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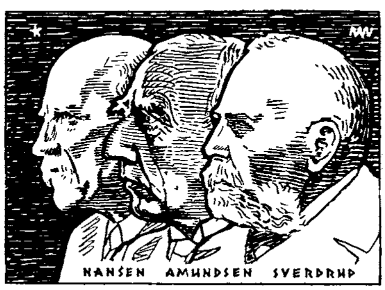

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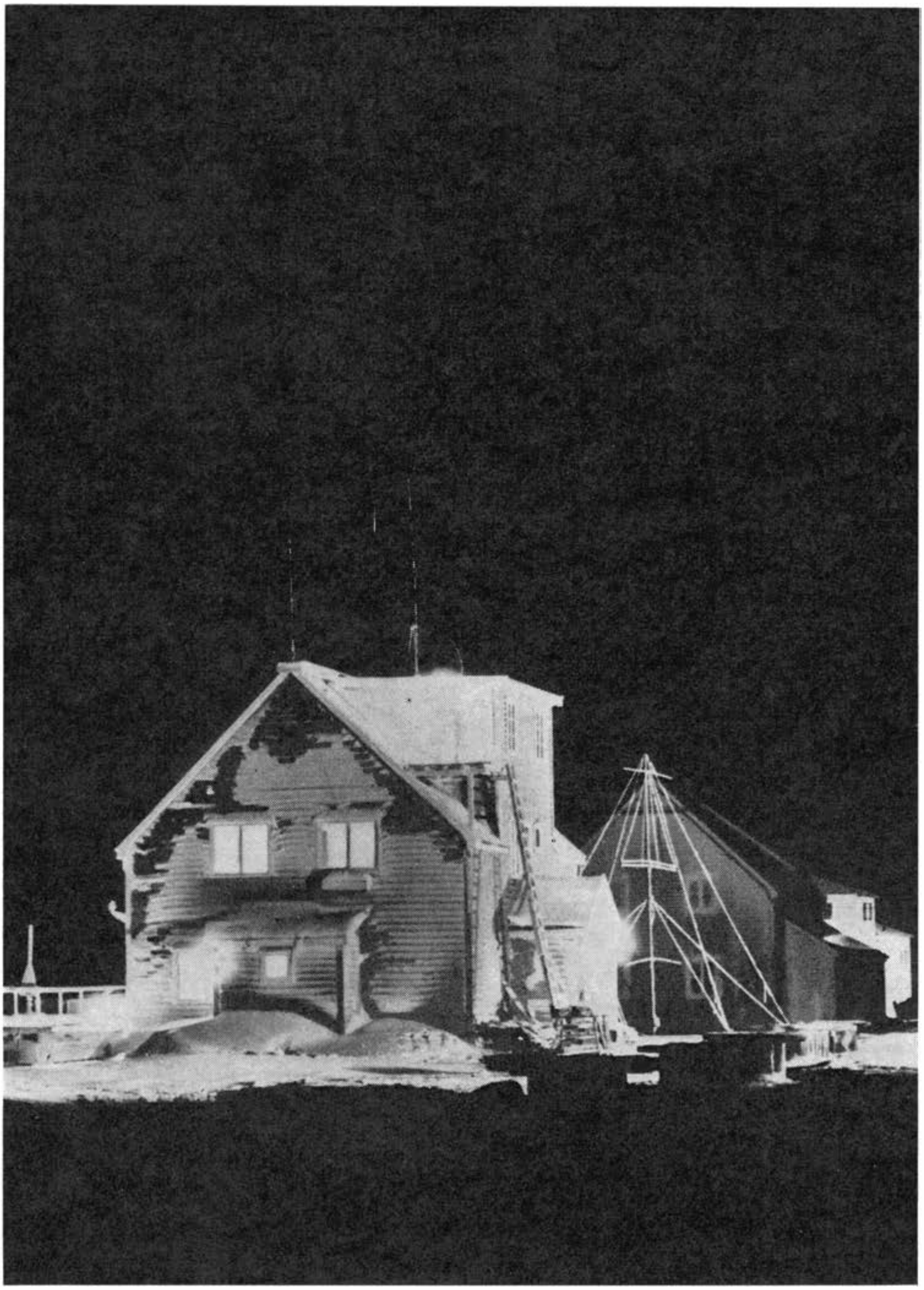

Forskningsstasjonen på Svalbard

Foto: J. ANGARD

Innholdsfortegnelse

The present status of the Brent goose *(Branta bernicla hrota)* in Svalbard

(Современное состояние популяции светлобрюхой черной казарки *(Branta bernicla hrota)* на Свальбарде)

BY

MAGNAR NORDERHAUG

Contents

Abstract

Observations, mainly from the period 1958–68, indicate that the population of Brent geese (*Branta bernicla hrota*) is still breeding in most parts of Svalbard (Fig. 2), but only in small numbers.

Observations from five small breeding localities in Spitsbergen indicate disappearance from two, a slight increase in number of breeding pairs in two, and no detectable changes in one. Based on ten different sources, the winter population of Brent geese in Svalbard and Franz Josef Land is estimated at 2500—3000 individuals in the middle of the 1960's. The figure indicates a further decrease from approximately 4000 individuals in the middle of the 1950's.

The following protective measures may be of importance in preventing further reduction of this population: Establishment of closed breeding reserves in Spitsbergen and local protection of Brent geese in the fjords of Randers and Mariager, Denmark.

Аннотация

Наблюдения, произведенные, главным образом, за последнее десятилетие (1958–1968 гг.), указывают на то, что популяция светлобрюхих черных казарок *(Branta bernicla hrota)* все еще гнездится в большинстве частей Свальбарда (рис. 2), но число их ограничено.

Наблюдениями, выполненными в пяти небольших гнездовых районах,

установлено, что указанный вид полностью отсутствует в двух районах, в двух других установлен незначительный прирост числа гнездовых пар, а в последнем районе никаких изменений в популяции не обнаружено. На основании десяти различных источников, зимняя популяция этих казарок на Свальбарде и Земле Франца-Иосифа в середине шестидесятых годов была оценена в 2500–3000 особей, Эта цифра указывает дальнейшее уменьшение, приблизительно, от 4000 особей в середине пятидесятых годов.

Для предотвращения снижения популяции предлагаются следующие защитные меры: Учреждение заповедников на месте гнездовий на острове Шпицберген и местная охрана этих птиц в датских фьордах Рандерс и Мариагер.

Acknowledgements

I wish to express my best thanks to persons and institutions who have contributed information both to this work and to the faunistic reviews published in the Norsk Polarinstitutt Årbok.

Personal discussions with cand. mag. M. FOG, Vildtbiologisk Station, Denmark, and Mr. M. A. OGILVIE, The Wildfowl Trust, England, have in this respect been of great value.

Nordisk Kollegium for Terrestrisk Økologi has supported my studies of the present situation of Brent geese in Denmark.

Introduction

The light-bellied Brent geese (*Branta bernicla hrota*), breeding in Svalbard and Franz Josef Land (small numbers), form, as far as we know, one single wintering population, which makes up only a small fraction of the total population at present wintering in Europe.

In general, the population of Brent geese in Europe has in recent years shown a gradual but irregular increase (BURTON 1962, and others) due to more effective protection in many countries, better feeding conditions, etc. This increase, however, refers to the European wintering population as a whole, while the position of the small stock breeding in Svalbard/Franz Josef Land is more uncertain. The present paper, mainly based on material (published papers, collected information, and the author's own field work) from the period 1958–68, deals with the distribution of light-bellied Brent geese in Svalbard and discusses the present population size.

Although the drastic reduction of *Branta bernicla hrota* in the first decades of this century is not further discussed in this paper, it is necessary to consider the present situation against the background of the decreases which already have taken place in this century.

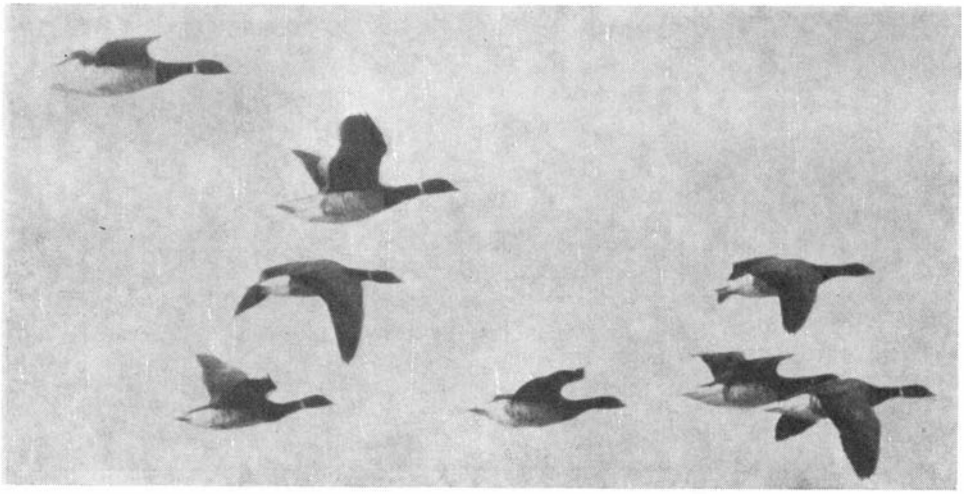

Fig. 1. *Light-bellied Brent geese gathering for migration, Edgeøya, August 1966.*
Photo: M. N.

Observations of Brent Geese in Svalbard 1958–1968

The information presented in this chapter has mainly been based on papers published in the period 1958–66, personal information, and my own, unpublished, material. A few data from the period 1954–58, not mentioned by LØVENSKIOLD (1964), have also been included.

Valuable information has been contributed by I. AHLÉN, M. ERONEN, C. HJORT, T. LARSEN, B. NORDNES, T. SIGGERUD, S. SIEDLECKI, and P. VALEUR. Published data have been taken from: BATESON & CUTBILL (1960), BURTON et al. (1960), DE NAUROIS (1963), FERENS (1958), FREI & TEICHMANN (1965), GOODHART et al. (1955), HEINTZ (1963), HEINTZ (1965), HEINTZ & NORDERHAUG (1966 a & b), LILJEQUIST (1960), NORDERHAUG (1967, 1969), NYHOLM (1965), REMMERT (1965), SCHWEITZER (1966), STRIJBOS (1957), TOLLÉN (1960), and ÖSTERHOLM (1966).

The observations have been geographically grouped in the same areas as used by LØVENSKIOLD (1964). See Fig. 2.

AREA I. BJØRNØYA

Breeding records

Brent geese have never been found breeding on Bjørnøya.

Other observations

During spring migration in 1965 the first Brent geese (3 ind.) were seen on May 23. During migration 1964–65 up to 15 individuals were observed. Furthermore, Brent geese were observed during autumn migration in 1966. In spring of 1967, Brent geese were observed for the first time on May 23 (17 ind.).

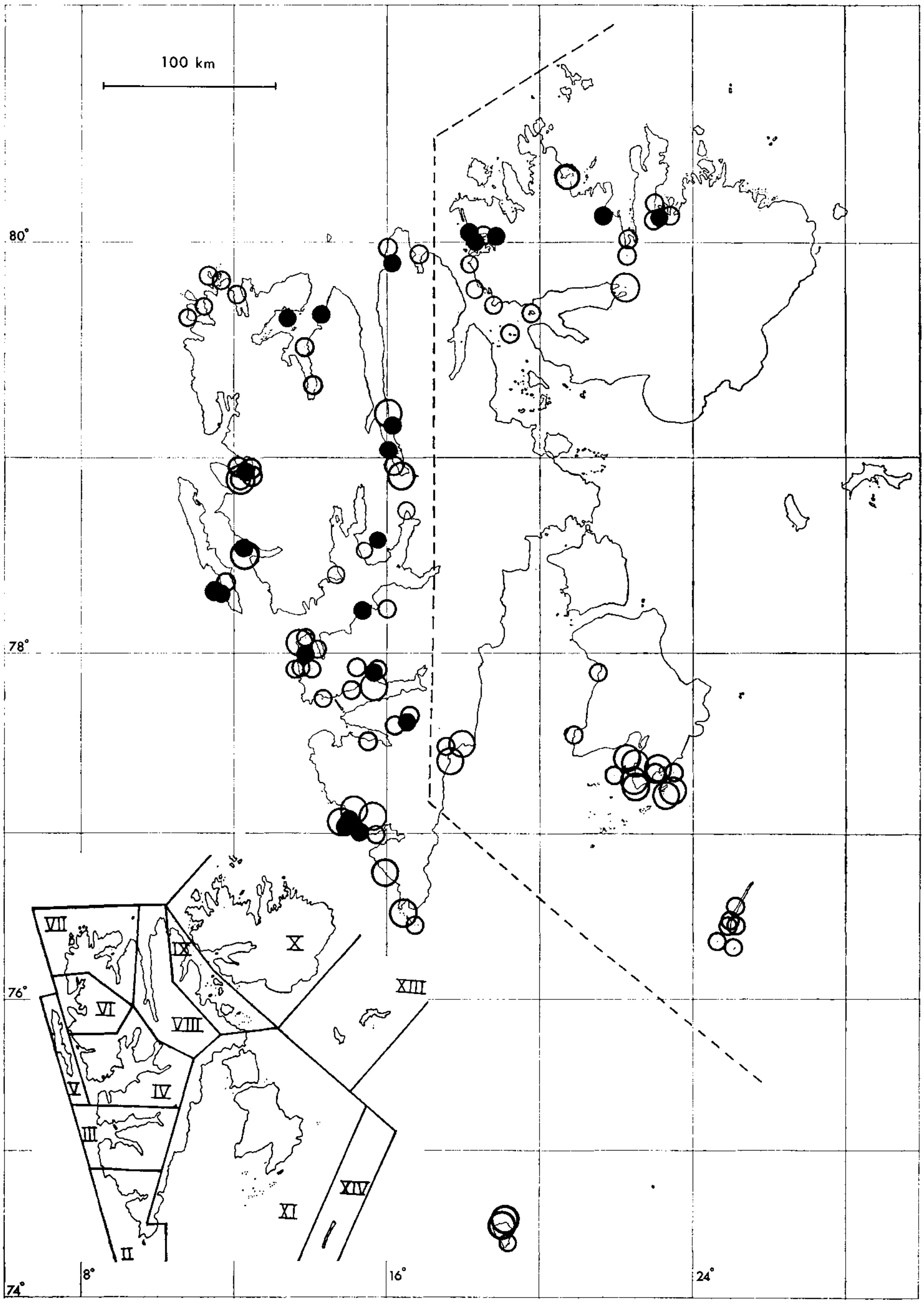

Fig. 2. Observations of Brent geese (*Branta bernicla hrota*) in Svalbard, *1958–1968*.
Black dots: localities where breeding has been observed (one or more times).
Small circles: observations of 1–10 individuals.
Large circles: observations of 11–130 individuals (maximum observed).
The small map shows the various areas referred to in the text. The area east of the broken line has not been thoroughly investigated.

AREA II. HORNSUND

Breeding records

Ornithological field studies were carried out in Area II (except Sørkapp) in the summer seasons 1962–65. Summarized situation: In 1962 no breeding was recorded from the area. There is for the season 1962 a correlation between poor breeding results and heavy ice conditions, leading to increased polar fox predation on the small islands along the coast.

In 1963, 10 used nests were localized on Dunøyane (4 on Store Dunøya, 6 on Nordre Dunøya).

In 1964, 6 used nests were observed, all on Nordre Dunøya.

In 1965, 16 used nests were found (3 doubtful) on Dunøyane.

In summary, breeding of Brent geese in Area II in 1962–65 has been recorded only from Dunøyane and in a number of 15–16 pairs or less per year.

Other observations

In the summer 1962, 5–6 individuals (adults) were seen on Sørkappøya. Breeding was not recorded. The same locality was visited on August 31, 1964. At least 120 Brent geese were seen, all on migration.

The Sørkapp area is most probably an important part of Svalbard during spring and autumn migration (see also observations from Negerpynten, Area XI).

During spring migration 1964, the first Brent geese arrived at the northern coast of Hornsund at the end of May. Only "a few" were seen.

In 1965 the first Brent geese (5 ind.) were observed on May 29 in the same place.

Remarks on the population size in Area II

In 1962 the biggest flock was observed on August 8 (31 ind.). Totally (except Sørkapp) the population in Area II numbered about 50 individuals this year.

In 1963 at least 140 individuals were seen at some distance from Dunøyane on July 24. It was not possible to decide whether the group consisted of non-breeding birds only, or also included some families.

On the basis of counted nests and field observations, it is reasonable to estimate the Brent goose population at minimum 150 individuals in August 1963.

In 1964 the observations from this part were scarce. No Brent geese were seen between Stormbukta and Hornsund in August. On July 27, 44 non-breeding birds were seen north of Hornsund. Only part of Dunøyane was examined. For 1964 the August population in this area consisted probably of minimum 70 individuals (the Sørkapp area not included).

In 1965, 60 non-breeding birds were observed on Dunøyane and minimum 13 used nests found. The August population then consisted of at least 100–110 individuals (the Sørkapp area not included).

In 1967 the area was only briefly investigated. A group of 38 adults was observed on Store Dunøya on August 16, on Nordre Dunøya 17 adults were observed on August 16, and 21 on August 27.

AREA III. BELLSUND

Breeding records

One pair with 4 goslings on the eastern side of Ronden July 14, 1966. In Reindalen 2 pairs with 8 goslings July 17, 1954. One pair with 3 goslings at Orustelva August 8, 1965.

Other observations

Eholmen, Van Keulenfjorden July 4, 1960: 9 ad. Levinbukta June 28, 1962: 9 ad. Akseløya July 25, 1965: 5 ad. Rokkbreen July 14, 1966: 3 ad. Ronden July 7–17, 1966: 1–2 ad. (and the breeding pair mentioned above). Four observations from Van Mijenfjorden, mouth of Berzeliusdalen, July 1, 1957: 2 ad. Mouth of Semmeldalen July 2, 1957: 4 ad. Reindalselva July 2, 1957: 13 ad. Reindalen July 16–17, 1954: 74 ad. (and the two breeding pairs mentioned above).

AREA IV. ISFJORDEN

Breeding records

Mouth of Bjørndalen August 18, 1964: 1 pair with 2 goslings. Between Mimerdalen and Lyckholmdalen August 21–23, 1963: 1 pair with 7 goslings. Hermansenøya: Approximately 60 adults with 20–25 goslings were observed close to the island on August 5, 1960. On July 1, 1965, 1 nest was found (and 6 pairs observed) in the same locality. On July 7, 1967, 4 individuals were seen. Breeding probably took place. No Brents were seen there on July 9, 1968. Owing to ice conditions during the spring, polar foxes were then present on the island.

Other observations

From the area Kapp Linné to Linnévatnet 7 observations of Brent geese (2–13 individuals) have been reported from the years 1963–68 (May–August).

The first observation of Brent geese on spring migration in 1965 was made on May 21. Adventdalen June 23, 1965: 5 ad. Bohemanflya July 15, 1962: 2 ad. Tschermakfjellet June 24, 1965: 4 ad. Petuniabukta August 21, 1957: 28 ad.

AREA V. PRINS KARLS FORLAND

Breeding records

Forlandsøyane June 26, 1963: 8 nests (2 on Midtøya, 6 on Nordøya). Same area June/July, 1968: 18 nests (7 on Midtøya, 11 on Nordøya).

Other observations

Twenty-three non-breeding birds were seen on Forlandsøyane on June 29, 1968.

AREA VI. KONGSFJORDEN

Breeding records

One pair with 3 goslings on Observasjonsholmen, Lovénøyane, July 27, 1956.

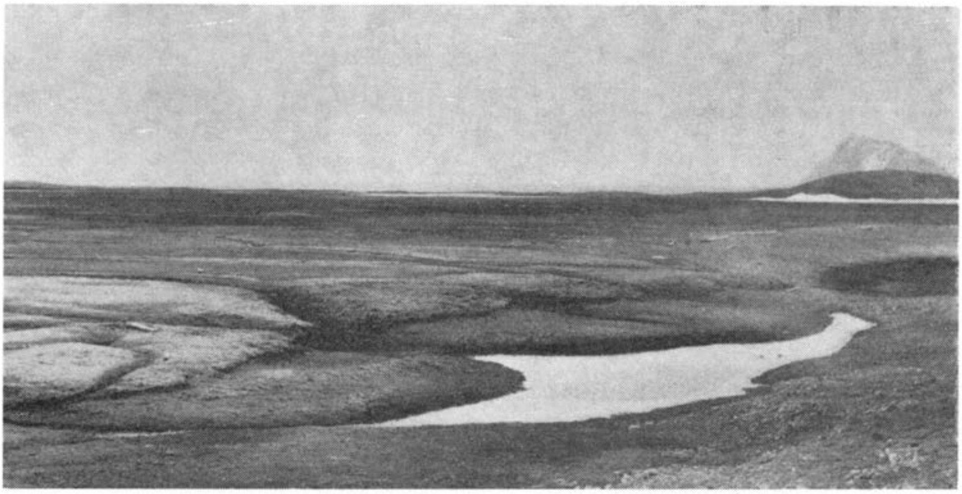

Fig. 3. *Breeding locality of Brent geese (Nordøya, 1968). In this area a small breeding population is now re-established. Wet moss bogs in the central part of the island are preferred for nesting.*
Photo: M. N.

Other observations

Brent geese were seen on Lovénøyane in July/August, 1954. Groups (5—18 non-breeding birds) were seen in the same place in July/August, 1956. Lovénøyane July 1—9, 1964: 23 non-breeding birds. Lovénøyane July 19, 1968: 4 non-breeding birds. Ny-Ålesund July 24, 1960: 5 ad.

AREA VII. NW SPITSBERGEN

Breeding records

Andréeøya,[1] Norskøyane, July 28, 1963: a pair with 2 goslings. Mushamna August 18, 1960: a pair with 4 goslings.

Other observations

West coast of Danskøya August 20, 1966: 2 ad. Smeerenburgfjorden August 18—19, 1965: 5 ad. Fuglesangen July 1, 1963: 4 ad. Indre Norskøya July 1, 1965: 2 ad. Kapp Auguste Viktoria July 18, 1962: 2 ad. Woodfjorden (inner part) July 12, 1964: 5 ad. Biskayerhuken July 3, 1965: 23 ad.

AREA VIII. WIJDEFJORDEN

Breeding records

Høegdalen August 12, 1957: 1 pair with 5 goslings. Zeipelelva[1] August 14, 1957: the pair mentioned above and another pair with 2 goslings. Below Grøssfjell August 21, 1965: a group of 7 adults and 14 goslings. Mosselvatnet August 18, 1965: 1 pair with 3 goslings.

[1] Unofficial name. (Editor's note.)

Other observations

West coast of Austfjorden (Zeipelelva) August 12, 1957: 15 ad., and August 15: 17 adults. Brent geese flying to Gyllensköldholmane were seen on August 12, 1957. One of the islets was visited on August 15. No nests were found. Below Grøssfjell August 16, 1965: c. 70–80 ad. Ellingsenodden July 15, 1965: 3 ad.

AREA IX. HINLOPENSTRETET

Breeding records

None. The area has not been frequently visited.

Other observations

Sorgfjorden July 8, 1965: 2 ad. Fosterøyane July 1966: 2 ad. In 1958 Brents were seen at different times in Hinlopenstretet outside Nordaustlandet.

AREA X. NORDAUSTLANDET

Breeding records

The outmost of Tvillingoddane, 1957: 1 pair breeding (also observed there in 1958). Depotøya, Murchisonfjorden, July 15, 1958: 1 pair with newly hatched nestlings, 3 pairs were breeding there. Kinnvika, Murchisonfjorden, July 31, 1966: 2 nests (3 and 4 eggs). Bengtssenbukta August 2, 1966: 2 nests (3 and 4 eggs). West of Innvika August 10, 1965: 1 pair with 3 goslings.

Other observations

Sparreneset 1958: 2 pairs. Gyldénøyane July 4, 1958: 6 ad. Approximately 10 km east of Oxfordhalvøya July 29, 1958: 17 moulting birds. The species was also seen (number unknown) in Rijpdalen in June (same year). Snaddvika, Murchisonfjorden, July 28, 1965: 3 ad. Lindhagenbukta July 24, 1966: 15 ad. Rijpfjorden (inner part) August 24, 1965: "some" seen on migration. Innvika August 4–12, 1965: 1–9 ad. (3 observations). Brageneset 1958: 1 pair.

AREA XI. STORFJORDEN

Breeding records

In the period 1956–67 no breeding records were reported from this area. However, Tusenøyane, where Brent geese most probably breed, has not been thoroughly investigated.

Other observations

From Kvalvågen, 1967: 28 ad., close to Strongbreen August 1, and 9 ad. in Kvalvågen August 3.

Brent geese were common in Tjuvfjorden at the beginning of June, 1965. West side of Negerpynten August 14, 1965: approximately 70 ad. East side of

Negerpynten August 15, 1964: 2 ad. Zieglerøya (Tjuvfjorden) August 7, 1966: 54 ad. Andréetangen August 9–12, 1966: c. 30 ad. At least 130 individuals were present at Negerpynten on August 12, 1966. The observations may indicate that the area is a resting- and feeding-place for Brent geese before autumn migration. Bjørnholmane (north of Kvalpynten) August 3, 1967: 6 ad. Diskobukta August 22, 1967: 3 ad. Dianabukta August 4, 1967: 10 ad. Andréetangen August 12, 1967: 10 ad. Halvmåneøya August 19, 1966: 10 ad., and 19 ad. on August 20. One of the Ryke Yseøyane (the eastern) was visited on August 6, 1966. No remains of Brent nests were seen.

AREA XIV. HOPEN

Breeding records

An empty goose nest found in a small tundra area in the southern part of Hopen (August 16, 1965) was supposed to be a Brent's nest, as this species was the only goose observed in the area. The record is doubtful and needs a closer consideration when more observations from Hopen are available.

Other observations

Brent geese were observed during autumn and spring migration in 1963–64. From 1963 and 1965 the following observations have been reported: Koefododden July, 1963: 7 ad., and 1 ad. in the same place on August 26–30, 1965. Bjørnsletta August 29, 1965: 1 ad. In 1966 1 individual was seen on June 16.

Nearly all observations in this chapter have appeared after the manuscript of LØVENSKIOLD's Avifauna Svalbardensis was finished in 1958/59. Some of the observations need further comments.

Of special interest is the observation of one pair with goslings in 1966 near Ronden in the inner part of Nathorst Land (Area III). This observation may indicate that parts of the Brent goose population in Svalbard breed as isolated pairs in the interior of the bigger islands. This supposition is also supported by the observation of a brood of Brent geese between Lyckholmdalen and Mimerdalen in Dickson Land (Area IV), 1963. In Wijdefjorden (Area VIII) a small but permanent population is found breeding today. LØVENSKIOLD (1964) states that no breeding records have been reported from this part in recent years. Breeding records from Nordaustlandet (Area X), 1958–65, confirm LØVENSKIOLD's (1964) supposition about a Brent population along the northern coasts of Nordaustlandet. Nordaustlandet is one of the least disturbed parts of Svalbard, and seems to be an important part of the breeding area of the Svalbard population today, in spite of the extreme environmental conditions in this part of the archipelago.

Local changes in the breeding populations

Some of the old, well-known localities of Brent goose in Spitsbergen have been visited more or less regularly up to the present time. A comparison of the present number of breeding pairs with the situation in former days is therefore of some interest.

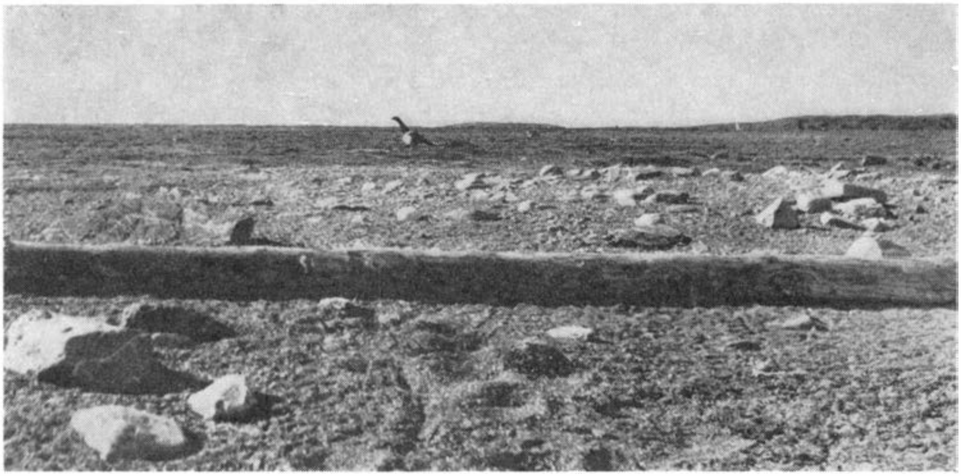

Fig. 4. *Breeding locality in the peripheral part of an island moss bog.*
Photo: M. N.

The situation in five Brent goose localities (Dunøyane, Isøyane, Forlandsøyane, Hermansenøya, and Lovénøyane), all on the western coast of Spitsbergen, are discussed below. All of them are located in the most visited/disturbed part of the breeding area, where local changes in the number of breeding pairs can most easily be observed. In spite of many visits by ornithologists to these localities from the beginning of the century and up to the present time, it is, however, a regrettable fact that very little quantitative information of value has appeared in literature. Terms like "quite a number", "abundant", and "many pairs" are not a valuable foundation for studies of changes in breeding populations. This, therefore, reduces to a great extent the accuracy and value of the available material from the Brent goose localities in Spitsbergen.

Dunøyane

1900: Breeding in great number (KOLTHOFF 1903).
1908: Breeds in great number on the three biggest islands (KOENIG 1911).
1924: C. 50 pairs were breeding (KRISTOFFERSEN 1926).
1950: At least 12 breeding pairs were found, and c. 50 ind. were observed (LØVENSKIOLD 1954).
1957: Fairly abundant on the western shore and on the Hornsund islands (FERENS 1958).
1962: Breeding failed owing to polar foxes on the islands (own observations).
1963: 10 used nests found (own observations).
1964: 6 used nests found (own observations).
1965: 13–16 used nests found (own observations).
1968: Polar foxes on the islands. Probably no breeding (B. FLOOD, pers. comm.).

Isøyane

1900: Breeding in great number (KOLTHOFF 1903).
1924: Many were breeding (KRISTOFFERSEN 1926).
ca. 1952: A few pairs are supposed to breed (LØVENSKIOLD 1964).
1963: No nests found; no birds seen (own observations).
1964: No nests found; no birds seen (own observations).
1965: No nests found; no birds seen (own observations).

Forlandsøyane

1900: A great number of nests found (KOLTHOFF 1903).
1910: Many pairs (MUNSTERHJELM 1911).
ca. 1956: Nests no longer found (LØVENSKIOLD 1964).
1963: 8 nests found (NYHOLM 1965).
1968: 18 nests found (own observations).

Hermansenøya

1930: 4 nests found (DALGETY et al. 1931).
1956: No nests found, but non-breeding birds seen close to the island (LØVENSKIOLD 1964).
1960: 75 ad. and 51 goslings observed (counted in photography taken by T. SIGGERUD).
1965: 6 pairs and 1 nest observed (NYHOLM 1965).
1967: A few pairs were probably breeding (C. HJORT, pers. comm.).
1968: No nests owing to polar foxes on the island (own observations).

Lovénøyane

1939: 1 nest found on Storholmen (STRIJBOS 1957).
1949: "... a couple of these birds" were seen (LØVENSKIOLD 1954).
1954: Some groups of adult birds (4–18) observed (DE NAUROIS 1963).
1956: Less numerous than in 1954. Non-breeding birds (5–10) observed (DE NAUROIS 1963). One pair with 3 goslings observed (STRIJBOS 1957).
1964: 2–3 ad. observed. No breeding (I. AHLÉN, pers. comm.).
1966: No birds seen (July, A. WALLERS, pers. comm.).
1968: 4 birds observed (July); no breeding (own observations).

Detailed conclusions cannot of course be drawn from the present material. The quantitative data are too scarce, and observations from the 1940's, when practically no ornithological activity took place, are lacking. Only some brief generalizations are therefore made:

Dunøyane, 1900–65. – Heavy reduction in number of breeding pairs in the first half of the period. Possibly a more stabilizing trend during the last 15 years, with a breeding population of max. 10–20 pairs. Failed breeding due to presence of polar foxes in some years.

Isøyane, 1900–65. – Heavy reduction in the first half of the period. Disappeared as breeding bird (probably before 1950).

Forlandsøyane, 1900–68. – Heavy reduction in the first part of the period. Probably disappeared as breeding bird before 1950, but re-established in the 1960's (max. 18 pairs).

Hermansenøya, 1930–68. – A small number of breeding pairs (under 10) disappeared probably before the middle of the 1950's, but some individuals have later returned. Failed breeding owing to occurrence of polar foxes in some years.

Lovénøyane, 1939–66. – A few pairs bred up till 1956, but the species now seems to have disappeared as a breeding bird.

The information from the five localities does not give a clear picture of the situation. As a breeding bird, the Brent goose has now disappeared from two localities (Isøyane and Lovénøyane). In two others (Forlandsøyane and Hermansenøya) a (slight) re-establishment has probably taken place in recent years. In one locality (Dunøyane) the number of breeding pairs seems to have been stabilized at a rather low level.

It is possible that this information may indicate a certain stabilization of the population level, but better quantitative data are needed.

Present population size

Figures indicating the present size of the Brent goose population in Svalbard/Franz Josef Land are scarce.

At present it is impossible to base population estimates on studies in the breeding areas because of their inaccessibility and extreme location. Estimates must therefore be based on figures from the wintering grounds on the North Sea coasts. Also from that area it is difficult to estimate the present size of the population, in spite of the international goose counts.

To give an impression of the present size of the population, some counts of *light-bellied Brent geese* from the years 1961–67 are given below. They include, most probably, the greater part of the Brent population from Svalbard/Franz Josef Land.

1. SALOMONSEN (1958) estimates the winter population (Denmark/Great Britain) at about 4000 individuals in the period from 1946/47 to the middle of the 1950's. "In the severe winter of 1946/47 the population of Northumberland increased from the usual 1–2000 to 5000, which implied that the entire Danish population of Pale-breasted birds had moved over to the British Isles. The figure, however, includes about 25 per cent Dark-breasted birds, giving a total of less than 4000 Pale-breasted ones. This tends to show that 4000 is the correct average size of the Pale-breasted European population."

2. BURTON (1962) mentions that max. 2000 individuals were seen at Holy Island, Northumberland, in February 1961. "A large influx occurred of about 2000, but nearly all were gone by the end of the month (F. Stabler). Holy Island is visited principally by birds of the Pale-bellied race (*B.b.hrota*)."

3. BURTON (1962) mentions an observation of 1200 individuals in Nissum Fjord, Denmark, on May 13, 1961.

4. ATKINSON-WILLES (1963): "The light-bellied *B.b.hrota* now winters in Britain only in very small numbers, although large flocks (1—3000) occur for short periods late in most winters near Holy Island, Northumberland. It is believed, though not yet proved, that these birds and others seen on the east coast are from the group wintering in Denmark and Germany and breeding in Spitsbergen and (in very small number) on Franz Josef Land (Salomonsen, 1958)."

5. BURTON (1965): "Some 2000 appeared at Holy Island about New Year 1963 and stayed until the end of the cold weather.....". "These birds are assumed to represent most of the Spitsbergen section of the Pale-bellied population."

6. FOG (1967): "Mr. P. Uhd. Jepsen, collaborator at the Game Biology Station, made observations in Nissum Fjord in the spring months 1965 and 1966. According to his reports there were between 1500 and 2000 light-bellied geese in the area in the spring of 1965, whereas the following spring he saw at most about 1000 geese, and of these some were dark-bellied."

7. M. A. OGILVIE (pers. comm., 1967): "In the Northumberland, the maximum figures from the four winters 1964—1967 were: 600 (Feb., 1964), 500 (Feb., 1965), 2750 (Feb. 22, 1966) and 500 (Feb., 1967)." 2750 individuals are the largest number observed there. The observations were made in a period of relatively cold weather in England.

8. C. MARTELL (pers. comm., 1967): Between 2 and 3000 light-bellied Brents were observed in Nissum Fjord on April 18, 1966. The estimate was based upon two independent counts.

9. Own observation (1967): About 1400 individuals were seen in Nissum Fjord on May 3, 1967. All were light-bellied.

10. M. FOG (pers. comm., 1967): Aerial counts conducted by the Game Biology Station, Kalø, on May 6, 1967, showed about 1500 Brents in Denmark. The main part was light-bellied (see observation 9).

