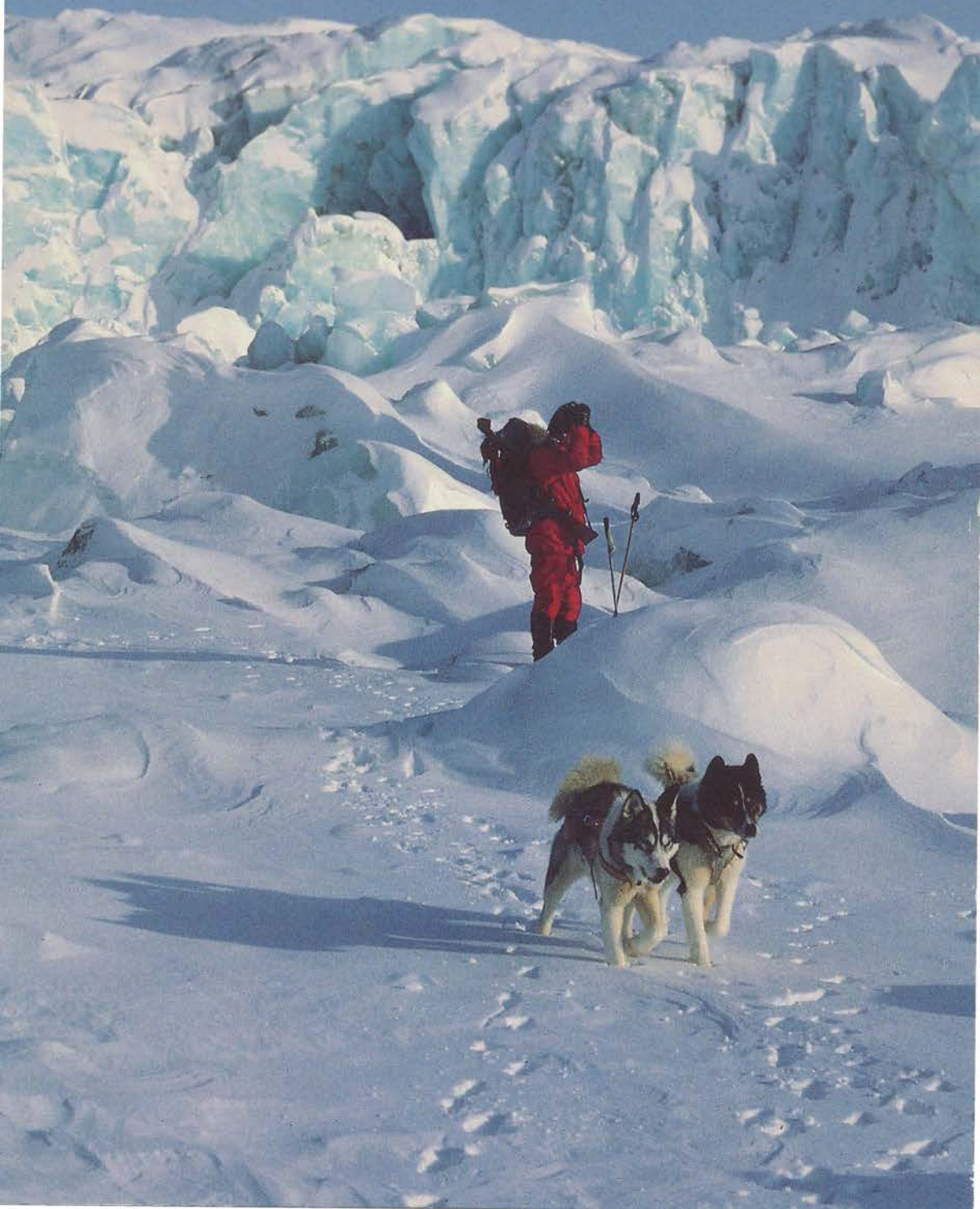




NORSK POLARINSTITUTT
ÅRBOK 1989





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The Annual Report
of the Norwegian Polar
Research Institute

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Annual report of the Norwegian Polar Research Institute

Norsk Polarinstitutt has roots back to 1906 with regular polar activity from 1909. It was officially established by Parliament in 1928 and is today an independent institution under the Ministry of the Environment. As Norway's central institute for the scientific research of Svalbard, Jan Mayen, the polar seas, and the dependencies in the Antarctic, it is also responsible for the mapping of the Norwegian polar land areas. Research concerning fishing and other marine-biological resources and petroleum exploration on the continental shelf are taken care of by other institutions.

Norsk Polarinstitutt has three main assignments:

1. It has consultative functions for and with the Norwegian authorities in polar matters. By its research and mapping, the Institute is part of the Government's execution of its sovereignty responsibilities, the management and observation of Norwegian interests in the Arctic and in Antarctica.
2. It shall contribute to the definition of research tasks and needs for new basic knowledge about the polar areas. The Institute's own research is part of this together with the effort to stimulate other institutions to increase their activities in the polar areas.
3. The Institute is a national centre for scientific activities in Norwegian polar areas with specific responsibility for tasks requiring continuity.

The following is a short description of some of the Institute's activities:

BIOLOGICAL RESEARCH: Because marine and terrestrial ecosystems in the polar regions are particularly vulnerable to human activities, the Institute's biological research has been directed towards problems within wildlife management and nature conservation in Svalbard and adjacent ice-covered waters. Marine birds, botany, and marine and terrestrial mammals have been main topics of study.

GEOPHYSICAL RESEARCH: The geophysical work of the Institute is primarily directed towards ice and climate. Glaciers, sea ice, and the interaction between the surface of the earth, ice, and the atmosphere are major topics of study. Oceanographic investigations of the ice-covered sea regions are incorporated in the research programme.

GEOLOGICAL RESEARCH: Geological mapping of the Norwegian polar areas is the most important aim and responsibility of the Institute's geological department. Research, which is the basis for maps and map descriptions, is carried out concurrently with the mapping activities. The Institute is responsible for the structural investigations and the charting of the sea floor in the polar sea regions.

TOPOGRAPHIC MAPPING: Norsk Polarinstitutt is responsible for the terrestrial mapping of Norwegian polar regions. Priority has been given to the task of completing the main topographical map series for Svalbard in the scale of 1:100,000.

THEMATIC MAPPING: Thematic maps published by the Institute include geological maps of land masses, loose deposits and upper layers of the sea floor in the polar regions, geophysical charts of sea ice distribution, ocean currents and gravity measurements, and maps of biological resources and abundancies.

RESEARCH STATION IN NY-ÅLESUND, SVALBARD: Norsk Polarinstitutt's Research Station is one of the most northerly scientific land stations in the world, located at 78°55'N, 11°56'E. It is open to all Norwegian scientists with government-funded projects and to foreigners cooperating with Norwegian institutions.

ADMINISTRATION OF JOINT SCIENTIFIC EXPEDITIONS: Norsk Polarinstitutt is responsible for the administration and implementation of Norwegian Antarctic research expeditions. The annual expedition to Svalbard also includes participants from other research institutions. In its function as central governmental body, the Institute also coordinates scientific studies in the polar regions, particularly in management-oriented investigations.

SERVICE: The Institute runs a service office in Longyearbyen in the summer season, providing practical advice and assistance for expeditions and field parties.

INFORMATION: The information service handles general enquiries from Norwegian and foreign institutions and individuals about the Institute's activities in Norwegian polar areas. Several scientific publications and news bulletins are published on a regular basis and the Library has one of Europe's best collections of polar literature.

CONTRACTUAL ACTIVITIES: As far as its capacity allows, the Institute accepts contract work on a non-profit basis within its fields of competence.

OTHER ACTIVITIES: The Institute has been responsible, since 1933, for the establishment and maintenance of a network of navigation lights and beacons for ships and air traffic on Spitsbergen.



Rubber boats are frequently used by field workers in Svalbard. Photo: K. Bratlien

THE PAST YEAR

The reduced tension between east and west had a positive effect in the Arctic. The founding of the International Arctic Science Committee, IASC, was delayed until 1990. However, cooperative bilateral projects and other contracts entered, proved the existence of a positive will for cooperation. The Institute has been involved in this process through cooperation projects within oceanography and geology, by offering use of our research vessel, and by several meetings.

The polar regions are key areas for important global environmental studies. This fact has been increasingly realized by scientists from all over the world. As a consequence, the Arctic has received more attention – also from scientists in non-Arctic countries. Although planning and fund-raising take a couple of years, the first signs of the renewed interest was observed in Svalbard in 1989. The Alfred Wegener Institut für Polarforschung in the Federal Republic of Germany signed an agreement for research establishment in Ny-Ålesund. The Natural Environmental Research Council, NERC, in the UK, had the same intentions, followed by similar inquiries from the National Institute for Polar Research in Japan. This development offers interesting possibilities for a close scientific cooperation.

The Norwegian Research Station in Ny-Ålesund saw significant extensions of its activities in 1989. Most noticeable is the erection of a new observatory for atmospheric research at Zeppelinfjellet, within walking distance of Ny-Ålesund. Located at 474 m above sea level, above the inversion layer, this should be an ideal site for measurements without local pollution. A new laboratory building and a laboratory with salt water intake have also been established.

A regional environmental initiative was taken at a meeting in Rovaniemi attended by government representatives from all Arctic countries. A planning process was initiated and an

increased need for environmental monitoring is expected. This Institute will be positive to further engagements in this field as the task requires long-term commitment and responsibility for management data.

Several reports on or related to Norwegian polar research were published in the past year. The report on polar research in Norway was published in August as *NOU 1989:9 Norsk Polarforskning*. An official committee, chaired by the deputy director of the Institute, was responsible. The institute also provided secretarial assistance. The report was sent on a public hearing at the end of the year.

A committee, chaired by the director of the Institute, finished a report on research bases in Svalbard. One proposal set forth in the report suggests that an overall plan for such bases be developed.

Another committee, appointed by the Institute, produced a report on a geographical information system for Norwegian polar areas. Large amounts of data connected to special geographical areas are collected and produced by the Institute. These data are today organized in several data bases under different systems. An integrated system with easy access for users will be a vital improvement both for internal and external users. The recommendations from the committee will be implemented as soon as resources are available.

Antarctica was in focus in 1989. Australia and France abstained from ratifying the mineral convention and proposed the elaboration of a comprehensive environmental protection in Antarctica. The environment question consequently became the key issue in Antarctic questions, and will most likely remain so for years. This will have an effect on the future Antarctic research to be carried out.

The Norwegian Antarctic Research Expedition 1989/90, NARE, left on the coast guard vessel

Andenes at the end of November. Research to be carried out gave priority to environment and management data. A new research station at 72°S, 2°40'E will be erected in Jutulsessen, Gjelsvikfjella, consisting of a prefabricated building of 100 square metres and one smaller unit. The station was named TROLL.

The discussion of possible logistical Antarctic cooperation with Sweden and Finland was

initiated. The main intention of such cooperation is to obtain better continuity in research for all three partners. With the increasing number of international cooperative research programmes and the needs for long-term monitoring of environmental parameters, continuity is of fundamental significance if Norway wants to be a useful contributor to Antarctic research.

FIELD ACTIVITIES IN 1989

The Institute's 1989 season in the Arctic was the 76th expedition sent out by the Norwegian Government to do systematic mapping and investigations of northern polar areas of interest to Norway. The 1989 season was Norsk Polarinstitutt's 62nd field season as central Norwegian institution for polar research.

The main field work in 1989 took place in Svalbard and nearby waters. Four disciplines were included in the expedition programme, biology, geology, geophysics and geodesy. The main activity took place within biology. In addition, a total of fifty radio beacons and radar lights for marine and air navigation were inspected by Institute personnel in 1989 and prepared for operation throughout the winter.

A total of 115 persons took part in Norsk Polarinstitutt's field work in Svalbard, in addition to the crews of the expedition ship and helicopters. 77 were financed by the Institute, 16 were cooperative partners from other institutions, and 22 were financed by research scholarships.

The field work started in March/April with polar bear investigations in the Hornsund area. The main activities were spread over large parts of Svalbard, and were dependent upon use of an expedition vessel. M/S *Lance* left Bodø for Svalbard on 7 July and was back on the mainland, in Bodø, on 18 September.

SECTION REPORTS

Biology

(leader: Fridtjof Mehlum)

Norsk Polarinstitutt is responsible for management-oriented biological research in the Norwegian polar areas. The Biological Division incorporates ecological mapping and population biology studies within such disciplines as marine biology (excluding the Directorate of Fisheries' area of responsibility), ornithology, land mammals, and botany.

The increasing industrial and other economic activities in Norwegian polar areas may cause considerable impact on the natural environment.

Our present knowledge of the polar ecosystems and their reaction to human interference is limited. The polar areas represent the limits for life on earth and the life systems in these areas are extremely vulnerable to environmental changes. The primary purpose of the division's work is to provide the authorities with



Walrus investigations carried out on the beach of Tjuvfjorden in 1989. Photo: Ø. Wiig

the necessary ecological information in order to secure proper management of the ecosystems in the Norwegian polar areas.

The division has two tenured scientists: one ornithologist and one mammalogist. One marine zoologist was contracted in 1988 (for four years) to conduct studies on polar bears and marine mammals. Two contracted ornithologists continued their work under the PRO MARE and AKUP programmes (PRO MARE: Programme for Marine Arctic Ecology; AKUP: Arbeidsgruppen for konsekvensutredninger av petroleumsvirksomhet). One research fellow continued his studies of the behaviour of the arctic fox, spending about half the year at the Research Station in Ny-Ålesund. Another continued a botanic project on vegetation damage caused by reindeer grazing and human activities in Svalbard. Several other biologists were contracted on short term bases for field and desk work.

Field work

The field work in 1989 focused on seabirds, the arctic fox, polar bears, reindeer, and vegetation.

SCIENTIFIC CRUISES - Two of the Institute's biologists participated on board the German research vessel R/V POLARSTERN in April/May for studies of seabirds in ice-filled waters east of Svalbard.

As a part of the Institute's Svalbard expedition 1989, a biological cruise was conducted in the Storfjorden area in July-August, on board the research vessel R/V LANCE. Several marine projects were performed, including hydro-acoustic surveys of small fish and crustaceans, oceanographic sampling and seabird studies. A main purpose was to investigate the dependence of seabird abundance at sea on oceanographic features and availability of prey. The research vessel also supported projects on tidal



Young of Glaucous Gull ring-marked at Bjørnøya in July, 1989. Some were retrieved in Greenland the following winter. Photo: Vidar Bakken

zone ecology, walrus, polar bears, geese and colony studies of seabirds. The work was done in collaboration with researchers representing the University of Gothenburg (Institute of oceanography), the Polish Academy of Sciences (Institute of oceanology), and the Game Biology Station (Kalø, Denmark).

