NORSK POLARINSTITUTT

ÅRBOK 1960

NORSK POLARINSTITUTT
OSLO 1962

DET KONGELIGE DEPARTEMENT FOR INDUSTRI OG HÅNDVERK

NORSK POLARINSTITUTT

Observatoriegt. 1, Oslo, Norway

Short account of the publications of Norsk Polarinstitutt.

The two series, Norsk Polarinstitutt — SKRIFTER and Norsk Polarinstitutt — MEDDELELSER, were taken over from the institution Norges Svalbard- og Ishavs-undersøkelser (NSIU), which was incorporated in Norsk Polarinstitutt when this was founded in 1948. A third series, Norsk Polarinstitutt — ÅRBOK, is published with one volume per year.

SKRIFTER includes scientific papers, published in English, French or German. MEDDELELSER comprises shorter papers, often being reprints from other publications. They generally have a more popular form and are mostly published in Norwegian.

SKRIFTER has previously been published under various titles:

Nos. 1—11. Resultater av De norske statsunderstøttede Spitsbergen-ekspeditioner.
No. 12. Skrifter om Svalbard og Nordishavet.
Nos. 13—81. Skrifter om Svalbard og Ishavet.
» 82—89. Norges Svalbard- og Ishavs-undersøkelser. Skrifter.
» 90— . Norsk Polarinstitutt Skrifter.

In addition a special series is published: NORWEGIAN–BRITISH–SWEDISH ANTARCTIC EXPEDITION, 1949—52. SCIENTIFIC RESULTS. This series will comprise 6 volumes. Hitherto 20 papers have been published, and the series will probably be completed in 1963.

Topographic and hydrographic surveys make an important part of the work done by Norsk Polarinstitutt. A list of the published maps and charts is found on the back of SKRIFTER.

A complete list of publications (including maps and charts) is enclosed in SKRIFTER Nr. 123.

ÅRBØKER

1960 — Årbok. 1962. Kr.

NORSK POLARINSTITUTT

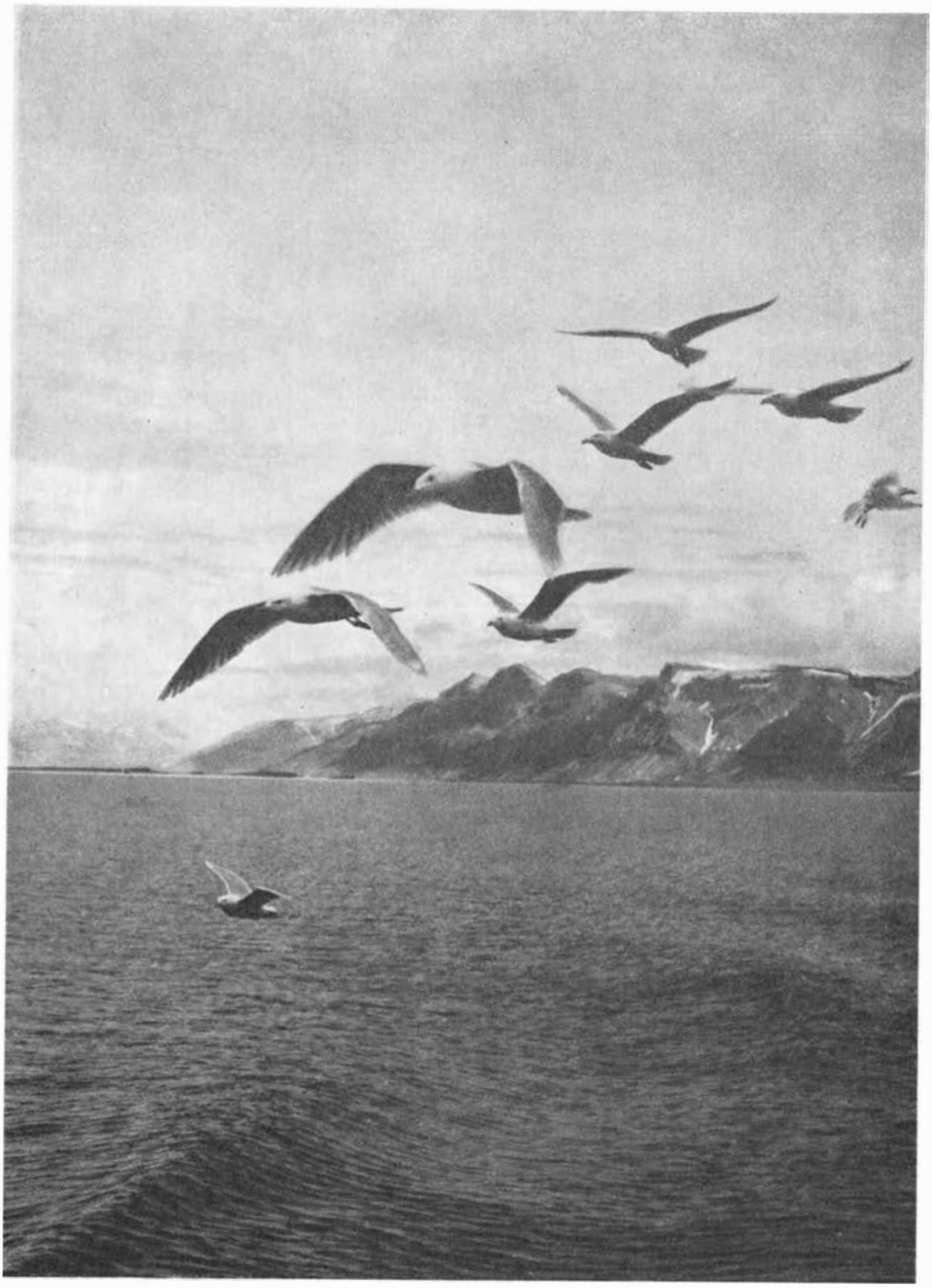
ÅRBOK 1960

NORSK POLARINSTITUTT
OSLO 1962

Printed March 1962

Utgitt ved: TORE GJELSVIK – direktør
Redigert av: NATASCHA HEINTZ

PUBLISHED BY NORSK POLARINSTITUTT
DISTRIBUTED BY OSLO UNIVERSITY PRESS
OSLO 1962



Ved munningen av Billefjorden, Vestspitsbergen. Foto: K. A. Edin.

Preface

With this volume Norsk Polarinstitutt initiates a new series of publications: ÅRBOK (Yearbook), in addition to SKRIFTER and MEDDELELSER. The purpose of this series is not only to give annual reports on the activities of the institute, but also to bring together information on the scientific work carried out by foreign expeditions in Norwegian Arctic and Antarctic territories.

Besides the annual report of the director and general information about Norsk Polarinstitutt, the ÅRBOK also will contain shorter scientific papers. In this respect it will be supplementary to some extent to MEDDELELSER without, however, superseding it. Although the main purpose is to present papers of the staff of the institute, students of polar matters are cordially invited to contribute. It is hoped that in this way Norsk Polarinstitutt, ÅRBOK, will promote the exchange of information among expeditions and scientists working in Svalbard, Jan Mayen and Dronning Maud Land.

TORE GJELSVIK
Director

Activities of Norsk Polarinstitutt*

BY

THORE S. WINSNES, SIGURD G. HELLE and TORE GJELSVIK

Abstract

Since 1906 Norwegian expeditions have gone to Svalbard nearly every summer (except during World War II), carrying out hydrographic, topographic and geological survey.

After establishment of Norwegian sovereignty in Svalbard through the international treaty of 1925, the institution Norges Svalbard- og Ishavs-undersøkelser (NSIU) (Norwegian explorations in Svalbard and the Polar Seas) was founded to continue the work of De Norske statsunderstøttede Spitsbergenekspeditioner (The Norwegian State-supported Spitsbergen Expeditions). The results were published in the series "SKRIFTER" (papers) and "MEDDELELSER" (communications). In 1948 the institution was reorganized and expanded under the name of Norsk Polarinstitutt.

The main activity has taken place on the island of Vestspitsbergen and the waters west of it. During the summers of 1936 and 1938 most of Svalbard was photographed from the air, and topographic maps in six colours at a scale of 1:100,000 are based on these photographs. Eight of these maps and fourten charts have been published.

The exploration of East Greenland was mainly carried out in the nineteenthirtieth, while mapping of Jan Mayen started in 1949. The work in Antarctica was taken up shortly after the reorganization of the institute in connection with the organization of the Norwegian-British-Swedish Antarctic Expedition, 1949–52, and was carried further by the Norwegian Antarctic Expedition, 1956–60.

The geological exploration has resulted in important paleontological and stratigraphical data being made evident, and large collections of fossils and rock specimens. Stress has been laid on the investigation of the Tertiary coal in Vestspitsbergen, which is mined in several places.

Glaciological research has been undertaken in Svalbard, Norway and Antarctica.

In addition, Norsk Polarinstitutt acts as an adviser to foreign expeditions, furnishing them with necessary maps, air photographs and information.

History

The scientific exploration of Svalbard started in 1827 when Professor B. M. KEILHAU, from the University in Christiania (Oslo), visited Bjørnøya (Bear Island) and Spitsbergen. Later followed a period of predominantly Swedish expeditions doing fundamental scientific exploration; but Norwegian sealing skippers also

* This article is a slightly modified and expanded version of a paper by THORE S. WINSNES: "Activities of Norsk Polarinstitutt (Norwegian Polar Institute) in Svalbard", appearing in "Geology of Arctic". Proceedings of the First International Symposium on Arctic Geology, University of Toronto Press, Toronto 1961.

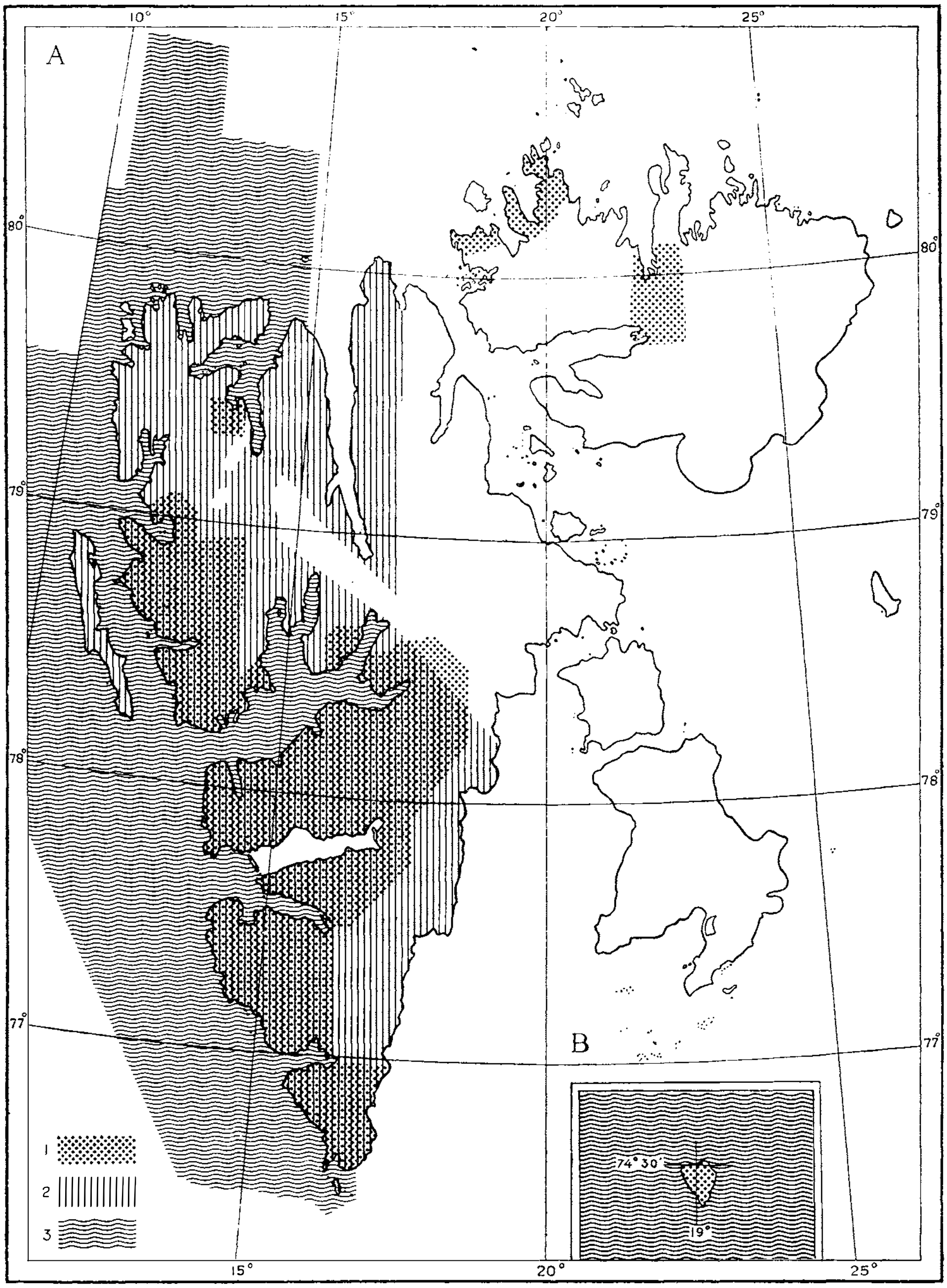


Fig. 1. *Map showing the areas in Svalbard that have been surveyed by Norsk Polarinstitutt and its predecessors:*
1. *Geological.* 2. *Topographical.* 3. *Hydrographical.*

made essential contributions to the exploration of Svalbard in those years, and in 1872 the first Norwegian oceanographic expedition was arranged, followed by two others in 1876 and 1878. In 1906 a new era in the Norwegian exploration of Svalbard began with an expedition, financed by Prince Albert of Monaco, that carried out topographical and geological exploration in the northwestern parts of Vestspitsbergen. The next year this work was continued, and as a result of the geological mapping, which showed a rich Downtonian and Devonian fauna in this area, an extensive Norwegian investigation of these formations was initiated. In the years 1909–15 and 1917–25, the Norwegian Government supported expeditions with grants and by making vessels available. Members of the expeditions were partly recruited from Government institutions. The mapping, charting, and geological surveying continued in these years. Botanical, zoological, and other investigations were also undertaken. The leader of the majority of these expeditions was ADOLF HOEL. The results of the expeditions were published in a series named: "Resultater av De Norske statsunderstøttede Spitsbergen-ekspeditioner" (Results of The Norwegian State-supported Spitsbergen Expeditions). In the period 1906–1926 a total of twenty-one Norwegian expeditions visited Svalbard.

In a treaty signed in Paris 1920 the sovereignty of Svalbard was assigned to Norway. On August 14, 1925, Norway officially took over its rights and duties. According to the treaty subjects of powers having signed the treaty enjoy the same rights in Svalbard as do the Norwegians.

In 1928 the institution "Norges Svalbard- og Ishavs-undersøkelser" (NSIU) (Norwegian explorations in Svalbard and the Polar Seas) was founded, coming within the Ministry of Commerce. The publication series changed its name to: "SKRIFTER om Svalbard og Ishavet" (Papers on Svalbard and the Polar Seas). In 1929 another series, "MEDDELELSER" (Communications) appeared, containing shorter papers of more popular character. Until 1961, 119 numbers of "SKRIFTER" and 86 of "MEDDELELSER" have been issued.

Initially, the staff of NSIU consisted of ADOLF HOEL, leader and geologist, GUNNAR HORN and ANDERS K. ORVIN, geologists, WILHELM SOLHEIM, BERNHARD LUNCKE and ALFRED KOLLER, topographers, and office personnel, ten to twelve in all. Already in the summer of 1928 the geologists and topographers that had joined the staff of NSIU went to Svalbard. They continued to do so nearly every summer, and before World War II eighteen expeditions were sent out. A hydrographic surveyor was added to the staff in 1929. In the same period twenty-four expeditions went to Northeast or Southeast Greenland, one to Davis Strait, and two to Frans Josefs Land.

Of course, the staff of the institute was not large enough to deal with all kinds of scientific problems, and from the very beginning co-operation was established with other institutions, such as the Geographical Survey of Norway, and various institutes of the University in Oslo.

In the years 1906–1926 the financial contributions to the Norwegian Svalbard expeditions amounted to 2.1 million N. kroner, 1.7 millions of which came from the Government, the rest from scientific funds, institutions, and private contributors. From 1928 to 1944 NSIU received 2.2 million kroner from the State, plus 160,000 kroner from funds and subscribers. The main part of this money was used for the scientific expeditions. During World War II the expedition activity was interrupted, to be taken up again in 1946. Dr. ANDERS K. ORVIN was then acting director of the institution.

In 1948 the institution was expanded under the name of Norsk Polarinstitutt. Professor Dr. HARALD U. SVERDRUP was appointed director and Dr. ANDERS K. ORVIN associate director. The other personnel consisted of one administration officer, two geologists, one glaciologist, two hydrographers, three topographers, one geodesist, one meteorologist, one librarian, two draftsmen and other office personnel, altogether twenty persons. After the death of Professor SVERDRUP in 1957, Dr. ORVIN was appointed director. When he retired in 1960, Dr. TORE GJELSVIK succeeded him.

The office of Norsk Polarinstitutt is in the old University Observatory, Observatoriegaten 1, Oslo, a building more than 100 years old, but plans for new, modern premises are well advanced.

The library contains about 15,000 volumes of polar literature and 7–8,000 papers, reprints and periodicals.

The activities of Norsk Polarinstitutt in the polar regions are restricted to certain fields of work because of the historical background, but apart from these, special funds can be used in other fields of investigation, such as ornithology, botany, Pleistocene geology, etc., and a number of expeditions in these fields have been financed by Norsk Polarinstitutt. The Svalbard expeditions from 1946 to 1959 have totalled seventy-nine field parties.

The ordinary budget of Norsk Polarinstitutt now averages about 1 million kroner annually, and is used for work in the Arctic region only. In the periods 1949–52, and 1956–60, when the institute maintained expeditions in Antarctica, the Government provided extra funds.

Organization of the expeditions

Summer expeditions to Svalbard and Jan Mayen

Each expedition consists of a number of independent field parties with one leader and two or three assistants. The field parties are now fitted with tents, food for the summer in standard crates, and a boat of about 17 feet with an outboard motor of 5 H. P., and other equipment (Fig. 2). The boat is a dory which, because of its steadiness and flat bottom, can be landed everywhere and pulled up onto the shore with a pulley. In this way the field parties are able to go along the coast and cover large stretches of land. For inland journeys smaller tents, manhauled sledges, skis and special food are being used. Radio telephones and field radio sets are used for internal and external communication.

For transportation of people and equipment from Norway a vessel of the necessary size is chartered (Fig. 3). From this vessel the field parties are landed at their working places and, if necessary, during the summer moved over larger distances. During the stay in Svalbard the ship is used for the hydrographic survey. The expeditions depart in this ship from Åndalsnes in western Norway in mid-June, and return in the beginning of September.

Although it is expected in the near future to employ more modern transportation means such as helicopters in order to speed up the field work, the traditional procedure will still be honoured, as it has proved very useful and safe. During a

Fig. 2. *A 17-foot dory equipped with outboard motor is used by the field parties.* (Photo: H. MAJOR)

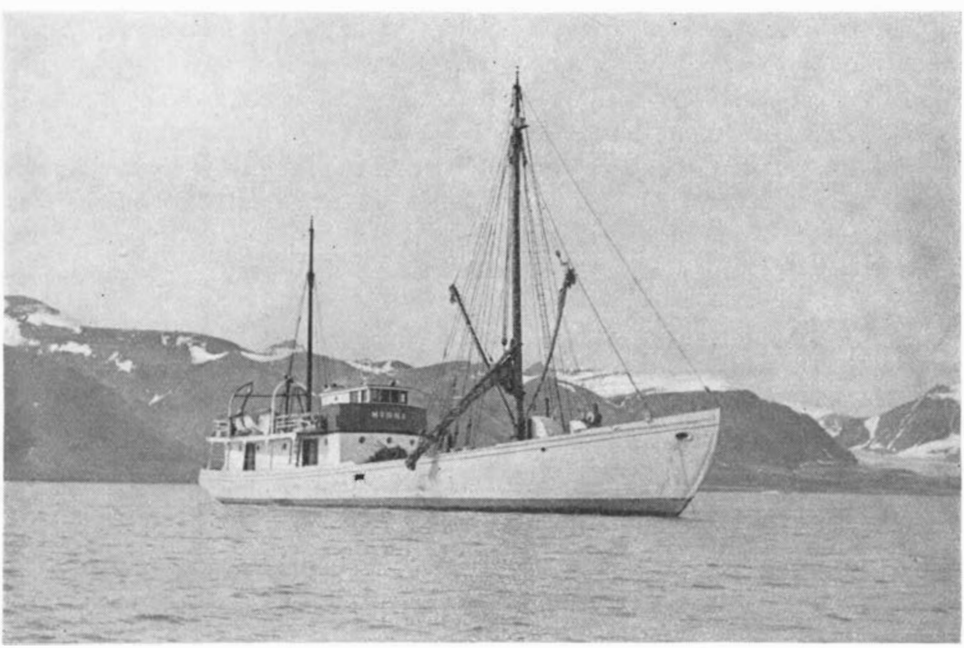


Fig. 3. *The expedition ship used from 1946 to 1959 was a former Nova Scotia schooner of 135 gross tons and 115 feet long.* (Photo: L. PEDERSEN)

period of more than fifty years, neither fatal accidents nor loss of valuable property occurred on any expedition in Arctic waters sent out by Norsk Polarinstitutt or its forerunners.

Expeditions to Antarctica

In connection with the reorganization in 1948 the institute was given responsibility for exploration of the Norwegian territories in the Antarctic region also. Accordingly, the institute took part in the planning of The Norwegian-British-Swedish Antarctic Expedition, 1949–52, to Maudheim in Dronning Maud Land, which was headed by the administration officer of the institute, Captain JOHN GIÆVER. The institute was particularly responsible for the logistic support of the expedition.

The institute also organized and sent out The Norwegian Antarctic Expedition, 1956–60, to Norway Station in Dronning Maud Land. The expedition was organized in connection with I. G. Y. and headed by another staff member, geodesist SIGURD G. HELLE. As a part of the expedition, an air photogrammetric party, headed by chief topographer of the institute, BERNHARD LUNCKE, with airplanes and crew from the Royal Norwegian Air Force, covered the central parts of the mountain range in Dronning Maud Land in the austral summer of 1958–59.

Account of the work

Hydrographic survey and geomagnetic observations

The hydrographic survey is carried out from a chartered vessel in the open sea, and by a boat-party operating in coastal waters, fjords, and harbours. The vessel is usually a sealer of a little more than 100 feet of length. The boat is 30 feet long and is equipped with a diesel engine of 20 H. P. The boat-party also undertakes tidal observations. The vessel operates off the coast as far as reliable positions are obtainable by angle measurements. However, the work is much hampered by fog and low clouds. During the years between World War I and II, the Bjørnøya waters and the west coast of Vestspitsbergen were charted, and a pilot for the Bjørnøya waters has been produced. In post-war years a number of harbours and the coastal waters in the northwestern part of Vestspitsbergen have been charted (Fig. 1).

Outside Svalbard the waters surrounding the island of Jan Mayen have been surveyed in the course of four summers. Also the East Greenland waters have to a considerable extent been hydrographically surveyed.

As a result of the hydrographic surveys up to recent, fourteen charts have been published.

In 1957 and 1958 geomagnetic observations were carried out at eighty-five stations in Svalbard.

Leader of the hydrographic work is KAARE Z. LUNDQUIST, who also has acted as leader of the Svalbard expeditions since 1947.

Topographic and geodetic survey

The older maps of Svalbard were based mainly on terrestrial photogrammetric methods of measurement and triangulation. In 1936 and 1938, however, most of Svalbard was photographed from the air, and about 5,500 photographs 18 × 18 cm were taken with a Zeiss RMK camera with a focal length of 21 cm. The

Fig. 4. *Krossfjorden (79° N – 11° 30′ E) at the west coast of Vestspitsbergen. One of about 5,500 18 × 18 cm oblique air photographs of Svalbard.* (Photo: B. LUNCKE)

photographs were taken obliquely in order to have a considerably larger area covered by a stereoscopic pair (Fig. 4). In later years vertical photographs have been taken to fill in gaps in the earlier work and to get a more up-to-date record of the glacier fronts.

The maps are constructed on aluminium plates at a scale of 1:50,000 with contour lines at 50 m intervals. They are published at 1:100,000 in six colours. There will be approximately thirty sheets covering Vestspitsbergen, the largest island of Svalbard. Eight of these sheets have been published so far, and one is in print. A general map in four sheets, at the scale of 1:500,000, covering all the islands of Svalbard is under way. In this map construction, results of surveys made by foreign, mostly English, expeditions are also incorporated.

The geodetic survey consists of determination of astrofixes, base measurements and triangulations. Tidal measurements have been carried out over a period of thirty days or more, to determine the mean sea level, from which all heights on land are measured. Since the summer of 1959 a tellurometer set is used to obtain larger base lines.

In 1959 two sheets at the scale of 1:50,000, covering Jan Mayen were issued. Four maps from East Greenland have been published. Several sheets at the scale of 1:250,000, covering coastal areas and mountainous inland areas in Dronning

Maud Land, Antarctica, will be published. They are based on ground control points and constructed from oblique air photographs.

Leader of the topographic works is BERNHARD LUNCKE.

Geological survey

The geology of Svalbard is most interesting because of the presence of rocks from nearly all the geological periods. The sedimentary sequence from the Upper Silurian to the Tertiary contains a vast number of fossils, telling about the geological history of Svalbard. In these sediments, especially from the earlier part of the Tertiary period, most of the coal seams worked today are found.

Norsk Polarinstitutt is charged with the task of making geological and paleontological investigations and geological mapping (Fig. 1). Special stress has been laid upon the examination of the coal deposits, both on Bjørnøya and in Vestspitsbergen, although lately only in the latter area. There is still extensive and protracted geological work to be carried out in Svalbard. With the new maps and aerial photographs, conditions for detailed geological investigation are much more favourable than was the case in the pioneer time, when few maps existed. Extensive work has been done on stratigraphy and paleontology, and rock specimens have been collected from all over the archipelago. The collections have been studied at the institute, or by other specialists in Norway and other countries.

With regard to the geological mapping, quite extensive material is available in drafts, either drawn directly on maps or redrawn on the new topographical maps, and it is planned soon to start publication of geological maps at a scale of 1:100,000.

After the war coal investigations have been carried out in the area between Isfjorden and Van Mijenfjorden. As a result of these investigations a fairly good knowledge of the various coal strata and their relationship in this area has been obtained. Some drilling has been done by the coal companies as well. However, still a good deal remains to be done to get a more intimate knowledge of the coal reserves in this region. A more particular branch of study has also been the investigation of spores and pollen.

Investigations on the older metamorphic rocks, the Hecla Hoek sequence along the west coast of Vestspitsbergen, were started in 1952 in the southernmost part, and will be continued northwards north of Isfjorden. The findings in 1952 and later on, of Cambrian and Ordovician fossils, now permit a clearer understanding of the stratigraphy. Special investigations of the microfauna of the Carboniferous and Permian sediments are also being carried out.

A third geologist, working in the field of petrography and mineralogy, was engaged in 1960.

Glaciological investigations

The glaciological work in Svalbard includes i. a. to keep a continuous record of the fronts of the various glaciers by examining older maps and photographs and later series of aerial photographs. Thus the peculiar behaviour of cold glaciers is studied.

In the southern part of Vestspitsbergen a glacier with a well defined accumulation area, Finsterwalderbreen, has been selected for a special study. Every second year accumulation and ablation is measured during the summer, and glacier flow is recorded. Meteorological observations are taken, and by means of thermistors at different depths the inner temperature is examined. Important contributions to the knowledge of glaciers are gained.

Glaciers in the mainland of Norway are also studied. Here two glaciers are selected for special investigations. On Storbreen in Jotunheimen are carried out measurements of the regime as well as the recording of meteorological factors involved in ablation. On Nigardsbreen, an outlet glacier of Jostedalsbreen, the work is mainly concentrated on flow measurements. In addition, the retreats and advances of some thirty glaciers are measured.

Meteorological investigations

The meteorological section has mainly been occupied with the analysis of observations from Maudheim and Norway Station in Dronning Maud Land. The working out of the data from the former station is nearly finished. Besides, the institute is responsible for the meteorological stations on board the Norwegian whaling factory ships. After each season microfilms containing the observations from these ships are sent to institutions interested.

Other works

As early as in 1932 a lighthouse and two lanterns were erected at Isfjorden under the direction of Norges Svalbard- og Ishavs-undersøkelser. During World War II they were demolished, and the Government asked NSIU to rebuild and extend navigational aids in Svalbard. From 1946 on a total of eleven lighthouses and four radio beacons in addition to one land radar station have been erected and are maintained by Norsk Polarinstitutt.

Assistance with regard to transportation of other Norwegian and foreign expeditions is regularly rendered.

The expedition members of Norsk Polarinstitutt have also to make many observations outside of their special working fields, such as taking notes on the wild life, flora, etc.

Geographical names in Svalbard have been given by expeditions from a number of countries, and thus the naming was far from satisfactory as to uniformity. To bring about order in this chaos of place-names about 360 maps and 500 books have been examined. More than 10,000 place-names were investigated. However, only about 3,300 of them were officially recognized. On more recent maps many new names have been added. Dr. A. K. Orvin has been in charge of this important task.

Considerable work is done by the institute in its advisory activity to other Svalbard expeditions, such as supplying them with adequate maps and photographs, and giving information on local conditions.

In 1960 the institute took part in the organization of the XXI International Geological Congress as well as the XIX International Geographical Congress, i. a. by arranging excursions in Svalbard.

The institute is an information centre in Norway on polar matters and is extensively used by newspapers, radio corporations, printing houses, government agencies, schools and others.

Footprints of Dinosaur in the Lower Cretaceous of Vestspitsbergen - Svalbard

BY

ALBERT F. DE LAPPARENT

Contents

Abstract

Thirteen tridactylous footprints of a large dinosaur were found on a vertical slab at Festningen during an excursion to Spitsbergen, organized under the leadership of Prof. Dr. A. HEINTZ and Mr. TH. WINSNES, before the meeting of the XXI International Geological Congress. The sandstone slab may be considered to correspond to the Wealden, i. e. the continental Lower Cretaceous. The author believes that these tracks must have been made by a large Iguanodon, such as for instance *Iguanodon bernissartensis*.

This discovery proves that Cretaceous dinosaurs occurred as far north as the 78° N, and that the range of the European genus *Iguanodon* extends right up to Spitsbergen.

Résumé

Une dalle gréseuse portant treize empreintes de pas tridactyles fut découverte sous le signal de Festningsodden, à l'angle du Grønfjord et de l'Isfjord, au cours de l'excursion au Spitzberg du XXI^{ème} Congrès géologique international. Le grès, portant aussi des traces de sol de végétation, est compris entre du Valanginien supérieur marin et de l'Aptien marin. Il correspond donc à du "Wealdien", et même plus précisément a du Barrémien continental. Les couches ont été redressées à la verticale par les plissements tertiaires.

Les empreintes de pas, atteignant 68 cm, sont dues à un très grand Dinosaurien bipède. On incline à les attribuer à un grand Iguanodon, de la taille de *Iguanodon bernissartensis*.

Ainsi, les Dinosauriens crétacés sont désormais reconnus par plus de 78° de latitude Nord et l'aire de répartition des Iguanodons se trouve du même coup fortement agrandie.

Before the meeting of the XXI International Geological Congress, Norden 1960, a geological excursion to Spitsbergen (No. A 16) was organized under the leadership of Prof. Dr. ANATOL HEINTZ and geologist THORE S. WINSNES, with the assistance of Dr. K. BIRKENMAYER. Cand. real. NATASCHA HEINTZ was in charge of the organization of the expedition.

The geologists, who were staying on board the ship "Valkyrien", each day went ashore and visited a series of localities of special interest both as to stratigraphy and palaeontolgy (WINSNES, TH. S., A. HEINTZ and N. HEINTZ, 1960).

The locality and the discovery

On 3rd August 1960 we disembarked at the mouth of Grønfjorden, in Isfjorden (long. 13° 57′ E; lat. 78° 06′ N)[1]. We set off on foot, intending to examine the fine continuous Festningen section from the Carboniferous to the Eocene (Fig. 1; cf. HOEL and ORVIN, 1937). Commencing from the Carboniferous and progressing stratum by stratum along the coast, we reached the Lower Cretaceous at Festningen by the evening.

From the Festningsodden beacon, placed on a vertical sandstone wall, the author decided to climb down the cliff, in order to examine the continental sediments. Reaching the shore with ROBERT LAFFITTE, we found ourselves at the foot of a high sandstone slab. On this we suddenly saw some very large footprints, probably those of a giant bipedal dinosaur. Most of the geologists taking part in the excursion overtook us and admired these impressive marks.

As this discovery was entirely unexpected, we were unable to make castings. Nor was it possible to remove a piece of the huge slab. We did not even have a piece of chalk, to show up the outlines of the prints. Faced with these problems Mr. LAFFITTE suggested using pebbles covered with a desiccated *Lithothamnium* crust, which he picked up on the spot. These made a sufficiently distinct trace on the rock. A number of photographs were taken in spite of unfavourable light conditions and the author is most grateful to Miss RUTH FRIDMAN, Mr. ROBERT LAFFITTE and Mr. ROBERT MICHEL for the photographs they have placed at his disposal.

After having measured the footmarks and made sketches, we were obliged to leave, as the "Valkyrien" was waiting to depart for Longyearbyen.

After the Congress-excursion had left Spitsbergen, Dr. E. F. ESCHER, originally a member of the excursion, with his assistants Messrs. J. P. COPPONEX, J. F. HENRIKSEN and T. SÆTRE, visited twice the dinosaur locality and re-examined the slab and its prolongation, but did not discover any new footprints. During the second visit on 12th August the weather conditions were excellent and they were fortunate enough to take a number of good photographs (Pl. III, 1–2) which they kindly placed at the author's disposal.

A short telegram on the find was sent from the ship on 4th August and the news were broadcasted throughout Europe and mentioned in different newspapers. Upon return to France, the author gave a more scientific announcement of the discovery in communication to the "Académie des Sciences" (LAPPARENT, 1960 b).

[1] See: Topografisk kart over Svalbard. Isfjorden, Blad B 9, 1:100,000. 1955.

Stratigraphical notes

The Cretaceous deposits of the Festningen section have previously been described in detail (SOKOLOV and BODYLEVSKI, 1931, FREBOLD und STOLL, 1937, HOEL and ORVIN, 1937). But the dinosaur footprints were not discovered perhaps as the impression may not have been exposed at all at that time, as the slab containing the footprints may only recently have become visible as a result of a landslide, the slab surface is namely still fresh and we may assume that the slab cannot have been exposed for long.

The continental Cretaceous deposits where the dinosaur tracks are found lay between two marine sequences (HOEL and ORVIN, 1937). All beds in Festningen section are placed nearly vertical as a result of folding, and the three main stratigraphical divisions of Cretaceous – A, B and C can easily be studied going from west to east along the shore (Fig. 1).

Division A belongs according to fossils to marine pelagic *Upper Valanginian* and is composed by c. 230 metres of black shales with limestone concretions. The partly abundant fossils are characteristic of the Arctic Valanginian (*Polypty-*

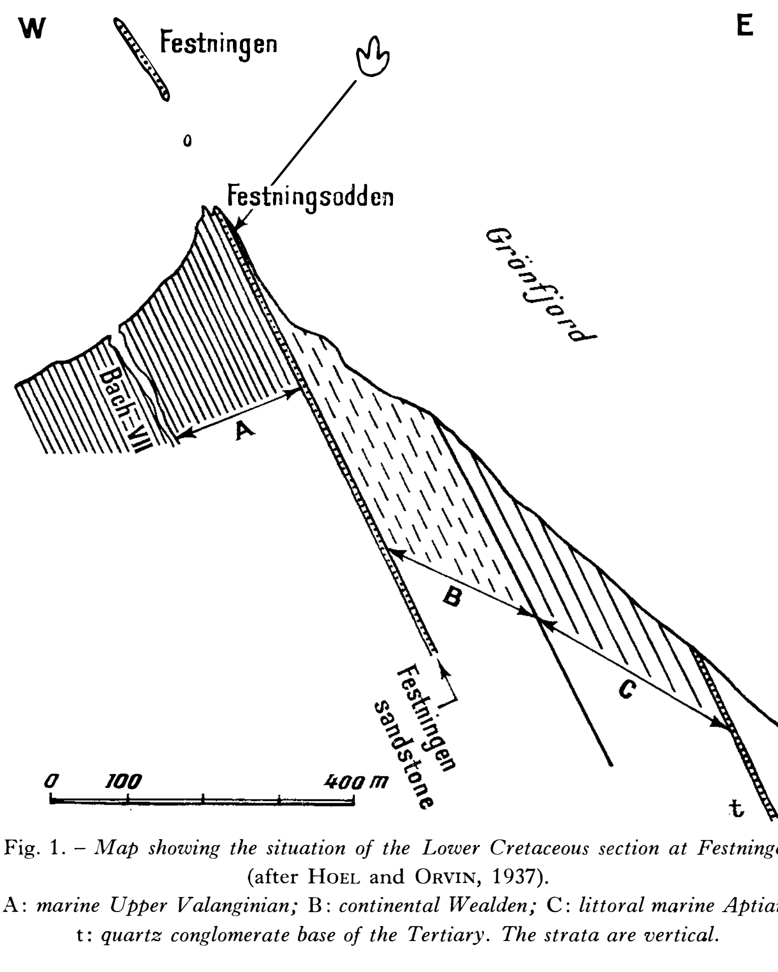


Fig. 1. – *Map showing the situation of the Lower Cretaceous section at Festningen* (after HOEL and ORVIN, 1937).
A: *marine Upper Valanginian;* B: *continental Wealden;* C: *littoral marine Aptian;* t: *quartz conglomerate base of the Tertiary. The strata are vertical.*

chites perovalis KOENEN, *P. hoeli* FREB., *Olcostephanus beani* PAVL., *Aucella sublaevis* KEYS., *A. contorta* PAVL., *A. terebratuloides* LAH., *A. keiserlingi* LAH. n. o. HOEL and ORVIN, 1937). The last metres of black shales with large concretions contain still a marine fauna, but not characteristic of any definite stratigraphical level (*Arca nana* D'ORB., *Leda seeleyi* GARDN., *Ditrupa decorata* STOLLEY, etc.).

Division B belongs to *continental Wealden.* It first consists of hard "Festningen-sandstone" – 3.55 m thick, which builds a pair of islets where it extends into the sea and forms a wall along the southwest shore of Grønfjorden (Pl. I, 1). The basal part of this deposit is a coarse sandstone or even a gravel with pebbles of slightly ferruginous quartz. Then follows finer grey sandstone containing some argillaceous substance. Festningen-sandstone contains no fossils, but is covered by a shale-sandstone about 125 m thick with fossil plants (*Elatides curvifolia* DKR., *Cladophlebis* sp., *Pityophyllum* sp., *Gingko* sp., etc.) described by NATHORST (1913).

The slab containing the footprints constitutes the last stratum of the Festningen sandstone. The exposed portion forms a smooth surface of about 7 × 5 metres. Parts of the surface show faint ripple marks and the numerous root holes seem to indicate a marshy soil with vegetation.

Division C belongs to *littoral marine Aptian.* From a certain horizon (No. 32), but without any sharp limit, some marine fossils (*Crioceras gracile* SINZOW, *Leda angulostriata* BODYL., *L. Mariae* D'ORB., *Pecten orbicularis* D'ORB., *Ditrupa notabilis* SINZ., etc. HOEL and ORVIN, 1937) appear in the shaly sandstone together with fragments of plants. This indicates a very littoral formation. The corresponding marine fossils are known from Aptian in Russia and Greenland. The whole shaly sandstone is about 245 m thick and is overlapped by a quartz conglomerate regarded as the basis of Tertiary.

As we have thus seen, between the fossiliferous marine Valanginian and Aptian deposits in Festningen-section, lay the continental division B without characteristic fossils. It must naturally correspond to the Hauterivian or Barremian. If we assume that it was a sufficient hiatus between the Upper Valanginian and the deposition of Festningen-sandstone, it is reasonable to assume that division B must mainly correspond to the Barremian. Then it is equivalent to a part of the Wealden, viz. the continental Lower Cretaceous in Europe. In Spitsbergen, as in the Wealden of Great Britain, this formation precedes the deposition of marine Aptian.

Ichnological note

Description of the traces

Ichnology is, as known, a section of palaeontology which deals with footprints of vertebrates (LULL, 1953; MURIE, 1954).

The footprints occur, however, only rarely as the probability for them to be preserved through the consolidation of the soft sediments is extremely small. Nevertheless the study of the footprints is of great interest as only a few traces can give much information about extinct animals.

Most footprints known from the Mesozoic strata are those of dinosaurs – i. e. terrestrial reptiles that mostly lived in swampy regions.