Nine of the figures above refer to counts of light-bellied Brents from the wintering grounds 1961—67. Most of them are probably well below the actual size of the total population. The most important figures are number 2, 5, 6, 7, and 8. These figures are partly maximum figures of light-bellied Brents from some frequently visited localities, partly figures from periods when the main part of the population probably was present in the same area. In this connection the two counts from 1966 (observations 7 and 8) are of special interest. On February 22, about 2750 individuals were seen in Northumberland. It was the highest number seen there for many years. Further, they were observed in a period when most Brents were thought to have left Denmark. The observation from Nissum Fjord (observation 8) on April 18, same year, of 2—3000 light-bellied Brents on spring migration, is in good accordance with the February observations in Northumberland.

It is therefore reasonable to suggest that the present wintering population of Brent geese from Svalbard and Franz Josef Land consisted of 2500–3000 individuals in the middle of the 1960's. Compared to the figure from the period 1946/47 and up to the middle of the 1950's (observation 1) of about 4000 individuals, this Brent population has therefore most probably continued to decrease in number up to the present time.

Further protective measures

Brent geese from Svalbard and Franz Josef Land most probably form one winter population. The population in Franz Josef Land seems, however, to be very small (GORBUNOV 1932, S. M. USPENSKIJ, pers. comm., 1967). In the present paper the birds from these archipelagos are treated as one collective group.

The present observations from the 1950's and up to the middle of the 1960's indicate a further decrease in the size of this population in spite of various protective measures put into force in Svalbard, Denmark, and England. It is therefore necessary to consider other steps which can be taken to protect the Svalbard/Franz Josef Land population from further decrease and even extinction.

Svalbard

The Brent goose was totally protected in 1955. Gathering of eggs and down on Eider islands in Svalbard, where Brents previously bred in numbers, decreased up to the 1960's, and, since the total protection of Eiders in 1963, no longer takes place. In the same period, however, tourists and expeditions have become more frequent, leading to some disturbance and reduction of the possibility of local re-establishment in some parts. A plan for the establishment of wildlife reserves and national parks in Svalbard is now in preparation. It is therefore reasonable to see the question of a better protection of the Brent goose population in Svalbard in this connection. Establishment of wildlife reserves on some of the most important Eider/goose islands along the western coast of Spitsbergen will reduce disturbance by man (including increased Glaucous gull predation) during the breeding period. Together with increased public information for visitors to Svalbard, establishment of breeding reserves seems at present to be the only practical measure for increased protection of the Brent geese in the breeding area.

Franz Josef Land

The position in Franz Josef Land is not known. As previously mentioned, only a small fraction of the population may breed there.

Norway

In Norway Brent geese may be hunted between August 21 and December 23, but, as migration takes place in the outer, thinly populated coastal zone, this is of little importance. However, in view of the present situation, it would not seem advisable to maintain an open season for this species in Norway.

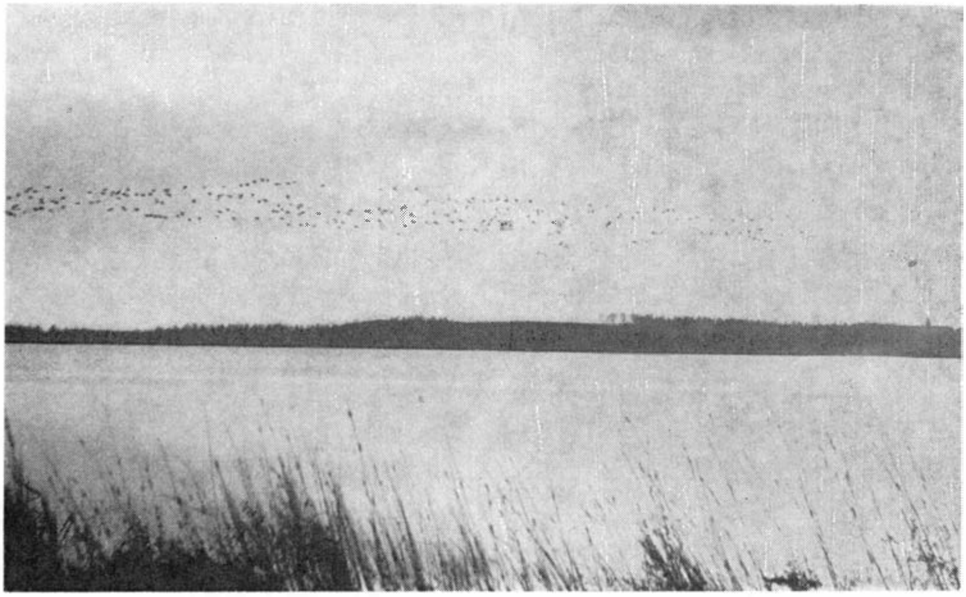

Fig. 5. *Light-bellied Brent geese in the wintering area, Mariager Fjord, Denmark, December 1967*
Photo: M. N.

Denmark

Ringing of 74 Brent geese in Svalbard in 1954 (GOODHART et al. 1955) shows that the main factor of mortality is hunting in Denmark (SALOMONSEN 1958, FOG 1965, 1967, and others). The number of Brents taken in Denmark each year is about 1300 individuals (FOG 1967). Of these approximately 220 light-bellied (from the Svalbard/Franz Josef Land population) were taken in 1961.

The main part of the light-bellied Brents are hunted in Randers and Mariager Fjord. Total protection of Brents in these parts of Denmark has been proposed by FOG (1967): "Irrespectively of the actual size of the bag, it would be desirable for the shooting of *Branta bernicla hrota* to be minimized, and this may possibly be done by local protection of Brent geese in and about the fjords of Randers and Mariager, which are the principal habitats in Denmark of these birds in the shooting season."

Because of the present situation of the light-bellied Brents, protective measures of this type could be an important contribution to the re-establishment of this population. A harvest of 200–300 individuals from this population can, in the present situation, be an important negative factor; this is undoubtedly the most important factor under direct control by man. A total protection of Brents in this part of Denmark will furthermore reduce the general disturbance of the geese in their winter habitats.

England/Scotland

The situation of the light-bellied Brents in England and Scotland seems satisfying with the present total protection of the species. The wintering grounds on Holy Island have also been established as a National Nature Reserve (M. A. OGILVIE, pers. comm., 1967).

In summary, it will appear that the following protective measures may be of most practical importance for a reestablishment of the Svalbard/Franz Josef Land population of Brent geese:

1. Establishment of closed breeding reserves along the coast of Spitsbergen, Svalbard.

2. Local protection of Brents in the fjords of Randers and Mariager, Denmark.

A continued negative trend, as observed up to the middle of the 1960's, will lead to a further reduction and danger of extinction of this population.

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The present status of the Barnacle goose *(Branta leucopsis)* in Svalbard

(Настоящее состояние белощекой казарки (*Branta leucopsis*) на Свальбарде)

BY

MAGNAR NORDERHAUG

Contents

Abstract

The present distribution of Barnacle geese in Svalbard is discussed. In the 1960's, the south-western parts of Spitsbergen were their main breeding area (Fig. 1). New breeding records are reported from Spitsbergen's north-western corner, Nordaustlandet, and Barentsøya.

In recent years there is a marked increase in the number of Barnacles, as indicated by new breeding localities, recorded number of nests on breeding grounds (Fig. 2), and recorded numbers in Scotland during the winter (Fig. 5). This increase is probably a result of protection in Svalbard and Scotland, negligible hunting on migration, and a changed breeding ecology. The importance of establishing breeding reserves is stressed.

Аннотация

Обсуждается настоящее распределение белощеких казарок на Свальбарде. Основными их гнездовыми районами в шестидесятые годы являются юго-западные части Шпицбергена (рис. 1). Получены сведения о новых гнездовьях в северо-западном углу Шпицбергена, на Северо-Восточной Земле и на острове Баренца.

В последние годы имел место заметный прирост числа белощеких казарок, на что указывают обнаружение новых гнездовых мест, увеличенное чило гнезд в гнездовьях (рис. 2) и большее число особей, замеченных зимой в Шотландии (рис. 5). Этот прирост, вероятно, является результатом защиты на Свальбарде и в Шотландии, незначительной охоты на этих птиц во время миграций и измененной гнездовой экологии. Подчеркивается важность создания гнездовых заповедников.

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Information for the present paper has come from many sources, partly as contributions to Norsk Polarinstitutt's annual review of animal life in Svalbard, partly as direct contributions to this work. I wish to express my best thanks to all these contributors. To Messrs. K. Hagelund, S. Hågvar, B. Mathiassen, L. Ljøterud, R. Syvertsen, and E. Wrånes, assistants in Norsk Polarinstitutt's biological field work parties during the period 1963–68, I am particularly greatful for their never failing interest. With Messrs. H. Boyd and M. A. Ogilvie of The Wildfowl Trust, I have had valuable discussions on the present Barnacle situation in the wintering quarter. A visit to the wintering area in Scotland in 1964 was supported by the Norwegian State Game Research Institute.

Introduction

This paper on the Barnacle geese in Svalbard is the second of three dealing with the present status of geese in this area.

The Barnacles have never been numerous in Svalbard, but recent years' information from breeding grounds, as well as from the wintering area, indicates important changes in the number and distribution.

This paper is based on Norsk Polarinstitutt's field work in Svalbard 1962–68, information from other sources, and available data from the wintering grounds. Some parts of Svalbard have not been frequently visited, and accordingly the known distribution may be incomplete for these areas. The author will, of course, be grateful for further information on this subject.

The breeding biology of the Barnacles in Svalbard has also been studied in recent years, but these results are not discussed here.

Observations of Barnacle geese in Svalbard 1958–1968

The information presented in this chapter is mainly based on papers published in the period 1958–68, personal information, and the author's own unpublished material. A few data from the period 1954–57, not mentioned by Løvenskiold (1964), have been included.

Valuable information has been contributed by M. Brooke, M. Eronen, N. Gullestad, O. Lønø, O. Nordhus, B. Nordnes, M. A. Ogilvie, B. Reese,

S. SIEDLECKI, and P. VALEUR. Published data have been taken from: BANG et al. (1963), BLURTON JONES and GILMORE (1959), BURTON et al. (1960), DE NAUROIS (1963), DHONT (1966), EHRSTRÖM (1958), FERENS (1968), GOODHART et al. (1955), HEINTZ (1963, 1965), HEINTZ and NORDERHAUG (1966a, 1966b), NORDERHAUG et al. (1965), NORDERHAUG (1968, 1969a and b (in prep.)), NYHOLM (1965), PENNIE and ANDREW (1956), SCHWEITZER (1966), STRIJBOS (1957), TEICHMANN and FREI (1965), and ÖSTERHOLM (1966).

The observations have been geographically grouped in the same areas as used by LØVENSKIOLD (1964), with a few modifications.

AREA I. BJØRNØYA

Breeding records

Barnacle geese have never been found breeding on Bjørnøya.

Other observations

On spring migration 1965, Barnacle geese were seen from May 20 to the end of the month. In 1967 the first individuals arrived on May 24.

AREA II. HORNSUND

Breeding records

Results of ornithological field work in the Hornsund area 1962–65 show that the Barnacle goose is a common breeder on small islands and skerries between the mouth of Hornsund in the south and Kapp Borthen in the north. Breeding on the mainland has not been observed in this area. However, on July 8, 1963, a pair with one gosling was observed in the inner part of Hornsund. The number of breeding pairs may vary from one year to another. In general, an increasing trend in the number of breeding pairs has been observed in the first part of the 1960's. In summers with unusual concentrations of sea ice along the western coasts of Spitsbergen, breeding may fail, partly or totally, owing to polar fox predation on the small islets. This happened in 1962 and in 1968.

Other observations

From the Sørkapp area (north to Stormbukta) no information is available from the nesting period. In August 1962 and 1964 no Barnacle geese were seen there. Further examination of the islands in this part is, however, necessary.

The species has not been found breeding between Stormbukta and the mouth of Hornsund. Outside the migration period, Barnacles have been recorded only occasionally in this part; five were seen close to Camp Erna on August 5, 1962. In 1964 (August 3–5) no Barnacles were seen between Hornsund and Stormbukta. On the northern side, Barnacles are common between Hornsund and Torellbreen during the breeding season.

On spring migration, the first arrived on May 20 in 1963, when flocks feeding together with Pinkfeets were observed along the coastal plains. In 1965, the first arrived on May 17.

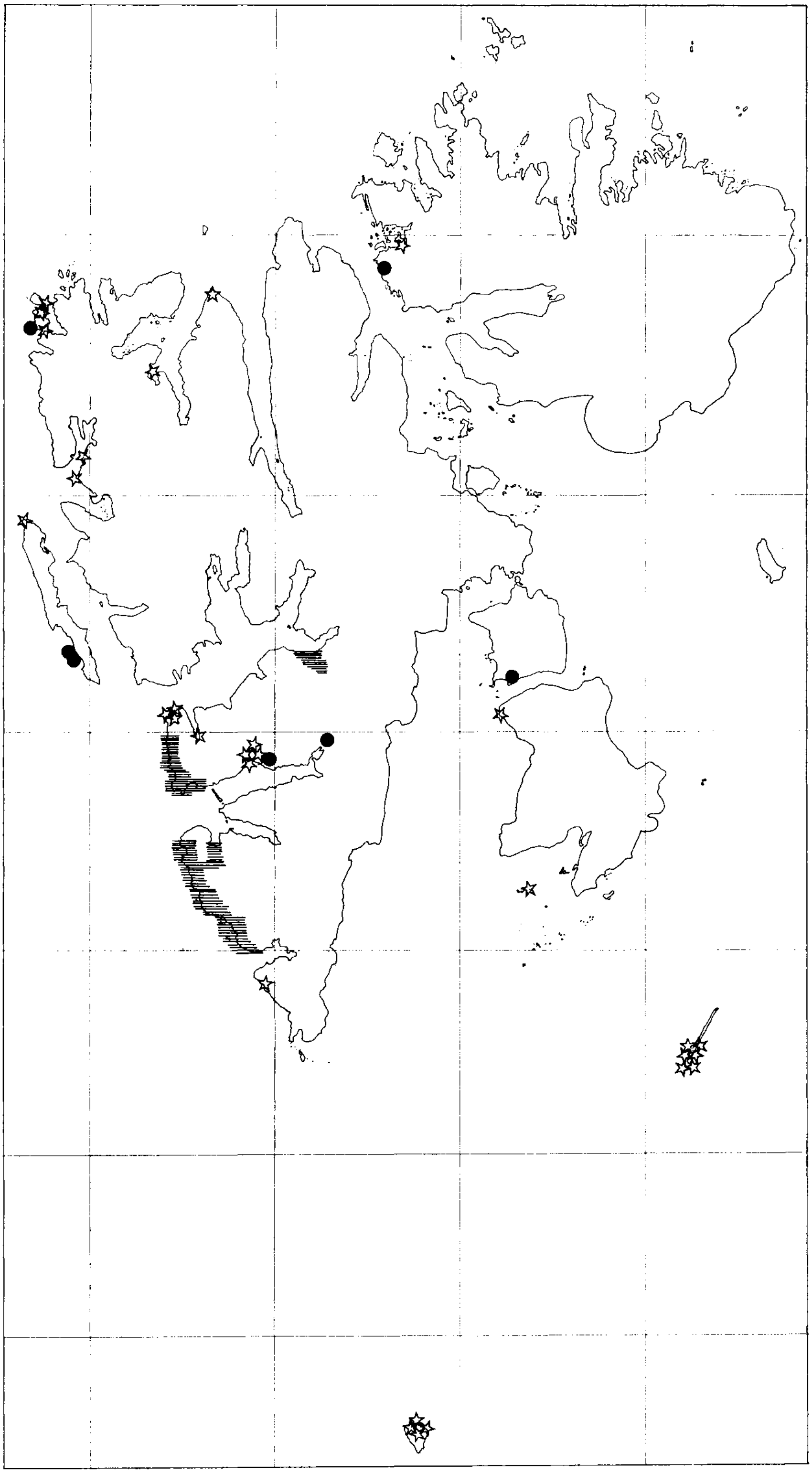

Fig. 1. *Distribution of the Barnacle geese in Svalbard, 1958–68.*

|||| : *Main breeding and moulting area.*

● : *Breeding records from outside the main area.*

★ : *Other observations of Barnacles.*

AREA IIIA. SOUTH OF BELLSUND

Breeding records

Thorkelsenholmen, north of Kapp Borthen: 4 used nests found in August 1964, and 5–6 nests from a previous season on an islet near by. Olsholmen, July 6, 1960: 6 nests with eggs and some robbed nests found. In August 1964: 16 used nests were located on the same island. In 1960, 2 and 3 pairs, respectively, were breeding on two small islets near Hannevigodden. No information is available from the northernmost islet, Småholmen. Between Thunaodden and Kapp Berg, July 1964: 33 pairs with 89 goslings.

Other observations

Vikvatna, first week of July 1960: 40 adults. Close to Kapp Berg, first week of July 1960: 29 adults. Thunaodden–Kapp Berg, July 1964: 509 non-breeding birds (plus family groups mentioned above). Kapp Berg–Kapp Borthen (August, same year): 180 adults. Northern part of Chamberlindalen, July 21, 1967: 300 adults. Reinodden, Recherchefjorden, August 15, 1967: 11 adults. In Recherchefjorden, 100–150 Barnacles were observed on August 13, 1958.

AREA IIIB. NORTH OF BELLSUND

Breeding records

In this area, Barnacles are mainly breeding along the coast from Isfjorden to Bellsund. The area was visited frequently in the years 1963–68, and the following picture of the breeding status was obtained:

1963: One breeding pair at Solfonnbekken, June 13. 1964: 47 adults and 41 goslings at Osodden, July 27 (maximum observed in the period July 7–27). Barnacles were not recorded from other parts of the area this year. 1965: totally 10–20 family groups and 250 adults were recorded. On one of St. Hansholmane, visited in August, were found three used nests (51 adults and 12 goslings seen in the vicinity). A breeding pair was found on an islet near Solfonnbekken on June 20 (totally 5 Barnacles seen). 1968: totally 72 adults seen in the area on June 21–22. Diabaspynten: minimum 3 breeding birds. St. Hansholmane: probably 5 breeding pairs. Breeding took probably also place near Solfonnbekken (13 adults seen).

From the Van Mijenfjorden area, two breeding records have been reported. In 1958, at least 3 nests were located in Litledalen. In 1968, Barnacles were probably breeding in Kjellströmdalen, but further information is not available.

Other observations

Kapp Linné: one Barnacle, June 19, 1965. In 1968, one pair was seen close to Fyrsjøen on June 24, and one on a small islet in the lake on June 26. Reindalen: a few Barnacles, July 12, 1954 (where 23 adults were ringed the same year). Near Litledalen, 15 adults, July 4, 1957, and 19 adults at Stormyrvatna the same day. These Barnacles probably belong to a local population breeding in the inner parts of Van Mijenfjorden (see above).

AREA IV. ISFJORDEN

Breeding records

Breeding has been reported from Sassendalen in different years. 1955: two breeding pairs near Deltadalen, June 30 (nests destroyed). 1957: totally 33 adults and 9 goslings near Deltadalen in July. 1961: one breeding pair NE of Fredheim. 1963: 28 adults and 32 goslings near Øyadammane,[1] Skarvrypehøgda, July 11. 1964: 12 adults and 8 goslings near Skarvrypehøgda.

Other observations

A flock of 26 in Grønfjorden, August 3, 1963, about 25 adults in Sassendalen, July 1954, and some moulting groups in the same area, 1965.

AREA V. PRINS KARLS FORLAND

Breeding records

In 1963, 3 nests on Forlandsøyane. In 1968, 25 pairs breeding in the same locality (one pair on Nordøya, 24 pairs on Midtøya). Another 10 non-breeding Barnacles were seen on June 29.

Other observations

A flock of 10 adults near Fuglehuken, August 20, 1965.

AREA VI. KONGSFJORDEN

Breeding records

None.

Other observations

Barnacles seen close to birdcliffs in Krossfjorden at different times in 1956; and three adults among nesting Eiders at Kapp Guissez on July 16 the same year. The two small islet close to Kapp Guissez are suitable breeding localities for Barnacles. However, when these islets were visited in July 1968, neither Barnacles nor remains of their nests were seen.

At Leinstranda, Brøggerhalvøya, 4 adults were seen on August 12, 1968.

AREA VII. NW SPITSBERGEN

Breeding records

On June 27, 1964, 15 nests on one of the two islets at Harpunodden, Danskøya; no nests were found there in 1963. On August 13, 1966, 8 adults and 6 goslings were observed in the same place.

Other observations

Moseøya, Sørgattet: 2 adults in June 1964. Æøya, Virgohamna: 5 adults on August 15, 1966, and 7–8 adults at Smeerenburgodden the same day. In Bockfjorden, 8 adults were seen on July 29, 1964, and 4 adults at Gråhuken on July 6, 1962.

[1] Unofficial name. (Editor's noet).

AREA VIII. WIJDEFJORDEN

No observations.

AREA IX. HINLOPENSTRETET

No observations.

AREA X. NORDAUSTLANDET

Breeding records

A Barnacle with 2 goslings was seen close to a small lake, 3 km south of Sparreneset on July 24, 1966.

Other observations

Four adults in Murchisonfjorden on August 11, 1957 (migration).

AREA XI. STORFJORDEN

Breeding records

A flock of 24 adults and 6 goslings near Andsjøen, Talaveraflya, Barentsøya, July 18, 1967.

Other observations

Some Barnacles seen on Kong Ludvigøyane on August 15, 1967, and 4 adults near Kapp Lee, August 1962.

AREA XII. KVITØYA

No observations.

AREA XIII. KONG KARLS LAND

No observations.

AREA XIV. HOPEN

Breeding records

None.

Other observations

Barnacles are frequently seen each spring and autumn. In 1964, the first arrived on May 25. In 1965, a Barnacle (ringed in Scotland) was recorded on May 24. From 1966 there are two records from June 10–12. In 1965, Barnacles were recorded on Hopen on August 16 and September 10.

Local changes in breeding populations

In connection with field research conducted by Norsk Polarinstitutt in the 1960's, the number of breeding Barnacles was counted in some localities of the Hornsund area. Counts include Dunøyane (3 islands and 3 small skerries) and

Isøyane (2 small islands). Furthermore, data are available from Forlandsøyane in 1963 and 1968: NYHOLM (1965), NORDERHAUG (unpublished).

On Forlandsøyane, the counts were based on the number of nesting birds. In the Hornsund area, nest counts were conducted after hatching (from the second part of July) to avoid disturbance by man, which on these islands in the breeding period may cause severe predation by Glaucous gulls (*Larus hyperboreus*) upon Barnacle eggs and newly hatched goslings.

Normally, nests from the present season can easily be distinguished from old nests (fresh excrements, down, and egg fragments), but mistakes can happen.

Data from the three localities during the years 1963–1968 are summarized in Fig. 2. They all indicate a general increasing trend in the number of breeding pairs in these localities.

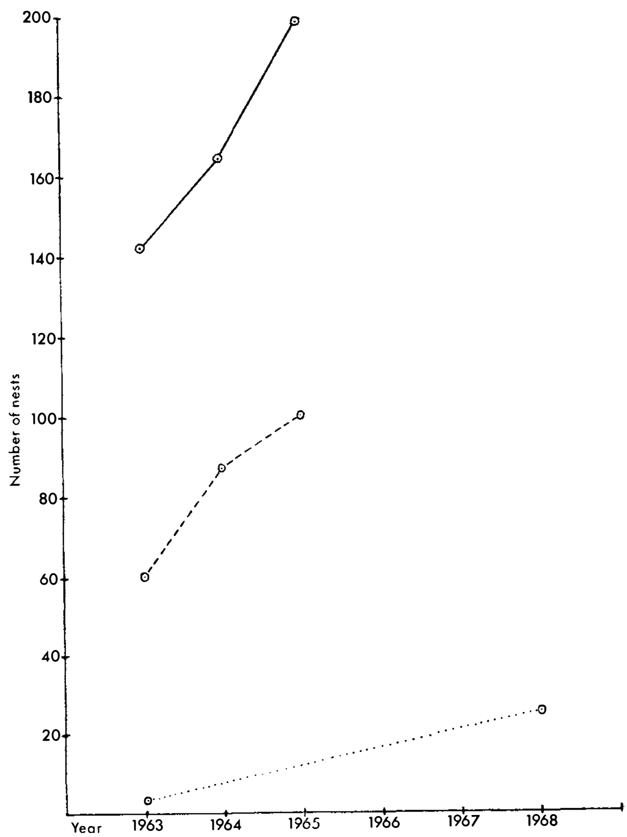

Fig. 2. *Changes in the number of Barnacle nests counted in 3 breeding localities, 1963–1968.*

. . . . : *Forlandsøyane.*

– – – – : *Isøyane.*

——— : *Dunøyane (in this locality breeding failed in 1962 ,.d 1968).*

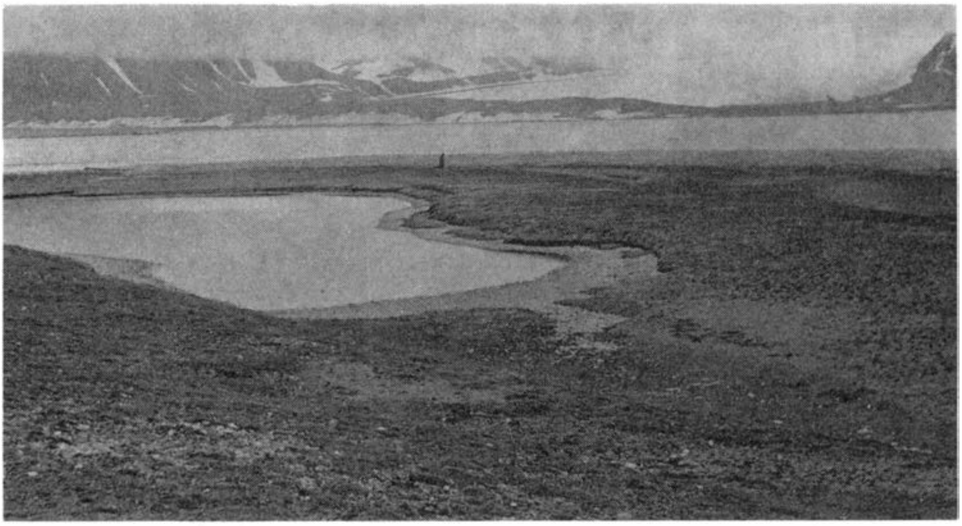

Fig. 3. *Breeding locality of Barnacle geese on an islet on the western coast of Spitsbergen.* (Photo: M. NORDERHAUG)

Population size

As shown by ringing (BOYD (1964), LARSEN and NORDERHAUG (1964)), the Barnacle population from Svalbard migrates to the British Isles in the autumn. They concentrate in winter in Caerlaverock National Nature Reserve, Dumfries, the Cumberland shores of the Solway Firth, and south-east Kirkcudbright.

From the wintering grounds (mainly Caerlaverock National Nature Reserve) the maximum number of Barnacles have been recorded since the middle of the 1940's (BOYD 1963, ROBERTS 1966). The expansion of the breeding area in

Fig. 4. *Typical island nesting site.* (Photo: M. NORDERHAUG).

Svalbard and the increasing number of breeding pairs in nesting localities investigated agree with the increasing number of Barnacles recorded from Scotland during the recent winter seasons (Fig. 5).

As the Caerlaverock National Nature Reserve was established only in 1957, the totals prior to 1957 are less reliable than those of recent years, since the Barnacles before that time were more scattered, and therefore located in places where they were rarely counted (BOYD 1963). The earlier estimates must accordingly be treated with caution.

Discussion

It appears from the information available in the 1960's that the south-western parts of Spitsbergen at present are the main breeding and moulting area of the Barnacle population (Fig. 1). Probably more than 50% of the total population is now concentrated in this part. The Barnacles stay mainly in coastal areas. New breeding records from outside the main distribution area (Spitsbergen's north-western corner (1964), Nordaustlandet (1966), and Barentsøya (1967)) indicate that reproduction now also takes place in the northernmost and most extreme parts of Svalbard.

In general, the Barnacle population in Svalbard has in recent years shown a

Fig. 5. *Highest recorded numbers of Svalbard Barnacle geese on the Solway Firth, Scotland, 1946/47–1965/66 (based on data from* BOYD *(1963) and* ROBERTS *(1966)). See text for further comments.*

Table 1.
Occurrence of Barnacle geese in different parts of Svalbard.

	Area									
	II Horn-sund	III Bell-sund	IV Is-fjorden	V Pr.Karls Forland	VI Kongs-fjorden	VII NW-Spitsb.	VIII Wijde-fjorden	IX Hinlopen-stretet	X Nord-aust-landet	XI Stor-fjorden
Known occurrences up to 1959	B	B	B	O	O	O	B ?	—	—	O
Known occurrences 1960–1968	B	B	B	B	—	B	—	—	B	B

B: Breeding records
O: Observed. No breeding records

In area I and XIV (Bjørnøya and Hopen) Barnacles are only found on migration.
From area XII and XIII (Kvitøya and Kong Karls Land) there are no records of Barnacles.

marked expansion, partly by occupying new breeding localities inside its former breeding area, partly by expanding into new areas.

Table 1 reviews the situation in different parts of Svalbard before and after 1960. Information on the situation before 1960 is mainly based on Koenig (1911) and Løvenskiold (1964).

The increase in Svalbard's Barnacle population during the last 10–15 years can be explained by the combined effect of different positive factors: total protection in breeding and wintering areas, the virtual absence of hunting during migration, the establishment of the Caerlaverock National Nature Reserve, and a marked change in breeding ecology. New protective measures are, however, necessary to ensure the future of this population. Attention should in this connection be drawn to the increasing number of breeding pairs now concentrating on small islands along the western coasts of Spitsbergen. These colonies are easily disturbed by human activity and Glaucous gull predation during the breeding period. It is therefore important, not only for the Barnacles, but also for Eiders and the restricted number of Brent geese, that the plans, now in preparation, to establish closed breeding reserves on the most important bird islands, can be realized.

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A Helicoprion from the Permian of Spitsbergen

BY

STANISLAW SIEDLECKI[1]

Contents

Abstract

During the summer of 1965 the author carried out geological investigations in Bellsund, Spitsbergen. While examining outcrops of the Permian Brachiopod Cherts, the imprints of two fragments of the symphyseal tooth-spiral of the fossil "shark" *Helicoprion* were found. It appears that the fragments represent an unknown species, which is described as *Helicoprion svalis* n. sp. This is, however, similar and undoubtedly closely related to *Helicoprion bessonowi* KARPINSKY (1898). This find of *Helicoprion* from Spitsbergen, together with other finds of this same fossil (known from the Permian of Indo-China, Western Australia, Urals in Russia, U.S.A., Mexico, northeastern British Columbia, Canadian Arctic Archipelago, and Japan) presumably can serve to establish the world-wide stratigraphical significance of the genus *Helicoprion.* Thus is seems possible that this genus is restricted to beds of Artinskian age (following the Russian scheme of Permian stratigraphy). If so, the "Svalbardian Stage", proposed as a new chronostratigraphical unit by STEPANOV (1957), may be correlated, at least in part, with the Artinskian.

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Introduction

During the summer of 1965, as leader of one of the field parties sent out by Norsk Polarinstitutt, I carried out geological investigations on the northern coast of Bellsund, Spitsbergen. The main object of the investigations was the study of Late Palaeozoic (Carboniferous and Permian) and Eo-Triassic deposits, which occur in the area west of Fridtjovhamna and on Akseløya. A new geological map of the area was made, and some stratigraphic sections were described in detail.

While investigating the outcrops of the Permian Brachiopod Cherts along the shore profile between the eastern part of Diabasbukta and Sundodden (see Fig. 1), besides brachiopods, sponges and bryozoans, typical for the Brachiopod Cherts, two imprints of a rare fossil were found. The imprints proved to be fragments of the symphyseal tooth-spiral of the fossil Elasmobranch *Helicoprion.*

Since A. KARPINSKY (1899) established the genus *Helicoprion*, and described the new Edestidae species, *Helicoprion bessonowi*, every new find of this fossil has attracted the attention of paleontologists and geologists, and has given rise to discussion of the problems of anatomy, taxonomy, ecology and the stratigraphic significance of *Helicoprion.*

Discoveries of *Helicoprion* have been reported[1] from the Upper Palaeozoic deposits of Russia (KARPINSKY 1899, 1916, 1922, 1925; OBRUCHEV 1953), Western Australia (WOODWARD 1886; DAVID 1928; TEICHERT 1940), Japan (YABE 1903), Indo-China (HOFFET 1933), U.S.A. – Idaho, Nevada, California (HAY 1907, 1909; WHEELER 1939; BENDIX-ALMGREEN 1966), Mexico (MÜLLERIED 1945), North-eastern British Columbia (LOGAN and MCGUGAN 1968) and Melville Island in the Canadian Arctic Archipelags (BAMBER, pers. com. 1969). The wide palaeogeographical distribution of this fossil, now including also Spitsbergen, and its presumably limited stratigraphic range within the Upper Palaeozoic marine deposits of the Tethys, is very remarkable. For this reason the specimen found in the Brachiopod Cherts of Bellsund, although representing a very incomplete tooth-spiral of *Helicoprion*, is nevertheless worth a detailed study.

Systematic position

The taxonomy of the genus *Helicoprion* has been discussed several times and by many authors, more recently by TEICHERT (1940), NIELSEN (1952), OBRUCHEV (1952, 1953, 1964) and BENDIX-ALMGREEN (1966). The incomplete imprints of a spiral of *Helicoprion* from Bellsund do not show any features which contribute to the present knowledge of this problem.

The systematic position of the genus *Helicoprion* adopted here is that given by BENDIX-ALMGREEN (1966, p. 50).

Class:	*Elasmobranchiomorphi*	Order:	*Holicoprioniformes*
Sub-class:	*Elasmobranchii*	Family:	*Helicoprionidae*
Super-order:	*Helicoprioni*	Genus:	*Helicoprion*

[1] Only the principal papers concerning the discovery of *Helicoprion* in the different regions are mentioned here; more comprehensive lists of publications are to be found in the articles by OBRUCHEV (1953) and BENDIX-ALMGREEN (1966).

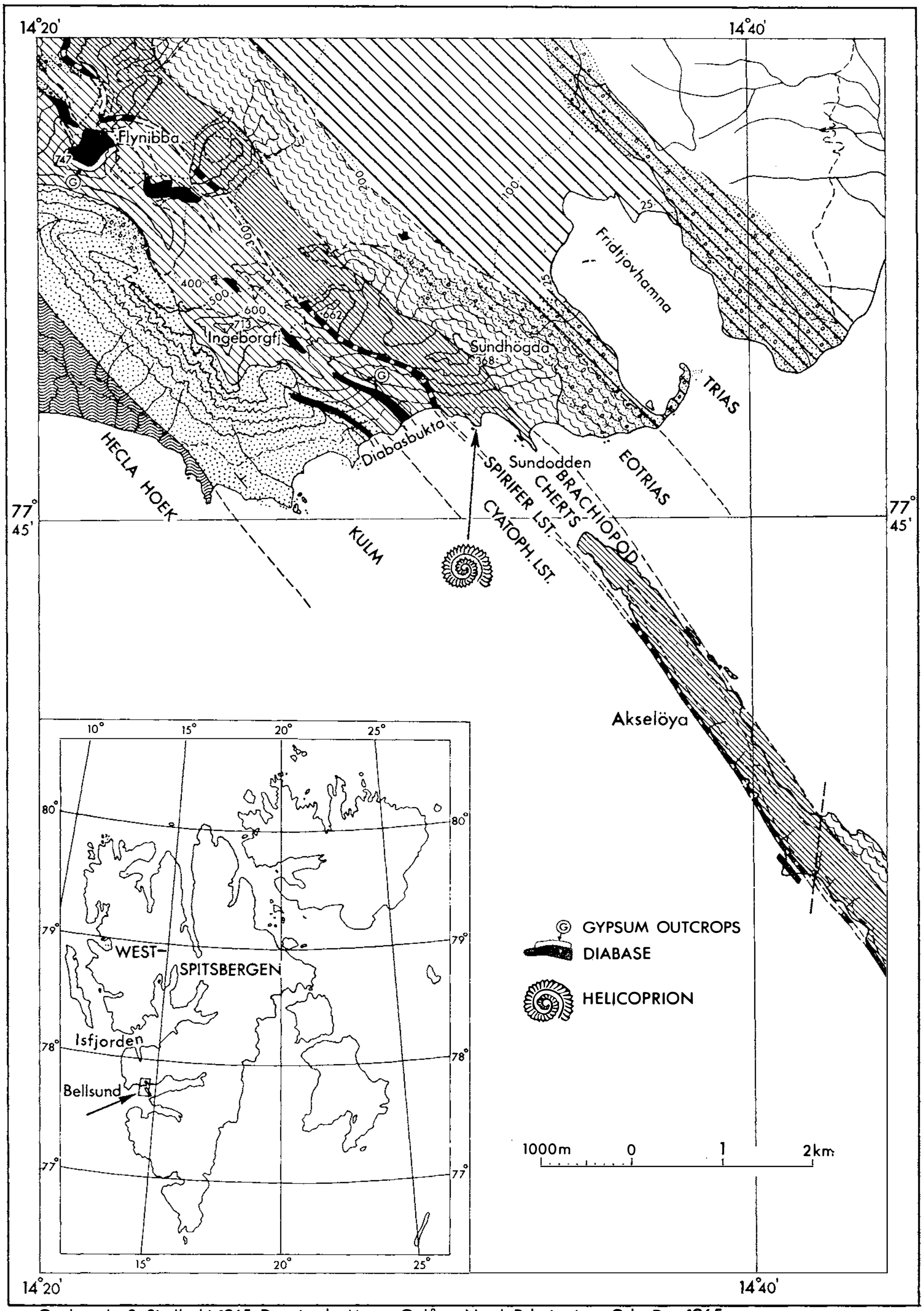

Fig. 1. Geological sketch-map ef the area where the specimen of *Helicoprion svalis* n, sp. was found.