TERRESTRIAL FIELD WORK – Seabird studies at Bjørnøya, initiated under the AKUP programme, were continued in June-July, focusing mainly on the development of alcid populations after the severe decline in the common guillemot population between 1986 and 1987. Seabird energetic studies were made in the Kongsfjorden area in April-May and June-July.

Reindeer population studies, including tagging and tracking telemetry, were continued on Reinsdyrøya, Nordenskiöld Land, and Brøggerhalvøya. The cooperation with the University of Tromsø regarding reindeer ecology in Svalbard was continued. Studies of the arctic fox in the

Kongsfjorden area were continued with emphasis on tracking telemetry. Polar bear studies were conducted in the Hornsund area. Five bears were instrumented with satellite transmitters.

The Institute's botanist continued the evaluation of the effect of erosion and reindeer grazing on the vegetation. Field work was done during winter and summer, mainly in the Isfjorden area.

Within the MUPS programme (Miljøundersøkelser på Svalbard), field work was conducted in Gipsdalen and Gipsvika in connection with environmental evaluation of planned coal exploitation.

Projects

BIOLOGICAL DATA BASES FOR NORWEGIAN POLAR AREAS (F. Mehlum) – Several biological data bases are established and updated every year.

They include single observations and time series of abundance of birds and mammals, data on colony sizes and pelagic distribution of seabirds, intertidal zone ecology, and scientific literature.

SEABIRD ECOLOGY IN THE SVALBARD AREA (F. Mehlum and G.W. Gabrielsen) – The project concerns population and feeding ecology as well as physiological energetics of seabirds. It is a part of the PRO MARE programme. Field work in 1989 was carried out in the Kongsfjorden area. The project was ended in December 1989.

SEABIRD STUDIES IN BJØRNØYA (V. Bakken) – Because of the dramatic decline in the population of Common Guillemots at Bjørnøya in recent years, a project has been started to monitor the population development of this and other seabird species at the island. Breeding biology and feeding ecology studies are included in the project. Field work was carried out in June-July.

MONITORING OF SEABIRD POPULATIONS IN SVALBARD (F. Mehlum) – The project involves long-term monitoring of selected seabird colonies to detect changes in the population size of different arctic seabird species, including waterfowl.

IDENTIFICATION OF SEABIRD POPULATIONS BY MEANS OF GENETICAL METHODS (F. Mehlum) – The Barents Sea area is inhabited by large numbers of seabirds most of the year. We know little about the movement and distribution of the populations outside the breeding season, however. Therefore, we are unable to determine which breeding populations might be influenced by major oil spills or other hazards in their pelagic areas. New DNA-techniques based on blood samples are applied for population identification.

REINDEER STUDIES IN SVALBARD (N.A. Øritsland) – The project concerns primarily population monitoring and feeding ecology. This year's field work was carried out at Reinsdyrflya, Nordenskiöld Land and Brøggerhalvøya.

BEHAVIOUR AND SOCIAL BIOLOGY OF THE ARCTIC FOX (K. Frafjord) – Tagging, tracking telemetry, and ethological observations of the arctic fox were carried out in the Kongsfjorden area. The project includes experimental feeding of captive foxes at the Research Station in Ny-Ålesund.

POLAR BEAR STUDIES (Ø. Wiig) – A long-term study of the migration of female polar bears in the Svalbard area was initiated in 1989. Each year during a four to five year period polar bears will be instrumented with satellite transmitter collars. The movements of the bears will be followed continuously by satellite throughout more than a year and will give information on the range of the population and its denning and feeding areas.

WALRUS STUDIES (Ø. Wiig) – A five-year project was started in 1989 aiming at obtaining documentation on the status of the walrus population in the Svalbard area. The main goal is to estimate the size of the population and its total distribution area but other aspects will also be studied. The project is financed by NFFR (Norwegian Fisheries Research Council)

VEGETATION STUDIES IN SVALBARD (L. Gulbrandsen) – A three-year botanical project for a research fellow started in 1988 continued in 1989. It involves evaluation of the effects of erosion, reindeer grazing and human activities on arctic vegetation, with emphasis on the population dynamics of vegetation. Detection of damage and vegetation dynamics in damaged areas are carried out by means of field investigation combined with remote sensing techniques.

VEGETATION MAPPING IN SVALBARD BY USE OF LANDSAT MSS SCENES (N.A. Øritsland and J. Amlie) – The project aims at determination of vegetated areas all over the Svalbard archipelago. It was nearly finished by the end of 1989.

ENVIRONMENTAL IMPACT STUDIES IN SVALBARD (MUPS) – When industrial activities are planned in the Svalbard area, companies are required to provide the authorities with infor-

mation on the environmental impact of their activities. The Institute conducts environmental evaluation studies for several companies on a contract basis. In 1989 the following contract projects were carried out: Studies in connection with environmental impact assessment of coal mining in Gipsdalen, production of an environmental atlas of Reindalen (in cooperation with SINTEF), and studies on the impact of helicopter traffic on seabird colonies. Version 2 of the MUPS analysis system for environmental impact assessment was translated into English.

COMPUTER ASSISTED IMPACT ASSESSMENT OF INDUSTRIAL ACTIVITIES (DAKON) (N.A. Øritsland) – In this three year project (1988-90) a computerized version of the MUPS analysis system will be developed. Deterministic and stochastic population models will be included and the utility of expert systems shells explored.

Geology

(leader: Audun Hjelle)

The main objective of the geological division is to obtain data from polar areas which can contribute to the knowledge about the geological environment and the understanding of former and present geological processes. An important part of this work is the production of geological maps, publications and reports which can be used in research and environmental planning. In Svalbard a main series of terrestrial geological maps are published to the scale of 1:100,000, while the Barents Sea maps are to the scale of 1:1,500,000. Coastal thematic maps are published to the scale of 1:200,000.

The division has nine permanent posts, including one technician. Five persons were occupied with terrestrial bedrock geology, one with terrestrial Quaternary geology, and two with marine geology/geophysics. Six Geological Polar Colloquia were arranged at the institute in 1989. Six geologists did field work in Svalbard.

Thore Winsnes retired on 1 November after more than 40 years of service at Norsk Polarinstitut. He has participated in more than 40 Arctic and Antarctic expeditions. He is now engaged as geologist in a part time retirement position.

K. Birkenmajer from the University of Krakow came to the Institute in November for a six month stay as visiting scientist. His work is mainly concerned with the geology of southwest Spitsbergen and is part of a cooperation project between the University of Krakow and Norsk Polarinstitut.

Field work

TERRESTRIAL GEOLOGY – Four groups worked in southwest Spitsbergen, in the Sørkapp Land and Torellbreen map sheet areas. The 1:100,000 map of Billefjorden was printed in 1989, and the Van Keulenfjorden map made ready for printing. M. Bjørnerud, Miami University, Ohio, USA, joined the summer expedition.

Projects

REGIONAL GEOLOGICAL INVESTIGATIONS IN SVALBARD (W.K. Dallmann, A. Hjelle, Y. Ohta, O. Salvigsen, T.S. Winsnes) – Geological mapping was done in 1989 on the Torellbreen (B12), Sørkapp (C13), and Markhambreen (C12) map sheets. The compilation of data from western Spitsbergen continued, with special emphasis on Wedel Jarlsberg Land, Torell Land, and Sørkapp Land. The following state of progress is achieved on the the 1:100,000 geological map series: Van Keulenfjorden (B11G) – in press; Isfjorden (B9G) – field work finished, under final compilation; Markhambreen (C12G) – map compilation finished, inspection still to be done; Kongsfjorden (A7G), St. Jonsfjorden (B8G), Torellbreen (B12G), Sørkapp (C13G) – mapping/compilation at an advanced stage.

SVALBARD COASTAL MAPPING (A. Elverhøi and O. Salvigsen) – Thematic map C4 Edgeøya was



Most of the old driftwood in Svalbard originates from Siberia. Radiocarbon dating of this wood, reveals much about former land uplift and coastal development. Photo: O. Salvigsen

printed and B3 made ready for print in 1989. The project will continue in 1990 with compilation for three maps of the eastern and north-eastern part of Svalbard. Kirsti Høgvard is engaged on the project, and the Geographical Institute of the University of Oslo is cooperative partner.

SEDIMENT MAPPING (SEDIMENT THICKNESS, SURFACE SEDIMENT COMPOSITION, SHALLOW BEDROCK), NORTHERN AND CENTRAL BARENTS SEA (A. Elverhøi and A. Solheim) – In this long-term mapping programme the regional series of maps to the scale of 1:1,500,000 is completed. Larger scale maps will be prepared, mainly as part of graduate student theses, for areas where the data density is adequate.

TERTIARY TECTONICS OF SVALBARD (W.K. Dallmann and Y. Ohta) – This five-year project to investigate the Tertiary fold-and-thrust belt's structure, was focused on the Hornsund-

Sørkapp region in 1989. Cooperating scientists from the Universities of Oslo and Nebraska contributed data from Oscar II Land. A first tectonic compilation map of southern and middle Spitsbergen to the scale of 1:200,000 will be presented in 1990. An international symposium on this topic is planned to take place next year.

GLACIATION AND DEGLACIATION OF SVALBARD (O. Salvigsen) – Field investigations were done in Sørkapp Land between Hornsund and Olsokbreen. Special emphasis was given to studies of the last glaciation and raised beaches. About 20 radiocarbon dates will appear from this area where no such dates have been available before. This project will continue for another four years and will be included in the PONAM project of the ESF.

QUATERNARY GLACIATIONS IN THE NORTHERN AND CENTRAL BARENTS SEA, TIMING AND MECH-



Trolløsen in Stormbukta, Sørhapp Land. Outlet of subterranean stream which has drained several kilometres through the limestone cover. Photo: O. Salvgisen

ANISMS (A. Elverhøi and A. Solheim) – This long-term project studies the extent, chronology and mechanisms of deglaciation of the late Quaternary (or older) glaciations. The project involves three Cand. scient. theses. Special emphasis is given to studies of the processes and mechanisms of deglaciation. The main activities in 1989 involved completion of the analytical work for the theses and preparation of manuscripts for publication.

SEDIMENTATION AND SEDIMENTARY PROCESSES IN MODERN GLACIOMARINE ENVIRONMENTS (A. Solheim and A. Elverhøi) – Various aspects of glaciomarine deposition and processes are studied off Svalbard and on the Weddell Sea ice shelves in Antarctica. Low activity in 1989, but a manuscript was made ready for publication.

UPPER BEDROCK (SUBCROP) GEOLOGY OF THE NORTHERN AND CENTRAL BARENTS SEA. (A. Elverhøi and A. Solheim) – Based on shallow seismic data, Quaternary samples and a few in

situ rock samples, the lithology, stratigraphy and shallow structure of the upper bedrock (0-500 m) are studied and mapped. The work concentrates on relatively high resolution information from the Olga Basin. Further data processing was carried out in 1989, including interpretation of sonobuoy refraction data. One manuscript from the Olga Basin was completed. H.P. Antonsen was employed on the project, and cooperative institutions were the Norwegian Petroleum Directorate and The University of Oslo.

SUBMARINE PERMAFROST AND GAS HYDRATES IN THE BARENTS SEA AND SVALBARD WATERS (A. Elverhøi and A. Solheim) – Possibilities for and distribution of submarine permafrost and gas hydrates were studied. This project was finalized in 1989 and a report is in press. H.P. Antonsen has been employed on the project, and cooperative institutions are the Norwegian Petroleum Directorate, the Norwegian Geotechnical Institute, and Veritec A/S.

PHYSICAL PROPERTIES OF GLACIGENIC SEDIMENTS IN THE ANTARCTIC CONTINENTAL SHELF, IMPLICATIONS FOR THE GLACIAL HISTORY OF EAST ANTARCTICA (A. Solheim) – This is a part of ODP Leg 119, and involves geotechnical analyses of samples from five drill sites on the shelf and upper slope of Prydz Bay in the Indian Ocean sector of Antarctica. Most analyses were completed in 1989 and manuscripts have been prepared for publication. The Norwegian Geotechnical Institute is cooperative institution.

ICEBERG SCOURING IN THE NORTHERN BARENTS SEA AND ON THE ANTARCTIC CONTINENTAL SHELF (A. Solheim and A. Elverhøi) – One study from the Weddell Sea was completed and published. A programme based on already existing data is planned for 1990-91.

GEOCHRONOLOGICAL STUDIES (Y. Ohta) – Radiometric dating was carried out to establish the development history of the unfossiliferous old basement rocks. In cooperation with foreign laboratories, about 50 U-Pb, Rb-Sr, ^{40}Ar - ^{39}Ar data were published in 1989. Another five samples from the Torellbreen map sheet are being prepared.

TECTONIC COMPILATION OF THE CALEDONIAN OROGENY (Y. Ohta) – Two international organizations, the European Geological Union and the IGCP, are compiling tectonic maps from North Atlantic coastal areas. Norsk Polarinstitutt is contributing by summarizing the data from the Svalbard – Barents Sea area. The same data are presented in the geological map of the NE Atlantic and Norway to the scale of 1:3,000,000, edited by NGU.

INVESTIGATIONS OF THE BASAL DEVONIAN FORMATIONS, NORTHERN SPITSBERGEN (T. Gjelsvik) – The preparation of material and observations from Kong Haakon VII Land continued. Descriptions of profiles and localities were made based on field data from 1989. Microscopical studies will continue. Structural data are being treated by computer.

SEDIMENTOLOGICAL AND PALEONTOLOGICAL INVESTIGATIONS OF UPPER CARBONIFEROUS AND

LOWER PERMIAN SUCCESSIONS IN CENTRAL SPITSBERGEN. (H. B. Keilen) – Studies were continued based on field work in 1986 and 1987. Thin sections were studied together with field data. The project aims at a more detailed stratigraphy and interpretation of the entire depositional environment of the Gipshuken Formation from Brøggerhalvøya to SE Tempelfjorden.

Informal cooperation was established with Prof. Nakamura and his group of geologists at the Hokkaido University, Japan. They are working on paleontological problems of the Upper Permian Kapp Starostin Formation in central parts of Spitsbergen.

GEOLOGY DATA BASES FOR SVALBARD (A. Hjelle, H.B. Keilen) – Compilation of data continued for the test data base for the Kongsfjorden 1:100,000 map (No. A7G). The data base contains field data, and references to published and unpublished material. Awaiting the establishment of a GIS system, the input of data has come to a temporary end. The input in a database for thin sections commenced in the autumn. Information includes lithology, locality, map sheet no., formation, member, UTM coordinates, publication, current number, and describing text. Input of data significant for the estimation of consequences of pollution and data on the geological resources of Svalbard, continued.