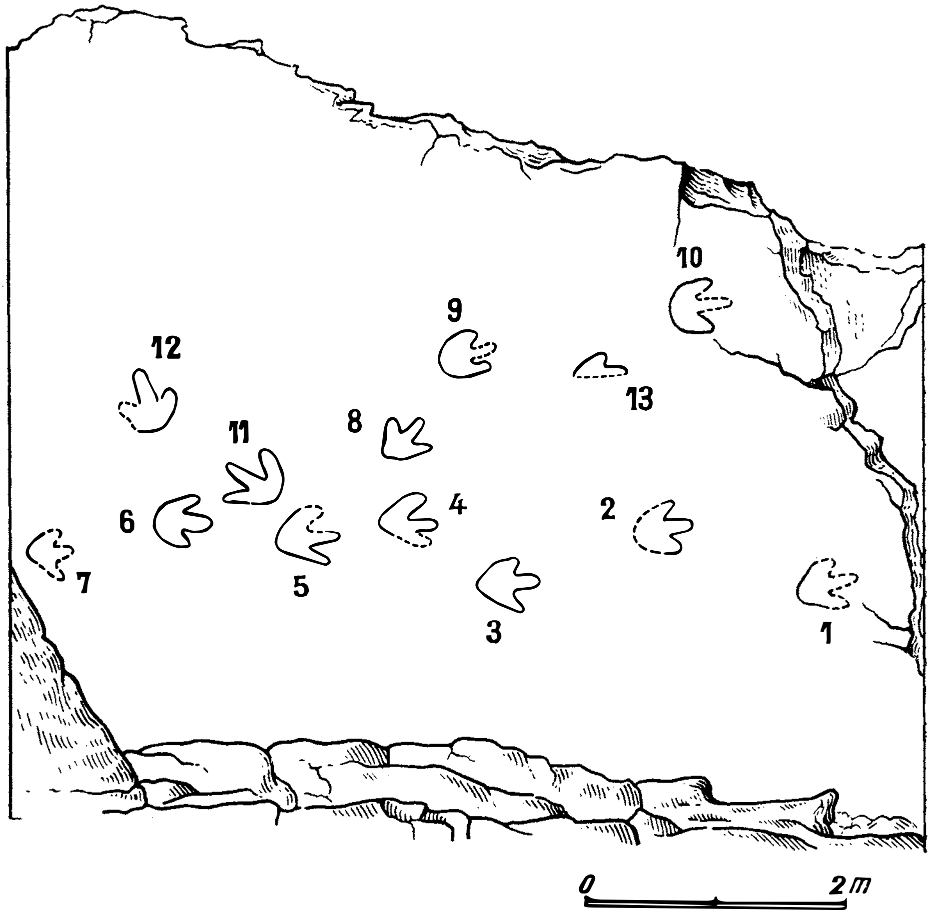


Fig. 2. – *Plan of footprints on the sandstone slab at Festningen.*

The Spitsbergen footprints are left by an animal walking across soft ground. No counterprints were found as the layer which covered the deposits with footprints had been probably recently destroyed by waves. Using the proper implements it should, however, probably be possible to remove some few slabs to the south and thus uncover new tracks and get both prints and counterprints.

The Festningen footprints are tridactylous and have been made by bipeds; they certainly indicate an animal of immense size.

The drawing on Fig. 2 should make the description easier to follow.

First, seven footprints forming track A can be identified. The animal that made them was walking from left to right.

No. 1: Right foot, incomplete print. No. 2: Left foot, impression only left by toes II and III. No. 3: Right foot, the finest and most distinct print of the lot; total length from the heel to the middle toe, 68 cm; maximum width between the extremities of the two lateral toes, 60 cm; depth of the impression from 2 to 3 cm. No. 4: Left foot, poorly preserved print. No. 5: Right foot. No. 6: Left foot, very distinct print, the dimensions of which are the same as those of No. 3. No. 7: Right foot, poorly preserved impression. Other footmarks of the same track are probably hidden further to the left under the strata which here cover the slab containing the imprints.

The distance between two footprints on the same side is not constant. There are more than 2 metres between impressions Nos. 3 and 1 (Pl. II, 4), whereas between the rest, there are from 1.50 to 1.80 m. This suggests that the animal had an irregular gait.

Track B shows two prints, which clearly can be seen from above as well as from the right (Nos. 9 and 10). Both are probably from a left foot. The stride measures 1.70 m and the size of the prints is about the same as those of track A. Another poorly preserved footprint (No. 13) can be seen between impressions Nos. 9 and 10 (Pl. III, 1).

In addition, three isolated footprints which have no connection with the tracks can also be seen. Print No. 8 is very distinct and deeply impressed in the sediment. It is smaller than the former footmarks and has probably been made by a younger animal. Prints Nos. 11 and 12 on the other hand, are very shallow, so that the author did not notice them at all on the day the discovery was made. This was probably due to the unfavourable light conditions. They show up very clearly, however, in Dr. ESCHER's colour photographs and in the black and white ones taken by J. F. HENRIKSEN (Pl. III, 1). Both were of approximately the same size as the footprints of tracks A and B.

The tracks do not intercross at all, so that it cannot be determined which one was made first. Footmark No. 8, which is deeply imprinted in a soft sediment, must have been made before the neighbouring marks Nos. 11 and 12, as these are less distinct, the sediment already having been in the process of consolidation.

No tail trace is visible. The author did not see any desiccation cracks on the slab, which seems quite reasonable, as the original sandy sediment would not crack upon being consolidated. There are faint, though nevertheless definite, ripple marks on the top of the sandstone slab (Pl. I, 2).

No explanation has been found to the linear marks visible on all the photographs. It is impossible to say whether they are genuine traces of invertebrates or merely mechanical phenomena.

Interpretation of the footprints

The Spitsbergen tracks are definitely those of dinosaurs. Among these animals, the bipedal type with three-toed hind feet, is found in two quite different groups, the Theropoda and the Ornithopoda.

Of the Theropoda, the Coelurosauria may be excluded. These slenderly built animals were of a comparatively modest size, with hollow and slender bones and feet with lithe and extremely elongated toes.

The large carnivorous Theropoda, called Carnosauria, on the other hand, had limbs with three powerful toes. On finding the footprints at Festningen, we first believed them to belong to the Carnosauria. This was also the opinion of Dr. JOSEPH T. GREGORY, as they reminded him of the large Theropoda from America, such as *Tyrannosaurus* or *Gorgosaurus*.

At Festningen, however, the author found no trace of the sharp claws which are so characteristic of the Carnosaurian foot. On the contrary the imprints of the toes were rounded, specially the middle toe (Pl. II, 4). In this aspect the footprints show a closer resemblance to an Ornithopodous foot, as for instance that of the *Iguanodon* of Bernissart, the toes of which end in a flattened phalanx. Besides, a Theropodous footprint would be proportionally narrower. A comparison between the skeleton of the foot of *Iguanodon bernissartensis* (CASIER, 1960, Pl. XVIII, Fig. 4) and that of the Carnosauria *Allosaurus fragilis* (MARSH, 1896, Pl. XI, Fig. 2) and *Gorgosaurus libratus* (LAMBE, 1917, Fig. 49) points towards the footprints at Festningen belonging to an *Iguanodon*.

Indeed, the foot bones of *Iguanodon bernissartensis* reach a length of 50 cm, with a distance of 60 cm between the two extremities of the lateral toes. When flesh and skin are taken into account, such a foot could well produce marks like those at Festningen. Moreover, a certain expansion of the imprint is inevitable when the animal rested and put all its weight down on the soft sediment.

In the "Institut royal des Sciences naturelles" at Brussels it is preserved a not especially good cast of a Tridactylous dinosaur footprint from Hannover, determined by DOLLO (1883) as belonging to *Iguanodon*. As a matter of fact, however, the Hannover footprints, which are only 40 cm long and 35 cm wide, are too small and narrow to be made by an *Iguanodon*.

The author supposes thus that the Festningen footprints in all probability have been made by *Iguanodon bernissartensis* or by a near related form.

Significance of the discovery

The discovery of dinosaur footprints on Spitsbergen is interesting from several points of view.

Firstly, it increases the number of localities where such imprints have been found. As the geological knowledge of all parts of the world increases, the discovery of imprints are being more and more frequently reported. The Spitsbergen locality will be the twenty-seventh or the twenty-eight. This unexpected discovery shows that the more heed is paid to the possibility of finding such fossil traces in the Mesozoic strata, the greater is the chance of coming across them.

This discovery also extends the range of Cretaceous dinosaurs further northwards. They are known in England and in Germany as far north as the 52nd parallel.[1] In Canada, footprints described by STERNBERG (1930) near the 56° were regarded as "the most northerly dinosaur tracks". Now they have been found as far north as the 78° on Spitsbergen.

From this the conclusion may be drawn that continental Wealden formations covered a widespread area during the Lower Cretaceous. Not only the same flora, but also the same reptiles seem to have occurred all over the area with analogous facies. This is new evidence of a zone of uniform tropical climate, reaching from the tropics right up to Spitsbergen in the beginning of Cretaceous times, although this is a circumstance which is most difficult to explain.

[1] Professor I. HESSLAND has informed the author that dinosaur footprints have been identified in Scania, South Sweden (BÖLAU, 1953); this layer, however, is older and is conferred to the Rhetian.

After the first *Iguanodon* discoveries in Great Britain and Belgium the palaeontologists believed that they only occurred in western Europe. This genus of dinosaurs has namely never been found in America or other parts of the world. Recently, however, traces of these animals have been found in Mongolia and China. During the prospecting in Africa the author has come across a tooth of *Iguanodon* in southern Tunisia (LAPPARENT, 1951, 1960a). And now in the last summer the author made the discovery of *Iguanodon* footprints on Spitsbergen. In both last cases the *Iguanodon* remains and traces were found in continental sediments of Lower Cretaceous age.

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Gigantaspis - a new genus of fam. Pteraspidae from Spitsbergen

A preliminary note

BY

NATASCHA HEINTZ

Abstract

The genus *Gigantaspis* – previously only once briefly mentioned by KIÆR – is described and depicted. Its relation to other pteraspids is discussed and the opinion is put forward that *Gigantaspis,* owing to the absence of cornual plates, the branchial openings being posteriorly situated, and the long orbital plates forming a transverse ridge together with the rectangular pineal plate, shows a closer relationship to the genus *Protaspis* than to any other pteraspids.

Two species of this genus, viz. *G. isachseni* and *G. bocki,* are depicted and preliminarly described and their mutual relationship is discussed.

Norwegian and foreign expeditions to Spitsbergen have in the course of the years collected quite a large amount of Heterostracian fishes, including i. a. several different types of the family *Pteraspidae.*

These collections were first studied by J. KIÆR, who mainly concentrated on the *Cyathaspids.* However, among his posthumous papers were several notes dealing with the *Pteraspidae.* Along with a number of new species of the genus *Pteraspis* KIÆR also recorded two new genera, which he named *Gigantaspis* and *Doryaspis.* In the preliminary diagnosis for *Gigantaspis* KIÆR says i. a.: "The ventral disc very large, up to 20 cm long, strongly vaulted, posteriorly pointed. Dorsal disc flatter, some shorter, up to 17 cm long. Rostral plate broad, pointed anteriorly, about 8 cm long. The dentin ornamentation fine".

As FØYN and HEINTZ (1943) and DINELEY (1960) point out the large discs of *Gigantaspis* with their fine, smooth and even dentin ridges are very characteristic of the Kapp Kjeldsen Division of the Wood Bay Series, and can be considered as quite a good guide fossil for this division. However, specimens of this genus have also been recorded from the lowermost part of Lykta Division, though they are not very common there.

Until quite recently only separate plates (mainly dorsal and ventral discs and some rostral plates) have been known of *Gigantaspis,* which has made it rather difficult to compare this genus with other Pteraspidian fishes. In 1956 H. MAJOR, geologist of Norsk Polarinstitutt's expedition to Svalbard, found a complete dorsal shield of this genus in the talus at the bottom of Bockfjorden in the north of Vestspitsbergen. The complete outline of the dorsal shield of this specimen was preserved, including the eye-notches and one branchial opening. (Pl. I, B. Fig. 1.)

The find of an almost complete dorsal shield of *Gigantaspis* points towards this genus being quite closely related to the genus *Protaspis,* of which several species have been found in North America and one in Polodien, Poland. This interesting fact, in the opinion of the author, justifies a preliminary note on this genus, until further investigations have been made.

Gigantaspis gen. nov. (Kiær (MS)) (Pl. I, A, B, C, D. Fig. 1)

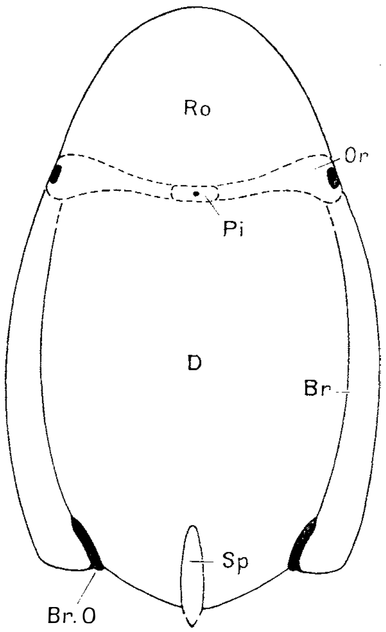
Diagnosis: Very large pteraspids with oval, slightly vaulted dorsal discs and medium-sized, median-dorsal spine inserted in the hinder margin of the disc. Long, narrow branchial plates extend from the orbital plates to the posterior rim of the dorsal disc. Branchial openings situated posteriorly between the branchial plate and dorsal disc, and opening upwards. No cornual plate. Orbital and pineal plates long and slender, forming a complete ridge that separates the dorsal disc from the broad, anteriorly pointed rostral plate. Ventral disc oval, strongly vaulted and posteriorly somewhat pointed. Dentin ridges very fine, smooth and entire. Plates rather thin, but all three layers clearly developed.

Genotype: *G. isachseni* sp. nov. (Kiær (MS)). (Pl. I, A, C). Kapp Kjeldsen Division, Wood Bay Series (Lower Devonian), Vestspitsbergen.

Species: *G. bocki* sp. nov. (Pl. I, B. Fig. 1). Kapp Kjeldsen Division, Wood Bay Series (Lower Devonian), Vestspitsbergen.

Discussion: In the diagnosis for the fam. *Pteraspidae* White (1935) i. a. says: "Heterostracans with carapace consisting of dorsal shield divided into nine plates superficially rostrum, pineal, dorsal disc, and paired orbitals, enclosing orbits, branchials and cornuals". However, even if *Gigantaspis* does not have cornual plates and crenulated dentin ridges, and the pattern of the main sense-canals is as yet unknown, the structure of the shield and the development of all the other plates, in the opinion of the author, fully justifies referring *Gigantaspis* to the fam. *Pteraspidae.* The divergences found in this new form are certainly neither of family nor even of sub-family rank.

White (1935) divides the fam. *Pteraspidae* into two genera, *Cyrtaspis* and *Pteraspis,* the first being split into two subgenera, viz. *Cyrtaspis* and *Protaspis.* White continues by saying that further studies of this family will undoubtedly lead to the establishment of new genera. After having studied quite a large collection of *Protaspis* from Utah and Wyoming, Denison (1953) reached the conclusion that *Protaspis* must be considered a separate genus and not only a subgenus as proposed by White. In his amended diagnosis of the genus *Protaspis,* Denison especially draws attention to the structure of the branchial opening and the presence of what "possibly represents the posterior parts of the cornual plates". White, on the other hand, in his diagnosis maintains that small cornual plates have been developed even if they cannot always be seen, as in several of the specimens described by Bryant (1932, 1933). Brotzen (1936), in describing a new species of *Protaspis* from Podolien, shows that in this species there is a small



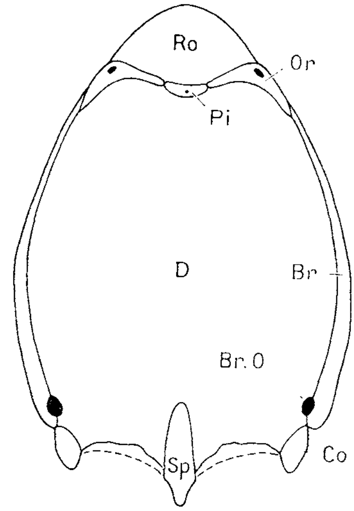


Fig. 1, A. *Gigantaspis bocki* sp. nov. (× 2). Outline of the dorsal shield. Ro – rostrum; Pi – pineal plate; Or – orbital plate; Br – branchial plate; Sp – median-dorsal spine; Br. O – branchial opening; D – dorsal disc.

B. *Protaspis dorfi* (Bryant) (× 2). Outline of the dorsal shield. Co – cornual plate. For other abbreviations see under A. From DENISON (1953).

cornual plate between the dorsal disc and the branchial plate, forming the median edge of the branchial opening.

Consequently, on comparing *Gigantaspis* with the genera mentioned by WHITE and DENISON, it seems quite reasonable to regard *Gigantaspis* as a separate genus, since it i. a. has a combination of a medium-sized, median-dorsal spine, probably no cornual plates or only, in case, some very reduced ones, and long, narrow branchial plates. In most respects, however, *Gigantaspis* resembles the large *Protaspis* from North America (Fig. 1, A, B). This is an especially interesting point as so far little connection has been found between the pteraspidian faunae of North America and Northern Europe. Nevertheless the dentin ridges of the shield of *Gigantaspis* are smooth and entire, and in this respect differ from the conditions found in *Protaspis*, where the dentin ridges are crenulated and divided up into short lengths. On the other hand, the fine, entire dentin ridges of *Gigantaspis*, in addition to the clearly developed, medium-sized median-dorsal spine, show a greater resemblance to the conditions found in the genus *Pteraspis*.

Gigantaspis isachseni sp. nov. (KIÆR (MS)) (Pl. I, A, C, D)

The following diagnosis and short description are mainly based on KIÆR's notes.

Diagnosis: As for the genus, with the following addendum: Dorsal disc up to 17 cm long. The dorsal-median spine upright, and the posterior edge vertical, 2.5–3.0 cm high. The length of the base of the spine approximately equals the height of the same. Rostral plate triangular, 8–9 cm long, and 9–10 cm broad along the base. Ventral disc up to 20 cm long.

Holotype: P.M.O. A 28721. (Pl. I, D).

Occurrence and material: KIÆR based his studies on quite an extensive material from the north-west side of Reinsdyrhalvøya. Both this and most of the newer collections, mainly from Woodfjorden, are preserved in Paleontologisk Museum, Oslo, Norway.

DINELEY (1960) records *Gigantaspis* from Eckmanfjorden in layers belonging to Kapp Kjeldsen Division, and on the whole *G. isachseni* is a good guide fossil for this division.

Description and remarks:

Dorsal shield. The anterior margin of the dorsal disc is almost straight, slightly concave in the centre, giving room for the pineal plate, and a little convex near the lateral corners. The lateral sides straight and parallel, only being a little convex near the posterior corners. Posterior margin convex and from here the large, upright dorso-median spine projects (Pl. I, C). Pineal plate rectangular, the breadth being approximately about half the length. Orbital plates long and slender, medianly joining the pineal plate, the lateral part is rounded and somewhat broader. Eye-notches funnel-shaped, open at the lateral rim of the orbital plate. (Pl. I, D). Rostral plate has the shape of an equalsided triangule. The lateral rim slightly thickened, and the anterior tip rounded. The branchial plates as yet unknown.

Ventral shield. The ventral disc is strongly vaulted, the anterior margin rounded with a small projection in the centre. The lateral sides also rounded, the posterior margin strongly convex. According to KIÆR's sketches a central loop of the sensory canal is developed along the middle of the ventral disc, as in *Pteraspis* proper, although it extends further backwards than in these species.

In his notes KIÆR does not discuss the relationship between *G. isachseni* and the genus *Gigantaspis* in general and other pteraspids. DINELEY (1960) says that *Gigantaspis* "may be related to *Pteraspis* (*Rhinopteraspis*) *duensis*".

However, I presume that DINELEY bases his assumptions on a rather limited material of *Gigantaspis*. Several characters discovered during the present study show that there can hardly be any close relationship between *Gigantaspis* and *Pteraspis*. While, as indicated under the discussion of the genus *Gigantaspis*, they seem to have more characters in common with *Protaspis*.

Gigantaspis bocki sp. nov. (Pl. I, B. Fig. 1, A)

Diagnosis: A large pteraspid, though somewhat smaller than *G. isachseni*. The dorsal disc almost rectangular, only with a small pointed projection where the dorso-median spine inserts the posterior margin. The disc fairly flat, slightly vaulted posteriorly. The length of the disc approximately 10 cm, the breadth approximately 7 cm. Branchial plates long and slender, the branchial openings are situated between the branchial and the dorsal disc. The eye-notches are found on the lateral rim of the shield. Rostral plate broad and evenly rounded anteriorly, the length being approximately 3.8 cm and the width approximately 6.6 cm at the base.

Holotype: As holotype is chosen P.M.O. A 28722. (Pl. I, B)

Occurrence and material: So far only one dorsal shield is known. It was found in the lower part of the talus at the bottom of Bockfjorden, north Vestspitsbergen.

Description:

Dorsal shield. The dorsal disc is anteriorly almost flat, posteriorly somewhat vaulted, the disc rises on both sides towards the base of the dorsomedian spine. The lateral margins of the disc almost parallel, the posterior margin convex, the two halves meeting at the point from where the spine projects. The base at the dorso-median spine is approximately 2.5 cm long, and the spine is more slender than in *G. isachseni*. The branchial plates are long and slender, being a little broader at the posterior end. The branchial openings are slit-like. They are situated between the dorsal disc and the branchial plates near the posterior corners of the shield. The rostral plate broad, the anterior part almost of a semi-circular shape. The dentin ridges fine, smooth and unbroken.

No details concerning orbital and pineal plates are as yet known. No ventral plate has so far been found.

Discussion: *G. bocki* is smaller than *G. isachseni*, but it can hardly be considered a juvenile stage of this species, as especially the proportions of the rostrum are quite different. In *G. isachseni* the relation between the width (RW) and the length of the rostrum (RL) is 1.1–1.2, while in *G. bocki* the same relation is 1.7. During growth the length of the rostrum, in most cases, increases relatively more than the width, with the result that the proportions RW:RL become smaller. Denison (1953) says about *Protaspis* that it "regularly shows such a proportional change with increase in size, resulting in relatively narrower rostrum at a large size". Thus, if one should assume that *G. bocki* is a juvenile stage of *G. isachseni*, the changes in the proportions of the rostrum have to be very large. A 150 % increase in the length of rostrum would be required to make it as long as in *G. isachseni*, while the dorsal disc of *G. bocki* is only about 50 % shorter than in *G. isachseni*.

However, until more material of this genus has been studied, I would suggest that at least the two above mentioned species, *G. isachseni* and *G. bocki* should be considered as constituting the *Gigantaspis*-fauna of Spitsbergen.

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Maudheim Revisited: The Morphology and Regime of the Ice Shelf, 1950-1960

BY

CHARLES SWITHINBANK

Maudheim, the base of the Norwegian-British-Swedish Antarctic Expedition, 1949–52, (71° 02′ S, 10° 56′ W) was revisited in January 1960 by the Norwegian Antarctic Expedition, 1956–60 under the leadership of SIGURD HELLE. HELLE has very kindly made his observations available to me and has read the manuscript of this note. The work of his party gives a reliable measure of the accumulation of snow at Maudheim from 1952 to 1960 and allows a better estimate of the bottom melting on the ice shelf than was possible from the 1950–52 measurements. Air photographs taken in December 1958 by B. LUNCKE show the extent of changes in the ice front since 1951.

Norselbukta (Fig. 1) has now been photographed on two occasions eight years apart (Plates 1 a and 1 b). The area was described by SWITHINBANK (1957, p. 29). Norselbukta is the more distant of the two inlets in Plate 1 b, and there has been no significant change in its outline. Even the H-shaped depression system (top right) leading from the little inlet in which *Norsel* discharged her cargo in 1950 appears very much as it was mapped at that time (Ibid, p. 48, Fig. 3). Maudheim in 1960 was as far from the ice front as it was in 1950. But the nearer of the two inlets, now at least 3 km long and 1 km wide, was only "a small niche in the ice front" in 1951. The shallow depression beside the niche was suggested to be "a line of weakness". The subsequent calving of an iceberg, leaving the present inlet, seems to bear this out.

Plates 2 a and 2 b are photographs taken eight years apart of a point in the ice front in longitude 11° 24′ W. The earlier photograph has been described and compared (Ibid, p. 28) with the same area as it was in 1930 (RIISER-LARSEN 1930, p. 160). The point is of particular interest in that it appears to be aground. Little has changed in 28 years. In all three photographs there are grounded icebergs off the point, showing that a shoal extends seaward from it. The icebergs themselves change, but a group of them is to be found in the same place each time. The smooth sweep of the apparently grounded ice front on the right continues unbroken (in other photographs) for 20 km to the south, and contrasts with the

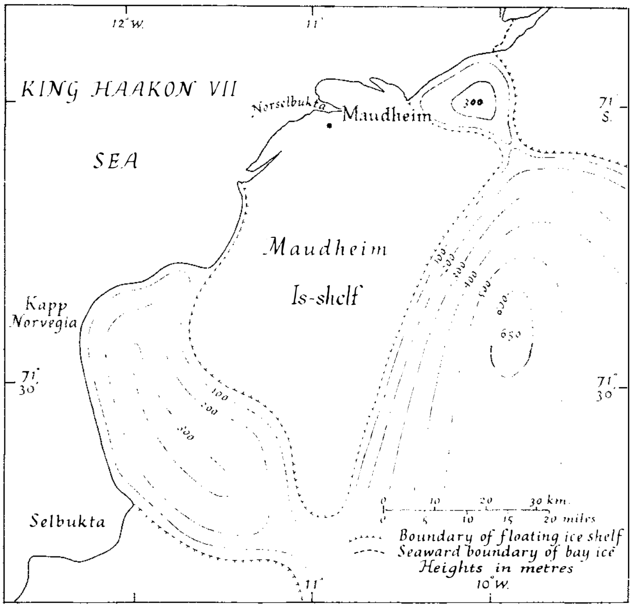

Fig. 1.

irregular series of bays and headlands characteristic of the freely floating ice front to the east. Grounding was confirmed by a sounding from *Norsel* in 1950 of 55 m of water off the point. But the significance of the features noted in the photographs is that it may often be possible to recognize the local grounding of an ice front from air photographs alone.

The height of five masts (Plates 3 a and 3 b) above the snow surface at Maudheim was measured on 12 January 1952 and again on 16 January 1960. Three of the masts were situated within the area affected by snowdrifts from the buildings, but two were well clear of any disturbance. These two recorded 6.69 m and 6.83 m accumulation of snow for the 8-year period, or 85 cm/yr. Using the mean density of the top 7 m (0.495) as measured in deep pits at Maudheim in 1950–51 (SCHYTT 1958, p. 41), this is equivalent to a mean annual accumulation of 42 gm/cm². The comparable figure from pit measurements for the years 1935–51 is 36.5 gm/cm² (Ibid, p. 37); and from stake measurements during 1951 it is 37.5 gm/cm² (SWITHINBANK 1957, p. 63). Since the standard deviation in the pit measurements was 9 gm/cm² (SCHYTT 1958, p. 37), the 15 % rise in the mean accumulation may not definitely be termed significant, though it does appear to reflect an increase over the last 8 years.

The height above sea level of the snow surface at Maudheim was measured by standard levelling techniques in March 1950 and again in January 1960. The results show a decrease in elevation from 37.5 m to 36.0 m over the ten year period. The significance of thinning near the ice front is discussed by SWITHINBANK (1958, p. 93); and with respect to the Ross Ice Shelf by CRARY (1961, p. 876). At Maudheim the ratio of surface elevation to ice thickness was found to be about 1:5.3. The measured lowering of the surface at the rate of 15 cm/yr should therefore correspond with a thinning of the ice sheet of 80 cm/yr. We can now summarize the annual changes of thickness of the ice shelf at Maudheim to compare them with CRARY's figures for Little America V. The Maudheim values are found from the observed horizontal strain rate for a point 2.8 km from the ice front: 97×10^{-5} per year (SWITHINBANK 1958, p. 91); a maximum density of 0.91 gm/cc for the ice at the bottom of the ice shelf; and a mean density of 0.835 gm/cc obtained from the thickness and the known density of sea water off the ice front (SCHYTT 1958, p. 126). CRARY's figure for bottom melting is deduced from the observed temperature profile in a drill hole.

Change in thickness per year

	Maudheim		*Little America*	
	cm	*gm/cm²*	*cm*	*gm/cm²*
Surface accumulation	+46	+42	+26	+24
Ice creep	—39	—33	—54	—46
Bottom melting	—87	—79	—80	—73
Net change	—80	—70	—108	—95

It was suggested in the original calculations for Maudheim (SWITHINBANK 1958, p. 93) that bottom melting would be 12 cm/yr if the ice were maintaining an equilibrium thickness, and 60 cm/yr if the ice moved 300 m/yr and the surface slope was 30 cm/km. It now appears that our estimate of surface slope was too low, for with steady state conditions at a given position the net thinning of the ice sheet of 80 cm/yr corresponds with a surface slope of 50 cm/km. Owing to excessive refraction we had no good measurements of surface slope, and our estimate was influenced by the results of a levelling survey in January 1952. This survey indicated that the elevation of the surface of the ice shelf had changed less than 5 cm since March 1950. But the 1960 survey shows that the surface has fallen at an average rate of 15 cm/yr since 1950, and since it refers to a 10-year period of measurement, this is evidently the more reliable figure. The 1952 surface level may have been affected by the passage of a snow dune over the area.

The values for bottom melting at Maudheim and Little America are in close agreement. This may be explained by the similar position of the two stations with respect to the ice front. According to calculations by ROBIN (1955, p. 531) the new figure for Maudheim will fit the observed temperature profile. The need now is for measurements of strain, accumulation, surface slope and absolute movement at a series of points along a line directed inland from the ice front. Only in this way will it be possible to establish the effect of bottom melting or freezing upon the overall regime of the ice shelf.

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Høydegrenser for høyere planter på Svalbard

(Height limits for vascular plants in Svalbard)

AV

PER SUNDING

Innhold

Abstract

The present paper gives the results of investigations on height limits for vascular plants in Vestspitsbergen, carried out during the summer-season 1960. Some of the mountains in the surroundings of Adventfjorden and Kongsfjorden were investigated. A review is given of previous observations from various parts of Svalbard made by other authors.

Records are given of the upper limits of the various localities for each of the 81 species of vascular plants present above 150 m a. s. l. Vascular plants were found growing up to a height of 940 m within the investigated area, the actual species being *Papaver Dahlianum* NORDH.

In other parts of Svalbard less is known about height limits for vascular plants, making it difficult to compare the investigated area with the rest of the islands. However, on the north and east coast the height limits seem to be somewhat lower.

In addition a list is given of some observations concerning height limits for lower plants, i. e. a few species of mosses, among those *Dicranoweisia crispula* (HEDW.) LINDM., has been found at 1040 m.

Innledning

(Introduction)

Ved Norsk Polarinstitutts ekspedisjon til Svalbard sommeren 1960 ble det satt opp et parti med hovedoppgave å foreta innsamlinger av plantefossiler fra tertiære lag. Partiet besto av cand. mag. BJARNE FALKANGER og forfatteren. Ved siden av det geologiske arbeidet ble det også foretatt undersøkelser over de levende planter, og noen av resultatene av undersøkelsene vil bli fremlagt i dette arbeidet.

Det geologiske innsamlingsarbeidet ble foretatt i området nærmest omkring Adventfjorden og Adventdalen og i området på Brøggerhalvøya like syd for Ny-Ålesund. Da disse strøk imidlertid har vært meget besøkt av botanikere og derfor er relativt godt kjent floristisk sett, har jeg ikke funnet det nødvendig her å gi noen artsliste med angivelser av hvor de enkelte arter er samlet. De forholdsvis få av våre funn som kan antas å være av spesiell interesse, vil bli publisert for seg senere. En rekke av de øvrige funn inngår forøvrig i listen over høydegrensene nedenfor.

I stedet for å foreta en floristisk undersøkelse av de områder vi skulle arbeide i, valgte vi å konsentrere oppmerksomheten omkring undersøkelser av høydegrensene for høyere planter, et felt hvor det ennå er gjort ganske lite. Dette passet svært godt også av den grunn at vårt geologiske innsamlingsarbeid vesentlig kom til å foregå i høyder over 800 m o. h.

Jeg vil gjerne få si takk for all hjelp og for godt selskap til alle de deltakere ved ekspedisjonen jeg kom i kontakt med. En spesiell takk må jeg imidlertid få gi min reisekamerat, BJARNE FALKANGER, for de mange hyggelige turer rundt i en natur vi begge sikkert sent vil glemme.

En takk må jeg også få rette til førstekonservator PER STØRMER ved Botanisk Museum, Oslo, som har vært så vennlig dels å bestemme, dels å kontrollere mine bestemmelser av moseprøver fra de høyeste lokalitetene.

Professor OVE ARBO HØEG og cand. real. NATASCHA HEINTZ vil jeg få takke for mange gode råd i forbindelse med utarbeidelsen av dette manuskriptet.

Steder hvor høydegrenser er notert

(Localities where height limits have been observed)

Som nevnt ble våre undersøkelser foretatt i to områder: 1. området omkring Adventfjorden og Adventdalen, med Longyearbyen som hoved-utgangspunkt (ca. 78° 15′ N, 15° 40′ E), dekkes av kartbladet C 9, «Adventdalen»; og 2. den nærmeste omegn av Ny-Ålesund på Brøggerhalvøya (ca. 78° 56′ N, 12° 0′ E). De enkelte fjell som ble besøkt, rutene som ble fulgt og datoene er oppgitt i listen nedenfor. I det følgende vil det i stedet for «m o. h.» bare bli brukt forkortelsen «m».

Området ved Adventdalen
(The area around Adventdalen)

Nordenskiöldfjellet, sydvest for Adventfjorden. Høyde 1050 m. Fra ca. 550 (?) til ca. 760 m består grunnen av jevne skråninger av en svært oppsmuldret skifer («øvre mørke skifer» i de tertiære lag på Svalbard), over ca. 760 m blir det hardere bergarter med bl. a. meget av mer eller mindre grove sandstener.

På nordsiden av fjellet går det to rygger opp mot toppen, begge disse ble gått opp flere ganger, den østre: 28. juni (til 820 m), 10. august (til topps) og 15. august (til 940 m); den vestre: 13. juli (til 920 m) og 15. juli (til topps).

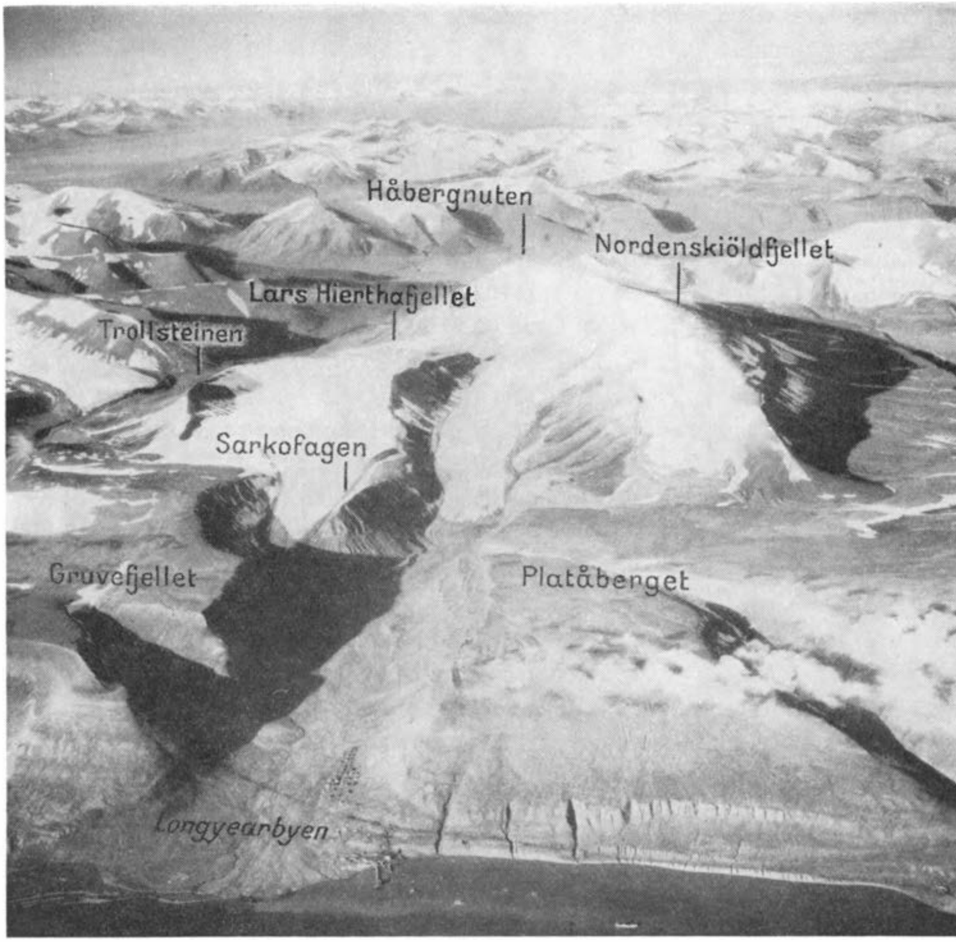

Fig. 1. *Del av området omkring Adventfjorden med de besøkte fjell inntegnet.*
(Parts of the area around Adventfjorden with indication of the mountains investigated.)

Følgende rute på Nordenskiöldfjellet ble benyttet ennå mer: opp østskråningen av fjellet, fra den øvre enden av sidemorenen ved Longyearbreen (ved ca. 520 m) til oppå den tidligere nevnte østlige ryggen, og derfra videre mot toppen. Besøkt: 6. juli (til topps), 7. juli (til topps), 11. juli (til 860 m) og 16. august (til 650 m); 14. juli og 6. august (noe lenger nord i østskråningen av fjellet, til henholdsvis 500 og 775 m).

Teltberget, forlengelsen av Nordenskiöldfjellet mot syd. Høyde ca. 1030 m. Besøkt: 7. juli, til toppen ad ryggen fra Nordenskiöldfjellet, retur samme vei, og 10. august, til toppen ad ryggen fra Nordenskiöldfjellet, videre i sydskråningen av Teltberget, dels mot Håbergnuten, dels mot skaret ved den øvre ende av Longyearbreen.

Håbergnuten, syd for Nordenskiöldfjellet. Høyde 1031 m. Besøkt: 10. august, opp kammen på nordsiden til toppen, retur samme vei.

Platåberget, sydvest for Adventfjorden. Utgjør platået som selve Nordenskiöldfjellet reiser seg opp fra, består (under ca. 500 m) av en hard, grågrønn sandsten. Ble besøkt og delvis krysset en rekke ganger, både fra Longyeardalen og fra Bjørndalen: 28. juni, 13. juli, 15. juli, 19. juli og 10. august.

Sverdruphammeren, den nordøstlige delen av Platåberget. I rasmarkene under denne, opp for Longyearbyen, ble det den 18. august notert en del høydegrenser, opp til ca. 400 m.

Sarkofagen, ved Longyeardalen, øst for Longyearbreen. Øvre del ca. 550 m, går videre jevnt over i Lars Hierthafjellet. Besøkt 5. juli, 5. august, 11. august og 19. august, alle ganger fra Larsbreen til helt oppå ryggen, med retur enten samme vei eller sydover mot Lars Hierthafjellet.

Lars Hierthafjellet, ved Longyeardalen, øst for Longyearbreen. Høyde 878 m. En løs, lett oppsmuldrende skifer opp til ca. 750 m på nordsiden, til ca. 700 m på vestsiden; ovenfor denne opp til toppen veksler det mellom fastere skifre og sandstener. Ble som oftest besøkt i forbindelse med turer over kammen mot Trollsteinen lenger øst (se nedenfor). Besøkt: 16. juli, vestsiden, til 700 m, 18. juli, vestsiden til topps, østover mot Trollsteinen, retur samme vei, 5. og 11. august, ryggen fra Trollsteinen til toppen, ned kammen på nordsiden, 8. august, kammen på nordsiden til toppen, retur samme vei.

Trollsteinen, ved Longyeardalen, øst for Larsbreen. Høyde 837 m. Den øvre delen, fra ca. 790 m til toppen, består av sandstenslag, nedenfor kommer den bløte, løse «øvre mørke skifer». Besøkt: 18. juli, 20. juli, 5. august og 11. august, alle ganger til toppen, fra Gruvefjellplatået eller ad ryggen fra Lars Hierthafjellet.

Gruvefjellet, øst for Longyeardalen. Et platå som liksom Platåberget er dannet ved den øvre grense for den harde, grågrønne sandstenen. Platået eller deler av det ble krysset: 9. juli, 20. juli og 21. juli.

Den østre sidemorenen ved Larsbreen ble undersøkt den 9. juli opp til dens øvre ende, som da var på ca. 575 m.

Adventtoppen, på nordsiden av Adventfjorden. Høyde 786 m. Ble den 13. august undersøkt til en høyde av 570 m, opp kammen på vestsiden, ned nordskråningen mot Hanaskogdalen.

Soleietoppen, i Bolterdalen (sidedal til Adventdalen), like nordøst for Burralltoppen, mellom denne og Bolterskaret (ca. 78° 6′ N, 16° 0′ E). Høyde 802 m. Har ennå ikke fått noe navn på det topografiske kartet, som navn er i dette arbeidet brukt Soleietoppen. Ble undersøkt til topps den 1. juli fra Bolterskaret, retur samme vei.

Fig. 2. *Brøggertinden ved Ny-Ålesund, sett fra toppen av Zeppelinfjellet, tvers over Austre Brøggerbre. 30. juli 1960.* Foto P. S.
(Brøggertinden near Ny-Ålesund, seen from the top of Zeppelinfjellet, across Austre Brøggerbre.)

Området ved Ny-Ålesund
(The area around Ny-Ålesund)

Zeppelinfjellet, syd for Ny-Ålesund. Høyde 553 m. Besøkt: 25 juli, kammen fra øst til toppen, retur samme vei, og 30.–31. juli, østkammen til toppen, ned nordsiden.

Brøggertinden, sydvest for Ny-Ålesund. Høyde 715 m. Kammen fra Austre Brøggerbre mot den nordlige toppen, som er 656 m høy (Fig. 2), ble 2. august gått opp til en høyde av ca. 410 m, retur samme vei.

Høydegrenser for moser og lav på Svalbard
(Height limits for mosses and lichens in Svalbard)

Samtidig med studiene av høydegrensene for høyere planter på Svalbard, undersøkte vi også hvor høyt en del mosearter ble funnet på de samme fjell.

I litteraturen har jeg bare hos Hadač (1944, p. 7) funnet nøyaktige angivelser av hvor høyt bestemte mosearter er funnet på Svalbard. Det dreier seg her om 5 arter fra høyder over 900 m, disse vil bli nevnt i sammenstillingen nedenfor.

Høydegrenser for moser er blitt notert på følgende av fjellene i omegnen av Longyearbyen: Nordenskiöldfjellet, Lars Hierthafjellet og Trollsteinen. En art, *Dicranoweisia crispula* (Hedw.) Lindm., ble funnet nesten på den høyeste toppen av Nordenskiöldfjellet i en høyde av 1040 m. Den var forøvrig på dette stedet bemerkelsesverdig frodig og vokste i dype, tette matter. Førstekonservator STØRMER har i en prøve herfra kunnet telle nedover i tuen omkring 30 skuddgenerasjoner, som muligens svarer til antall år. *Dicranoweisia crispula* er også en av de arter som HADAČ oppgir går høyest i Sassenområdet, til 972 m.

