paren

# SYMPOSIUM ON SNOW AND GLACIER RESEARCH RELATING TO HUMAN LIVING CONDITIONS

Lom, Norway, 4 - 9 September 1988

## FIRST CIRCULAR

September 1986 The Society will hold a symposium on Snow and glacier research relating to human living conditions, in Lom, Norway in 1988. Registration will take place on Sunday 4 September and sessions will be from Monday 5 to Friday 9 September.

#### TOPICS

The Symposium will be concerned with science nd engineering aspects of the following topics:

- 1. <u>AVALANCHES OF SNOW, ICE &</u> <u>MIXED SNOW AND WATER</u>
  - a) release mechanisms and flow dynamics,
  - b) control and protection measures,
  - c) forecasting, risk levels, cost-benefit analyses.
- 2. DRIFTING SNOW
  - a) processes of snow drifting,
  - b) liquid water storage and movement within the snowpack,
  - c) impact of snow drifting on human activity.
- 3. GLACIER & SNOW HYDROLOGY
  - a) glacier hydrology processes,
  - b) forecasting of streamflow with emphasis on problems of low tide,
  - c) catastrophic floods,
  - d) sediment transport in glacial streams,e) glacier advances impinging directly
  - upon human actions

#### PAPERS

The Papers Comittee will be happy to consider papers on these topics. Details about the summaries and final papers will be given in July 1987. Dates for submissions are firm ones and must be adhered to. The Committee may decide to invite review papers on some of the topics if submitted contributions do not give sufficient coverage.

#### PUBLICATION

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

#### SESSIONS

Sessions will be held on four full days. A full- day excursion will be held during the week. Workshops may be arranged for detailed discussions on some of the topics.

#### ACCOMMODATION

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

POST SYMPOSIUM TOUR (3 - 4 days) A three- to four-day tour will be organized to visit avalanche and glacier areas in the Western Norway fjord district.

#### FURTHER INFORMATION

You are invited to attend the symposium and to 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 K. Lied (Chairman) H. Norem

O. Orheim B. Wold INTERNATIONAL GLACIOLOGICAL SOCIETY SYMPOSIUM ON SNOW AND GLACIER RESEARCH 1988

Family name .....

First	name	
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Address .....

.....

I hope to participate in the symposium in 1988

I expect to submit a summary of a proposed paper on topic number without obligation

TO BE SENT TO: Secretary General, International Glaciological Society, Lensfield Road, Cambridge CB2 1ER, England.

# AMERICAN GEOPHYSICAL UNION - FALL MEETING

December 8 - 12 1986, San Francisco, USA

## EARTH/ICE TEMPERATURE AND THE CLIMATE OF THE LAST CENTURY

The purpose of this special session is to assess the evidence for climate change as seen in ice, frozen ground, and in unfrozen ground. In addition, the relationship between atmospheric heat and mass fluxes and the resultant heat flux (or other climatic signal) that is transmitted into the subsurface will be explored. Appropriate questions to be addressed include the following: What determines "mean surface temperature" of the air, the solid earth, and how are they related? How can changes in subsurface heat fluxes be interpreted as change in specific elements? What changes in climate can be seen in the last century or so from evidence in the solid earth and ice? The focus of this special session is on the physical and thermodynamic processes involved, not on proxy indicators of climate. This special session is sponsored by the AGU Committee on Snow, Ice, and Permafrost.

For further information, contact either cochair: Mark F. Meier, INSTAAR, Campus Box 450, University of Colorado, Boulder, CO 80309, U.S.A.; OR Arthur H. Lachenbruch, US Geological Survey, MS 923, 345 Middlefield Road, Menlo Park, CA 94025, U.S.A.

## PROPERTIES OF DEFORMABLE GLACIER BEDS: PAST AND PRESENT

The mechanical and hydraulic characteristics of deformable substrates at the base of glaciers have recently emerged as principal unknowns in considerations of glacier dynamics. This session is organized to assemble information and to promote discussion of deformable glacier beds among glaciologists and glacial geologists. Papers are sought that can shed light on specific physical conditions at the base of past or present glaciers. Appropriate topics include, but are not restricted to, the following: subglacial observations (displacement profiles, ubiquity of debris, hydraulic and mechanical properties of subglacial sediments, overconsolidation), till features (structures, sorting, indicators of strain, void ratio, temperature, extent of ice bed separation and water channelization, seismic studies of basal debris), modeling (conservation of debris, basal hydrology), and constitutive relations for till and bedrock erosion by till.

For further information, contact Bernard Hallet, University of Washington, Quaternary Research Center, Department of Geological Sciences, Seattle, WA 98195, USA.

# SYMPOSIUM ON THE USE OF ISOTOPE TECHNIQUES IN WATER RESOURCES

30 March - 3 April 1987, Vienna, Austria

A international symposium on the use of isotope techniques in water resources development will be held in Vienna, Austria from 30 March to 3 April 1987. This is organized by the International Atomic Energy Agency in co-operation with the United Nations Educational, Scientific and Cultural Organization.