Geophysics

(leader: Torgny Vinje)

The geophysical division studies long-term aspects of different climatic conditions, with emphasis on ice research. Eight geophysicists worked in the division on a full-time basis: one meteorologist, three glaciologists, one oceanographer, and three sea ice researchers. Three persons were assigned to short term projects.

Sea ice and iceberg investigations based on satellite imagery, automatic ice drift buoys, and



*Deployment of an automatic weather and positioning buoy on a tabular iceberg in the Barents Sea.
Photo: Å. Johnsen*

moored ice thickness monitoring upward looking sonars continued. Field investigations of sea ice and the seasonal structure of water masses in the northern Barents Sea and the eastern part of the Fram Strait were conducted on several cruises. The oceanographic work is devoted to studies of the exchange of water and heat between the Arctic Ocean and the North Atlantic and to investigations of mixing processes, primarily convection, and water mass formations in the Barents Sea, the Greenland Sea, and the Arctic Ocean. The work is both observational and theoretical and concentrates on the climatological aspects of these processes.

Theoretical model studies of the internal stress field related to the observed fracture pattern in ice fields were continued. So was the ice drift in the Barents Sea based on long term series from ice drift buoys.

The collection of meteorological observations from automatic stations in the Arctic Ocean and Svalbard, on Bouvetøya and Peter I Øy was continued, and so was the recording of radiation components in Ny-Ålesund.

LANDSAT TM and SPOT satellite imagery were used to study snow and ice features in Dronning Maud Land.

Field work

Oceanographic data were collected by R/V AKADEMIK SHULEYKIN under the Soviet-Norwegian Oceanographic Programme (SNOP): in the Fram Strait 20 April - 24 May and in the Barents Sea 25 July - 14 August. Data were collected from the R/V LANCE in the Barents Sea and part of the eastern Fram Strait 25 August - 14 September. The Barents Sea cruise with the Soviet vessel also included

sea ice investigations and deployment of three current meter moorings in the straits between Frans Josef Land and Nordaustlandet, and of two ARGOS meteorological ice drift buoys south of Frans Josef Land. One of the moorings was equipped with an upward looking sonar for ice thickness recordings every 10 minutes. A similar device was attached to a mooring deployed in the main core of the East-Greenland Ice Drift Stream at 78°N from R/V POLARSTERN under the international Greenland Sea Project.

A joint cruise for oceanographic and biological studies took place in Storfjorden between 18 July and 16 August in cooperation with the University of Gothenburg. A mooring north of Svalbard was recovered by the Norwegian Coast Guard in August under a cooperative programme with LODYC, Paris.

A comprehensive mapping of the ice bottom topography of the Oceanographic Camp (O-Camp) under the Coordinated Eastern Arctic (CEAREX) was conducted in March/April using the NP scanning sonar.

Altogether twelve icebergs were instrumented with ARGOS positioning and temperature monitoring buoys under a project for the Operatørkomite Nord (OKN). Nine of them were deployed from R/V LANCE 7-17 April on Spitsbergenbanken, two from R/V AKADEMIK SHULEYKIN south of Frans Josef Land in July, and one from R/V LANCE near Kong Karls Land in August.

Two new automatic weather stations were sent to the Antarctic for continuation of the meteorological observation series on Bouvetøya (R/V AURORA) and Peter I Øy (US Coastguard: POLAR DUKE).

Terrestrial investigations were carried out on Storbreen, mainland-Norway, in May, and on Brøggerbreen, Lovénbreen and Kongsvegen, Svalbard, in May. Temperature profiles in some glacier fronts were measured and a programme on Polar Hydrology started with the building of a river discharge measuring

arrangement in Brøggerelva, Ny-Ålesund. The radiation instruments in Ny-Ålesund were calibrated and serviced in September.

Projects

OIL POOLING CAPACITY IN ICE FIELDS (Å.S. Johnsen and T. Vinje) – A scanning sonar was applied on ten occasions during the R/V LANCE cruise for the mapping of sub-surface topography. This is a longterm project initiated by the Ministry for Oil and Energy under a programme for the assessment of consequences of oil exploration in the Barents Sea. Altogether 55 scanning surveys have been performed up until now, on different types of ice, each covering an area of about 3000 m. The objective is to get a good statistical basis for the estimation of the oil pooling capacity of ice fields under different conditions.

ICE DISTRIBUTION STATISTICS (T. Vinje and Å.S. Johnsen) – Digitizing of the 1987 and 1988 ice-maps was performed under a contract with DNMI (Det norske meteorologiske institutt). A series covering the 1966-1988 period is thereby completed. Sea surface temperatures are available from 1972. The dataset is based on Norwegian (DNMI), American, and English satellite-based ice-maps and additional retrospective field observations from ships and aircraft, collected by Norsk Polarinstitutt. The dataset is prepared for publication in an atlas. J. Sundet worked part time on this project.

ARCTIC OCEAN BUOY PROGRAMME (T. Vinje) – The cooperation between the Institute and the University of Washington continued. The Norwegian part of the programme was established in 1976 to study the variability of the Transpolar Ice Drift Stream emerging through the Fram Strait. No Norwegian buoys were deployed in 1989, but Norsk Polarinstitutt organized the transmittal of an American buoy to Leningrad for later deployment from a Soviet ship in Eastern Arctic. Two Norwegian buoys deployed in the Transpolar Ice Drift Stream in November 1988 unexpectedly passed southwards and drifted in the Barents Sea in 1989.

GREENLAND SEA PROJECT (GSP) (T. Vinje and B. Rudels) – This is a comprehensive long-term international project with emphasis on climatic aspects. The Institute's task in GSP is to monitor the outflow of ice from the Arctic Ocean through the Fram Strait and to perform studies conducted by large-scale oceanic surveys and field experiments combined with theoretical modelling of convection and deep water formation. The project is conducted in cooperation with the Institute für Meereskunde, University of Hamburg, LODYC Paris, and the Alfred-Wegener-Institut, Bremerhaven. NAVF supports this project.

ICE DATA ACQUISITION PROGRAMME (IDAP) (T. Vinje and Å.S. Johnsen) Icebergs in the Barents Sea are of such a size and occur occasionally in such great numbers, that they may represent a hazard to oil exploration. Projects are carried out for MOBIL on behalf of the OKN. A field programme was carried out on Spitsbergenbanken with R/V LANCE and helicopter, in cooperation with SINTEF/NHL between 7 and 17 April when nine ARGOS buoys were deployed on icebergs for drift monitoring and analysis. Altogether 85 icebergs were located from 21 helicopter reconnaissances, and only six from the ship. This should be compared with the number of 200 icebergs encountered in March 1988 under a similar IDAP-project on Spitsbergenbanken. Another three ARGOS buoys were later in the season mounted on icebergs S and SW of Frans Josef Land from the R/V AKADEMIK SHULEYKIN and the R/V LANCE.

1989 was an exceptional year in that icebergs were observed in the sailing route along the coast of Finnmark. Studies of Soviet literature have increased the number of observations considerably. DNMI will evaluate the contemporary meteorological conditions under this joint project.

SOVIET-NORWEGIAN OCEANOGRAPHIC PROGRAMME (SNOP) (T. Vinje) – A five-year oceanographic programme was established in 1988 under an agreement between the NAVF and the Soviet State Committee for Science and Tech-

nology. Three joint cruises were undertaken in 1989, one in the Fram Strait with the R/V AKADEMIK SHULEYKIN in April-May and two in the Barents Sea in July-August-September, one by the Soviet ship and one by R/V LANCE.

The main objective of SNOP is to monitor the exchange of water and ice in the passages between Frans Josef Land and Greenland. Modelling of the Barents Sea circulation will also be a part of the joint programme. The other Norwegian participants are the Institute of Marine Research, University of Bergen, and the Meteorological Institute. The Soviet counterpart is the Arctic and Antarctic Research Institute in Leningrad and its affiliates. The first year of cooperation has been a success.

ICE FIELD STRUCTURE AND INTERNAL STRESS (B. Erlingsson) – A new model designed to show the relation between the internal forces and the fracture pattern and ice thickness distribution in ice fields has been developed. The model is further refined and will be tested by small-scale field investigations and large-scale satellite imagery fracture pattern. Knowing the external forces and the fracture pattern, the internal stress acting between the ice floes can be determined from the model. This is a NAVF-funded project and will be the basis for a Dr. Scient. thesis.

SEA ICE CLIMATIC VARIABLES (ICECLIMA) (T. Vinje) – This is a programme on remote sensing using microwave data from the ERS-1 satellite which will be launched in October 1990. Preparation has gone on for several years and the Norwegian Space Centre plans to support the different national activities. The project is approved by the European Space Agency. The statistical evaluation of imagery derivatives continues. Drift vectors derived from the Synthetic Aperture Radar on board the ERS-1 will be combined with automatic ice thickness series for volume transport estimates. The ice transport through the Fram Strait amounts to a discharge of fresh water from the Arctic Ocean of the same magnitude as the Amazon river. A change in this outflow will have a dominant effect on the regional oceanic



Mass balance measurements on a Spitsbergen glacier. Photo: J. O. Hagen

circulation and on a longer time scale on the global climate.

HISTORICAL SEA ICE DATA SERIES (T. Vinje) – All available sea ice observations collected from the Barents Sea, Svalbard and the Greenland Sea since the 17th century are now being studied for the establishment of an extended series. This implies extended studies of old archives and literature. It turns out that spring and summer observations may be available almost every year back to about 1850 for the Barents and Greenland Seas. This series will be digitized to be used in climate studies. G. Kjernli has been working part-time on this project.

CLIMATE AND SOCIETY IN NORTHERN NORWAY (T. Vinje) – A NAVF-funded project started in 1989 for the evaluation of climatic prognoses of possible change in ice conditions in the northern areas and the accompanying consequences for the society in Northern Norway. This is a

cooperative project between Norsk Polarinstitutt, the Marine Research Institute, FORUT, and NIBR.

ARCTIC ICE THICKNESS MONITORING PROJECT (AITMP) (T. Vinje) – A prototype upward looking sonar (ULS) for automatic ice thickness measurements from top of moorings has been developed at Chr. Michelsens Institute in cooperation with Norsk Polarinstitutt. The first series was retrieved last year. The instrument ability looks very promising and large international programmes have already been proposed under the World Climate Research Programme (WCRP) both for the Antarctic and the Arctic using 20-30 ULS in each region for the next five years. The Institute has been asked by WCRP to coordinate AITMP. At the moment NP has two ULS in the field and four more to be deployed next year (1990) in strategic areas in the Arctic. The series will be delivered to the World Data Centre for use in climate modelling.

MIXING PROCESSES AND WATER MASS FORMATION IN THE BARENTS SEA (B. Rudels) – This project involves theoretical and field work in cooperation with the Universities of Gothenburg and Hamburg. The Barents Sea stands out as an important area for water mass transformation and an exchange area with other aquatories.

CIRCULATION AND WATER EXCHANGE IN THE FRAM STRAIT (B. Rudels) – The Fram Strait is the main exchange area of water and ice between the Arctic Ocean and the world oceans and climatic, very important processes go on in this region. The field work involves hydrographic measurements, tracer observations and the use of SOFAR floats, while theoretically inverse methods will be applied. The work is partly financed by NAVF as a Norwegian-French cooperative programme and is carried out in cooperation with the University of Hamburg and LODYC, Paris.

CIRCULATION AND WATER FORMATION IN THE WEDDELL SEA (B. Rudels) – This work began with the Swedish Antarctic expedition and is a cooperative project with the University of Gothenburg.

RADIATION DATA FROM NY-ÅLESUND (V. Hisdal and Ø. Finnekåsa) – The long-term registration of the main components of the radiation energy budget continued. The new recording system installed last year has proved to be considerably more reliable than the former ones. Publication of radiation data with introductory description is under preparation.

TEMPERATURE CONDITIONS IN THE SVALBARD AREA (V. Hisdal and T. Berge) – Temperature data from Greenland, Svalbard, and the Soviet Arctic have been examined, and as far as possible completed by means of regression equations. Time series analyses were made and the variance properties and persistency tendency of air temperature studied. The climatological implications of the regional temperature pattern were investigated.

LENGTH MEASUREMENTS OF GLACIERS IN NORWAY (J.O. Hagen) – Glacier front fluctua-

tions have been regularly registered in Norway since about 1900. The measurements give an approximate estimate of the average mass balance over a long period of time, and may be useful in modelling glacier response to climatic change. Ten glaciers were measured in 1989.

MASS BALANCE STUDIES OF STORBREEN IN NORWAY (J.O. Hagen) – Mass balance measurements on Storbreen continued. Started in 1948, this is the second longest continuous series of its kind in the world.

MASS BALANCE STUDIES OF GLACIERS IN SVALBARD (J.O. Hagen) – Mass balance investigations were carried out on Austre Brøggerbreen, Midre Lovénbreen, and Kongsvegen in the Kongsfjorden area, NW Spitsbergen.

SURGE INVESTIGATIONS (J.O. Hagen) – 90 per cent of the glaciers in Svalbard are subpolar and most of them seem to be of the surging type (i.e. with periodic rapid advances). The surge process is complex. Investigations include velocity, profile and volume change recordings, and temperature regime measurements of some selected glaciers in Svalbard.

POLAR HYDROLOGY (J.O. Hagen) – Polar hydrology, studies of hydrological processes, and data collection in areas with permafrost, have been given high priority by the Norwegian Hydrological Committee. A hydrological research station has been established in Bayelva, Ny-Ålesund, and another two stations are planned. This is a joint project with Norges Vassdrags- og Energi- verk (NVE) and Norges Hydrotekniske Laboratorium (NHL).

GLACIER ATLAS OF SVALBARD AND JAN MAYEN (J.O. Hagen) – All available data about the glaciers have been stored in a data-base. They are registered by name, geographical locality, area, depth, volume and morphological data. Torild Jørgensen was contracted as a part-time project assistant in 1989.

GLACIER BORDERS AND CALVING RATES (J.O. Hagen and B. Lefauconnier) – A selected

number of glaciers in the eastern part of Svalbard were studied on all available photographs from Norsk Polarinstitut's missions since 1936, as well as on LANDSAT imagery. Variations in front positions and calving rates will be estimated. This project is funded by Operatørkomite Nord and will be finished in 1990.