I alt ble 10 arter notert i høyder over ca. 790 m.

1. *Dicranoweisia crispula* (HEDW.) LINDM.
   Toppen av Nordenskiöldfjellet, 1040 m.
   Lars Hierthafjellet, kammen fra toppen vestover, 760 m.
   Toppen av Trollsteinen, 835 m.
   (HADAČ: 972 m (Arctowskifjellet ?))
2. *Dicranum elongatum* SCHLEICH.
   Toppen av Trollsteinen, 835 m.
3. *Tortula ruralis* (HEDW.) CROME
   Lars Hierthafjellet, 840 m.
   (HADAČ: («Tortula ruralis f.») > 900 m.)
4. *Orthothecium chryseum* (SCHWAEGR.) B.S.G.
   Lars Hierthafjellet, 840 m.
5. *Hypnum revolutum* (MILL.) LINDB.
   Toppen av Trollsteinen, 835 m.
6. *Schistidium apocarpum* (HEDW.) BR. EUR.
   Toppen av Trollsteinen, 835 m.
7. *Rhacomitrium lanuginosum* (HEDW.) BRID.
   Nordsiden av Nordenskiöldfjellet, 830 m.
   Toppen av Trollsteinen, 830 m.
   (HADAČ: 972 m.)
8. *Rhacomitrium canescens* (HEDW.) BRID.
   Nordsiden av Nordenskiöldfjellet, 790 m.
   (HADAČ: > 900 m.)
9. *Andreaea rupestris L.* var. *papillosa* (LINDB.) PODP.
   Nordsiden av Nordenskiöldfjellet, 790 m.
10. *Chandonanthus setiformis* (EHRH.) MILL. var. *nemoides* KAAL.
    Toppen av Trollsteinen, 835 m.

HADAČ oppgir dessuten *Hylocomium alaskanum* fra en høyde av over 900 m.

Det ble ikke gjort noen undersøkelser over høydegrenser for lav sommeren 1960 av oss, men man kan finne gode opplysninger om slike i andre arbeider. LYNGE (1940), som bearbeidet EMIL HADAČ' innsamlinger av lav fra Sassenområdet, nevner 114 arter med høydeangivelser fra en rekke fjell. SCHOLANDER (1934, p. 122) oppgir fra Nordaustlandet 22 lavarter funnet mellom 230 og 350 m.

Høydegrenser for høyere planter på Svalbard

(Height limits for vascular plants in Svalbard)

Arbeidsmetodikk

Nedre grense ved disse undersøkelsene over hvor høyt til fjells plantene kunne vokse, ble satt ved ca. 150 m. Dette var like ved den høyde hvor vi hadde vårt hovedkvarter, og er dessuten den utgangshøyde som er brukt ved andre systematiske undersøkelser av høydegrenser på Svalbard.

De høyder som oppgis i teksten, er målt med et vanlig aneroidbarometer. Sikkerheten av de oppgitte verdier er imidlertid blitt øket ved at de fleste turer er gått flere ganger, og høydene er blitt målt både på opp- og nedtur. Etterhvert fikk vi på den måten også flere «faste punkter» på de enkelte rutene, som ved senere turer ble brukt til kontroll.

Tidligere arbeider

De fleste opplysninger om finnehøyder for høyere planter på Svalbard har man hos HADAČ (1944), dette er også de som kommer nærmest opp til våre egne resultater, idet HADAČ' Sassenområde må sies å være nærmeste nabo til vårt område ved Adventdalen. HADAČ angir 60 arter fra over 150 meters høyde.

RØNNING (1959) oppgir 42 arter høyere planter fra over 150 m på 5 fjell. Disse fjellene er imidlertid stort sett forholdsvis lave, slik at det ikke er blitt anledning til å finne ut fordelingen mellom de arter som går svært høyt og de som har sin grense ved lavere høyder. Dette er i ennå større grad tilfelle med de resultater som SCHOLANDER oppgir (1934), noe han forøvrig selv var oppmerksom på (p. 121–122: "These mountains are all very low. – – – It is probable that most of these maximum values for the whole of North-East Land (Nordaustlandet) will be increased when the granite mountains of the Laponian Peninsula and the north coast are properly examined.").

SCHOLANDER (p. 122) gir en tabell med finnehøyder for 13 arter på Nordaustlandet, men har også ellers i teksten en del notater om høydegrenser, slik at man i alt finner opplysninger om 24 arter karplanter som går opp til høyder mellom 170 og 360 m. SCHOLANDER siterer også noen angivelser fra en svensk ekspedisjon til Svalbard i 1861.

I de arbeidene som behandler resultatene fra denne ekspedisjonen, MALMGREN (1863) og CHYDENIUS (1865), er det også en del andre angivelser av funn av høyere planter høyt til fjells, og tilsammen foreligger det i disse to arbeidene opplysninger om 19 arter fra lokaliteter på de nordlige deler av Vestspitsbergen og på Nordaustlandet.

ASPLUND (1919) oppgir høydegrenser for *Braya purpurascens* og *Draba subcapitata*, begge fra Sassendalen.

De siterte forfattere oppgir følgende lokaliteter for sine undersøkelser av høydegrenser på Svalbard, egne lokaliteter medregnet:

Vestspitsbergen

Ved Isfjorden:

Vesuv	Rønning (1959)
Nordenskiöldfjellet Teltberget Håbergnuten Platåberget Sarkofagen Lars Hierthafjellet Trollsteinen Gruvefjellet Adventtoppen Soleietoppen	Egne lokaliteter
Duboistoppen Albert Bruntoppen Botneheia Konussen Gattytoppen Ottofjellet Arctowskifjellet Lusitaniafjellet Hiorthfjellet Valmuetoppen Marmierfjellet Sticky Keep	Hadač (1944)
Stensiöfjellet[1]	Asplund (1919)
Campbellryggen Oxåsfjellet Lundbohmfjellet	Rønning (1959)

Ved Kongsfjorden:

Zeppelinfjellet Brøggertinden	Egne lokaliteter

Ved Magdalenafjorden:

Magdalena Hookfjellet	Chydenius (1865)
«Magdalena-bay»	Malmgren (1863)

Nord- og nordøstkysten:

Solanderfjellet	Rønning (1959)
Faxefjellet	Scholander (1934)
«Vid Hinlopen-strait»	Malmgren (1863)

Østkysten:

Agardhbukta	Heuglin (1874), iflg. Dahl (1937)

[1] Hos Asplund omtalt som «Anderssons Berg».

Nordaustlandet

Forsiusfjellet Ismåsefjellet	SCHOLANDER (1934)
Idunfjellet	MALMGREN (1863) («Augusti-bay», se SCHOLANDER (1934))
Floraberget Wargentinfjellet	SCHOLANDER (1934)
«North-East Land 80°»	MALMGREN (1863), også sitert hos SCHOLANDER (1934) (Murchinsonfjorden ?)
Depotodden ved Brennevinsfjorden	CHYDENIUS (1865), jfr. også SCHOLANDER (1934)

De lokaliteter som her har vært nevnt, er avmerket på kartet nedenfor, Fig. 3.

Egne notater

Nedenfor følger en liste over de arter karplanter som ble funnet over 150 m, og til hvilke høyder disse ble funnet på de forskjellige steder. Det dreier seg om 64 arter, og i tillegg er tatt med 17 arter som av andre er angitt fra høyder over 150 m, slik at det totale antall arter er 81. Fra de siterte forfattere er fra hvert arbeid tatt med den høyeste angivelse.

I listen er dessuten anført forhold vedrørende blomstring og fruktsetting fra de høyeste lokalitetene.

POLYPODIACEAE

1. *Cystopteris fragilis* (L.) BERNH.
subsp. *Dickieana* (SIM.) HYL.
(Syn.: *C. Dickieana* SIM.)
Zeppelinfjellet, 320 m.
(HADAČ: 50 m, Skjørlokstupet.)

EQUISETACEAE

2. *Equisetum arvense* L. var. *alpestre* WBG.
Nordenskiöldfjellet, østskråningen, 480 m.
Ovenfor Longyearbyen, 200 m.
(HADAČ: 320 m, Duboistoppen.
RØNNING: 220 m, Lundbohmfjellet.)
Equisetum variegatum SCHLEICH.
(HADAČ: 500 m, Botneheia.
RØNNING: 380 m, Lundbohmfjellet.)
3. *Equisetum scirpoides* RICH.
Adventtoppen, 250 m.

LYCOPODIACEAE

4. *Lycopodium selago* L.
Ovenfor Longyearbyen, 160 m.
(HADAČ: 250 m, Kreklingpasset.)

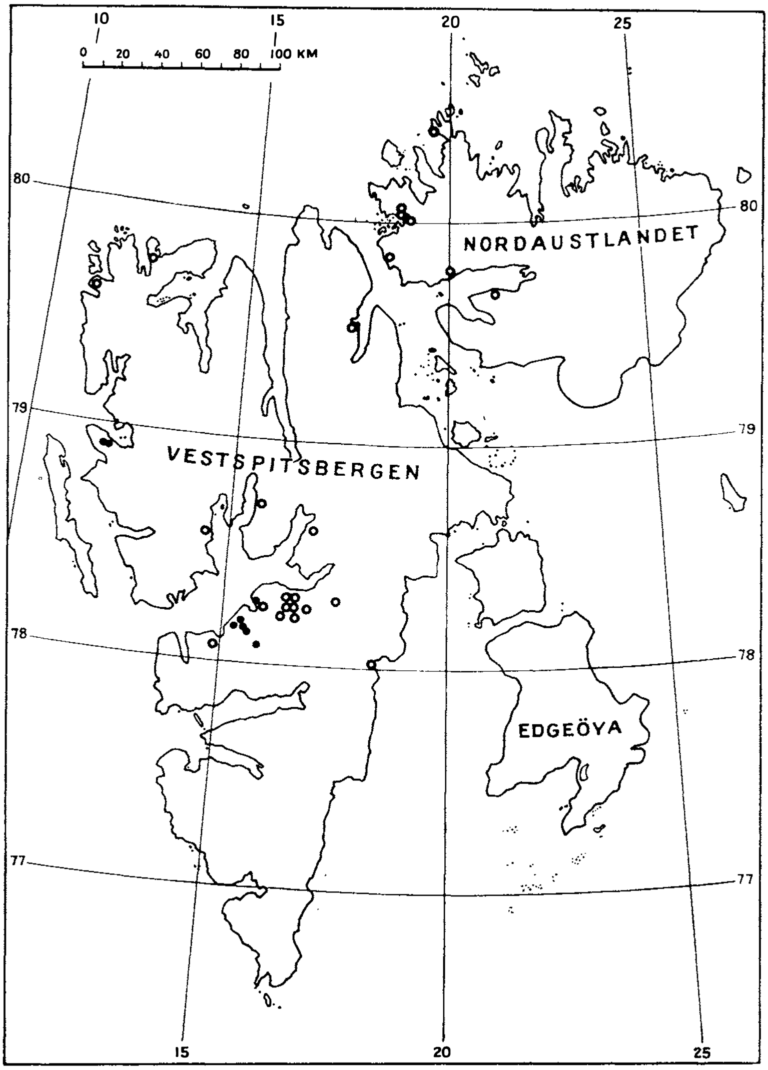

Fig. 3. *Kart over Svalbard med angivelse av de steder hvor høydegrenser for høyere planter er undersøkt.*
(Map of Svalbard with indication of localities where height limits have been investigated.)
o *Lokaliteter nevnt i tidligere arbeider.* (Localities mentioned by other authors.)
• *Egne lokaliteter, sommeren 1960.* (Localities investigated by the author, summer 1960.)

GRAMINEAE

5. *Alopecurus alpinus* SM.

Nordenskiöldfjellet, østskråningen, 440 m.
Teltberget ved den øvre enden av Longyearbreen, 685 m.
Platåberget, kanten mot Longyeardalen, 500 m.
Sarkofagen, 520 m.
Lars Hierthafjellet, kammen på vestsiden, 740 m.
Gruvefjellet, 560 m.
Adventtoppen, 570 m.

(HADAČ: 710 m, Botneheia.
RØNNING: 460 m, Vesuv.)
Calamagrostis neglecta (EHRH.) G. M. S.
(HADAČ: 210 m, Arnicadalen.
RØNNING: 300 m, Oxåsfjellet.)
Deschampsia alpina (L.) R. et S.
(HADAČ: 255 m, Imisdalen.
RØNNING: 160 m, Solanderfjellet.
SCHOLANDER: 200 m, Faxefjellet.)

6. *Trisetum spicatum* (L.) RICHT.
Ovenfor Longyearbyen, under Platåberget, 290 m.
Under Sverdruphammeren, 350 m.
Sarkofagen, 520 m.
Adventtoppen, 330 m.
(HADAČ: 250 m, Kreklingpasset.
RØNNING: 420 m, Lundbohmfjellet.)

7. *Poa arctica* R. BR.
Nordenskiöldfjellet, østskråningen, 430 m.
Teltberget, ved den øvre enden av Longyearbreen, 685 m.
Sarkofagen, 450 m.
Gruvefjellet, 380 m.

8. *Poa arctica* R. BR. var. *vivipara* (MALMGR.) NANNF.
Nordenskiöldfjellet, den østligste av ryggene på nordsiden, 775 m.
Nordenskiöldfjellet, østskråningen, 500 m.

9. *Poa alpigena* (FR.) LINDM.
var. *vivipara* (MALMGR.) SCHOL.
Morenene ved Rieperbreen i Bolterdalen, ca. 180 m.

10. *Poa alpina* L. var. *vivipara* L.
Sarkofagen, 450 m.
Lars Hierthafjellet, kammen på vestsiden, 760 m.
Gruvefjellet, 390 m.
Adventtoppen, 570 m.
(HADAČ: 800 m, Albert Bruntoppen.
RØNNING: 480 m, Lundbohmfjellet.
SCHOLANDER: 340 m, Faxefjellet.)

11. *Poa glauca* VAHL.
Ovenfor Longyearbyen, under Platåberget, 290 m.
Under Sverdruphammeren, 310 m.
Gruvefjellet, 380 m.
(HADAČ: 130 m, Tobredalen.)

12. *Poa abbreviata* R. BR.
Zeppelinfjellet, 360 m.
(HADAČ: 450 m, Botneheia.
SCHOLANDER: 360 m, Faxefjellet.)

13. *Phippsia algida* (SOL.) R. BR.
Nordenskiöldfjellet, den vestlige av ryggene på nordsiden, 830 m.

Platåberget, 490 m.
Sarkofagen, 520 m.
Lars Hierthafjellet, 875 m.
Trollsteinen, 835 m.
Gruvefjellet, 600 m.
Den østre sidemorenen ved Larsbreen, 575 m.
Zeppelinfjellet, 550 m.
(HADAČ: 905 m, Albert Bruntoppen.
RØNNING: 460 m, Vesuv.
SCHOLANDER: 230 m, Wargentinfjellet.)

Colpodium vahlianum (LIEBM.) NEVSKI
(Syn.: *Puccinellia vahliana* (LIEBM.) SCR. et MERR.)
(HADAČ: 200 m, ved Ottofjellet.)

14. *Festuca cryophila* KRECZ. et BOBR.
(Syn.: *F. rubra* L. var. *arenaria* (OSB.) FR. f. *arctica* HACK.)
Nordenskiöldfjellet, østskråningen, 570 m.
(HADAČ: 430 m, Aucellaskaret.
RØNNING: (sub nom. *Festuca rubra* L. coll.) 380 m, Lundbohmfjellet.
SCHOLANDER: (sub nom. *Festuca rubra* L. var. *arenaria* (OSB.) E. FRIES) 200 m, Floraberget.)

15. *Festuca vivipara* (L.) SM.
Platåberget, kanten ut mot Longyeardalen, 450 m.
Lars Hierthafjellet, kammen på vestsiden, 740 m.
Gruvefjellet, 380 m.
Adventtoppen, 570 m.
(HADAČ: 590 m, Duboistoppen.)

16. *Festuca brachyphylla* SCHULTES
Adventtoppen, 440 m.
(HADAČ: 530 m, Botneheia.)

CYPERACEAE

Eriophorum Scheuchzeri HOPPE
(HADAČ: 250 m, Kreklingpasset.)

Carex lachenalii SCHKUHR.
(HADAČ: (sub nom. *Carex bipartita* ALL.) 280 m, Arctowskifjellet.)

17. *Carex nardina* FR.
Zeppelinfjellet, 410 m.
Brøggertinden, 410 m.
(RØNNING: 310 m, Solanderfjellet.
SCHOLANDER: 360 m, Faxefjellet.)

Carex misandra R. BR.
(HADAČ: 210 m, Trangdalen.
RØNNING: 160 m, Solanderfjellet.)

JUNCACEAE

Juncus biglumis L.
(SCHOLANDER: 340 m, Faxefjellet.)

18. *Luzula confusa* (HARTM.) LINDEB.
Nordenskiöldfjellet, østskråningen, 520 m.
Teltberget, ved den øvre enden av Longyearbreen, 700 m.
Platåberget, 480 m.
Sarkofagen, 550 m.
Gruvefjellet, 570 m.
Adventtoppen, 570 m.
Soleietoppen, 615 m.
Zeppelinfjellet, 290 m.
(HADAČ: 650 m, Konussen.
RØNNING: 480 m, Lundbohmfjellet.
SCHOLANDER: 270 m, Ismåsefjellet.
CHYDENIUS (1865): (sub nom. *Luzula hyperborea*) ca. 450 m, iflg. SCHOLANDER sannsynligvis Depotodden ved Brennevinsfjorden.
CHYDENIUS (1865) og MALMGREN (1863): (sub nom. *Luzula hyperborea*), ca. 700 m, Magdalena Hookfjellet.)

19. *Luzula nivalis* (LÆST.) BEURL.
(Syn.: *L. arctica* BLYTT)
Platåberget, 510 m.
Gruvefjellet, 560 m.
(HADAČ: 800 m, Botneheia.
RØNNING: 420 m, Lundbohmfjellet.
SCHOLANDER: 340 m, Faxefjellet.)

SALICACEAE

20. *Salix polaris* WAHLENB.
Nordenskiöldfjellet, østskråningen, 560 m.
Platåberget, kanten mot Longyeardalen, 500 m.
Platåberget, kanten mot Bjørndalen, 410 m.
Sarkofagen, 540 m.
Gruvefjellet, 520 m.
Soleietoppen, 615 m.
Zeppelinfjellet, 350 m.
Brøggertinden, 410 m.
(HADAČ: 650 m, Konussen.
RØNNING: 480 m, Lundbohmfjellet.
SCHOLANDER: 360 m, Faxefjellet.)
Salix reticulata L.
(RØNNING: 220 m Lundbohmfjellet.)

POLYGONACEAE

21. *Oxyria digyna* (L.) HILL.
Nordenskiöldfjellet, østskråningen, 620 m.
Platåberget, kanten mot Longyeardalen, 460 m.
Sarkofagen, 515 m.
Gruvefjellet, 460 m.

(HADAČ: 570 m, Gattytoppen.
RØNNING: 480 m, Lundbohmfjellet.)

22. *Polygonum viviparum* L.
Nordenskiöldfjellet, østskråningen, 440 m.
Platåberget, 490 m.
Sarkofagen, 515 m.
Gruvefjellet, 330 m.
(HADAČ: 450 m, Konussen.
RØNNING: 190 m, Campbellryggen.
MALMGREN (1863): ca. 180 m, Nordaustlandet ved 80°, se også SCHOLANDER (1934).)

CARYOPHYLLACEAE

23. *Sagina intermedia* FENZL.
Adventtoppen, på nordsiden, 235 m.
(HADAČ: 255 m, Louisdalen.)

24. *Minuartia biflora* (L.) SCH. et TH.
Nordenskiöldfjellet, østskråningen, 430 m. (I blomst den 14. juli.)
(HADAČ: 320 m, Duboistoppen.
RØNNING: 380 m, Lundbohmfjellet.)

25. *Minuartia rubella* (WAHLENB.) HIERN.
Brøggertinden, 410 m. (Avblomstret 2. august.)
(HADAČ: 450 m, Konusdalen.
RØNNING: 620 m, Campbellryggen.
SCHOLANDER: 360 m, Faxefjellet.)

Minuartia Rolfii NANNF.
(Syn.: *M. Rossii* (R. BR.) GRAEBN.)
(SCHOLANDER: 200 m, Faxefjellet.)

26. *Stellaria crassipes* HULT.
(Syn.: *S. longipes* GOLDIE)
(Som oftest steril i de høyere strøk.)
Nordenskiöldfjellet, den østlige av ryggene på nordsiden, 770 m.
Nordenskiöldfjellet, den vestlige av ryggene, 830 m.
Nordenskiöldfjellet, østskråningen, 680 m.
Teltberget, ved den øvre enden av Longyearbreen, 685 m.
Sarkofagen, 550 m.
Lars Hierthafjellet, 830 m.
Trollsteinen, 837 m.
Gruvefjellet, 570 m. Ved 520 m ble 20. juli funnet blomstrende eksemplarer.
Den østlige sidemorenen ved Larsbreen, 575 m.
Adventtoppen, 570 m.
(HADAČ: 890 m, Lusitaniafjellet.
RØNNING: 680 m, Vesuv.
SCHOLANDER: 230 m, Floraberget.
CHYDENIUS (1865): (sub nom. *Stellaria Edwardsi*) ca. 450 m,

iflg. SCHOLANDER er lokaliteten sannsynligvis Depotodden ved Brennevinsfjorden.

27. *Cerastium alpinum* L.
(Oftest steril.)
Nordenskiöldfjellet, den vestlige av ryggene på nordsiden, 630 m.
Nordenskiöldfjellet, østskråningen, 670 m. (Blomstret i en høyde av 580 m den 6. august.)
Teltberget, sydsiden, 700 m.
Platåberget, kanten mot Longyeardalen, 450 m.
Platåberget, kanten mot Bjørndalen, 410 m.
Sarkofagen, 515 m.
Lars Hierthafjellet, kammen vestover, 760 m.
(Ble den 16. juli funnet blomstrende litt lenger nede samme sted, ved 700 m.)
Gruvefjellet, 560 m.
Adventtoppen, 570 m.
Soleietoppen, 802 m.
Zeppelinfjellet, 550 m. (Blomstret her den 30. juli.)
Brøggertinden, 410 m. (Ble den 2. august funnet avblomstret.)
(HADAČ: (inkl. *C. arcticum* LGE.) 915 m, Albert Bruntoppen.
SCHOLANDER: («*Cerastium alpinum* L. sens. lat.», inkl. *C. arcticum* LGE.) 230 m, Floraberget.
CHYDENIUS (1865, p. 341–344) og MALMGREN (1863, p. 241): ca. 700 m, Magdalena Hookfjellet.)

28. *Cerastium arcticum* LGE.
Adventtoppen, 570 m.
Endalen (sidedal til Adventdalen), 250 m.
(RØNNING: 710 m, Vesuv.)

29. *Cerastium regelii* OSTF.
(I høyere strøk alltid bare i form av sterile tuer.)
Morenene ved foten av breen på nordsiden av Nordenskiöldfjellet, 570 m.
Teltberget, ved Longyearbreens øvre ende, 685 m.
Lars Hierthafjellet, ryggen på vestsiden, 760 m.
Gruvefjellet, 570 m.
Østre sidemorene ved Larsbreen, 560 m.
Adventtoppen, 570 m.
Morenene ved Bogerbreen i Endalen, ca. 400 m.
(HADAČ: 700 m, Duboistoppen.
RØNNING: 540 m, Vesuv.
SCHOLANDER: 360 m, Faxefjellet.)

30. *Melandrium furcatum* (RAF.) HADAČ
(Syn.: *M. affine* VAHL.)
Ovenfor Longyearbyen, under Platåberget, 290 m.
(HADAČ: 280 m, Arctowskifjellet.
HEUGLIN (1874), iflg. DAHL (1937, p. 14): ca. 250 m, Agardhbukta.)

31. *Melandrium apetalum* (L.) FENZL.
subsp. *arcticum* (TH. FR.) HULT.
Ovenfor Longyearbyen, under Gruvefjellet, 250 m.
Under Sverdruphammeren, 270 m.
Brøggertinden, 270 m.
(HADAČ: 380 m, Duboistoppen.)

32. *Silene acaulis* (L.) JACQ.
Platåberget, på kanten ut mot Bjørndalen, 390 m.
(Blomstret her den 19. juli.)
(HADAČ: 450 m, Botneheia.
RØNNING: 160 m, Solanderfjellet.
MALMGREN (1863): ca. 600 m, «Magdalena-bay».)

RANUNCULACEAE

Ranunculus hyperboreus ROTTB.
(HADAČ: 320 m, Duboistoppen.)

33. *Ranunculus pygmaeus* WAHLENB.
Nordenskiöldfjellet, østskråningen, 440 m.
Platåberget, 510 m.
Under Sverdruphammeren, 370 m.
Lars Hierthafjellet, kammen vestover, 700 m.
(Var på dette sted avblomstret allerede 16. juli.)
(HADAČ: 575 m, Hiorthfjellet.
RØNNING: 540 m, Vesuv.
MALMGREN (1863): ca. 300 m, ved Magdalenafjorden («Magdalena-bay»).)

34. *Ranunculus nivalis* L.
Platåberget, 510 m.
(HADAČ: 320 m, Duboistoppen.
RØNNING: 480 m, Lundbohmfjellet.)

35. *Ranunculus sulphureus* SOL.
Nordenskiöldfjellet, østskråningen, 440 m.
Teltberget, ved Longyearbreens øvre ende, 685 m.
Platåberget, 490 m.
Sarkofagen, 515 m.
Lars Hierthafjellet, kammen på vestsiden, 750 m.
Soleietoppen, 802 m. (Blomstrende allerede den 1. juli!)
(HADAČ: 800 m, Albert Bruntoppen.
RØNNING: 460 m, Vesuv.
MALMGREN (1863): ca. 300 m, ved Hinlopenstretet.)

PAPAVERACEAE

36. *Papaver Dahlianum* NORDH.
Nordenskiöldfjellet, den østlige av ryggene på nordsiden, 820 m.
Nordenskiöldfjellet, den vestlige av de to ryggene, 900 m.
Nordenskiöldfjellet, østskråningen, 825 m.

Teltberget, sydsiden, 940 m. (Rikelig med planter, og rikt blomstrende den 10. august.)
Håbergnuten, 915 m. (To visne tuer.)
Sarkofagen, 550 m.
Lars Hierthafjellet, 875 m. (Blomstrende den 18. juli, alle farvetyper fra mørk gul til hvit.)
Trollsteinen, 837 m. (Blomstrende den 18. juli, gule og hvite.)
Gruvefjellet, 570 m
Den østre sidemorenen ved Larsbreen, 575 m.
Soleietoppen, 802 m.
Zeppelinfjellet, 350 m.
Brøggertinden, 410 m. (Avblomstret den 2. august.)
(HADAČ: 915 m, Albert Bruntoppen.
RØNNING: 739 m, Vesuv.
SCHOLANDER: (sub nom. *Papaver radicatum* ROTTB.) 340 m, Faxefjellet.
CHYDENIUS (1865, p. 231): ca. 450 m, Depotodden.)

CRUCIFERAE

37. *Cochlearia officinalis* L. sens. lat.
Ovenfor Longyearbyen, ca. 300 m.
(HADAČ: (*C. groenlandica L.*) 520 m, Konussen.
CHYDENIUS (1865, p. 341–344): (sub nom. *Cochlearia fenestra*) ca. 700 m, Magdalena Hookfjellet.)

Draba. For *Draba*-artene kan man regne med at de oppgitte verdier gjelder for fullstendige planter med blomster og frukt, i alle fall det siste. Har det vært tvil til stede, er dette angitt.

38. *Draba lactea* ADAMS
Ovenfor Longyearbyen, 190 m.
Teltberget, ved den øvre enden av Longyearbreen, 685 m.
(HADAČ: 570 m, Duboistoppen.)

39. *Draba fladnizensis* WULF.
Ovenfor Longyearbyen, under Platåberget, 290 m.
Gruvefjellet, 560 m.

40. *Draba subcapitata* SIMM.
Nordenskiöldfjellet, den vestlige av de to ryggene på nordsiden, 790 m.
Nordenskiöldfjellet, østskråningen, 600 m.
Teltberget, ved Longyearbreens øvre ende, 685 m.
Platåberget, kanten mot Longyeardalen, 400 m.
Lars Hierthafjellet, ryggen vestover, 740 m.
Gruvefjellet, 560 m.
Adventtoppen, 570 m. (Bare steril.)
Zeppelinfjellet, 553 m.
Brøggertinden, 410 m.
(HADAČ: 835 m, Duboistoppen.

RØNNING: 700 m, Campbellryggen.
ASPLUND (1919, p. 32): ca. 500 m, Stensiöfjellet.)

41. *Draba nivalis* LILJEBL.
Nordenskiöldfjellet, østskråningen, 440 m.
Ovenfor Longyearbyen, under Platåberget, 290 m.
Sarkofagen, 515 m.
(Dessuten: «cfr. *Draba nivalis*», Zeppelinfjellet, 410 m.)

42. *Draba cinerea* ADAMS
Ovenfor Longyearbyen, under Platåberget, 290 m.
Gruvefjellet, 420 m.
(HADAČ: 250 m, Deltadalen.)

43. *Draba daurica* DC.
Sverdrupbyen i Longyearbyen. 140 m.
Morenene ved Rieperbreen i Bolterdalen, ca. 180 m.

44. *Draba alpina* L.
Nordenskiöldfjellet, østskråningen, 430 m.
Platåberget, på kanten ut mot Longyeardalen, 460 m.
Sarkofagen, 450 m.
Lars Hierthafjellet, kammen på vestsiden, 750 m.
Gruvefjellet, 470 m.
Zeppelinfjellet, 350 m.
(RØNNING: 700 m, Campbellryggen.)

45. *Draba bellii* HOLM
(Inkl. *Draba macrocarpa* ADAMS)
Nordenskiöldfjellet, østskråningen, 610 m.
Morenene ved breen på nordsiden av Nordenskiöldfjellet, 570 m.
Platåberget, ved foten av Nordenskiöldfjellet, 530 m.
Zeppelinfjellet, 540 m.
Brøggertinden, 410 m.
(Dessuten, mindre sikre bestemmelser («cfr. *Draba bellii*»):
Nordenskiöldfjellet, 650 m.
Lars Hierthafjellet, 700 m.
Soleietoppen, 615 m.
(RØNNING: 380 m, Lundbohmfjellet.
SCHOLANDER: 230 m, Floraberget, 230 m, Forsiusfjellet.
MALMGREN (1863): (sub nom. *Draba glacialis* ADAMS) ca. 180 m, Idunfjellet («Augusti-bay»).)

46. *Draba gredinii* E. EKMAN
Sarkofagen, 510 m.
Under Gruvefjellet, opp for Longyearbyen (Fig. 4), 390 m.
Blomsterdalen nord for Longyearbyen, 240 m.

47. *Draba oblongata* R. BR.
(Inkl. *Draba micropetala* HOOK.)
Platåberget, 460 m.
Sarkofagen, 550 m.
Trollsteinen, 835 m.

Fig. 4. *Draba gredinii, plante med modne frukter. Under Gruvefjellet ovenfor Longyearbyen, 270 m o. h. 21. juli 1960.* Foto P. S.
(*Draba gredinii* with ripe siliques. Below Gruvefjellet near Longyearbyen.)

Gruvefjellet, 600 m.
Den østre sidemorenen ved Longyearbreen, 380 m.
Ved Bogerbreen i Endalen (sidedal til Adventdalen), 250 m.
(Dessuten: ett tvilsomt eksemplar fra
Adventtoppen, 250 m.)
(RØNNING: *D. oblongata:* 335 m, Oxåsfjellet.
D. micropetala: 300 m, Oxåsfjellet.)

Braya purpurascens (R. BR.) BGE.
(HADAČ: 400 m, Aucellaskaret.
RØNNING: 348 m, Oxåsfjellet.
ASPLUND (1919, p. 30): ca. 600 m, Stensiöfjellet.)

48. *Cardamine bellidifolia* L.
Nordenskiöldfjellet, østskråningen, 580 m. (I frukt den 6. august.)
Platåberget, 430 m.
Ovenfor Longyearbyen, 210 m.
Gruvefjellet, 520 m. (I frukt den 20. juli.)
(HADAČ: 845 m, Gattytoppen.
SCHOLANDER: 230 m, Floraberget.
MALMGREN (1863): 250 m, ved Hinlopenstretet.)

Fig. 5. *Saxifraga tenuis i blomst i rasmarkene under Gruvefjellet, 390 m o.h. 20. juli 1960.* Foto P. S. (*Saxifraga tenuis* with flowers, found at talus below Gruvefjellet, 390 m a.s.l.)

SAXIFRAGACEAE

49. *Saxifraga oppositifolia* L.

Nordenskiöldfjellet, den østlige av ryggene på nordsiden, 800 m.
Nordenskiöldfjellet, den vestlige ryggen, 830 m.
Nordenskiöldfjellet, østskråningen, 780 m.
Sarkofagen, 450 m.
Lars Hierthafjellet, 865 m. (Uten blomster, men blomstret den 18. juli like nedenfor på 860 m.)
Trollsteinen, 830 m. (Blomstrende den 18. juli.)
Adventtoppen, 570 m.
Soleietoppen, 802 m.
Zeppelinfjellet, 550 m. (Blomstrende den 25. juli.)
Brøggertinden, 410 m. (I blomst den 2. august.)
(HADAČ: 915 m (blomstrende!), Albert Bruntoppen.
RØNNING: 739 m, Vesuv.
SCHOLANDER: 270 m, Ismåsefjellet.
MALMGREN (1863): ca. 300 m, «på norra kusten».

50. *Saxifraga nivalis* L.

Morenene ved breen på nordsiden av Nordenskiöldfjellet, 570 m.
Platåberget, 460 m.
Sarkofagen, 530 m.
Lars Hierthafjellet, ryggen vestover, 760 m.

Gruvefjellet, 480 m.
Østre sidemorene ved Larsbreen, 560 m.
Adventtoppen, 570 m.
Soleietoppen, 400 m.
(HADAČ: 680 m, Duboistoppen.
RØNNING: 310 m, Solanderfjellet.
SCHOLANDER: 230 m, Floraberget.
MALMGREN (1863): ca. 180 m, Idunfjellet («Augusti-bay».)

51. *Saxifraga tenuis* (WAHLENB.) H. SM.
Nordenskiöldfjellet, østskråningen, 440 m.
Teltberget, sydsiden, 700 m.
Platåberget, 410 m.
Under Sverdruphammeren, 370 m.
Under Sarkofagen, ovenfor Longyearbyen, 250 m.
Lars Hierthafjellet, kammen på vestsiden, 760 m.
Gruvefjellet, 390 m (Fig. 5).
Bjørndalen (nord for Platåberget og Nordenskiöldfjellet), 280 m.
(HADAČ: 635 m, Duboistoppen.
MALMGREN (1863): (sub nom. *Saxifraga nivalis* var. *tenuis*) ca. 180 m, Idunfjellet («Augusti-bay».)

52. *Saxifraga hieraciifolia* W. et K.
Under Sverdruphammeren, 200 m.
(HADAČ: 430 m, Aucellaskaret.
SCHOLANDER: 200 m, Faxefjellet.)

53. *Saxifraga foliolosa* R. BR.
Platåberget, 510 m.
Under Sverdruphammeren, 320 m.
Gruvefjellet, 330 m.
(HADAČ: 380 m, Konussen.
RØNNING: 460 m, Vesuv.)

Saxifraga hirculus L.
(HADAČ: 220 m, Sticky Keep.)

Saxifraga setigera PURSH.
(Syn.: *S. flagellaris* WILLD.)
(HADAČ: 590 m, Duboistoppen.
MALMGREN (1863): ca. 180 m, Idunfjellet («Augusti-bay»).)

54. *Saxifraga cernua* L.
Nordenskiöldfjellet, den østlige ryggen på nordsiden, 820 m.
Nordenskiöldfjellet, den vestlige ryggen, 780 m.
Nordenskiöldfjellet, østskråningen, 820 m.
Teltberget, 860 m.
Sarkofagen, 550 m.
Lars Hierthafjellet, 878 m (blomstret litt lenger nede på vestsiden, ved 700 m, den 16. juli).
Trollsteinen, 837 m.
Gruvefjellet, 570 m.

Den østre sidemorenen ved Larsbreen, 575 m.
Soleietoppen, 802 m.
Zeppelinfjellet, 420 m.
Brøggertinden, 410 m.
(HADAČ: 905 m, Albert Bruntoppen.
RØNNING: 739 m, Vesuv.
SCHOLANDER: 230 m, Floraberget.
MALMGREN (1863): ca. 300 m, Nordaustlandet ved 80°.)

55. *Saxifraga rivularis* L.
Nordenskiöldfjellet, østskråningen, 430 m.
Platåberget, 500 m.
Sarkofagen, 520 m.
Lars Hierthafjellet, kammen nordover mot Larsbreen, 800 m.
Gruvefjellet, 600 m. (Blomstrende den 20. juli.)
Adventtoppen, 570 m.
(HADAČ: 830 m, Valmuetoppen, 830 m, Duboistoppen.)

56. *Saxifraga groenlandica* L.
(Syn.: *S. caespitosa* L.)
Nordenskiöldfjellet, den østlige av ryggene på nordsiden, 630 m.
Nordenskiöldfjellet, østskråningen, 520 m.
Teltberget, sydsiden, 690 m.
Morenene ved breen på nordsiden av Nordenskiöldfjellet, 590 m.
Platåberget, 410 m.
Vestre sidemorene ved Longyearbreen, 470 m.
Sarkofagen, 540 m.
Lars Hierthafjellet, kammen på vestsiden, 740 m.
(Sto i blomst her den 18. juli.)
Gruvefjellet, 530 m. (Blomstrende den 20. juli.)
Østre sidemorene ved Larsbreen, 575 m.
Ved Bogerbreen i Endalen, ca. 500 m.
Adventtoppen, 570 m.
Zeppelinfjellet, 553 m. (Ble den 30. juli funnet avblomstret på dette stedet.)
Brøggertinden, 410 m. (I blomst den 2. august.)
(HADAČ: 650 m, Konusdalen.
RØNNING: 420 m, Lundbohmfjellet.
MALMGREN (1863): ca. 600 m, ved Magdalenafjorden.)

ROSACEAE

Potentilla. I rasmarkene under Sverdruphammeren ble den 18. august funnet en hel del sterkt varierende *Potentilla*-typer, med alle mulige overganger. Noen av disse minnet om *P. nivea* L. subsp. *subquinata* (LGE.) HULT., andre kunne nærme seg *P. hookeriana* LEHM., men jeg vil foreløbig ikke si noe mer bestemt om disse. Voksestedene for alle disse var ca. 310 m.

57. *Potentilla pulchella* R. BR.
Under Sverdruphammeren, 310 m.
(HADAČ: 250 m, Botneheia.)

58. *Potentilla hyparctica* MALTE
(Syn.: *P. emarginata* PURSH.)
Nordenskiöldfjellet, østskråningen, 545 m.
(Avblomstret og med modne frø den 6. august.)
Platåberget, 490 m. (Blomstrende den 13. juli.)
Sarkofagen, 515 m. (Blomstrende den 5. juli.)
Lars Hierthafjellet, vestsiden, 740 m.
Gruvefjellet, 390 m.
Adventtoppen, 310 m. (Avblomstret den 13. august.)
Soleietoppen, 615 m.
(HADAČ: 500 m, Marmierfjellet.
MALMGREN (1863): ca. 600 m, ved Magdalenafjorden.)

59. *Dryas octopetala* L.
Platåberget, på kanten mot Bjørndalen, 370 m.
Sverdruphammeren, 390 m.
Sarkofagen, 540 m. (I frukt den 11. august.)
Gruvefjellet, 490 m. (Blomstrende den 20. juli.)
Adventtoppen, 400 m.
Zeppelinfjellet, 400 m. (I blomst her den 25. juli.)
Brøggertinden, 410 m. (Avblomstret den 2. august.)
(HADAČ: 450 m, Botneheia.
RØNNING: 460 m, Vesuv.
SCHOLANDER: 360 m, Faxefjellet.)

ERICACEAE

60. *Cassiope tetragona* (L.) D. DON
Under Sverdruphammeren, 310 m.
Gruvefjellet, 510 m.
(HADAČ: 320 m, Duboistoppen.
RØNNING: 380 m, Lundbohmfjellet.
SCHOLANDER: 340 m, Faxefjellet.)

EMPETRACEAE

Empetrum hermaphroditum (LGE.) HAGERUP
(HADAČ: 200 m, mellom Ottofjellet og Albert Bruntoppen.)

POLEMONIACEAE

61. *Polemonium boreale* ADAMS
(Syn.: *P. humile* WILLD.)
Nordenskiöldfjellet, østskråningen, 580 m (Fig. 6).
(Blomstrende den 6. august. Var allerede den 14. juli i blomst i en høyde av 500 m på samme sted.)
Under Sverdruphammeren, 270 m.
(HADAČ: 335 m, Hiorthfjellet.)

Fig. 6. *Polemonium boreale, i østskråningen av Nordenskiöldfjellet ovenfor Longyearbreen, 500 m o. h. 6. august 1960.* Foto P. S.
(*Polemonium boreale* at the east slope of Nordenskiöldfjellet above Longyearbreen, 500 m a. s. l.)

SCROPHULARIACEAE

62. *Pedicularis hirsuta* L.
Nordenskiöldfjellet, østskråningen, 440 m.
Sarkofagen, 515 m.
Gruvefjellet, 470 m.
(HADAČ: 405 m, Duboistoppen.
RØNNING: 420 m, Lundbohmfjellet.)

Pedicularis dasyantha (TRAUTV.) HADAČ
(Syn.: *P. lanata* CHAM. et SCHLECHT. var. *dasyanhta* TRAUTV.)
(HADAČ: 130 m, Botneheia.
RØNNING: 220 m, Lundbohmfjellet.)