Helicoprion svalis n. sp.

Plate I, figs. 1 and 2; Plate II, fig. 2.

Derivation of the name. – Svalis means cool ice (Norwegian), and is the telegraphic address of the Norwegian Polar Institute (Norsk Polarinstitutt formerly Norges Svalbard- og Ishavs-undersøkelser).

Type locality. – Svalbard, Spitsbergen, Bellsund, Sundodden (a small peninsula on the northern side of Akselsundet, 77°45'N–14°20'E; see "Topografisk kart over Svalbard", Blad B-10, Norges Svalbard- og Ishavs-undersøkelser, 1948). In this paper see Fig. 1 and Plate 2, fig. 1.

Stratigraphic position. – Permian Brachiopod Cherts. "Svalbardian".

Holotype. – Specimen number P.M.O. A-33961, deposited in the Paleontologisk Museum, Oslo. The holotype specimen is an imprint of the fragments of a tooth-spiral. The plastic casts taken in the Museum gave the positive form of the fossil. The following description is based on observations and measurements of both the negative original specimen, and of its positive cast in plastic, on which some anatomical details are easier to recognize.

Morphological terminology. – My description in general follows the morphological terminology proposed by WHEELER (1939, p. 103), which agrees with KARPINSKY's description of *Helicoprion bessonowi* (1899). This terminology has also been used by many other authors, and has been corrected in part and supplemented by TEICHERT (1940, p. 144), NIELSEN (1952, p. 25) and BENDIX-ALMGREEN (1966, p. 36). To this terminology the term "basal angle" is added here, this being equivalent to TEICHERT's (1940, p. 147) "angle between longitudinal axis and base of teeth". Following many other authors, I also use the term "tooth-crowns" for the "enamel-covered units of spiral", and the term "shaft" as equivalent to the term "compound root" (see Fig. 2).

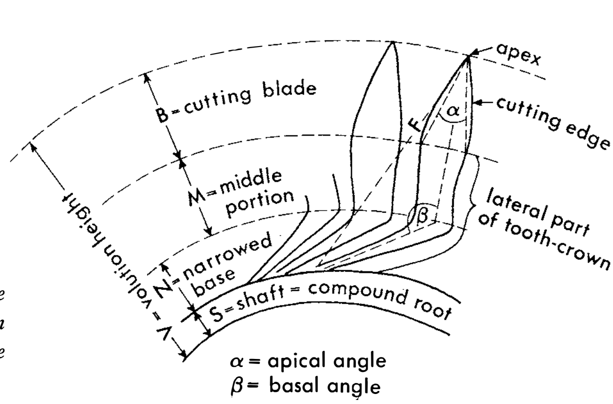

Fig. 2. *Simplified sketch showing the morphological terminology used in this paper. The sketch is based on the holotype of new species.*

Description of the specimen

State of preservation. – The original specimen from Bellsund shows two fragmentary external imprints of two unlike rows of teeth. They are visible on the bedding surface of dark grey cherty rock.[1] The imprints are, for convenience, referred to as "fragment A-minor" and "fragment B-major" (see Fig. 3). Each fragmnet is only a small part of a symphyseal tooth-spiral of *Helicoprion.*

In the specimen from Bellsund these parts are not arranged in a manner which is usual for this genus. Fragment A-minor, which must be considered as a part of the more internal, i.e. older, volution of the spiral, lies outside the row of teeth of fragment B-major. The question therefore arises, as to whether or not these fragments belonged to the same animal. On the basis of an anatomical study of the fragments, it can only be stated that they presumably belong to the same species.

It should be pointed out, however, that although the Permian deposits in Svalbard have been studied repeatedly, and at many places in this archipelago, this is the first specimen of *Helicoprion* to have been recorded. Therefore it would seem that the *Helicoprion* is a very rare fossil in the Permian sediments of Spitsbergen. It would be highly improbable that two different individuals of this mobile pelagic fish could have died or lost their spirals at the same place in the Permian sea which once covered Svalbard. It seems more likely that the two fragments are parts of the same symphyseal tooth-spiral, i.e. that they belonged

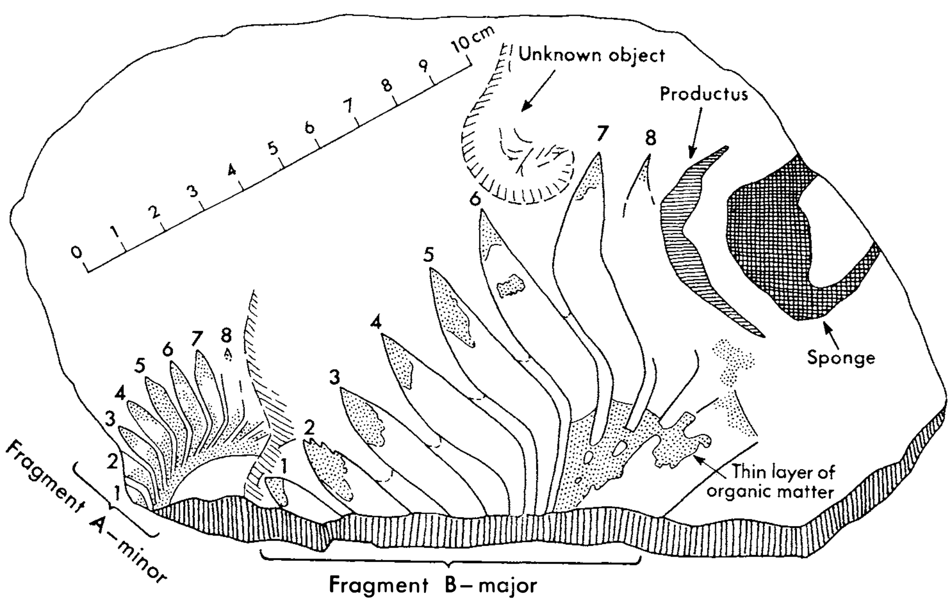

Fig. 3. *Sketch of the specimen P.M.O. A-33961 showing the imprints of two fragments of sumphy seal tooth-spiral of Helicoprion svalis n. sp.*

[1]Petrological characteristics of the rock sequence in which the imprints of the tooth-spiral of *Helicoprion svalis* has been found is given by SIEDLECKA (1970).

to the same animal. As traces of subaqueous slides were observed in the beds containing the fragments, the present abnormal position of the tooth-roofs in the rock appear to have been caused by a slight displacement of the unconsolidated sediment in which the fossil was deposited.

The present position of these fragments on the surface of the rock is not exactly parallel. The surface on which the fragment A-minor rests is inclined about 15 degrees in relation to that of the fragment B-major. From the photograph, Pl. I, fig. 2, which represents the positive cast of the specimen, it can also be seen that the row of teeth of the fragment B-major partly covers the row of teeth of the fragment A-minor. Consequently, it seems likely that the spiral was damaged when the sediment was being redeposited, and the broken fragments were pushed together.

Both on the major and on the minor fragments of the specimen, the imprints of eight teeth and part of a shaft (compound root) are recognizable. In the fragment A-minor weak and incomplete imprints of the narrowed bases of the 9th and 10th teeth occur. To facilitate the description, the tooth-imprints are numbered (see Fig. 3).

On both fragments the imprints of the extreme teeth, i.e. Nos. 1, 2, and 8, are very incomplete. The best impressions of teeth were obtained with Nos. 6 and 7 of fragment A-minor, and 5 and 6 of B-major. Therefore the measurements of these imprints were preferred for systematic determinations and comparison.

The depth of the most regularly preserved imprints of teeth, measured near the base of the cutting blades, reaches about 2 mm in the major fragment, tooth No. 6, and about 1 mm in the minor one, tooth No. 5. It seems probable that the depth of the imprints is equal to about a half of the thickness of the cutting blades, and therefore the original thickness of the teeth close to the base of the cutting blades must have been about 4 mm and 2 mm for the major and minor fragments respectively. The imprints of the teeth Nos. 1, 2, and 3 of the major fragment are slightly deeper and narrower when compared with those of teeth Nos. 4–7. This irregularity appears to have been caused by deformation of the casts on the sea bottom before the sediment was consolidated, and not by any distinct differences in the shape of the teeth. This is also the case with the fragment A-minor in which the imprints of teeth Nos. 1–4 are somewhat deeper and slightly deformed as compared with the teeth Nos. 5–8.

The shape of the imprint of tooth No. 7 in the major fragment deserves special attention, as the longitudinal axis of this tooth is noticeably more curved than in the case of the other teeth. The axis runs from the apex of the tooth to its narrowed base in an S-shaped curve (see Fig. 3, and Plate I, figs. 1–2). Having only this incomplete specimen at my disposal, it is difficult to state whether the phenomenon is due to some abnormality in the shape of the tooth, or due to some mechanical deformation of the tooth after the deposition of the spiral on the sea floor. The latter possibility seems to be more acceptable, since between the imprints of teeth Nos. 6 and 7, and near the apex of the abnormally curved tooth No. 7, a relatively deep imprint of an unrecognizable convex object can be observed on the rock surface. This object (possibly a brachiopod valve) could have caused deformation of the tooth, especially during compaction of the sediment. It may also be noted that tooth No. 8, fragment B-major, although very slightly imprinted, appears to be deformed in a manner similar to that of tooth No. 7.

Only minute traces of organic matter have been preserved in the *Helicoprion* specimen from Bellsund. In both the fragments A-minor and B-major, the imprints of the cutting blades are partially covered by a thin blackish layer which could be a remnant of a hard enamel-like tissue that originally covered the tooth-crowns. Parts of the narrowed bases and of the shafts are also covered with a similar dark organic film. This is shown in the sketch Fig. 3, and in Plates I and II. The histological character of this organic remnant could not be studied in any greater detail because of the unsatisfactory state of preservation of the specimen.

No traces of striae were observed on this layer, and it seems most likely that the external surfaces of tooth-crowns were smooth-faced in this new species.

In the case of teeth Nos. 2 and 7 in fragment B-major, it is possible to observe that near the cutting edges of these teeth the thin and nearly black organic layer forms a saw-like margin (see Plate II, fig. 2) which resembles the serration on the cutting edges of tooth-crowns in other *Helicoprion* species. In the specimen from Bellsund this "serration" is quite coarse, the largest "denticles" reaching up to 1 mm in height. Somewhat more detailed microscopic observation of these "denticles" shows, however, that the saw-like margin of organic matter covering the imprints of cutting blades of the above-mentioned teeth is due only to a mechanical damaging of the organic layer.[1] Original serration of the cutting edges may have existed in the new species but no unambiguous evidence for this can be found in the present specimen. It seems possible that the true serration was too fine and the denticles too small to leave their distinct impressions on the rock surface.

On examining the positive cast of the fragment B-major, especially when using inclined light, it is also possible to distinguish feeble imprints of the root-parts of the teeth (see Fig. 3, and Plate I, fig. 2). Although no anatomical details of these root-parts can be observed, it would appear that the root-parts occupying the spaces between neighbouring lateral parts of the tooth-crowns were relatively large in *Helicoprion svalis*. It seems that the enamel-covered tooth-crowns in the new species, particularly in the younger volutions of the tooth spiral, did not come in contact with each other, the bases of the cutting blades being proportionally short. In the case of the fragment A-minor no imprints of root-parts are recognizable.

It is the rule in other *Helicoprion* species that the neighbouring tooth-crowns make contact at the base of the cutting blades, where the front lower corner of the anterior (younger) tooth touches the lower points of the posterior cutting edge of the (older) tooth-crown in front. The lack of such contact in the *Helicoprion* specimen from Bellsund can possibly be used as a diagnostic feature, thus distinguishing *Helicoprion svalis* from other species of this genus.

[1] This explanation was suggested to me by Prof. D. Obruchev from Moscow, when examining my specimen of *Helicoprion* from Bellsund, during his visit to the Paleontological Museum in Oslo in the spring of 1966.

Table 1

Species	Specimen	Tooth	V Height of volution	B Height of cutting blade	M Height of middle portion	B Lenght of base of cutting blade	N Lenght of narrowed base	F Distance from apex to lateral end of narrowed base	S Height of shaft	B+M	V/B	V/(B+M)	V/B′	B/B′	S/V	α Apical angle (°)	β Basal angle (°)	Source of data
Helicoprion svalis n. sp.	Fragment A, minor	tooth No. 6	21.0	9.0	5.0	4.5	9.0	20.0	3.5	14.0	2.3	1.5	4.7	2.0	0.17	30	120	Holotype and cast in plastic of holotype
		tooth » 7	21.0	9.0	5.0	4.5	9.0	20.0	3.5	14.0	2.3	1.5	4.7	2.0	0.17	30	120	
	fragment B, major	tooth » 5	70.0	25.5	17.0	8.5	—	—	7.0	42.5	2.7	1.6	8.2	3.0	0.10	30	130	
		tooth » 6	72.0	27.0	18.0	8.0	28.0	68.0	7.0	45.0	2.7	1.6	9.2	3.4	0.10	30	135	
Heliocoprion bessonowi KARPINSKY		tooth about 1½ volutions	22.0	9.0	5.0	5.5	11.0	22.0	—	14.0	2.4	1.6	4.0	1.6	—	40	125	KARPINSKY 1899, pl. 1
		3rd tooth from the end of last volution	64.0	18.0	23.0	12.5	33.5	67.0	—	41.0	3.6	1.6	5.1	1.4	—	45	130	
H. sierrensis WHEELER		tooth at the end of 2nd volution	22.0	7.5	7.0	6.0	9.5	21.0	—	14.5	2.9	1.5	3.7	1.3	—	35	125	WHEELER 1939, fig. 4
H. nevadensis WHEELER		tooth about 1¾ volutions	22.0	8.0	7.5	5.5	9.5	23.0	—	15.5	2.9	1.4	4.0	1.5	0.10	40	120	—»— —»— fig. 3
H. davisii WOODWARD		smallest tooth	23.1	9.0	5.6	8.0	14.6	21.0	3.3	15.5	2.3	1.5	2.9	1.1	0.14	38	120	TEICHERT 1940, p. 145 and pl. 22, fig. 1
Helicoprion ferrieri HAY		specimen Idaho No. 1-L.T. 3 (No. 58)	20.0	9.0	—	6.5	—	—	3.0	—	2.2	—	3.1	1.4	0.15	35	120	BENDIX-ALMGREEN 1966, p. 37 and pl. I-III
		Idaho No. 4. – tooth about 1 volution	26.0	12.0	5.5	7.5	12.5	26.0	3.5	17.5	2.2	1.5	3.5	1.6	0.13	35	125	—»— —»— pl. I
		Idaho mrk. Thiel "P"–S.T. 4 (No. 110)	76.8	30.1	—	22.0	—	70.8	—	—	2.6	—	3.5	1.4	—	40	125	—»— —»— p. 39 and pl. X

It must be pointed out, however, that the study and even the measurements of some anatomical details of the specimen from Bellsund may be imprecise, since the specimen is only an imperfect cast of the spiral.

Number of teeth in a volution. – In the case of the fragment A-minor it is possible to calculate the approximate number of teeth in the corresponding volution. Since the fragment represents a sector of about 90 degrees, i.e. about a quarter of the entire volution, and as it comprises the imprints of 10 teeth (including the most incomplete imprints), the total number of teeth in the volution would have been about 40.

With the fragment B-major the calculation is more difficult, but taking into consideration the general shape of the fragment and its slight curvature, it can be assumed that the number of teeth in the corresponding volution would have been distinctly greater than in older volutions, i.e. probably exceeding 50.

Dimensions of teeth. – In Table 1 measurements of the teeth of *Helicoprion svalis* are given, together with corresponding dimension in *Helicoprion bessonowi* KARPINSKY, *Helicoprion sierrensis* WHEELER, *Helicoprion nevadensis* WHEELER, *Helicoprion davisii* (WOODWARD), and *Helicoprion ferrieri* (HAY). In order to permit a good comparison to be made, the criterion of similar volution height has been adopted in this instance.

All measurements are given in millimetres.

Comparisons and affinities

It can be seen from Table 1 that the dimensions of teeth which display a similar volution height do not differ greatly from one species to another. This confirms the previously known fact that *Helicoprion bessonowi, Helicoprion ferrieri, Helicoprion sierrensis, Helicoprion nevadensis* and *Helicoprion davisii,* now also including *Helicoprion svalis,* "apparently form one group of closely allied species" (BENDIX-ALMGREEN 1966, p. 35).

The height of cutting blades (B in the table) in *Helicoprion svalis*, fragment A-minor, displays the same value as the height of cutting blades of analogous teeth both in *Helicoprion bessonowi* and in *Helicoprion ferrieri.* In *Helicoprion davisii* the height of the cutting blade of the smallest tooth is apparently of the same dimension, but the volution height is greater in the tooth measured in *Helicoprion davisii*; thus the proportion $\frac{V}{B} = 2.3$. In the case of fragment B-major (in *Helicoprion svalis*) the height of the cutting blades is distinctly greater than the equivalent dimensions in *Helicoprion bessonowi.* In *Helicoprion svalis* the cutting blades are more elongated and their heights show more similarities to *Helicoprion ferrieri* and *H. davisii,* especially when the proportion $\frac{V}{B}$ is considered. It must be pointed out, however, that the general shape of tooth-crowns in *Helicoprion ferrieri,*

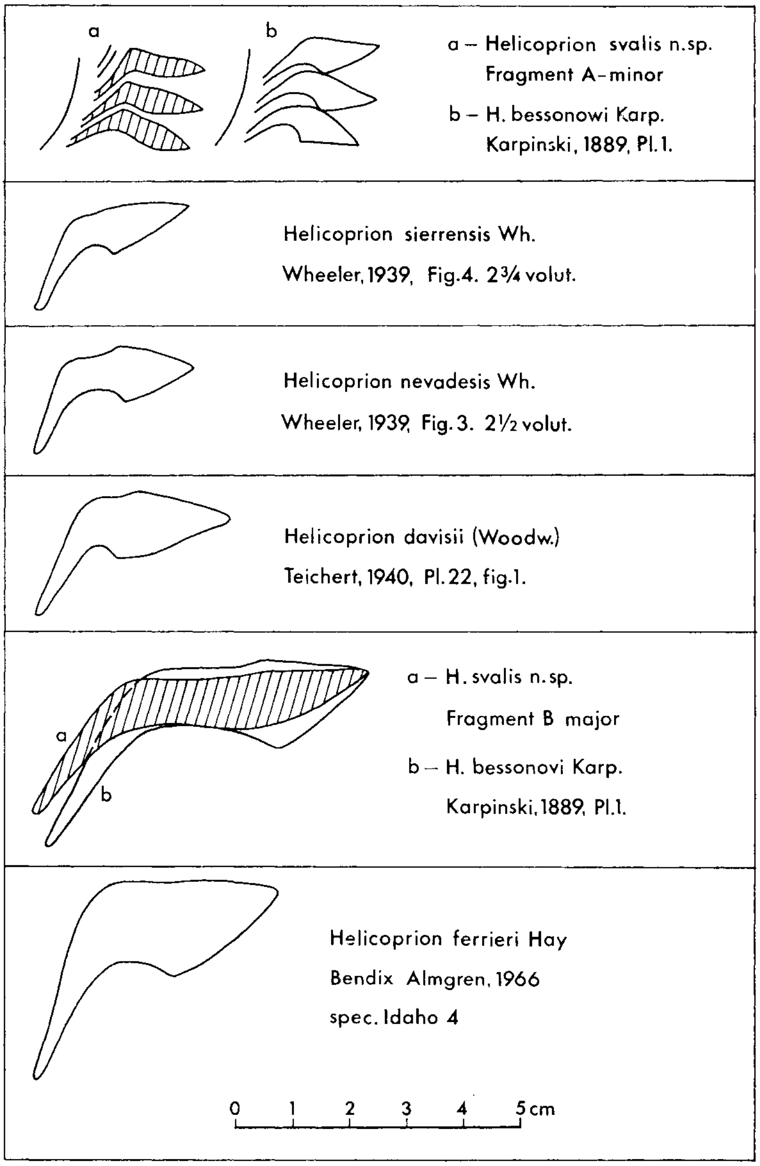

Fig. 4. *Sketch showing the similarities and differences between the shape of tooth-crowns in the new species and related species of genus Helicoprion.*

especially in younger volutions, differs markedly from the shape of analogous teeth in the fragment B-major of *Helicoprion svalis*. This is because the length of the base of the cutting blades is evidently greater in *Helicoprion ferrieri* than in the new species (see Fig. 4).

The height of middle portions (M in the table) in *Helicoprion svalis*, fragment A-minor, is of the same value as in *Helicoprion bessonowi*, i.e. in teeth with equivalent height of volution. On the contrary, in fragment B-major in the new species, middle portions of tooth-crowns are distinctly shorter than in corresponding teeth in *Helicoprion bessonowi*. In general, in all *Helicoprion* species, the height of the middle portions of teeth-crowns is inversely proportional to the height of cutting blades, i.e., the shorter the cutting blade the longer the corresponding middle portion, and vice-versa. Thus the proportion $\frac{V}{B+M}$ has nearly the same value in all the discussed species.

The length of the base of the cutting blades (B' in the above table of measurements) clearly shows differences existing between the shape of tooth-crowns in *Helicoprion svalis* and those in other *Helicoprion* species. Bases of cutting blades in the new species are relatively narrow, although the respective dimensions in fragment A-minor in *Helicoprion svalis* are comparable with equivalent dimensions in *Helicoprion bessonowi* and in *Helicoprion nevadensis*. Fragment B-major of the new species displays more pronounced dissimilarities. The length of bases of cutting blades in this fragment is about 1.2 × smaller than the equivalent dimensions in *Helicoprion bessonowi*, and about 1.8 × smaller when compared with *Helicoprion ferrieri*. The proportion $\frac{B}{B'}$ in the new species seems to be greater, not only if compared with the equivalent proportions in the other discussed *Helicoprion* species, but as far as I could evaluate, it is greater than in all other known *Helicoprion* species, *Helicoprion ivanowi* KARPINSKI, *Helicoprion karpinskii* OBRUČHEV, *Helicoprion mexicanus* MÜLLERIED, and *Helicoprion ergasaminon* BENDIX-ALMGREEN included.

The length of narrowed bases (N in the table) in the present specimen of *Helicoprion svalis*, can be measured approximately in the imprints Nos. 3—8 in the fragment A-minor, and in the best preserved imprint No. 6 in the fragment B-major. The narrowed bases in the new species are only slightly shorter than in other Helicoprion species, and the same can also be said for dimension F (distance from apex to lateral end of narrowed base) which is somewhat smaller in *Helicoprion svalis*. The tooth-crowns of *Helicoprion sierrensis* and of *Helicoprion nevadensis* show nearly the same length of narrowed bases as the equivalent teeth in *Helicoprion svalis*.

A noteworthy feature of the anatomy of the tooth-spiral in the new species is thus that the narrowed bases in general follow the rule given by KARPINSKY (1899, figs. 24—26, pp. 394—395) for *Helicoprion bessonowi*. In fragment B-major in the new species the narrowed base of the tooth No. 6 terminates at a point below the centre of the 3rd tooth-crown in front (i.e. below the centre of tooth No. 4). In fragment A-minor the narrowed bases are somewhat shorter: they terminate below the front margin of the 2nd tooth-crown in front (see Fig. 4).

The narrowed bases in the new species, especially in the fragment B-major, have a large angle between the upper and lower borders similar to that of *Helicoprion bessonowi* but quite different from that in *Helicoprion ferrieri*.

The height of the shaft (S in the table) is relatively great in *Helicoprion svalis*, and is equal to about 1/6 (in fragment A-minor) to 1/10 (in fragment B-major) of the total height of volution. It differs appreciably from the equivalent proportions in *Helicoprion bessonowi*, where the ratio $\frac{S}{V}$ is about 1/15 according to KARPINSKY (1899). The shaft in the fragment A-minor in the new species has a height similar to the equivalent dimension in Helicoprion ferrieri, the $\frac{S}{V}$ ratio in the latter being, according BENDIX-ALMGREEN (1966, p. 54), about 1/5–1/7. In fragment B-major in *Helicoprion svalis* the shaft is more similar to the shaft in *Helicoprion sierrensis* and *Helicoprion nevadensis* in which the ratio $\frac{S}{V}$ is about 1/10 according to WHEELER (1939, pp. 112–113).

The apical angle (α) is smaller in *Helicoprion svalis* than in all other species discussed, this coinciding with the narrower shape of the tooth-crowns in the new species.

The basal angle (β) in *Helicoprion svalis*, fragment A-minor, is of the same value as in *Helicoprion nevadensis*, *Helicoprion davisii* and *Helicoprion ferrieri*. In fragment B-major in the new species, the basal angle is relatively greather than in the previously mentioned species and is of nearly the same value as that in equivalent tooth-crowns in *Helicoprion bessonowi*.

The number of teeth per volution, totalling about 40 in the fragment A-minor in *Helicoprion svalis*, and about 50 in the fragment B-major (see p. 00), is almost the same as the number of teeth in presumably corresponding volutions in *Helicoprion bessonowi*.

KARPINSKY (1899, p. 403) gives the number of teeth per volution in the best preserved specimens of *Helicoprion bessonowi* as follows: 1st volution – 36 and 38 teeth (in specimen I and specimen II, respectively); 2nd volution – 48 and 42 teeth; 3rd volution – 51 and 49 teeth.

Other *Helicoprion* species discussed here have a rather smaller number of teeth per volution, usually not exceeding 40. However, the data given by WHEELER (1939, pp. 109 and 112) for *Helicoprion nevadensis* (about 37 and 39 teeth in the 1st and 2nd volutions respectively) and for *Helicoprion sierriensis* (about 32, 36, and 41 teeth in the 1st, 2nd, and 3rd volutions respectively), do not differ greatly from the data of fragment A-minor in the new species.

BENDIX-ALMGREEN (1966, p. 44) emphasizes that in his new species *Helicoprion ergasaminon* the number of tooth-crowns represented per volution amounts to 48–50. This is also an amount comparable with equivalent data concerning both the youngest volutions in *Helicoprion bessonowi* and the younger volution in *Helicoprion svalis* from which the fragment B is derived.

While considering the *Helicoprion ergasaminon* it should be noted that this species also seems to be closely related to the group of Helicoprions discussed here. BENDIX-ALMGREEN (1966, p. 44) concludes that *Helicoprion ergasaminon* is most closely comparable to *Helicoprion nevadensis*. Broader and stronger tooth-crowns, and especially a very distinct crenulation of cutting edges in *Helicoprion ergasaminon,* are important features that show this species to be different from *Helicoprion svalis*.

The symphyseal tooth-spirals (or in some cases the tooth-roofs only) in all other "Helicoprions" hitherto described (i. e. in *Helicoprion sp.* reported by KOKEN in 1901 from the Upper Productus limestone of the Salt Range, India; *Helicoprion clerci* KARPINSKY 1916; *Helicoprion ivanovi* KARPINSKY 1922; *Helicoprion mexicanus* MÜLLERIED 1945; and *Helicoprion karpinskii* OBRUCHEV 1953) display still more distinct differences as compared with the fragments of spiral of *Helicoprion svalis*. It is noteworthy, however, that most of the above-mentioned species have in recent times been considered as belonging to several different genera. These can be listed briefly as follows:

Helicoprion sp. KOKEN 1901, from Upper Productus limestone (Chideru group), India, has proved to be a different genus, *Helicampodus,* which has a straight, not coiled, row of teeth (BRANSON 1935, TEICHERT 1940, OBRUCHEV 1964).

Helicoprion clerci KARPINSKY 1916 has been transferred by the same author (KARPINSKY 1922, 1925) to a different genus, *Parahelicoprion*.

Helicoprion ivanovi KARPINSKY 1922 has strong and robust teeth markedly different from the relatively fine teeth in *Helicoprion svalis*. The neighbouring tooth-crowns in *Helicoprion ivanovi* touch each other in a specific manner, a feature which is absent in other *Helicoprion* species. The cutting edges of tooth-crowns in *Helicoprion ivanovi* are strongly serrated. KARPINSKY (1922, pp. 370–373) discussed several differences existing between *Helicoprion ivanovi* and *Helicoprion bessonowi* and now the same differences are found when comparing the anatomical features if the tooth-spiral in *Helicoprion ivanovi* with the corresponding features of the tooth-spiral in *Helicoprion svalis*. OBRUCHEV (1964, p. 253) classifies the species *Helicoprion ivanovi* within the genus *Campyloprion* EASTMAN 1902. Following this estimation BENDIX-ALMGREEN (1966, p. 13) also states "that *Helicoprion ivanovi* KARPINSKY (1922) is in fact a species of Campyloprion".

In *Helicoprion mexicanus* MÜLLERIED 1945, the lateral parts of the tooth-crowns are distinctly crenulated, and the neighbouring tooth-crowns contact each other along this crenulated boundary line. The teeth are robust with serrated cutting-edges, and the enamel-like layer covering the tooth-crowns shows fine longitudinal striation. All the above-mentioned anatomical features are absent in *Helicoprion svalis*.

After studying the description of *Helicoprion mexicanus* and the respective illustrations of the specimen from Coahuila, Mexico, given by MÜLLERIED (1945, pp. 208–212, and Figs. 1–6), I am convinced that this species also needs further investigations and discussion. It seems possible to me that *Helicoprion mexicanus* MÜLL. can prove to be not a true *Helicoprion* but another genus.

In *Helicoprion karpinskii* OBRUCHEV 1953, the anatomical features of the teeth show even greater differences when compared with corresponding features in *Helicoprion svalis*. This problem, however, will not be discussed here as, according to Prof. OBRUCHEV (pers. comm., august 1966), *Helicoprion karpinskii* OBR. is to be considered as another genus.

Summarizing all the available data concerning the anatomy of the tooth-spiral in *Helicoprion svalis,* it can be assumed that the closest similarity and consequently relationship exists between the new species and *Helicoprion bessonowi*, although some anatomical differences are also evident. The main differences are that in *Helicoprion svalis* the tooth-crowns are relatively narrower and elongated, bases of cutting blades are shorter, spaces between the neighbouring enamel-covered tooth-crowns are wider, and the shaft is higher. Fig. 4 illustrates the main similarities and differences in the shape of tooth-crowns within the related *Helicoprion* species discussed in the present paper.

Future investigations based on new and, it is to be hoped, well-preserved finds of *Helicoprion* from Brachiopod Cherts in Svalbard, may reveal that some of the above-mentioned differences existing between the new species and *Helicoprion bessonowi* are more or less superficial and due only to the incomplete state of the imprints in the present specimen from Bellsund. It is possible that if, in the future, a more complete spiral of *Helicoprion* should be found in Brachiopod Cherts in Svalbard, the two discussed species *Helicoprion svalis* and *Helicoprion bessonowi* may prove to be identical. The same conclusion was emphasized by TEICHERT (1940, p. 148) when discussing the similarities in the anatomy of tooth-spirals in *Helicoprion davisii* and *Helicoprion bessonowi*. KARPINSKY (1912, p. 83) emphasized that there is a considerable intraspecific variability in *Helicoprion bessonowi*; thus the possibility cannot be excluded that the above-mentioned differences in some dimensions of the teeth and in some anatomical features existing between *Helicoprion svalis* and *Helicoprion bessonowi* belong to the category of intraspecific variation. Consequently the following diagnosis must be considered as being only provisional.

Diagnosis

The symphyseal tooth-spiral in the new species is composed of a compound-root (shaft) and of several teeth placed on it in a manner which is characteristic for the genus *Helicoprion* KARPINSKY 1899. The number of teeth per volution amounts to about 40 in the presumably middle part of the spiral, and to about 50 in the outer, i.e. younger, volution. The maximum known height of the outer volution is 72 mm.

The enamel-covered tooth-crowns are elongate, with proportionally long and narrow cutting blades. Apical angle is about 30 degrees. Presumably the enamel-covered tooth-crowns, especially in younger volutions of the tooth-spiral, do not touch each other in adjacent teeth. The width of tooth-roots, situated in the spaces between the neighbouring enamel-covered tooth-crowns, is proportionally great, particularly in younger volutions. Cutting blades with slightly convex-cutting edges, the front cutting edge being more distinctly curved. The cutting edges are presumably either devoid of any serration or crenulation, or have only a very fine serration. The lateral surfaces of cutting blades, and the entire enamel-covered tooth-crowns, smooth and devoid of any striation. Middle portions of tooth-crowns (in the middle and outer volutions of the spiral) with slightly concave margins. No crenulation along the margins of middle portions nor along the narrowed bases. Narrowed bases (directed toward the older parts of the spiral) terminate in younger volutions at a point below the centre of the third tooth-crown in front. In the middle part of the tooth-spiral the point of termination of the narrowed bases is situated approximately below the front margin of the second tooth-crown in front. In older volutions of the tooth-spiral the narrowed bases are proportionally slender, in younger ones broader, and display a greater angle between their front and rear margins. A solid and proportionally high shaft (compound-root) reaches up to about 1/10—1/6 of the entire height of a volution.

Age of Brachiopod Cherts and the stratigraphical significance of the genus *Helicoprion*

The age of the Brachiopod Cherts and the stratigraphical significance of the genus *Helicoprion* have been discussed by several authors, and although both these matters have been the subject of much debate the principal geological and palaeontological problems are not yet satisfactorily resolved. As a consequence of the abundance of brachiopods and an almost complete lack of other diagnostic fossils in the sediments of the Brachiopod Cherts in Svalbard, most conceptions concerning the age of this series have naturally been based on studies of brachiopod faunas. These faunas have been described mainly by Toula (1874, 1875), Wiman (1914), Frebold (1937, 1942), Stepanov (1937), and Ustrický (1962), and a more recent discussion of their stratigraphical significance presented by e. g., Dunbar (1955), Stepanov (1957), Forbes et al. (1958), Harker and Thorsteinsson (1960), Harland (1961), Gobbett (1963), and Birkenmajer (1964).

The oldest notion regarding the age of the Brachiopod Cherts was that these sediments were of Carboniferous or even "Permocarboniferous" age. Frebold (1937) had claimed an Artinskian age for the Productus Cherts, and an uppermost Carboniferous age for the underlying Spirifer Limestone. His conclusions were supported by Licharev and Einor's (1939) studies on the Lower Permian fauna of Novaya Zemlya. Frebold's view was also accepted by Orvin (1940) and by several other authors.

Stepanov (1937), however, correlated the Brachiopod Cherts (referred to in his paper as Spirifer limestone and Productus beds) with the Kungurian and partly even with the Lower Kazanian stages. This same author (Stepanov 1957) proposed a new stage name in Arctic Permian stratigraphy, the "Svalbardian" stage. According to Stepanov, this new stage is the marine equivalent of the Kungurian and is situated between the marine Artinskian and marine Upper Permian Kazanian stages. Stepanov's proposal was later accepted by many, though not all (Burov et al. 1965), authors.

It must be emphasized, however, that studies based on brachiopod faunas alone seem to be inadequate to solve the question of the precise stratigraphic position of the Brachiopod Cherts. The reasons for this are several. The first is that most of the Permian brachiopods generally exhibit a distinct intraspecific variability. This phenomenon — together with the fact that a number of Arctic species were described on the basis of small, fragmentary and in part poorly preserved collections (Dunbar 1955, p. 46) — undoubtedly resulted in the creation of several "new species" which impeded a correct stratigraphical correlation with the known "standard" faunal associations. Moreover, brachiopod faunas in the "standard" stratigraphic sections must always be regarded as benthonic biocenoses inevitably dependent on and connected with facial conditions in the palaeogeographic environment of each "standard" locality. In addition to these difficulties it is apposite to mention an important opinion of GERTH (1950, p. 294) who states that: "...die Brachiopoden Fauna des Perms wird am Ende das Paläozoicums im allgemeinen sehr indifferent, die Arten haben vielfach eine lange Lebensdauer und in den meisten Geschlechten lässt sich keine deutliche Entwicklung mehr beobachten...."