GLACIER AND CLIMATE MODELLING (O. Orheim and J.O. Hagen) – The project involves glaciologists and geologists from three institutions in Norway, and from two other nations. The aim is to investigate glacier and climate variations in Norway (and possibly in polar areas), using hard data in glaciological models. This should lead to: 1) a better insight into glacial variations and thereby a better understanding of natural climatic variations, 2) an increased Norwegian competence in glacier modelling, and 3) improvement of the models.

STUDIES OF TABULAR ICEBERGS IN ANTARCTICA (O. Orheim) – The processing of iceberg data from Antarctic waters collected through an international programme led by the Institute was continued. Information has now been collected on 150,000 icebergs.

POLLUTION OF THE NORWEGIAN ARCTIC – A REVIEW (Z. Jaworoski) – Studies on the levels of pollutants (acids, heavy metals, radionuclides, organic compounds and gases) in air, precipitation, soil, plants and animals, carried out in the Norwegian Arctic were critically reviewed and compared with studies performed in other regions. The review was published in Norsk Polarinstitut's Rapportserie Nr. 55.

POSTDOCTORAL FELLOWSHIP (B. Lefauconnier) – This is part of the French-Norwegian cooperation funded by NTNF. Lefauconnier is working in cooperation with J.O. Hagen on 1) statistical analysis of mass balance data and climatic parameters, 2) possibilities for use of satellite imagery in mapping of annual equilibrium lines on Svalbard glaciers, and 3) shallow core analysis of Chernobyl radioactive layer to determine the mean accumulation rates.

Geodesy/topography

(leader: Knut Svendsen)

Norsk Polarinstitut is responsible for the mapping and the production of maps of Norwegian polar land areas. Three topographers and one geodesist are employed in this work. Another two persons were engaged to work half-time in the division in 1989.

Triangulations made on expeditions to Svalbard and Jan Mayen in 1989 and tide measurement data from Ny-Ålesund for the 1986-1988 period, and a new triangulation net on Hopen were calculated. Two maps were constructed and four edited in the 1:100,000 series of Svalbard. One satellite image map of Svalbard (1:100,000) and four of of Dronning Maud Land (1:250,000) were processed on the image processing system IVAS – system 600. The area of Ny-Friesland (Spitsbergen) was aerotriangulated. All magnetic data surveyed in Svalbard from 1985 to 1987 are now calculated. Planning activity for the Norwegian Antarctic Research Expedition 1989/90 took up much time in the second half of 1989.

A number of topographical maps and whiteprints were published in 1989, as listed under Maps and Charts on page 32.

Field work

Triangulation was done in Spitsbergen and Tusenøyane/Edgeøya. The tide gauges in Longyearbyen and Ny-Ålesund received their necessary annual check. A new station was built in Longyearbyen and a tide gauge rig was set out in the southern part of Bjørnøya (Sørhamna). Six baseline points were measured in the Storfjorden area.

In Jan Mayen some doppler and GPS-measurements were performed in cooperation with Statens Kartverk.



Baseline point measurements east of Halvmaneøya. Photo: B. Lytskjold

Cartography

(Leader: Bjørn Arnesen)

The cartographical division's main responsibilities are the technical preparation and production of the Institute's topographic and thematic maps, and the administration of the final preparation for the map printing work which is done outside the Institute. Three cartographers and one illustrator were occupied with this as well as with illustrating work for the Institute's publications. One cartographer was engaged in bathymetric mapping of the Barents Sea. The division was represented in the Place-name Committee.

Six maps were published in 1989, of which one in cooperation with the Department of Geography, University of Oslo. See list under

Charts and maps on page 32. A total of 101 illustration tasks were performed.

The division was also occupied with the preparation of three topographic maps, two geological maps, and 23 smaller maps for the Glacier Atlas of Svalbard and Jan Mayen. Three thematic maps were under preparation in cooperation with the Department of Geography, University of Oslo. Three maps were prepared for the Antarctic Expedition 1989-90.

Information/documentation

(leader: Annemor Brekke)

An information officer, a publications editor, a librarian, a translator and a part-time assistant



*Giant cairn built by Hoel's expedition between the Torell- and Recherchebreen glaciers in 1918.
Photo from Norsk Polarinstitutt's historical archives.*

cover the multitude of documentation tasks resulting from the Institute's responsibility for the scientific research in the Norwegian polar areas. The continued interest in polar matters made 1989 a very busy year for the division.

In addition to answering day-to-day questions on polar matters, the Information Service seeks to give as extensive information as possible. Several press releases, news and information bulletins, in addition to the annual report of the Institute, were sent out in 1989. A symposium on climatic changes in polar areas arranged by the Institute in April drew eighty participants and got much attention in the press, radio and television.

The Norwegian Antarctic Research Expedition which left for the Antarctic at the end of the year got much attention in the press. Several

press conferences were held and press releases sent out.

A pamphlet on «Norway in Antarctica» was written, edited and published in cooperation with the Ministries of Justice, of Foreign Affairs, and of the Environment.

The publication of scientific literature is an important part of the Institute's documentation service. Two issues of the journal *Polar Research*, one *Skrifter*, two *Temakart* (thematic map), two *Polarhåndbok* (Handbooks), and eight *Reports* appeared in 1989 and were exchanged and sold to scientists all over the world. See «Published in 1989», page 31.

The services of the Institute also include sale of aerial photographs and topographic and thematic maps. The sale and subscription rou-

tines for Institute publications are handled by the Documentations Division.

The Institute library has one of the best collections of polar literature in Europe and is open to the public during office hours. 1989 saw another 131 titles registered, including 56 new purchases, 24 old titles, 12 reprints, 29 titles from exchange partners, and 22 gifts. The reprint collection totals 6600 titles. 700 loans were registered, including loans to other libraries.

The translator is mainly occupied with the translation from Russian to English of scientific literature. A list of the translations carried out this year may be obtained at the Institute.

Photographic material from Norwegian polar history

(Susan Barr)

This NAVF/NP project is now well underway as far as resources allow. Several hundred photographs in the Institute's historical-photograph archive have been registered in the Institute's data base for historical material. This work is continuing steadily now that an assistant has been engaged for the purpose. Such computer registering of photographs is however a slow process as the finding and checking of information about the subject of the photograph is so important.

A photograph archive outside the Institute – belonging to Store Norske Spitsbergen Kulkompani a/s in Longyearbyen – has been visited and registered as a test case for incorporating external collections in the Institute's data base. Other collections of interest outside the Institute have been noted for visits later.

Two small exhibitions of old photographs from the Institute archives have been made. One is now in Svalbard Museum and the other at Longyearbyen School.

Nitrate film in the Institute's archive is steadily being transferred to 70 mm repro-film. At the present time the material has to be sent to a laboratory in Sweden.

Logistics

(leader: Thor Siggerud)

The division has five permanent posts and a number of part-time helpers. The personnel situation was still unstable in 1988 owing to illness and leave. A total of 278 scientists were given logistic and other support by the logistic division in 1989. Through the use of a rota system, there is always an on-the-spot representative in charge of the equipment at the research station in Ny-Ålesund. Preparations for and equipment of the Norwegian Antarctic Research Expedition 1989/90 required a lot of work by the Logistics division during the last half of the year.

Norsk Polarinstitutt has the practical responsibility for establishing and maintaining a network of navigation lights and beacons for ships and aircraft on Spitsbergen. Personnel from the logistics division are responsible for their annual inspection and service. In addition to general maintenance work, two lights were erected at Sørkapp and in Kransbukta at Edgeøya.

NORSK POLARINSTITUTT'S SVALBARD OFFICE – The Institute has had a base for its Svalbard expeditions in Longyearbyen since 1977. The logistics division is responsible for the service function of this office, both for the Institute's own people and for other visiting scientists. The office was manned during the main field season on land, from the middle of March to the beginning of September in 1989. It functioned during the rest of the year on a part-time basis.

Norsk Polarinstitutt's Research Station,
Ny-Ålesund

The Research Station in Ny-Ålesund was established in 1968 and is one of the most northerly land stations in the world. It serves as an observatory, a laboratory and a field base and is available all year round for Norwegian scientists and others working with arctic problems in cooperation with Norwegian scientific institutions. The most important part of the activity takes place in connection with the station's observatory functions, which involve a considerable recording of mainly geophysical data.

The permanent scientific registration programmes of the Research Station in Ny-Ålesund were in operation throughout 1989. Some of them involve cooperation with scientists from other countries. The following phenomena are recorded continually or observed during longer periods of the year:

Components of the radiation

energy budget	- Norsk Polarinstitutt
Tide measurement	- Norsk Polarinstitutt
Mass balance of glaciers	- Norsk Polarinstitutt
Atmospheric pollution	- Norsk Institutt for Lufforskning
Meteorological conditions	- Det norske meteorologiske institutt
Seismic disturbances	- University of Bergen
The Earth's magnetic field	- Universities of Tromsø and Oslo
Ionospheric activity, including aurora	- Universities of Tromsø and Oslo
Ozone measurements	- University of Oslo
Permafrost measurements	- University of Oslo/ Norsk Polarinstitutt
Hydrological investigations	- Hydrologisk komite/ Norsk Polarinstitutt
Polar fox studies	- Norsk Polarinstitutt

During the course of 1989, 63 visiting scientists stayed at the station for a total of 1093 visitor days. Not included in this number are more randomly visiting researchers, stopping over in Ny-Ålesund on their way to field work elsewhere in Svalbard. Visits are, unfortunately, not evenly spread throughout the year. More than 60 per cent of all visits to Ny-Ålesund take place in the period 15 June to 15 August. During the remaining ten months of the year,

particularly in October-November and in March, there is ample room for visitors. July is the busiest month. About 60 per cent of all visits in 1989 were concerned with biological projects, 30 per cent with geophysics, and 10 per cent with geological work.

Last year's research fellow studied the behavioural ecology of the arctic fox in Svalbard, sharing his time between the Research Station and the office at Norsk Polarinstitutt.

A station for mostly atmospheric chemistry studies was opened in September, 472 m above sea level, near the top of Zeppelinfjellet. It is accessible via a cable car.

Several summer courses aimed at giving its participants an overall knowledge of Svalbard, are arranged in Ny-Ålesund each summer. Staff members of Norsk Polarinstitutt contribute with several lectures on research carried out in Svalbard. Scientists visiting Ny-Ålesund at other times of the year were also asked to give informational lectures on their different research projects.

The small boat AURORA which has served the Station in Ny-Ålesund since 1968, was replaced in 1989. The new boat is of a similar type, but faster-going and of a more modern design.

Place-name Committee

(Leader Olav Liestøl)

The four members of the Place-name Committee had seven meetings in 1989. The following topics were handled:

- Place-name proposals in the Arctic and Antarctic discussed and inquiries answered.
- 48 new place-names in Svalbard approved.
- 15 new place-names in Dronning Maud Land approved.
- Transliteration for place-names containing russian elements discussed and approved.



A magnificent view opens up at the top of the cableway leading to the new atmospheric research station in Ny-Ålesund. Photo: E. M. Widemark

- Problems of Norwegian/foreign place-names in Dronning Maud Land discussed to establish directives for further handling.

The registration of all polar place-names into a computer data base has not yet been concluded.

Antarctica

Most of the year was spent planning and organizing the Norwegian Antarctic Research Expedition (NARE) 1989/90. A major task of this expedition was to build a new station, TROLL, on snow-free ground in Jurulsessen,

Dronning Maud Land. This required overland transport of 300 kilometres, and meant new challenges both in station design and construction, and in logistics.

The expedition used the Coast Guard vessel ANDENES, which had also been used for the previous national expedition. She sailed from Norway on 29 November. Scientists and logistic personnel flew from Norway on 26 December, and the expedition left from Montevideo on 28 December. ANDENES visited Port Stanley on the last day of the year where a British scientist joined the expedition. The complete expedition consisted of 91 persons, including a 42-strong ship crew. Nine of the participants were women.

Polar events

COOPERATION WITH SOVIET GEOLOGISTS

In June Norsk Polarinstitutt made an agreement for collaboration on the regional mapping project with the Soviet arctic geological survey 'Sevmorgeologia'. Their geologists will, together with geologists from other nations, contribute to the regional mapping of Svalbard and be co-authors of NP maps and other publications. The agreement includes exchange of material and joint excursions. The first map sheets touched by this agreement are 'Negribreen' (D8G) and Agardhfjellet (D9G).

WHAT HAPPENS TO THE POLAR CLIMATE

The climate is continually changing. Many scientists believe that effects of human activities are on the point of surpassing natural variations. There is a lot of uncertainty around this question. We do not know how such changes will occur or in what parts of the world. Everybody seems to agree, though, that the strongest climatic reactions will happen in the polar areas. The present great and increasing international efforts made within climate research prove the importance placed upon this topic.

All human created activity does not necessarily have to be dangerous. Data indicate that the climatic system of nature has built-in self-reinforcing mechanisms, which might perhaps result in great and rapid changes taking place as a result of little external influence. It might be feared, therefore, that the present outlet of greenhouse gases which has already increased the level 20 per cent over anything previously experienced by man, may lead to irreversible climatic changes. We do not have the necessary information today to correctly evaluate the magnitude of this danger.

Based on this, the Norwegian Polar Research Institute arranged a climatic symposium in April 1989, financed by the Ministry of the Environment and the National Committee for Environmental Research. Named «What happens to the climate in polar regions?», the symposium drew an attendance of 80 participants. Several internationally well known scientists gave lectures. A panel discussion which concluded the two-day conference, gave proof of much interest among the participants.

All lectures given at the symposium, or extracts thereof, are published in Norsk Polarinstitutt Rapport No. 53 (see under Publications, page 32).

A GOOD START FOR NORWEGIAN/SOVIET OCEANOGRAPHIC COOPERATION PROJECT

Measurements made in the straits between the Polar Ocean and the Barents Sea, will help us to determine the exchange of water and ice between the Polar Ocean and the Barents Sea. This is the main purpose of the oceanographic cooperative program taken on by the Soviet Union and Norway. The program had a good start in 1989.



A coast Guard vessel, K/V Andenes, was used as expedition vessel for the Norwegian Antarctic Research Expedition 1989/90. Photo: B. Amundsen/Norsk Polarinstitutt

Three joint cruises were made in the waters between Frans Josef Land and Greenland. Two went with the Soviet vessel *AKADEMIK SHULEYKIN* and one with the expedition vessel of Norsk Polarinstitutt, *LANCE*. Two rigs were set out for short-term registrations in the Fram Strait, and three for long-term registrations in the straits east of Svalbard. An upward-looking echo sounding sonar was mounted on one of the rigs to register the thickness of the ice drifting above during the course of the winter. Two Soviet scientists took part in cruises with the *HÅKON MOSBY* and *G.O. SARS* in more southern waters.