COMPOSITAE

Erigeron uniflorus L. sens. lat.
(MALMGREN (1863): ca. 250 m, ved Magdalenafjorden. MALMGREN's angivelse gjelder vel sannsynligvis *E. unalaschkensis* (DC.) VIERH.)

63. *Taraxacum arcticum* (TRAUTV.) DAHLST.
Nordenskiöldfjellet, østskråningen, 420 m. (Blomstrende den 14. juli.)
Under Sverdruphammeren, 310 m. (I frukt den 18. august.)
Sarkofagen, 515 m. (Blomstrende den 5. august.)
Adventtoppen, 570 m. (Med modne frø den 13. august.)
(HADAČ: 450 m, Botneheia.)

64. *Taraxacum brachyceras* DAHLST.
Under Sverdruphammeren, 310 m. (Rikelig, både blomstrende og med modne frø den 18. august.)

Konklusjoner vedrørende plantenes høydegrenser på Svalbard

(Conclutions concerning the height limits of vascular plants in Svalbard)

Det foreligger ennå alt for lite materiale om karplantenes høydegrenser på Svalbard til at man kan trekke noen særlige sikre slutninger. Fremfor alt er det såpass mange tilfeldige faktorer som bestemmer hvor høyt en plante kan finnes på et enkelt fjell, man kan bare tenke på et slikt forhold som at en stor del av fjellene på Vestspitsbergen består av forholdsvis flattliggende lag, med en derav følgende tendens til platådannelse. Man får platåer i flere etasjer, med en mer eller mindre rik vegetasjon på de flate partiene, mens de brattere skråninger imellom er nesten plantetomme.

På tross av alle usikkerhetene kan likevel noen generelle konklusjoner trekkes, i hvert fall når det gjelder de best undersøkte områder, vestkysten av Vestspitsbergen og da særlig strøkene omkring Isfjorden.

De som har foretatt undersøkelser over høydegrensene her, finner alle en bestemt gruppe arter som de aller høyestgående:

Papaver Dahlianum	(til 940 m)
Saxifraga oppositifolia	(» 915 »)
Saxifraga cernua	(» 905 »)
Phippsia algida	(» 905 »)
Stellaria crassipes	(» 890 »)

Som de neste i det selskap man vanligvis møter når man kommer ned fra en fjelltopp, kommer:

Draba subcapitata	(til 835 m)
Saxifraga rivularis	(» 830 »)
Ranunculus sulphureus	(» 802 »)
Cerastium alpinum	(» 802 »)[1]
Poa alpina var. *vivipara*	(» 800 »)
Luzula nivalis	(» 800 »)

Unntagelsesvis kan andre arter, som nok oftest finner sin grense ved en lavere høyde, finnes blant disse:

Cardamine bellidifolia	(845 m, HADAČ)
Draba oblongata	(835 m, egen notat)

RØNNING (1959) regner også *Oxyria digyna* og *Salix polaris* med til den gruppe arter som har de høyestliggende grenser. Disse to arter er imidlertid hittil bare kjent til henholdsvis 620 og 650 m (p. 44), og finner vanligvis sin grense ved en ennå noe lavere høyde.

[1] (HADAČ (1941) nevner denne art helt til 915 m, men inkluderer samtidig her *C. arcticum* LGE.)

Den videre fordeling av plantearter nedover fjellsiden er ganske jevn, og stadig flere arter kommer til etter hvert. Ser man på fordelingen av de 81 arter som er nevnt i listen ovenfor (p. 40–56), vil man få følgende tallforhold (hele Svalbard under ett, den høyeste notering for hver art):

900–1000 m:	4 arter	Over 900 m:	4 arter
800– 900 » :	9 »	» 800 » :	13 »
700– 800 » :	14 »	» 700 » :	27 »
600– 700 » :	7 »	» 600 » :	34 »
500– 600 » :	16 »	» 500 » :	50 »
400– 500 » :	6 »	» 400 » :	56 »
300– 400 » :	8 »	» 300 » :	64 »
200– 300 » :	15 »	» 200 » :	79 »
150– 200 » :	2 »	» 150 » :	81 »

Ser man på de enkelte fjell som vi besøkte, kan også noen trekk av interesse nevnes. En topp som Soleietoppen i Bolterdalen (p. 35) er et typisk eksempel på en slik ujevn fordeling som jeg nevnte ovenfor, med grunnlag i en platådannelse: på toppen, 802 m, ble notert 5 arter; videre nedover fjellsiden kommer det ingen nye arter til før man kommer ned til noen små avsatser på ca. 615 m, men her får man så til gjengjeld 4 arter på én gang. Et lignende eksempel gir Adventtoppen, med 14 arter på 570 meters høyde, mens det videre nedover fjellet, ned til 235 m, ble notert 6 arter i tillegg.

Noen av de besøkte fjell er imidlertid blitt såpass godt undersøkt fra flere kanter, at det lar seg gjøre å eliminere denne faktoren. Fordelingen av arter på Nordenskiöldfjellet–Teltberget (inkl. Platåberget) gir således en langt mer regelmessig fordeling, på tross av at man også her ofte finner en utpreget platådannelse:

900–1000 m:	1 art	Over 900 m:	1 art
800– 900 » :	4 arter	» 800 » :	5 arter
700– 800 » :	5 »	» 700 » :	10 »
600– 700 » :	8 »	» 600 » :	18 »
500– 600 » :	9 »	» 500 » :	27 »
400– 500 » :	10 »	» 400 » :	37 »

De 5 høyestgående arter, over 800 meter, er nettopp de samme som ble nevnt ovenfor (p. 56). Også på fjellpartiet Lars Hierthafjellet–Trollsteinen (inkl. Gruvefjellet) er det disse arter som er de høyestgående, fordelingen er her forøvrig:

800–900 m:	7 arter	Over 800 m:	7 arter
700–800 » :	21 »	» 700 » :	28 »
600–700 » :	2 »	» 600 » :	30 »
500–600 » :	13 »	» 500 » :	43 »

Her har man igjen en noe ujevn høydegrense-fordeling, med en uforholdsmessig stor mengde arter som finner sin grense mellom 700 og 800 m. Dette har også en rent topografisk årsak: på vestsiden av Lars Hierthafjellet, nedover mot skaret ved den øvre enden av Longyearbreen, løper en ganske slakt skrånende rygg, med rik vegetasjon og relativt stor artsrikdom, og en rekke arter finner akkurat her sine høyeste kjente voksesteder på Svalbard.

For strøkene lenger mot nord på Vestspitsbergen og på Nordaustlandet er såpass lite ennå kjent at man skal være forsiktig med å si noe sikkert om forholdet mellom høydegrensene her og i de trakter som nettopp er nevnt. I tillegg kommer at de fjell som her er undersøkt alle er relativt lave. For fjellene på nordvestkysten av Vestspitsbergen, hvor man ennå kan merke en viss påvirkning fra Golfstrømmen, later det til at høydegrensene ligger relativt høyt, kan hende på omtrent samme nivå som ved Isfjorden. Såpass gamle og usikre angivelser som man har fra f. eks. den svenske Svalbard-ekspedisjonen i 1861, MALMGREN (1863) og CHYDENIUS (1865), skal man vanligvis være forsiktig med å legge for meget vekt på. Når man imidlertid hos CHYDENIUS (p. 341–344) finner opplyst at 3 arter (*Luzula confusa*, *Cerastium alpinum* og *Cochlearia officinalis*) ble funnet i en høyde av ca. 700 m (2300 f.) på «Magdalena Hook-fjellet», som samme sted blir angitt til å være 2310 f. høyt (etter nyere målinger er høyden på det fjellet det iflg. beskrivelsen hos CHYDENIUS dreier seg om, 711 m), er dette opplysninger man burde kunne stole på. Disse eksemplene tyder på at det ikke er noen nevneverdig forskjell i livsvilkårene for plantene høyt til fjells her på nordvestkysten av Vestspitsbergen sammenlignet med Isfjord-området. I samme retning peker også angivelser hos MALMGREN (1863) av *Silene acaulis*, *Saxifraga groenlandica* og *Potentilla hyparctica* fra en høyde av ca. 600 m ved Magdalenafjorden. De opplysninger som foreligger herfra fra senere tid, fra Solanderfjellet ved Raudfjorden (RØNNING, 1959) og fra Zeppelinfjellet og Brøggertinden ved Kongsfjorden (egne angivelser) er alle sammen fra såpass lave høyder at de hverken kan motsi eller bekrefte denne antagelsen.

Når man så kommer lenger mot nordøst og øst på Vestspitsbergen, evt. til Nordaustlandet, later det til at plantene finner sin grense ved en lavere høyde, en overgang til strengere livsvilkår som også gjenspeiles i et lavere artsantall for disse områder, men det er her vanskelig å si noe sikkert om hvilken størrelsesorden det kan dreie seg om for forskjellen til vestkysten av Vestspitsbergen, RØNNING (1959, p. 59) antar 1–200 meter.

Det er ennå meget igjen å gjøre før man kan si å ha fått noe egentlig uttømmende kjennskap til høydegrensene for plantene på Svalbard. Spesielt gjelder dette, som det vil ha gått frem, de nordøstlige og østlige strøk. Det er vel også for Isfjord-området sannsynlig at man ved å foreta en nærmere undersøkelse av høyere fjell enn de som hittil har vært undersøkt med hensyn på plantenes høydegrenser, vil få en vesentlig hevning av høydegrensene.

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Note on occurrence of limburgite in Dronning Maud Land, Antarctica

BY

TORE GJELSVIK

Abstract

The rocks from Dronning Maud Land, collected by T. LUNDE along 72° S and between 3° W and 7° E are mostly ordinary gneisses. However, a black, basaltic rock, apparently belonging to a sill or a dyke has been found on Jutulsessen. The rock is lacking feldspar and consists only of augite, olivine, devitrified glass, and accessories. The chemical composition of the rock, mode and norm are given in table I. The present investigation shows that the Antarctic *limburgite* seems to be related to the normal olivine basalts, and not to the derivates of the basanite series.

During glaciological research in the mountain range in Dronning Maud Land, TORBJØRN LUNDE also collected rock specimens from the nunataks along 72° S, between 3° W and 7° E. Most of the specimens he brought back are ordinary gneisses, partly granitic, partly granodioritic, similar to the rocks of the "metamorphic complex" found by the geologists of the Norwegian-British-Swedish Antarctic Expedition, 1949–52 (ROOTS, 1953). However, on the northern plateau of Jutulsessen mountain (approximately at 72° S, 3° W) consisting mainly of ordinary gneisses he found a narrow belt with black, basaltic rocks. The belt was extending in EW-direction, and the rock was disintegrated and displaced by frost action, but apparently not removed far from its original location. LUNDE's field notes indicate that the rock belongs to a dike or a sill rather than to a flow.

The rock specimen has a dark, dense appearance with a joint system similar to that of columnar basalt. Microscopical investigation of thin sections discloses that the "basaltic" rock is of a quite unusual mineralogical composition. It lacks visible crystals of feldspar, and consists only of augite, olivine, devitrified glass, and accessories. Structurally it is quite extraordinary too, showing a kind of reversed ophitic texture with lath-shaped augite crystals distributed in a matrix of devitrified glass. The augite laths have a tendency to concentration in starlike clusters (Fig. 1). Olivine, sometimes of an unusual, platy shape, is only found as phenocrysts. Differences in the size of the crystals give the rock a faint banded appearance. A few amygdales, filled with devitrified glass, can be seen. The

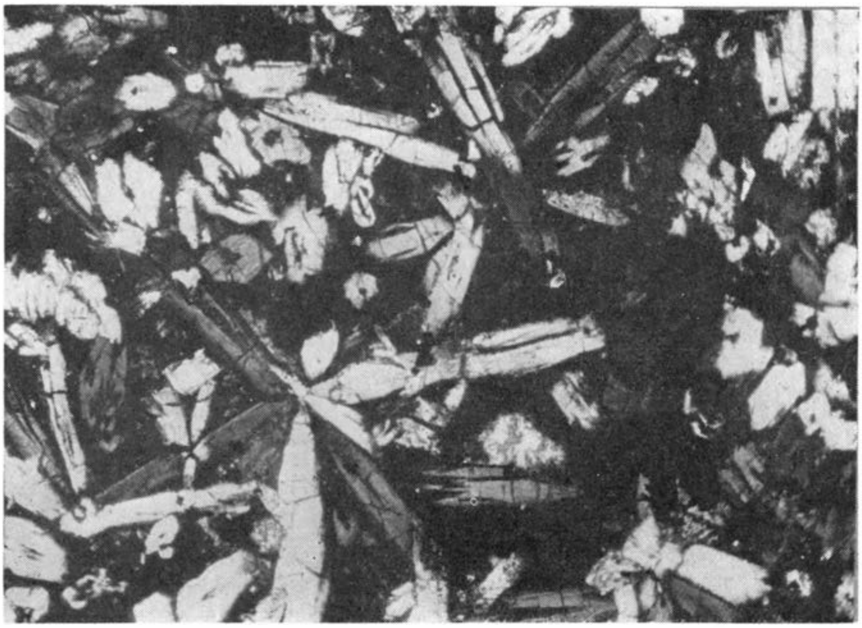

Fig. 1. *Starlike aggregates of augite (white) in devitrified glass matrix. 2 nic. ×40.*

minute crystals of the devitrified glass are of an elongated shape, looking like needles, laths or thin plates (Fig. 2). Judged from the chemistry of the rocks, they ought to be feldspar or mica crystals, however, they are too small to be identified.

The accessory minerals, iron ores, pyrite and apatite, mainly occur in the devitrified glass-matrix and appear only in very small crystals. Most of the iron ore is ilmenite, which usually forms dentritic intergrowth. Magnetite in most cases forms individual and idiomorphic crystals, sometimes rimmed by ilmenite.

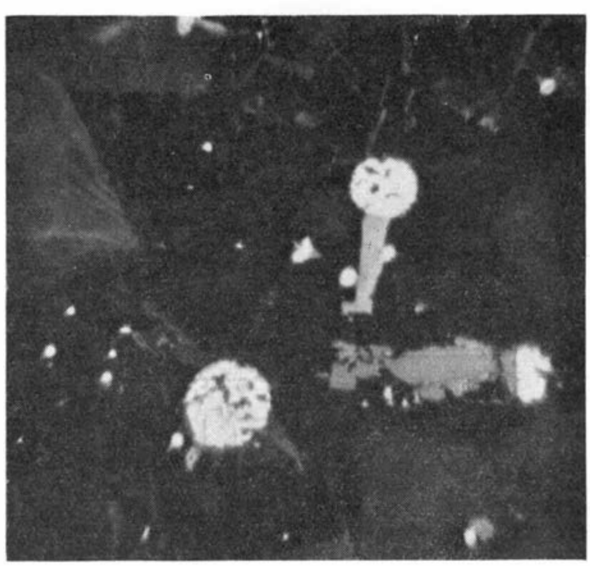

Fig. 2. *Polished section showing globules and globular aggregates of pyrite (white) and ilmenite (grey) in a base of devitrified glass (black), showing minute, elongated crystals of unidentifiable minerals. Ordinary light. 1 nic. ×880.*

Pyrite occurs in globules, usually less than 10μ. Larger globules, with diametres up to 100μ usually consist of aggregates of tiny pyrite crystals (Fig. 2). These globules can most reasonably be explained as crystallization products of scattered drops of a sulphide phase, formed by liquid immiscibility during the cooling of the magma.

The chemical composition of the rock, as well as mode and norm in cation percentages, are presented in table I.

TABLE I

	Weight per cent	Cation per cent
SiO_2	44.84	43.5
TiO_2	2.07	1.5
Al_2O_3	12.03	13.8
Fe_2O_3	3.92	2.9
FeO	9.41	7.6
MnO	0.15	0.1
MgO	8.69	12.6
CaO	10.50	11.0
Na_2O	2.55	4.8
K_2O	1.15	1.4
H_2O^-	0.68	–
H_2O^+	2.95	–
P_2O_5	0.35	0.3
SO_3	0.57	0.4
Cr_2O_3	0.20	0.2
	100.06	100.1

Norm	
Or	= 7.0
Ab	= 21.0
An	= 19.0
Ne	= 1.8
Di	= 26.8
Ol	= 15.5
Mt	= 4.7
Il	= 3.0
Pr	= 0.6
Ap	= 0.8
	100.2

Mode	
Devitrified glass	32.5
Olivine	11.2
Augite	52.5
Magnetite	1.1
Ilmenite	1.4
Pyrite	0.6
Apatite	0.8
	100.1

Chemical data, norm and mode of *limburgite* from Dronning Maud Land.

By point counting the main phases, and disregarding the accessories, it is found that the ratio of olivine, augite, and devitrified glass is 9 : 49 : 42. Recalculated to weight per cent: olivine 10, augite 54, and "glass" 36. The mode given in table I is calculated from this relationship and from the cation percentages. In this calculation the composition of olivine is thought to be Fo_{80} Fa_{20} (its axial angle is close to 90°), and the composition of augite as in table II.

A preliminar calculation, using the theoretical composition of augite with Wo : En + Fs = 1 : 1, gave a deficiency of 2 per cent of Ca disregarding the quantities of this metal in other phases. Apparently augite must be subcalcic, perhaps even more so than inferred in table II. No exact determination of the optical properties of augite has yet been carried out, but the extinction angle c v γ is

TABLE II

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Sum
42.5	2	11.5	6	12	8	18	100

Inferred composition of augite used in the calculation of the mode.

close to 45°, and even the double refraction appears to be normal. Given the inferred composition of augite, the composition of the devitrified glass, in cation percentage, will be:

Or	22
Ab	73
An	5

Such a low content of anorthite in glass of a rock of basaltic composition is not reasonable, and the high quantity of Al used in the inferred composition of augite is not very reasonable either. Accordingly, it is thought that augite contains less Ca and Al, the devitrified glass more anorthite, than that given in the mode calculations. An attempt will be made to isolate augite from the rock for determination of its true chemical composition.

In the norm of the *limburgite* from Dronning Maud Land, only 1.6 per cent of nepheline appears. In this respect, as well as in its complete lack of visible feldspar crystals, it differs from *limburgite* described elsewhere. According to BARTH (1956, table 4) the normative nepheline content of the *limburgites* from Alaska, Corea and Leward Islands varies between 9 and 12 per cent. The latter ones are all derivatives of basanite series, the Antarctic *limburgite* appears to be related to more normal olivine basalts. The genesis of the rock cannot be explained as long as its field relationship is unknown.

Acknowledgement

Stud. real. H. C. Seip has done the calculations and the microscopical point counting for the determination of norm and mode in table I.

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Discovery of a tree stump in front of Engabreen, Svartisen

BY

OLAV LIESTØL

In 1951 cand. real. ALF BERGERSEN found a number of tree stumps in the ground moraine in front of Engabreen. BERGERSEN described the location in his thesis, "En undersøkelse av Svartisen ved Holandsfjorden 1950–51", and took samples of the stumps. The place where the discovery was made became free of ice about 1940; it is situated in the relatively flat area south of the lake now lying in front of Engabreen. The tree stumps stand in the original surface, which is covered by a layer of recent ground moraine. The layer is greatly compressed and has an almost schist-like character. When at its maximum here, the ice was about 180 m thick; it is remarkable that the location is not more disturbed than it is. The stumps were snapped during an advance of the glacier, and everything was moved forward in the direction of the ice movement, but all stumps stand at their place of growth. One must suppose that the site was covered quite rapidly by ground-moraine which since then has acted as a protective layer against further destruction.

A sample sent to Botanisk Institutt, Universitetet i Oslo, was identified as birch (*Betula odorata*). The age of the tree when it was broken down, indicated by the annual rings, was over sixty years. Later in 1961 another sample was sent to Laboratoriet for Radiologisk Datering, Trondheim, for determination of the age by the C-14 method. The age was found to be 350±100 years. Thus the glacier advance which buried the area must have occurred about 1600 A.D.

At the end of the seventeenth century PEDER DASS wrote in "Nordlands Trompet" that Svartisen went "straight down from the highest mountains almost to the lowest shore". This suggests that Engabreen at this time extended fairly far forward and that, from all appearance, it must have overridden the described location. It is known from historical sources that Engabreen advanced in 1723, destroying the farm Storsteinøren and damaging the farm Fondøren. Whether the outermost moraine ridge found today dates from this year is not known. By and large, later measurements have indicated that the Svartisen outlets vary more or less in correspondence with the glaciers of south Norway, which had their maximum extension about 1750. It is likely therefore that the outermost moraine in front of Engabreen dates from about the same decades. About the seventeenth century the glaciers of south Norway were of much the same extent as at the present, and thereafter they advanced rather quickly. The dating of the stumps to about the year 1600 thus fits quite well into the picture that has been formed of the glacier variations. The relatively thick layer of humus in which the stumps were standing indicates that for a relatively long period, perhaps ever since the area was raised above sea level, no advance had reached down to this location.

The Nansen Ridge has become the Nansen Trough

A review of some recent Soviet-Russian papers on oceanographic conditions in the Greenland Sea

BY

NATASCHA HEINTZ

Abstract

The results of recent Soviet-Russian oceanographical investigations showing the presence of a trough – called the Nansen Trough, connecting the North Polar Basin with the Greenland Sea are referred. The trough, which is from 3100 to 3900 m deep, cuts the presumed Nansen Ridge along the meridian of 1° W.

The bottom topography and bottom sediments in the Greenland Sea are briefly described and the recent results concerning the temperature, salinity and speed of the East Greenland and the Atlantic currents are mentioned.

The Norwegian and the Greenland Seas and parts of the North Polar Basin have for many centuries been the hunting and fishing grounds of people from North European countries. Sailors and fishermen visiting these waters had considerable knowledge regarding weather-conditions and main currents in this area, but scientific exploration did not commence before the first part of the 19th century.

Since then many outstanding scientists, especially F. NANSEN, have dealt with the problems concerning the appearance of different currents and the variation of the temperature and salinity of the different layers of water, according to their origin and depth.

Many new data were gathered when the "Fram" drifted across the North Polar Basin in the years 1893–96, among the most important being the recognition of the great depth in the central parts of the North Polar Basin (Fig. 1) and the presence of 3 different strata of water, each with a characteristic temperature and salinity. The bottom layer, commencing at about 8–900 m below sea level, was found to have an average salinity of 35.1‰ and a temperature of –0.8° to –0.9° C, while the temperature of the corresponding strata of the Norwegian Sea was –1.3° to –1.4° C and the salinity 35.06‰. On the basis of these data NANSEN (1906) said: "We are therefore obliged to assume that the basin of the Norwegian sea is separated from the North Polar Basin by a comparatively shallow sub-oceanic ridge (or plateau) uniting Spitsbergen with Greenland". (Figs. 1 and 2.)

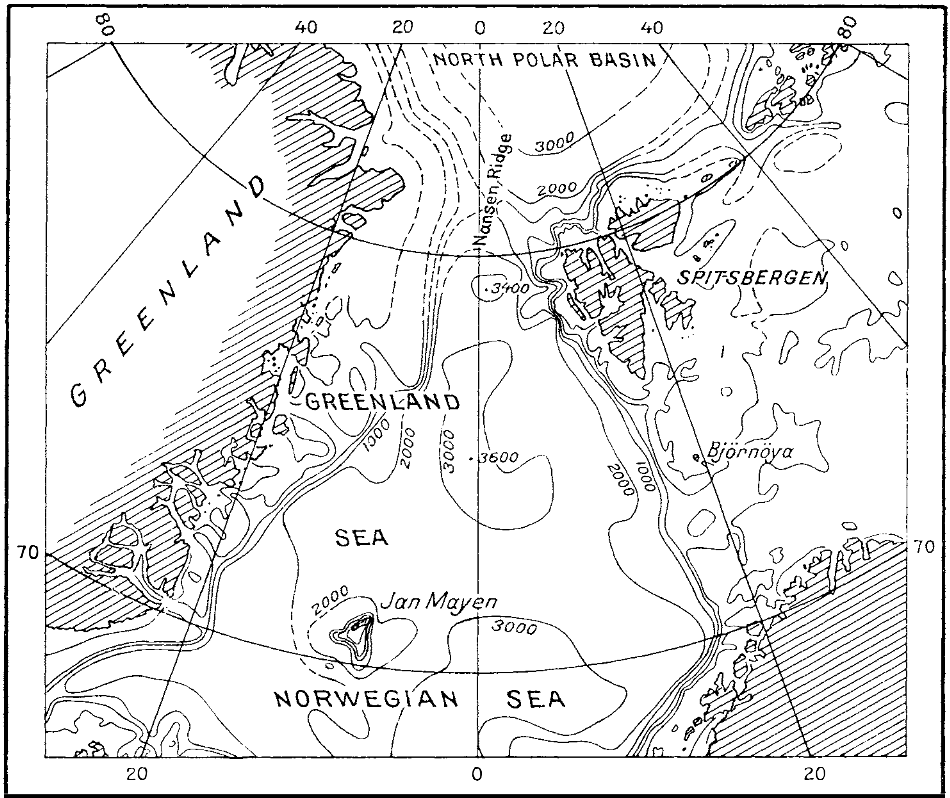

Fig. 1. *The map shows the different depths in the Norwegian and Greenland Sea and the North Polar Basin. The presumed Nansen Ridge between Vestspitsbergen and Greenland is indicated.* After F. NANSEN.

More recently improved technique in measuring the salinity has shown that in the bottom strata both of the Greenland Sea and the North Polar Basin the salinity is 34.9 $^0/_{00}$, while the temperature differs in the same way as mentioned above. In view of these discoveries NANSEN (1915) discusses the differences in the temperature of the bottom waters, and says that this "might be due to its becoming heated (by intermixture) in its circulation from the Norwegian Sea northwards into the North Polar Basin". The fact that the bottom waters of the Greenland Sea and the North Polar Basin have the same salinity, causes NANSEN to add that "it is no longer necessary to assume the presence of a sub-marine ridge between Spitsbergen and Greenland". However, he continues by saying that such a sub-marine ridge might give a reasonable explanation to the difference in temperature of the bottom waters in the two areas. NANSEN believed the ridge to reach a height of about 1200 to 1500 m below sea level, basing this assumption on the fact that the temperature of the water of the Greenland Sea at this depth is only -0.9° C, which is also the temperature of the bottom layers of the North Polar Basin.

The discovery by MYLIUS-ERICHSEN of a large submarine peninsula extending from the northeast corner of Greenland, was considered a further support of the existence of a submarine ridge between Greenland and Spitsbergen.

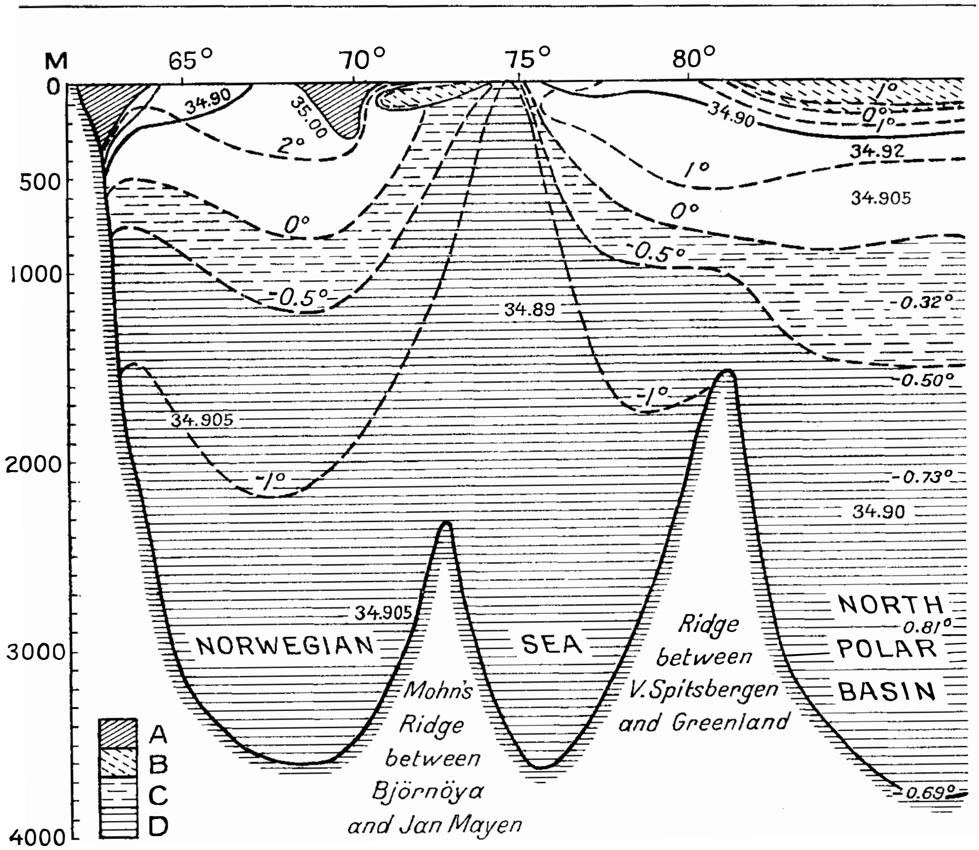

Fig. 2. *A N–S section through the Norwegian Sea showing Mohn's ridge between Bjørnøya and Jan Mayen and the presumed ridge between Vestspitsbergen and Greenland. The different layers of water are indicated. A. Water with salinity of more then 35 ‰.*
B. Water from the polar current, the mean temperature being below 0° C and the salinity below 34.60 ‰.
C. Deep sea layers with mean temperature between 0° and –0.5° C and salinity about 34.91 ‰.
D. Deep sea layers with mean temperature below –0.5° C and salinity about 34.90 ‰.
After F. Nansen.

The submarine ridge, which had been proposed by Nansen on what must be considered fully adequate scientific grounds, was named the *Nansen Ridge* (Figs. 1 and 2).

Several scientists have been engaged in the research and discussion as to the height of the Nansen Ridge. As mentioned, Nansen himself (1915) believed it to reach to approximately 12–1500 m below sea level, while Šokalski (1933) presumed the depth above the ridge to be only about 800 m. Berezkin (1939), on the other hand, says that the depth above the northern part of the Nansen Ridge is as much as 2000 m, and is supported by Vise (1948), who has recorded the still greater depth of 2200 m.

However, a German expedition working in this area in 1938 did not find the Nansen Ridge at all, although they made a great number of soundings.

After the Second World War extensive investigations have been carried out in these northern waters. There have, among others, been several Norwegian expeditions, but, especially since 1955, the Soviet-Russians have been carrying

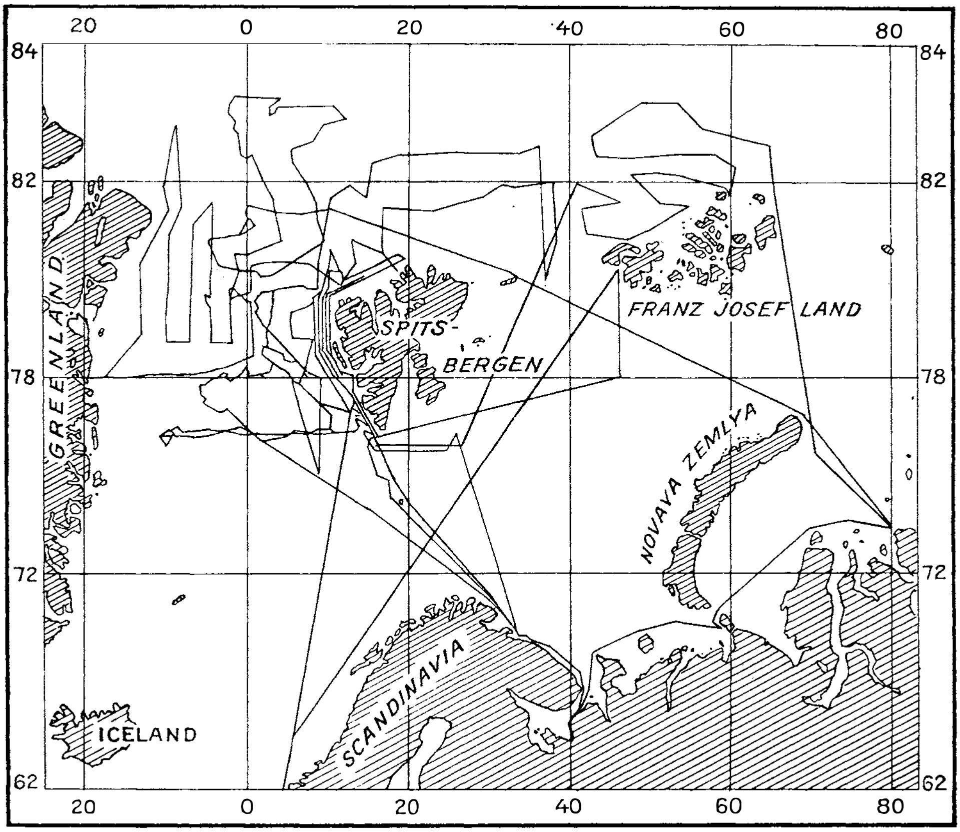

Fig. 3. *The routes of four Soviet-Russian, scientific oceanographical expeditions, that took place in this northern waters from 1955 to 1958.*
After A. F. LAKTIONOV, V. A. SAMONTEV and A. V. JANES.

out scientific observations on quite large scale. Fig. 3 shows the routes of four Soviet-Russian oceanographic expeditions which took place in this area from 1955 to 1958, and since 1958 they have been making regular hydrographical observations every season in the whole of the Greenland Sea (LAKTIONOV, SAMONTEV and JANES (1960).)

As a result of the soundings made from the research vessels "Ob" (in 1956) and "Lena" (in 1958) it has been possible to compile the chart given on Fig. 4.

The most interesting discovery is the existence of a deep trough connecting the North Polar Basin and the Greenland Sea. This trough cuts the presumed Nansen Ridge along the meridian of 1° W, and the Russians have named it the *Nansen Trough.* The axis of the trough goes north-south and its centre is in the north approximately 3100–3400 m deep, while in the south it reaches a depth of 3500–3900 m. The distance between the 3000 m isobats is in the narrowest part of the trough only approximately 20–25 km, this being in the area between 79° N and 80° 20′ N.

The Russian investigations of the Greenland Sea have also revealed a great number of other interesting facts concerning the topography of the ocean bed, the bottom sediments and the hydrological and hydrochemical conditions in these regions.

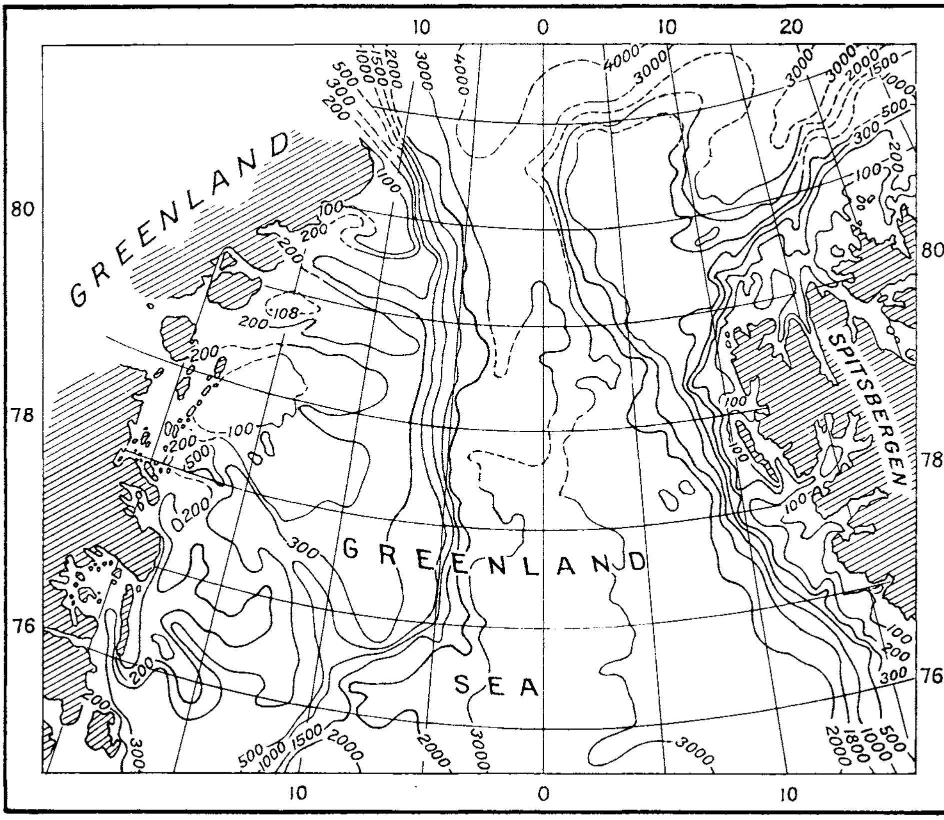

Fig. 4. *Chart compiled on the basis of soundings made by the Soviet-Russian oceanographical expeditions in 1956 and 1958. The chart shows the presence of a deep trough-like connection between the North Polar Basin and the Greenland Sea.*
After A. F. LAKTIONOV, V. A. SAMONTEV and A. V. JANES.

Fig. 4 shows that the width of the continental shelf along the northeast coast of Greenland increases from north to south. While it at Nordøstrundingen is only approximately 55 km wide, at 78° N it has already widened to 300–350 km. The topography of this northern part of the shelf is rather complicated, with banks and regions of shallow waters, the depths of which vary from 40 to 85 m. The shelf is frequently cut by deeper, ice-eroded valleys, some of them reaching depths of 200–300 m.

The maximum inclination of about 5° – 6° is found in the north part of the shelf, while further south, at 79° 30′ N, it is only 1.5° – 2°, which is the smallest value so far recorded.

Along the west coast of Vestspitsbergen the continental shelf is of a rather fjord-like appearance. The shelf is considerably narrower here than along the northeast coast of Greenland, and the 200 m isobat nowhere lies more than 60–75 km from land. At places the shelf is cut by deep troughs, i. a. outside Isfjorden, Kongsfjorden and Krossfjorden. The maximum inclination of the shelf is 6.5°, and the 2000 m isobat then lies only 90–130 km from the coast.

In the northern part of the Greenland Sea the continental shelf, as well as the ocean floor itself, is to a rather great extent covered by a brown, light-brown or brownish-grey mud. However, in the areas below 2460 m there is mostly brown or dark brown mud, while south of 78° 30′ N the sea floor is mainly covered by *Globigerina*-mud. In shallow regions the mud is to some extent replaced by clay sediments, mingled with a certain amount of shell fragments and larger stones. Large areas of the East Greenland continental shelf are down to a depth of 287 m covered by grey or greyish-brown sandy mud, while on the Spitsbergen side the colour of the mud covering the shelf to the same depth is brownish-grey.

There is also a great deal of coarser material, such as gravel, erratic boulders etc. to be found on the sea floor and near the coast of Greenland. The erratic boulders are especially abundant, as they are brought there by the calf-ice from the glaciers.

N. A. Bebov and N. N. Lepina have studied the drill-cores, collected by the Russian expeditions, and they have determined the variations in sedimentation and the corresponding oscillation between colder and warmer water during the last 80,000 to 90,000 years.

These investigations have revealed that during the last glaciation, from about 20,000 to 28,000 years ago, the depth of the sea in this region was approximately 500 m less than it is today. Large glaciers extended out on to the continental shelf to about 300 m below present sea level on the Greenland side, and to 200 m on the Spitsbergen side. The water was colder than it is today, and hardly any Atlantic water reached the Greenland Sea or areas further north. The layer of sediments deposited every 1000 years averagely measures 4 cm.

During the last interglacial period from about 28,000 to 50,000 years ago, the sea level of the Greenland Sea was between 500 and 700 m higher than today. Warm Atlantic waters moved into the Greenland Sea as well as into the southern parts of the North Polar Basin. In Greenland and Spitsbergen the glaciers had receded and only a 1.5 cm thick layer of sediments was deposited every 1000 years.

According to the sediments from the subsequent cold period (from 50,000 to 90,000 years ago) the Atlantic water once more was unable to reach the northern parts of the Greenland Sea, and, with a few exceptions, the water was cold. Both in Greenland and Spitsbergen the glaciers covered great parts of the present continental shelf and extended as far out as to 300–400 m below the present sea level. The depth of the sea was from 500–700 m less than today and averagely a 4 cm thick layer of sediments were deposited every 1000 years.

The hydrology of the northern part of the Greenland Sea is mainly influenced by the warm Vestspitsbergen current and the cold East Greenland current.

The speed of the Vestspitsbergen current increases from summer to winter, thus varying at 77° N from 0.1 knots in the summer to 0.3 knots in the winter. According to recent calculations made by the Russians, the Vestspitsbergen current averagely carries approximately 100,000 km^3 of warm Atlantic water per annum into the North Polar Basin, which corresponds to about $200{,}000 \times 10^{12}$ kcal of heat. However, the amount of Atlantic water, reaching the northern parts of the Greenland Sea and the North Polar Basin varies considerably from year to year. In dealing with the period 1933–1959 V. T. Timofeeva says that the greatest amount of Atlantic water reached these regions in the years 1939, 1954 and 1956, with an average of 122,000 km^3 of water with the mean temperature of

$+1.8°$ C, which corresponds to $225{,}000 \times 10^{12}$ kcal of heat. In contrast to approximately only 81,000 km^3 of water with the mean temperature of $+1.7°$ C passed into this area in 1957, giving approximately $140{,}000 \times 10^{12}$ kcal of heat. The minimum influx is in May approximate 7.8 km^3 per hour, while the peak is reached in November–December with an average of 14.3 km^3 of Atlantic water per hour.

The East Greenland current, on the other hand, carries along great quantities of ice and cold water. However, as confirmed by recent studies of hydrographical profiles along the meridians of 78° N and 76° 30′ N some water from the Vestspitsbergen current also returns west- and southwards and thus joins the cold East Greenland current. Generally we can say that the East Greenland current is characterized by great stability and speed, which increases as the current moves southwards. However, during summer, with prevailing southerly winds, the current may be impeded and may even sometimes practically stop altogether.

The considered data seem to indicate that the intensity of the Vestspitsbergen and East Greenland currents varies considerable, and when the one current decreases the other increases accordingly. As an example it may be mentioned that observations made from "Lena" in the spring of 1958 showed that approximately 6.2×10^{12} kcal of heat was brought into the North Polar Basin by the Vestspitsbergen current, while the amount of water carried away by the East Greenland current from the North Polar Basin in the same period was equivalent to 11×10^{12} kcal of heat.