Topics will include snow and ice hydrology: snow accumulation and ablation; glacier chronology.

Participants will be accepted only if the Participation Form is transmitted through the government of a Member State of the IAEA or UNESCO, or by the organization invited to participate.

For further information contact the Secretariat:

International Atomic Energy Agency IAEA-SM-299 Vienna International Centre P.O.Box 100 A 1400 Vienna Austria.

#### 9 - 22 August 1987, Vancouver, Canada

In response to an invitation from the National Research Council of Canada on behalf of the Canadian National Committee for the International Union of Geodesy and Geophysics, the I.U.G.G. will hold its XIX General Assembly in Vancouver, Canada from 9 to 22 August 1987. The meeting is co-hosted by the University of British Columbia and will be held on its campus.

#### The Union

The International Union of Geodesv and Geophysics (IUGG) which was established in 1919 is dedicated to the scientific study of the Earth and the application of the knowledge gained by such studies to the needs of society, such as more rational use of mineral resources, reduction of the effects of natural hazards and environmental protection.

The Union's objectives are the promotion and co-ordination of physical, chemical and mathematical studies of the Earth and its environment in space. These studies include the shape of the Earth, its gravitational and magnetic fields, the dynamics of the Earth as a whole and of its component parts, the Earth's internal structure, the hydrologic cycle including snow and ice, all aspects of the oceans, the atmophere, the ionosphere, magnetosphere, and solar-terrestrial relations, and analogous problems associated with the Moon and other planets.

The Union comprises seven semi-autonomous Associations, each responsible for a specific range of topics or themes within the overall scope of the Union's activities. The seven Associations are:

International Association of Geodesy (IAG)

- International Association of Seismology and Physics of the Earth's Interior (IASPEI)
- International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI)
- International Association of Geomagnetism and Aeronomy (IAGA)
- International Association of Meteorological and Atmospheric Physics (IAMAP)
- International Association of Hydrological Sciences (IAHS)
- International Association for the Physical Sciences of the Ocean (IAPSO)

Each Association is managed by a Bureau and Executive Committee whose members are elected during their General Assemblies. The Associations convene their own General Assemblies and sponsor particular symposia, often in partnership with one another, and also with intergovernmental organizations, such as UNESCO and WMO. Within its own discipline each Association is responsible for

determining its own programme of investigations and for supporting the activities of its own component parts. Owing to the interactive nature of the subject fields managed by the Union's Associations, a number of Inter-Association Commissions have been established which serve the Union and the international geophysical community by promoting the study of particular interdisciplinary problems.

#### XIX General Assembly

The meetings and symposia at the General Assembly will include: Association symposia and meetings of Association Working Groups, Commissions, and Workshops. Those of interest to glaciologists are in the programme of the International Association of Hydrological Sciences (IAHS).

- (Workshops are indicated by the prefix W)
- 1. Large scale effects of seasonal snow cover (B.E.Goodison)
- Forest hydrology and watershed manage-2. ment (R.H.Swanson)
- 3. The influence of climatic changes and climatic variability on hydrological regime and water resources (S.I.Solomon)
- 4. Irrigation and water allocation (R.H.Clark)
- The physical basis of ice sheet modeling 5. (E.D.Waddington)
- 6. Dynamic systems approach to natural hazards (A.E.Scheidegger)
- W1. Methods of runoff and streamflow simulation applied to various physiographic and climate conditions (D.Dawdy)
- W2. Spatial variability and representativeness of hydrological parameters (R.A.Freeze)
- W3. Estimation of areal evapotranspiration (T.A.Black)

- W4. Remote data transmission (A.L.Johnson)
  W5. River ice (K.S.Davar)
  W6. Erosion and sediment transport: A-debris torrrents (O.Slaymaker); B-erosion and sediment transport resulting from volcanic eruptions (R.F.Hadley); C-morphological measurements of sediment transport (T.J.Day); D-Fluvial transport of sediment associated nutrients and contaminants (E.D.Ongley)
- W7. Hydrological sciences in developing countries (N.B.Ayibotele)
- W8. Estimation of natural baseline conditions as a basis for detecting changes in water quality (D.Rickert)

NOTE: Special requirements and earlier deadlines for submission for IAHS symposia and workshops may be obtained by contacting Inland G.J. Young CNC/IAHS, Waters Directorate, Environment Canada, Ottawa, Ontario, Canada KIA OE7.