According to the agreement, each country shall be responsible for a couple of joint cruises each year. A total Norwegian cruise effort of 200-300 field days is required. Another important decision in the agreement points out that joint publications should be published.

NORGE I ANTARKTIS - NEW INFORMATION PAMPHLET

Joint efforts by the Ministries of Justice, Foreign Affairs, the Environment, and the Norwegian Polar Research Institute, resulted in the publication in 1989 of a handsome little pamphlet called *Norway in the Antarctic*. The first part contains a physical description of Antarctica, a historic review of Norwegian presence in this enormous continent at the end of the world, and a description of Norwegian Antarctic research efforts.

The second part deals with political questions in Antarctica. The international cooperation within different fields is dealt with, and Norwegian Antarctic politics described.

This information pamphlet will fill a long-felt need for people interested in Antarctica. English, Spanish, and French editions are planned to be published in 1990.

OFFICIAL REPORT ON NORWEGIAN POLAR RESEARCH FINISHED

An official committee, headed by the Research Director of Norsk Polarinstitutt, finished its report on Norwegian polar research in the summer of 1989. It was delivered to the Minister of the Environment in August.

In its conclusion, the Committee recommends that Norwegian polar research be increased by an extra ten per cent in addition to the expected increase in Norwegian grants to research. This would imply that polar research would get a share of 4 %, against today's 2 % over a seven-year period.

According to the Committee, polar research in Norway should concentrate on certain fields:

- Environmental research with special priority to physical oceanography, climate and protection studies,
- nature monitoring with special priority to management of renewable resources, and
- operations, with special priority to safety, polar offshore technology and sovereignty questions.

It further recommends that a national information system be established, consisting of a database for research results and a national information network. Education and training for and recruitment to the field of polar research should be improved.

The Committee was provided secretarial assistance by Norsk Polarinstitutt. Free copies of the report, in Norwegian only, may be ordered from the Institute.

SATELLITE TRACKING OF WALRUS

The distribution and wandering pattern of the walrus in Svalbard will be better known through a new project started by Norsk Polarinstitutt in 1989. The Atlantic walrus was found in great numbers along the coasts of Svalbard a couple of hundred years ago, but heavy hunting depleted the population to the verge of extinction. After the total protection in 1952, the population seems to be back in Svalbard waters now, although not in the same abundance as earlier.



Walrus with radio transmitter fastened to one tooth. Photo: Ø. Wiig

Three researchers surveyed the Tjuvfjorden-Tusenøyane area in the Southeast Svalbard Nature Reserve from helicopter, boat and on foot. All walrus seen were registered, and the area was also investigated for bone remains from former hunting activity. Two animals were instrumented with radio transmitters, which via satellite will signal their location and diving activity at given intervals.

The project will be carried on for a period of five years, as a part of the national research programme for marine mammals. Funding in 1989 was provided by the Norwegian Fishery Research Council and the Norwegian Polar Research Institute.

Published in 1989

Several series are published by the Institute. The journal *Polar Research* contains original scientific papers in English and appears in two-three issues per year. The *Skrifter* series is for monographs in English, French or German, while *Meddelelser* is a series for articles of a more popular character. *Polarhåndbok* has appeared in four issues, on the flora, geography, history, and birds and mammals of Svalbard. *Årbok* has been published annually since 1960. The *Temakart* series (Thematic maps) was started in 1985, two new issues appearing in 1989.

The following is a list of literature and maps published by the Norwegian Polar Research Institute in 1989. The publications may be ordered from bookstores or directly from the Institute.

PUBLICATIONS

Polar Research

This journal, started in 1982, has attracted many subscribers and is exchanged with the scientific literature of about 250 institutions around the world. Two issues, Vol. 7 Nos. 1 and 2, appeared in 1989.

Norsk Polarinstitutt Polarhåndbok

No. 3 – Mehlum, F.: Svalbards fugler og pattedyr.

No. 4 – Arlov, T.B.: A short history of Svalbard.

Norsk Polarinstitutt Skrifter

No. 19 – Mehlum, F.: Summer distribution of seabirds in northern Greenland and Barents Seas.

Norsk Polarinstitutt Årbok 1988

In addition to being the annual report of the Norwegian Polar Research Institute, this year-book contains an article on polar bear investigations in Svalbard.

Norsk Polarinstitutt Temakart

Temakart No. 4 – Steel, R., Winsnes, T.S. & Salvigsen, O.: Geological map of Svalbard 1:100,000. Sheet C10G Braganzavågen.

Temakart No. 5 – Lauritzen, Ø., Andresen, A., Salvigsen, O. & Winsnes, T.S.: Geological map of Svalbard 1:100,000. Sheet C8G Billefjorden.

Research in Svalbard 1989

This yearly bulletin gives information on the scientific work planned to take place in Svalbard during the coming season. Based on data collected by Norsk Polarinstitutt it is distributed to all contributors before the beginning of the field season each year.

Norsk Polarinstitutt Report Series

The following papers appeared in the Report Series in 1989 which are published for limited distribution. They are for sale at the Institute.

No. 48 Hansson, R., Prestrud, P. & Øritsland N.A. (red.): Analysesystem for miljø- og næringsvirksomhet på Svalbard – Versjon 2. NOK 75.–

No. 49 Rudels, B. & Finnekåsa, Ø.: Cruise with R/V Lance to the Barents Sea and the Fram Strait, September 1988. NOK 35.–

No. 50 Symposium 10-13/2, 1988: Nordisk samarbeid? Arktisk terrestrisk økologi. Internal – not for sale

No. 51 Vinje, T. & Berge, T.: Upward looking sonar recordings at 75°N – 12°W from 22 June 1987 to 20 June 1988. Data report. NOK 30.–

No. 52 Jensen, H. & Vinje, T.: IDAP 89 Lance

deployment. Volume 1. Cruise report. NOK 35.–

No. 53 Orheim, O. & Brekke, A. (red): Hva skjer med klimaet i polarområdene? Sammendrag av foredrag på symposium 25-26 april 1989.

No. 54 Gjelsvik, T.: Place-names of Heimefrontfjella and Lingetoppene, Dronning Maud Land, Antarctica. NOK 45.–

No. 55 Jaworowski, Z.: Pollution of the Norwegian Arctic: a review. NOK 50.–

Polarinform

This information bulletin gives short notes on general news topics from the polar areas. It is meant to be published twice or four times a year, but unfortunately was not published at all in 1989. Four issues are planned for 1990 and will be distributed free of charge to those interested.

MAPS AND CHARTS

Topographical maps published in 1989:

Svalbard: 1:100,000

B9 Isfjorden
A7 Kongsfjorden
(satellite image map)

Published as whiteprints:

Svalbard: 1:100,000

D7 Hinlopenbreen
G14 Hopen

Geological maps published in 1989:

Arktis: 1:1,500,000

Western Barents Sea, Bathymetry

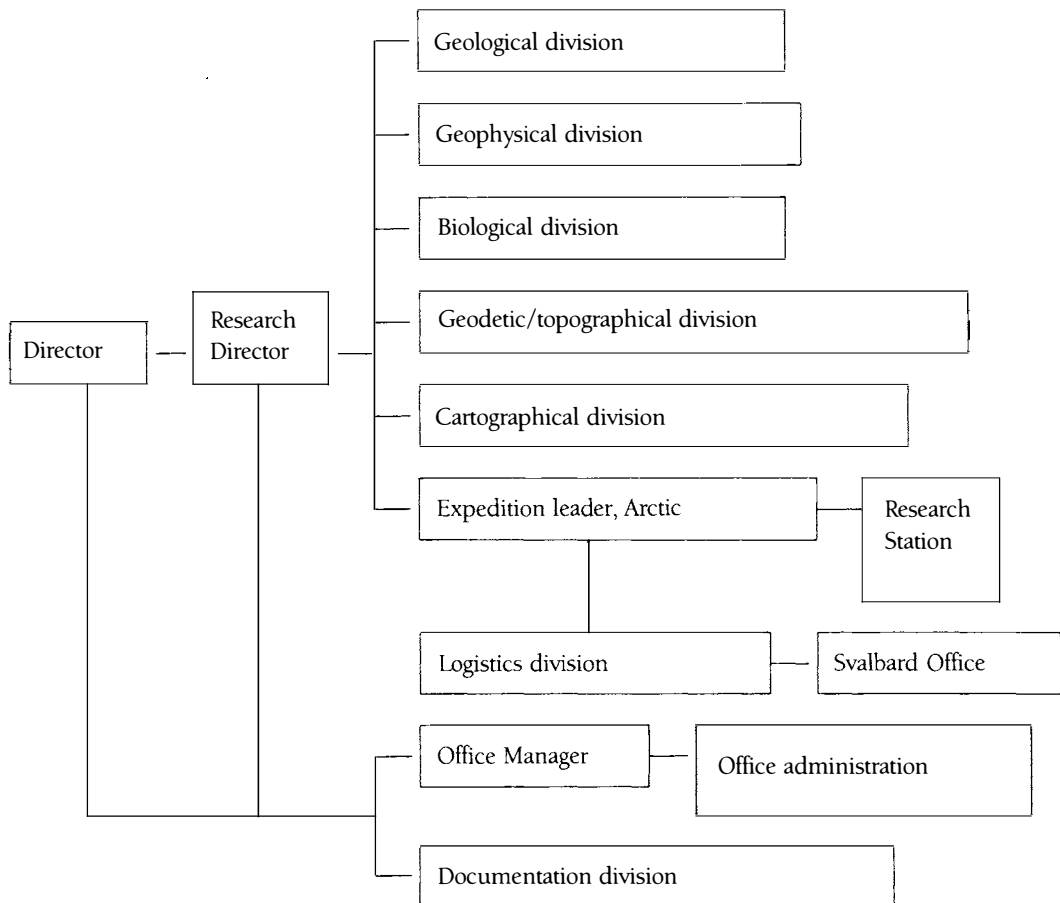
Thematic maps published in 1989:

Kystkart Svalbard 1:200,000

B5 Sørkapp (in cooperation with the department of Geography, University of Oslo)

Institute staff

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 Research Director
 Acting Research Director

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 Thor Larsen (on leave)
 Olav Orheim

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 Economic consultant
 Accounts
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 Asbjørn Traaholt
 Bjørg Grimsrud
 Hildegunn Ardal
 Nora Lisen Bugge (part time)
 Mary Caspersen (part time)

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	Åsta Marie Reinsli (part time, until 30.4)
	Aud Vigtel (part time from 1.7)
	Maryanne Rygg (part time from 17.7)
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»	Gunnar Krogh-Hansen (until 7.6)
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	Torstein Berge
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Editorial assistant	Knut Arnesen
Russian translator	Peter Hagevold
Librarian	Reidunn Lund
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Cartographer	Reidar Mandt
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Expedition Leader, Arctic, and leader of Logistics division and Research Station, Ny-Ålesund:

Thor Siggerud

Logistics division:

Leader	Frøystein Olsen (from 17.7)
Deputy leader	Jan Mikalsen
Technician	Eilif Frantzen
»	Georg Johnsrud
»	Jarl G. Pedersen
Temporary	Knut Hovrud (periodically)
	Lars Bakke

Research Station, Ny-Ålesund (temporary posts):

Station leader, shared with KBKC	Harald Gule (until 9.5)
	Knut Hovrud (10.5 – 21.6)
	Jomar Barlaup (22.6 – 1.9)
	Arnfinn Buås-Hansen (from 2.9)
Research fellow	Karl Frafjord
Engineer	Sverre Norman Thon (from 13.6)

Engineer	Lars Inge Sæther (from 31.8)
Engineer	Kurt Karlsen
Engineer	Paul Hinsch (until 18.6)
Logistics	One person from Logistics division on a rota system

Field service office, Longyearbyen:	
Local representative	Grethe Moltu (from 1.9)

Scientific Divisions

Project coordinator	Rasmus Hansson (from 1.12)
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Biology:

Leader, biologist	Fridtjof Mehlum
Biologist	Nils Are Øritsland
Contracted biologist	Geir Wing Gabrielsen
»	Vidar Bakken
»	Øystein Wiig
»	Ian Gjertz (periodically)
»	Rasmus Hansson (until 30.11)
»	Bente Brekke (from 1.8)
Research fellow	Linn Gulbrandsen
Temporary	Kenneth Eggen
Graduate student	Eva Fuglei
»	Kristen Fossan

Geophysics:

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Meteorologist	Vidar Hisdal
Glaciologist, Antarctic	Olav Orheim
Oceanographer	Bert Rudels (on leave from 31.8)
Oceanographer	Svein Østerhus (from 1.9)
Glaciologist	Jon Ove Hagen
Contracted	Zbigniew Jaworowski (from 1.7)
Contracted, sea ice	Ånund Sigurd Johnsen
»	Geir Kjærnli (periodically, part time)
»	Bjørn Erlingsson
» glaciologist	Torild Jørgensen (until 1.7)
»	Jostein Sundet (periodically, part-time)
»	Arne Sætrang (periodically)
Graduate student	Arnt Kvermdal

Geology:

Leader	Audun Hjelle
Geologist	Thore S. Winsnes (until 31.10)
»	Yoshihide Ohta
»	Otto Salvigsen
»	Hilde B. Keilen
»	Winfried K. Dallmann
Marine geologist	Anders Elverhøi
»	Anders Solheim

Technician	Jon Erik Møller
Temporary	Hans Petter Antonsen (12 months)
»	Astrid Stadheim (1 month)
Graduate student	Mona Nyland Berg
»	Lars Russwurm

Geodesy/Topography:

Leader, topographer	Knut Svendsen
Geodesist	Trond Eiken
Topographer	Bjørn Lytskjold
Topographer	Brit Åse Luktvasslimo
Temporary	Arild Petersen (periodically)
»	Bjørn Barstad (periodically)

Post retirement positions:

Geology	Tore Gjelsvik
Topography	Sigurd Helle
Geology	Thore S. Winsnes (from 1.11)
History	Bjørn Vidar

Visiting scientists

Glaciologist	Bernard Lefauconnier
Geologist	Krzysztof Birkenmajer
Geologist	Claude Lepvrier

Nordic exchange visitor

Dansk Polarcenter	Karen Christensen
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On leave:

Bert Rudels
Thor Larsen

DISTINCTION AND DEGRESS

Former head of the Topographic Division, Sigurd Helle, was awarded His Majesty the King's Order of Merit in Gold, in 1989. Now in a post retirement position at the Institute, Sigurd Helle received this distinction for his many years of excellent service in Norwegian polar areas.