It seems reasonable to assume that the decrease of the Vestspitsbergen current is not only due to the fact that a certain amount of its waters returns west- and southwards as a branch of the East Greenland current, but also to variations in the total amount of Atlantic water passing into the Greenland Sea.

Generally the water temperature in the Greenland Sea is lower in the westerly and northerly regions. The maximum temperature recorded is $+8°$ C in August and September off the west coast of Vestspitsbergen. At the same time of the year the temperature of the water along the northeast coast of Greenland varies from $+6°$ to $-1.7°$ C, and only in the most easterly areas of this region the temperature sometimes rises to $+2°$ C. The surface layers attain a minimum temperature of from $+2$ to $+3°$ C in February and March off Vestspitsbergen. Quite near to the coast and in the fjords, however, the temperature drops below freezing point, and off North East Greenland to between $-1.7°$ and $+1.8°$ C.

During the winter season the water along the west coast of Vestspitsbergen receives a considerable addition of warmer Atlantic water. Nevertheless it cools down quite rapidly, and at a depth of 300–400 m the temperature is $+3°$ to $+4°$ C.

Slightly to the south of the latitude 80° N the warm water of the Vestspitsbergen current dips below the surface layers, and at 80° N it reaches a depth of 50 to 75 m. Here the temperature during the summer months is a little more than $+5°$ C, while on the surface the temperature at the same time is from 0° to $+2°$ C.

The central parts of the Greenland Sea are during the winter characterized by the total absence of warm Atlantic water, and the water temperature of the entire area is below 0° C. This is due to the cold water from the bottom rising and the presence of very intensive convection currents.

The salinity of the water of the Greenland Sea varies between 21 and 35 ‰, and there is very little variation in the course of the year. The maximum salinity of about 35 ‰ is found in the regions of the Vestspitsbergen current and in the deeper layers of the Greenland Sea and the North Polar Basin. The minimum salinity of approximately 21 ‰ has been recorded from the East Greenland current. In this area melting of the ice causes great variations in the salinity during the summer season, while during the winter it is more stable.

Heavy seas have very rarely been observed behind the edge of the ice. However, the Soviet-Russian research vessel "Lena", in March 1958, encountered tall seas in the heavy East Greenland pack ice, some 80 to 100 km east of the ice-edge.

The exceptional ice conditions found in the Greenland Sea, with the presence of great amount of different types of ice all the year round, are mainly due to the large quantities of ice being brought there by the East Greenland current. Based on recent observations, the Russians have figured out that an average of about 1800 km^3 of ice is annually brought to the Greenland Sea from the North Polar Basin.

The ice which in the winter can be observed in the vicinity of Sørkapp, Vestspitsbergen, comes from the Barents Sea and is not very heavy. However, several year old ice of larger dimensions has also been recorded from this area, as for instance in 1959.

The waters of the northern part of the Greenland Sea are first of all hydrochemically characterized by a high content of oxygen. The amount of oxygen varies from 91 to 116 % near the surface, with a maximum at a depth of 10–25 m, and from 81 to 95 % near the bottom. Normally all the strata of water have a lower content of oxygen in the winter than in the summer, and the Atlantic water carries less oxygen than the arctic water.

The waters in the central part of the Greenland Sea has quite a high content of appanaged alkalies (0.0068 or more). This is due to the great amount of ice from the North Polar Basin, which melts here. This ice is quite rich in $CaCO_3$, and observations show an average content of 0.03 g $CaCO_3$ per 1 kg of ice. In the coastal waters both on the Greenland and Spitsbergen side the content of appanaged alkalies is not so great. On the Greenland side this is due to the ice from the Greenland glaciers containing very little alkalies. When this ice melts during the summer, the resulting water contains hardly any alkalies at all. In Spitsbergen waters the amount of appanaged alkalies is from 0.0066–0.0067, which approximately equals that found in the Atlantic Ocean. From time to time, however, the amount may increase to 0.0068, owing to the great afflux of water from the Barents Sea, which is rich in alkalies.

The distribution of appanaged alkalies according to depth is very complicated, with several characteristical maxima and minima depending on the origin of the different layers of water. For instance, the fairly large amount of appanaged alkalies, found in the strata of water in the depth of between 500 and 1500 m, is due to these layers partly having their origin in the North Polar Basin.

The water of the Greenland Sea is further characterized by pH values varying between 7.9 and 8.27, an amount of nitrates from 0 to 6.7 mg/m^3, phosphates from 0 to 42 mg/m^3, and SiO_2 from 0 to 830 mg/m^3. In the areas furthest to the north there is from 10 to 100 mg of iron per 1 m^3 of water, from 8 to 23 mg/m^3 of molybdenum, while beryllium has as yet not been recorded.

The above mentioned data show that the present hydrochemical conditions in the Greenland Sea are to a great extent determined by the large amount of ice coming there from the North Polar Basin.

Many problems connected with the oceanography of the Greenland Sea and the adjacent waters still remain unsolved. However, the investigations which are being carried out in these regions, both by Norwegian and Soviet-Russian scientists will definitely reveal many new interesting facts in the coming years.

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Indianerne ved Peel River

(The Peel River Indians.)

AV

THOM ASKILDSEN

Abstract

The Peel River Indians live in the northwestern part of Canada. They make their living mainly by fishing and hunting. These Indians have been in contact with white people for more than a century. However, their way of living has been markedly changed since the last World War.

This article deals with both the present way of living of these Indians as well as some marked trends in connection with the present change of the culture in this area.

Den følgende artikkel bygger på etnografiske feltstudier i Nordvest-Canada, utført med støtte av Norsk Polarinstitutt sommeren 1961. Arbeidet er et ledd i en undersøkelse av kulturendringen i arktiske strøk. Lignende studier er tidligere utført ved Enare, Nord-Finnland (sommeren 1956), Frederikshåb kommune, Vest-Grønland (sommeren 1957) og Povungnituk, Hudson Bay, Canada (sommeren 1960). For all hjelp i forbindelse med disse feltarbeidene ønsker jeg å uttrykke min dypeste takknemlighet til Norsk Polarinstitutt ved dets tidligere og dets nåværende leder, dr. ANDERS K. ORVIN og dr. TORE GJELSVIK. Uten deres velvilje og interesse vil neppe disse studiene blitt utført.

Peel River er det nordvestligste tilløp til MacKenzie-elven før den munner ut i MacKenzie Bay i Beaufort Sea. Den har sitt utspring i Rocky Mountains på grensen mellom Canada og Alaska, og renner gjennom tempererte områder med skog og bratte elveskråninger til den når arktisk vegetasjon og deltaområder nord for Fort McPherson. (Fig. 1.)

Ved denne elven bor omkring 400 indianere som offisielt går under navnet Loucheux, men som selv kaller seg Tatlit Kutchin (OSGOOD, 1936, p. 13). Dette navnet kan muligens best bli oversatt med indianerne ved Peel River. Disse indianerne har hatt kontakt med hvite siden 1830-årene, da den første Hudson's Bay Company handelsstasjon ble åpnet noen kilometer sør for det nåværende Fort McPherson. Likevel var det først i 1921 at denne indianerstammen overga sitt landområde til de offisielle kanadiske myndigheter (SLOBODIN, 1960, p. 68).

Sentrum for Peel River-indianerne i dag er Fort McPherson. Stedet har ukentlig flyforbindelse med Inuvik som er det nye administrasjonssentret i denne delen av Canada etter at Aklavik er besluttet nedlagt. Fra Inuvik er det flyforbindelse

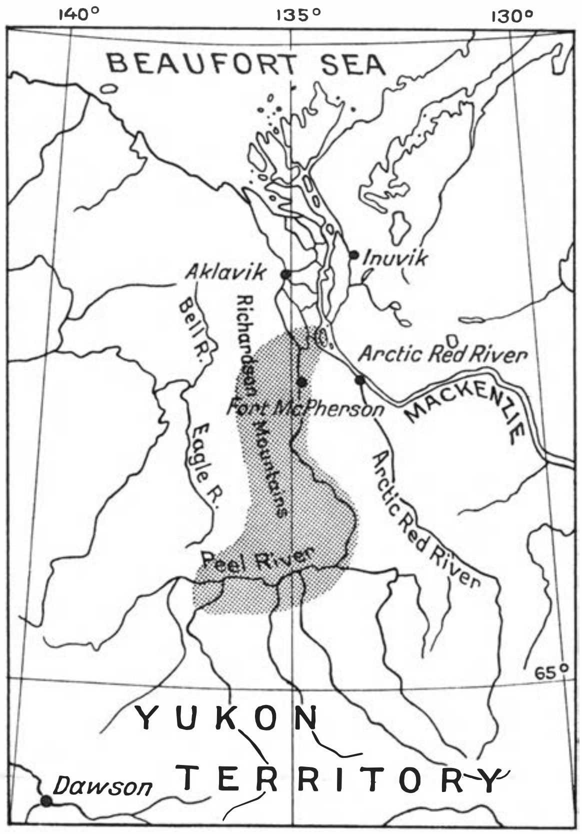

Fig. 1. *Peel River indianerne bor ved Peel River som er det nordvestligste tilløpet til MacKenzie-elven. Det skraverte feltet angir deres jaktområder.*
(The Peel River Indians live at Peel River, which is the most northwestern tributary to MacKenzie River. The hatched area shows their hunting grounds.)

to ganger i uken til Edmonton. For indianerne er det stort sett bare flyforbindelsen med Inuvik som har praktisk betydning, for billetten til Edmonton koster for meget, f. eks. sommeren 1961 var billettprisen Edmonton–Fort McPherson 270 dollar tur-retur. Likevel hender det at indianerne blir sendt dit på statens regning, enten i forbindelse med sykdom, utdannelse eller arbeid. Den tidligere passasjertrafikk på MacKenzie-elven er nedlagt, og det er kun varer som i dag blir sendt med båt.

Peel River indianerne er en av åtte Kutchin-stammer som holder til i området mellom elvene Yukon og MacKenzie, fra ca. 65° N. br. til eskimoenes område mot nord. Offisielt utgjør denne stammen 411 personer regnet pr. 15. juli 1961. Men da barnetallet i de enkelte familier kan være opptil 16 stykker, er befolkningen på over 15 år ikke mer enn 246 personer. I tillegg til indianerne kommer 60 hvite og 70 av hvit/indiansk avstamning. Av de siste er det en del som juridisk har hvit manns status, mens resten har status som indianere.

Det naturlige erverv for indianerne ved Peel River er jakt og fiske. Mens fisket hovedsakelig foregår om sommeren og høsten, så er vinteren og våren jakttiden. I mai måned går isen på Peel River, og fra slutten av juni til midten av august går fisken opp i elven. Først kommer herring (*Argyrosomus artede*), som veier 2–3 kg, dernest conny (*Lota maculosa*) som kan veie opptil 50 kg og så whitefish (*Coregonus clupeiformis*) på mellom 3 og 5 kg.

Indianerne fisker med nylongarn som er mellom 10 og 15 meter lange og fra

Fig. 2. *Indianere som arbeider med å rense og tørke fisk ved Peel River.* (Foto: TH. ASKILDSEN.)
(Indians working with cleansing and drying fish at Peel River.)

1,5 til 3 meter dype. Garnene blir satt i bakevjer hvor strømmen er liten, og best fiske er det om sommeren når vannet er ugjennomsiktig av gjørme på mer enn en halv meters dyp. Garnene blir trukket to ganger om dagen, og ved godt fiske kan indianerne få opptil 250 kg fisk i to garn. Garnmengden blir bestemt av fiskeforekomstene, for indianerne har som regel ingen mulighet for å selge fisken. Den blir tørket og brukt som vintermat for mennesker og hunder. (Fig. 2.) En del indianere legger også fisk ned i groper i jorden. Disse er gravd ned til permafrosten og dekket med kvister og jord. Selv om fisken råtner en del før den blir brukt, så egner den seg bra til hundefor.

Når isen har lagt seg i september, fisker indianerne i elven med garn under isen. De fisker også med krok og snøre og med line. Fisk tatt på denne årstiden blir oppbevart frosset på stilaser utenfor hundenes rekkevidde. Ved siden av de tre nevnte fiskesortene får indianerne også lake, gjedde, laks og ørret foruten den såkalte sucker (*Catastomus commersoni*) og dogsalmon (*Oncorhynchus keta*).

Om vinteren er det en del indianere som driver med fiske i småvann, men på denne årstiden er de som regel opptatt med andre gjøremål.

Den 1. november begynner indianerne fangst på mår og mink. Fra 1950 til 1959 hadde hver familie sitt spesielle fangstområde, men på grunn av dårlig utnyttelse av enkelte områder og konsentrasjon av dyr på bestemte steder langs Peel River, er denne fremgangsmåten i realiteten oppgitt. Selv om jakttiden på mår varer til 1. februar og på mink til 1. mars, så er denne fangsten avviklet alt ved juletider, både fordi det er lite dyr, og fordi prisen på skinn er dårlig. Vinteren 1960/61 ble det fanget 332 mink og 289 mår. Mens prisen på minkskinn varierte fra 20 til 30 dollar, så var prisen på mår ca. 50 dollar. Samme år ble det fra

1. mars til 15. juni fanget 32 000 moskusrotter som ble solgt for ca. 50 cent pr. skinn. Indianerne fanger også en del vesel, gaupe, ulv, jerv og bjørn, men disse teller lite økonomisk.

Tatt i betraktning at et fiskegarn i Fort McPherson koster det dobbelte av hva det gjør i Edmonton og at salt koster 35 cent pr. kg og er omtrent like dyrt som sukker, så blir det ikke mange kontanter igjen av en jaktsesong. Ofte har indianerne også stiftet gjeld hos en av de lokale handelsmennene og er derfor nødt til å selge fangsten der, selv om de som regel ville oppnå langt bedre priser ved å sende fangsten direkte til oppkjøperne i Winnipeg eller Edmonton.

Fra midten av januar til slutten av februar driver indianerne jakt på det kanadiske reinsdyret caribou (*Rangifer caribou*). Da drar de over Richardson Mountains på en av de elvene som drenerer dette fjellområdet mot øst. Derfra drar de sørover mellom Eagle River og Richardson Mountains og så langt som det er nødvendig for å treffe caribou. Stundom støter indianerne på dyrene på østsiden av fjellene, og da er kjøttmaten for vinteren sikret. Men når de i dagevis må trekke lenger og lenger sørover uten å finne dyr, da hender det at hundene spiser brød mens indianerne sulter.

Under jakten bor kvinner og barn i teltleirer, mens mennene drar på jakt. Dersom det er lite dyr, drar jegerne hver for seg. Skulle en av dem oppdage en reinsdyrflokk, blir det organisert fellesjakt ledet av den dyktigste jegeren. Dyrene blir da drevet mot bestemte poster hvor jegerne skyter så mange dyr de kan frakte med seg. Når kjøttet er transportert til leiren, blir det tørket i teltene.

Indianerne kan nyttiggjøre seg alt på et reinsdyr. Mageinnholdet blir stundom blandet med sukker og spist som delikatesse. Til andre tider blir det kokt sammen med innvollene og brukt til hundefor. Benene blir knust og kokt, for margen blir brukt til steke- og bakefett.

Også om sommeren driver indianerne ved Peel River jakt på reinsdyr, men denne er avhengig av hvor nær dyrene er sommerboplassen, for det er ofte vanskelig å frakte dyrene frem. Både sommer og vinter driver indianerne jakt på hare, elg og fjellsau, og disse dyrene tjener til utfylling av kjøttdieten. (Fig. 3.)

En del av Peel River-indianerne arbeider for hvite, men antallet av dem som er beskjeftiget, varierer med årstidene og med arbeidsmengden som skal utføres. Under utbyggingen av Fort McPherson og Inuvik var det lett for indianerne å få arbeid, men slik er det ikke i dag. Av den grunn setter de offentlige myndigheter igang tømmerhugging eller ulike former for vedlikeholdsarbeid. Sommeren 1961 var arbeidslønnen for en indianer som arbeidet for administrasjonen i Fort McPherson omkring 1,80 dollar pr. time. Da indianerne er avhengige av kontanter, er dette en måte hvorved en unngår direkte offentlig understøttelse.

Indianernes boligforhold varierer med bostedet. I Fort McPherson består deres del av bebyggelsen av ca. 100 tømmerhus. De er som oftest i størrelsen 6×6 meter med ett værelse og loft. Da temperaturen om vinteren kan synke til —54° C, er veggene som regel kledd med papp og huntonitplater. Gulvet har som oftest husets beste isolering, for siden det ikke er noen kjeller under det, er det kun noen få cm til permafrosten. På åpen mark er det ca. 50 cm ned til permafrosten. Byggemåten varierer ellers fra lafting til spikring, og fugene mellom tømmerstokkene blir fylt med leire. Inventaret i husene skifter fra hjem-

Fig. 3. *Indianerhus ved Peel River. I forgrunnen et elgskinn som er vridd sammen for å presse ut vann og sepe under garvingen.* (Foto: TH. ASKILDSEN.)
(Indian house at Peel River. In the foreground a moose-skin, twisted in order to remove water and soap while tanning.)

Fig. 4. *Fra Fort McPherson. Om sommeren foretrekker indianerne å koke maten ute. Kvinnen til venstre har pipe i munnen, for både kvinner og menn røker intenst.* (Foto: TH. ASKILDSEN.)
(From Fort McPherson. In the summer the Indians prefer to cook outdoors. The woman to the left is smoking; both women and men smoke intensely.)

melagete bord og krakker til mahognysenger og vaskemaskiner. Felles for dem alle er at kjøkkenutstyr og redskaper er av alminnelig kanadisk butikkstandard. (Fig. 4.)

Når indianerne er på jakt eller fiske, bor de i telt eller tømmerhus, alt avhengig av hvor lenge de oppholder seg på de ulike plassene. En rekke indianere har tømmerhus på flere steder, og mange av dem betrakter derfor ikke Fort McPherson som sitt faste oppholdssted, men f. eks. Mouth of Peel. Teltene syr indianerne selv av lerret, men det er bare én indianerfamilie ved Peel River som bor i telt året rundt.

Indianernes viktigste fremkomstmidler er kano og hundeslede. Kanoene kan variere i størrelse fra ca. 12 til 22 fot. Disse blir i dag kjøpt hos handelsmannen, og mens de mindre kanoene blir brukt til jakt og fiske, blir de store kanoene med påhengsmotorer fra 3 til 10 hk mest brukt til transport. Mer vanlig enn store kanoer er det likevel å bruke prammer på ca. 30 forts lengde og 6 fots bredde. I disse kan indianerne laste hunder, husgeråd, utrustning og hele familien når de flytter fra det ene fangststedet til det andre. Prammene er laget av marin kryssfinér, og de blir drevet frem med påhengsmotorer. (Fig. 5.)

Denne overgangen til mekaniserte fremkomstmidler har øket indianernes bruk for penger. Deres aksjonsradius er dermed blitt utvidet, men da prisen på bensin er høy, f. eks. sommeren 1961 var prisen på bensin 70 cent pr. gallon, kan de ikke gjøre bruk av disse fremkomstmidler i den grad de kunne ønske det.

Om vinteren kjører indianerne med hundeslede. Selve sleden lager de fleste indianerne selv av hickory eller ask. Disse materialene blir enten kjøpt hos en av de lokale handelsmennene, eller også bestilt direkte fra Edmonton. Selv om de

Fig. 5. *Pram og kanoer av den type indianerne bruker ved Peel River.* (Foto: TH. ASKILDSEN.)
(Scow and canoes of the type used by the Indians at Peel River.)

kan få kjøpt ferdige hundesleder, så er de hjemmelagete mye sterkere og varer 2–3 ganger så lenge. Som regel bruker indianerne 4–5 hunder til et spann, men de fleste familieforsørgerne ved Peel River har 8–10 stykker. Hundene er helt uunnværlige for indianerne, for uten dem kan de vanskelig drive jakt og fiske om vinteren.

Grunnlaget for indianernes samfunnsordning er familien. Det er vanlig at indianerfamilier med få eller ingen barn adopterer ett eller flere hos familier som har mange, eller som av en eller annen grunn ikke kan beholde dem alle. Under jakt og fiske slår flere familier seg sammen, og grunnlaget for gruppedannelsen er slektskap eller vennskap. Men det behøver ikke alltid være de samme familiene som grupperer seg sammen. Det hele er avhengig av de ulike familiers måte å drive jakt og fiske på. De områdene hvor de ulike gruppene holder til, er bestemt av tradisjon. Selv om indianerne kan slå seg ned hvor som helst ved Peel River, så vil en befolkningskonsentrasjon på ett område føre til for meget jakt og fiske, og dermed minske utbyttet for den enkelte.

Når hele stammen samler seg i Fort McPherson, er det for i løpet av 3–4 uker å fornye den sosiale kontakt, diskutere og fastlegge felles interesser og avgjøre saker i forbindelse med den hvite administrasjonen. Denne tiden fører til en rekke møter mellom høvdingen og rådgiverne, mellom disse og den øvrige indianske befolkningen og mellom stammen som helhet og de hvite. Mens høvdingen er bindeleddet mellom indianerne og de hvite, så er det også høvdingen som på stammens vegne fører forhandlinger med andre stammer. Han representerer i det hele sin stamme både innad og utad og fungerer så lenge han har sitt folks tillit. Det samme gjelder for rådgiverne. Disse samlingene tjener også til proviantering for en ny periode på boplassene. De er dessuten tiden for bryllup og barnedåp, for dans og fest, selskaper og kirkegang.

Indianerne ved Peel River er anglikanere, men ved siden av en protestantisk kirke i Fort McPherson, finnes det også en katolsk. En uoverensstemmelse mellom katolikkene og protestantene i 1870-årene, resulterte i at katolikkene dro til Arctic Red River ved MacKenzie-elven. I dag står den katolske kirken på handelsstedet nærmest som et minne om svundne tider. Den begynner etterhvert å få ny betydning, men nå først og fremst for en del av den hvite befolkningen.

Opprinnelig var det de anglikanske misjonærene som sto for indianernes skoleopplæring, men i dag er den overtatt av staten. Fra barna er 7 til 15 år får de gratis undervisning. I tiden 1. september – 30. juni bor de i skoleinternatet hvor de får gratis kost, losji og klær. De av barna som er egnet til det, får videre skolegang i Inuvik og Yellowknife. Også her er undervisningen gratis, og den kanadiske stat sørger for universitetsutdannelse for dem som har evner til det.

I Fort McPherson finnes det ved siden av representanter for Indian Affairs, Northern Affairs og Royal Canadian Mounted Police også en sykestue som blir betjent av en sykepleierske. Ved mer alvorlige sykdommer blir pasientene sendt til Inuvik eller Edmonton. For indianerne er all hjelp til lege og sykehusopphold gratis.

Siden indianerne ved Peel River kom i fast kontakt med de hvite i 1830-årene,[1]

[1] Før Fort McPherson ble opprettet, var nærmeste handelssted Fort Good Hope.

har kulturendringen vært bestemt av arten og graden av kontakt og følgelig har den gått gjennom ulike stadier. I slutten av 1850-årene kom de første anglikanske misjonærene. I 1890-årene dro gullgravere på vei til Alaska forbi Fort McPherson, og endel indianere arbeidet for dem. I 1920-årene kom det private handelsmenn til Peel River, og indianerne fikk øket adgang til handelsvarer. I 1950-årene tiltok den offentlige interesse for indianerne i dette området i form av tiltagende byggevirksomhet og sosial aktivitet.

Hvilke hovedlinjer er det så kulturendringen hos Peel River-indianerne konsentrerer seg omkring i dag?

Utbyggingen av Fort McPherson og Inuvik har gjort det lettere for indianerne å få lønnet arbeid. Tatt i betraktning at prisen på pelsskinn er så lav at det knapt lønner seg å drive jakt på dem, så er indianerne nærmest nødt til å søke arbeid. De trenger penger til mat, klær og utstyr, for deres livsførsel er preget av pengehusholdningens tidsalder. Resultatet er blitt at indianerne holder seg omkring handelsstedet i håp om at det skulle bli en jobb, selv om dette kan føre til at de må gå arbeidsløse en tid. En følge av arbeidet for de hvite er at indianerne ikke lenger bryr seg om å ha kano eller hunder, for dette skaper utgifter som er unødvendige ved lønnsarbeid. Indianerne kan derfor ikke utnytte ledigheten mellom to jobber til å fiske eller drive jakt. Dessuten er det en viss konkurranse om jobbene, slik at det gjelder å være til stede når slike dukker opp.

Samtidig som lønnsarbeid har intensivert overgangen fra naturalhusholdning til pengehusholdning og til konsentrasjon omkring handelsstedet, så har det også ført til større kontakt mellom indianerne og de hvite. For barna har særlig skoleinternatet miljøforandrende innflytelse. Størstedelen av året bor barna i internatet, mens foreldrene bor i telt eller tømmerkoier på jakt eller fiske. (Fig. 6.) Dermed får barna liten kontakt med foreldrenes levevis, og livet i internatet fører til at det faller vanskelig for dem å vende tilbake til foreldrenes levemåte. De som kan få arbeid hos hvite, prøver derfor å få det. Et eksempel på resultatet av kontakten mellom indianerne og de hvite er at de aller fleste indianerbarna ikke forstår sitt eget morsmål. Når foreldrene snakker til mindreårige barn, foregår det på engelsk, mens de derimot snakker sitt eget språk, kutchin, seg imellom. Selv om internatlivet virker sterkest på barna, virker det indirekte tilbake på foreldrene. Da disse gjerne vil beholde kontakten med sine barn, blir overgangen fra telt til tømmerhus intensivert, og utstyret i husene blir skaffet til veie etter mønster av de hvite.

Denne kontakten med hvite har ført til redusering av kirkens innflytelse i Fort McPherson. Mens kirken og misjonærene tidligere var det sentrale i indianernes religiøse og sosiale liv, så er kirken nå i alt vesentlig redusert til kun å foreta kirkelige handlinger. Mens det tidligere nærmest var en selvfølge at alle som hadde anledning til det, gikk til gudstjeneste, så har antallet kirkegjengere minket sterkt. Dersom misjonærene klandrer indianerne for avtagende interesse for kirkegang, svarer de: «Men de hvite går jo ikke til kirke.» Kirken som institusjon er heller ikke lenger det sted hvor indianerne henvender seg når det gjelder sykdom, økonomiske vanskeligheter, undervisning og kontaktproblemer med hvite. Andre instanser har overtatt, og mens administrasjonen tilsynelatende har penger nok, så arbeider misjonærene med små midler. En rekke indianere har derfor funnet ut at penger hjelper mer i materiell henseende enn kirken. Det er også mulig at

Fig. 6. *Indianertelt ved Peel River.* (Foto: TH. ASKILDSEN.)
(Indian tents at Peel River.)

lønnsarbeidet krever større konsentrasjon for indianerne enn jakt og fiske, slik at deres tid til å tenke på livet og døden blir redusert og dermed også den religiøse interessen.

En annen ting som har øket sekulariseringen og skapt nye problemer, er indianernes nåværende rett til å kjøpe brennevin. Endring i rusdrikkloven for de innfødte i Northwest Territories skjedde i 1960, men alt før den tid hadde indianerne ulovlig laget hjemmebrent. Adgangen til alkoholholdige drikker har ført til øket pengeforbruk på slike nytelsesmidler. En ting er nemlig at brennevinet i seg selv er dyrt for indianerne, men en annen ting er at de som regel reiser med fly til Inuvik for å kjøpe det. Sommeren 1961 kostet det 70 dollar med charterfly tur/retur Fort McPherson–Inuvik. I tillegg til disse utgiftene kommer stundom en bot, for som en indianer uttrykte det: «Når vi kjøper brennevin er det ingen lov, men straks vi har kjøpt det, er loven der.»

Med misbruk av alkohol fører seksuelle utskeielser, og antall barn født utenfor ekteskap har vist sterk økning siden slutten av 1950-årene. Dessuten kommer ekteskapelige problemer som resulterer i separasjon og dernest ulykker av forskjellig slag som ofte ender med døden. Etter uttalelser av indianerne gjennomførte de hvite brennevinsendringen i Fort McPherson mot høvdingens, rådgivernes og de eldstes vilje. Resultatet ble da også skifte av høvding og rådgivere, for de tidligere gikk av i protest. Nå er det gjort et forsøk på å la indianerne få lov til å lage hjemmebrent, for en rekke indianere og hvite mener at dette i lengden vil bli mindre økonomisk skadelig for indianerne. Under en avstemning i Fort McPherson sommeren 1961, gikk alle indianerne inn for dette, bortsett fra en som mente at rusdrikk i en hvilken som helst form er skadelig.

Et faktum som også er med å bestemme de endrete livsforhold i Fort McPherson, er befolkningsøkningen. Indianerne driver ikke noen kunstig barnebegrensning, og en rekke familier har mellom 5 og 10 barn. På grunn av de bedrete hygieniske forhold er barnedødeligheten redusert samtidig som levealderen har øket. Da de naturlige resursene for indianerne er relativt konstante, og mulighetene heller avtagende på grunn av bedre jakt og fiskemetoder, blir det mindre utbytte pr. jeger. Dessuten kan det være grunn til å tro at den tiltagende hvite aktivitet i form av anleggsvirksomhet og oljeleting virker forstyrrende bl. a. på reinsdyrene. Selv om derfor bedre fangstmetoder til sine tider kan øke nettoutbyttet, så er den innfødte befolkning ved Peel River i ferd med å bli for stor for fangstområdet.

Indianerne er derfor klar over at de hvite hjelper dem på en rekke områder. «Det finnes ikke lenger en indianer som behøver sulte,» er et fast ordtak, «for han vil alltid få litt hjelp av myndighetene.» Det er heller ingen gamle, krøplinger, enker eller foreldreløse som lider nød. Ved sykdom og naturkatastrofer hjelper staten. I det hele er det indianernes mening at staten etter overenskomsten av 1921 har sørget godt for dem. Men fremdeles er det indianere som heller sulter enn ber de hvite om hjelp. Dette gjelder særlig den eldre generasjonen. De har fremdeles en fast forankring i den gamle levemåten på boplassen. Verre er saken for den del av befolkningen som i de siste ti årene har vært vitne til de materielle endringer i denne del av arktis. De har fått til vane å bruke penger og har muligens funnet ut at lønnsarbeid gir et sikrere næringsgrunnlag enn jakt og fiske og at det dessuten er mindre anstrengende. Verst stillet er likevel den del av ungdommen som ikke er egnet for videre skolegang og som har mistet kontakten med fedrenes levevis. En del av disse utgjør et sosialt problem.

Men indianerne ved Peel River er ikke bare fornøyd med den hvite administrasjonen. Noen av årsakene til dette er muligens at de fleste hvite administratorer viser liten eller ingen personlig interesse for deres spesielle problemer. De er statsfunksjonærer som utfører et arbeid de er betalt for. De har alle en levestandard som står i sterk kontrast til indianernes, og de utgjør en sosial gruppe over og utenfor de innfødte. «Når en hvit mann kommer til boplassen vår,» var det en indianer som sa, «så innbyr vi ham på en kopp te, men når vi kommer til Fort McPherson er det ingen hvit som tilbyr oss te, ikke engang misjonæren.»

På grunn av manglende fellesskap har det lett for å oppstå et spenningsforhold mellom de to befolkningsgrupper. Sterkest er dette forholdet i selve Fort McPherson hvor disse gruppene er mest i kontakt med hverandre. Det kan ofte være tilsynelatende bagateller som er årsak til spenningen, men småting for hvite kan ha helt andre dimensjoner for indianerne. I Fort McPherson skal f. eks. alle hunder etter loven være bundet. Når så politiet skyter en lederhund som har slitt seg, er dette et alvorlig tap for en indianer, og kan få konsekvenser for hele vinterjakten.

Det er mulig at spenningsforholdet indianer/hvit er en av årsakene til at de mest driftige holder seg så meget borte fra Fort McPherson som mulig. «Skogen er vår tilflukt,» sa flere av mine informanter, «for på boplassen kan vi leve vårt eget liv.»

Etter alt å dømme er det ingen grunn til å tro at spenningen vil bli mindre i den nærmeste fremtiden. Tvert imot må en anta at den vil øke etterhvert som de to befolkningsgrupper blir trengt mer innpå hverandre og «the colour bar» trer mer tydelig frem. De mulighetene som synes å være til stede for å redusere spenningen, er hvite funksjonærers personlige interesse for indianerne, respekt for deres egenart og fortsatt politisk interesse for indianerne i denne del av Canada.

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The iron occurrence at Farmhamna, Vestspitsbergen

BY

THOR SIGGERUD

Abstract

An extensive prospecting took place in Spitsbergen at the beginning of this century, resulting in many claims being staked. One of these claims, at the northern tip of Hamnetangen peninsula near Farmhamna, has been visited. It is a hematite mineralization in a breccia at the border between a limestone and a quartz conglomerate. The mineralization has no economical value and the reason for taking up work at a locality like this must have been to establish the right to the country.

In a great area like Spitsbergen (about 68,000 km^2), where the geology varies so much, it should be a theoretical possibility of finding economically workable ore deposits, although ice and snow cover more than half of the land. After the general principles of the geology in Spitsbergen were known, explorers and geologists became aware of the possibilities, and particularly in the beginning of this century a race to stake claims took place all over the accessible coastal areas of Vestspitsbergen. Companies were organized to carry out this prospecting and to mine the ores that were supposed to be found. It is really remarkable how many ore mineral occurrences were discovered in a short period of time; many of them have also been "mined" to some extent.

This paper deals with one of these occurrences. However, the expectations connected with this occurrence seem to be rather typical for the view on the ore mineralization in Spitsbergen in those days.

The "mine" is an iron occurrence situated on the northern tip of Hamnetangen peninsula, just west of Farmhamna, at the north side of the entrance to Isfjorden. The "L"-shaped peninsula protudes about one km westwards from the fairly low strandflat, and runs about two km northwards; to the west lie some small islands and rocks. The highest point on the peninsula is thirteen m a. s. l.

Until recent the area was supposed to be built up of Precambrian, Cambrian and Ordovician sediments, all metamorphosed during the Caledonian orogeny. However, already HOLTEDAHL (1913) drew attention to the fact that rather undisturbed rocks are found on the peninsula. The boulders in a present conglomerate are not affected by the same type of stresses as usually found in Hecla Hoek rocks elsewhere on the west coast. The conglomerate mentioned resembles the Carboniferous conglomerate farther east.

In 1951 (BAKER et al., 1952) fossils of Carboniferous age were found at Kapp Scania, about fifteen km south of Farmhamna, and WEISS (1953) mentions that Carboniferous beds can be traced from Eidembukta to St. Jonsfjorden, limited by a faulting on the eastern side. It seems reasonably safe to conclude that it must be the same down-faulting in all cases.

The general structure of the peninsula has a strike N 20–30° W, with a dip that is practically vertical or slightly to the WSW in the western part. It is thus parallel to the general faultzones, and also to the Tertiary faults in Forlandsundet.

On the northern tip of the peninsula the well exposed rock series, as observed from W to E, comprises quartzitic sandstone with several layers of quartz conglomerate, followed by a sequence of phyllitic schists, intercallated with limestone beds. This again is followed by a light grey limestone containing some iron carbonate weathering with a typical yellowish colour. The limestone is broken up in all directions like a breccia, and cemented with quartz and calcite, looking like a typical Hecla Hoek rock. East of the limestone beds the quartz conglomerate is repeated, and then follows limestone again. The border between this last limestone bed and the conglomerate is broken up by a breccia. (Fig. 1.)

The matrix of the breccia is red coloured and rich in iron. Closest to the limestone beds the breccia is particularly rich in iron. On the northernmost tip of the peninsula there are even some bodies of hematite ore.

The quartzitic beds with conglomerates can be followed all the way to the southern tip of the peninsula, more or less as ridges in the moore-covered inland. The iron-mineralized area can be traced along the strike for about 350 m, this being on the eastern side of the tip where the sea has eroded. However, there may be more mineralized areas southwards under the cover of loose material. The iron-mineralization is not continous, but appears as intermittent irregular lenses in the breccia zone. The lenses can be up to twenty m long, and the average width of the larger ones are one and a half m. The biggest of the rich hematite orebodies is about one m³. A basic dike cuts practically parallel to the strike on the western side of the peninsula.

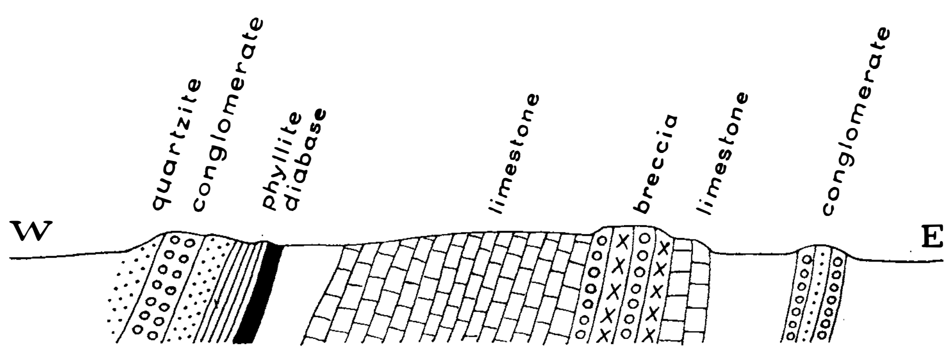

Fig. 1. *A profile across the northern tip of Hamnetangen peninsula, Vestspitsbergen. The length of the profile is about 200 m.* (After HOLTEDAHL.)

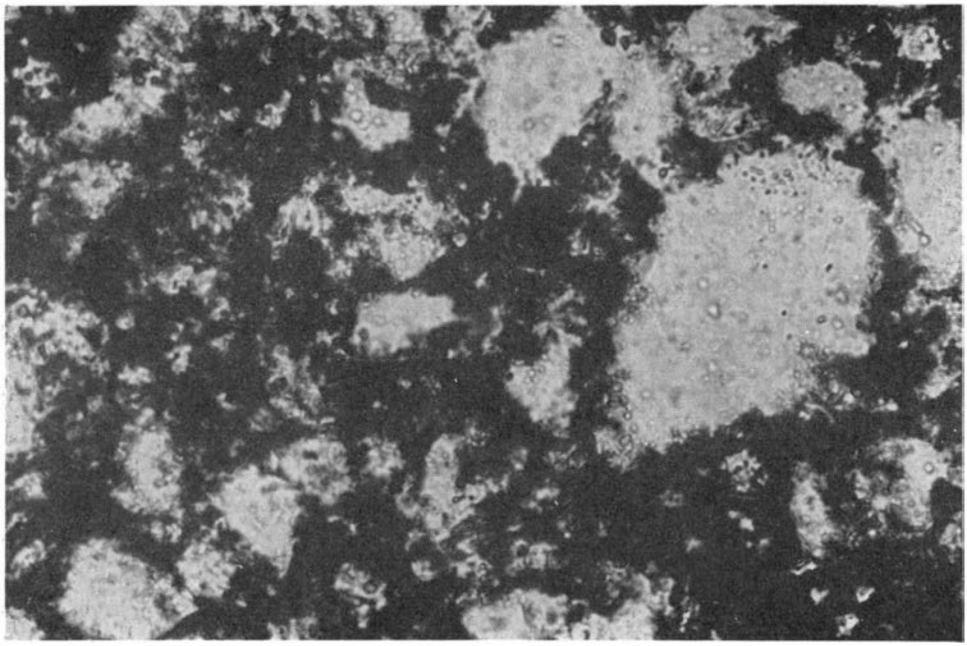

Fig. 2. *Photomicrograph of quartz surrounded by hematite. The hematite mineralization has reacted with the quartz. Hamnetangen near Farmhamna, Vestspitsbergen. Ordinary light.* × *570.*

The geology of the small islands to the west is of about the same type. The general strike is N-S. The iron mineralization occurs in a fracture zone at the contact between a dolomite and an ironbearing limestone, where a faulting has caused some brecciation. The iron staining can easily be seen, but very little solid hematite is found and in very small amounts.

The iron occurs in the following forms:

Hematite in a quartzite and limestone breccia.

Cherty hematite, i. e. hematite closely interwoven with chert.

Jaspery quartz, dark red coloured.

Iron stained limestone.

The hematite in the breccia occurs as a very fine-grained (1–5μ) aggregate, in between the quartz particles in the breccia. These hematite aggregates are grey in reflected light. A red coating of the quartz is usual, often looking as when the quartz has reacted to an etching solution. Very few traces of calcite are present in the iron-rich thin-sections.

The other ferruginous rocks, except for the limestone, must have been formed by recrystallization after the brecciation, and when the iron-solutions passed the breccia.

The genetical question of the iron occurrence is still open. The mineralization must be post-Carboniferous, and the iron could come from the iron-carbonate beds found in the Triassic and Jurassic periods. It seems very probable that the faulting is connected with the down-faulting of the younger Tertiary rocks further north in Forlandsundet.

According to WEISS (1953) there is strong evidence of Tertiary folding in the

Carboniferous and only a weak one in the Hecla Hoek rocks just east of the fault, i. e. the down-faulting is younger than the Tertiary folding at St. Jonsfjorden.

In this case the iron mineralization is perhaps related to the volcanism that has been activ in Spitsbergen up to quite recent times. The more so since the mineralization gives an oxidic ore, and the replacement of the quartz grains indicates a hydrothermal solution.

The conclusion reached after visiting this iron occurrence is that it has absolutely no economical value. It is rather difficult to understand why it has been claimed and some work undertaken. Fifty years ago it must have been nearly impossible to mine this occurrence, situated in a broken limestone a few meter above the sea level, the water must i. a. have been a great problem. In addition come the general difficulties with operating under the severe climatic conditions at such high latitudes.

From an economic point of view it is no ore deposit at all, because the largest body of workable ore is only about five tons. Nevertheless the locality seems to have been carefully studied, and some blastings have been undertaken. Several iron rods and markers are firmly bolted down into the ground.

Trying to understand the motives of the people working here, we must keep in mind that at that time Spitsbergen was practically a virgin country. It was actually possible to take a tourist steamer, only some days sailing from England, to a place where geologists had never prospected before, and where the wilderness still had a romantic lure of its own.