Taking into consideration the above arguments, it would seem that the discovery of *Helicoprion* in the Brachiopod Cherts in Svalbard could prove to be of special interest. There can be no doubt that the anatomical features of this pelagic, mobile fish, which represents an evolutionary advanced and extremely specialized genus, distinguish the *Helicoprion* as truly diagnostic fossil. It could have attained a wide palaeo-geographical range within a short time of its appearance.

Several authors have discussed in detail the problem of stratigraphical significance of the genus *Helicoprion*, and some writers (e.g. HOFFET 1933, GERASIMOV 1937, WHEELER 1939, TEICHERT 1940) even introduced biostratigraphical units into Permian stratigraphy based on the appearance of *Helicoprion.* Of particular interest is the paper of WHEELER (1939) in which the author not only described two new *Helicoprion* species, but also introduced the new biostratigraphical term "*Helicoprion* biozone" and discussed its stratigraphical position. A precise stratigraphical application of the genus *Helicoprion* was, however, precluded by inadequate knowledge of its true stratigraphical range. Thus it was almost generally accepted that the oldest beds containing *Helicoprion* were of Upper Carboniferous, Uralian age. The youngest ones were the Upper Permian Chideru beds of the Upper Productus Limestone of Salt Range in India.

The gradual development of palaeontological studies of the genus *Helicoprion* have now led to a revision of these ideas. In this connexion it must be noted that only one species of a genus, erroneously described as *Helicoprion,* has been found in Upper Carboniferous beds. This is *Helicoprion ivanovi,* KARPINSKY (1922), found in the vicinity of Moscow in a dolomite of Upper Carboniferous, Gshelian age. As already mentioned above (p. 47), the species *Helicoprion ivanovi* must be regarded as an another genus, *Campyloprion.* Thus the oldest "true" *Helicoprion* specimens are now known with certainty from sediments of the Lower Permian, Artinskian stage.

It can also be mentioned that the apparently Upper Permian species of "*Helicoprion*" described by KOKEN (1901) from Chideru Beds, Upper Productus Limestone, Salt Range in India, has been redescribed by BRANSON (1935) and determined as *Helicampodus kokeni,* n.g. et n.sp.

From these various remarks it is clear that the geological age range of all true *Helicoprions* described to date is quite restricted, and lends support to WHEELER's (1939, p. 105) view that the "Helicoprion biozone" does not extend above the top of the Artinskian.

Other *Helicoprion* species discovered recently from other parts of the world, have been found as follows:

a) in beds whose Artinskian age is indisputable (the Upper Artinskian beds in Krasnoufimsk);
b) in beds which had not yielded any fossils other than *Helicoprion*; in this instance the *Helicoprion* was used to determine a stratigraphical position of the otherwise unfossiliferous rock series (e.g. Koipato formation in Nevada, U.S.A.);
c) in beds whose exact age within the Permian system has not yet been elucidated with certainty, but for which an Artinskian age (in particular Upper Artinskian) is very probable or has even been accepted, although not adequately confirmed, by the occurrence of fossils other than *Helicoprion* (e.g., Phosphoria Formation in U.S.A., Houei Nam Cam Limestone in Indo-China, Assistance Formation in the Canadian Arctic Archipelago, Wandagee "stage" in Western Australia, and the "limestone of Hanawa" in Japan).

The find of *Helicoprion* in the Hanawa Limestone in Japan must be regarded as being of special interest, because in the rock-specimen containing *Helicoprion* some fusulinids have been observed. The intensive studies on Permian fusulinids carried out in Japan in recent times have resulted in the setting up of a very detailed stratigraphical scheme of Japanese Permian deposits based on these fossils (TORIYAMA 1967) and have permitted an accurate determination of the stratigraphical position of the Hanawa Limestone.

SAGAWA (1900) first reported that a specimen of *Helicoprion* had been found "near Aso copper mine, in a limestone of palaeozoic age, the Fusulina Limestone". YABE (1903) described this specimen as *Helicoprion bessonowi* and emphasized that the Hanawa Limestone containing *Helicoprion* "belongs to the same horizon as that containing *Fusulina japonica* GUEMBEL" and, consequently, was of an Artinskian age. YABE's conclusions have been discussed and accepted by WHEELER (1939) and several other authors.

Recently the present author received a written communication from Professor RYUZO TORIYAMA, Kyushu University, concerning the Limestone of Hanawa. In this Professor TORIYAMA noted that

"The limestone from which the *Helicoprion* came is a small limestone lens intercalated in the *Tanukihara Formation* of the Fukuoka Group (Kiyosuke KAWADA in H. FUJIMOTO, "Regional Geology of Japan, Kwanto Province", pp. 88–89 (in Japanese, 1953). The Tanukihara Formation consists mostly of chert, containing a subordinate amount of clayslate and limestone. The *Helicoprion* was collected by Yabe from a limestone exposed at Yagihara, Kurohone-mura, Seta-gun, Gumma Prefecture. Because of a close similarity of fusulinid fauna, the Tanukihara Formation was correlated with Nabeyama Formation by Fujimoto who mentioned that YABE is right in his conclusion that the limestone of Hanawa (Yagihara) with *Helicoprion* is Artinskian in age. More exactly, in my opinion, the limestone of Yagihara is at least correlated with the *Pseudofusulina japonica* member, the lower part of the Nabeyama Formation of the Aso Group."

In summarizing the present state of knowledge of the stratigraphical significance of the genus *Helicoprion*, it would appear probable that the appearance of this genus is restricted to the beds of Artinskian (presumably Upper Artinskian) age following the "standard" Russian scheme of Permian stratigraphy. If so, the Svalbardian stage, represented on Svalbard by the Brachiopod Cherts which has yielded a new specimen of *Helicoprion* very closely related to *H. bessonowi* KARPINSKY, could be tentatively correlated with the Krasnoufimskian (Upper Artinskian) beds in Russia. This problem, however, still requires further investigation.

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Fig. 1. Holotype specimen (an imprint) of *Helicoprion svalis* n. sp.

Fig. 2. Cast in plastic of the holotype specimen of *Helicoprion svalis* n. sp.

Fig. 1. View on the type locality where the *Helicoprion svalis* n. sp. has been found.

Fig. 2. Enlarged part of the *Helicoprion svalis* n. sp.. The arrow shows the apparent "denticles" and the cutting blade of the second tooth on the fragment B-major.

The Norwegian Antarctic Expedition 1968-69

BY

THORE S. WINSNES

In the middle of March 1968 newspapers told that a Norwegian expedition to Dronning Maud Land was to take place next season.

The aim of the expedition was to carry out mapping, geological survey, and glaciological investigations in Vestfjella, the westernmost mountains in Dronning Maud Land. The expedition, which was organized by Norsk Polarinstitutt, was made possible by generous help from the National Science Foundation, Washington, and American equipment and transportation were placed at its disposal. The expedition could be flown from the American main base in Antarctica, McMurdo Station, across the continent and put down at Vestfjella. At the end of the season, it was to be picked up and brought back by another aircraft.

The C-130 Hercules aircrafts can take a cargo of 12 000 pounds, and consequently it was possible to supply an expedition consisting of six men with provisions and equipment enough to operate in the field for more than 75 days. This was sufficient for a thorough investigation of the Vestfjella area.

The mountains are a cluster of nunataks, lying in a row and extending for about 140 km from north-east to south-west along the southern margin of a 100 km wide ice-shelf. See Fig. 1. The mountains were photographed from the air during the Norwegian-British-Swedish Antarctic Expedition, 1948–50, which to a great extent facilitated the planning of the field operation.

The first three members of the expedition left Oslo on October 20 for McMurdo Station in order to make equipment and everything else ready for a start in the middle of November. They were joined by the three others on November 12, and two days later all were ready to start. Owing to unfavourable weather and bad radio conditions, the start had to be adjourned until the 22nd. Then the six members of the expedition with all their gear were put into the hold of the Hercules, and after eight hours in the air, with a short stop at the South Pole Station for refuelling, they were put down south of the central part of Vestfjella on a spot selected after careful study of air photographs as being the most suitable for landing and for a base of operation.

The investigations of the area were organized in two field groups, each consisting of one topographer and one geologist, equipped with a snow toboggan and two sledges for transportation. For safety, the two groups travelled together and operated from joint field camps. They were in daily radio contact with the

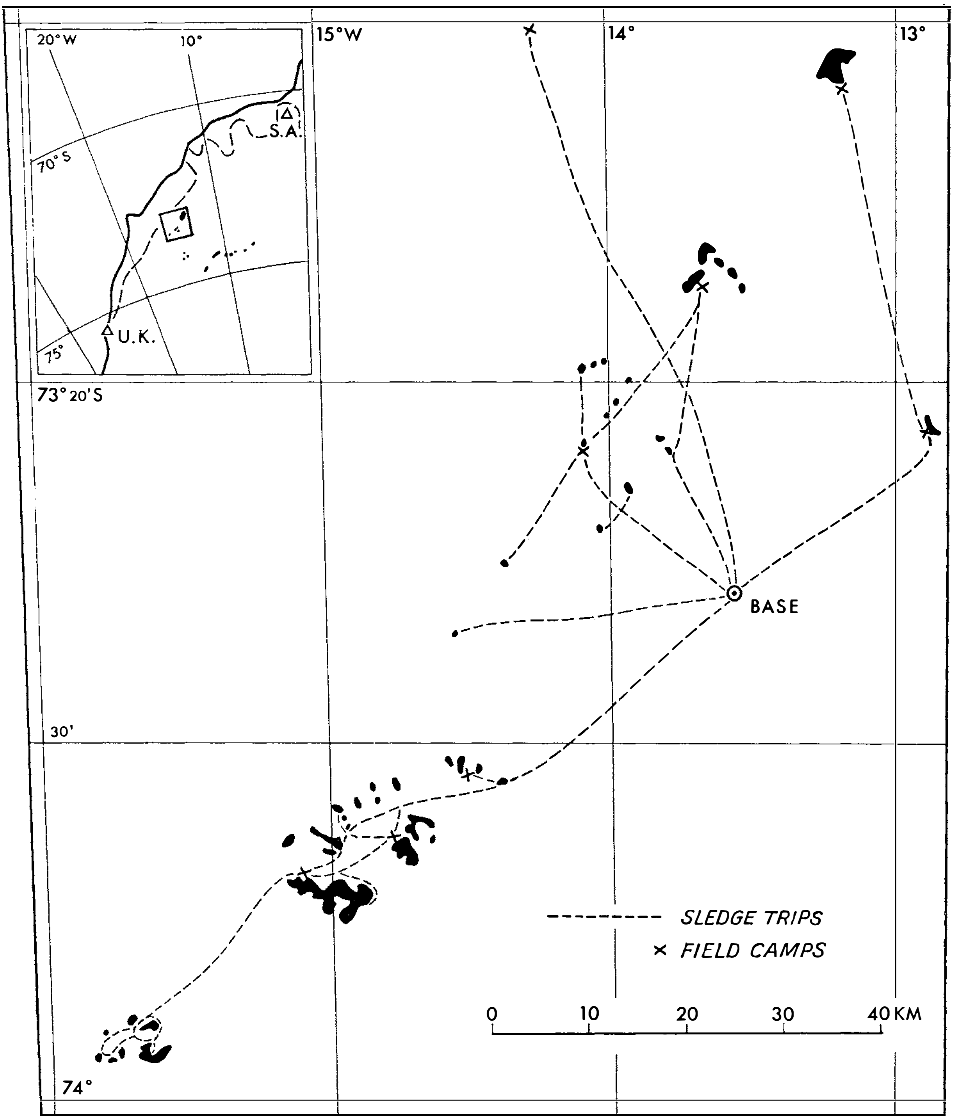

Fig. 1. *Map of the Vestfjella area; inserted map shows the location in Dronning Maud Land.*

main base, where glaciological studies and meteorological observations were carried out by the glaciologist and the radio operator. In case of emergency, this group would be able to operate with a third snow toboggan as a rescue team. Radio contact was maintained several times a week with the British Halley Bay base and the South African SANAE base. From SANAE a direct contact with Norway worked very well and was greatly appreciated during Christmas time.

After a few days spent in building up the main base, the sledge journeys started in favourable weather. The eastern and northernmost mountains were first visited. To be able to find the way back to the base even in bad weather, the trails were marked with flags. Several areas were crevassed and had to be avoided. After a week, the men were back in the camp. Interesting geological phenomena were observed, e.g. fossil plants and thick masses of lava rocks. The topographers took the first measurements in their triangulation network and measured a base line with advanced electronic equipment.

The central area was then visited. While the topographers – to get the exact location – made their measurements in an astronomical 'observatory' erected at a mountain top, the geologists made several trips to the neighbouring mountain tops. On December 15 everybody was back in the base.

Before Christmas, a trip to the mountains in the south-west was managed, where investigations were started and a depot was laid out for later trips further west.

Bad weather forced the field groups back to the base on the 21st, and Christmas was celebrated in full storm, truly a "white Christmas".

When the glaciological investigations at the base were nearly finished, the glaciologist and the radio operator went about 70 km northwards, down on the ice-shelf, to make comparative studies there. After short trips to isolated outcrops of rock near the base and another measurement of a base line of about 30 km in length towards west, the final trip towards the south-west started. Favourable conditions facilitated the work, and by January 10 everybody was once again safe back in the base. After a new set of astronomical fixes in the 'observatory', measurements of the horizontal and vertical force of the terrestrial magnetic field, and a trip to collect some more fossil plant material, the message that the planned work was finished, and that the expedition was ready to be picked up from January 16, was sent off to McMurdo.

Initially it was planned to do the 'pick up' operation at the end of the month, coordinated with a similar operation for British scientists from the Halley Bay Base, but plans were changed. On January 20, a Hercules landed at the base, and people and gear were loaded aboard. But Vestfjella presumably did not want the expedition to leave. Coarse sastrugi and soft snow prevented the aircraft to get the speed necessary for taking off. After six tries, the pilot was forced to climb a hillside with the plane and take off downhill. He succeeded very well, and after some very bumpy moments he got the Hercules airborne. After a few hours in the air, the expedition again landed at the South Pole. It had to wait there for twelve hours because of bad weather at McMurdo, and the time was spent in visiting the true Pole point and inspecting the Amundsen–Scott Base. On January 20, the expedition arrived in McMurdo and after a few days there it started the long flight back to Norway. With a week's stop in New Zealand and three days in Washington, it landed on Fornebu, Oslo, on February 5, 1969.

A glacial-meteorological study of Gråsubreen, Jotunheimen

BY

TORMOD KLEMSDAL[1]

Contents

Abstract

Measurements of the ablation were carried out on Blåbreen and Gråsubreen, Jotunheimen, in the central part of South-Norway in 1962 and 1963. Some features of the variation in the ablation with height, with different surfaces (ice or snow), and with different environments of the glacier have been pointed out. Glacial-meteorological observations were made in parts of June, July, and August 1963. The measurements included ablation, recording of in-coming short-wave radiation, measurements of air temperature and humidity, together with wind velocity and cloud cover. The relative importances of radiation, conduction/convection, and condensation are determined on the basis of these measurements. It turns out that radiation accounts for almost 100% of the ablation early in the ablation season, and decreases to about 40% towards the end, meaning that conduction/convection and condensation increase in importance through the season. If mean values are calculated for the measurements in July/August, radiation accounts for c. 60%, conduction/convection for c. 25%, and condensation for c. 15% of the ablation. The results are difficult to compare with other investigations, since they are strongly affected by the local weather conditions and the time in the ablation season at which they were obtained. It can be concluded, nevertheless, that on Gråsubreen, which lies farthest east of the glaciers in South-Norway, radiation plays a considerable part in the ablation, as a result of the continentality of the climate.

Introduction

The first investigations of single glaciers were undertaken to see whether the glacier front advanced or retreated, as an indication of whether the glacier was increasing or diminishing. Later, glaciologists began to investigate melting or

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ablation on certain glaciers, and it was not long before the reasons for ablation were drawn into the study. The most important causes are:

a. transference of heat to the glacier by long- and short-wave *radiation*,
b. *conduction/convection*, which are the transference of sensible heat to the glacier surface from the air above,
c. transference of heat by *condensation* of atmospheric water vapour on the glacier surface.

Besides these factors, calving, wind erosion and transport, rain, and earth heat contribute to the loss of material from the glacier. These last factors have little or no importance for Norwegian glaciers.

Much research has been undertaken to decide the relative importance of the different factors, e. g. on Baffin Island (W. H. WARD and S. ORVIG 1953, and S. ORVIG 1954), in the Alps (H. HOINKES and N. UNTERSTEINER 1952, and H. HOINKES 1953), and in Antarctica (G. LILJEQUIST 1957), but the first important works were those by H. U. SVERDRUP (1935a, 1935b, and 1936) on the Isachsenfonna (The Isachsen Plateau) in Spitsbergen, and by C. C. WALLÉN (1948) on the Kårsa glacier in North-Sweden in the period 1942–1948. O. LIESTØL (1961) states, from measurements on Storbreen in Jotunheimen (Fig. 1), that radiation accounts for 55%, conduction/convection for 35%, and condensation for 15% of the ablation.

Glacial-meteorological observations for a thesis at Oslo University, Department of Geography, were undertaken by the author on Gråsubreen, Jotunheimen (Fig. 1), during parts of June, July, and August 1963, in order to decide the relative importance to ablation of the radiation, conduction/convection, and condensation factors. Gråsubreen lies in the north-easternmost part of Jotunheimen and has the most continental climate and the highest firn line, c. 2100 m a.s.l. (T. KLEMSDAL 1964) of all glaciers in Norway. It is a small cirque glacier on the north-eastern slopes of Glittertind. Fig. 2 illustrates how the glacier surface slopes evenly down from about 2250 to 1875 m a.s.l.

The measurements

The meteorological observations were carried out together with measurements of ablation and the recording of in-coming short-wave radiation, at a station 1975 m a.s.l. (Fig. 2, point M). The measurements were taken between 12 and 18 June, and 27 July to 16 August 1963. In the calculations of the relative significance of radiation, conduction/convection, and condensation, the observations were divided into four periods (see Figs. 5 and 6). The reason for this division lies in the meteorological conditions. Between 10 and 16 August there was little ablation, changing weather conditions, and frequent snowfalls, such that the measurements during that period were unreliable.

During June 1963, the sinking of the snow surface was measured by use of 6 stakes and by 8 stakes during July/August. The stakes, which were bored 60–90 cm

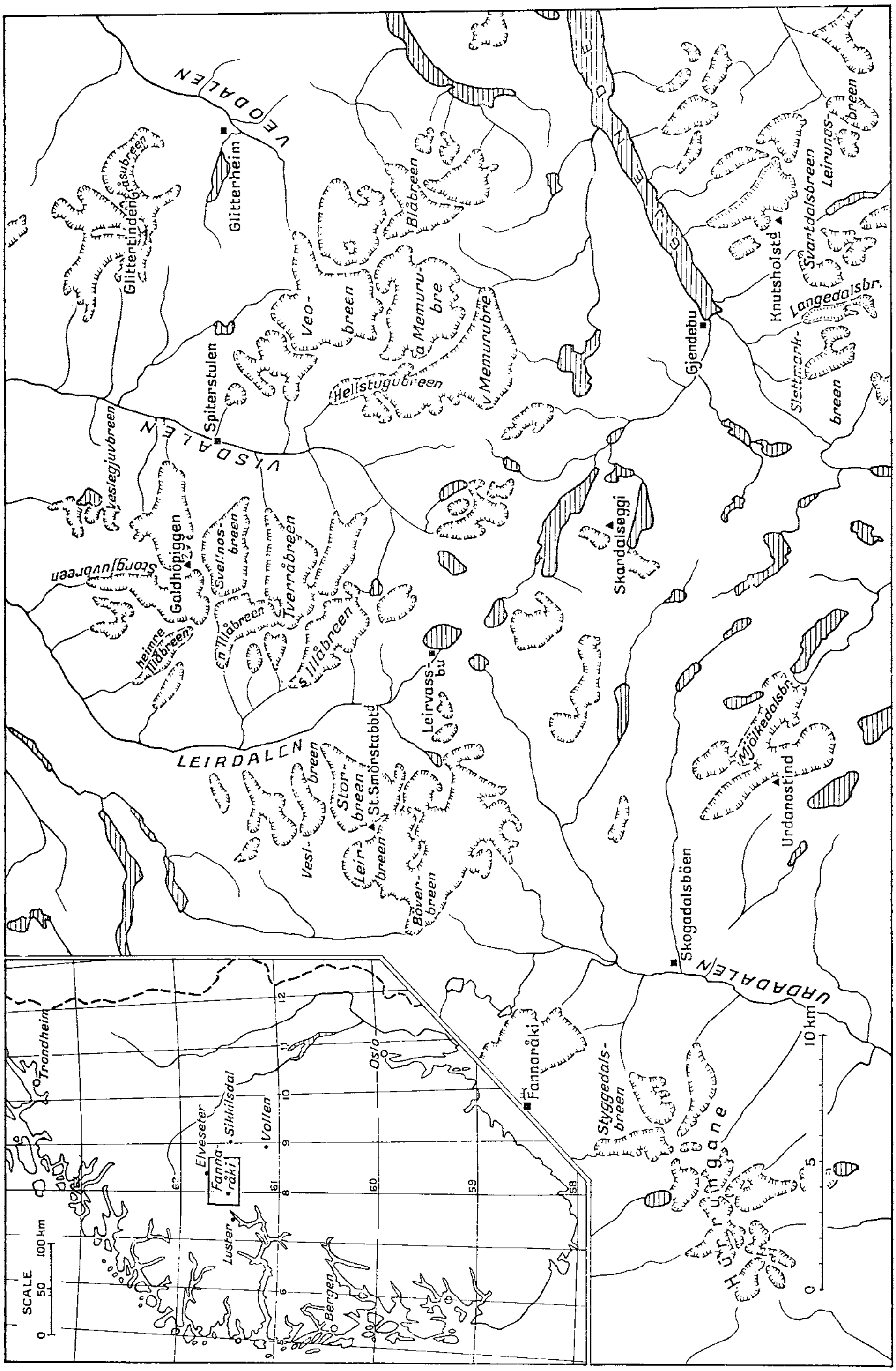

Fig. 1. *Map of the Jotunheimen area.*

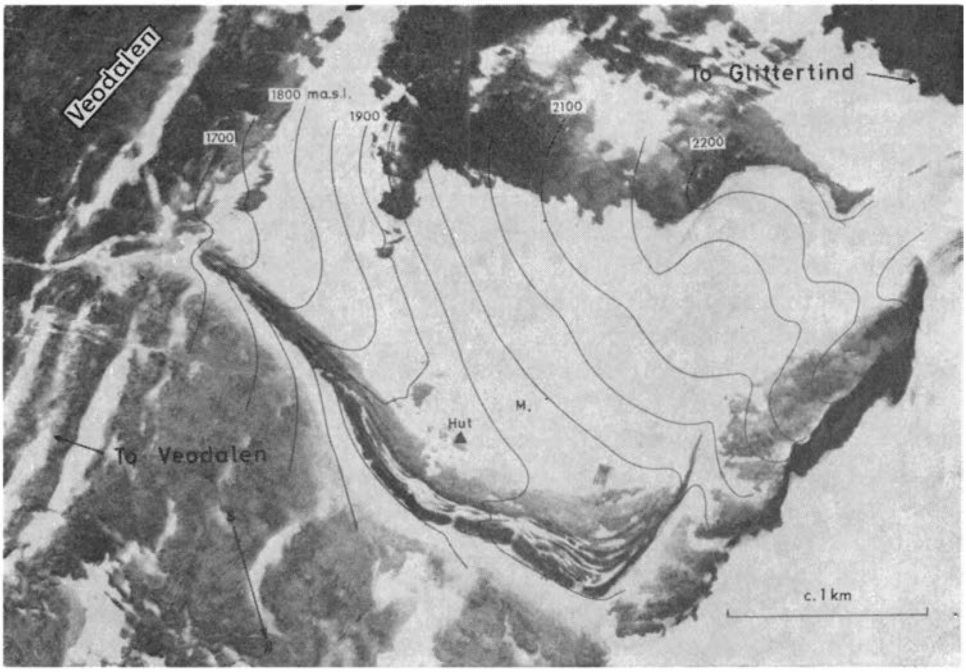

Fig. 2. *Air photograph of Gråsubreen with the meteorological observation point M shown.*

down into the ice, were placed round the meteorological instruments at a distance of about 15 metres. Bamboo stakes were chosen to reduce sinkage under their own weight which would affect the result. The measurements were taken every other hour during periods 3 and 4, and every third hour during periods 1 and 2. Each measurement was carried out in the same manner. A slotted, thin metal plate was placed on the surface and around the stake. Thence, the distance from the metal plate to a fixed point on the stake was measured. With this method the measurements were very reliable. Uncertainty and errors were made small by taking the mean of 6 or 8 stakes. The density of the snow layer was found to be 0.43 g/cm^3 in June, and 0.53 g/cm^3 in July/August. Fig. 5 shows the diurnal variation in ablation (averages for each interval of 2 hours) during the different observation periods. The ablation between 2200 and 0800 MET on the following day, is distributed over the night. The total ablation for each period is shown in Table 2. Concurrently with these measurements, the ablation was also observed on a series of aluminium stakes on both Gråsubreen and Blåbreen (Figs. 1 and 4). The results of these observations are shown in Fig. 3.

The global in-coming radiation was registered by a SIAP actinograph, which was set up with an east-west orientation of its black metal strip. The calibration of the instrument both before and after use was carried out by the owner, Norsk Polarinstitutt. From the recordings, the total in-coming short-wave radiation was read for intervals of 2 hours. The albedo was measured on a series of occasions, using a solarimeter. The results compare most agreeably with albedo measurements of others (C. C. WALLÉN 1948). The amount of short-wave radiation absorbed was calculated from the total in-coming short-wave radiation and the surface albedo (Table 2). Since an instrument for measuring long-wave radiation was unobtainable, this had to be calculated (see p. 63 and Table 2).

A thermohygrograph was placed in a well ventilated, white screen, 130 cm above the snow surface. Furthermore, the temperature and relative humidity were measured by an Assman psychrometer every other or third hour, according to the observation period. The measurements were made at a height of respectively 130 and 10 cm above the snow surface, and the 130 cm level measurements were used in the calibration of the thermohygrograph. By comparing the different temperature observations, and with the help of the thermohygrograph recordings, means of the air temperature and relative humidity were calculated for the 10 cm level during the different periods (Table 2). Furthermore, the number of degree-days were calculated for each 24 hour interval from the thermohygrograph recordings at a height of 130 cm. A degree-day is one degree multiplied by one day (24 hours). The mean temperature on days with positive temperatures only, is equal to the number of degree-days.

The wind velocity was measured at heights of 200 cm and 15 cm above the surface, and the readings were taken during two intervals of 5 minutes each, every other (or third) hour. The observations were made during day-time only, and the mean values (Table 2) are therefore presumably too high, since the wind strength is generally weaker at night. The wind direction was very constant. Only a few observations deviated from south or south-west.

The cloud cover (Table 2) was observed in tenths. The horizon round Gråsubreen is even, but the cloud height above the glacier is small, and it was difficult to determine the cloud cover in certain cases. The mean nocturnal cloud cover was put equal to the mean of the last two observations of one day and the first two of the next.

The theory

The heat balance equation for a melting snow surface is:

$$80H = aI - R \pm Q \pm Q_S \pm 600F \qquad (1)$$

where

- H is the total ablation in gm or cm of water, 80 cal/gm is the latent heat of fusion of snow and ice.
- I is the in-coming short-wave radiation from the sun and the sky.
- aI is the amount of in-coming short-wave radiation absorbed by the surface layer of the snow.
- R is the long-wave radiation balance.
- Q is conduction (+) or convection (–).
- Q_S is snow conduction. All the measurements on Gråsubreen were made above a melting snow surface, and as the temperature is 0°C in the upper layer, $Q_S = 0$.

600F is condensation (+) or sublimation (–) of water vapour on the snow surface. F is the number of grams of water which either condenses or sublimates at the snow surface.

The quantities R, Q, and F in formula 1 require a closer examination. It was not possible to measure the in-coming and out-going long-wave radiation. For a melting snow surface under a clear sky, the out-going is greater than the in-coming long-wave radiation, and the upper snow layer accordingly loses heat through this type of radiation. A. ÅNGSTRÖM (1915, 1916, 1918; C. C. WALLÉN 1948) found the following formula for the net long-wave radiation.

$$R_0 = \sigma \cdot T_0^4 \cdot (A + B \cdot 10^{\div \gamma e_0}) \qquad (2)$$

where σ is the Stefan-Boltzmann constant, which is equal to $8.23 \cdot 10^{\div 11}$, $A = 0.194$, $B = 0.236$, $\gamma = 0.069$, and e_0 is the observed water vapour pressure. For a melting snow surface, $e_0 = 4.58$ mm Hg and $T_0 = 273$. Thus $R_0 = 0.142$ cal/cm²/min. C. C. WALLÉN tested this constant and found a good correlation between the calculated and measured values. Other values for A, B, and γ have also been found, but calculations with different constants show little difference in the final result.

The net long-wave radiation is also dependent on the cloud cover, and A. ÅNGSTRÖM gives the following relationship:

$$R = R_0\, (1 \div \varkappa \cdot C) \qquad (3)$$

where C is the cloud cover in tenths, and $\varkappa$ is a constant equal to 0.09. C. C. WALLÉN tested this constant also, and found the correlation between calculated and observed value, and values from other observations, to be good. Thus, the long-wave radiation balance may be expressed as:

$$R = \quad \cdot T_0^4 \cdot (A + B \cdot 10^{\div \gamma e_0})\, (1 \div \varkappa \cdot C) \qquad (4)$$

On the basis of a comparison of the meteorological and topographical conditions on Gråsubreen with those on the Kårsa glacier, it seems reasonable to suppose that the formula for the negative long-wave radiation balance on the latter also applies to Gråsubreen. R is therefore dependent only upon the cloud cover above the melting snow or ice surface. From the observations of cloud cover, the long-wave radiation balance was calculated for 2 hours intervals, and also as a total for each period. The latter is shown in Table 2.

Conduction/convection ($\pm$ Q), condensation (+F), and sublimation (–F), were earlier calculated according to the following formulae (H. U. SVERDRUP 1935a, C. C. WALLÉN 1948):

$$F = A_* \frac{\partial f}{\partial z} \cdot T_* = A_* \cdot \frac{0.623}{p} \cdot \frac{\partial e}{\partial z} \cdot T_* \qquad (5)$$

$$Q = c_p \cdot A_* \frac{\partial t}{\partial z} \cdot T_* \qquad (6)$$

Here f is relative humidity, later expressed as q, z is the height above the snow surface, T_* is the time in seconds, p is the air pressure, e is water vapour pressure, c_p is the specific heat of air, and t is temperature. A_* is the eddy conductivity. The calculation of A_* from wind observations is time consuming. S. L. HESS (1959) has arrived at a simpler formula for A_*, and this is used here in the later calculations:

$$A_* = \rho \cdot k \cdot u_* \cdot z \tag{7}$$

where ρ is the density of the air, k is von Karmans constant, which has been determined by experiments equal to 0.38, u_* is friction velocity, and z is the height at which the measurements are made. The friction velocity can be determined by assuming that the wind speed is zero at a height $z_* \neq z_{00}$. The roughness parameter (z_*) is here taken to be 0.5 cm. It is usually accepted that the wind profile follows a logarithmic curve (S. L. HESS 1959)

$$u = \frac{u_*}{k} \cdot \ln \frac{z}{z_*} \tag{8}$$

The value for u_* which is determined from wind speed measurements is substituted in (7). Similarly $\rho/\rho_0 = p/p_0$, where p_0 is the normal air pressure at sea level, i.e. 760 mm, and p is normal air pressure at 2000 m a.s.l., i.e. 590 mm, when the temperature is 0°C at both levels. Thus (7) becomes

$$A_* = \frac{\rho_0 \cdot p \cdot k^2 \cdot z_{15}}{p_0 \ln \frac{z_{15}}{z_*}} \cdot u_{15} \tag{9}$$

The indices show that the measurements were taken at a height of 15 cm.

S. L. HESS (1959) and R. GEIGER (1961) give an expression for the transport of atmospheric property through a surface, the expression is:

$$T_q = \div A_{*z} \frac{\partial q}{\partial z} \tag{10}$$

This applies to sublimation from the snow surface, and is fully accordant with (5) when it is considered that F is the number of grams of water sublimated, and that (5) is calculated for the whole period. Using (5) and (9) and t_* as time in hours:

$$F = \frac{\rho_0 \cdot p \cdot k^2 \cdot z_{15}}{p_0 \cdot \ln \frac{z_{15}}{z_*}} \cdot u_{15} \cdot \frac{0.623}{p} \cdot \frac{\partial e}{\partial z} 3600\, t_* \tag{11}$$

where $\partial e = e_{10} - e_{00}$. The saturation pressure for water vapour on a melting snow surface (e_{00}) is 4.58 mm, and $\partial z = z_{10} - z_{00}$ where $z_{00} = 0$. Then we get:

$$F = \frac{\rho_0 \cdot k^2 \cdot z_{15} 3600 \cdot 0.623}{p_0 \cdot z_{10} \cdot \ln \frac{z_{15}}{z_*}} \cdot u_{15} \cdot (e_{10} - 4.58) \cdot t_* \qquad (12)$$

$$F = 2.43 \cdot 10^{-5} \cdot u_{15} \cdot (e_{10} \div 4.58) \cdot t_* \qquad (13)$$

Here, F is the number of grams of water that are sublimated if e_{10} is less than 4.58 mm, or condensed if e_{10} is greater than 4.58 mm.

From (6) and (9), conduction/convection to or from a snow surface becomes:

$$Q = c_p \cdot \frac{\rho_0 \, p \, k^2 \, z_{15}}{p_0 \ln \frac{z_{15}}{z_*}} \cdot u_{15} \cdot \frac{\partial t}{\partial z} \cdot 3600 \cdot t_* \qquad (14)$$

where $\partial t = t_{10} \div t_{00}$, with $t_{00} = 0°C$ in the melting snow surface, $z = z_{10}$ and $c_p = 0.24$ cal/°C/gram. Then

$$Q = 5.53 \cdot 10^{-3} \cdot u_{15} \cdot t_{10} \cdot t_* \qquad (15)$$

Formulae (1), (4), (13), and (15) plus the data of Table 2 are used in calculating the influence of radiation, conduction/convection, and condensation or evaporation.

The results

The ablation, as a function of height above sea level, was found from measurements at different points both on Gråsubreen and Blåbreen. The variation of ablation with altitude and with time is shown in Fig. 3. For all curves, with the exception of No. 4, ablation is calculated from the beginning of the ablation season to a known point of time (Table 1). Curve 4 represents ablation during the closing period of the ablation season in 1961 on Blåbreen.

Table 1

Length of the different ablation periods used in Fig. 3. The ablation from the beginning of the ablation season and to different dates (except No. 4). For Blåbreen A is below 1800 m a.s.l., and B is above 1800 m.

Blåbreen	days
1A 27.6.– 1.8. 1962	33
1B 4.7.– 1.8. 62	26
2A 27.6.–14.8. 62	47
2B 4.7.– 4.8. 62	31
3A 27.6.– 6.9. 62	97
3B 4.7.– 4.8. 62	31
4A 16.8.–15.10. 1961	60
4B 16.8.– 3.10. 61	48
5A 10.5.–29.7. 1963	80
5B 24.5.–29.7. 63	66
6A 10.5.– 2.8. 63	84
6B 24.5.– 2.8. 63	70
7A 10.5.–11.8. 63	93
7B 24.5.–11.8. 63	79

	days
8A 10.5.–10.9. 1963	123
8B 24.5.– 5.9. 63	104
3 is the total ablation 1962	
8 is the total ablation 1963	
Gråsubreen	
9 5.7.– 4.8. 1962	30
10 29.5.–31.7. 1963	63
11 29.5.– 6.8. 63	69
12 29.5.–13.8. 63	76
13 29.5.–25.8. 63	88
9 is the total ablation 1962	
13 is the total ablation 1963	

Table 2

Measured and calculated values for the different periods.