PUBLISHED BY THE INSTITUTE STAFF

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Wiig, Ø. 1989: The Grey Seals *Halichoerus grypus* (Fabricius) and the Common Seals *Phoca vitulina* L., in Lofoten and Vesterålen, northern Norway. *Fauna norv., Ser. A* 10, 1-4.

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Lyderson, C., Angantyr, L.A., Wiig, Ø. & Øritsland, T. 1989: Feeding habits of northeast Atlantic harp seals *Phoca groenlandica* along the summer ice edge of the Barents Sea. *Coun. Meet. Int. Coun. Explor. Sea 1989 N11*, 1-13.

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MEETINGS, COURSES AND TEACHING

Institute staff members attended meetings and short courses in Norway, the Netherlands, Denmark, Finland, France, Great Britain, Italy, Japan, Poland, the Soviet Union, Sweden, United States and West Germany.

The following have held regular University lectures and tuition:

Eiken, Trond: Surveying – University of Oslo
Elverhøi, Anders: Geology- University of Oslo
Hagen, Jon Ove: Glaciology – University of Oslo
Orheim, Olav: Glaciology – University of Bergen
Øritsland, Nils: Physiology – University of Oslo
Svendsen, Knut: Photogrammetry – Univ. of Oslo

LECTURES AND CONFERENCE CONTRIBUTIONS

Barr, Susan – *Jan Mayen i krigstid*. Defense Museum, Oslo, February.

- *The Norwegian wintering expeditions of Nansen, Amundsen and Sverdrup*. Conference on Survival Strategies – Life in the Polar Winter. University of Groningen, February.
- *Norsk polarhistorisk billedmateriale*. NAVF konferanse om Humanistisk forskning om Svalbard. Longyearbyen, May.
- *Hvordan Jan Mayen ble norsk*. 60th anniversary for Norwegian sovereignty over Jan Mayen, Oslo, May.

Dallmann, W.K. – *Modern aspects of Tertiary fold and thrust tectonics on Spitsbergen*. Guest lecture at SEVMORGEOLGIA, Leningrad, 16 November 1989.

Dallmann, W.K. & Maher, H.D. jr. – *Structural zonation of the Tertiary fold-and-thrust belt, Spitsbergen*. European Union of Geosciences V Meeting, Strasbourg, 20-23 March 1989.

Elverhøi, A. – *Sokkelrelevant forskningsaktivitet ved Norsk Polarinstitutt*. Oljedirektoratets Informasjonsmøte, februar 1989.

– *Submarin permafrost og gasshydrater i nordlige og nordvestlige Barentshav*. Oljedirektoratets Informasjonsmøte, februar 1989.

– *Glacial geologiske modeller for Barentshavet*. Maringeologisk seminar, Univ. i Tromsø, september 1989.

Elverhøi, A., Antonsen, P., Solheim, A., Flood, S.B., Riis, F. & Dypvik, H. – *Geologien i Olgabassenget – Nordvestlige Barentshav*. NGF XI Landsmøte, Bergen, januar 1989.

Elverhøi, A. & Antonsen, P. – *Sedimentologi i Olgabassenget med tilstøtende områder*. Barentshavsseminar 1989, Statoil Harstad. Februar 1989.

Elverhøi, A. & Antonsen, P. – *Bedrock geology and shallow structures of the Olga Basin*. IL-møte, Institutt for geologi, Univ. i Oslo, september 1989.

Erlingsson, Bjørn – *Coastal sea ice deformations*. POAC 89 Conference in Luleå, Sweden 12-16 June. –

– *The stress-strain relations for sea ice as an ideal granular material*. Symposium on Regional and Mesoscale modelling of ice-covered oceans, Bergen, 23-27 October.

Frafjord, K. – *Fjellrev/polarrev: Hva vet vi om arten med relevans til forvaltningen*. Landsmøte for viltforvaltere, Longyearbyen. June.

– *Fjellrev*. Foredrag for skoleklasse i Longyearbyen, Ny-Ålesund. September.

Gabrielsen, G.W. – *Moderne amerikanske akvarier*. Foredrag på årsmøte i Nordkapp akvarieforening. February.

– *Effekt av menneskelige forstyrrelser på arktiske fuglearter*. Foredrag på årsmøte for norske viltforvaltere i Longyearbyen. June.

– *Adaptations of seabirds to arctic environment*. Int. Union of Game Biologists. Trondheim. September.

– *Energetics of arctic breeding seabirds*. British Ornithologist Union. Autumn meeting regarding «The cost of reproduction in birds». Glasgow. September.

– *Energetics of Kittiwakes*. Int. workshop on «Population dynamics of Lari in relation to food resources». Groeningen. September.

Hagen, Jon Ove – *Isbreer og permafrost som klimaindikatorer*. Internatinal Symposium: Hva skjer med klimaet i polarområdene? Oslo, 25-26 April.

Hjelle, A. – *Computers in geological research at Norsk Polarinstitutt, present use and future plans*. Guest lecture at SEVMORGEOLOGIA, Leningrad, 16 November 1989.

Johnsen, Ånund S. – *Relations between top and bottom ice topography using a scanning sonar*. POAC 89 Conference, Luleå, Sweden 12-16 June.

– *Fysiske forhold, is og isdrift i Barentshavet Nord*. AKUP-møte Sundvollen, Juni.

– *Use of scanning sonar on ice and icebergs*. IDAP-møte Godøysund, Juni.

Løvø, V. & Elverhøi, A. – *Gas hydrates in high latitude continental shelf environment*. Shallow gas and leaky reservoirs. NPF Meeting, Stavanger, April 1989.

Mehlum, F. – 1) *Ornitologiske undersøkelser i Svalbardområdet*. 2) *Naturforvaltning på Svalbard*. Kalo Vildtbiologiske Stasjon. February.

Ohta, Y.: *Structural relations between Svalbard, North Greenland and Ellesmere Land from Precambrian to Early Carboniferous*. NGF Landsmøte, Bergen, 13 January.

- *Metamorphic rocks and charnockite in Gjelsvikfjella and western Mühlig-Hoffmannfjella, and their Rb-Sr ages*. Intern. Workshop on Antarctic Geochronology, München.
- *Caledonian configuration of Svalbard – North Greenland – Ellesmere Island*. NGF, Oslo, 6 April.
- *Recent advances in Arctic Research in Norsk Polarinstitut*. Japanese Polar Institute, Tokyo, 23 May.
- *Thin skinned tectonics along a transpressional tectonic zone; example from west Spitsbergen*. Niigata Univ., 25 May.
- *Geochronology of Svalbard basement rocks*. Guest lecture at SEVMORGEOLOGIA, Leningrad, 16 November 1989.

Østerhus Svein – Planning meeting for the 1990 expeditions in Sovjet-Norwegian Oceanographic Programme, Oslo, December 5-8 1989.

- Norsk brukergruppe for oseanografiske data: NSKV, Stavanger, November.

Orheim, Olav – 1) *Experience with Norwegian data collecting platforms in polar regions*. 2) *Iceberg observation programme and ship safety*. Meeting on cooperation on ice forecasting and ice research in Antarctic Waters, Leningrad, February.

- *Hvor høyt er havnivået i år 2050?* International Symposium: Hva skjer med klimaet i polarområdene? Oslo, 25–26 April.
- 1) *Investigating climate change by digital analysis of blue ice extent on satellite images of Antarctica*. 2) *Extracting climatic information from observations of icebergs in the southern ocean*. International glaciological Society, Seattle August.

Rogne, Odd – *Research and research facilities in Svalbard. Some thoughts on British needs and implementation*. Royal Geographical Society, London, February.

- *Norwegian Polar Research in the Arctic Ocean*. Nansen Centennial Arctic Programme. An international workshop on Arctic ocean research, Tromsø, March.
- *Samordnet forskningsservice – behov og planer*. Nærings-samlingen, Longyearbyen, May.
- *Utenlandsk forskning i norske nordområder. Konsekvenser for norske interesser*. Statssekretærgruppen for nordområdene, Norwegian Foreign Office, June.
- *Forskning i Ny-Ålesund nå og i tiden fremover*. Svalbardkurset, Ny-Ålesund, July.
- *Forskning i Ny-Ålesund*. NIF/SINTEF Studietur Nord, Ny-Ålesund, August.
- *Forskningsfasiliteter og pågående forskning i Ny-Ålesund*. Forskerkurset, Ny-Ålesund, August.
- 1. *A survey of the research in Ny-Ålesund*; 2. *International Arctic research cooperation*; 3. *The future of Svalbard as an industrial research site for Arctic research*. Lectures given during the visit of Minister of Science Dr. Herbert Currier, August.
- *A survey of Norwegian polar research, the Norwegian Polar Research Institute and other institutions involved*. Lecture given for Canadian RD Delegation, October.

Øritsland, N.A. – *Arktiske pattedyr*. Foredrag/seminar Kalø Vildtbiologiske Stasjon, Danmark. February.

- *Isbjørnens vandringer og overlevingsmuligheter*. Foredrag ved Det Finske Nordenskiöld-samfundets 50 års jubileum.

Peucat, J.J. & Ohta, Y. – *Greenvillian ages from Spitsbergen*. Intern. Eclogite Conference, Würzburg, 18 April.

Solheim, A. – *Recent and relict iceberg ploughing in the northern Barents Sea*. Ice Data Acquisition Program (IDAP), Godøysund, Norway, 10-20 June.

– *Glacialgeologisk utvikling i det nordlige Barentshav fra pleistocen til 1989*. Norsk Geologisk Forening, Trondheims avdelingen, 7 November 1989.

Solheim, A. & Elverhøi, A. – *Sea floor craters in the Barents Sea; a discussion of their origin. Shallow gas and leaky reservoirs*. NPF Meeting, Stavanger, April 1989.

Solheim, A. & Forsberg C.F. – *Geotechnical properties of glacial diamictites in Prydz Bay; Implications for the glacial history of East Antarctica*. Am. Geophys. Union, Spring Meeting, Baltimore, USA, May 1989.

Solheim, A., Forsberg, C.F. & ODP Leg 119 Shipboard Scientific Party – *Glasiasjonshistorien i Øst-Antarktis, Resultater fra Ocean Drilling Program, Leg 119 i Prydz Bay, med vekt på geotekniske analyser*. NGF XI Landsmøte, Bergen, January 1989.

Solheim, A., Russwurm, L., Elverhøi, A. & Berg, M.N. – *Glacial geomorphic features in the northern Barents Sea: Direct evidence for grounded ice and implications for the pattern of deglaciation and late glacial sedimentation*. Glaciomarine Environments: Processes and sediments, Geol.Soc.London, March, 1989.

Vinje, Torgny – *Automatic ice thickness measurements from an upward looking sonar*. Greenland Sea Project Work Shop, Monterey, 13–20 February.

– *Icebergs in the Barents Sea*. Offshore Mechanics and Arctic Engineering, den Haag, 19–23 March.

– *Variasjoner i havsisens utbredelse i Barentshavet/Grønlandshavet*. International Symposium, Oslo 25–26 April: Hva skjer med klimaet i polarområdene?

– *Icebergs and sea ice in the Barents Sea*. IDAP-meeting in Godøysund, Bergen, 18–20 June.

– *Ice Thickness Measurements from upward looking sonars*. Working Group on Sea Ice and Climate under World Climate Research Programme, Roma, 20–23 November.

– *Sjøis og isfjell i Barentshavet*. Naturdatakonferansen, OD, Harstad, 26–28 September.

Accounts for 1989

Chap.1412. Debit items	Budgeted	Expenditure
01. Salaries, wages, etc	13,456,000.-	13,670,501.-
11. Goods and services	15,384,000.-	15,360,055.-
21. Special expenses:		
Ordinary	17,158,000.-	16,555,753.-
Contracts	5,700,000.-	8,622,930.-
45. Large new purchases	780,000.-	780,000.-
70. Scholarships	215,000.-	215,000.-
	<hr/>	<hr/>
	52,693,000.-	55,204,239.-
	<hr/>	<hr/>
Chap.18. Beacons and radio beacons in Svalbard	2,184,000.-	2,190,000.-
Chap.4412. Credit items	Budgeted	Received
01. Sale income	1,000,000.-	963,896.-
03. Income from various services	4,700,000.-	7,659,034.-
04. Reimbursement from Svalbard budget	2,150,000.-	2,150,000.-
	<hr/>	<hr/>
	7,850,000.-	10,772,930.-
	<hr/>	<hr/>

Grants and financial assistance for research projects

Norsk Polarinstitutt gives financial support to polar research at the Norwegian universities and research institutions in the form of fellowships and project grants. Fellowships are granted to individuals, mainly students, to support and stimulate new scientific projects in Svalbard. More extensive management-oriented projects will be supported under the Programme for Biological Research and Investigations in the Arctic, see project grants below.

FELLOWSHIPS IN 1989

- Andresen, Arild, University of Oslo: Post-caledonic tectonics in Svalbard.
- Bjørn, Tor Harry, University of Tromsø: Adaptive significance of nest parasitism and egg stealing in Svalbard Eider.
- Endal, Arild, NLVF scholar: Associative nitrogen fixation in arctic low nitrogen soils.
- Haremo, Pål, University of Oslo: Post-caledonic tectonics along the fault zone in southern parts of Billefjorden and Lomfjorden and their relation to the fold belt of western Spitsbergen.
- Ims, Rolf A. & Steen, H., University of Oslo: Southern mice in Svalbard. Adaptation to an arctic environment.
- Jacobsen, Bjørn, University of Oslo: Day and night dynamics of aurora borealis in relation to sunwind/magnetosphere – theories and observations.
- Korsen, Ole Martin, University of Oslo: Drainage of subpolar glaciers.
- Michelsen, Lisa & Ilyes, Robert R., University of Oslo: Paleontology/sedimentology.
- Nilsen, Lennart, University of Tromsø: Mapping of vegetational changes at Uversøyra by means of satellite data.
- Paulsen, Torgeir & Opsvik, Dagfinn, University of Oslo: Construction, testing and absolute calibration of an aurora borealis TV-camera for the Research Station in Ny-Ålesund.
- Schjetlein, Jan, University of Tromsø: Parasites in Svalbard ptarmigan as indication of migration dynamics.
- Staaland, Hans, Norwegian Agricultural University: Interaction between Svalbard reindeer and vegetation at Brøggerhalvøya, Svalbard.
- Sørbel, Leif, University of Oslo: Terrain wear in Sassendalen and Adventdalen – risk analysis by means of a geographical information system (GIS-system)
- Vatne, Geir, University of Oslo: Drainage in subpolar glaciers.
- Aarset, Arne V., Aunaas, T., Torres, J.J., University of Trondheim: Ice fauna ecophysiology.