Perhaps one should not forget either that staking claims in Spitsbergen in those days, when the sovereignity of this country was not yet settled, was the most useful way to establish the right to the land for the prospectors and their nations. But of course when the claimed mine was never worked and had no value, the claims of this type could not be taken seriously.

The files of Norsk Polarinstitutt yields several notes on claims, probably of the same geological significance as the one described above. Some of these claims are still being mentioned by people who know Spitsbergen.

The claims will be visited in due time to find out if they, when looked upon from a modern point of view, and taking into consideration the modern methods of mining and ore-dressing, could be of any economical value.

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The Norwegian Svalbard Excursion in connection with the XIXth International Geographical Congress Norden 1960

BY

RAGNAR THORÉN

In connection with the XIXth International Geographical Congress Norden 1960 OLAV LIESTØL, glaciologist at Norsk Polarinstitutt, and KÅRE LANDMARK, director of Tromsø Museum, organized a two weeks scientific excursion to Svalbard for the purpose of demonstrating areas and phenomena typical of Svalbard, and important to arctic research, especially regarding glaciology, physical geography and geology.

Tromsø.

The excursion was planned to start on board the nice 500 tons ship S/S "Lyngen" from Tromsø on July 24th. The authorities of this real pearl of northern Norway, and the communities of Tromsøsund showed the fourty-two participants, representing fourteen countries, very great hospitality, honouring them with a memorable banquet and wishing them a successful expedition into the high Arctic. The Tromsø-people are, as a matter of fact, "arctic-minded" from their earliest childhood.

On the night of July 24th "Lyngen" left Tromsø bathed in the magic light of a radiant midnight sun. When leaving Tromsø the excursion was headed by one of our two excursion-leaders, viz. ROLF W. FEYLING-HANSSEN, state geologist at Norges geologiske undersøkelse, Oslo, as OLAV LIESTØL was going to join the excursion in Svalbard. (Fig. 1.)

Bjørnøya.

The Polar basin was a bit rough the next day, and because of a wet fog we never caught sight of Bjørnøya in Norskehavet, lying not far from the western slope of the continental shelf. On our way back from Svalbard, on the other hand, the visibility was better, and we were able to study the mighty bird cliff "Fuglefjellet" close inshore, greeted by numerous fulmars (*Fulmarus glaciales*) of the brilliant

Fig. 1. *The route of the excursion.*

flying family *Procellaridae.* This mountain consists of Younger Dolomite, capped with Upper Carboniferous and Permian limestone.

Hornsund.

On the 26th we received by radio a kind invitation to the Polish IGY-station at Hornsund, where geological, geomorphological and periglacial research, as well as glaciological investigations, were carried out. Later the same evening "Lyngen" anchored in front of Hansbreen, which ends in the fjord, where Professor Dr. ALEKSANDER KOSIBA, Poland, gave a very interesting lecture on general characteristics and changes of this receding glacier. After having examined different parts of the glacier we inspected a patterned ground area on raised beaches at Isbjørnhamna and Fuglebergsletta. We found not only *sorted polygons* and *sorted stripes*, but also extraordinarily well developed *sorted circles* (Fig. 2), the best the author ever saw. At midnight the hospitable Polish scientists invited all of us to an excellent "Arctic" supper. Professor KOSIBA then joined the "Lyngen"-party for later to take part in the geographical congress in Stockholm.

Van Keulenfjorden.

"Lyngen" anchored next morning in Van Keulenfjorden, where our program included investigations of glaciers and moraines, marine deposits and geological structures. Here OLAV LIESTØL joined us as excursion-leader and specialist on glaciology.

The fjord has been cut across the principal direction of geological folding, thereby presenting a fine view of the large syncline, the axis of which extends in the direction NNW–SSE plunging towards the SE, as well as the partially strongly folded sediments.

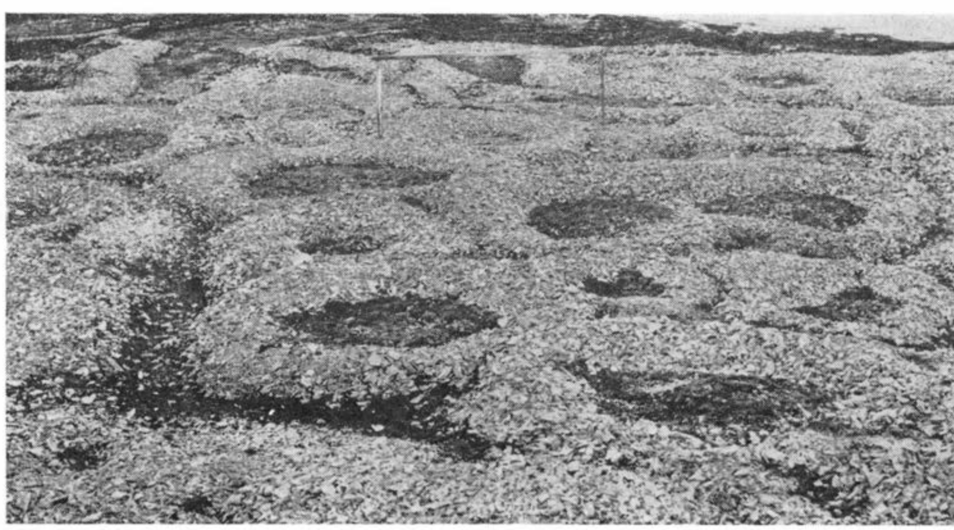

Fig. 2. *Cryoturbation phenomenon, sorted cirles, near Isbjørnhamna, Hornsund, demonstrated to the Excursion by the Polish IGY – Spitsbergen Expedition. July 26th, 1960 at midnight.* (Photo: R. THORÉN)

We found Penckbreen with its beautifully developed moraine forms of special interest. The end-moraine had pushed sediments, containing marine fossils, in front of the glacier together into a number of regular ridges. The shore plain was formed of alluvium deposited by glacier rivers, and it was patterned by gently sloping alluvial fans.

Bellsund to Isfjorden.

After a final examination of Finsterwalderbreen we turned northwards via Bellsund to Isfjorden, sailing along the low strandflat lying in front of the higher mountain ranges, all the way up to Kapp Linné. We anchored the same night inside the cape and visited early in the morning Isfjord Radio Station. The station buildings were of an up-to-date design. There we met a Swedish archaeological expedition busy exploring old Russian settlements on the strandflat at Russekeila.

Longyearbyen in Adventfjorden.

The next item of our program was a visit at the Norwegian mining settlement Longyearbyen in Adventfjorden, where about 1000 people are wintering. Passing along the south coast of Isfjorden we saw the beautiful Vesuvfjellet, the mighty Lindström- and Nordenskiöldfjellene, and several fine peaks. We also saw three of the four Russian settlements which are found on Vestspitsbergen today, namely Barentsburg, Colesbukta and Grumantbyen.

The mountains on either side of Adventfjorden consist of Cretaceous sediments, overlain by Lower Tertiary strata. The more or less flatlying coalseams occur in the Tertiary rocks, and consequently the mine-entrances are located high up on the steep mountain slopes. At this high arctic latitude (78° 13′ N), where the permafrost exceeds 300 m in depth, it is impressive to find a town with church, school, hospital and radiostation, club premises, lecture hall, shops and post office, as well as the residence of the Norwegian Governor of Svalbard.

Director Christian Bing of Store Norske Spitsbergen Kulkompagni A/S arranged interesting excursions to the coal mines and invited us all to a reception and dinner at the club, where director Bing and governor Birketvedt bid us welcome.

As a final excursion in this area we paid a visit to the moraine in front of Longyearbreen, east of Nordenskiöldfjellet. There we collected very fine specimens of Lower Tertiary plant fossils and petrified wood of continental origin.

Tempelfjorden.

Leaving Adventfjorden at midnight, we proceeded into Sassenfjorden and in the morning of July 29th we sailed along the famous and beautiful Tempelfjellet, built up of nearly horizontal Permo-Carboniferous strata and magnificently sculptured by weathering. "Lyngen" then anchored at Bjonahamna in Tempelfjorden, the easternmost branch of Isfjorden. During an excursion to the triangular, raised beach plain west of the bay, Rolf W. Feyling-Hanssen gave a very interesting lecture on this magnificent littoral formation with parallel beach ridges marking temporary positions of the shore line. The quarrying power of frost action is here evidenced by the accumulation of angular rock debris, collected as mighty cones at the base of the steep slopes of Tempelfjellet. At the west side of the plain lovely arctic flowers were growing, i. a. *Ranunculus glacialis* and *Melandrium angustiflorum*, worthy targets for the colour photographer.

From Bjonahamna we travelled to Von Postbreen at the bottom of Tempelfjorden. This glacier has medial as well as lateral moraines, and is calving into the fjord. Glacier rivers discharge muddy water via arch shaped tunnels and deposit treacherous submerged ridges of fine-grained moraine parallel to the ice front. "Lyngen" grounded on such a ridge for an hour or so, and it was a real pleasure to study the excellent seamanship proved by the captain, OLAV JENSEN, in manoeuvering his ship to get her afloat again.

Billefjorden.

The next item of our program included excursions to magnificent raised terraces at the east side of Billefjorden, the northeasterly branch of Isfjorden. These terraces occur at different levels from a few meters only up to about ninety m. There are heaps of driftwood on the beach including logs stamped with Russian marks, coming either directly from Siberia or from the Russian settlements at Svalbard only.

In Phantomområdet there was a rich fossil fauna of littoral deposits with *Astarte borealis* dominating between six and fourty m a.s.l. and *Mytilus edulis* between three and six m. Because of that the terraces are named Astarte terraces and Mytilus terraces respectively. In the lower part of the Permo-Carboniferous strata, gypsum-bearing horizons occurred. North from Phantomodden we studied raised shingle and tilted shorelines, and at Kapp Ekholm raised shingle with polygons. Hollows between shingle ridges carried *Saxifraga oppositifolia*, *Salix polaris* and other flowers. From the high marine terraces north of Ekholmvika we saw the Russian settlement and coal mines at Pyramiden, near the bottom of the fjord.

Ekmanfjorden.

On July 30th in the afternoon we travelled to Ekmanfjorden, the northwestern branch of Nordfjorden, passing Sveabreen bathed in lovely sunshine. "Lyngen" anchored in the inner part of the fjord, between Kolloseumfjellet and Coraholmen, the half of which consists of terminal moraines of the strongly receding Sefströmbreen. The dead-ice moraine, rich in fossils, contains a fine collection of marine shells. In the mountains of this area we could study Devonian sandstone and Culm deposits, composed of yellow, reddish, grey and partly black sandstones. The peaks are capped by Middle and Upper Carboniferous Cyatophyllum limestone. Strata of sandy, clay-ironstone concretions give the rocks a more red colour, when weathered. The water of the innermost part of the fjord is coloured in the same reddish shade, a rare sight to many of us.

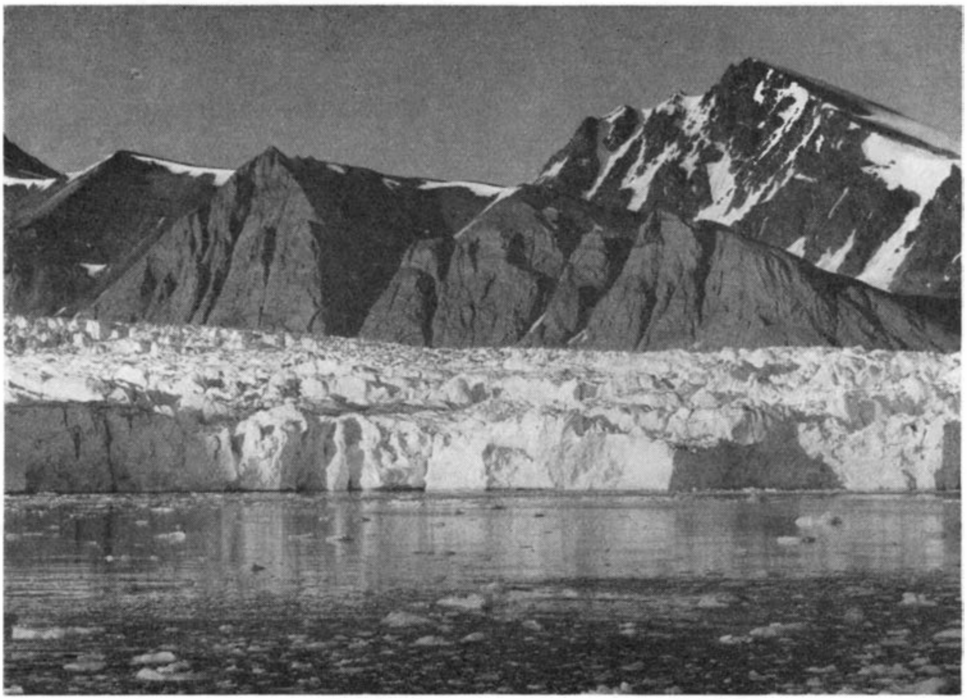

Fig. 3. *The front of Blomstrandbreen in Kongsfjorden, in a state of advance at our visit. July 31st, 1960.* (Photo: R. THORÉN.)

Grønfjorden.

On our further way northwards, to Kongsfjorden, we visited Grønfjorden, the westernmost branch at the south side of Isfjorden. Here we saw the Russian main base Barentsburg, which is the administrative centre with a consulate and several large buildings.

Kongsfjorden.

Ideal weather conditions, a calm sea and a radiant midnight sun greeted us when "Lyngen" steamed northwards along the west coast of Prins Karls Forland. On July 31st we had a very fine program in Kongsfjorden, visiting the northernmost town in the world, Ny-Ålesund, at about 78° 56′ N, a Norwegian mining centre, surrounded by glaciers in all directions. There we had excursions to Bröggerbreen with lateral moraines of Devonian clay of a reddish shade, and red coloured glacier rivers as well. Further we visited shore plains with polygon patterned ground, and areas with very interesting Hecla Hoek formations. The glaciers Kongsvegen and Kongsbreen were calving into the fjord, causing a mighty thunder all day long. Towards the evening we travelled to Blomstrandhamna to study a glacier of special interest, the front of which was in a state of advance at our visit. The other glaciers of Vestspitsbergen, which we visited, were receding; Blomstrandbreen, on the other hand, had advanced not less than 150 meters in a couple of months. The velocity at the centre of the glacier had been especially great, causing large vertical crevasses (Fig. 3).

Fig. 4. *The participants of the excursion to Svalbard in connection with the XIXth International Geographical Congress Norden 1960.*

A. *From left to right: E. L. Costello (USA); C. Chestnutwood (USA); R. Maling and D. Maling (England); C. H. Weed (USA); D. Innis (Canada); R. K. Gresswell (England). In front, from left: M. Kingman (USA); and N. Ferrar (England).*

B. *From left to right: R. Raynal (Morocco); G.J. C. Couvreur (Morocco); K. Iwata (Japan); A. Picard, and crouching, E.-J. Picard (France); A. Kosiba (Poland); G. Nangeroni (Italy).*

C. *Standing from left to right: N. Alroth (Sweden); O. Liestøl, excursion leader, (Norway); I. Olsson (Sweden); G. Ljungstedt (Sweden); R. Blomgren (Sweden). Sitting, from left: R. W. Feyling-Hanssen, excursion leader, (Norway); A. L. Kristiansson (Sweden); B. Hedenstierna (Sweden); K. Gåve (Sweden); R. V. A. Thorén (Sweden); E. Ljungstedt (Sweden); K. Persson (Sweden).*

D. *From left to right: J. D. de Jong (Netherlands); P. Dorff (Germany); O. Lehovec (Germany); K. Storm (Germany); K. Wiche (Austria); O. Liestøl, excursion leader, (Norway). Sitting: T. Sauerland (Germany); M. Friemann (Germany).*

The following members were not present when the photographs were taken: L. E. Hamelin (Canada); G. Klausen (Norway); R. M. Lebeau (France); O. Løkholm (Norway); S. Løkholm (Norway); W. Meckelein (Germany) and O. Ruud (Norway). (Photo: R. THORÉN.)

From there we proceeded northwards into Krossfjorden, studying the receding phases of Fjortende Julibreen, then further north to Kong Haakons Halvøy and close inshore to the famous bird-rock Kongshamaren where millions of birds were nesting on the steep mountain sides, a fantastic sight. "Lyngen" then entered Lilliehöökfjorden where Lilliehöökbreen was continuously calving into the fjord.

We there met an unbroken series of icebergs sailing slowly as silent ships out of the fjord. It was a fascinating picture, painted in strong shades of blue, green and white in the magic light of the midnight sun. I think none of us will ever forget this wonderful night.

Southwards again.

When leaving Krossfjorden we sighted towards the east the beautiful mountains Tre Kroner, raising their "crowned" peaks with dignity above the surroundings. In Van Keulenfjorden we said good-bye to one of our leaders, our dear friend OLAV LIESTØL, who was to continue his fieldwork at Finsterwalderbreen. After having enjoyed good fishing at Bjørnøya close inshore at Fuglefjellet, we left for the final trip back to Norway, to our dear Tromsø.

Conclusion.

An extraordinary well organized, in every detail well prepared scientific excursion had been carried out with complete success. The weather had been favourable, and the ice conditions too. We had learned a lot from our lecturers and from nature herself. This fascinating textbook told us about lovely glaciers, their economy and mechanics, about moraines and marine deposits, majestic mountains and their geological formation, the formation and structure of shore lines, about talus, plant fossils and marine fossils as well. Further, we had seen lovely arctic birds and other zoological peculiarities of the Polar region, and botanical wonders in this high-arctic land with the many mountain-peaks and cold coasts.

All the participants had the feeling of being members of one and the same family, who had spent some days of complete happiness and satisfaction aboard a fine Norwegian ship in the fascinating Arctic. To one of our dear and popular leaders, ROLF W. FEYLING-HANSSEN, we expressed our gratitude through a gift from all of us: A mountain axe, the shaft symbolizing the drift-wood of Spitsbergen, the head the science of Geology. This gift was a few weeks later presented to him via the Norwegian Embassy in Stockholm and the Foreign Office in Oslo at a ceremony at the University in Oslo. The shaft was mantled in leather with the following text deep-printed by hand: "To Rolf W. Feyling-Hanssen, the leader of the I.G.U. Spitsbergen Expedition, July 24–August 5, in connection with XIX Geographical Congress Norden 1960, with admiration and deepest gratitude from all the participants for his kind, intelligent, courteous, and well-informed guidance of this scientific excursion. (Found at the moraine of the Brøgger Glaciers in Kings Bay, July 31, 1960.)"

Geological Excursion to Svalbard in connection with the XXI International Geological Congress in Norden 1960

BY

NATASCHA HEINTZ

When it was definitely decided that the XXI International Geological Congress was to be held in Norden in 1960, the question concerning excursions immediately arose. The Norwegian Commitee soon got to the conclusion that if it would be possible one would, i. a., try to arrange an excursion to Svalbard.

The greatest difficulty regarding an excursion to Svalbard was to get a vessel proper for this purpose. After several possibilities had been examined the Norwegian Commitee got in contact with the Royal Norwegian Navy. In a conferance between Prof. Dr. O. HOLTEDAHL and first-curator J. A. DONS, the head and the secretary of the Norwegian Government's organizing commitee for the XXI International Geological Congress, and the Minister of Defence, Mr. O. HANDAHL, the commitee was promised, that if the international situation would permit, the excursion to Svalbard could be arranged with KNM "Valkyrien". This vessel had until quite recently been used as a coastal steamer. However, being a navy vessel, it would need more crew, so unfortunately it would only be room onboard for fourty persons, the excursion-leaders included.

During 1959 the excursion programme was worked out by geologist T. S. WINSNES of Norsk Polarinstitutt in cooperation with Prof. Dr. A. HEINTZ and cand. real. N. HEINTZ of Palaeontological Museum in Oslo.

It seems that the excursion to Svalbard must have attracted many geologists, because, when the respite for taking part in the excursions was expired, altogether about 160 people wanted to join it. It was thus a great pity that it was only room for one fourth of them.

The final group counted thirty-eight participants and three excursion leaders, however, during the last days before the departure, one Japanese and one Italian geologist sent their excuse, and the Russian participant just did not turn up in Bodø.

Thus when leaving Bodø in the evening of July 29th, there were thirty-three participants and three leaders on board "Valkyrien", as two of the group already were in Svalbard, and were going to join the excursion there.

The members of the excursion were (Fig. 3):

Prof. J. G. C. Anderson (England), Dr. D. J. Atkinson (USA), Prof. P. Bellair and Mrs. R. Bellair (France), Dr. K. Birkenmajer (Poland), Dr. H. Bode (Germany), Dr. E. Escher (Netherlands), Dr. R. Feys (France), Miss R. Fridman (France), Prof. W. M. Furnish (USA), Dr. P. Gevin (Algeria), Dr. M. Gordon jr. (USA), Dr. J. T. Gregory (USA), Mr. W. B. Harland (England), Dr. W. W. Hay (USA), Prof. I. Hessland (Sweden), Dr. N. F. Hughes (England), Dr. G. A. L. Johnson (England), Dr. H. R. Katz (Chile), Mr. L. Krasser (Austria), Dr. R. Laffitte (Algeria), Prof. A. F. de Lapparent (France), Mr. A. E. Linna (Finland), Prof. R. Maack (Brazil), Prof. R. Michel (France), Mr. R. K. Morse (USA), Dr. W. Nöldeke (DDR), Dr. W. Remy (West-Germany), Mr. J. Ricour (France), Prof. M. Rutten (Netherlands), Mr. A. Sabitay (USA), Prof. J. B. Thompson (USA), Mrs. B. S. Westoll and Prof. T. S. Westoll (England).

The excursion-leaders were:

Prof. Anatol Heintz, Palaeontological Museum, Oslo, geologist Thore S.

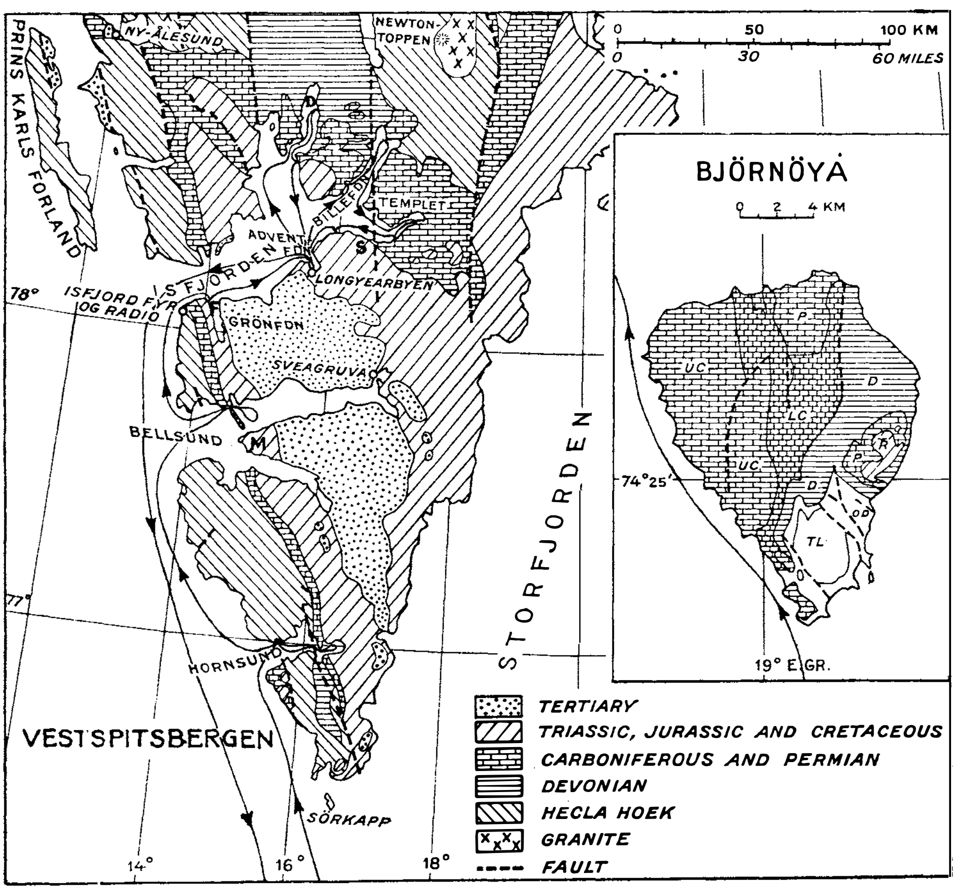

Fig. 1. *The route of the excursion. F = Festningen, D = Dicksonfjorden, S = Sassenfjorden, and M = Midterhuken.*

WINSNES, Norsk Polarinstitutt, and cand. real. NATASCHA HEINTZ, Palaeontological Museum, Oslo.

July 30th. In the morning a short stop was made in Harstad, and at 12 a. m. "Valkyrien" left Norway bound for Bjørnøya, in fine weather, warm, sunny and calm.

July 31th. At about 4 p. m. we were approaching Bjørnøya. However, as usual this island was covered by fog, making it impossible to see any thing of the geology. Only now and then the fog unveiled for some minutes, and glimpses could be caught of the steep southwest coast of Bjørnøya. Even being a geological excursion, the participants found codfishing on the Bjørnøya bank rather fascinating, and the enthusiastic "fishermen" provided fish enough for a full dinner for all on board. Following the west coast of Bjørnøya northwards the fog disappeared little by little, and the flat-lying Devonian and Carboniferous layers became visible.

August 1st. In brilliant sunshine we were approaching Hornsund in the morning. In Hornsund the Polish geologists, having worked in this area during the last four years, were in charge of the excursion. Fortunately there were no problems with pack ice in this fjord, as it often will be, and in late morning we anchored in the bay in front of the Polish scientific station in Isbjørnhamna. Hurrying out to meet "Valkyrien" two Polish scientists in a small dory run on a huge flake of ice and "upset their dory, in the water, cold and damp" – to quote the excursion song about "The Svalbard Volunteers". Spending some five minutes in the bitterly cold water midst the ice, the both Poles happily did not get any severe harm from their unpleasant baths.

A detour into Hornsund gave the participants an impression of the Hecla Hoek sequence and the highly tectonized younger beds of Devonian, Carboniferous and Permian age. During the night an excursion over land was arranged, visiting Revdalen, where progressive metamorphoses in the Precambrian beds could be studied.

This trip also gave the participants the chanse of driving a car on the moors in Isbjørnhamna, not talking about the crossing of Revvannet on rubber-rafts equipped with out-board motors (Fig. 2). The tour to Revdalen was ended by a memorable reception in the Polish scientific station.

August 2nd. A couple of hours break, and a smaller group of enthusiastic geologists went off for a short trip in Hornsund to see the highly pressed conglomerate at Fannypynten.

Later in the day "Valkyrien" proceeded from Hornsund to Bellsund, passing on some distance the ragged coast, where the large glacier Torellbreen deproaches into the sea.

In Bellsund we passed Akseløya, that nearly blocks the entrance to Van Mijenfjorden, to have a closer view of Midterhuken where, on the way out, the beautifully folded sediments of Carboniferous, Permian and Triassic age could be studied with binoculars.

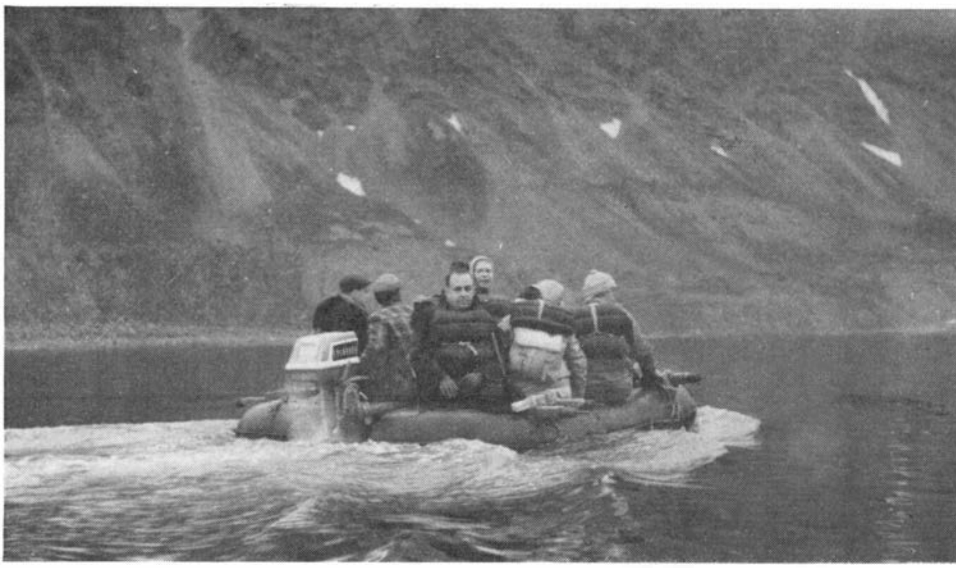

Fig. 2. *Some of the participants crossing Revvannet on the rubber-raft equipped with outboard motors, during the excursion in Hornsund.* (Photo: K. BIRKENMAJER.)

August 3rd. As the weather was a little unpleasant in the morning, the landing was made in Grønfjorden and not near Kapp Starostin as originally planned. The Festningen section – ranging from Carboniferous up to Tertiary – yields many interesting fossils and lithological problems. However, the peak of that day, and the whole excursion as well, was the find of dinosaur footprints in the lower Cretaceous sandstone at Festningen, made by Prof. DE LAPPARENT. Prof. DE LAPPARENT – being a specialist on reptilian footprints, had remarked to one of the other French geologists, when passing the Festningen sandstone, that one could expect to find footprints in these layers. Descending at a steep slope down to the beach, there they were faced with – altogether 12 rather well exposed footprints, presumably of an *Iguanodon.* This footprints were the first evidence found in Svalbard of the large terrestrical reptiles having lived there.

August 4th. After a short stay in Longyearbyen the excursion proceeded along the west side of Nordfjorden, trying to see how the Permian sediments had been thrusted eastwards during the Tertiary orogeny. The large Sveabreen comes right down to the fjord and we would hear the noise when the calf-ice fell into the sea. Turning eastwards we entered Dicksonfjorden a little later, and anchored right south of Kapp Smith.

August 5th. In brilliant, sunny weather we went ashore in the morning, just a little south of Kapp Wijk, to study the sequence of Kongressfjellet. This sequence begins with Permian layers followed by Triassic beds, yielding one "fish-horizon" and two "saurie-horizons" with fragments of different vertebrates. In addition also several invertebrate fossils were found, mostly ammonites and lammelibranchiats.

Fig. 3. *Members of the excursion A 16 to Svalbard.* (Photo: L. PEDERSEN.)

First row from left to right: *Mrs. B. Westoll (England); Prof. I. Hessland (Sweden); Miss R. Fridman (France); Prof. R. Maack (Brazil); Dr. H. Bode (Germany); Dr. K. Birkenmajer (Poland); Mr. L. Krasser (Austria); Prof. R. Michel (France); Mrs. R. Bellair (France); Prof. P. Bellair (France); Cand. real. N. Heintz (Norway); Dr. P. Gevin (Algeria) and Cand. real. T. S. Winsnes (Norway).*

Second row from left to right: *Dr. W. W. Hay (U.S.A.); Prof. A. Heintz (Norway); Dr. W. Nöldeke (D. D. R.); Dr. R. Feys (France); Mr. A. Sabitay (U.S.A.); Prof. M. Rutten (Netherlands); Dr. A. Laffitte (Algeria); Mr. J. Ricour (France); Prof. J. G. C. Anderson (England); Dr. H. R. Katz (Chile); Dr. J. T. Gregory (U.S.A.); Dr. G. A. L. Johnson (England); Dr. N. F. Hughes (England); Mr. W. B. Harland (England).*

Third row from left to right: *Mr. A. T. Linna (Finland); Prof. J. B. Thompson (U.S.A.); Dr. D. J. Atkinson (U.S.A.); Prof. W. M. Furnish (U.S.A.); Mr. R. K. Morse (U.S.A.); Prof. T. S. Westoll (England); Cand. real. T. Siggerud (Norway); Dr. E. Escher (Netherlands); Dr. W. Remy (West-Germany).*

Fourth row from left to right: *Kapteinløytnant Maagerø; løytnant Evensen; løytnant Solberg; kapteinløytnant Snøfjellå, løytnant Olsaker, fenrik van der Hagen; fenrik Mjåtvedt and løytnant Thoresen. Dr. M. Gordon jr. (U.S.A.) was not present when the photo was taken.*

In the evening there was a picknick on the shore at Kapp Wijk. Great amount of drift wood made it easy to make an enormous bonfire. A visit to a trapper's hut not far away closed the program for that day.

August 6th. The inner part of Dicksonfjorden with its mighty, red Devonian beds, overlaid on the top by either Carboniferous Cyathophyllum limestone or Culm beds, was the area to be visited this day. An over-land excursion to Nathorstdalen gave the participants good opportunity to collect Devonian fishes. While having lunch-break a little polar fox turned up, and it seemed to enjoy getting sandwiches.

When hungry hurrying back to the beach, we found the tide being so low that even the dories could not manage to reach the shore. However, several of the participants showed great engineering ability in building a quay and also helped by the rising tide, we reached "Valkyrien" just a couple of hours late for dinner.

August 7th. After calling at Longyearbyen during the night to get water, the lack of which was a rather constant problem on board "Valkyrien", we proceeded to Billefjorden, where the first stop was made in Skansbukta.

An excursion overland to the lower parts of Høgskulefjellet made in possible to collect Permian brachiopods, mostly *Productids* and *Spiriferids.*

The gypsum beds at Skansbukta have been subjected to mining in the thirties. However, the high percentage of anhydrite made the mining not profitable. The inner part of the mining shaft is now full of the most perfect ice-crystals, some of the more complex ones measuring up to ca 50 cm in diametre.

During a detour into Billefjorden later in the day the rather complicated and

Fig. 4. *The excursion in the inner part of Dicksonfjorden.* (Photo: K. BIRKENMAJER.)

interesting geology of this area could be studied. The presence of several faults of different ages explains why the Culm beds on the SE coast of the fjord rest on Hecla Hoek formation, while on the NW side the Cyathophyllum limestone is overlying folded Devonian layers.

In the evening we passed from Billefjorden along the beautiful mountain Tempelet and stopped for the night in Tempelfjorden.

August 8th. From the boat we could see Von Postbreen with its characteristical mid-moraine and also the little bay – Bjonahamna – where several raised beaches are developed.

A landing in Tempelfjorden brought us to the lower part of the Cyathophyllum limestone, where we visited a zone containing vast numbers of foraminifers.

Later in the day a stop was made in Sassendalen. This is one of the most colourful valleys in Vestspitsbergen, and we saw quite a lot of different flowers and not to forget two reindeers. As the lower part of the valley consists of Permo-Carboniferous layers, the participants got good possibilities to collect Lower Permian brachiopods from the Spirifer limestone.

August 9th. At Deltanesset we landed at the continental Upper Triassic layers. Walking up the hill, we proceeded to Jurassic sediments and at about 300 m a.s.l. we found the Cretaceous limestone, reddish brown when weathered. An abundance of ammonites and pelecypods was collected in these beds, together with fossil wood and some fragments of vertebrates.

Returning to Longyearbyen in the afternoon an excursion to Longyearbreen was arranged. In the moraine in the front of the glacier usually abundant lots of Tertiary plant fossils can be found.

In the evening we had our farewell dinner, a little early perhaps, as we were leaving Svalbard on the next day. According to the menu we should have been eating mostly fossils, but they were so nicely prepared that it all tasted deliciously and were even not a bit tough. We were very pleased that both the Governor of Svalbard and director BING from Store Norske Spitsbergen Kulkompagni A/S had found time to be present.

August 10th. Thanks to kind obligingness Store Norske Spitsbergen Kulkompagni A/S arranged an excursion to their newest mine. When off for the mines, one of the participants being so used always to put on the life-jacket when leaving "Valkyrien" seemed to find it more safe also to wear a life-jacket when going on shore.

Our time at Svalbard ended with a reception in the mess of the coal-company and in the evening we left Longyearbyen bound for Norway.

August 11th. Passing along the southern coast of Vestspitsbergen we still once more could see the peaks and montains, glaciers and fjords of this beautiful, ragged country.

August 12th. A little past midnight we got the sight of Bjørnøya – this time not covered with clouds. However, the time did not permit to make any stop.

Fig. 5. *A little collection of fossils found during the Svalbard excursion. Compiled and drawn by A. Heintz.*

August 13th. We got the first sight of Norway about midnight, passing Tromsø very early in the morning. The journey along the Norwegian coast down to Bodø was very pleasant – as the weather was exceptionally fine.

August 14th. Early Sunday morning the whole group left Bodø by plane, bound for the Congress in Copenhagen. Beautiful weather and a good vessel certainly had contributed greatly to make the Svalbard excursion such a pleasant one. However, this report cannot be finished without specially mentioning the officers and the crew on board "Valkyrien". Their skill, help and kindness added such a lot of pleasure to our journey.

And to close this story I would like to quote the last lines of the last verse of "The Svalbard Volunteers" written during the excursion by Dr. GORDON jr. and Prof. WESTOLL:

"For all the world's geologists
One group in dreams appears:
It's the gay, life-jacked,
Luncheon – packeted
Svalbard volunteers."

The weather in Svalbard in 1960

BY

VIDAR HISDAL

The year opened with the passages of some weak depressions and relatively mild winds. However, about the middle of January the general circulation pattern changed. An anticyclone formed over Greenland and colder air from the north entered the Svalbard area. The last part of January and most of February were colder than normal. In March and April some of the depressions passing Svalbard were quite intense, and the weather was variable, but mostly mild. May and June, and still more July and August, were characterized by several high-pressure situations. In the two latter months a very stable anticyclone over Svalbard and adjacent oceans resulted in one of the longest spells of fine summer weather ever observed in this region. About September 10th the anticyclone started to move towards the southeast, and for a couple of weaks mild southerly winds were predominating. During large parts of October cold air from the north streamed over the islands, causing the mean temperature of the month to be comparatively low. The same applies to December. The intermediate month November was somewhat better, due to a greater frequency of southerly winds.

The table contains preliminary monthly temperature means for Isfjord Radio for 1960 (in degrees centigrade) as well as their deviations from the means of the period 1949–58. (The final data for 1960 are not yet available. They will be published later on in "Norsk meteorologisk årbok 1961".)

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
1960 means	-8.4	-13.9	-8.3	-6.1	-1.0	2.0	6.1	5.0	3.5	-6.5	-6.3	-11.0
Deviation of 1960 means from 1949–58 means	1.7	-5.0	3.0	2.4	2.2	0.0	1.3	0.6	2.4	-4.0	-1.2	-3.3

Absolute age determinations on rocks from Dronning Maud Land, Antarctica

BY

NATASCHA HEINTZ AND THOR SIGGERUD

Abstract

Age determinations made by Belgian, Japanese and Soviet-Russian scientists on rocks from Dronning Maud Land, Antarctica are referred. These age determinations, done by different methods all indicate an age of about 500 million years for the last orogeny in this area, a result already expected on bases of geological evidence from other areas.

Several expeditions have studied the geology in Dronning Maud Land, i. a. The Norwegian-British-Swedish Antarctic Expedition 1949–52, and Belgian, Japanese and Soviet-Russian expeditions during and after the International Geophysical Year.

Some absolute age determinations have been made on samples from the collected materials, and the results have been published in several different papers. This note is an attempt to compare the results and the methods used.

The area from which the rock samples have been collected lies between 68° and 73° S and 10° and 41° E (Fig. 1). With only few samples from such a vast area, the results of the age determinations are only the first approximation of the time when the last orogeny took place in this area. However, if the age of the rock samples from all of Dronning Maud Land is very much the same, it is more likely that the results are significant for a greater part of this area.

This has also proved to be the case and the only remarkable fact is that the age of the rocks from different places in this enormous country is to such a great extent more or less the same.

The results obtained by different age determination methods from 28 analyses made on materials from 14 different localities, all give an age of about 500 million years.

The average of eight Russian analyses from four localities lying between 10° and 20° E is 432 million years.

The average of twelve Belgian analyses from six localities in Sør-Rondane lying between 24° and 27° E is 475 million years.

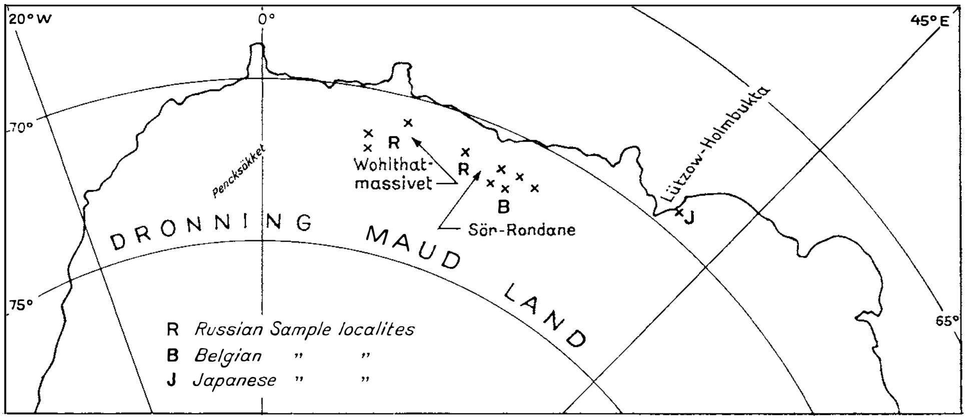

Fig. 1. *Map of Dronning Maud Land, Antarctica, showing where the samples have been taken, that have been used for age determinations.*

The average of seven determinations from four localities sampled by the Japanese expedition is 496 million years, not taking into consideration a very low Pb/Th age. The three ages obtained from one sample by the U/Pb method are 470 million years and somewhat lower than the ages obtained by the Rb/Sr method on material from the same vicinity, the average of which was 516 million years.

More detailed work will perhaps show that there is a tendency towards older rocks eastwards in Dronning Maud Land, but the difference is, on the other hand, not larger than can be expected taking into consideration the different methods used for the age determinations.

As can be seen from tab. I the methods used in age determination differs and both K/Ar, Rb/Sr and U/Pb have been applied. The Russian investigators usually employ the K/Ar method based on the decay constants $5.57 \cdot 10^{-10}$ and $4.72 \cdot 10^{-10}$. In a personal communication to one of the authors Prof. RAVIČ explains that the whole rock sample has been used for the age determinations, and not just the feldspar og biotite minerals. All rocks containing more than 1 % K can be used for this type of age determination.