	1	2	3	4
Ablation (H measured) in cm water	3.0	3.8	7.0	20.3
Albedo A	64	64	54	54
Short-wave in-coming effective radiation aI, cal/cm^2	1032	345	991	1346
Long-wave out-going radiation R	444	71	572	587
Air temperature t_{10} °C	-1.8	0.2	1.2	2.9
Air humidity e_{10} mm	3.50	4.60	4.80	5.25
Wind speed u_{15} cm/sec	185	185	120	210
Cloud cover	5	8	3	8
S (aI–R) cal/cm^2	588	274	419	759
Q cal/cm^2	-147	7	81	807
F cal/cm^2	-233	2	33	492
S %	36	96.5	78.5	37.0
Q %	(25)	2.5	15.0	39.0
F %	(39)	1.0	6.5	24.0

In the summer of 1962, the weather conditions were not favourable for ablation processes, with the result that no glacier ice melted on either Gråsubreen or Blåbreen. On Gråsubreen, the ablation season lasted only 30 days, and curve 9 shows how the ablation decreased evenly with altitude, or in other words, with decreasing air temperature. The variation at certain levels was small, which can be attributed to the small ablation and the fact that no glacier ice melted out. The results from Blåbreen show some deviation from the even decrease in ablation with height. The measurements between 1700 and 1750 m a.s.l. show a greater ablation than was to be expected from the measurements above and below the area. The same ablation pattern occurred in 1963 (curves 5, 6, 7, and 8), and in addition it appeared that the lowest area, around 1650 m a.s.l. had a smaller ablation than that higher up the glacier. The explanation of the latter must be, that the area below about 1650 m a.s.l., i.e. the snout, faces east and is steep, such that the in-coming short-wave radiation is less than it is higher up (Fig. 4). The reason for greater ablation between 1700 and 1750 m a.s.l. is presumably the glacier's environment. A steep east-west orientated mountain-side lies on the north side of the glacier. This emits long-wave radiation, which is absorbed by the adjacent glacier surface. Therefore, the surface receives more long-wave energy than does a glacier like Gråsubreen, which is not surrounded by such mountain sides. The result will be that the surface of Blåbreen in the proximity of the mountain side receives an extra transference of energy, which leads to greater ablation than in the other areas on the glacier. This distribution appears clearly on the 1963 ablation map of the glacier (Fig. 4). This shows an ablation of 300 cm of water in a zone about 1750 m a.s.l., while the ablation decreases rapidly away from the valley side. This ablation pattern also occurred in the summer 1962, despite the small amount.

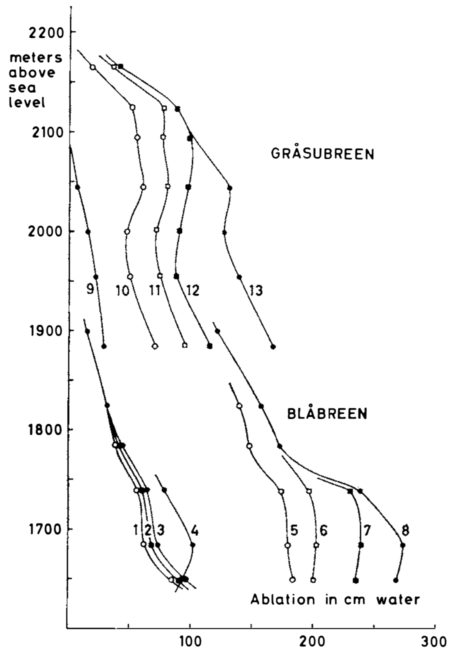

Fig. 3. *Ablation in cm water from the start of the ablation season to different dates (except No. 4, see Table 1).*

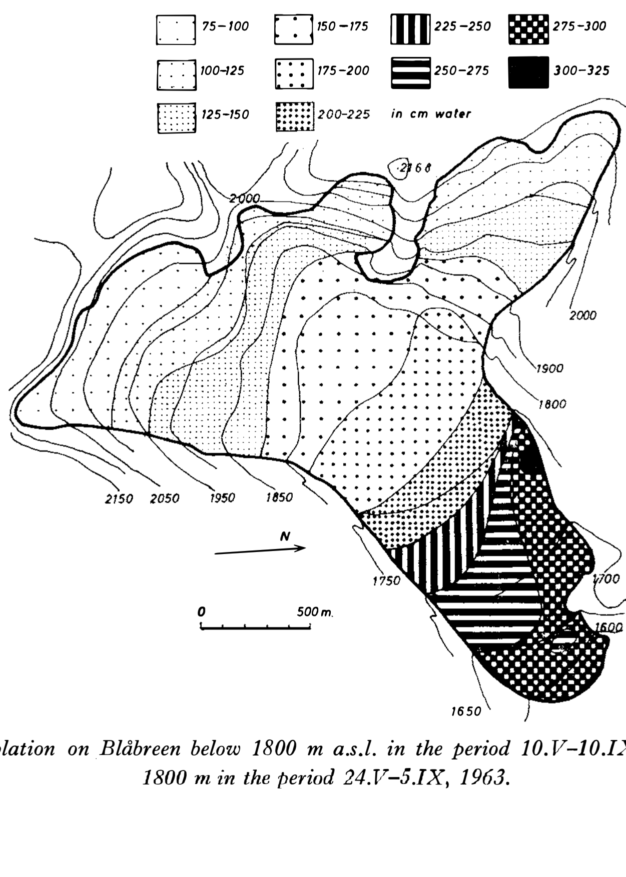

Fig. 4. *The ablation on Blåbreen below 1800 m a.s.l. in the period 10.V–10.IX, 1963 and above 1800 m in the period 24.V–5.IX, 1963.*

If the results of the ablation seasons in 1962 and 1963 are compared (Fig. 3), a marked difference between the ablation above and below 1700 m a.s.l. appears during both seasons. In the summer of 1962, there was snow over the whole glacier and thus the same albedo all over the snow-covered glacier, while in 1963 the snow remained only above 1800 m a.s.l. at the end of the ablation season. Therefore, in the lower areas, a greater amount of short-wave radiation was effective in ablation than higher up the glacier. The result was a more varied ablation pattern with height.

The same result applies to Gråsubreen (curves 10, 11, 12, and 13), but here the pattern is different from that of Blåbreen. It appears that the area between 2050 and 2150 m a.s.l. had a relatively large ablation. The reason for this was that the area had the least accumulation, and glacier ice appeared there first, such that the albedo became less and the ablation increased. From curves 10 and 13 it appears that this differential ablation began early in the season, and that the difference in ablation rate between the 2050–2150 m belt and the area below it became less as the season progressed. Towards the end of the season, glacier ice also melted out on the lowest parts of the glacier; and since the ablation season lasted a few more days, this area had a greater ablation than those higher up the glacier.

Diurnal variations in ablation were only measured on Gråsubreen, and the result is shown in Fig. 5. During the first two observation periods, ablation began at 0400 MET and continued until about 2200 MET, while in the last periods ablation also occurred during the night. The great nocturnal ablation during the last period is of special note. The ablation variation throughout the 24 hours is marked, with little or none at night, and a considerable ablation during the day with a maximum between 1200 and 1400 MET. The ablation during this 2 hour interval for period 1 was 1.5 mm of water, which is a relatively low value in comparison with 3.8 mm for period 2. During periods 3 and 4, the maximum ablation were respectively 3.3 mm and 2.5 mm of water. The ablation in period 1 was 0.9 cm of water/day, while it was 1.9, 1.9 and 2.0 cm/day in the last three periods.

Period 1. – This period lasted 96 hours; but in the calculations 80 hours are assumed, since there was a period at night when no ablation occurred. The cloud cover was 5, and the mean value for the air temperature 10 cm above the snow surface was –1.8°C, while the relative humidity, which was 86%, gave a mean water vapour pressure of 3.50 mm. The meteorological conditions were, therefore, favourable to evaporation and conduction/convection from the snow surface to the air above. The calculations give an evaporation of 0.389 g, which required 233 cal/cm^2 during the period, while conduction/convection accounted for 147 cal/cm^2. The total amount of heat transmitted to the snow surface by radiation was 588 cal/cm^2 over the period, of which 208 cal/cm^2 was used to melt the snow.

Of the radiation energy, 36% contributed to melting, 25% was used in conduction/convection from the snow surface to the air above, and 39% was utilized in evaporation. In other words, the ablation during the period was due to radiation

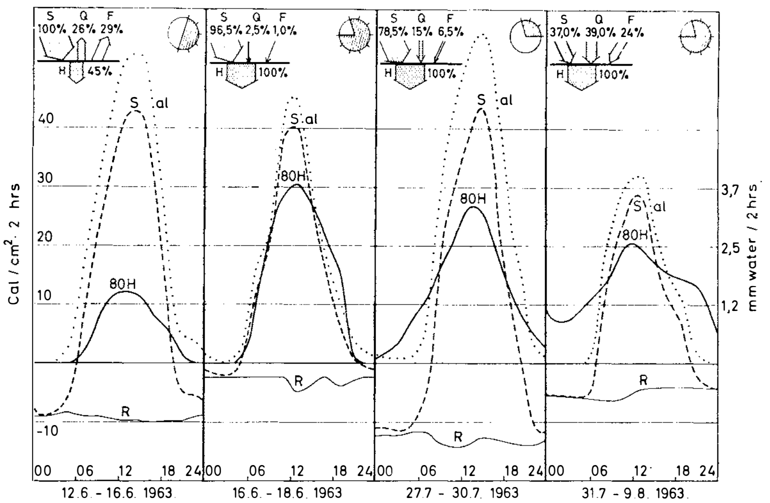

Fig. 5. *Diurnal variations in the ablation, the effective in-coming short-wave radiation, and the radiation balance for the different periods. The shaded part of the circle represents the cloud cover. H is the ablation, in period 1 H is the sum of melting and evaporation. Curve 80H can be read against both the vertical scales to show either ablation in mm water (H) or latent heat of fusion of snow (80H).*

alone. This is shown in Fig. 5, where the diurnal variations in the ablation curve follow the positive parts of the curve for the radiation balance.

Period 2. – The wind conditions during the first two periods were the same with a speed of 185 cm/sec; but in the second period, the air temperature was near to 0°C, with a mean value of 0.2°C. This temperature and a relative humidity of 97%, i.e. a water vapour pressure of 4.60 mm, produced heat transference by conduction/convection from the atmosphere to the snow surface, and also condensation. The total value for these factors was low. Condensation released 2 cal/cm² or 1.0%, and conduction/convection 7 cal/cm² or 2.5% of the total ablation. The rest, 96.5% or 274 cal/cm² resulted from radiation. Despite the high cloud cover, 8, radiation was of great importance during this period, as a result of the special temperature and humidity conditions.

Period 3. – Owing to the low cloud cover of 3 during this period, the incoming and out-going radiation were great (see Figs. 5 and 6). The air temperature 10 cm above the snow surface had risen to a mean of 1.2°C. With a relative humidity of 93%, the water vapour pressure was 4.80 mm. The conditions were now more favourable for conduction/convection and condensation. The latter contributed 33 cal/cm² or 6.5% of the total heat necessary to the ablation. For conduction/convection, the figures were respectively 81 cal/cm² and 15.0%. That radiation was responsible for 78.5% of the ablation, was the result of low cloud cover. Conduction/convection and condensation increased in importance by comparison with the earlier periods as a result of the higher air temperature

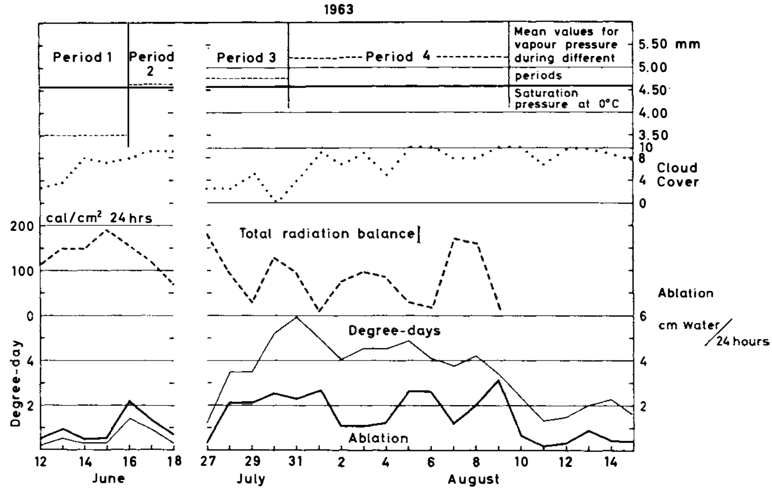

Fig. 6. *The variations in cloud cover, radiation balance, number of degree-days, and ablation on Gråsubreen in parts of June, July, and August 1963.*

and humidity. Fig. 6 shows clearly that the ablation was no longer directly dependent upon radiation, but there is a good correlation between the total number of degree-days and the ablation for each day of the period.

Period 4. – During this period, which consisted of 240 hours, the measurements were made over a snow surface for the first 6 days and over an ice surface for the last 4 days. There sometimes occurred a large ablation at night. The temperature (at the 10 cm level) was relatively high, 2.9°C, the cloud cover was equal to 8, the relative humidity was 93% with a water vapour pressure of 5.25 mm. The conditions were accordingly favourable to conduction/convection and condensation, which were responsible respectively for 39 and 24% of the ablation, while radiation produced only 37% as a result of the high cloud cover, air temperature, and relative humidity. The ablation's independence of radiation and its dependence upon the air temperature are shown in Figs. 5 and 6.

It was during this period that a great difference occurred between the measured and the calculated values for ablation, with the latter as the greater. An important reason must be that the mean value for the wind speed is too large. If the wind speed was reduced by about 0.5 m/sec, the measured and calculated values for the ablation would agree well. The mean wind speed is calculated from measurements obtained at daytime, with very few observations during the nights. The wind speed by night is, as a rule, weaker than that of the day; therefore, the mean wind speed for the periods may be somewhat too high. This reduction, however, would somewhat displace the relative importance of the factors: radiation from 37 to 45%, conduction/convection from 39 to 33%, and condensation from 24 to 22%.

During June, radiation was the only heating agent of any importance. The difference between the first two periods in respect to conduction/convection and evaporation/condensation was due to the fact that the air temperature and humidity rose from the first to the second period. The ablation was greater in period 2 than in period 1, the reason being that the conditions were no longer conducive to evaporation, so that a greater amount of radiation energy contributed to melting. In July and August, the conditions had changed. The air temperature and humidity had risen. Heat transfer occurred through conduction/convection and condensation, such that the contribution of radiation was comparatively reduced. In period 3, which had a low cloud cover, radiation was of relatively great importance, c. 80%, while in period 4 with a high cloud cover, the percentage was only c. 40. In June there was a good correlation between ablation, radiation, and the number of degree-days (Fig. 6). Furthermore, at this time there was a small number of degree-days per 24 hours as a result of the low temperature, and conduction/convection and condensation were of little importance. Towards the end of the ablation season, in July/August, there was a good correlation between the number of degree-days and the ablation, while the radiation in August varied almost in contrast to the ablation. The number of degree-days per 24 hours in July/August was greater than in June, while conduction/convection and condensation had increased in importance.

From the description of the four periods, it appears that the importance of radiation decreases, while that of conduction/convection and condensation increases throughout the ablation season, with increasing cloud cover and number of degree-days.

Comparison with other observations

A comparison with observations from other glaciers is difficult, since the results from the different periods on Gråsubreen show great variations in the importance of the different factors because of variable weather conditions. Furthermore, the height above sea level and the location of the observation station are of vital importance to the results. Whether the observations have been made over snow or ice must also be considered; and it is important to remember that the results are mean values for the whole or part of the ablation season. If one is aware of these limitations in the results, then a simple comparison may be made from Table 3.

There are no results comparable with those obtained on Gråsubreen during the first two periods. This is due to the special weather conditions, and also that in other research the individual periods have not been defined and measurements made so early in the ablation season.

The results for August are similar to those obtained for the Kårsa glacier in northern Sweden (C. C. Wallén 1948), Hornkees in the Austrian Alps (H. Hoinkes 1953), and Leirvåg on the east coast of Greenland (B. E. Eriksson 1942), Barnes Ice Cap (W. H. Ward and S. Orvig 1953), and the Penny Ice Cap on Baffin Island (S. Orvig 1954).

On the whole, the contribution of radiation increases with decreasing latitude,

Table 3

Results from other investigations and from Gråsubreen of the relative importance of radiation, conduction/convection, and condensation. These are mean values for the observation period, but those marked are mean values for periods in August. For Gråsubreen, the results are divided into three groups.* 1) *mean values of measurements made in June,* 2) *mean values of measurements made in July/August, and* 3) *mean values of all measurements. The results for "Sveanor" and Leirvåg have been calculated from measurements over an isolated snow-patch and not over glacier snow.*

Place	Position h.a.s.l.	Time	S	Q	F	Remarks
Isachsenfonna (Isachsens Platå)	79°09′N 12°56′E 870 m	26.6.– 15.8. 1934	33* 56.0	40* 29.0	27* 15.0	Snow on glacier H. U. SVERDRUP 1935a
"Sveanor"	79°56′N 18°18′E 5 m	30.6– 6.8. 1931	1* 24	69* 59	30* 17	Isolated snow-patch H. U. SVERDRUP 1935a
Fjortende Julibreen (14th of July Glacier)	79°08′N 12° E –	31.5.– 31.8. 1934	40 47 55	60 53 } + Conden-sation 45		0 m 600 m } H. U. SVERDRUP 1935a 900 m
Frøyabreen	74°24′N 20°50′W 543 m	1.8.– 18.8. 1939	8*	83*	9*	Snow B. E. ERIKSSON 1942
Leirvåg	(74°24′N) (20°50′W) 5 m	1.8.– 18.8. 1939	52*	34*	14*	Isolated snow-patch B. E. ERIKSSON 1942
Hoffellsjøkull	64°30′N 15°30′W 100 m	April– October 1936	8* 14.0	92* } + Conden sation- 86.0		Ice H. W. AHLMANN and S. THORARINSSON 1938
Kårsaglaciären	68°20′N 18°20′E	August 1942– 1948	55* 32*	29* 44*	16* 24*	<1000 m a.s.l. Ice >1000 m a.s.l. Snow C. C. WALLÉN 1948
Vernagtferner	46°50′N 10°45′E 2000 m	11 days August 1950	81*	15*	3.5*	Rain H. HOINKES und N. UNTERSTEINER 1952
Hornkees	c. 47°N c. 12°E 2260 m	3.9.– 9.9. 1951	58	29	12.5	Rain H. HOINKES 1953
Barnes Icecap	69°43′N 72°13′W 866 m	25.6.– 4.8. 1950	68	32 + Conden-sation		Snow W. H. WARD and S. ORVIG 1953
Penny Icecap	66°59′N 65°28′W 2050 m	13.7.– 26.7. 1953	61	9	30	Snow S. ORVIG 1954
Storbreen	61°34′N 8°05′E		55	35	15	O. LIESTØL 1961
Gråsubreen	61°39′N 8°35′E 1975 m	1 2 3	98.5 59.5 79.0	1.0 26.5 14.0	0.5 14.0 7.0	Snow } } 10 days snow } } 4 days ice

while conduction/convection and condensation are of greater importance in higher latitudes (H. W. AHLMANN 1953). The local climate of course modifies this picture. On glaciers in regions with continental climate, such as Barnes Ice Cap, The Penny Ice Cap, Vernagtferner, Hornkees, Storbreen, and Gråsubreen, radiation has a greater importance than conduction/convection, and condensation. On an east-west profile across South-Norway, over Gråsubreen, Storbreen, Jostedalsbreen, and Ålfotbreen (Fig. 1), glacial-meteorological observations have been made only on Storbreen and Gråsubreen, i.e. on the eastern part of the section. Despite the short distance between these two glaciers, the results show a tendency towards an increased importance of radiation and a decrease in the importance of conduction/convection and condensation from west to east. The degree of maritime climate increases westward, and research in West-Norway will presumably give values for the different factors comparable with the results from Hoffelsjøkull in Iceland (H. W. AHLMANN and S. THORARINSSON 1938). Contemporaneous and more detailed studies of the glaciers along this profile should be a task for the future.

Acknowledgements

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Some observations of the ice drift in the East Greenland Current

BY
TORGNY E. VINJE

Information on the ice drift in the East Greenland Current (EGC) is sparse, and from the great variation in the records obtained (cf. KOCH 1945, p. 145) it follows that there is a need for more systematic speed measurements. Satellite pictures now offer the possibility of tracing giant floes in this area, and this is very promising. In addition to the information obtained from satellite pictures, some observations obtained by a Norwegian sealer will be given below.

In Fig. 1 is shown the drift of the sealer «Polarbjørn» which was beset NW of Jan Mayen for 22 days during April 1969. This information was kindly given to the author by Captain B. BRANDAL. The captain also reported that there was relatively little drift in the ice this year, and that this might be due to the fact that the polar floes had been consolidated. This consolidation took place in connection with a long period of cold weather, between April 4 and 25, with temperatures falling to –20°C.

As can be seen from Fig. 1, the drift is very irregular, and this accords with the variability shown by the currents in this area. The total displacement is, however, towards SW and the average speed is 5.2 km/24 h. According to the weather reports, the drift is to a great extent determined by the wind speed. The maximum speed towards the NE, 30 km/24 h, was recorded between April 19 and 20 in connection with a wind of 15–20 kts from the SW. Between April 11 and 12, NNE winds (15–20 kts) caused a drift towards the SSW at a speed of 25 km/24 h. As the ice border is found towards the NE, it is possible that a retarding effect, on the drift towards the SSW, is caused by the packing of the ice.

In Figs. 2 and 3 some drift speed values obtained from the identification of giant floes on the American ESSA satellite pictures are shown.

Fig. 2 shows the average drift for the period May 3–30, 1969. The figure indicates the well-known increase in speed as the drift ice leaves the Polar Basin. The average drift based on all observations, except the most northern one, is 9.2 km/24 h. This is in good agreement with the average value estimated from the budget calculations made by MOSBY (1963), namely 8.6 km/24 h. It is also noted that the greatest velocities are observed near the continental slope. And this is in fair accordance with the dynamical calculations and observations of sea currents represented by KIILERICH (1945, pl. 3). However, all the current speeds given by

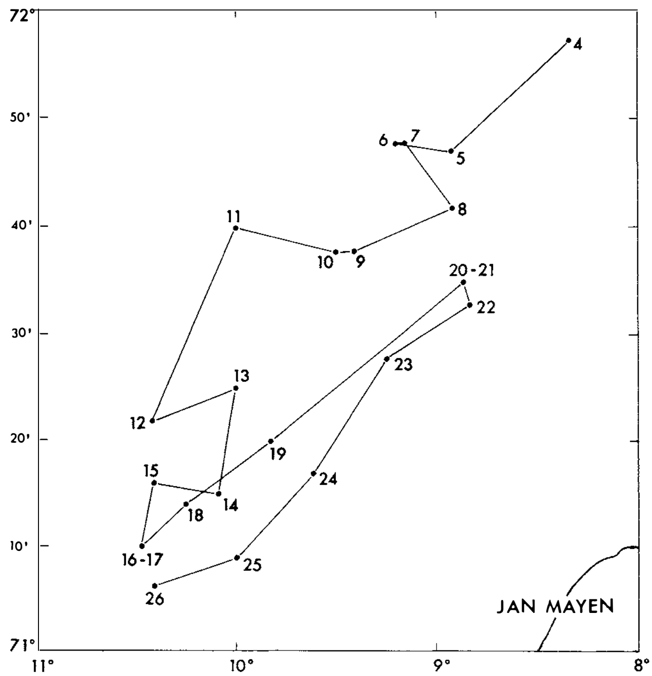

Fig. 1. *The drift of the sealer «Polarbjørn» in April 1969. The dates are noted at each position which is determined with the aid of LORAN.*

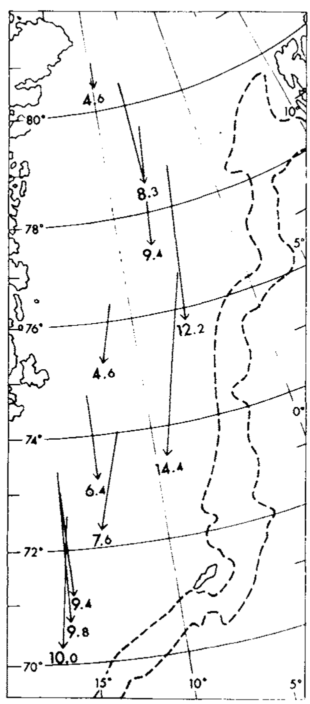

Fig. 2. *The average speed of floes in km/24 h between May 3 and 30, 1969. The maximum and minimum extension of drift ice during May is stipulated. Determined from ESSA satel. pictures.*

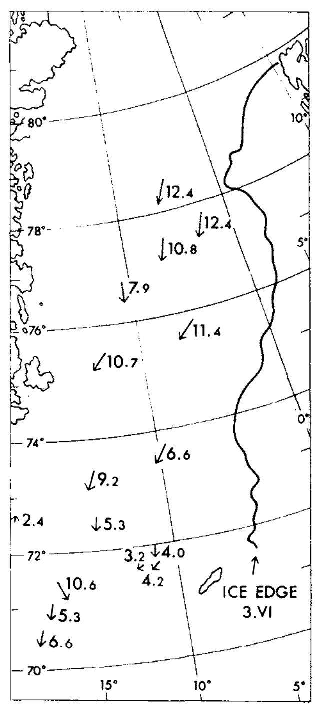

Fig. 3. *The average speed of floes in km/24 h between May 30 and June 3, 1969. Determined from ESSA satellite pictures.*

by KIILERICH are in general considerably higher than the ice drift speeds obtained from the ESSA sattelite pictures.

In January 1938 PAPANIN on «North Pole I» observed a drift speed of about 22 km/24 h at about 77°N and 13°W. During four days in 1962, March 25 to 28, a ship was beset off Scoresbysound, and Captain B. BRANDAL reports a drift from NNE of about 20 km/24 h at about 70.5°N 17°W. During February 1965 «Arlis II» had a drift speed of about 15 km/24 h in the EGC north of 73°. (Cf. SCHINDLER 1968.) Observations obtained from satellite pictures during a period of 11 days, between April 8 and 19, 1968, show a speed of 17.3 km/24 h between 77 and 79°N and between 2 and 6°W (VINJE 1969). As can be seen, the drift speeds obtained for May 1969 (Fig. 2) are generally considerably smaller.

Fig. 3 shows some drift speeds based on a four-day average, between May 30 and June 3, 1969, and was also obtained from the ESSA satellite pictures. The average speed for this period, based on all observations, except the one closest to the coast, is 8.0 km/24 h. This is in fair accordance with the average values given above.

Due to increasing cloudiness, as well as disintegration of the ice in the EGC, it was later in the season difficult to obtain as many drift speed values as in May. In Table 1 is given some additional observations for 1969.

Table 1

Position	Speed km/24 h	Drift from	Period
77N 08W	5.6	NNE	16.VI–20.VI
75N 11W	5.6	NNW	–»–
77N 08W	6.8	NNE	20.VI– 3.VII
74N 17W	9.2	NNE	20.VI– 8.VII

From the displacements given in Fig. 2 it has been calculated that a divergence of 10^{-7} sec^{-1} occurs in the considered area north of 74°N, and that a covergence of the same order of magnitude occurs south of this paralell. And this change from divergence to convergence is in accordance with the decrease in breadth of the drift ice stream in the Jan Mayen area. The calculated divergence should cause a growth of new openings corresponding to about 20% of a given area per month. This relatively high divergence may be supported by the observations made under the project «Birds Eye», which show that there is much greater quantities of new ice in the EGC than was previously believed (WITTMAN and SCHULE 1966). It is reported that between 26 and 52% of the ice in the EGC is new ice, depending upon the season of the year. It must be expected that much of this new ice is formed in the EGC in areas where divergence occurs. Therefore, when making estimations of the amount of ice which leaves the Polar Basin through the EGC, it is important to know the conditions in the Fram strait, (between Spitsbergen and the NE coast of Greenland). From Fig. 2 it can be seen that the speed is about 5 km/24 h at about 81°N and 8–10°W. This figure may be compared with that observed in the same area on «North Pole I», namely 10 km/24 h (PAPANIN, p. 184). A similar drift speed from NNE of 10.7 km/24 h was observed from the ESSA satellite pictures in the period April 8–19, 1968, in this case, at about 80.4°N and *5°E* (VINJE 1969). This comparison shows that there may be a great variability either in the drift speed or in the position of the core of the ice stream in this area. The position of this core is of greatest importance for the ice conditions north of Svalbard. And the relatively bad ice conditions north of the archipelago during the summer 1968 (VINJE 1970) supports the possibility of a more easterly position this year.

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Namnebrigde på Svalbard

(Change of name in Svalbard)

(Об изменении названий на Свальбарде)

Av

SIGURD G. HELLE

Abstract

Norwegian authorities have in 1969 accepted a proposal made by Norsk Polarinstitutt for a change in the use of two main place-names of Svalbard – *Spitsbergen* and *Vestspitsbergen.* According to this change, the latter, previously being the official name of the largest island of the archipelago, is now disused and replaced by the former (Spitsbergen), which is no longer to be used in its previous meaning – all islands of Svalbard except Bjørnøya, Hopen, Kong Karls Land, and Kvitøya. This part of Svalbard will no longer have a common name.

Резюме

В 1969-ом году норвежские власти одобрили предложение Норвежского Полярного Института (Norsk Polarinstitutt) о применении названия Spitsbergen (Шпицберген) к главному острову архипелага Svalbard (Свальбард), ранее называвшемуся Vestspitsbergen (Западным Шпицбергеном). Последнее название употребляться больше не будет, так же как и название Шпицберген для той части Свальбарда, которая не включает в себя острова: Bjørnøya (Медвежий), Hopen (Надежды), Kong Karls Land (Земля Короля Карла) и Kvitøya (Белый). Таким образом эта часть Свальбарда остается безыменной.

Etter framlegg frå Norsk Polarinstitutt har Industridepartementet i brev dagsett 10. juni 1969 godkjent brigde i bruken av to viktige stadnamn på Svalbard – *Spitsbergen* og *Vestspitsbergen.*

Figurane viser heile Svalbard, som var og framleis er namnet på alle øyane mellom 74° og 81° n. br. og mellom 10° og 35° a. l. Før brigdet i namnebruken femnde Spitsbergen om alle øyane på Svalbard med unnatak av Bjørnøya, Hopen, Kong Karls Land og Kvitøya (Fig. 1). Reint morfologisk var namnet dekkjande berre for Prins Karls Forland og delar av Vestspitsbergen, den største øya på Spitsbergen.

Svalbard, Spitsbergen og Vestspitsbergen har lenge vori offisielle namn på veldefinerte område, men trass i dette hadde mange – og då særleg utlendingar –

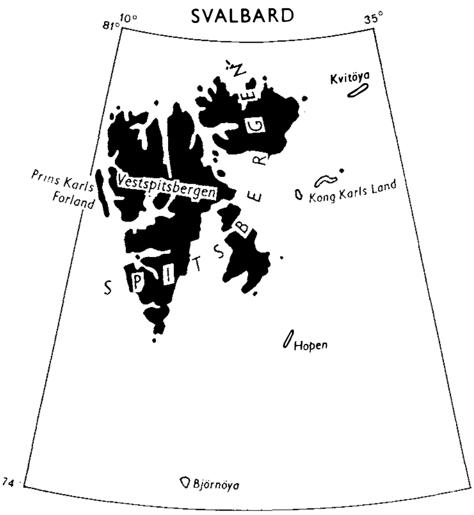

Fig. 1. *Spitsbergen før brigdet i namnebruken.*
Spitsbergen as used previously.
Раньше называвшаяся
Шпицбергеном часть Свальбарда.

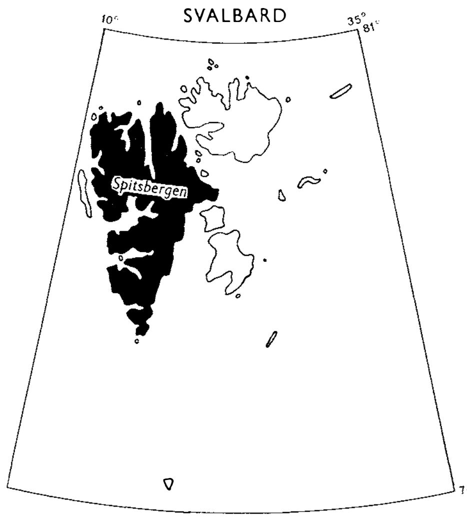

Fig. 2. *Spitsbergen etter brigdet i namnebruken.*
Spitsbergen as used now.
Теперь называющаяся
Шпицбергеном часть Свальбарда.

ein sterk tendens til å bruka ymse former av namnet Spitsbergen når dei meinte heile Svalbard – mogeleg med unnatak av Bjørnøya, som ligg så isolert. Samstundes bruka andre same namnet, Spitsbergen, når dei berre meinte Vestspitsbergen. Det siste var kan henda mest utbreitt mellom nordmenn med ufullstendig kjennskap til kva namnet stod for. Spitsbergen vart såleis stundom bruka i for vid og stundom i for trong tyding. I tillegg kom at mange som visste kva det offisielt meintest med Spitsbergen, ikkje hadde bruk for namnet for di det fall meir naturleg å nemna anten heile Svalbard eller berre einskildøyar i området.

Norsk Polarinstitutt tok konsekvensen av dette og rådde Industridepartementet til å gjera øygruppa som bar namnet Spitsbergen, namnlaus, og samstundes overføra dette namnet til den største øya i same gruppa – og på Svalbard i det heile (Fig. 2). Dermed fall namnet Vestspitsbergen – som er heller tungt – bort.

Framlegget vart som nemnt godkjent, og det er å vona at både namnet Svalbard – med same tyding som før – og namnet Spitsbergen – med den nye tydinga – kan verta bruka rett og konsekvent i skrift og tale heretter både av dei som arbeider på Svalbard, og av alle andre som nemner desse stroka.

Litteratur

NORGES SVALBARD- OG ISHAVS-UNDERSØKELSER, 1942: The Place-Names of Svalbard. *Skrifter om Svalbard og Ishavet.* Nr. 80. Oslo.

Glasiologiske undersøkelser i 1968

(Гляциологические исследования в 1968-ом году)

AV

OLAV LIESTØL

Abstract

Norsk Polarinstitutt carried out mass balance measurements on five glaciers in the budget year 1967–1968: on Storbreen, Hardangerjøkulen, and Omnsbreen, all in southern Norway, and Austre Brøggerbreen and Lovénbreen in Spitsbergen. The results are listed in Table II, together with the results from the glaciers measured by Norges Vassdrags- og Elektrisitetsvesen. The energy balance on the surface of Omnsbreen was measured from June 3 to September 9. On the average 50% of the ablation was due to radiation, 34% to heat supply by convection, and 16% to condensation.

Ice front varations were measured for twelve glaciers; eight were retreating and four were advancing. (See Table III.)

Storbreen 1967–1968

På Storbreen ble akkumulasjonen målt under en tur til breen 9.–10. mai. Bare 5 av målestengene var synlige p.g.a. de store snømasser. Disse var imidlertid fordelt jevnt over hele høydeintervallet. På samme måte som året før ble selve akkumulasjonsmålingene foretatt ved sondering på 2 representative områder, ett i ca. 1630 m h. og et annet i ca. 1850 m h. På grunnlag av tidligere års omfattende og nøyaktige målinger har man funnet en meget god korrelasjon mellom disse områder og den totale akkumulasjon på hele breen. Arbeidet med akkumulasjonsmålingen blir på denne måten betraktelig redusert. Den beregnede verdi av akkumulasjonen med tillegg av snø som falt etter at målingene ble tatt, ble 1,62 m.

Ved siste besøk på breen 18. oktober ble samtlige stenger funnet intakt. Man hadde ikke behøvd å bore om noen av stengene. Beregningen av ablasjonen ble derfor meget enkel. Verdien for ablasjonen som ble funnet til 1,56 m, er over normalen, men p.g.a. den store akkumulasjon ble likevel balansen positiv, nemlig +0,06 m. Usikkerheten i målingene er beregnet til litt under ±10 cm. Man kan derfor si at breen i dette år praktisk talt var i balanse. Se Fig. 1 og 2. De siste års materialoverskudd har gjort at breen har øket i tykkelse i de øvre områder. Overskuddet har imidlertid ikke rukket å forplante seg ned under firngrensen, slik at bretungen fremdeles er på retur.