PROJECT GRANTS 1989

- Amlien, Jostein, Norsk Polarinstitutt: Biological investigations in the Arctic 1989.
- Bakken, Vidar, Norsk Polarinstitutt: Sea bird investigations in Bjørnøya.
- Elvebakk, Arve & Spjelkavik, Sigmund, University of Tromsø: Evaluation of reindeer grazing and satellite mapping of vegetation in Svalbard.
- Elverhøi, Anders, Salvigsen, Otto, Sollid, Johan L., Norsk Polarinstitutt and University of Oslo: Classification and mapping of beach zones in Svalbard.



Helicopters may be used in the lighthouse maintenance work performed by the Norwegian Polar Research Institute. Photo: N. G. Flaata

Gulbrandsen, Linn, Norsk Polarinstitutt: Vegetation damage due to reindeer grazing and human activities in Svalbard.

Jørgensen, Inge, Hegdehaugen Voksengymnas: Freshwater biological investigations in Moselhalvøya.

Prestrud, Pål, Ministry of the Environment: Arctic fox project in Svalbard.

Tyler, N.J.C., University of Tromsø: Demography of reindeer in Adventdalen.

Wiig, Øystein, Norsk Polarinstitutt: Polar bear investigations.

Øritsland, Nils, Norsk Polarinstitutt: Biological investigations in the Arctic 1989.

Glaciers in the Kongsfjorden area

OLAV LIESTØL

The glaciers draining to Kongsfjorden cover an area of 1013 square kilometres. Their main part consists of the large glacier complex (on older maps named Kongsbreen) with three different calving fronts at the head of Kongsfjorden. In the middle part, Kronebreen is distinguished from the others by its heavily crevassed surface and its high speed. It drains a large part of the Isachsen- and Holtedahlfonna ice fields, and contributes with the main part of the icebergs in the fjord. The maps show the different drainage areas.

The Blomstrand glacier flows down from the north to the Blomstrand peninsula with two fronts in the sea, and, at the moment, is separated by a narrow ice passage. The sea is melting its way from both sides and threatens to break through the ice passage and thus convert the peninsula into an island. At the moment there is only about 200 m left.

The glaciers on the south side of the fjord are all small wellbordered valley glaciers. None of them reaches the sea.

Temperature conditions in the glaciers

Temperature is of great importance for the flow and hydrology of the glaciers. Only shallow measurements down to 15 m have been carried out up until now. We know, however, based on indirect observations, that large parts of the higher areas above the equilibrium line are at the melting point.

Just outside the front of Brøggerbreen permafrost has been registered in a borehole down to 140 m. It is therefore likely that the frost goes underneath the glacier tongue and sides. In the firm area, where accumulation is high, pressure melting point temperatures reach down to bedrock, except for some few metres near the surface in winter time. This is due to the fact that the snow is soaked with meltwater during the summer and the heat capacity of this water is high enough to prevent freezing below 5-10 m during the winter. In this way groundwater below the permafrost outside the glaciers is supplied by meltwater. Even though the ice in the tongue is frozen to the ground, water finds its way along the bed. During the winter the subglacial water freezes in front of the glacier and forms large icings. This is the case in front of all large glaciers ending on land. The icings are also a good indicator of whether a glacier is totally below freezing point or of a subpolar type with accumulation areas at melting point.

On the southern side of the fjord, near Ny-Ålesund, the two glaciers Brøggerbreen and Midre Lovénbreen are relatively well studied. Radioecho soundings show that Brøggerbreen is rather shallow, with a maximum depth of about 130 m. This glacier does not drain water during the winter whereas Lovénbreen, with ice depths almost double that of Brøggerbreen, has large icings between the front and the old end moraines. The large tidewater glaciers all produce water during

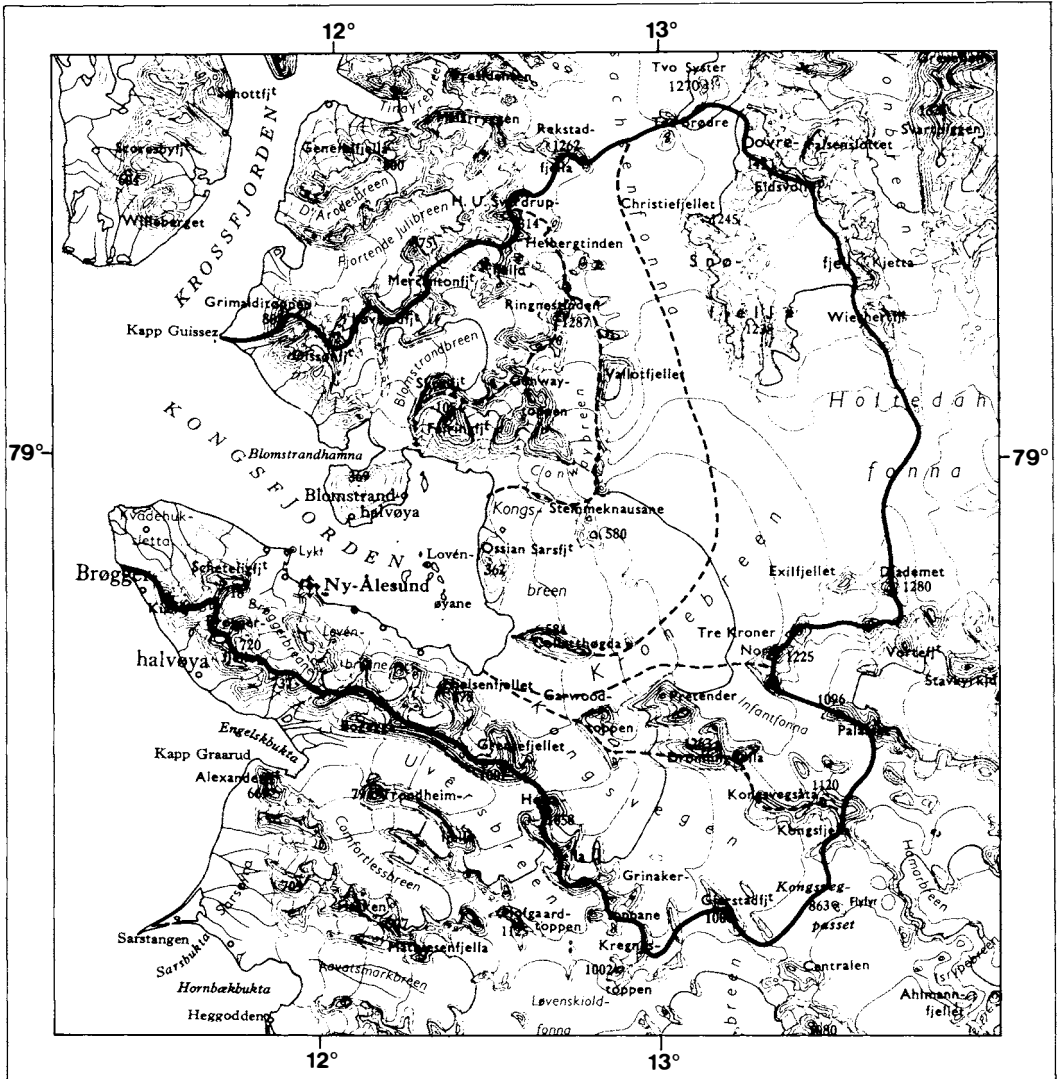


Fig. 1. Glacier drainage areas to Kongsfjorden.

the winter. The fresh water flows up to the surface and forms extra thick fjord ice near the front. This ice, however, is normally crushed by the forward moving ice front during the winter.

The ice movement is also essential to the temperature and water production along the glacier sole, and thus to the glacier flow. The fast moving Kronebreen ice stream, with a mean velocity of more than one metre a day, is therefore most likely not frozen to the bottom, even in the ablation area.

Glacier flow

The surface velocity of the glaciers around Kongsfjorden is well investigated. During German expeditions in the years 1938, 1962, 1964 and 1965, extensive photogrammetric measurements

were made on the Lovénbreen, Kongsvegen, Kongsbreen and Blomstrandbreen glaciers. In addition researchers at the Norwegian Polar Research Institute have been measuring velocity on the Brøgger- and Lovénbreen glaciers since 1970.

As might have been expected, the velocity of the small glaciers is low. This is especially the case with Brøggerbreen, which in addition is thin and cold at the base. At the centre of the glacier, where maximum speed would be expected, the velocity was only about one centimetre a day. At Lovénbreen which is of the same size but much thicker, the velocity is more than twice this amount. It is also, as earlier mentioned, of the subpolar type.

In 1938, Pillewizer made measurements in cross sections on the lower part of Kronebreen. The velocity was low on the southern side of the middle moraine but had a marked increase towards Colletthøgda on the north side. The maximum velocity in the middle was more than 4 m per day. Measurements were repeated at intervals in 1962 and 1964-65 (Voigt 1969). Winter registrations were also made in the last period, the maximum velocity reaching 3 m a day and the mean being about 1.5 m a day. These velocities are much larger than found on other glaciers of similar size in Spitsbergen.

The Kronebreen and Kongsvegen ice streams join about 10 km from the sea, the border between them being a large middle moraine. There is a distinct difference in the surface of the two streams. Kronebreen is heavily crevassed, whereas Kongsvegen is smooth with almost no crevasses at all. Depth and velocity cross profiles have been measured just above the confluence at both glaciers. The depth and surface gradients are almost the same, but the velocities are quite different. In the summer of 1964, the velocities at Kongsvegen and Kronebreen were about 4 cm and 100 cm a day, respectively.

This large difference may have been caused by the friction heat generated at the bottom of the fast-flowing Kronebreen ice stream. With its high and four times larger area, the supply is large enough to maintain the same profile and gradient in spite of the large drainage. Kongsvegen, on the other hand, is frozen or partly frozen to the bottom. Transport through the profile is therefore

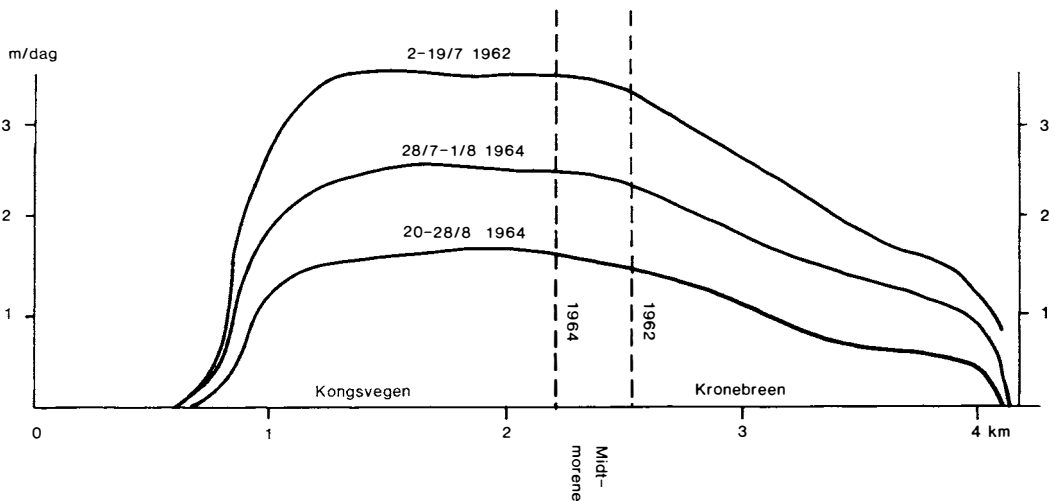


Fig. 2. Velocity profiles across the lower part of Kongsvegen-Kronebreen. The measurements were made by photogrammetry during German expeditions in 1962 and 1964 (Voigt 1969).

not large enough to bring the accumulation surplus down from the firm area. The glacier is probably bulding up to a surge in this way.

Brøggerbreen could also be expected to build up to a surge, with its very slow movement. The mass balance deficit, however, has been so large during recent years that not even the higher parts of the firm area have increased in thickness.

Glacier fluctuations

Whalers from the Netherlands and England were the first people to arrive in Svalbard. They left maps that perhaps for the first time had symbols representing glaciers or glacier fronts. At many of the locations where glacier fronts exist today, the Dutch maps have a rugged contour named «Ysberg». Only phenomena seen from the sea were of interest for the whalers, and glacier borders inland are absent on their maps.

On maps from about 1700 an «Ysberg» is placed at the head of Kongsfjorden. This ice front is believed to represent Kongsbreen, but the map is too inaccurate for any conclusion to be drawn as to the position of the glacier front in those days. Another interesting observation could be made on the same map. A large island is placed on the north side of the fjord. It might be possible that this is the Blomstrand peninsula, unconnected with the Blomstrandbreen glacier. Radio echo depth measurements made in 1980 by the Norwegian Polar Research Institute and the Scott Polar Institute show that if the ice connection melts, the Blomstrand peninsula would convert into a real island as indicated earlier. If this assumption is correct, the Blomstrandbreen glacier was much smaller in the whaling period than in later years. Scoresby's map from 1820 and Nordenskiöld's map from 1861 show the glacier with a broad connection to the island. The continuous retreat of the front since 1860 was interrupted by a surge about 1960, when the front pushed forward about 600 metres. Fig. 3 shows the positions of the fronts since 1861.

We have no information on the maximum expansion of this glacier. The weathering and the vegetation on the outermost moraines indicate an age of about 200 years.

As mentioned earlier, old maps indicate a glacier front at the head of Kongsfjorden, but its position is difficult to place on modern maps. There are indications, however, that the front of the Kronebreen and Kongsbreen glaciers was behind its present position for long periods in post-glacial times. A distinct shoreline appears at the lee side of a large rock knob that emerged out of the glacier front a few years ago. It could be an old line, but the fact that it is situated at present sea level and cut into solid rock indicates that it has been formed after some time with ice-free conditions.

The first information on the joint front position of the Kronebreen and Kongsvegen glaciers is found in Lovén's notebook (Torell 1865) from 1837. He visited Leirholmen, one of the islands in Kongsfjorden, and made a sketch of a dead ice moraine then covering part of the island. The dead moraine forms indicated in the sketch, look like similar forms in moraines left by ice some fifty years earlier. A reasonable time for the advance might therefore be about 1800.

The Swedish expedition visiting Kongsfjorden in 1861 did not construct a map, but made a good sketch of the glaciers and the islands in the foreground. According to this sketch the glacier front had retreated considerably, but the ice still covered the southern part of Ossian Sarsfjellet.