The Belgian scientists have used spiked samples of biotite in a 33 cm mass spectrograph, with decay constant for Rb^{87} of $1.39 \cdot 10^{-10}$, and with Rb^{87} as 0.283 g/g Rb.

Of the Japanese material the samples studied by the Rb/Sr methods consisted of large biotite crystals. The decay constant used is $1.386 \cdot 10^{-10}$. Euxenite was examined by chemical and isotope analysis. The Pb 208/Th 232 gave a low value, viz. 375 million years, but the other ages coincide fairly well with the results obtained by the others. That the Pb/Th determination gives a smaller age than the others is a phenomenon well known in the literature.

That Rb/Sr ages are somewhat higher then the K/Ar ages are also not unusual, the more so as the Russian determinations are not on micas alone, but on the whole rock. The feldspars may therefore have contributed more than the biotites to the total K content. It seems to be evident from the literature that feldspars have a tendency to lose Ar compared with biotite.

If the ages found in Dronning Maud Land are compared with ages obtained in

TABLE I

AGE DETERMINATIONS MADE ON ROCKS FROM DRONNING MAUD LAND, ANTARCTICA

Sampled by	Determined by	Sample No.	Locality	Type of rocks and minerals used for age determination	K %	Ar $\frac{cm^3}{g} \times 10^{-5}$	Rb (p.p.m.)	Rb^{87} concentration	$\frac{\text{Radiogenic } Sr^{87}}{\text{Total } Sr^{87}}$	Radiogenic Sr^{87} concentration (p.p.m.)	Sr^{87} abundance	Age in mill. years
M. G .Ravič (1959)	M.G. Ravič and A.Ja. Krylov	17 V	Forpost-fjellene	Feldspatized and biotized pyxorene plagiogneiss	1.18	2.4						475
»	»	16 G	»	Cataclased pegmatitic plagiogranite	0.51	1.01						460
»	»	34	Schirmacher-oasen	Cataclased, migmatized garnet biotite gneiss	3.30	5.42						390
»	»	28	»	Pegmatitic granite with muskovite	4.19	7.10						400
»	»	31 B	Lodočnikov fjellet, northernmost on Konrad-ryggen	Biotite pegmatite	8.06	13.52						400
»	»	31 D	»	Cataclased, fine-grained granite with biotite and garnet	3.81	7.32						450
»	»	31 Z	»	Cataclased alaskite granite (vein)	4.56	8.02						420
D.S. Soloveva	»	512	North side of Konrad-ryggen	Porphyroblastic granite	4.08	8.05						460
Belgian expedition in 1958	S. Deutsch E.E. Picciotto M. Reinharz		Romnøs-fjellet	Porphyroblastic granite			563		0.42			478
»	»		»	Pegmatite vein in granite			1108		0.91			465
»	»		Småhausane	Quartz diorite			139		0.56			458
»	»		»	Diorite			328		0.39			457

»	»		Nordtoppen	Biotite gneiss (xenolith in diorite) fine fraction			1477		0.92			476
»	»		»	Coarse fraction			1459		0.89			481
»	»		»	Coarse biotite crystals from xenolith in diorite			786		0.59			493
			Strandru-fjellet	Biotite gneiss			545		0.56			455
»	»		»	Fine-grained granite (anatectic ?)			1329		0.90			483
»	»		Bautaen	Fine-grained granite (anatectic ?)			1282		0.93			506
»	»											
»	»		Trillingane	Amphibole biotite gneiss			371		0.50			471
»	»		»	Leucocratic pegmatite			842		0.60			474
Japanese expedition 1957–58	L.O. Nico-laysen A.J. Burger T. Tatsumi L.H. Ahrens	JARE 57112001	Langehovde district, Lützow-Holmbukta	Granitic pegmatite in granitic gneiss				250±3		1.82±0.13	0.139	525±40
»	»	JARE 57102622	E.ridge of 190 m high mountain, Skallen district	Granitic pegmatite in dioritic gneiss (charnockite)				447±9		3.29±0.07	0.59	530±16
»	»	JARE 57110704	E.ridge of 410 m high mountain, Skarvsnes district	Granitic pegmatite in dioritic gneiss				182±3 181±2		1.28±0.07	0.267	510±30
»	»	JARE 57122307	West Ongul Island	A small biotite rich mass in a basic charnokite lens, occurring in grano-dioritic gneiss				248±3		1.71±0.09	0.170	500±30
»	N. Saito T. Tatsumi K. Sato		East coast of Lützow-Holmbukta	Euxenite from granitic pegmatite in dioritic gneiss	Age in million years. – After U/Pb method. Pb–206/U–238 485±12			Pb–207/U–235 468±12		Pb–208/Th–232 375±27		Pb–207/Pb–206 458±21

other parts of Antartica, they fall into two distinctive age groups. The rocks from Dronning Maud Land are approximately 500 million years, while others are between 950 and 1100 million years. The youngest rocks are found in Dronning Maud Land, Victorialand and in the area between Victorialand and Wilkies Land. The age of the rocks from the eastern side of Ross Bay is also about 500 million years. In some other localities, even if the samples look as the same type of rock, i. e. the petrographical name given to the rock samples are the same as given to the rocks from Dronning Maud Land, the rocks have a higher age. These localities lay in between the areas where the younger ages have been found east of 55° E.

Regarding the westernmost parts of Dronning Maud Land, there are yet not made any age determinations of rocks from this region. ROOTS (1953) assumes by analogy with the geological history of the Ross section (as described by DAVID and PRIESTLEY (1914) and FAIRBRIDGE (1949)) that it might be tentatively presumed that the metamorphism of the basement complex in the eastern part of West Dronning Maud Land (east of Pencksøkket) was generally completed by the Cambrian period. The continuation of this complex is the Wohlthat area, and ROOTS' assumptions seem to have been verified by the above mentioned age determinations.

It should now be of interest to carry out age determinations on the dioritic intrusions in the extensive younger sediments that cover the basement complex, i. a. in the area west of Pencksøkket. These seem to be the next and last igneous activity in Dronning Maud Land.

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Norsk Polarinstitutts virksomhet i 1960. Organisasjon og administrasjon

AV

TORE GJELSVIK

Personale

Norsk Polarinstitutt hadde pr. 31. desember 1960 22 regulære stillinger. 10 personer var midlertidig engasjerte, vesentlig for oppgaver vedrørende Antarktis.

Den faste staben:

Direktør:	ANDERS K. ORVIN, dr. philos., til 31. mars, da han fratrådte etter oppnådd aldersgrense etter 39 års tjeneste.
Direktør:	TORE GJELSVIK, dr. philos. Tiltrådte 1. april.
Geolog I:	HARALD MAJOR, cand. real.
Geolog II:	THOR SIGGERUD, cand. real. Tiltrådte 1. januar.
Geolog II:	THORE S. WINSNES, cand. real.
Glasiolog:	OLAV LIESTØL, cand. real.
Meteorolog:	VIDAR HISDAL, cand. real.
Hydrograf I:	KAARE Z. LUNDQUIST, o/kapt.
Hydrograf II:	HELGE HORNBÆK.
Topograf I:	BERNHARD LUNCKE, ingeniør.
Topograf I:	WILHELM SOLHEIM, ingeniør. Fratrådte 5. august ved oppnådd aldersgrense etter 42 års tjeneste.
Topograf II:	HÅKON HILL, jordskiftekandidat. Rykket opp til topograf I fra 1. september.
Topograf II-stilling ubesatt fra 1. september.	
Geodet II:	SIGURD G. HELLE, cand. mag.
Karttegner I:	BJØRN ARNESEN
Karttegner III:	BJARNE EVENSEN
Konsulent I:	NATASCHA HEINTZ, cand. real. Tiltrådte 1. oktober.
Sekretær I (bibliotekar):	SØREN RICHTER, mag. art.
Kontorsjef:	JOHN GIÆVER, kaptein. Invalidepensjon fra 1. juli og før den tid sykepermittert.

Fullmektig I:	SIGNY BANG
Fullmektig I:	ALFHILD HORN. Avgikk ved døden 15. september.
Fullmektig II:	MARTHA LUNCKE
Fullmektig II:	GUDRUN EDWARDSEN
Vaktmester og bud:	KIRSTEN DANIELSEN

Midlertidig engasjerte:

Cand. real. TORBJØRN LUNDE
Meteorolog, cand. real. JARL TØNNESEN, inntil 31. mai.
Cand. real. TORGNY E. VINJE, fra 1. juli.
Sivilingeniør EINAR JONSJORD, fra 1. juli.
Jordskiftekandidat SVERRE ØYGARD, fra 1. august.
Ingeniør THOR ASKHEIM
Ingeniør WILHELM SOLHEIM, fra 5. august.
Konsulent, jordskiftekandidat NILS ROER, fra 15. oktober.
Radiotekniker JOHN SNUGGERUD, fra 1. juli.
Meteorologfullmektig KÅRE J. HANSEN, fra 7. mars til 1. juli.
Radiotelegrafist KNUT ØDEGAARD, fra 7. mars.
Korrespondent ALINE TORSTENSON, i deltidsstilling fra 9. november.

Medlemmer av Den Norske Antarktis-ekspedisjon, 1956–60, som overvintret 1959–60 var:

Leder og geodet SIGURD G. HELLE
Meteorolog TORGNY E. VINJE
Radiotekniker JOHN SNUGGERUD
Mekaniker HENRY R. BJERKE
Stuert ROLF L. JOHNSON
Radiotelegrafist KNUT ØDEGAARD
Meteorologfullmektig KÅRE J. HANSEN
Meteorologfullmektig JAN P. H. MADSEN
Meteorologassistent ASTOR O. K. ERNSTSEN

Tjenestefrihet

VIDAR HISDAL har hatt tjenestefrihet fra 26. mars til 11. juli og fra 3. november – for studier ved meteorologiske institusjoner i Sveits og Frankrike.

SIGURD G. HELLE hadde tjenestefrihet til 1. mars for å lede Den Norske Antarktis-ekspedisjon, 1956–60, til Dronning Maud Land, Antarktis.

Utmerkelser

Direktør dr. philos. ANDERS K. ORVIN ble 20. mai utnevnt til Ridder av 1ste klasse av Den Kgl. Norske St. Olavs Orden.

Ingeniørene THOR ASKHEIM og WILHELM SOLHEIM ble tildelt Kongens Fortjenstmedalje i gull 26. september.

H. M. Kong Olav V har 3. februar 1960 innstiftet Antarktis-medaljen til erindring om Den Norske Vitenskapelige ekspedisjon til Antarktis 1956–60.

Denne ble tildelt 21 overvintrere, 12 deltakere i flyfotograferings-ekspedisjonen 1958–59 og kapteinene på ekspedisjonsfartøyene.

Av instituttets faste og midlertidige medarbeidere er følgende tildelt medaljen: SIGURD G. HELLE, BERNHARD LUNCKE, THORE S. WINSNES. KÅRE J. HANSEN, TORBJØRN LUNDE, JOHN SNUGGERUD, JARL TØNNESEN, TORGNY E. VINJE og KNUT ØDEGAARD.

Oppnevnelser

Direktør TORE GJELSVIK har avløst direktør ANDERS K. ORVIN som formann i Den Norske Nasjonalkomité for Antarktisk Forskning, (SCAR), og er videre oppnevnt som medlem av Komitéen for bevaring av polarskipet "Fram", som medlem av styret for Det norske geografiske selskap og for Fridtjof Nansen-stiftelsen på Polhøgda.

REGNSKAP FOR HALVÅRET 1. JULI – 31. DESEMBER

Kap. 565 Poster:		Bevilget	Medgått
1. Lønninger		kr. 222 100	kr. 221 803
2. Til disposisjon etter Departementets bestemmelse		» 32 000	» 32 000
3. Kontorutgifter		» 25 000	» 25 675
4. Trykning og bearbeidelse		» 30 000	» 30 027
5. Svalbardekspedisjonen		» 275 000	» 228 182
6. Antarktisekspedisjonen 1949–52 Trykning og bearbeidelse		» 25 000	» 20 645
7. Breundersøkelser i Norge		» 6 000	» 6 133
		kr. 615 100	kr. 564 465
Kap. 31. Fyr og radiofyr på Svalbard		kr. 35 000	kr. 21 196
	Budsjettert:	Innkommet:	
Kap. 2506. Inntekter	kr. 2 700	kr. 4 078	
Kap. 2251. Svalbardbudsjettet	kr. 100 000	kr. 100 000	
Kap. 224 *C.* Antarktisekspedisjonen 1956–60.			
Beholdning pr. 30. juni 1960:	kr. 985 807		
Medgått			kr. 108 275
Tilbakeført	» 471 219		» 362 944
	kr. 514 588		

Ad. Kap. 565, post 5 – Svalbardekspedisjonen – kan henvises til redegjørelsen under Svalbardekspedisjonen nedenfor. I tillegg kan nevnes at båtleien ble rimeligere enn budsjettmessig forutsatt. I forbindelse med den forestående omleggingen av ekspedisjonen ble en del ekspedisjonsmateriell og instrumenter fornyet.

Ad. Kap. 31: Besparelsen skyldes her bl. a. at man, i stedet for å kjøpe ny sektorlykt til Kapp Ekholm, flyttet hit lykten fra Blåhuken i Van Mijenfjorden. Dessuten innskrenket de ekstraordinære fyrarbeidene seg til lykten på Kapp Ekholm, slik at arbeidet kunne utføres av besetningen ombord på ekspedisjonsfartøyet i stedet for ved engasjement av eget fyrparti.

Ad. Kap. 224 C: Det tilbakeførte beløpet innbefatter en refusjon på kr. 218.239 fra Syd-Afrika for materiell som ble overtatt på Norway Station, samt kr. 144.705, som ikke lenger er overførbart.

Fig. 1. *Norsk Polarinstitutts kontorbygning i Observatoriegt 1, Oslo.* Foto: T. S. WINSNES

Diverse

Den sterke økningen i behov for lokaler som var oppstått, dels på grunn av nyansettelser og dels fordi alle de nye midlertidige medarbeidere fra Antarktis-ekspedisjonen kom til, har bare kunnet bli løst provisorisk ved at enkelte av instituttets medarbeidere har fått arbeidsplass på Universitetet eller har vært bortreist. Således har O. LIESTØL fått kontor på Geologisk Institutt på Blindern og T. SIGGERUD og T. WINSNES på Geologisk Museum på Tøyen, mens V. HISDAL har hatt tjenestefri. Dessuten har en del ominnredninger og omplaseringer på hovedkontoret i Observatoriegaten ført til at det er blitt noen flere arbeidsplasser. Installering av sentralbord har også forbedret arbeidsforholdene. Derimot har det ikke lykkes å skaffe noe mer kontorplass i rimelig nærhet av hovedkontoret. (Fig. 1.)

Universitetet lot bygningen bli pusset opp utvendig i løpet av sommeren og høsten, og instituttet har selv bekostet en oppussing av inngangen og trappeoppgangen.

Avtalen med Vassdragsvesenet om kontorlokaler i deres nye bygg i Middelthunsgaten er blitt fastlagt i nærmere detaljer. Instituttet vil her, når bygget blir ferdig, forutsetningsvis i 1963, få meget tilfredsstillende kontorlokaler. En intern byggekomité samarbeider med arkitekten og Vassdragsvesenet i planlegging av rominnredningen.

Samlingene fra Svalbard har helt siden de Statsunderstøttede Spitsbergen-ekspedisjonenes tid blitt levert til Universitetets Paleontologiske Museum. Samlingene har imidlertid stort sett ligget nedpakket i kasser, da det ikke har vært tilstrekkelig skuffe- eller hylleplass for dem. Dette har bevirket at de har vært vanskelig tilgjengelig, og materialet er ikke blitt utnyttet eller bearbeidet i den grad som det ellers kunne ha blitt. Instituttet har derfor i år bevilget kr. 7.500 til innredningsarbeider for disse samlingene etter en plan utarbeidet av prof. dr. ANATOL HEINTZ ved Paleontologisk Museum. Et eget rom vil bli innredet for Svalbardsamlingene for en total omkostning av ca. kr. 30.000, hvorav instituttet og museet vil bidra med en halvpart hver. I denne forbindelse er det sluttet en skriftlig avtale om disponeringen av Svalbardmaterialet. Denne ordning gjør at en kan se bort fra å ha egne lagerrom for de geologiske samlinger ved hovedkontoret også i tiden fremover.

Instituttets administrasjonskontor har i det forløpne år vært sterkt redusert på grunn av sykdom og dødsfall. KAARE Z. LUNDQUIST er fra 1. juli gitt et administrasjonstillegg for å fungere som utrustningssjef og ellers for å bistå direktøren, inntil en fastere ordning for instituttets administrasjon er truffet.

Forvaltningen av Arktisk Næringsdrift A/S ligger ikke lenger under instituttet.

Ekspedisjonsvirksomheten

Svalbard

Årets Svalbardekspedisjon ble noe redusert i forhold til det som var forutsatt i budsjettet. Det skyldtes først og fremst at en fant å måtte holde alle topografene tilbake i Oslo for konstruksjonsarbeidet vedrørende Antarktis-kartene. Dertil kom at arrangeringen av ekskursjoner til Svalbard i forbindelse med både Den XXI Internasjonale Geologiske Kongress og Den XIX Internasjonale Geografiske Kongress la beslag på instituttets geologer og glasiolog, og i noen grad reduserte deres virksomhet på Svalbard. Til gjengjeld ble det arrangert et ornitologisk parti, et botanisk parti og et paleo-botanisk parti. Ekspedisjonen kom dessuten noen dager tidligere tilbake enn forutsatt, fordi den fungerende ekspedisjonsleder, orlogskaptein HARRY LIND-ANDERSEN, måtte tilbake til sitt virke i marinen. (Bl. a. på grunn av direktørskiftet måtte instituttets vanlige ekspedisjonsleder, K. Z. LUNDQUIST, oppholde seg om sommeren ved hovedkontoret.) Ekspedisjonsbåten, M/S "Brandal", med kaptein JOHS. BRANDAL, forlot Åndalsnes med de fleste av ekspedisjonsdeltakerne 18. juni og returnerte til samme sted 2. september.

Værforholdene var stort sett meget tilfredsstillende på Vestspitsbergen, da særlig i fjordene og i innlandet. Ute ved kysten var også været jevnt over bra, men det var likevel atskillige dager med skodde eller usiktbart vær. Isforholdene i Svalbardområdet var usedvanlig gode denne sommeren. Ekspedisjonen ble gjennomført uten uhell av noen art.

Årets Svalbardekspedisjon besto i alt av 21 mann fordelt på:

2 hydrografiske partier	1 ornitologisk parti
2 geologiske partier	1 botanisk parti
1 glasiologisk parti	1 paleobotanisk parti

Den nye direktør reiste oppover med ekspedisjonsbåten, og fulgte med denne inn i fjordene på vestsiden og nordsiden av Vestspitsbergen, da de forskjellige partiene ble satt ut. Han var deretter med på en del av fyrkontrollen og reiste i begynnelsen av juli til glasiologpartiet i Van Keulenfjorden, hvor han foretok en del geologiske undersøkelser. Herfra foretok han sammen med O. LIESTØL en prøveflyging med helikopter til Hornsund, og senere besøkte han sammen med O. LIESTØL og T. SIGGERUD den polske vitenskapelige leiren i Isbjørnhamna i Hornsund. Den polske ekspedisjonen skulle avslutte sin virksomhet i denne omgang etter å ha gjort meget omfattende geologiske, glasiologiske og biologiske undersøkelser i Hornsundområdet gjennom fire somrer og en vinter. Ekspedisjonen etterlater seg et stort hus og meget utstyr, som inntil videre skal stå under beskyttelse av Sysselmannen på Svalbard og Norsk Polarinstitutt. Direktøren reiste hjem til Norge i midten av juli sammen med representanter for Industridepartementet og Utenriks- og Konstitusjonskomitéen, som hadde vært på befaring på Svalbard.

Hydrografisk parti 1. – Orlogskaptein HARRY LIND-ANDERSEN med ekspedisjonsfartøyet utførte hydrografvirksomhet i 17 dager. Av forskjellige grunner ble båten meget opptatt med utsetting og forflytting av de forskjellige partier og med tilsyn og reparasjonsarbeider av fyr og radiofyr. Hydrograferingen fant sted fra 1. til 23. august, med avbrudd 8. til 13. august for en tur til Kong Karls Land. Det var imidlertid så uheldig at nettopp i dette tidsrommet var det atskillig skodde på nordsiden, og det ble ikke mange dagers effektiv opploddingsvirksomhet.

Hydrografisk parti 2. – Leder HELGE HORNBÆK, med assistenter HENRY BJERKE, OTTO STABENFELDT og MATHIAS AASEN, gjorde ferdig opploddingen av Breibogen, og partiet kom godt i gang med opploddingen av Liefdefjorden. Partiet var landstasjonert, og foruten de vanlige teltene, hadde det fått utlånt et stort forlegningstelt fra marinen, som viste seg å egne seg meget godt for formålet. Partiets arbeid ble en del sinket ved at hverken båten "Svalis" eller ekkoloddet fungerte tilfredsstillende.

Geologisk parti 1. – Leder HARALD MAJOR, med assistenter JENÖ NAGY, EIGILL NYSÆTHER og BO WINGÅRD, utførte sondérboringer og supplerende avdekninger av kullforekomstene i området Bolterdalen – Foxdalen. De hadde god erfaring med en roterende bormaskin som var tatt med i forsøksøyemed. Partiet utførte videre rekognoserende undersøkelser ved Van Keulenfjorden. Det ble ikke funnet brukbare kullfløtser, men partiet arbeidet en del med å klarlegge grensen mellom tertiær- og krittformasjonene som er uklare i dette området. Gruppen ble i august måned, etter anmodning formidlet av byråsjef HARRY LINDSTRØM, stillet til disposisjon for Store Norske Spitsbergen Kulkompagni A/S for å ordne med supplerende utmål på selskapets traktateiendommer. Dette arbeidet ble utført ved hjelp av et helikopter, og det ble anmeldt 75 funnpunkter i eiendomsområdene i Longyeardalen, Grøndalen, Grønfjordbotnen, Indre Lågfjorden og Indre Billefjorden.

Geologisk parti 2. – Leder THOR SIGGERUD, med assistenter ERIK T. FORFANG og REIDAR A. MEHL.

Dette var SIGGERUDS første ekspedisjon til Svalbard, og det var meningen at han skulle sette seg inn i de geologiske forholdene i de eldre, metamorfe formasjonene på Vestspitsbergen, særlig mellom Isfjorden og St. Jonsfjorden.

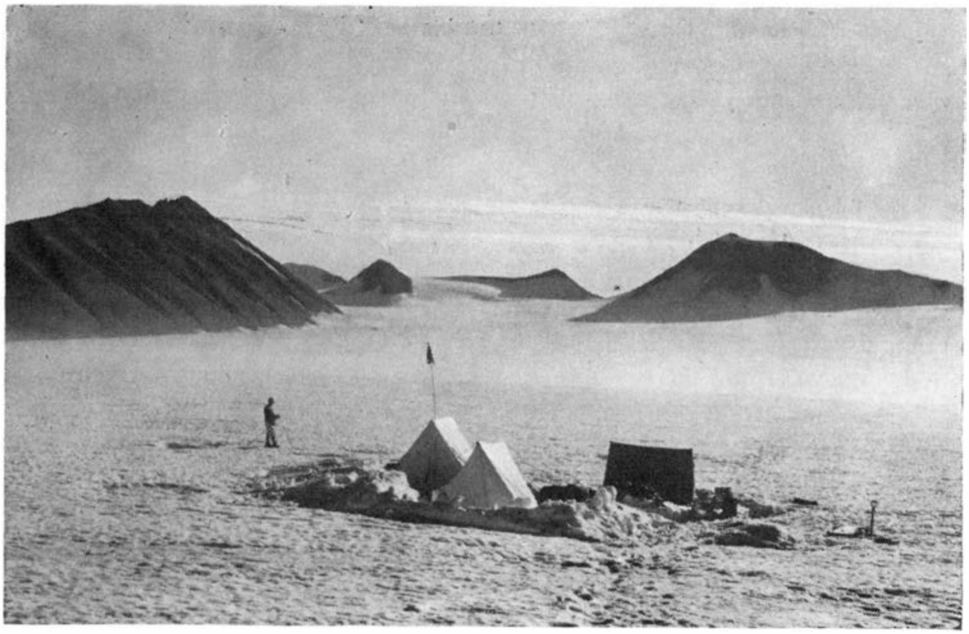


Fig. 2. *Teltleiren til en av Polarinstituttets geologpartier på Vestspitsbergen.* Foto: T. SIGGERUD

Gruppen ble landsatt i Trygghamna 27. juni. Dette viste seg å være noe for tidlig, da området ennå var snedekket. Undersøkelsene ble dessuten også hemmet av mangel på gode topografiske karter. Senere flyttet partiet til St. Jonsfjorden, og her ble de stratigrafiske forhold i det vesentlige klarlagt. SIGGERUD fant i Kulmformasjonen i nærheten av Trygghamna en nylig fremsmeltet 3 m mektig kullbenk, som dessverre var meget uren. Videre undersøkte han to kopperforekomster i St. Jonsfjorden, en jernmalmforekomst ved Farmhamna og rustsoner nær Alkhornet i Trygghamna. Ingen av disse forekomstene syntes å være av økonomisk betydning. Sammen med direktøren besøkte SIGGERUD senere Sinkholmen i Bellsund. Denne forekomsten viser en ren og vakker sinkblende, men malmarealet er ubetydelig i dagen og avtagende mot dypet. Malmen over havets nivå er for det meste utdrevet, og forekomsten kan ikke gi anledning til drift. Den vil imidlertid tjene som utgangspunkt for videre undersøkelser inne på fastlandet. SIGGERUD avsluttet sin ekspedisjon 13. august for å delta i ekskursjonen til Den XXI Internasjonale Geologiske Kongress og fulgte ekskursjonen tilbake til Norge.

Glasiologisk parti. – Leder OLAV LIESTØL, med assistenter FINN CHRISTENSEN og KNUT A. NILSEN, var stasjonert ved instituttets lille hytte i Van Keulenfjorden. LIESTØL fortsatte sine undersøkelser på Finsterwalderbreen og foretok også målinger på Nathorstbreen og Recherchebreen. Ved et senere besøk i Hornsund ble Hornsundbreens front innerst i fjorden målt inn. Fra 27. juli til 1. august ledet LIESTØL sammen med statsgeolog ROLF W. FEYLING-HANSSEN fra Norges Geologiske Undersøkelse en internasjonal geografekskursjon som besøkte Svalbard.

De fleste breene på Svalbard viste i 1960 en usedvanlig stor avsmeltning, og enkelte av dem trakk seg flere hundre meter tilbake. Andre breer har imidlertid rykket frem i den senere tid. På tilbakereisen til Oslo besøkte LIESTØL tappetunnelen for den bredemte sjøen foran Østerdalsisen i Rana og den engelske ekspedisjonen som med støtte fra Norsk Polarinstitutt foretok undersøkelser av Svartisen.

Ornitologisk parti. – Leder dr. HERMAN L. LØVENSKIOLD, med assistenter, konservator PETER VALEUR og forfatteren HARALD SVERDRUP, arbeidet den første tiden ved Recherchefjorden og i Storvika nord for Kapp Borthen. Senere dro de til Kongsøya, Kong Karls Land, og tok stasjon i hytta ved Kapp Koburg. Det viste seg imidlertid at det var så mye isbjørn i området at det ikke ble særlig anledning til ornitologisk arbeid. Fuglelivet her bør undersøkes fra et ekspedisjonsfartøy. Det ble tatt opp en interessant film av isbjørnene.

Paleobotanisk parti. – Partiet besto av cand. mag. BJØRN FALKANGER og stud. real. PER SUNDING og foretok etter forslag av prof. dr. OVE ARBO HØEG innsamlinger av plantefossiler fra tertiærformasjonen omkring kullfeltene i Longyearbyen og Ny-Ålesund. Ved Longyearbyen ble undersøkt området sydvest for Adventdalen med sidedalene Longyeardalen, Endalen og Bolterdalen innover til vannskillet mot Colesdalen og Reindalen. I Ny-Ålesundområdet er de fossilførende lagene mest dekket av løsmateriale, og det beste materialet ble her tatt fra «tippen» utenfor Estergruven. Det ble i alt samlet inn 23 kasser prøvemateriale som er overlevert til Universitetets Paleontologiske Museum for bearbeidelse. Gruppen utførte også en del botaniske undersøkelser, og fant således nye plantearter som er innført med mennesker. Det ble også samlet en del sopp. Høydegrenser for forskjellige plantearter ble registrert, og en del frø innsamlet for Botanisk Museum i Oslo.

Botanisk parti. – Lektor JENS STORDAL kom i midten av juli til Svalbard. De første 14 dager undersøkte han soppvegetasjonen omkring Longyearbyen. Deretter sluttet han seg til T. SIGGERUDS leir i St. Jonsfjorden og flyttet med SIGGERUDS assistenter til Kapp Wijk og senere igjen til Longyearbyen. STORDALS undersøkelser omfattet vesentlig hattsopper. Utbyttet var meget godt og vel 400 herbarieprøver ble innsamlet. Han kom til Vestspitsbergen da soppfloraen akkurat var i god vekst, og den var på sterk retur da han reiste igjen 24. august. Soppfloraen viste seg særlig rik omkring fuglefjellene.

Tromsø Museum sendte i 1960 sin båt M/S "Asterias" med et zoologisk parti på fire mann og et botanisk parti på tre mann for å foreta undersøkelser forskjellige steder langs kysten av Vestspitsbergen. Ledere var henholdsvis konservator BENGT CHRISTIANSEN og konservator OLAF I. RØNNING.

Utenlandske ekspedisjoner til Svalbard

University of Nottingham: Fysiologiske og geologiske undersøkelser i Kongsfjordenområdet. Leder dr. G. W. G. SHARP – 11 deltakere.

Durham University: Geologiske og biologiske undersøkelser ved Kongsfjorden. Leder J. P. COOK – 7 deltakere.

Imperial College, London: Topografisk kartlegging i Dicksonfjorden. Leder dr. P. SMITH – 4 deltakere.

Skotsk ekspedisjon i Billefjorden: Fysiologiske undersøkelser. Leder dr. H. SIMPSON – 7 deltakere.

Oulu Universitet, Finnland: Biologiske undersøkelser. Leder fil. mag. E. S. NYHOLM – 2 deltakere.

Krakow Universitet, Polen: Geologiske og glasiologiske undersøkelser i Hornsund. Leder doc. dr. S. SIEDLECKI – 22 deltakere, foruten en filmgruppe på 5–7 mann.

Würzburg Universitet: Geomorfologiske undersøkelser på Barentsøya og Edgeøya. Leder prof. dr. J. BÜDEL – 9 deltakere. Egen ekspedisjonsbåt M/S "Norsel" og et helikopter.

Wilhelm Universitet, Münster/Westfalen: Geologiske og geografiske studier. Leder hr. G. TIDTEN - 4 deltakere.

Internasjonal arkeologisk ekspedisjon: Leder dos. H. CHRISTIANSON – 11 deltakere.

American Overseas Petroleum Limited. Norsk Caltex Oil A/S: Oljeundersøkelser. Ledere H. D. KLEMME og A. S. WESTERHOLM – 10 deltakere. Egen ekspedisjonsbåt M/S "Polarøy" og 2 helikoptere.

Bataafse Internationale Petroleum Maatschappij N. V., Haag. A/S Norske Shell: Oljeundersøkelser. Leder dr. E. F. ESCHER – 4 deltakere. Egen ekspedisjonsbåt R/K "Olav Østensjø jr."

I tillegg kom en del ekspedisjoner med fjellklatring som vesentlig formål og enkeltpersoner med mer turistmessige interesser, samt presse- og kringkastingsfolk.

Jan Mayen

Det ble ingen ekspedisjon til Jan Mayen fra Norsk Polarinstitutt, da geolog dr. HARALD CARSTENS, som begynte geologiske undersøkelser i 1959, ikke kunne foreta noen reise i 1960 på grunn av sine plikter overfor Den XXI Internationale Geologiske Kongress.

Utenlandske ekspedisjoner til Jan Mayen

Birkbeck College, London: Geologiske undersøkelser. Leder dr. J. DOLLAR – 2 deltakere.

Dronning Mand Land, Antarktis

Instituttets ekspedisjon utsendt i 1956, som hadde ligget på Norway Station, Dronning Maud Land, og hele tiden var under ledelse av SIGURD G. HELLE, ble ble fraktet tilbake til Norge i begynnelsen av 1960. Ekspedisjonsbåten M/S

Fig. 3. *Ankomsten til Antarktis i 1956. M/S "Polarbjørn" og M/S "Polarsirkel" ligger ved barrieren* og losser utstyr. Foto: S. G. HELLE

"Polarbjørn", kaptein H. MARØ, ankom 8. januar til losseplassen nordenfor stasjonen, etter å ha ligget fast i isen i lengre tid. Den sørafrikanske overvintrings-ekspedisjonen på ti mann som skulle overta stasjonen, fulgte med den. M/S "Polarbjørn" ble losset, og sørafrikanerne ble på beste måte satt inn i forholdene på stasjonen, samtidig som de fikk de nødvendige instruksjonene om bruken av de instrumentene og det utstyret som de skulle overta.

15. januar dro den norske ekspedisjonen på hjemvei. M/S "Polarbjørn" gikk først vestover langs barrieren med kurs for Maudheim. På det stedet hvor Maudheimstasjonen hadde ligget, ble det funnet noen master. Det ble utført noen observasjoner, men været var dessverre for dårlig til å foreta en ny astronomisk stedsbestemmelse på stasjonen.

Etter planen skulle ekspedisjonen på hjemturen også ha gått i land på Bouvetøya for å foreta en del observasjoner, og de sørafrikanske observatørene skulle rekognosere på øya i forbindelse med planleggingen av en ny meteorologisk stasjon som skulle opprettes der. Imidlertid tillot ikke været noen landstigning.

Ekspedisjonen nådde Cape Town 27. januar. Her gikk den amerikanske observatøren, admiral S. S. MANDARICH i land sammen med en rekke sør-afrikanere som hadde fulgt med på turen.

M/S "Polarbjørn" kom til Ålesund 23. februar direkte fra Cape Town.

I begynnelsen av april ble ekspedisjonens vellykkete forløp feiret med en fest i Oslo, der ekspedisjonsdeltakerne med sine fruer og en rekke innbudte med utenriksminister HALVARD LANGE og frue i spissen var til stede. Før festen ble Antarktisfarerne overrakt en av H. M. Kongen innstiftet Antarktis-medalje.

Utenlandske overvintringsekspedisjoner i Dronning Maud Land 1960

På følgende fire stasjoner i Dronning Maud Land lå følgende utenlandske overvintringsekspedisjoner:

1. Norway Station, 70° 30′ S, 2° 32′ V, sørafrikansk ekspedisjon. 10 overvintrere.
2. Lazarev, 69° 58′ S, 12° 55′ Ø, russisk ekspedisjon. 10 overvintrere.
3. Roi Baudouin, 70° 29′ S, 24° 19′ Ø, belgisk ekspedisjon. 21 overvintrere.
4. Syowa, 69° 22′ S, 39° 35′ Ø, japansk ekspedisjon. 15 overvintrere.

Bearbeidelse av materiale fra Svalbard og Jan Mayen

Topografisk-geodetisk avdeling

Kart A 7, Kongsfjorden, målestokk 1:100 000, ble ferdig til reproduksjon i februar og sendt til Norges Geografiske Oppmåling, men kartet er ennå ikke trykt. En del arbeid er utført i forbindelse med den nye kartserie i 1:500 000 over Svalbard, til dels ved hjelp av en autograf ved NGO. Dr. ANDERS K. ORVIN har påtatt seg å fortsette navnsettingen for denne kartserien.

Tegnerne har, ved siden av arbeidet i forbindelse med kartkonstruksjonene, bl. a. rentegnet 45 småkart for dos. ADOLF HOELS verk over Svalbards nyere historie.

Avdelingen har hatt meget service for oljeselskapene og forskjellige vitenskapelige ekspedisjoner på Spitsbergen gjennom anskaffelse av flyfotografier, og har videre assistert Widerøes Flyveselskap A/S som skal dekke Svalbard med vertikale flyfotografier fra stor høyde. Ca. 20 % av området ble dekket i løpet av sommeren.

Hydrografisk avdeling

Et nytt sjøkart, nr. 514, Barentshavet, er blitt ferdig redigert i løpet av året og vil bli publisert våren 1961.

Redigering av et nytt sjøkart, nr. 515, Grønlandshavet, er påbegynt.

Bearbeidelsen av opploddingsmaterialet fra Liefdefjorden og Breibogen har fortsatt.

KAARE Z. LUNDQUIST har assistert den nye direktøren i overgangstiden, og til dels fungert som kontorsjef. Han vikarierte for direktøren under dennes opphold på Svalbard. Han har gjort forberedende arbeider for vurdering av elektroniske systemer for sjøkartleggingen i Svalbardområdet og Norskehavet.

Geologisk avdeling

Kullundersøkelsene

HARALD MAJOR har fortsatt bearbeidelsen av materialet fra kullundersøkelsene mellom Bolterdalen og Foxdalen og omkring Van Keulenfjorden. Han har gjennomført koordinatberegningene for alle avdekningspunktene og for stolldriften, og analyseresultatene for kullprøvene er gjennomarbeidet og vurdert og beregningen av kullmengdene justert. Forslag til utmålsbelegning av Store Norske Spitsbergen Kulkompagni A/S's traktatområder med beregning av grensepunktenes geografiske koordinater er utarbeidet for selskapet.

Andre arbeider

THORE S. WINSNES har gjort forberedende arbeider for ekskursjon til Svalbard i forbindelse med Den XXI Internasjonale Geologiske Kongress.

THOR SIGGERUD var leder for uranseksjonen på Den XXI Internasjonale Geologiske Kongress under møtene i København.

Avdelingen har hjulpet de selskapene som driver oljeundersøkelser på Svalbard med tilretteleggingen av det kjente geologiske materialet.

Avdelingen har også tatt på seg hovedtyngden av arbeidet i forbindelse med planleggingen av ominnredningen på instituttet og forberedelsene av de nye kontorlokalene instituttet skal få i Vassdragsvesenets nye bygg.

Planleggingen av en helikoptertjeneste under ekspedisjonen sommeren 1961 har også i det vesentlige vært utført av denne avdelingen.

Geofysisk avdeling

OLAV LIESTØL har vesentlig bearbeidet materiale innsamlet fra tidligere ekspedisjoner i Norge og til Svalbard. Dessuten krevde forberedelsene til en ekskursjon til Svalbard i forbindelse med Den XIX Internasjonale Geografiske Kongress, meget arbeid. En guide ble i denne forbindelse utarbeidet og mangfoldiggjort. Som i tidligere år har LIESTØL holdt forelesninger i glasiologi ved Universitetet i Oslo og veiledet hovedfagstudenter i glasiologi og kvartærgeologi.

VIDAR HISDAL har vært permittert en god del av året for studieopphold i Sveits og Frankrike. Forøvrig har han vært behjelpelig med bearbeidelse av meteorologiske observasjoner fra Norway Station og korrekturarbeid i forbindelse med Maudheimserien. Det meteorologiske utstyret ombord på de norske hvalkokeriene ble i løpet av høsten inspisert og komplettert for fangstsesongen 1960/61.

Bearbeidelse av materiale fra Antarktis

Etter sin tilbakekomst fra Antarktis har SIGURD G. HELLE ledet den videre bearbeidelse av Antarktismaterialet.

Glasiologi

En endelig oversikt over resultatene av akkumulasjonsmålingene fra 1957 til 1959 er ferdig bearbeidet av TORBJØRN LUNDE. Arbeidet omfatter også en kort morfologisk oversikt over området.

Kartarbeider

I løpet av året er det blitt etablert en særlig avdeling for konstruksjonsarbeidene vedrørende kart over Dronning Maud Land, bestående av NILS ROER, HÅKON HILL, EINAR JONSJORD og SVERRE ØYGARD. Dessuten har det øvrige personalet ved den topografiske avdelingen måttet gi prioritet til dette arbeidet. THORE S. WINSNES har også hjulpet til.

Triangulerings- og passpunktberegningene for Orvinfjella, Wohlthatmassivet og Sør-Rondane er ferdige. De barometriske høydemålingene og en basismåling i disse områdene er beregnet. Tilsvarende beregninger for Mühlig-Hofmannfjella og østre del av Gjelsvikfjella er påbegynt. I forbindelse med beregningen av de trigonometriske data har den elektroniske regnemaskinen ved Norges Geografiske Oppmåling vært nyttet.

Kartkonstruksjoner. Planigrafen har vært i kontinuerlig bruk, på slutten av året også i to skift pr. dag, til konstruksjon av Maudheimkartene etter det nye billedmaterialet. Det første bladet, H. U. Sverdrupfjella, H 6, ble ferdig og rentegningen ble satt i gang ved årsskiftet. Wohlthatmassivet er under konstruksjon hos Widerøes Flyveselskap A/S, hvor det nyttes en Wild A 5 autograf i to skift pr. dag. Dette arbeidet ledes av selskapets topograf K. Krogh, og er under tilsyn av Norsk Polarinstitutts topografiske avdeling.

Det er oppnevnt en intern navnekomité til å forestå navnsettingen av kartbladene fra Dronning Maud Land, bestående av SIGURD G. HELLE, NILS ROER og konservator ASLAK LIESTØL, den siste er engasjert som konsulent.

Meteorologi

Bakkeobservasjonene for tiden 1956/60 er ferdig punchet og kontrollert.

Aerologi. Alt materialet frem til september 1958, unntatt en del ekstraoppstigninger, er ferdig kontrollert og ført inn på IGY-skjemaer, likesom det også er gjort klart for punching. Skjemaene er sendt til IGY Meteorological Data Centre i Genéve.

Strålingsmålinger. Strålingsdata for 1957/58, unntatt balanseverdier, er sendt til IGY Meteorological Data Centre. Utslagsverdiene for samtlige komponenter for tidsrommet mai 1958–desember 1959 er avlest for hver time. Kalibreringskurver for alle instrumentene er utregnet.