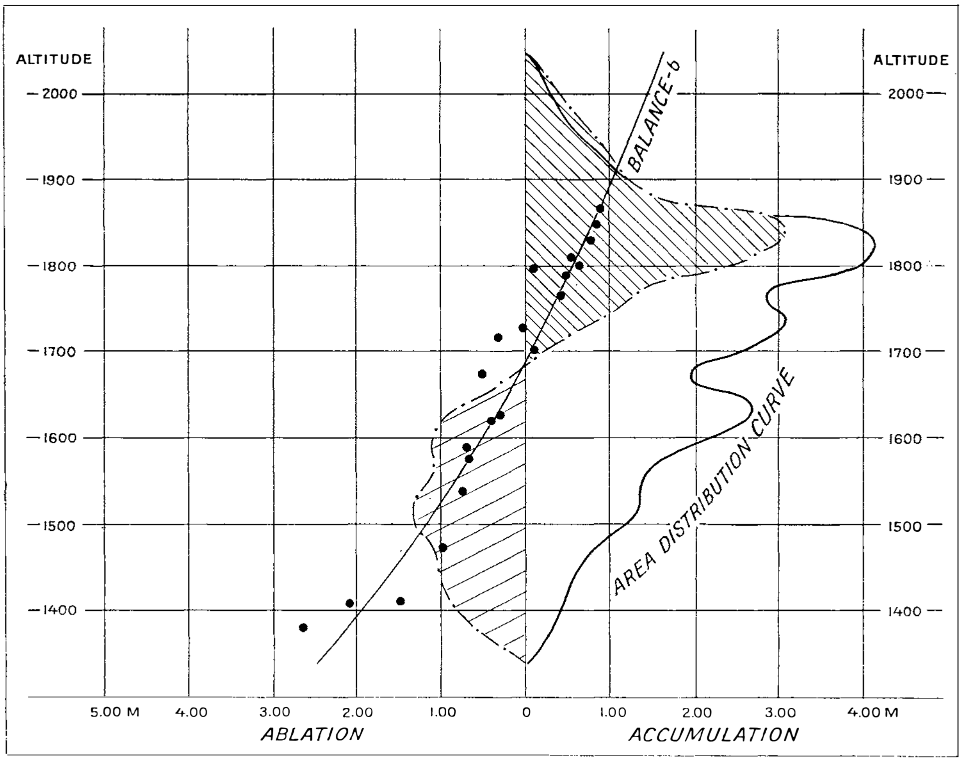

Fig. 1. *Variasjon av akkumulasjon, ablasjon og balanse på Storbreen 1967–68 i forhold til høgd over havet.*

Variation in accumulation, ablation and balance on Storbreen 1967—68 in relation to height above sea level.

Вариация аккумуляции, абляции и баланса ледника Storbreen в 1967-68 гг. по отношению к высоте над уровнем моря.

Hardangerjøkulen 1967–1968

Akkumulasjonen på Hardangerjøkulen ble usedvanlig stor vinteren 1967—68. Været gjorde det vanskelig å komme opp på breen og få skjøtt på ablasjonsstakene før de fleste var nedsnødd. Et forsøk ble gjort 10. januar, men ble mislykket p.g.a. værforholdene. Et nytt forsøk ble gjort 2. februar; 5 stenger ble da funnet og nye stenger forsøkt plassert i de nedsnødde stengers posisjon. Stengene ble kontrollert 19. februar og 24. februar, og igjen 30. april til 1. mai. Ved den siste turen ble akkumulasjonsmålingene foretatt. Vanlig sondering i de øvre områder var så å si umulig å få gjennomført p.g.a. den store snødybden. Et islag i ca. 150 cm over fjorårets overflate gav imidlertid god støtte til målingen. Etter hvert som de nedsnødde staker kom fram utover sommeren, ble også disse ved interpolasjon brukt til beregning av akkumulasjonen. Etter 5 års målinger er også snøens fordelingsmønster blitt ganske godt kartlagt. Det viser også som antatt å holde seg meget stabilt fra år til år. Stakeobservasjonen alene vil derfor etter hvert kunne brukes til å bestemme akkumulasjonen. Siste akkumulasjonsmåling ble foretatt 17. mai. Akkumulasjonen etter denne dato er beregnet ut fra meteorologiske observasjoner på nærliggende stasjoner. Fig. 4 viser den totale akkumulasjon på Rembesdalsskåki 1967–68. I forhold til tidligere år viser akkumulasjonskurven et meget steilere forløp med mindre snømengde nederst og større øverst. Snødybden i den sentrale del av breen i 1750 m h. kom opp i over 6 m. Denne store forskjell skyldes at de store nedbørsmengder i oktober og november delvis falt som regn i de lavere områder.

To studenter var engasjert i målingen av ablasjonen. De holdt til i brehytta fra begynnelsen av juli til slutten av august. Ved siden av de rutinemessige målinger ble en stakerekke på 7 stenger fordelt i høydeintervallet fra 1675 til 1810 m o. h.

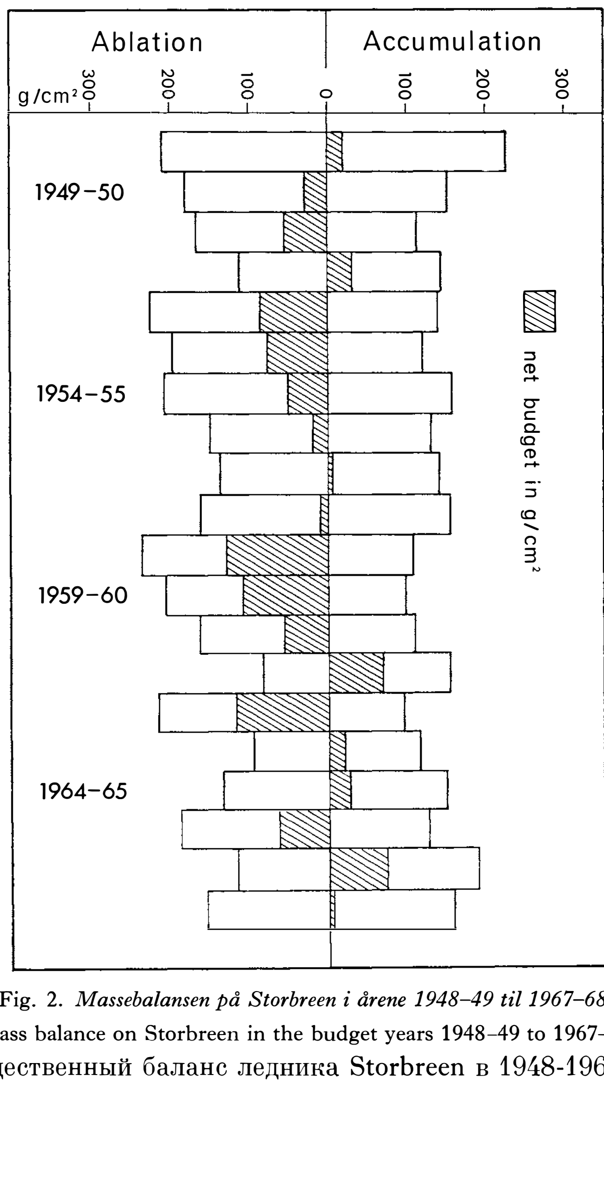

Fig. 2. *Massebalansen på Storbreen i årene 1948–49 til 1967–68.*
Mass balance on Storbreen in the budget years 1948–49 to 1967–68.
Вещественный баланс ледника Storbreen в 1948-1968 гг.

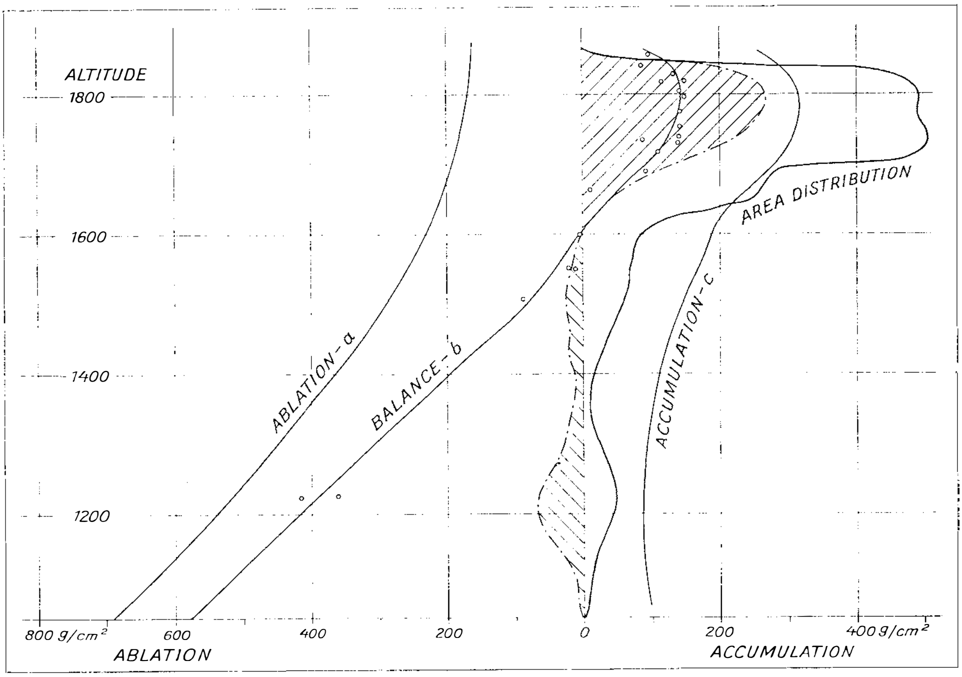

Fig. 3. *Variasjon av akkumulasjon, ablasjon og balanse på Hardangerjøkulen (Rembesdalsskåki) i 1967–68 i forhold til høgd over havet.*

Variation in accumulation, ablation and balance on Hardangerjøkulen (Rembesdalsskåki) 1967–68 in relation to height above sea level.

Вариация аккумуляции, абляции и баланса ледника Hardangerjøkulen (Rembesdalsskåki) в 1967-1969 гг. по отношению к высоте над уровнем моря.

målt daglig. En ablatograf var i gang det meste av tiden. Det ble også målt forskjellige meteorologiske komponenter for bedømmelse av varmebalansen på snøflaten. Bl. a. ble det foretatt en kontinuerlig måling av strålingsbalansen.

På grunn av en relativ varm sommer ble ablasjonen større enn normal, men ikke stor nok til å kompensere for den uvanlig store akkumulasjon. Resultatene ble, som Tabell I viser, et overskudd på 0,53 m. Se også Fig. 3 og 4.

Omnsbreen

Massebalanseundersøkelsene på Omnsbreen ble utført av cand. mag. SIGMUND MESSEL. Måling på Omnsbreen, ca. 4 km nord for Finse, har pågått siden 1966. Nytt topografisk kart i målestokk 1:5 000 med 5 m ekvidistanse ble laget i 1968 på grunnlag av tachymetrisk oppmåling. Fra og med 1968 er undersøkelsene utvidet til også å gjelde måling av energibalansen. Resultatene av arbeidet på Omnsbreen vil foreligge som hovedfagsoppgave i geografi ved Universitetet i Oslo våren 1970.

I 1966 var akkumulasjonen 1,44 m og ablasjonen 2,28 m. Verdiene for 1967 er

Tabell I
Hardangerjøkulen 1967–68

Høydeintervall *Height interval* m.o.h. – *m.a.s.l.*	Areal–S *Area* km²	Akkumulasjon–c *Accumulation* m	Ablasjon–a *Ablation* m	Balanse–b *Balance* m
1850–1900	0.080	2.60	1.65	+0.95
1800–1850	3.742	3.08	1.68	+1.40
1750–1800	3.870	3.12	1.77	+1.35
1700–1750	3.910	3.09	1.87	+1.22
1650–1700	2.082	2.58	2.01	+0.57
1600–1650	0.931	1.82	2.15	—0.33
1550–1600	0.640	2.03	2.40	—0.37
1500–1550	0.345	1.71	2.56	—0.85
1450–1500	0.321	1.40	3.20	—1.80
1400–1450	0.191	0.93	3.55	—2.62
1350–1400	0.110	1.04	3.98	—2.94
1300–1350	0.082	0.98	4.30	—3.32
1250–1300	0.270	1.15	4.70	—3.55
1200–1250	0.325	0.93	5.12	—4.19
1150–1200	0.324	0.85	5.55	—4.70
1100–1150	0.105	0.90	6.20	—5.30
1050–1100	0.025	0.95	6.68	—5.73
1000–1900	17.55	2.68	2.15	+0.53

henholdsvis 2,21 m og 1,72 m. I 1968 har akkumulasjonen vært 2,20 m og ablasjonen 2,38 m; nettobalansen viser således et underskudd for Omnsbreen på 0,18 m. Alle verdier gjelder vannhøyde jevnt fordelt over breen. Omnsbreen viser altså i 1968 et underskudd på 0,18 m, mens Hardangerjøkulen som bare ligger ca. 10 km lenger sør, viser et overskudd på 0,53 m. Dette kan for dette års vedkommende bero på de to breers forskjellige høydefordeling, men det kan også støtte den antakelse at Omnsbreen i grunnen er klimatisk død og at den er en relikt fra de siste par 100 års kaldere klima.

I løpet av de 3 år målingene har pågått, er Omnsbreen tappet for 0,805 · 10^6 m^3 vann, svarende til 0,53 m vannhøyde jevnt fordelt over den 1.521 km^2 store breen.

Energibalansemålingene på Omnsbreen var i gang fra 3. juni til 9. september. I denne periode er de forskjellige meteorologiske faktorers andel beregnet til: stråling 49,6%, konveksjon 15,7% og kondensasjon til 15,7%. Regn og sublimasjon ytet henholdsvis 0,4% og 0,1%. Se Fig. 5.

Breer på Spitsbergen

Helårsmålingene på Austre Brøggerbreen syd for Ny-Ålesund ble i 1967–68 fortsatt på samme måte som året før. I tillegg ble det i 1967 om sommeren boret ned stenger på Midre Lovénbreen. Lovénbreen har tidligere vært undersøkt av en østtysk ekspedisjon, som i 1962 laget et detaljkart i målestokk 1:10 000 over hele breen. Sommeren 1967 triangulerte Olav Orheim inn alle stenger fra de faste

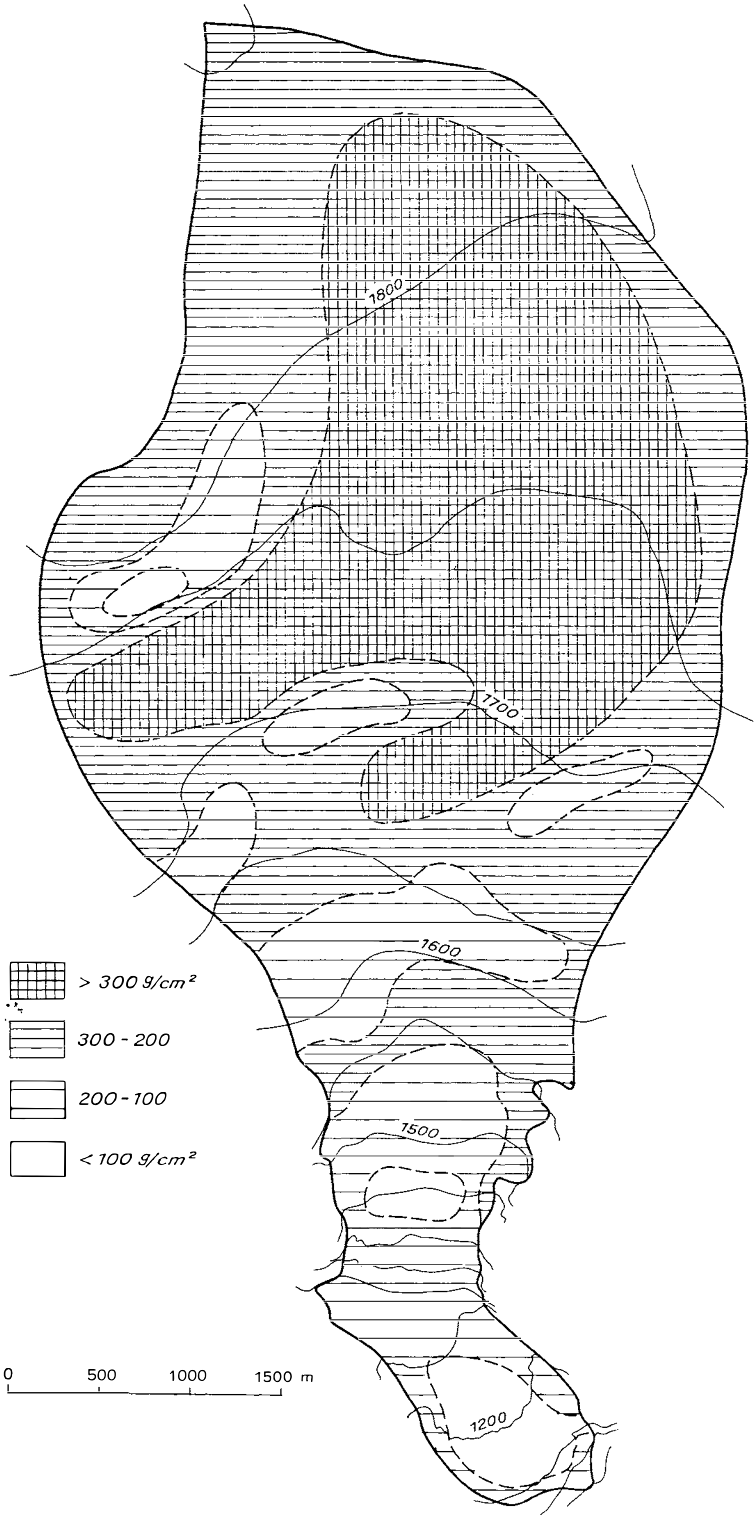

Fig. 4. *Kartet viser akkumulasjonen inntil midten av mai 1968 på den del av Hardangerjøkulen som dreneres til Rembesdalsskåki.*

Map showing accumulation until the middle of May 1968 in the part of Hardangerjøkulen that flows to Rembesdalsskåki.

На карте показана аккумуляция до середины мая 1968 г. части ледника Hardangerjøkulen, текущей иа выводной ледник Rembesdalsskåki.

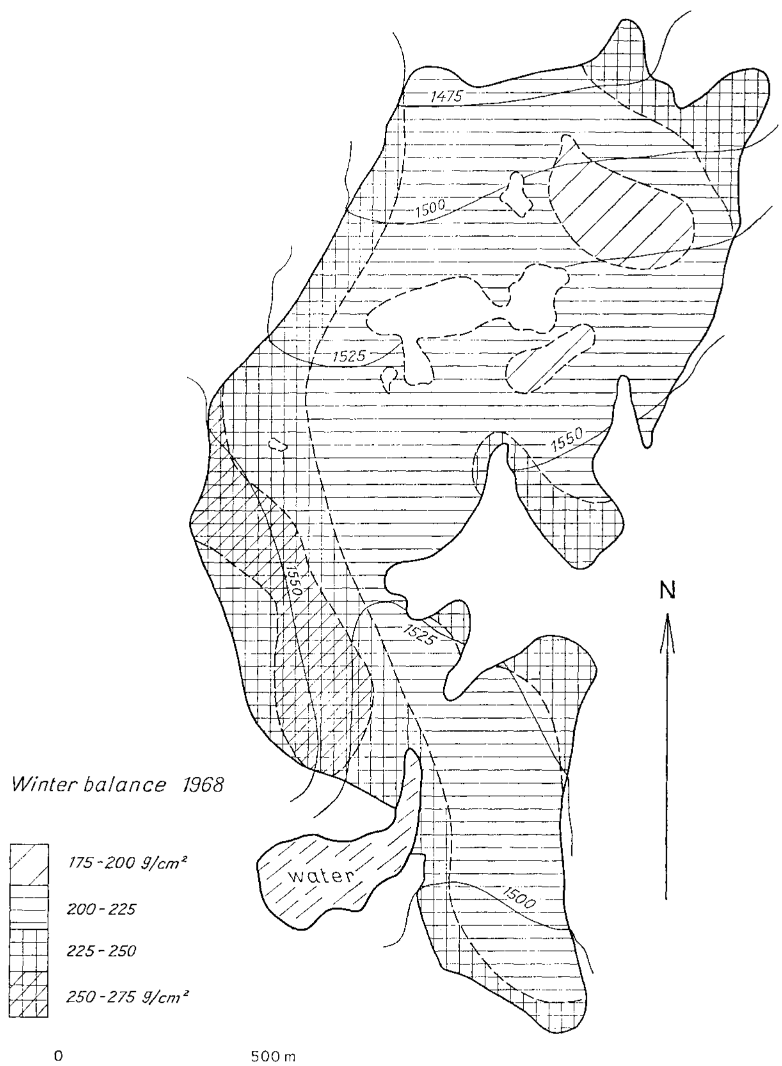

Fig. 5. *Akkumulasjonen på Omnsbreen 1967–68.*
Accumulation on Omnsbreen 1967–68.
Аккумуляция ледника Omnsbreen в 1967-1968 гг.

trig. punkter rundt breen og beregnet høyder og posisjoner av alle stengene. Det samme ble gjort sommeren 1968 av RANDI PYTTE. Hun foretok også ablasjonsmåling på både Austre Brøggerbreen og Lovénbreen, samtidig som hun boret ned de stenger som hadde kommet for langt opp. På grunnlag av flyfotografering i 1966 er det nå laget et kart i 1:20 000 over området omkring Austre Brøggerbreen. Endel av Lovénbreen kom også med på dette kart. Sammenlikner man disse kart, vil man se at breen har minket i de nedre områder og øket i de øvre. Det samme ser man ved sammenlikninger med PYTTE's og ORHEIM's trianguleringer. Dette er det vanlige bilde man får så å si av alle breer på Spitsbergen.

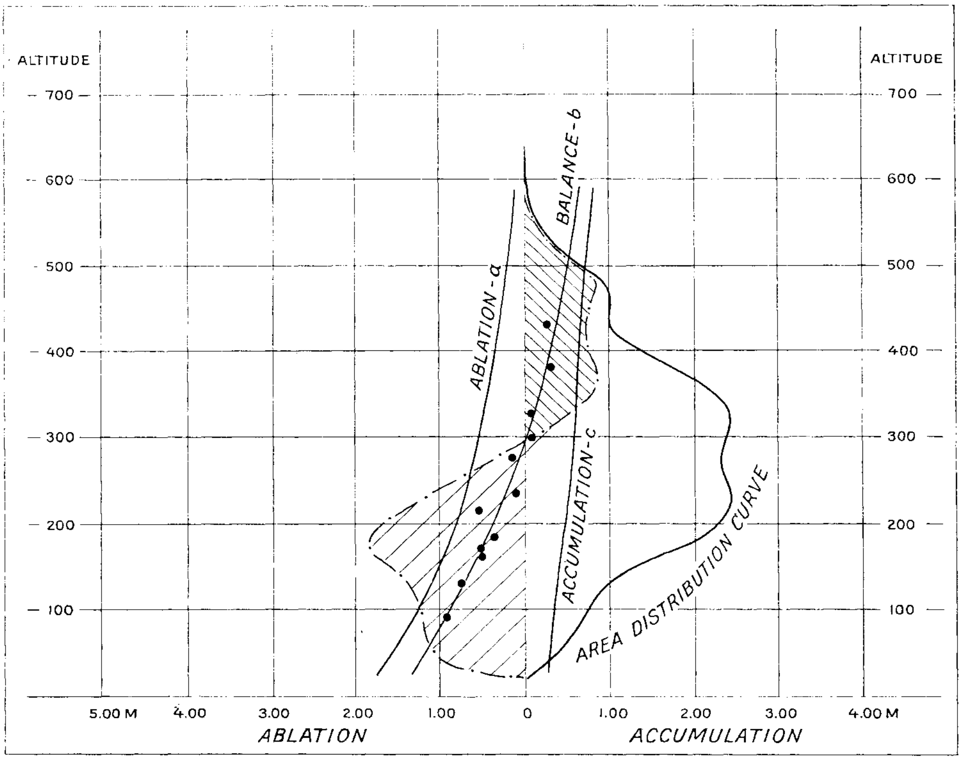

Fig. 6. *Variasjon i massebalansen på Austre Brøggerbreen 1967–68 i relasjon til høgd over havet.*
Variation in mass balance on Austre Brøggerbreen 1967–68 in relation to height above sea level.
Вариация вещественного баланса ледника Austre Brøggerbreen в 1967-1968. гг. по отношению к высоте над уровнем моря.

Normalt er hastigheten i breen så liten at man ikke på langt nær får ført ned overskuddet i firnområdet til ablasjonsområdet. Dette fører da til at breen øker i de øvre områder og minker nederst. Med tiden vil dette utliknes ved en såkalt «surge», der breen plutselig får en voldsomt forøket hastighet og i løpet av noen få år utlikner den store høydeforskjell som har opparbeidet seg i kanskje størrelsesorden 100 år.

Akkumulasjons- og ablasjonsmålinger er utført av JENS ANGARD ved den faste geofysiske stasjonen i Ny-Ålesund en rekke ganger i løpet av budsjettåret. Målingene er foretatt ved direkte avlesning på stengene. Dette gir et litt spinkelt grunnlag for bedømmelse av akkumulasjonen over hele breen. For det kommende budsjettår vil det derfor bli utført sonderinger langs bestemte linjer over hele breen.

Resultatet av målingene for året 1967–68 sees av Fig. 6 og 7. Figurene er forsynt med en arealfordelingskurve, og denne viser at Austre Brøggerbreen har et større område under firngrensen enn Lovénbreen. Dette har gitt seg utslag i materialbalansen. Mens Lovénbreen så å si er nøyaktig i balanse, har Austre

Brøggerbreen et underskudd på ca. 0,10 m. Dette skulle indikere at Austre Brøggerbreen har hatt en «surge» senere enn Lovénbreen og at firnområdet ikke er blitt bygget opp så høyt som på Lovénbreen.

Andre undersøkelser

Ved siden av undersøkelsene som Norsk Polarinstitutt foretok på Storbreen, Hardangerjøkulen, Omnsbreen, Austre Brøggerbreen og Lovénbreen, utførte Norges Vassdrags- og Elektrisitetsvesen målinger på 12 andre breer, 9 i Sør-Norge og 3 i Nord-Norge. Samtlige målinger er vist i Tabell II.

For Sør-Norges vedkommende er de forskjellige breer satt opp i diagram, Fig. 8. Til sammenlikning er gjennomsnittet for de 5 foregående år samt en beregnet normal likevektstilstand tegnet inn.

Beregninger av breenes fram- og tilbakerykking i meter ble foretatt ved i alt 11 breer, og resultatet er vist i Tabell III. Som man ser rykker fremdeles 4 breer fram på tross av den relativt varme sommer. Bretungene har et visst «time lag». Det er derfor de foregående års overskudd de reagerer på.

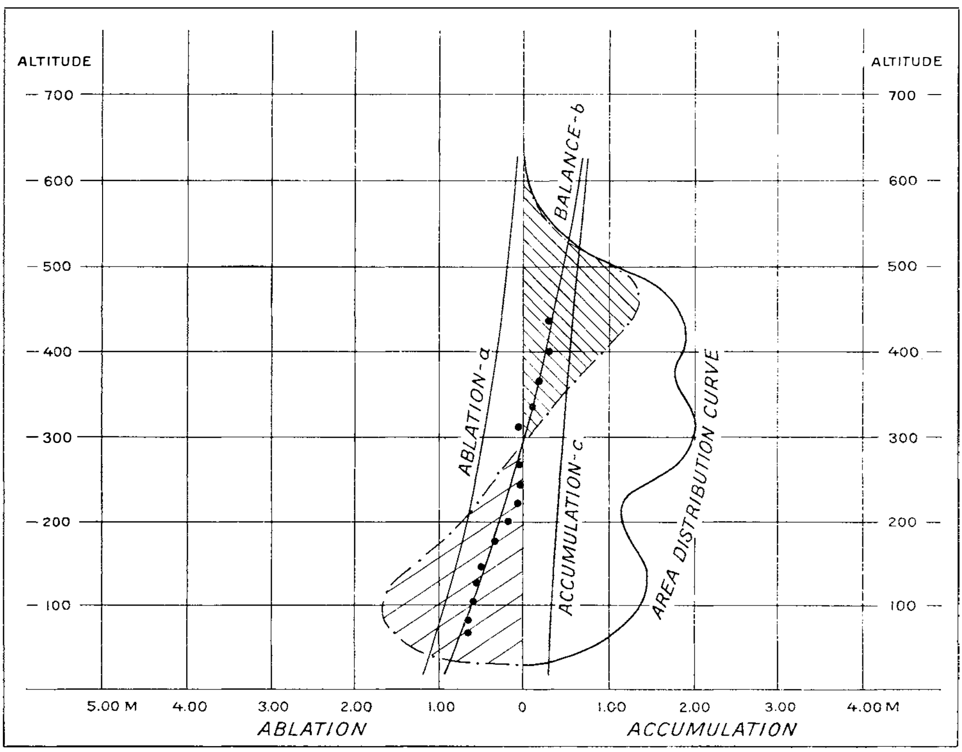

Fig. 7. *Variasjon i massebalansen på Midre Lovénbreen 1967–68 i relasjon til høgd over havet.*

Variation in mass balance on Midre Lovénbreen 1967–68 in relation to height above sea level.

Вариация вещественного баланса ледника Midre Lovénbreen в 1967-1968 гг. по отношению к высоте над уровнем моря.

Tabell II

Massebalansemålinger

Mass balance measurements

Bre *Glacier*	Areal *Area* km^2	Akkumulasjon–c *Accumulation* m	Ablasjon–a *Ablation* m	Balanse–b *Balance* m	Likevektslinje *Equilibrium line* m
Ålfotbreen	4.76	4.55	3.60	+0.95	1075
Folgefonni	19.52	3.36	2.72	+0.64	1365
Vesledalsbreen	4.22	3.14	2.50	+0.64	1320
Nigardsbreen	47.03	2.72	2.50	+0.22	1550
Tunsbergdalsbreen	43.77	2.74	2.70	+0.04	1270
Hardangerjøkulen	17.55	2.68	2.15	+0.53	1600
Omnsbreen	1.52	2.20	2.38	—0.18	1530
Storbreen	5.45	1.59	1.54	+0.05	1700
Hellstugubreen	3.33	1.38	1.49	—0.11	1875
Vestre Memurubre	9.06	1.70	1.46	+0.24	1820
Austre Memurubre	8.86	1.77	1.76	+0.01	1960
Gråsubreen	2.53	1.03	1.11	—0.08	2140
Blåisen	2.18	1.62	1.36	+0.26	1010
Storsteinsfjellbreen	6.12	1.44	0.99	+0.45	1275
Cainhavarre	0.68	1.31	1.05	+0.26	1290
Midre Lovénbreen	6.03	0.48	0.51	—0.03	295
Austre Brøggerbreen	6.08	0.57	0.67	—0.10	295

Tabell III

Enkelte breers lengdeforandring

Variation in the position of the glacier fronts

Jotunheimen		*Folgefonni*	
Storbreen	— 8	Bondhusbreen	— 1
Styggedalsbreen	— 1		
		Møre	
Jostedalsbreen		Trollkyrkjebreen	+ 5
Briksdalsbreen	+ 17		
Stegholtbreen	—110	*Svartisen*	
Lodalsbreen	—131	Engabreen	+10
Fåbergstølbreen	—137		
Austerdalsbreen	— 22		
Bersetbreen	+ 12		

Резюме

В балансовом году 1967-1968 сотрудниками Норвежского Полярного института был измерен вещественный баланс пяти ледников: Storbreen, Hardangerjøkulen, Omnsbreen (в южной Норвегии), Austre Brøggerbreen и Midre Lovénbreen (на Шпицбергене). Результаты измерений сопоставлены в таблице II с соответствующими результатами исследований других ледников, полученными представителями учреждения Norges Vassdrags- og Elektrisitetsvesen (управление гидрологической службы). Энергодаланс на поверхности ледника Omnsbreen был регистрирован с 3-го июня по 9-ое сентября, В среднем, 50% абляции причиннено радиацией, 34% – приходом тепла конвекцией и 16% – конденсацией.

Измерены колебания ледниковых фронтов двенадцати ледников, из которых отступали восемь, а наступали – четыре. (См. табл. III.)

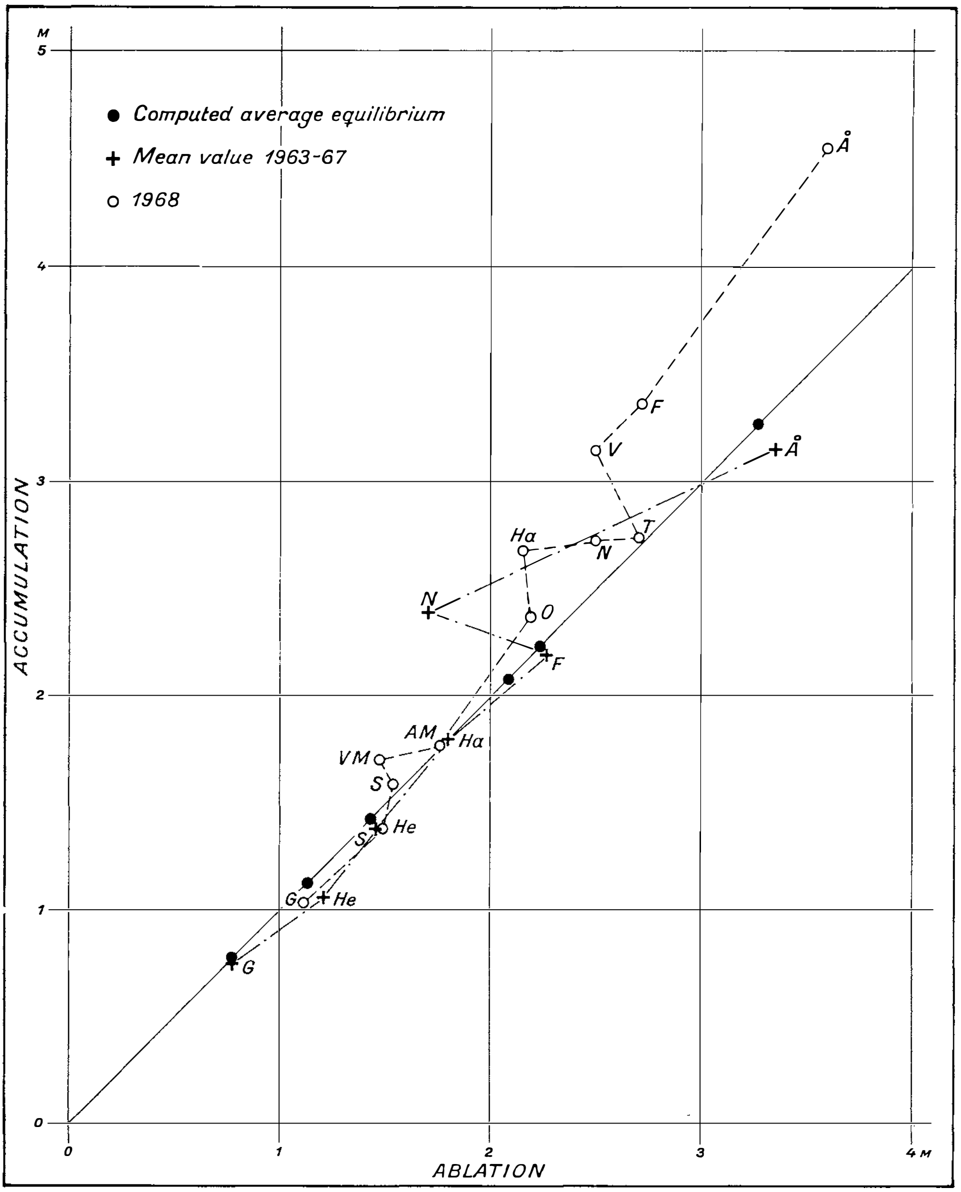

Fig. 8. *Diagrammet viser forholdet mellom akkumulasjon og ablasjon i relasjon til gjennomsnittet for de foregående 5 år og til et beregnet normalt gjennomsnittsår.*

Å = Ålfotbreen, F = Folgefonni, T = Tunsbergdalsbreen, N = Nigardsbreen, V = Vesledalsbreen, Ha = Hardangerjøkulen, He = Hellstugubreen, S = Storbreen, G = Gråsubreen, VM = Vestre Memurubre, AM = Austre Memurubre, O = Omnsbreen.

Relation between accumulation and ablation compared to the mean of the previous 5 years and a year with a balanced budget and a "normal" mass exchange.

На диаграмме показано взаимоотношение между аккумуляцией и абляцией относительно к их средним значениям предыдущих пяти лет и к расчетному среднему «нормальному» году.

The weather in Svalbard in 1968

By
Vidar Hisdal

The diagram, Fig. 1, presents some important meteorological elements observed at Isfjord Radio during 1968: the daily maximum and minimum temperatures, the cloud amount, and the direction and the speed of the wind. The cloud and wind observations entered are those taken at 13 MET. The figure furthermore shows the average annual temperature variation for the period 1947–67. The symbols used are explained by examples in the diagram.

The table contains the monthly mean temperatures for Isfjord Radio and Bjørnøya for 1968 as well as their deviations from the monthly means based on the period 1947–67.