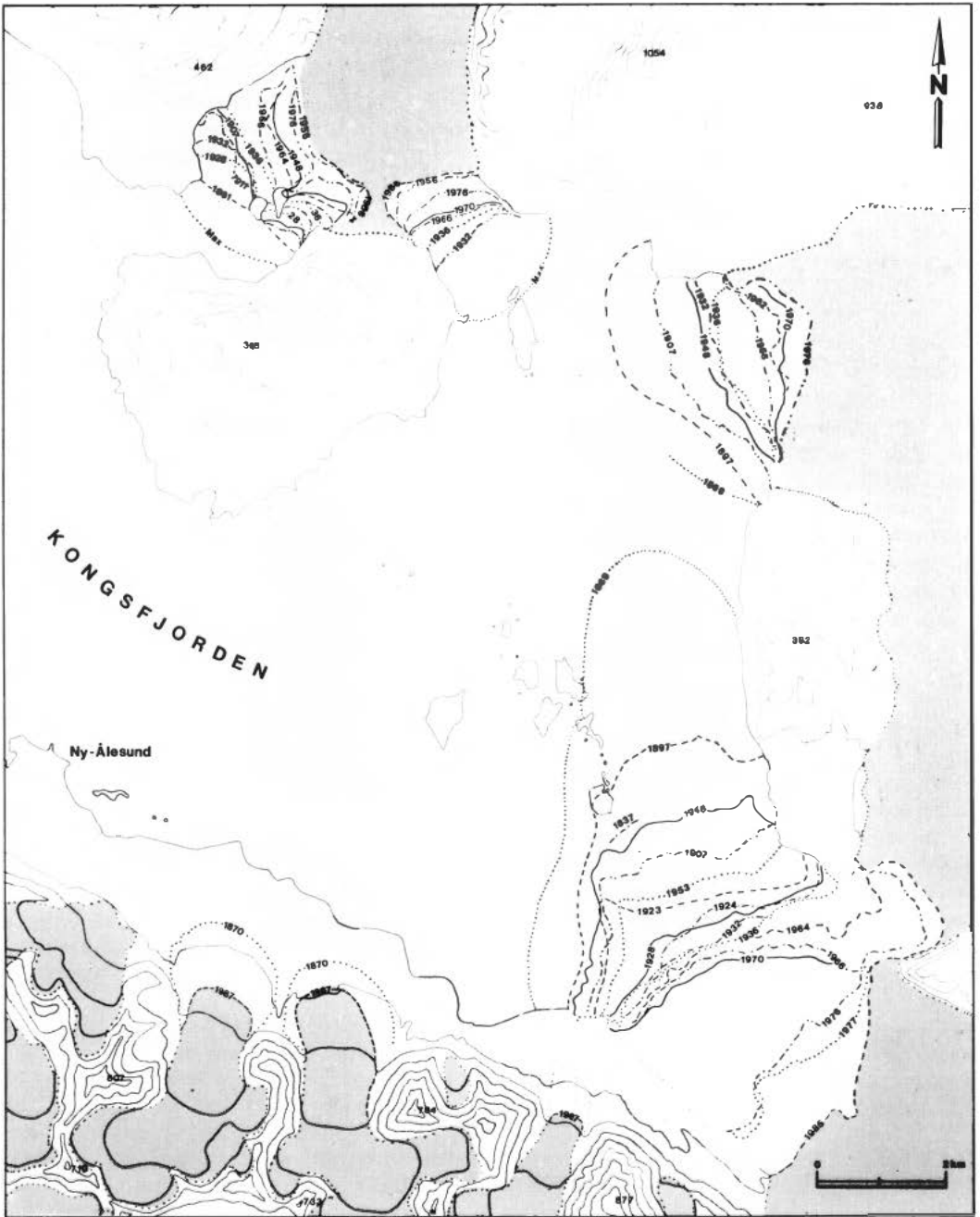


Fig. 3. Glacier front fluctuations in Kongsfjorden.

Lamont (1876) visited Kongsfjorden in 1869. He did not describe the glaciers well, but his expedition report includes a very accurate drawing which has possibly been made from a photograph (Fig. 4). Both Kongsbreen and Kronebreen-Kongsvegen appear here as large heavily crevassed ice streams filling the fjord between Ossian Sarsfjellet and the Lovénøyane islands. This should indicate a large surge including both Kongsvegen-Kronebreen and Kongsbreen, and

should also represent their maximum expansion. The glacier left marked moraine deposits along the shores below Ossian Sarsfjellet. These deposits with a typical red marine clay also cover Leirholmen, part of Innerholmen and the Sigridholmen islands. According to Lovén's notes from 1837 the glacier never reached further west than to the middle of Leirholmen. At that time the western part had a thick continuous cover of moss and tufts of *Dryas octopetala*.

From Lamont's sketch it is not possible to tell how far the glacier reached during the surge on the southern side of the islands.

The large retreat following the maximum advance was interrupted by an advance in the years just before 1948. Air photographs from that year show the glacier about 500 m east of Leirholmen, which means an advance of about two kilometres from the 1936 position. The surge probably started from a position perhaps half a kilometre further back.

The retreat in the last forty years has been about 150 m a year, and the glacier front is now about ten kilometres behind its maximum position.

The changes in the position of the middle moraines at the Kronebreen and Kongsvegen ice-streams give information on the variation in ice flow of the different glaciers. The most distinct is the middle moraine that originates from Garwood-toppen and marks the border between Kronebreen and Kongsvegen. On Lovén's sketch it is pressed over to the northern side and indicates that the advance before 1837 was caused by the Kongsvegen glacier. Lamont's sketch showing the advance in 1869 has no moraines, but on Canway's (1898) and Isachsen's maps from 1897 and 1907 it is pressed over to the southern side. This fact should indicate that the maximum advance was caused by Kronebreen. Later maps show that the moraine remained on the south side until 1948 when it was pushed northwards by Kongsvegen, which obviously caused this last surge. Later the larger and more active Kronebreen has gradually pressed the moraine southwards again.

Infantfonna, a tributary glacier to Kronebreen is separated from this glacier by another moraine that does not always reach the sea. On a map from 1923 it stops in an arc about 3 km from the front. In 1936 the arc reached the sea. According to the maps from 1966, a new arc formed by an advance between 1950 and 1960 had passed Garwoodtoppen. Today it has disappeared again into the sea.

The variation of the smaller glaciers in the area is less known. Hamberg (1895) visited the southern side of the fjord in 1890 and described and photographed the fronts of Midre- and Vestre Lovénbreen, when the glacier fronts were almost vertical and located just at the outermost moraine ridge. The ice front shape is typical for glaciers some years after a surge. During the surge the front is also steep but with a crushed and heavily cracked surface. Some time after the surge has stopped, the surface is smoothed by ablation. On comparing with the development of recent surging glaciers, this surge could be dated to between 1860 and 1880. According to photographs from 1906, Brøggerbreen further west seems to have a similar development, probably starting some years later. After this maximum stage a continuous decrease started. This fact is documented by photographs and maps, and from 1966 by direct mass balance measurements. The lower part, especially the area near the front, is exposed to the largest thinning. This is a phenomenon common to nearly all glaciers, especially surging ones.

Relatively, the smaller glaciers have been exposed to the largest losses, some have lost more than half their original volume.

Table 1 Specific mass balance in m/y water equivalent and annual equilibrium line (ELA) for Austre Brøggerbreen and Midtre Lovénbreen 1967–1989.

Balance year	Austre Brøggerbreen			Midtre Lovénbreen		
	c	a	b	c	a	b
1966/67	0.77	1.42	-0.65			
1967/68	0.57	0.67	-0.10	0.48	0.51	-0.03
1968/69	0.40	1.33	-0.93	0.41	1.25	-0.84
1969/70	0.37	0.91	-0.54	0.36	0.89	-0.53
1970/71	0.65	1.23	-0.58	0.70	1.16	-0.46
1971/72	0.95	1.26	-0.31	0.98	1.20	-0.22
1972/73	0.74	0.82	-0.08	0.82	0.84	-0.02
1973/74	0.75	1.67	-0.92	0.70	1.59	-0.89
1974/75	0.78	1.09	-0.31	0.83	1.04	-0.21
1975/76	0.72	1.17	-0.45	0.75	1.10	-0.35
1976/77	0.76	0.87	-0.11	0.80	0.84	-0.04
1977/78	0.75	1.31	-0.56	0.81	1.29	-0.48
1978/79	0.77	1.48	-0.71	0.80	1.46	-0.66
1979/80	0.75	1.27	-0.52	0.83	1.26	-0.43
1980/81	0.46	1.01	-0.55	0.51	0.97	-0.46
1981/82	0.64	0.68	-0.04	0.66	0.64	+0.02
1982/83	0.70	0.97	-0.27	0.75	0.92	-0.17
1983/84	0.69	1.42	-0.73	0.74	1.42	-0.68
1984/85	0.93	1.48	-0.55	0.98	1.46	-0.48
1985/86	0.98	1.30	-0.32	1.06	1.27	-0.21
1986/87	0.82	0.60	+0.22	0.82	0.58	+0.24
1987/88	0.61	1.13	-0.52	0.56	1.05	-0.49
1988/89	0.56	1.01	-0.45	0.63	0.87	-0.24
1967–89	0.70	1.13	-0.42	0.72	1.07	-0.34

c = winter accumulation

a = summer ablation

b = net balance

In 1966 the Norwegian Polar Research Institute started mass balance measurements on Austre Brøggerbreen and a year later on Midtre Lovénbreen. The results are given in Table 1. Of the 22 years of measurements, only one year shows positive balance and two near equilibrium; the rest are negative. In order to check the mass balance measurements, photogrammetric maps have been constructed together with an accurate levelling of the ablation stakes. The measurements show that the mean loss of Brøggerbreen has been 0.40 m per year.

As mentioned above, all the glaciers in the area have decreased in the last hundred years. The climatic cause for this large shrinkage is not quite understood. Put simply, one could say that the glacier reacts to the variations of two parameters: winter precipitation and summer temperatures.

It is difficult to draw any conclusions from the meteorological observations from Spitsbergen. The measurements were started about eighty years ago. We have therefore no observations from a period with glacier increase. The summer temperatures are almost constant during the whole period, and the precipitation measurements are very problematic. Wind and snow drift make it



Fig. 4. Drawing from Kongsfjorden 1869. See page 56.



THE THREE CROWNS. KING'S BAY. SPITZBERGEN.
(A Midnight Sketch)

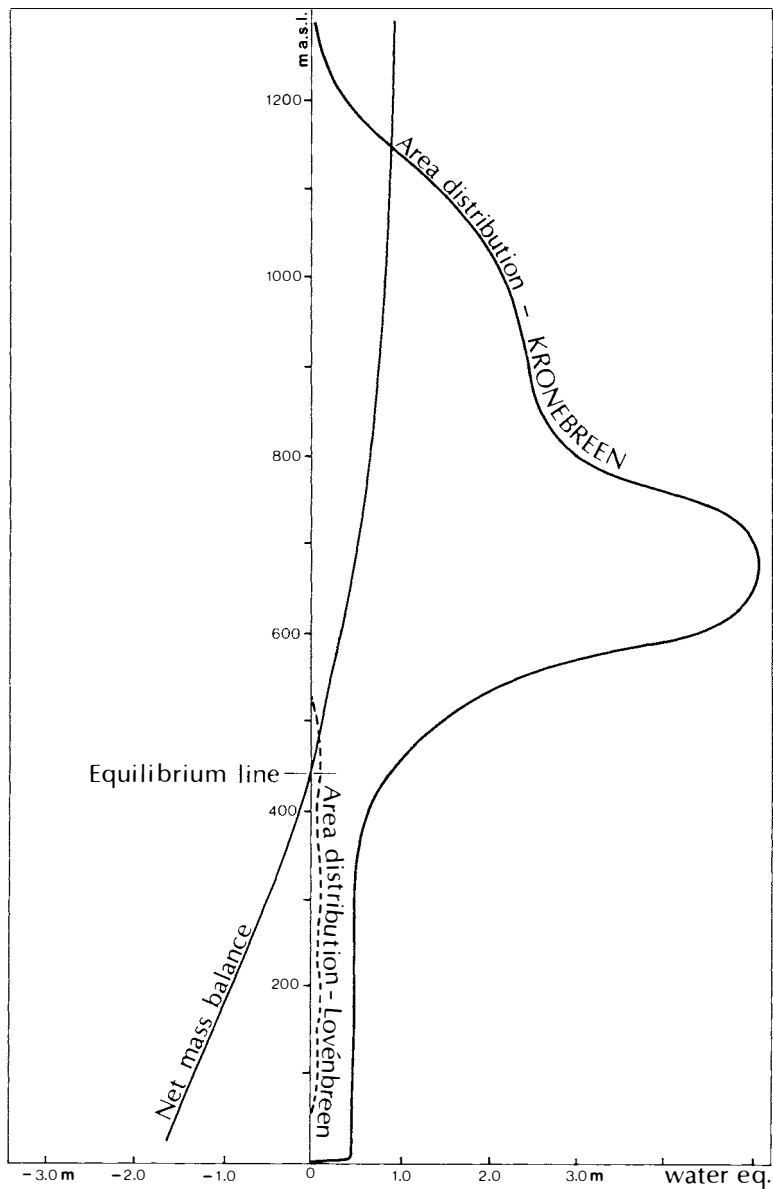


Fig. 5. Area distribution and mass balance with height of Kronebreen and Midre Lovénbreen.

almost impossible to get a true catch of the snow fall. In addition, the variation is large over short distances and height above sea level. If the temperature is the decisive factor, the summers have obviously been much colder in the last century than in this. The other possibility might be that the precipitation was higher, or of course a combination of fluctuation in both summer temperatures and winter precipitation. The mean equilibrium line during the last twenty years is

about 400 m above sea level at Brøgger- and Lovénbreen, which is about 100 m above a computed line that keeps the glaciers in balance. This balance could roughly be obtained with the summer temperature lowered by 0.5- 1.0°C, or by an about 50 per cent higher winter precipitation.

The area distribution curve in Fig. 5 shows that the main part of Kronebreen lies higher than 400 m above sea level. The ablation area is therefore too small to compensate for all the surplus mass transported from the higher part, and has to get rid of this extra ice mass by calving. Calculations show that Kronebreen needs a velocity of about 700 m a year at the front, and a corresponding calving rate to obtain balance. These calculations are based on uncertain mass balance data, especially the accumulation rate. Observations at Kongsvegen in 1987 could also indicate a higher equilibrium line in the eastern part of the Kongfjorden area than the measured height at the Brøgger- and Lovénbreen glaciers. It is likely, however, that a rise in the equilibrium line of 100 m caused by temperature increase, may have little influence on the mass balance of Kronebreen. A decrease in precipitation is therefore more likely, as this parameter would have more influence on the entire height interval.

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