#### Preliminary Call for Papers

The third circular, distributed in October of 1986, will contain detailed instructions for the preparation and submission of abstracts. The abstracts will be photoreproduced from author-prepared copy and thus must conform to specific style and space guidelines. All abstracts will be submitted by March 1, 1987 to convenors who will assemble their respective portions of the program before sending it to their Association secretary and to the Local Committee in Vancouver for publication. At this time those who are planning to submit a paper should consult with the appropriate Association secretary or

# **NEWS**

symposium convenor. The convenors have the responsibility to solicit abstracts and to accept or reject unsolicited abstracts, and to offer 20 or 30 minute time slots for presentation and discussion or poster presentation times, as they deem appropriate.

For copies of the 2nd Circular or further information contact:

Conference Secretariat, c/o Venue West, 801 -750 Jervis Street, Vancouver, B.C., Canada V6E 2A9, Tel:(604) 681-5226, or Telex 04-352848 VCR.

#### FLUCTUATIONS OF GLACIERS 1975 - 1980 (VOL.IV)

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A video on Dynamic processes in shear of ice as as rock analogue has been prepared by Dr C.J.L. Wilson, Department of Geology, University of Melbourne, Parkville, Victoria 3052, Australia.

The video is based on research material published in 1986:

- 1. Wilson, C.J.L., Burg, J.P. and Mitchell, J.C., The origin of kinks in polycrystalline ice. Tectonophysics, <u>126</u>.
- 2. Wilson, C.J.L., Deformation induced recrystallisation of ice. In H.C. Heard and

B.E. Hobbs (Editors), Mineral and rock deformation laboratory studies. Geophysical Monograph, A.G.U. <u>36</u>.

3. Burg, J.P., Wilson, C.J.L. and Mitchell, J.C., Dynamic recrystallisation and foliation development during the simple shear deformation of ice. J. Struct. Geol.

Reprints of these papers will be available only to purchasers of the video.

Anyone interested in obtaining a copy of the video should write to Dr Wilson.

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    Offshore Mechanics and Arctic Engineering Division (OMAE) 6th International Symposium- Ice properties or ice mechanics. Houston, Texas, USA. (N.Sinha, Geotechnical Section, Div. Building Res., National Research Council of Canada, Ottawa, Ontario, Canada)
  - 30 March 4 April
- Symposium on Ice-core analysis. Bern, Switzerland. (Secretary General, IGS, Lensfield Road, Cambridge CB2 1ER, U.K.)
  - 30 March 3 April Symposium on the Use of isotope techniques in water resources development. Vienna, Austria. (International Atomic Energy Agency, IAEA-SM-299, Vienna International Centre, P.O.Box 100, A 14400 Vienna, Austria.)
- 1-5 June
  - Symposium on Glacier fluctuations and climatic change. Amsterdam, Netherlands. (J. Oerlemans, Princetonplein 5, 3508 TA Utrecht, The Netherlands)
- 4-6 June
  - International Symposium on Cold regions heat transfer. Edmonton, Alberta, Canada. (V.J. Lunardini, CRREL, 72 Lyme Road, Hanover, NH 03755, U.S.A., or K.C. Cheng, Dept. Mechanical Engineering, University of Alberta, Edmonton, Alberta, Canada T6G 2G8, or N. Seki, Dept. Mechanical Engineering, Hokkaido University, Sapporo 060, Japan)
  - 31 July 9 August 12th Congress of the International Union for Quaternary Research. Ottawa, Ontario, Canada. (L. Baignée, Secretariat, XII INQUA Congress, c/o National Research Council of Canada, Ottawa, Ontario K1A 0R6, Canada)
- 31 July 9 August Holocene glacier fluctuations, 12th INQUA Congress. Ottawa, Ontario, Canada. (P.T. Davis, Dept. Geology, Mount Holyoke College, South Hadley, MA 01075, U.S.A. or G. Osborn, Dept. Geology, University of Calgary, Calgary, Alberta, T2N 1N4, Canada)

- 9-22 August
  - Symposium on the Physical bases of ice-sheet modelling. IUGG General Assembly. Vancouver, BC, Canada. (E. Waddington, Geophysics Program AK-50, University of Washington, Seattle, WA 98195, U.S.A.)
- 9-22 August
  - Symposium on Marginal ice zone processes. IUGG General Assembly. Vancouver, BC, Canada. (R.D. Muench, Science Applications Inc., 13400 B Northrup Way, Suite 36, Bellevue, Washington 98005, USA or K. Davidson, Dept. Meteorology, Naval Postgraduate School. Monterey, CA, U.S.A.)
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  - Symposium on Large-scale effects of snow cover. IUGG General Assembly, Vancouver. BC, Canada. (B.E. Goodison, Atmos. Environ. Service, Environment Canada, 4905 Dufferin St., Downsview, Ontario M3H 5T4, Canada)
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- 7-12 September
- Fourth SCAR International Symposium on antarctic glaciology. Bremerhaven, FRG. (H. Kohnen, Alfred-Wegener Inst. for Polar Research, Columbus Center, D-2580 Bremerhaven, Fed. Rep. Germany)
- 1988
- 14-19 February
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- 4-9 September
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1989

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