Avkjølingsmålinger. Forarbeider er gjort med disse observasjonene.

Sydlys.

Ascaplot-data for 1957 og mesteparten av 1958 er utarbeidet. Skjemaene for 1957 er sendt til ing. W. STOFFREGEN, Uppsala.

Bidrag til innsamlinger og bearbeidelse utført av andre forskere

Dr. HERMAN L. LØVENSKIOLD har fortsatt sin bearbeidelse av Svalbards fugleliv. Hans publikasjon «Avifauna Svalbardiensis» nærmer seg nå sin fullførelse, og en del er allerede i trykk. Resten vil bli levert inn i løpet av 1961. Det trykkes i SKRIFTER, delvis med bidrag fra instituttet.

Dr. OVE WILSON har fått bidrag til bearbeidelse av medisinske observasjoner fra Maudheimekspedisjonen.

Dr. HARALD CARSTENS har bearbeidet geologisk materiale fra Jan Mayen innsamlet under hans ekspedisjon sommeren 1959. Et manuskript er allerede levert til instituttet for å trykkes i SKRIFTER.

Cand. real. PER SVENDSEN har fortsatt bearbeidelsen av sitt marinbiologiske materiale fra Svalbardekspedisjonen 1959.

Instituttet har videre gitt økonomisk støtte til lektor THOM ASKILDSEN for etnografiske undersøkelser i Canada. HELGE INGSTAD har fått bidrag til sine undersøkelser i forbindelse med den norske bosetningen på Vest-Grønland.

Biblioteket

I det forløpne år er registrert og katalogisert publikasjoner og karter fra ca. 250 faste bytteforbindelser, til sammen noe over 2 000 nummer. 52 bøker er innkjøpt, 18 bøker og ca. 200 småskrifter er mottatt som gaver. En ny stor bokreol er satt opp i biblioteket, som derved er blitt vesentlig forbedret. Distribueringen av instituttets egne publikasjoner er overdratt Universitetsforlaget, men biblioteket har fremdeles mye arbeid i forbindelse med dette, og med direkte forsendelser.

Konsulent- og informasjonstjeneste

NATASCHA HEINTZ' arbeid består i å orientere staben om russisk polarlitteratur og oversette det som er nødvendig. I første omgang har hun, foruten å skaffe seg en generell oversikt over den russiske litteratur som finnes ved instituttet, bearbeidet den sovjet-russiske litteraturen vedrørende utforskningen av Antarktis. Hun har også i oppdrag å behandle spørsmål i forbindelse med naturvernsarbeidet på Svalbard.

Også den utadvendte konsulent- og informasjonsvirksomheten er i stadig vekst. Tretten vitenskapelige institusjoner, to oljeselskaper, samt en rekke selskaper og enkeltpersoner som planla ekspedisjoner eller turer til Svalbard, Jan Mayen eller Dronning Maud Land, henvendte seg til Norsk Polarinstitutt for å få karter, flyfotografier og informasjoner. Dette arbeid belaster i stigende grad alle avdelinger, særlig den topografiske og den geologiske. Videre rettes det mange henvendelser til instituttet i forbindelse med publikasjoner av polare skrifter, studiearbeid vedrørende polarområdene osv., og dette arbeid faller vesentlig på SØREN RICHTER. Som tidligere nevnt er instituttet også konsulent for forskjellige departementer, og særlig viktig er samarbeidet med Utenriksdepartementet. I det forløpne år har det vært forhandlinger i forbindelse med Antarktistraktaten og samarbeidet i SCAR (Scientific Committee on Antarctic Research) som har vært av størst betydning. Konsulentvirksomheten for Forsvarsdepartementet har bl. a. dreiet seg om utbyggingen av LORAN-stasjonen på Jan Mayen.

Reiser, kongress- og møtevirksomhet

THORE S. WINSNES deltok i Det Internasjonale Symposium for Arktisk Geologi, Calgari, Alberta, Canada, i tidsrommet 9.–18. januar.

Under Den XXI Internasjonale Geologiske Kongress i København ble det også holdt et møte av deltakere fra dette symposiet, hvor foruten WINSNES også TORE GJELSVIK deltok.

Instituttet deltok i forberedelse og gjennomføring av så vel Den XIX Internasjonale Geografiske Kongress i Stockholm 6. til 13. august og Den XXI Internasjonale Geologiske Kongress i København 15. til 25. august. Begge kongressene var fellesnordiske foretagender og arrangerte ekskursjoner til Svalbard.

THORE S. WINSNES ledet sammen med prof. dr. ANATOL HEINTZ og cand. real. NATASCHA HEINTZ geologekskursjonen i tidsrommet 29. juli til 13. august. Ekskursjonen var fulltegnet, og i alt 35 utenlandske geologer deltok.

OLAV LIESTØL ledet sammen med statsgeolog ROLF W. FEYLING-HANSSEN geografekskursjonen i tidsrommet 24. juli til 4. august. Den tellet 42 deltakere.

Begge ekskursjoner var begunstiget av godt vær og ble i enhver henseende meget vellykket.

Under Den Geologiske Kongress i København fungerte THOR SIGGERUD som leder for Seksjon 15 «Genetic Problems of Uranium and Thorium Deposits» og TORE GJELSVIK var viseformann i seksjon 16 «Genetic Problems of Ores».

I København ble det 21. august holdt et møte om vitenskapelig samarbeid i Arktis, arrangert av Arktisk Institut, København. Direktøren var til stede på dette møtet.

På det fjerde møtet i SCAR i Cambridge fra 29. august til 3. september deltok TORE GJELSVIK (de tre første dagene), KAARE Z. LUNDQUIST og SIGURD G. HELLE. Gjennom SCAR er det vitenskapelige samarbeidet i Antarktis blitt godt koordinert.

HÅKON HILL deltok i Den Internasjonale Fotogrammetriske Kongressen i tidsrommet 5. til 17. september. SIGURD G. HELLE besøkte også denne kongressen etter ovennevnte SCAR-møte.

Av reiser forøvrig kan nevnes at TORE GJELSVIK besøkte Grønlands Geologiske Undersøgelse i København et par dager i november for å drøfte erfaringene fra helikoptervirksomheten på Grønland.

KAARE Z. LUNDQUIST var i mai med et amerikansk fly på et tokt over den nordlige del av Norskehavet for kontroll av LORAN C-systemet, og var i samme måned til stede i Stockholm ved en demonstrasjon av Deccas HI-FIX-system.

OLAV LIESTØL reiste 1. november til Antarktis etter en invitasjon fra National Science Foundation i U.S.A. for å studere de amerikanske glasiologiske undersøkelser ved McMurdo Station. Han avla i denne forbindelse et kort besøk på Sydpolen, som den første nordmann etter ROALD AMUNDSEN.

Besøk

I tillegg til de to nevnte kongressene i Stockholm og København var det også en internasjonal kongress for geodesi og geofysikk i Helsinki. Ved alle tre kongressene møtte det en rekke forskere som var interessert i polarområder eller polarforskning, og instituttet hadde i den anledning et usedvanlig stort besøk av utenlandske forskere.

På tilbakereisen fra Svalbard besøkte flere ekspedisjonsledere og vitenskapsmenn instituttet, således doc. dr. S. SIEDLECKI og prof. A. KOSIBA fra den polske ekspedisjonen, lederen av Würzburg-ekspedisjonen prof. J. BÜDEL. Dr. O. T. JONES, Antarctic Program Director, National Science Foundation, U.S.A. og dr. A. P. CRARY avla besøk ved instituttet i april. I løpet av sommeren kom visepresidenten for Centre National de Recherches Polaires de Belgique, Baron G. DE GERLACHE, og direktøren for the Nordic Institute, University of Saskatchewan, Canada, prof. J. B. MAWDSLEY. Prof. E. S. W. SIMPSON fra Cape Town

University og medlem av den nasjonale komité for Antarktis i Syd-Afrika oppholdt seg ved Universitetet i Oslo i lengre tid, og hadde ved flere anledninger drøftelser i Polarinstituttet.

Publikasjoner

Skrifter:

Nr. 117 – NATASCHA HEINTZ – The Downtonian and Devonian Vertebrates of Spitsbergen. X. Two new species of the genus *Pteraspis* from the Wood Bay Series in Spitsbergen.

» 118 – KÅRE RODAHL – Nutritional Requirements under Arctic Conditions.

» 119 – ANDERS RAPP – Talus Slopes and Mountain Walls at Tempelfjorden, Spitsbergen.

Meddelelser:

Nr. 84 – ODD LØNØ – I. Transplantation of the Muskox in Europe and North-America. II. Transplantation of Hares to Svalbard.

» 85 – SVEIN MANUM – Some Dinoflagellates and Hystrichosphaerids from the Lower Tertiary of Spitsbergen.

En preliminær abstrakt av OLAV LIESTØL «The Glaciers and Snowfields of Norway», *Skrifter* nr. 114, ble trykt i anledning Den XIX Internasjonale Geografiske Kongress, men er ikke blitt distribuert på vanlig måte.

Norwegian-British-Swedish Antarctic Expedition, 1949–52.
Scientific Results:

Vol. I – Meteorology I, Part 2 – Surface Observations, C: Vidar HISDAL – Temperature (Maudheim, 71° 03′ S, 10° 56′ W).

Vol. III – Glaciology I; F: CHARLES SWITHINBANK – Ice Movement Inland.

Vol. IV – Glaciology II; D: VALTER SCHYTT – Snow and Ice Temperatures in Dronning Maud Land.

Instituttets medarbeidere har dessuten i andre serier publisert:

VIDAR HISDAL – The Diurnal Temperature Variation during the Polar Night. – Quart. Journ. Royal Met. Soc. Vol. 86, No. 367.

OLAV LIESTØL – Det subkambriske peneplan i området Haukelifjell–Suldalsheiene. – Norsk Geologisk Tidsskrift, bd. 40, h. 1, 1960, pp. 69–72.

Glaciers of the Present Day. – Geology of Norway. Norges Geologiske Undersøkelse. Nr. 208.

BERNH. LUNCKE – Norwegian Air Photography in Dronning Maud Land: Operation "Pingvin", 1958–59. Polar Record, Vol. 10, No. 64.

THORE S. WINSNES, ANATOL HEINTZ and NATASCHA HEINTZ:

Aspects of the Geology of Svalbard. Guide to excursion No. A 16 – International Geological Congress, XXI Session, Norden 1960.

SØREN RICHTER har sammen med HELGE INGSTAD vært redaktør av *Polarboken.*

The activities of Norsk Polarinstitutt in 1960

Summary of the annual report

BY

TORE GJELSVIK

Staff

At the end of the year the institute had twenty-two permanent positions, while ten persons were temporarily engaged, mostly to prepare the data collected by The Norwegian Antarctic Expedition, 1956–60. On March 31 the director, Dr. philos. ANDERS K. ORVIN, retired and was succeeded by Dr. philos. TORE GJELSVIK. August 5 topographer I, WILHELM SOLHEIM, retired after 42 years of service, and Captain JOHN GJÆVER was given invalidity pension from July 1. Cand. real. THOR SIGGERUD, geologist, cand. real. NATASCHA HEINTZ, biologist and translator of Russian polar literature, have joined the staff in 1960.

Expeditions to Svalbard

The exploration activity in Svalbard became somewhat less than planned, since no topographers could be sent out, and two of the three geologists were involved in work connected with the XXI International Geological Congress in Norden. However, eight field parties totalling twenty-one men left Norway around June 20, most of them on the chartered sealer M/S "Brandal". The expedition returned at the end of August.

The director went to Svalbard with the expedition ship, and stayed there until mid-July. He visited the field parties on the north and west coast of Vestspitsbergen and a Polish scientific station in Hornsund.

Hydrography

Commander H. LIND ANDERSEN, using M/S "Brandal", was able to survey only for 17 days, because of being busy with logistic support of the other parties, and control and maintenance of the coastal navigational aids during the rest of the time. The surveying, being accomplished outside the northern coast of Vestspitsbergen, was hampered by fog.

H. HORNBÆK, working on the north coast of Vestspitsbergen, used the hydrographic survey-boat "Svalis", and completed the sounding of Breibogen and got well under way with Liefdefjorden.

Geology

H. MAJOR, being in charge of the coal exploration, completed test drilling, excavation and sampling of the Tertiary coal beds in Foxdalen and Bolterdalen in central Vestspitsbergen. Later he explored the inner part of Van Keulenfjorden in the southern part of the island.

T. SIGGERUD, having his first season in Svalbard, investigated the Hecla Hoek formations in Trygghamna and St. Jonsfjorden on the west coast of Vestspitsbergen, including some copper mineralization in the latter place. Together with the director he visited a sphalerite deposit at Sinkholmen in Bellsund.

T. S. WINSNES, together with Prof. Dr. A. HEINTZ and cand. real N. HEINTZ, both of Paleontological Museum in Oslo, led the excursion A 16 of the XXI International Geological Congress. The excursion visited Hornsund, Bellsund, the well known Festningen profile in the outer part of Isfjorden, inner parts of Isfjorden, and the collieries in Longyearbyen. Thirty-five geologists from thirteen different countries took part, and the excursion was a success. One of the participants of the excursion, Prof. Dr. A. F. DE LAPPARENT from France, discovered twelve footprints of Dinosaurs (*Iguanodon*) on a rock surface at Festningen in Grønfjorden, this being the first evidence of terrestrical reptiles having lived in Spitsbergen.

Glaciology

O. LIESTØL continued his investigations of Finsterwalderbreen and other glaciers on the south coast of Van Keulenfjorden, and later he measured the front of Hornbreen at the head of Hornsund. He found that there is still a general tendency of retreat in most of the glaciers in Svalbard.

LIESTØL, together with state geologist R. W. FEYLING-HANSSEN, led an excursion to Svalbard, arranged in connection with the XIX International Geographical Congress in Norden. The excursion, counting fourty-two members, visited Hornsund, Van Keulenfjorden, Kapp Linné, Longyearbyen, Tempelfjorden, Billefjorden, Eckmanfjorden, Kongsfjorden, Krossfjorden and Ny-Ålesund, and was a success.

Paleobotany

Two students of botany, stud. real. P. SUNDING and cand. mag. B. FALKANGER, advised by Prof. Dr. O. A. HØEG of the University in Oslo, collected plant fossils from the Tertiary beds in the neighbourhood of the coal fields in Longyearbyen and Ny-Ålesund. The students also made botanical observations.

Biology

Dr. H. L. LØVENSKIOLD carried out ornithological studies in Recherchefjorden and Storvika on the west coast of Vestspitsbergen, and later at Kongsøya, Kong Karls Land.

Cand. real. J. STORDAL investigated the fungi flora around Longyearbyen, in St. Jonsfjorden and in Dicksonfjorden.

Tromsø Museum

sent one zoological and one botanical party on scientific exploration in Vestspitsbergen during the summer.

Foreign expeditions

Nine foreign scientific expeditions worked in Svalbard, and in addition two private firms initiated investigations for oil.

One British expedition visited the island of Jan Mayen.

Expeditions in Dronning Maud Land, Antarctica

The Norwegian Antarctic Expedition, 1956–60 was sent out by the Institute in 1956 in connection with the IGY. It was during the whole time headed by S. G. HELLE. The expedition finished its work at its base, Norway Station, in the beginning of 1960.

The expedition ship "Polarbjørn" brought down ten members of a South African expedition which should take over the base according to an agreement between the government of Norway and the Union of South Africa. The ship then returned to Norway with the Norwegian expedition, reaching Ålesund February 23. A planned landing on Bouvetøya for making some observations could not be realized because of bad weather. An observer from U.S.A., Admiral MANDARICH, and a party of eleven scientists from South Africa followed "Polarbjørn" on the roundtrip from Cape Town to Norway Station and retour.

Soviet Russia, Japan and Belgium each maintained one wintering scientific station in Dronning Maud Land.

Preparation of data from Svalbard

Construction of maps

As the topographic-geodetic section has mostly concentrated on the preparation of maps from Antarctica (Dronning Maud Land), little time has been devoted to the Svalbard maps. Dr. A. K. ORVIN has kindly continued the work with place-names for the Svalbard maps. The standard map sheet A 7 (1:100,000) Kongsfjorden has been prepared for reproduction. Some work has been done on a new series of a general map in four sheets at a scale of 1:500,000.

Construction of charts

Chart No. 514, covering the Barents Sea, was prepared for the first printing to be published early in 1961. Work on chart No. 515, the Greenland Sea, was initiated. Preparation of the sounding data from Breibogen and Liefdefjorden continued. Studies and preparatory work was done in order to investigate the possibility of using electronic navigation and location systems in charting in Svalbard waters and the Norwegian Sea.

Geology

Samples of coal from cuttings and adits have been chemically analyzed, and the quality and quantity of coal reserves in Bolterdalen and Foxdalen recalculated. In addition to routine preparation of field data, the geologists have also been charged with planning of new office premises, an airborn operation for the field season 1961, and the excursions in connection with the XXI International Geological Congress.

Geophysics

Glaciological data from former expeditions to Svalbard and in Norway have been collected and analyzed. Planning and preparations were undertaken for an excursion to Svalbard in connection with the XIX International Geographical Congress in Norden. The division also assisted in preparations of observation data from Antarctica.

Preparation of data from Antarctica

After the return from Norway Station S. G. HELLE has been in charge of the material collected in Antarctica, and preparation of maps and data from this region.

Map construction

A special team of four topographers was organized for construction of a new series of maps of the mountain range in Dronning Maud Land. It is planned to publish about 20 sheets at a scale of 1:250,000. The first sheet, H. U. Sverdrupfjella, was nearly ready for printing at the end of the year.

The calculations of a base line, the angular measurements and barometric height measurements carried out in Orvinfjella, Wohlthatmassivet and Sør-Rondane have been finished.

Meteorology

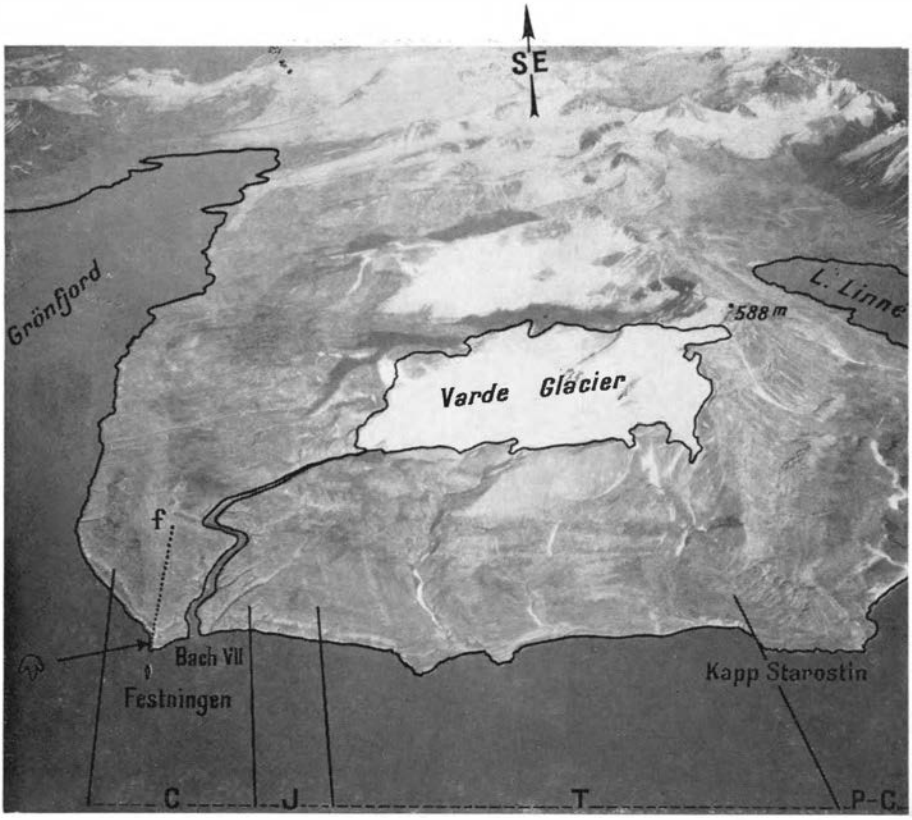
Ground observations from the years 1956–60 have been punched and checked. IGY forms for the aerological data obtained before September 1958 were prepared and sent to the IGY Meteorological Data Centre in Geneva. Data of radiation measurements for 1957 to 1958, with exception of the balance values, were dispatched to the same data centre. Calibration curves for all instruments were constructed.

Ascaplot data from 1957 and nearly all from 1958 are prepared and forms sent to Ing. W. STOFFREGEN, Uppsala.

Glaciology

A final report on the accumulation data from 1957–58, including a morphological description of the investigated area, has been prepared for publication.

Innholdsfortegnelse



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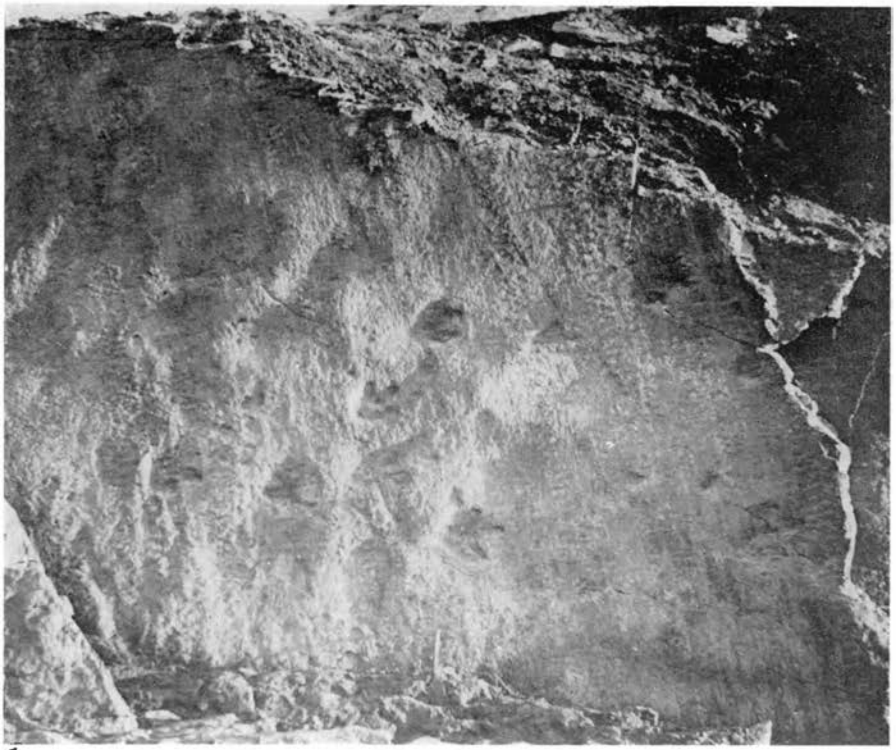
1) Aerial view of the southern coast of Isfjorden, between Kapp Starostin and Grønfjorden, seen from NW. (Air photo. N.P.I. No. 627.)
P–C – Permo-Carboniferous, c. 1000 m thick. *T* – Triassic, c. 1150 m.
J – Jurassic, c. 320 m. *C* – Lower Cretaceous, c. 735 m.
f – Festningen sandstone. Total thickness of Festningen section c. 3205 m.

2) The Festningsodden beacon. Vertical slabs of Festningen-sandstone seen to the north. Sandstone with the footprints in the foreground. Photo: A. F. DE LAPPARENT.

1

2 4 3

1) The footprints on the sandstone slab, immediately after theywere discovered. Photo: R. LAFFITTE.
2) Close-up view of footprint No. 3, the one which is best preserved. Photo: R. LAFFITTE.
3) N. HEINTZ near the footprint No. 3. Photo: A. F. DE LAPPARENT.
4) The distance between two prints of the same foot (seen on the right and left side of prof. A. F. DE LAPPARENT) is more than 2 m. Photo: R. LAFFITTE.



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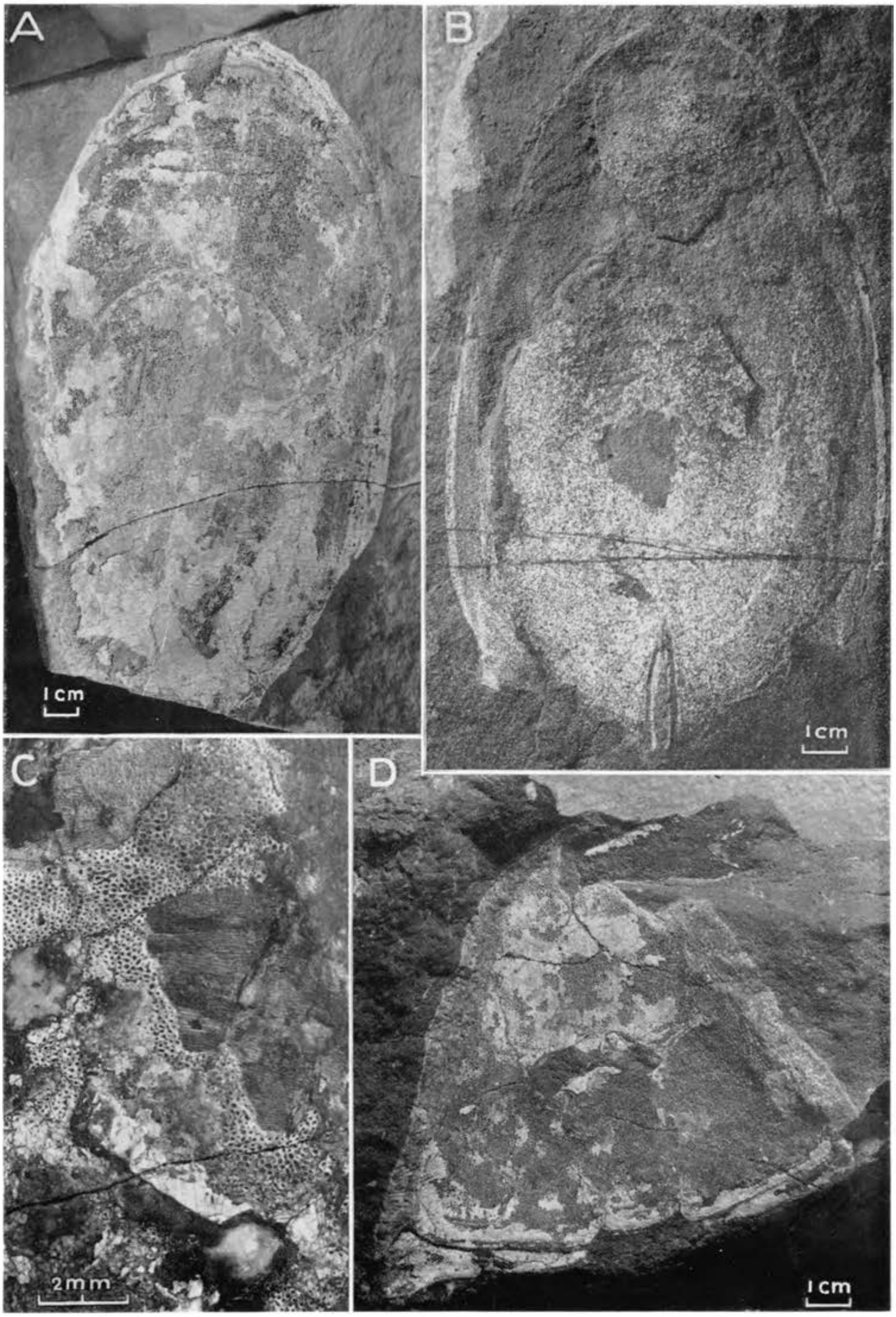
1) The slab with footprints photographed in the slanting rays of the midnight sun.
Photo.: J. F. HENRIKSEN.

2) The same slab, taken closer. Photo: J. F. HENRIKSEN.



A. Ventral disc of *Gigantaspis isachseni*. The posterior part of the disc is broken off.

Photo by: J. KIÆR.

B. Dorsal shield of *G. bocki*. Holotype, P.M.O. A 28722.

C. Detail of the dorsal disc of *G. isachseni*. The fine dentin ridges and the fairly dense calcellous layers can be seen.

D. Rostrum, orbital and pineal plates of *G. isachseni*. Holotype, P.M.O. A 28721.

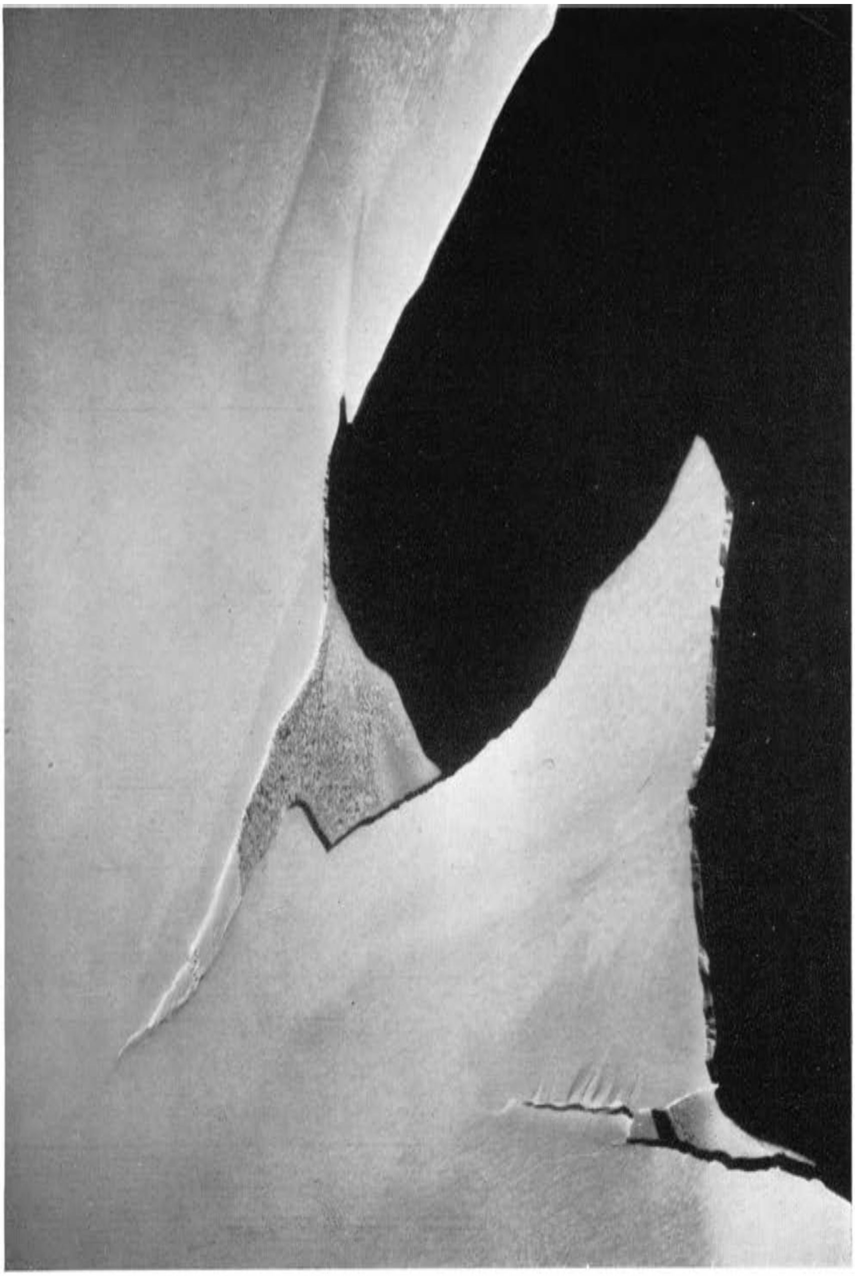


Plate 1 a *Norselbukta, January 1951. Air photograph from 2400 m above sea level, facing SE. The total length of the inlet is about 8 km. Loose pack ice has been temporarily confined to the head of the bay by wind and tide.*

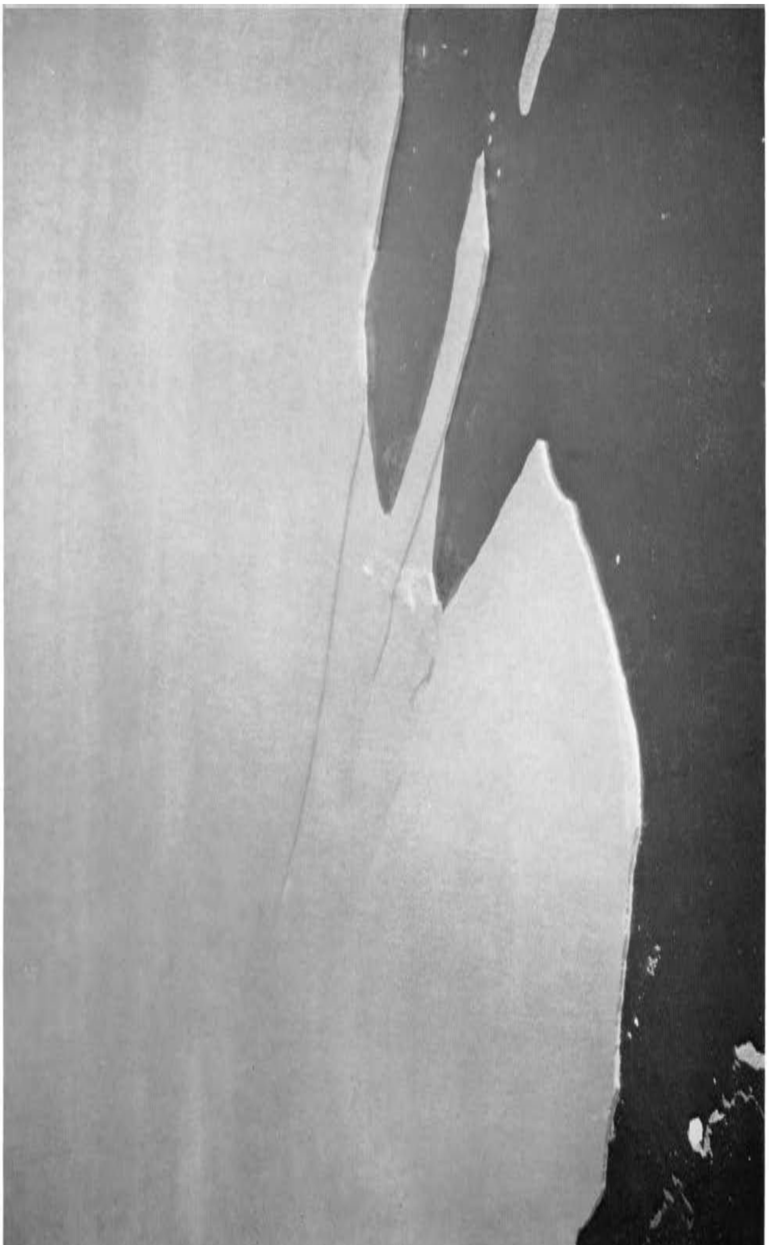


Plate 1 b *Norselbukta, 25 December 1958. Air photograph from 2800 m above sea level, facing SE. The nearer of the two inlets has formed since 1952.*

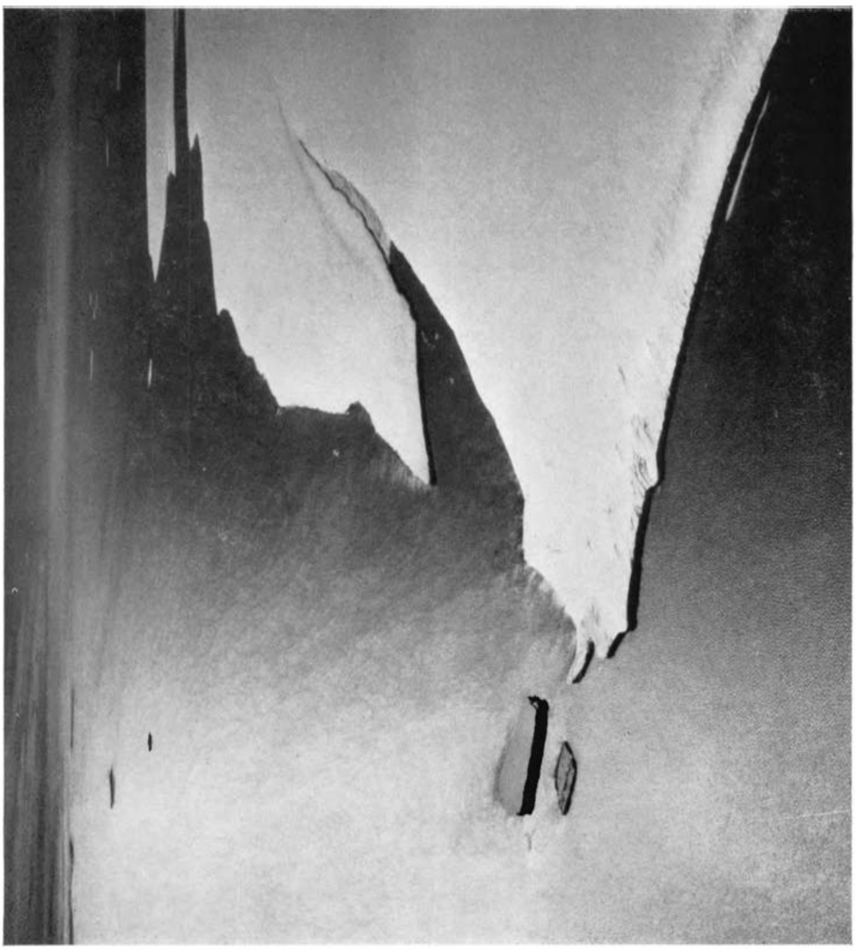


Plate 2 a *The point in longitude 11° 24′ W (left foreground), January 1951. Air photograph from 2500 m above sea level, facing NE by N. The headland in the foreground and the two icebergs near it are aground. The inlet in the freely floating ice behind is 9 km long. The mouth of Norselbukta can be seen in the right background.*

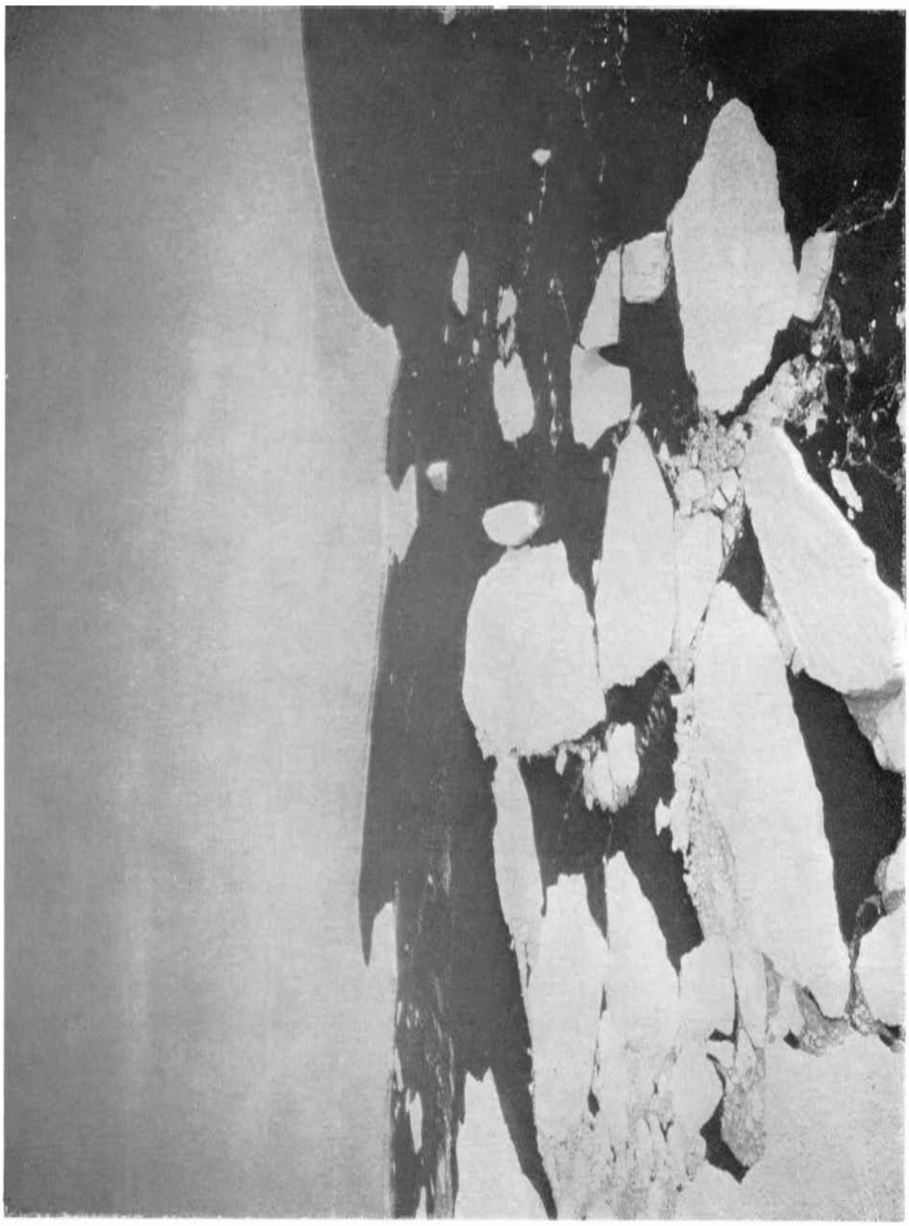


Plate 2 b *The point in longitude 11° 24′ W (right centre), 25 December 1958. Air photograph from 2x00 m above sea level, facing SSE. Ice floes and grounded icebergs in foreground.*

Plate 3 a *The meteorological mast at Maudheim, November 1950.*

Plate 3 b *The meteorological mast at Maudheim, 16 January 1960.*

SKRIFTER

Skrifter nr. 1—100, see numbers of Skrifter previous to Nr. 100.

Nr.

100. PADGET, PETER: *Notes on some Corals from Late Paleozoic Rocks of Inner Isfjorden, Spitsbergen.* 1954. Kr. 1,00.
101. MATHISEN, TRYGVE: *Svalbard in International Politics 1871—1925.* 1954. Kr. 18,00.
102. RODAHL, KÅRE: *Studies on the Blood and Blood Pressure in the Eskimo, and the Significance of Ketosis under Arctic Conditions.* 1954. Kr. 10,00.
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