The great temperature fluctuations in Svalbard are primarily due to the alternating influences of mild, southerly air streams and cold Arctic air invading the islands from northerly or easterly directions. Since the temperature contrast between these air masses is considerably more marked in winter than in summer, the temperature fluctuations are much greater during the former season. This is clearly illustrated by the diagram. In winter the advection effect is usually strengthened by the fact that northerly to easterly winds are positively correlated with clear skies and radiative heat loss from the ground, while southerly winds are connected with overcast skies, which prevent the heat loss of the ground and often lead to a considerable radiative heat gain.

The diagram and the tabulated values suffice to ascertain that 1968 was a very cold year in the Svalbard area. At Bjørnøya both the start and the end of the year are unusually cold, while at Isfjord Radio it is especially the end of the year that is signified by exceptionally low temperatures. This applies particularly to October. It has been possible to estimate fairly reliable monthly means for Isfjord Radio as far back as to December 1911 by means of observation series from Green Harbour and Longyearbyen. It turns out that for this series of years 1968 has the lowest October mean.

As would be expected, a study of the weather maps for 1968 shows that the extremely low mean temperatures may be considered as a combined effect of persistent advection of very cold Arctic air and long spells of strong radiative cooling of the ground in the Svalbard area. The typical pressure pattern during these situations is characterized by a high pressure system centered over Green-

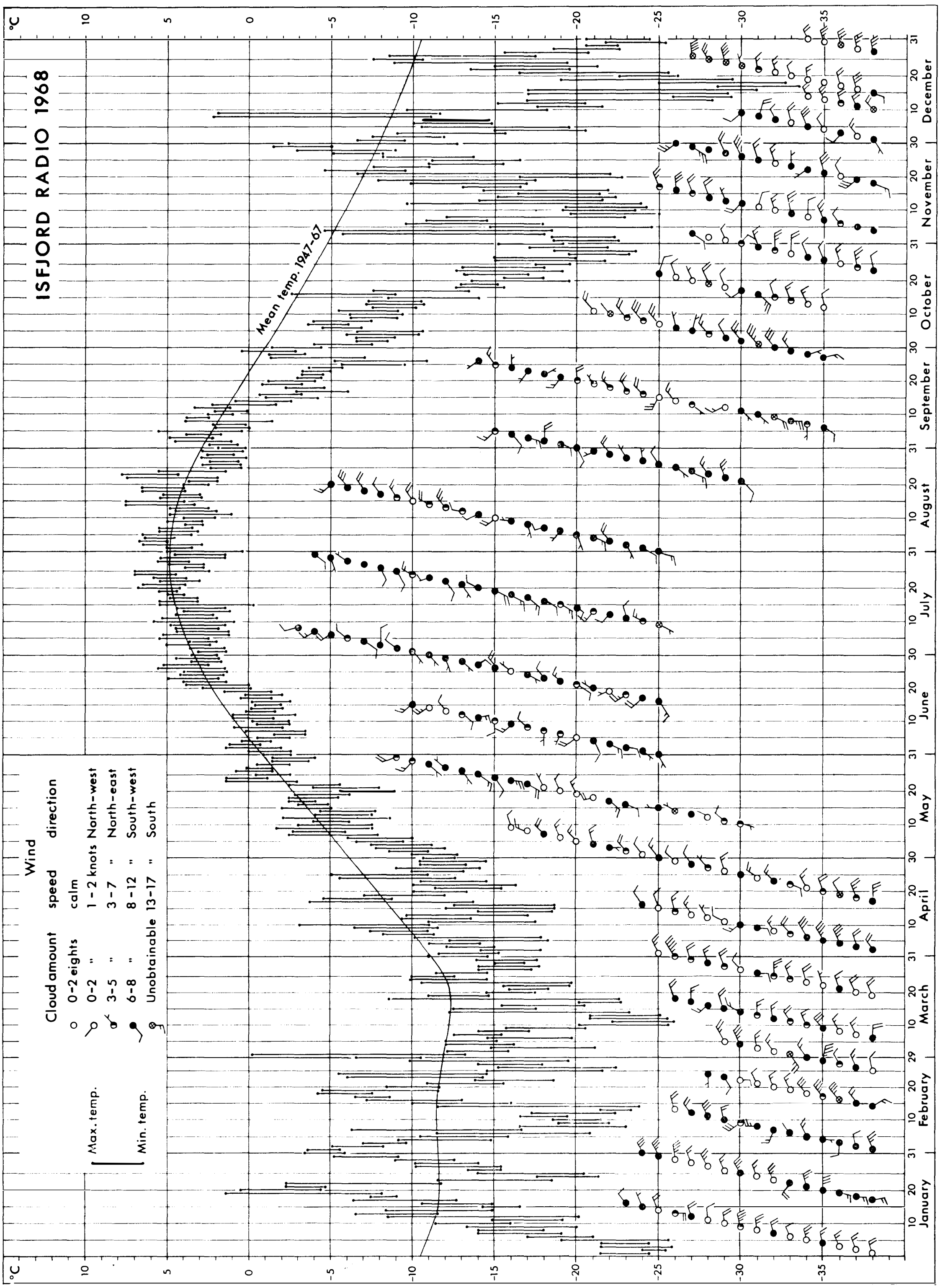
ISFJORD RADIO 1968
Mean temp. 1947-67
°C
10
5
0
-5
-10
-15
-20
-25
-30
-35
Max. temp.
Min. temp.
Cloud amount
0-2 eighths
0-2 "
3-5 "
6-8 "
Unobtainable
Wind
speed
calm
1-2 knots
3-7 "
8-12 "
13-17 "
direction
North-west
North-east
South-west
South
January
February
March
April
May
June
July
August
September
October
November
December

Fig. 1.

land or the Arctic basin, with cyclones moving towards the north-east in lower latitudes.

The lowest temperature of the year at Isfjord Radio, –33.5°C, was observed on 17 December, while the highest temperature, 7.8°C, occured on 23 August. The corresponding values for Bjørnøya are –29.5°C (14 March) and 11.5°C (23 August).

Monthly mean temperatures for 1968 (T) and their deviations (d) from the means of the period 1947–67.

		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Isfjord Radio	T	−13.5	−13.4	−16.2	−11.8	−4.6	0.4	3.6	3.7	−1.0	−12.0	−14.3	−17.8
	d	−1.9	−1.9	−3.9	−3.1	−1.1	−1.2	−1.0	−0.5	−2.0	−9.1	−8.3	−8.7
Bjørnøya	T	−13.5	−11.0	−13.5	−7.0	−3.7	0.6	3.3	3.5	0.8	−8.4	−6.6	−9.8
	d	−6.0	−4.0	−5.8	−1.8	−2.2	−1.3	−0.8	−0.7	−2.0	−8.6	−4.3	−4.2

Sea ice observations in 1968

BY
TORGNY E. VINJE

The distribution of sea ice between Iceland and Novaja Zemlja for the months March–September is shown in Figs. 1–7. The main source of data is the pictures taken by the American ESSA satellites. The date of the different observations is noted in the figures. When the observations are taken from aircrafts or from ships, the suffix 'air' or 'ship' has been noted. (Sources: U.S. Naval Oceanographic Office, The Royal Norwegian Airforce, and the montly charts edited by The English Meteorological Office.) For the Arctic stations Hopen, Bjørnøya, and Isfjord Radio, the maximum and minimum concentration in oktas and type of ice is given for each month (one okta equals one-eight ice concentration). In some charts the concentration is given with the date as a suffix. The ice edges marked with crosses have been observed by radar, and broken lines indicate assumed edge.

In Fig. 1 is given some names which are used by sealers and fishermen. These names are characteristic features of the ice border developed every year, more or less distinctly, by the prevailing current and wind conditions. It can be seen that these features are very well pronounced during March, April and May, particularly Bukta in late March and early April, as well as in late June and the first half of July.

When considering the figures, it can be seen that the variation in the position of the ice edge is considerable within relatively short periods. We note in this connection the development at Selneset at the end of March.

The ice conditions along the north coast of Iceland was extraordinarily bad during March, April, May, and June. It was not until July that the sea ice disappeared from this area. Considering the Svalbard area, it is seen that there was open water NW of the islands from late April. During the end of May northerly winds, however, pressed the ice against the coast, and this area stayed closed for navigation for the rest of the year. The western and southern areas of the archipelago were so to say free of ice in July, August, and the first part of September. The usual out-flow of ice from the eastern part was small during these months. In connection with relatively low temperatures from medio September on, these waters refroze rapidly. This caused great difficulties for navigation during the end of the normal shipping season.

Several new features in the sea ice distribution in Svalbard have been disclosed by the satellite photos. For instance, the Hinlopenstretet, between Nordaustlandet and the main island, is often partly free of ice during the cold season. This indicates that the north-going current is fairly strong. It is also observed that Storfjorden does not, as a rule, refreeze completely during winter. This might possibly indicate an upwelling of warmer water coming from SW and passing underneath the colder easterly current south of the main island.

In the East-Greenland Current some ice fields have been traced on the satellite pictures. It has thus been possible to determine some values of the ice drift in this area. Below is given the average position, the corresponding ice drift direction, and period of observation.

Position	Speed km/24 h	Drift from	Period
80.4N—05E	10.7	NNE	8.IV—19.IV
79.7N—01E	10.7	NNE	»
78.8N—05W	17.3	NNE	»
77.5N—13W	17.3	NNE	»
73.5N—13W	3.5	NW	24.V— 5.VI

The table indicates the well-known increase in speed of the ice as it is leaving the Polar Basin. The southernmost observation indicates a divergence in the ice current north of Jan Mayen in accordance with the often observed features of the ice border in this area.

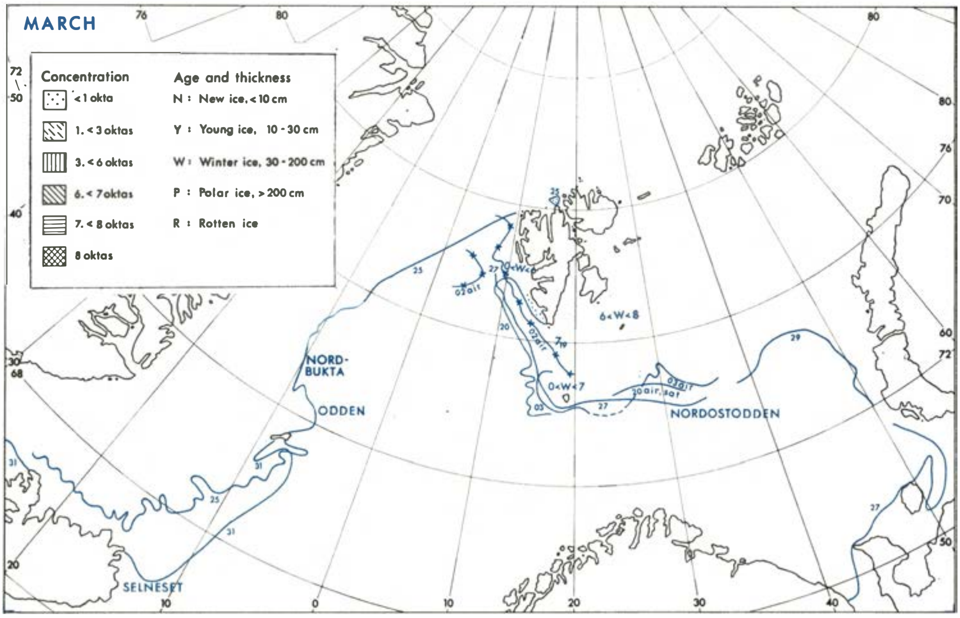
MARCH
Concentration
<1 okta
1. < 3 oktas
3. < 6 oktas
6. < 7 oktas
7. < 8 oktas
8 oktas
Age and thickness
N : New ice, < 10 cm
Y : Young ice, 10 - 30 cm
W : Winter ice, 30 - 200 cm
P : Polar ice, > 200 cm
R : Rotten ice
NORD-
BUKTA
ODDEN
NORDOSTODDEN
SELNESET
6<W<8
0<W<7

Fig. 1.

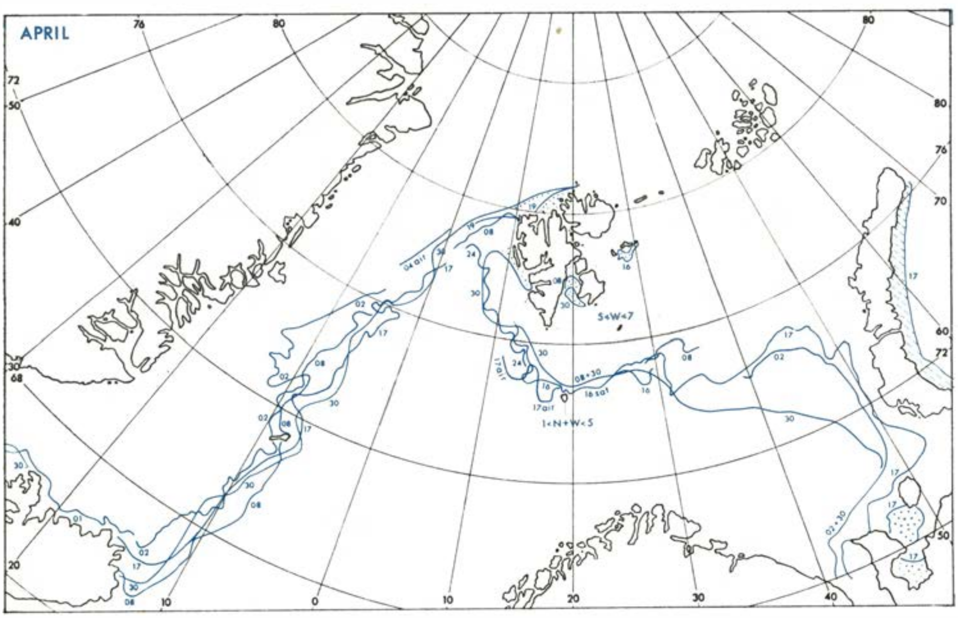
APRIL
5<W<7
1<N+W<5

Fig. 2.

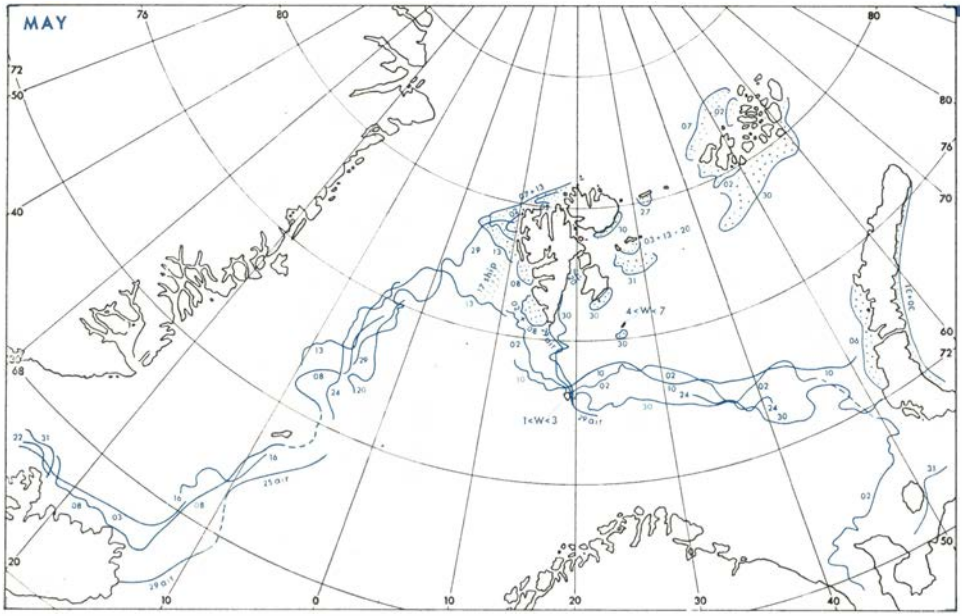

Fig. 3.

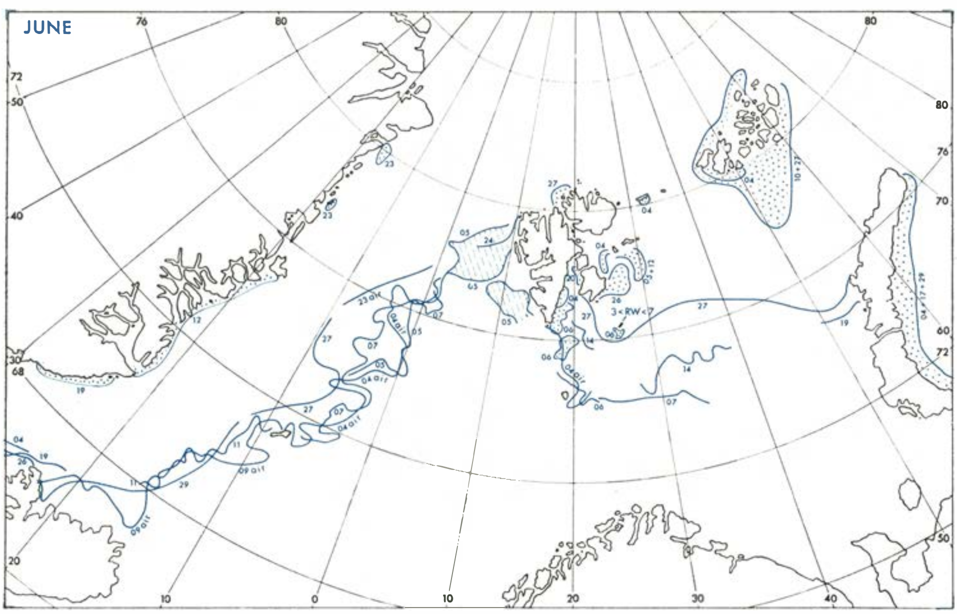

Fig. 4.

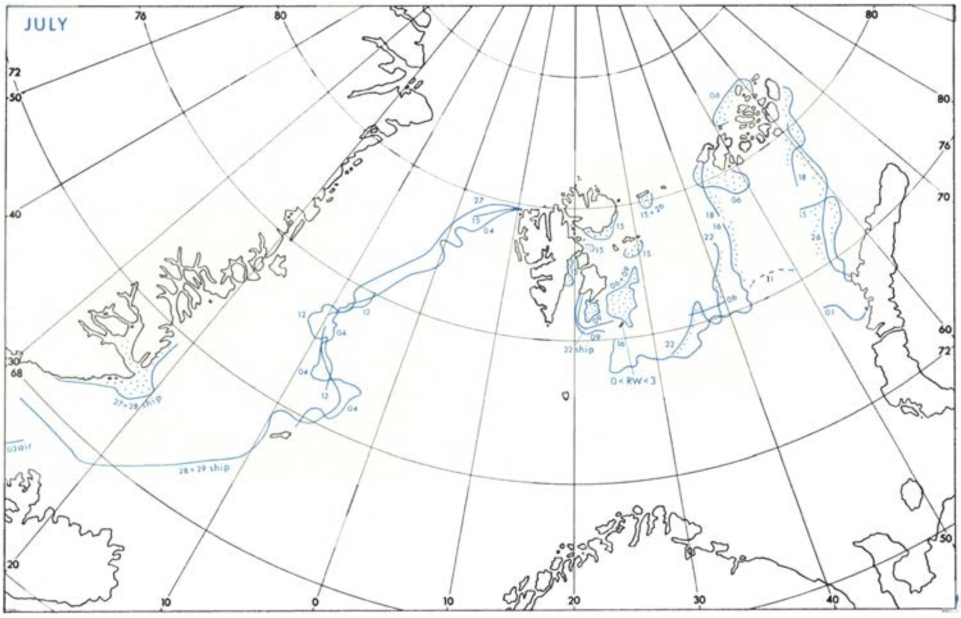
JULY
76
80
72
50
40
30
68
20
10
0
10
20
30
40
50
60
72
70
76
80
80
27+28 ship
28+29 ship
22 ship
0<RW<3

Fig. 5.

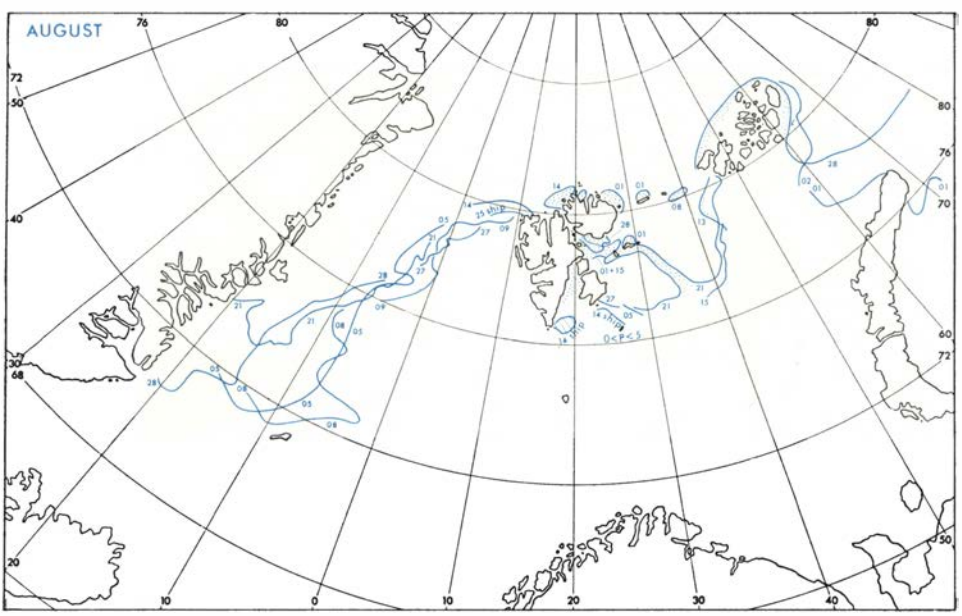
AUGUST
76
80
72
50
40
30
68
20
10
0
10
20
30
40
50
60
72
70
76
80
80
25 ship
14 ship
16 ship
0<P<5

Fig. 6.

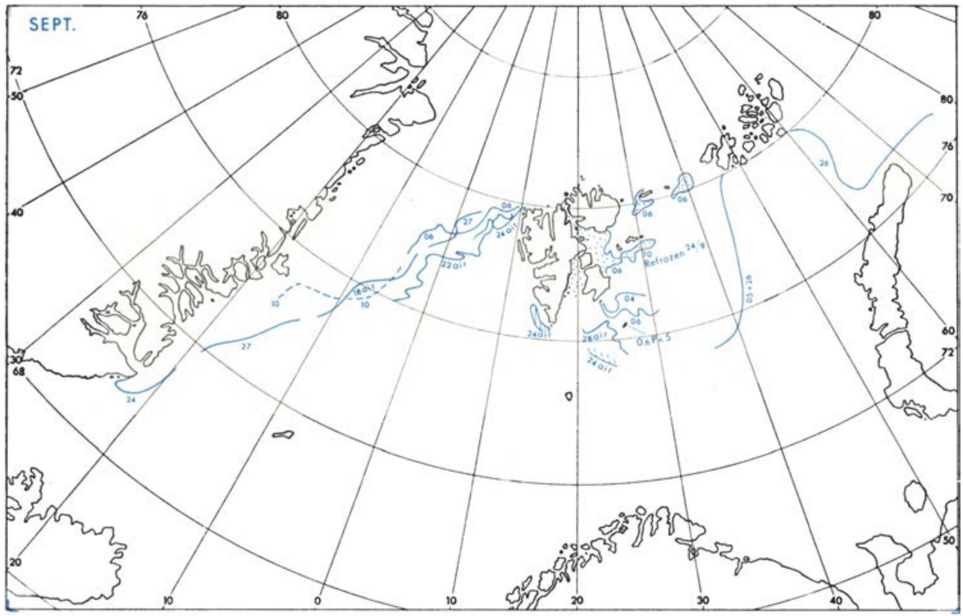

Fig. 7.

Iakttagelser over dyrelivet på Svalbard 1968

(Observations of animal life in Svalbard 1968)

(Наблюдения над фауной Свальбарда в 1968-ом году)

AV

MAGNAR NORDERHAUG

Abstract

The present report on observations of animal life in Svalbard is based on records from Norsk Polarinstitutt's expedition and information from other field parties and persons visiting Svalbard in 1968.

Four observations of walruses (*Odobenus rosmarus*) are mentioned. The local movements of Fulmar (*Fulmarus glacialis*) are discussed. Steller's eider (*Polysticta stelleri*), River warbler (*Locustella fluviatilis*), and Willow warbler (*Phylloscopus trochilus*) were recorded for the first time in Svalbard. The collected specimen of *Locustella fluviatilis* needs further examination. A dead Lapland bunting (*Calcarius lapponicus*) from Spitsbergen in 1968 is the second record of this species in Svalbard. Other birds observed are: Teal (*Anas crecca*), Common scoter (*Melanitta nigra*), Gyr falcon (*Falco rusticolus*), Redshank (*Tringa totanus*), Great skua (*Catharacta skua*), Snowy owl (*Nyctea scandiaca*), and Redpoll (*Carduelis flammea*).

Аннотация

Приведенный здесь годовой отчет о произведенных в 1968-ом году наблюдениях над свальбардской фауной основан на сведениях, полученных от участвующих в летней экспедиции Норвежского Полярного Института ((Norsk Polarinstitutt) и в других полевых группах, а также от посетивших Свальбард в том же году отдельных лиц. Четырежды были отмечены моржи *(Odobenus rosmarus)*. Обсуждаются местные миграции глупышей *(Fulmarus glacialis)*. Впервые на Свальбарде были обнаружены: *Polysticta stelleri*, *Locustella fluviatilis* и *Phylloscopus trochilus*. Однако найденный образец вида *Locustella fluviatilis* нуждается в более тщательном исследовании. Найденный на острове Шпицберген лапландский подорожник *(Calcarius lapponicus)* представляет собой второе известное появление этого вида на архипелаге. Другие отмеченные птицы: *Anas crecca*, *Melanitta nigra*, *Falco rusticolus*, *Tringa totanus*, *Catharacta skua*, *Nyctea scandiaca* и *Carduelis flammea*.

Innledning

I motsetning til de foregående år kommer observasjonsmaterialet i 1968 bare fra noen få kilder. Det vesentligste av materialet stammer fra en britisk ekspedisjon i Kongsfjordområdet, en finsk ekspedisjon i området Sveagruva–Longyearbyen og Norsk Polarinstitutts egen biologiske feltvirksomhet (Bellsund – Prins Karls Forland – Krossfjorden). En del mer spesielle observasjoner er dessuten innsamlet fra annet hold.

For bidragsyterne er følgende initialer brukt: J. ANGARD (JA), M. BROOKE (MB), B. FLOOD (BF), P. JOHNSON (PJ), G. RUSSEL COOPE (GRC), E. S. NYHOLM (ESN), K. C. VAUGHTON (KCV) og Norsk Polarinstitutts biologparti (NPB).

Takk

Jeg vil med dette få takke de som har bidradd med observasjoner i 1968, i første rekke MICHAEL BROOKE for utførlige informasjoner fra British School Exploration Society's ekspedisjon, og ERIK S. NYHOLM, leder av den finske biologiske vinterekspedisjon (T. HELLMAN, P. KURTTI og E. S. NYHOLM), for fugleobservasjoner i tidsrommet 23/8–23/10 1968, samt K. C. VAUGHTON, leder for Oxford Expedition to Svalbard, 1968. En særlig takk går også til mine assistenter, SIGMUND HÅGVAR og BJØRN MATHIASSEN, for deres innsats under feltarbeidet på Svalbard.

Pattedyr

Svalbardrein (*Rangifer tarandus platyrhynchus*). – Ved Kapp Linné hadde 11 rein tilhold 13/6–14/6 (NPB). Ifølge stasjonsbetjeningen holdt dessuten en flokk på ca. 20 dyr til sør ved Bellsund, slik at bestanden i kystområdet mellom Isfjorden og Bellsund antagelig var omkring 30 dyr.

På Blomstrandhalvøya i Kongsfjorden ble en rein sett i slutten av juni (JA). Kongsfjordområdet ble gjennomsøkt i siste halvdel av juli (NPB) uten at rein ble sett i området. På Gerdøya ble imidlertid spor og ekskrementer etter rein sett. Ting tydet på at mer enn ett individ hadde hatt tilhold der. Det eller de individer som våren 1968 oppholdt seg i Kongsfjordområdet har rimeligvis kommet fra nordøst (Liefdefjordområdet) eller fra sørøst (James I Land). Som kjent har rein ikke forekommet i Kongsfjordområdet på mange år.

Moskus (*Ovibos moschatus*). – En fullstendig moskustelling ble utført i Reindalen i tidsrommet 28–30/7 (KCV). Tellingen omfattet området fra Reindalens munning til Kokbreen. Totalt ble tre grupper med 13 individer (herav 4 kalver) lokalisert.

Hvalross (*Odobenus rosmarus*). – To hittil ukjente observasjoner fra foregående år skal først nevnes. Det gjelder ett individ som våren 1966 ble sett ved Halvmåneøya (PJ) og ett individ ved Kvadehuken våren 1967 (JA). Fra 1968 foreligger fire hvalrossobservasjoner: En velvoksen hvalross (store tenner) ble sett ved Calypsobyen 18/6 (BF). Ifølge stasjonsbetjeningen på Isfjord Radio hadde dessuten en hvalross med små tenner tilhold ved Kapp Linné i mai 1968 (NPB). I Yoldiabukta (Isfjorden) ble en stor hann sett i juli (PJ). Fra de østlige områder foreligger en observasjon fra Tjuvfjorden, der ett individ ble sett 10/8 vest for Negerfjellet (PJ).

Fugl

Islom (*Gavia immer*). – To individer ble sett mellom Stabbelva og Båtodden (Nordenskiöldkysten) 22/6 (NPB). Fire individer ble sett ved Brøggerhalvøya 1/8 (MB).

Havhest (*Fulmarus glacialis*). – Noen ord skal nevnes om det såkalte «havhesttrekk», som ofte registreres langs Svalbards kyster. Som kjent foregår det periodevis et trekk langs visse kyststrøk der tusener av havhester passerer i løpet av dagen. Dette er særlig merkbart på dager med hard vind. I juni 1968 ble vel 700 havhester innfanget for ringmerking ved Kapp Linné (NPB), og det var da god anledning til å studere dette trekket nærmere. Selve trekkets bevegelsesretning er i utpreget grad *mot* vindretningen og kan således i løpet av dagen snu 180° om vinden endres. Det er derfor ikke tale om noe regulært sesongtrekk. I en rekke tilfeller gulpet innfangede individer opp fisk og marine evertebrater, som tydet på velfylte maver. Av 131 undersøkte havhester hadde dessuten 123 (93.9%) rugeflekk. Hovedmengden besto med andre ord av individer i rugefasen. Følger man havhesttrekket nærmere, vil det ofte vise seg at trekket også finner sted på nesten vindstille dager. Fuglene følger da ikke kysten i utpreget grad, men sees spredt utover hele havflaten. Den rimeligste konklusjon er derfor at dette trekket vesentlig består av kjønnsmodne individer på vei mellom hekkeplass og næringsområde. Luftstrømmer forårsaket av kraftig vind utnyttes av individer i motgående retning, slik at disse lokale vandringer får et preg av et konsentrert trekk oppunder kysten.

Krikkand (*Anas crecca*). – Et par ble sett ved Levika (Nordenskiöldkysten) 19/6, og 6 individer (3♂♂, 3♀♀) på Nordøya (Forlandsøyane) 29/6, 1/7 (NPB).

Havelle (*Clangula hyemalis*). – Mellom Kapp Martin og Isfjord Radio ble 86 individer, hvorav 22 par, registrert 21–22/6. Dessuten hadde ca. 8 par tilhold ved Kapp Linné i siste del av juni. På Midtøya (Forlandsøyane) ble et par sett 29/6 (NPB). I Braganzavågen ble 32 individer sett 9/10 (ESN).

Svartand (*Melanitta nigra*). – Et par ble sett ved Fyrsjøen (Kapp Linné) 27/6 (NPB).

Stellers and (*Polysticta stelleri*). – En unghann i overgangsdrakt ble sett i ærfuglkolonien på Nordøya (Forlandsøyane) 4/7 (NPB). Dette er den første kjente observasjon av denne art fra Svalbard.

Praktærfugl (*Somateria spectabilis*). – Flere par hadde tilhold ved Kapp Linné. Et reir med to egg (ikke fullagt) ble funnet 27/6 (NPB).

Ringgås (*Branta bernicla hrota*). – To individer ble sett ved Kapp Linné 19/6, og 4 ved Sigridholmen (Kongsfjorden) 19/6. På Forlandsøyane hadde 59 individer, hvorav 18 par, tilhold i slutten av juni (NPB).

Hvitkinngås (*Branta leucopsis*). – To hvitkinngjess ble sett ved Reinodden, Recherchefjorden 1/6 (BF). Mellom Kapp Martin og Isfjord Radio ble 72 individer sett 21/6–22/6. Hekking fant antagelig sted ved Diabaspynten, St. Hansholmane og Solfonnbekken. Et par hadde dessuten tilhold i Fyrsjøen 24/6 (NPB). Ved Leinstranda (Brøggerhalvøya) ble 4 individer sett 12/8 (MB). På Forlandsøyane hadde 60 individer, hvorav 25 par, tilhold i slutten av juni (NPB).

Kortnebbgås (*Anser fabalis brachyrhynchus*). – To kortnebbgjess ble sett på Reinodden, Recherchefjorden, og 23 på Ahlstrandodden 30/5 (BF). Mellom Kapp Martin og Isfjord Radio ble 44 individer sett 21/6–22/6. På Forlandsøyane hekket 8 par, samt ett par på Lortholmen. I dette området hadde ca. 200 mytende kortnebbgjess tilhold i første uke av juli (NPB). Ved Isfjorden ble to flokker på henholdsvis 17 og 81 sett så sent som 15/9 (ESN).

Jaktfalk (*Falco rusticolus* (ssp ?)). – Ett individ ble observert 23/10 ved Sveagruva (ESN).

Sandlo (*Charadrius hiaticula*). -- Arten forekom fåtallig ved Kapp Linné. Spredte individer ble dessuten sett på Nordøya og Hermansenøya. De hekket antagelig på vestkysten av Forlandsletta (NPB). For øvrig foreligger observasjoner fra Longyearbyen og Ny-Ålesund (MB). I Adventfjorden ble arten om høsten sist sett 11/9 (ESN).

Steinvender (*Arenaria interpres*). – Ved Recherchefjorden såes 3 individer 19/6, og 2 individer 20/6 (BF). Ved Kapp Linné såes 1–10 daglig medio juni. Et reir ble funnet der 25/6. På strekningen Kapp Martin–Isfjord Radio ble 5 individer sett 19/6–22/6. På Forlandsletta ble enkeltindivider sett 2/7 og 5/7. Arten hekket antagelig i Ny-Ålesund (NPB). Ett individ ble sett under trekk sør for Bjørnøya 25/8 (MB).

Rødstilk (*Tringa totanus*). – Ett individ ble hørt 29/6 på Nordøya (NPB).

Polarsnipe (*Calidris canutus*). – Ett individ ble sett ved Kapp Linné 13/6, og 5 på Nordøya 4/7 (NPB).

Myrsnipe (*Calidris alpina*). – Enkeltindivider ble registrert ved Kapp Linné, Forlandsøyane og Hermansenøya (NPB). Ved Adventfjorden ble 5 individer sett 6/9 (ESN).

Sandløper (*Crocethia alba*). – En sandløper ble sett ved Kapp Linné 14/6, og to 15/6. Ved Marvågen (Nordenskiöldkysten) ble sett en 21/6. På Forlandsøyane ble 4 sandløpere sett 29/6, og en 1/7 (NPB).

Polarsvømmesnipe (*Phalaropus fulicarius*). – Ett individ ble sett 6/9 ved Adventfjorden (ESN). Dette er den seneste kjente høstobservasjon fra Svalbard, idet Løvenskiold (1964) anfører at det ikke foreligger noen observasjoner av arten senere enn 20/8.

Svømmesnipe (*Phalaropus lobatus*). – Ett eksemplar ble funnet dødt ved Isfjord Radio 15/6 (NPB).

Polarjo (*Stercorarius pomarinus*). – To individer ble sett i Tempelfjorden 25/7, og ett ved Kiærfjellet (Brøggerhalvøya) 1/8 (MB).

Fjelljo (*Stercorarius longicaudus*). – Ett individ ble sett ved Kiærfjellet 2/8, og ett 5/8 (MB).

Storjo (*Catharacta skua*). – Ved kysten på Brøggerhalvøyas vestside ble det sett 5 enkeltindivider i tidsrommet 6/8–17/8 (MB).

Svartbak (*Larus marinus*). – Ett individ ble sett ved Calypsobyen 13/6 (BF). En svartbak ble sett ved Dunøyane 23/9 (ESN). To såes ved Kapp Linné 20/6. Et par hevdet territorium ved Kapp Guissez 22/6 (NPB).

Gråmåke (*Larus argentatus*). – Arten ble sett daglig ved Longyearbyen 23/8 –28/8 (ESN).

Sabinemåke (*Xema sabini*). – Ved Kiærfjellet ble ett individ sett 14/8, og ett 20/8 (MB).

Snøugle (*Nyctea scandiaca*). – En snøugle ble sett ved Knausheia (Brøggerhalvøya) 30/7, og en ved Kiærfjellet 11/8 (MB). Ved Vallunden (Van Mijenfjorden) ble en sett 18/10–20/10 (ESN).

Steinskvett (*Oenanthe oenanthe*). – Ved Kapp Linné ble 1–2 sett 19/6 og på Nordøya en hunn sett 29/6. Ved Ossian Sarsfjellet (Kongsfjorden) ble et par på matsamling sett 23/7. Observasjonen tydet på at paret hekket i nærheten (NPB). I Ny-Ålesund ble en hunn sett 21/8–22/8 (MB). To ble sett i Longyearbyen 17/9 (ESN).

Elvesanger (*Locustella fluviatilis*). – I en kortfattet rapport fra dr. NYHOLM nevner han at en hann av denne art ble fanget i Longyearbyen 6/9. Nærmere detaljer foreligger ikke. Dersom funnet er korrekt, er det første gang denne østeuropeiske arten er påvist på Svalbard. Funnet bør imidlertid granskes nærmere og underbygges med belegg. SALOMONSEN & RUDEBECK (1964) angir at elvesangeren i den senere tid har vist kraftige ekspansjonstendenser mot nordvest.

Løvsanger (*Phylloscopus trochilus*). – I sin kortfattede rapport angir dr. NYHOLM at en hunn av denne art ble fanget i Longyearbyen 25/8. Funnet er det første kjente fra Svalbard.

Gråsisik (*Carduelis flammea* (ssp ?)). – Ett meget lyst individ ble fanget ved Sveagruva 3/10 (ESN).

Fig. 1. *Moskus, Spitsbergen.*

Foto: M. LØVFALDLI

Lappspurv (*Calcarius lapponicus*). – En død, velbevart lappspurvhunn ble funnet ved Aavatsmarkbreen (Brøggerhalvøya) 14/7 (GRC) og levert til forfatteren. Ut fra litteraturen er denne arten tidligere ikke funnet i Svalbard-området. I en upublisert rapport til Norsk Polarinstitutt fra dr. NYHOLM i 1967 angis imidlertid en observasjon av en lappspurv ved Kapp Dunér på Bjørnøya 5/6 1967.

Litteratur

LØVENSKIOLD, H. L., 1964: Avifauna svalbardensis. *Norsk Polarinst. Skr.* Nr. 129.
SALOMONSEN, F. & G. RUDEBECK, 1964: *Nordens Fugler.* (15), 553–616. Tanums Forl. Oslo.

Norsk Polarinstitutts virksomhet i 1968

AV

TORE GJELSVIK

Organisasjon og administrasjon

Personale

Norsk Polarinstitutt hadde i 1968 32 faste stillinger, det samme som ved utgangen av forrige år. KNUT JØRGEN VABRÅTEN ble fra 1. januar ansatt i den ledige stillingen som laborant i særklasse. Karttegner MAGNE GALÅEN hadde permisjon til 15. juli. Ellers var det ingen endring i den faste staben.

Midlertidig engasjerte:

Fullmektig ELI HOLMSEN
Assistentbibliotekar VIBEKE EEG-HENRIKSEN
Assistentbibliotekar INGRID DEVOR
Bibliotekar KJELL SEIPPEL
Cand. real. YNGVAR GJESSING
Cand. mag. LEIF-EGIL LØRUM
Cand. mag. MAGNAR STUBERG
Stud. real. TOR ERIK LYNNEBERG
Student KAROL MIŠUTTA
Tegner RUNE ANDERSSON
Assistent SIDSEL PAASKE
Assistent TURID SKANCKE

Stipend og forskningsbidrag er ytt til:

Cand. mag. OLAV ORHEIM, stipend til bearbeidelse av materiale fra ekspedisjoner til Dronning Maud Land og Svalbard. Han arbeidet i lengre perioder ved instituttet.

Lektor ODD LØNØ, stipend til bearbeidelse av innsamlet materiale om isbjørn.

Dr. philos. JOHANNES KJENSMO og cand. real. ANDERS BØYUM, reisestipend for limnologiske studier på Svalbard.

Forfatteren HELGE INGSTAD, bidrag til bearbeidelse av materiale fra Vinland-undersøkelsene.

Oppnevnelser:

Direktør TORE GJELSVIK ble oppnevnt til medlem av det rådgivende utvalg i NAVF for den norske vitenskapelige helårsstasjon i Ny-Ålesund, og av "Study Group for Economic Deposits" under "The International Geologic Correlation Programme", som skal iverksettes av Den Internasjonale Geologunion og UNESCO.

Underdirektør KAARE Z. LUNDQUIST ble i desember oppnevnt av UD til medlem av forhandlingskommisjon i anledning dansk billighetserstatning til eiere av norske hytter på Øst-Grønland.

REGNSKAPET FOR 1968:

Kap. 950, Poster:	*Bevilget*	*Medgått*
1. Lønninger	kr. 1 356 900	kr. 1 451 567
9. Deltakelse i antarktisekspedisjon	» 30 000	» 59 785
10. Kjøp av utstyr	» 340 000	» 339 845
15. Vedlikehold	» 35 800	» 41 000
20. Ekspedisjoner til Svalbard og Jan Mayen	» 720 000	» 714 058
22. Overvintringsekspedisjon Svalbard 1968/69	» 25 000	» 25 000
29. Andre driftsutgifter	» 290 000	» 303 406
70. Stipend	» 40 000	» 33 700
	kr. 2 837 700	kr. 2 968 361
Kap. 31. Fyr og radiofyr på Svalbard	kr. 25 000	kr. 24 055
Kap. 340. Forskningsstasjon på Svalbard:		
9. Driftsutgifter	kr. 110 000	kr. 58 642
30. Innreiing og vitenskapelig utstyr	» 190 000	» 136 929
	kr. 300 000	kr. 195 571
Kap. 3950:	*Budsjettert*	*Innkommet*
1. Salgsinntekter	kr. 25 000	kr. 25 225
2. Refusjon fra Svalbardbudsjettet	» 300 000	» 300 000
	kr. 325 000	kr. 325 225
Kap. 4909.		
Tilfeldige inntekter	—	kr. 936

Kommentar til regnskapet:

Kap. 950.

Post 1. Lønninger. – Merforbruket skyldes vesentlig generelle lønnstillegg og justering av enkelte stillinger.

Post 9. Deltakelse i Antarktisekspedisjonen. – Merforbruket her er tillatt av departementet mot tilsvarende innsparing i 1969.

Kap. 340. Forskningsstasjon på Svalbard.

Mindreforbruket skyldes at byggearbeidene ble forsinket slik at stasjonen først kom i drift fra 1. oktober mot forutsatt 1. juni. Men bevilgningen til innreiing og vitenskapelig utstyr er overførbar til 1969.

Feltarbeid

NORGE

Breundersøkelser

Akkumulasjonen på Hardangerjøkulen ble målt flere ganger i løpet av vinteren, siste gang i begynnelsen av mai. I tiden 2/7–28/8 foretok hovedfagsstudent Jarle Land spesielle målinger av varmeutvekslingen over breoverflaten, kontinuerlig glasiometeorologisk registrering på breen, og målte samtidig ablasjonen på samtlige stenger hver uke. De siste observasjoner på Hardangerjøkulen ble utført 8/10.

På Storbreen ble akkumulasjonen målt 9/5 bare på noen spesielt utvalgte, representative områder. Ablasjonen ble målt 8/8–9/8 og siste gang 20/10, da fly ble nyttet til transport.

Hovedfagsstudent SIGMUND MESSEL oppholdt seg storparten av sommeren på Omnsbreen nord for Finse, der han for sin hovedfagsoppgave gjorde massebalanseundersøkelser, en fortsettelse av det arbeid han gikk i gang med året før.

Målingene viste at akkumulasjonen var uvanlig stor i Sør-Norge. Den øvre del av Hardangerjøkulen hadde således over 6 m snø, svarende til 3400 mm vann. Men ablasjonen var også stor, slik at Hardangerjøkulen hadde et overskudd på bare ca. 53 g/cm^2, mens Storbreen fikk omtrent balanse i sitt budsjett. Lengdevariasjonene av flere norske breer ble målt. De siste års økning av bremassen gjorde seg fortsatt gjeldende i 1968. Fire av de tolv målte breene rykte fram, mest Briksdalsbreen med 17 m.

Etter oppdrag fra Norsk Polarinstitutt ble breer i Jotunheimen flyfotografert av Widerøes Flyveselskap A/S i slutten av august.

På Finse ble det oppsatt en garasje til instituttets snøscooter for breundersøkelser. Byggekostnaden ble dekket av Vassdragsvesenet, som også deltar i breundersøkelsene.

SVALBARD

Norsk Polarinstitutts sommerekspedisjon med THOR SIGGERUD som leder omfattet 41 personer foruten besetningene på ekspedisjonsfartøyene. Tretten tilhørte instituttets faste personale, 24 var engasjert som assistenter, og 4 var engasjert til selvstendig vitenskapelig feltarbeid. Ekspedisjonen spente over et lengre tidsrom enn vanlig, idet en gruppe reiste med fly til Svalbard alt 22. april, og de siste var tilbake 13. september. Sommeren 1968 på Svalbard var temmelig kjølig, og issituasjonen var også noe spesiell. På nordkysten var det fra slutten av mai uframkommelig for skip. «Signalhorn» ble i juli og august tre ganger stoppet av isen i Smeerenburgfjorden på tur nordøstover. Fjerde gangen fartøyet forsøkte seg (25. august) kom det et stykke lenger (til Biskayerhuken). På vestkysten og i farvannet Hopen–Bjørnøya var det nesten ingen ishindringer. Derimot var det uråd å ta seg fram med skip østover rundt Edgeøya, der det var tett is hele sommeren. Den vanskelige issituasjonen nødvendiggjorde en del omlegging av planene, men alle ekspedisjonsdeltakerne fikk likevel utført fullverdig feltarbeid.

M/S «Signalhorn» med ni manns besetning, ført av BJARTE BRANDAL, ble overtatt av SIGGERUD i Ålesund 29/6. Ekspedisjonsutstyret ble innlastet dagen etter i Åndalsnes. På Svalbard ble fartøyet brukt til å sette ut partier, bringe dem forsyninger, forflytte dem og innhente dem for hjemreise. Da fartøyet 6/8 var innom Bodø for innlasting, gikk SIGGERUD fra borde, og KÅRE M. BRATLIEN overtok. Skipet ble tilbakelevert 3/9 i Åndalsnes.

O/S «Andenes» var utleid til Norsk Polarinstitutt av Sjøforsvaret. Fartøyet ble overtatt av hydrograf JOH. H. CHRISTIANSEN 12/7 i Bodø og tilbakelevert samme sted 11/9. Det hadde 33 manns besetning, og skipssjef var kapteinløytnant JOHAN PEDERSEN. Bortsett fra 4 døgn i tjeneste for Fellessambandet og 2 døgn for isbjørnundersøkelsene ble fartøyet nyttet til hydrografiske arbeider i farvannet Sørkapp–Hopen–Bjørnøya.

Norsk Polarinstitutts båthus på Hotellneset ved Longyearbyen ble i løpet av sommeren påbygd. Arbeidet, som tok 2½ arbeidsdag, ble utført av SIGGERUD og mannskapet på «Signalhorn».

Direktør GJELSVIK reiste til Tromsø med fly 14. juli, videre med «Andenes» til Longyearbyen og med «Signalhorn» til Ny-Ålesund. Ved siden av geologisk feltarbeid besøkte han feltpartier og vitenskapelige stasjoner på vestkysten av Spitsbergen. I Longyearbyen inspiserte han gruvene VI og VII, representerte staten ved utmålsforretning og konfererte med dr. SOKOLOV, den vitenskapelige leder for den sovjetiske geologekspedisjonen. Før tilbakereisen i midten av august tok han en rask tur med «Andenes» til Storfjorden for å besøke isbjørnforskerne og se på levendefangst og merking av dyr.

Hydrografi

I månedene juli og august fortsatte hydrograf HELGE HORNBÆK med assistentene OLE JOHAN BRØTHER, KJELL MAGNUS HAUGSTAD (fra 31. juli avløst av IVAR LUND-MATHIESEN, som tidligere hadde vært STEINES assistent) og SIVERT UTHEIM detaljloddingen med M/B «Svalis» i Krossfjorden, rundt Kapp Mitra og nordover langs land til Fjerdebreen. Dette området ble på det nærmeste ferdigloddet. Det ble også loddet noe utenfor Prins Karls Forland – mellom Kapp Sietoe og Fuglehuken. Partiet hadde base i Ebeltofthamna hele sesongen.

Hydrograferingsarbeidet med «Andenes» ble ledet av hydrograf JOHAN HENRIK CHRISTIANSEN med ingeniør EINAR NETELAND som teknisk leder. Det ble hydrografert i farvannet Sørkapp–Hopen–Bjørnøya med slavestasjoner på Sørkappøya og Bjørnøya. Assistentene FREDDIE GUNDERSEN og KJELL REPP passet stasjonen på Sørkappøya, og assistentene ODD LIEN og HARALD NORDBY stasjonen på Kapp Posadowsky (Bjørnøya). Etter at det var skiftet inn nye reléer i «Hi-Fix»-anlegget, fungerte det meget godt hele sesongen, og det ble benyttet på avstander opp til 130 n. mil. Været var stort sett meget godt, og arbeidet ble bare i kortere perioder noe hindret av tåke og drivis. Det ble loddet ca. 5200 n. mil over et område på ca. 3600 n. mil^2. Kartlegging av dette området har på grunn av den betydning det har for fiskeriene, vært prioritert siden «Hi-Fix»-systemet ble anskaffet i 1963, men isforholdene har hittil hindret arbeidet der.

Topografi

Geodet OLA STEINE ledet to feltpartier på Svalbard: et vårparti i tiden 28/5–27/6 med ARNE STENSRUD og JAN STEINE som assistenter og et sommerparti i tiden 7/7–1/8 med IVAR LUND-MATHIESEN som assistent. Vårpartiet drog fra Ny-Ålesund med snøscooter innover Kongsvegen til Tre Kroner, utførte passpunktmålinger i området fra Palatiumfjellet i sør til Snøfjella i nord og foretok en del triangulering. Norsk Polarinstitutt har ikke før drevet topografisk feltarbeid på Svalbard så tidlig på året, og en var derfor spent på hvordan resultatet

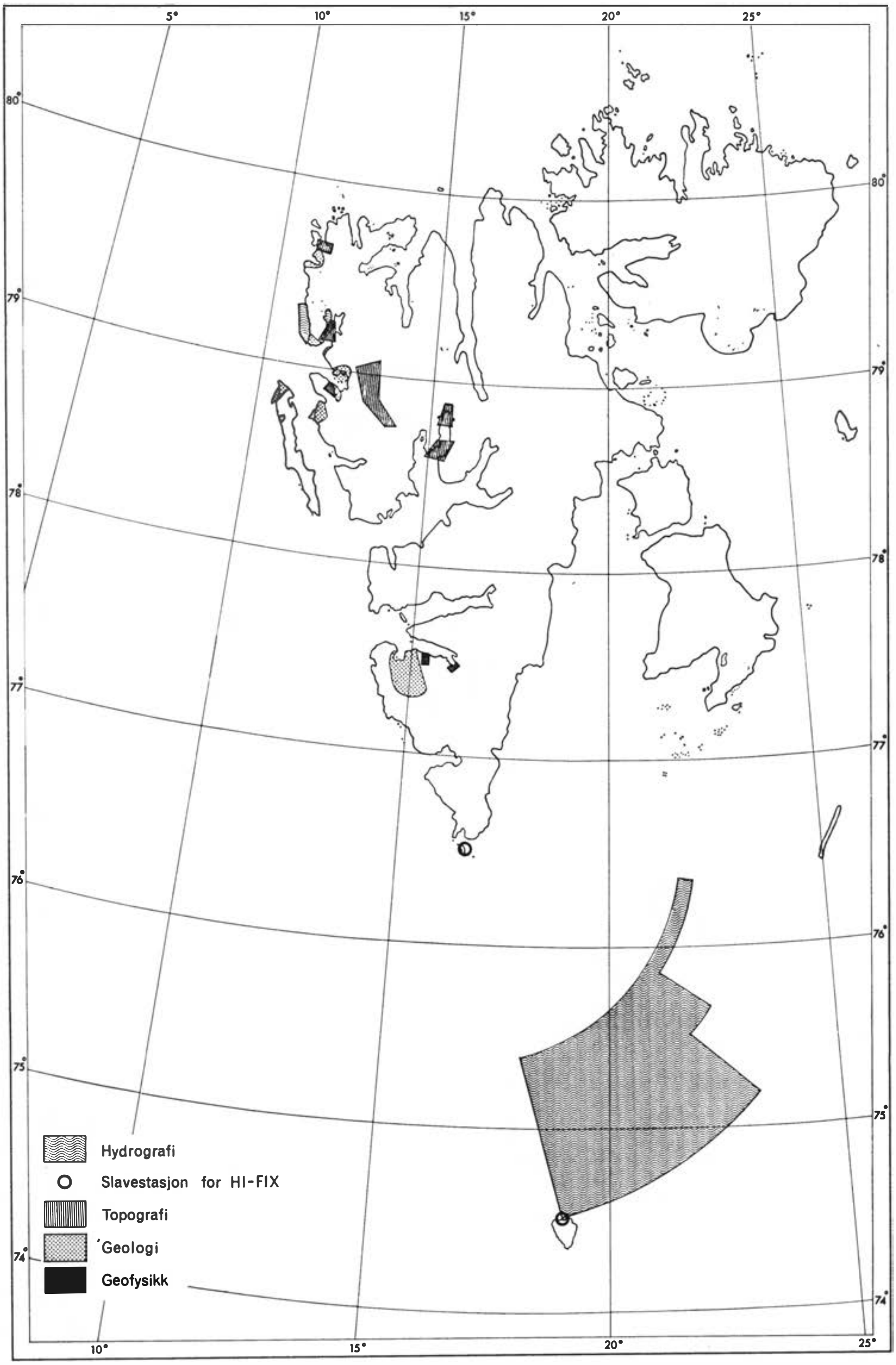

Fig. 1. *Kartet viser hvor Norsk Polarinstitutts feltpartier, unntatt biologpartier, arbeidet sommeren 1968.*

skulle bli. Faglig ble resultatet bedre enn ventet. Vardene var blottet og enkle å finne, men på grunn av nysnø kunne det være heller vanskelig å ta ut egnede passpunkter. Både observatør og assistent på et landmålerparti må stå stille i flere timer, med den relativt lave temperatur på den årstid var det ofte en sur jobb å få observasjonene i en stasjon vel utført. Sommerpartiet ble transportert rundt med ekspedisjonsfartøyet «Signalhorn» og målte passpunkter ved Dicksonfjorden, Kongsfjorden, Krossfjorden og Bjørnfjorden, men på grunn av ishindringer kom ikke fartøyet lenger nord.

Geologi

TORE GJELSVIK med assistentene TOR ANDERSEN og EYSTEIN GJELSVIK kunne på grunn av ishindringer på nordkysten ikke få gjennomført de planlagte undersøkelser der. Isteden gjorde partiet geologiske undersøkelser innen Hecla Hoekbergartene ved Kongsfjorden og på nordspissen av Prins Karls Forland i tiden 20/7–6/8.

HARALD MAJOR foretok i mars en befaring av den statseide Gruve VII ved Longyearbyen i forbindelse med et omfattende arbeid med kullforekomstene i dette området.

AUDUN HJELLE og BOYE FLOOD fortsatte arbeidet fra året før med å kartlegge bergartene innen Hecla Hoek-komplekset i området mellom Bellsund og austre Torellbreen. Som assistenter deltok ALASDAIR H. NEILSON, KNUT JORDE og NILS RØREN. Partiene startet fra Longyearbyen med snøscootere 24/4 og drog derfra til bunnen av Van Mijenfjorden, opp Paulabreen, sørover og ned Doktorbreen til Van Keulenfjorden, hvor det på sørsiden året før var utlagt depot. I tidsrommet 9/5–9/6 drev de kartlegging fra en hovedbase på Antoniabreen. Senere, inntil avhenting den 25/6, foregikk kartleggingen fra base i Calypsobyen.

EINAR TVETEN med assistentene OLA RØYRVIK og KARL-OTTO TENNØE ble 8/7 satt i land på Mitrahalvøya, der de fortsatte kartleggingen i dette område inntil de 1/8 ble flyttet til Engelskbukta, sør for Brøggerhalvøya. Her fortsatte partiet kartleggingen sør for bukta til det ble hentet 28/8.

Dr. YOSHIHIDE OHTA med assistentene CHRISTOFFER HEFFERMEHL og SVERRE MØLLER skulle etter planen ha arbeidet på Vasahalvøya, men på grunn av issituasjonen ble arbeidet forlagt til området mellom Sørgattet og Magdalenefjordens sørkyst. Partiet kartla dette området i tidsrommet 8/7–24/8 og utførte detaljerte undersøkelser i gneiskomplekset her.

Geofysikk

OLAV LIESTØL, som ledet et parti på Svalbard i slutten av mai og i juni med assistentene FINN HAGEN og JØRGEN BJELKE, fortsatte undersøkelsene av breer ved Van Keulenfjorden, spesielt Finsterwalderbreen. Han målte akkumulasjon, ablasjon og temperatur i flere snitt og borehull i breene. Dessuten utførte han en del triangulerings- og nivelleringsarbeider.

De helårlige målingene på austre Brøggerbreen og midre Lovénbreen ble utført av JENS ANGARD, som er stasjonert i Ny-Ålesund.

Glasiolog RANDI PYTTE utførte for Norsk Polarinstitutt i tiden 9/8–23/8 spesielle arbeider på breene ved Ny-Ålesund, særlig trianguleringsarbeider.

VIDAR HISDAL og TORGNY VINJE oppholdt seg i Ny-Ålesund fra slutten av mai til slutten av juni. HISDAL fortsatte målingene av sol- og himmelstrålingens spektrale intensitetsfordeling og foretok dessuten en del andre, supplerende undersøkelser av strålingsforholdene. VINJE målte de forskjellige komponenter av globalstrålingen og registrerte jordoverflatens albedo samt strålingsbalansen. Han foretok dessuten omkring 500 avlesninger av temperaturfordelingen i den nederste halve meter over snøoverflaten. Middelprofilet viste en markert siksakform.

I september deltok VINJE i isrekognosering fra fly i området omkring Svalbard etter innbydelse fra US Naval Oceanographic Office ("Birds Eye"-prosjektet).

Biologi

MAGNAR NORDERHAUG med assistentene SIGMUND HÅGVAR og BJØRN MATHIASSEN arbeidet vesentlig med ornitologiske undersøkelser på Spitsbergen (Nordenskiöld Land, Kongsfjorden, Krossfjorden) og Prins Karls Forland i tidsrommet 13/6–29/7. Partiet undersøkte produksjonsforholdene hos ærfugl og kartla hekkelokaliteter for ærfugl og gjess som et ledd i planleggingen av naturreservater på Svalbard. En del insektmateriale ble dessuten innsamlet, og 1013 sjøfugler (havhest, polarlomvi og krykkje) ble ringmerket. En ny fugleart for Svalbard, Stellers and, ble registrert.

ALASDAIR H. NEILSON arbeidet som assistent på FLOODS og HJELLES geologpartier i tiden 24/4–25/6 i Wedel Jarlsberg Land, der han fikk anledning til å gjøre iakttakelser over plantelivet så tidlig på året. Senere, i månedene juli og august, ledet han et biologparti med assistentene ARNE INGVAR DALLAND og PER EIDE DYRHAUG. Partiet gjorde botaniske undersøkelser på Spitsbergen (Kongsfjorden, Hornsund) og på Edgeøyas nordre del. Planter ble innsamlet fra 27 lokaliteter på Spitsbergen og fra 14 lokaliteter på Edgeøya. Fire nye plantearter ble registrert. For øvrig ble jord- og algeprøver innsamlet fra en rekke steder.

Fyr og radiofyr

Utskifting av gassflasker og batterier i lys- og radiofyr samt tenning av fyrene ble utført i august av BRATLIEN, delvis med hjelp fra mannskapet på «Signalhorn».

Radarstasjonen på Kapp Linné er nedlagt inntil videre, etter at behovet for den har avtatt de senere år.

Samarbeidende ekspedisjoner

En zoologisk ekspedisjon fra Universitetet i Oslo til de østlige Svalbardfarvann i august ble ledet av cand. real. THOR LARSEN. Formålet var å fortsette arbeidet med merking og undersøkelse av isbjørn som et ledd i et forskningsprosjekt som utføres i samarbeid mellom Universitetet i Oslo og Norsk Polarinstitutt. Ekspedisjonen, som arbeidet fra M/S «Polstjerna», ble i det vesentlige finansiert av World Wildlife Fund med støtte fra Norsk Polarinstitutt til gjennomføringen. I alt 32

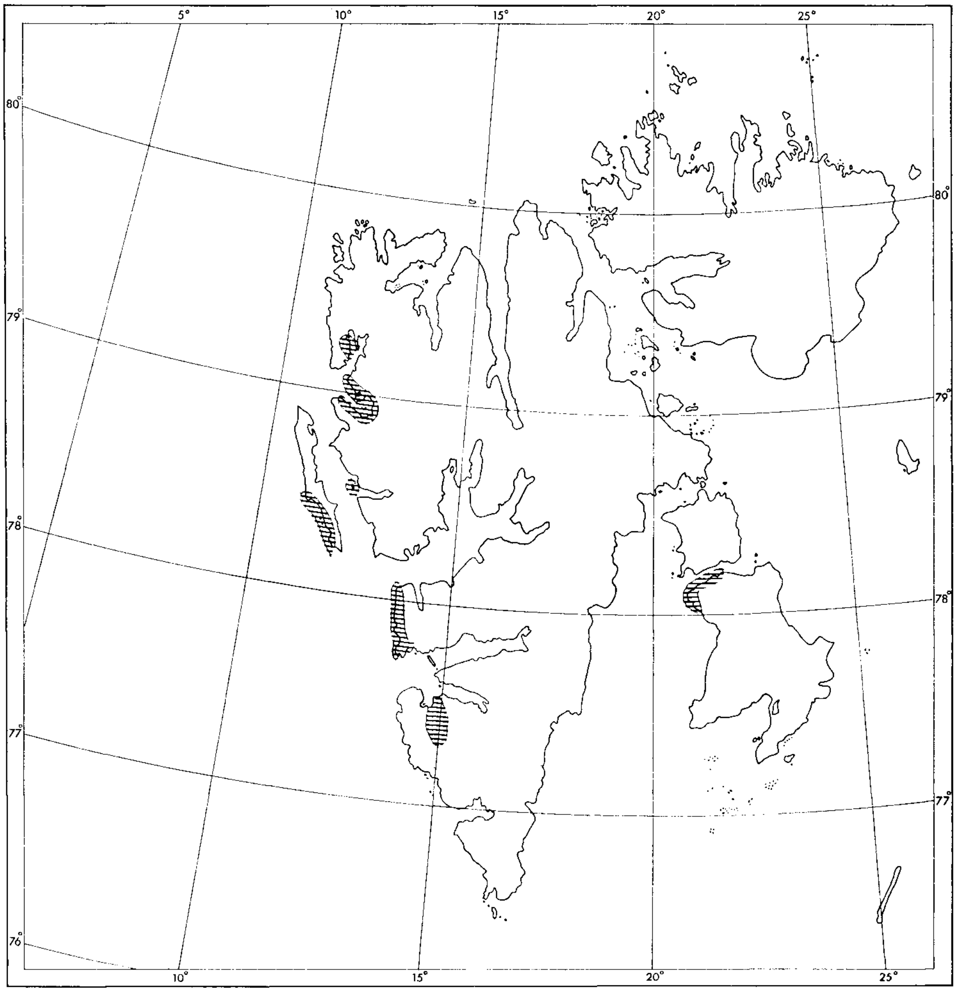

Fig. 2. *Kartet viser hvor Norsk Polarinstitutts biologpartier arbeidet sommeren 1968.*

levende isbjørn ble fanget ved hjelp av muskellammende midler, herav en gjenfangst fra 1967. Prøver av blod, melk og tenner ble innsamlet for nærmere analyser. Med på ekspedisjonen foruten lederen var: dr. Charles Jonkel, Canadian Wildlife Service, dr. Albert W. Erickson, University of Minnesota, to fotografer fra World Wildlife Fund, som alle reiste tilbake før vinteren, og nederlenderen Eric Flipse, medlem av den nederlandske vinterekspedisjon, som deltok som observatør. Dessuten deltok assistentene Kjell Reidar Hovelsrud og Per Johnson – sistnevnte ble for vinteren avløst av Tor Andersen, som tidligere på sommeren hadde vært direktør Gjelsviks assistent. Cand. real. Nils Are Øritsland sluttet seg til ekspedisjonen utpå høsten, da den slo seg ned på Andréetangen på Edgeøya for overvintring.

En nederlandsk zoologisk overvintringsekspedisjon, som samarbeidet vinteren 1968–69 med forannevnte ekspedisjon i isbjørnundersøkelsene, ble i august fraktet fra Bodø med utstyr og forsyninger av «Signalhorn». Ekspedisjonen, som skulle landsettes på Halvmåneøya, måtte endre sine planer om vinterkvarter og slå seg ned på Kapp Lee på den nordlige del av Edgeøya, siden isen i Halvmånesundet og mangelen på landråker ved Halvmåneøya ikke tillot landsetting der. Sammen med ekspedisjonen fulgte også lederen for de nederlandske isbjørnundersøkelsene, dr. A. VAN WIJNGAARDEN (Riksinstitutt for naturvernforskning, Zeist, Nederland), to nederlandske fjernsynsfolk og to bygningssnekkere, som alle reiste tilbake før vinteren.

Det såkalte "Astrogeophysical project Spitsbergen 1968–70" ble satt i gang av professor PAUL MELCHIOR fra Internasjonal Center of Earth Tides, Bryssel, dosent MANFRED BONATZ fra Universitetet i Bonn og geodet JAN CHR. BLANKENBURGH fra Norges geografiske oppmåling. De oppholdt seg i Longyearbyen i midten av juni for å undersøke mulighetene for å installere måleinstrumenter i en kullgruve for å registrere bølger i jordskorpa. Norsk Polarinstitutt skaffet geologiske opplysninger for prosjektet og bistod med praktiske råd.

Norsk Polarinstitutt hadde påtatt seg å legge ut depoter for WALLY HERBERTS transpolare ekspedisjon på nordkysten av Svalbard (Gråhuken, Kinnvika, Depotodden). Lasten ble tatt ombord i «Signalhorn» i Ålesund 29. juni, men på grunn av ishindringer kom ikke fartøyet lenger nord enn til Biskayerhuken, der et depot ble utlagt 25. august. Resten av lasten til depotene ble deponert i Longyearbyen hos sysselmannen på Svalbard i påvente av senere utsetting med «Nordsyssel».

Limnologene dr. philos. JOHANNES KJENSMO og cand. real. ANDERS BØYUM fra Limnologisk institutt ved Universitetet i Oslo, som i august undersøkte Linnévatnet, fikk foruten stipend til Svalbardturen og en del forsyninger også låne utstyr, som ble transportert til og avhentet fra Kapp Linné med «Signalhorn».

ANTARKTIS

Cand. real. YNGVAR GJESSING vendte tilbake 24. februar etter å ha deltatt i den amerikanske ekspedisjon "South Pole–Queen Maud Land Traverse III".

Den norske Antarktisekspedisjon 1968/69, som arbeidet i Vestfjella i vestre Dronning Maud Land i tiden 22/11–20/1, var den første norske ekspedisjon til disse områder siden ekspedisjonen med base i Norway Station 1956–60. Den kom i stand ved et generøst tilbud fra U.S. National Science Foundation om logistisk assistanse. Feltarbeidet omfattet geodesi-topografi, geologi, glasiologi og observasjoner over vær, magnetfelt, dyre- og planteliv. Ekspedisjonens medlemmer var THORE S. WINSNES, leder, og AUDUN HJELLE, geologer; TORBJØRN LUNDE, glasiolog; DAG NORBERG, topograf; OLA STEINE, geodet, og KÅRE M. BRATLIEN, radiotelegrafist og mekaniker. (Se for øvrig rapport om ekspedisjonen på s. 55.)

Arbeid ved avdelingene

Hydrografi

Sjøkartene 504, 505 og 510 ble revidert med modernisering og korreksjoner, blant annet av brefronter etter de siste flyfotografier. Omarbeidet utgave av sjøkart 503 ble ferdigtegnet og innlevert til reproduksjon og trykking. Det ble foretatt beregning og konstruksjon av ny omarbeidet utgave av sjøkart 507. De siste års tidevannsregistreringer fra Longyearbyen ble gjennomgått, og middelvannet beregnet. For havloddingen ble det beregnet og konstruert loddeoriginaler, og loddingene fra sommeren 1967 ble redigert.

Ved beregning og konstruksjon av loddeoriginalene for sommerens arbeider ble det konstatert en differanse mellom elektronisk og geodetisk avstand på ca. 500 m mellom stasjonene på Sørkappøya og Kapp Posadowsky (Bjørnøya). Årsakene til dette antas å ligge i loddavvikelser ved de astronomiske observasjoner som ligger til grunn for de geodetiske nett på henholdsvis Spitsbergen og Bjørnøya. Spørsmålet om posisjonsbestemmelser her ved satellittobservasjoner er derfor tatt opp. Redigeringen av ekkogrammene for 1968 vil derfor bli utsatt til nevnte avstand og eventuelle andre feilkilder er kontrollert.

Topografi–geodesi

Ved topografisk avdeling ble observasjoner fra *Svalbard* siste sommer og fra tidligere år beregnet. – Barentsøya, Tusenøyane og deler av Edgeøya ble konstruert, særlig med tanke på kartserien Svalbard 1:500 000. Videre ble i denne serien utført mindre korreksjoner på blad 1 (Vestspitsbergen, søre del) og blad 3 (Vestspitsbergen, nordre del). – Aerotrianguleringer ble utført med en ny Wild A7 autograf med tilleggsutstyr. Beregningene av dette materialet ble gjort av Norges geografiske oppmåling. – Kartblad B8 St. Jonsfjorden i serien Svalbard 1:100 000 ble konstruert i autografen. – Ajourføring og rettelser på en del kartblad i serien Namnekart Svalbard 1:100 000 ble foretatt, og det ble nedlagt noe arbeid på nye kart i målestokk 1:1 000 000 over flyfotograferingene. – Et kart over austre Brøggerbreen ble konstruert i målestokk 1:20 000, og det ble ytt hjelp ved konstruksjon av brekart i *Jotunheimen.*

Det ble arbeidet med stedsnavn i *Dronning Maud Land* og med kartserien Dronning Maud Land 1:500 000/1:250 000. I sistnevnte målestokk ble kartblad L5 Humboldtfjella og M5 Wohlthatmassivet utgitt.

Geologi

HARALD MAJOR fortsatte utarbeidelsen av kartbeskrivelsen til det geologiske kart Adventdalen og deltok i konferanse om utmålsspørsmål, særlig i forbindelse med overføring av statens utmål til Adventdalens Kullfelter A/S. Sammen med J. NAGY besørget han utmålsandragende på kull- og oljefelter innsendt. Han var med på behandlingen av forslag til sikkerhetsbestemmelser ved boring på Svalbard og førte videre arbeidet med undersøkelsen av kullforekomsten i den statseide Longyear Gruve VII. Med professor MELCHIOR fra Belgia og representanter for Norges geografiske oppmåling drøftet han plassering av instrumenter i kullgruver på Svalbard for måling av jordskorpens «tidevannsbevegelser».

THORE S. WINSNES bearbeidet kartmateriale fra de to siste somrers feltarbeid med henblikk på oljestrukturer og fortsatte redigeringen av et geologisk kart over Svalbard i målestokk 1:500 000. Han gjorde forberedelser til Den norske antarktisekspedisjon 1968/69, planla feltarbeidet og utarbeidet lister over utrustning og vitenskapelig utstyr. Den 20. oktober reiste han til Antarktis som leder for denne ekspedisjon (se egen rapport s. 55). For Årbok 1967 skrev han notisen "What is 'Mumiyo' from Antarctica?".

AUDUN HJELLE bearbeidet materiale samlet i Bellsundområdet 1967 og forberedte en tidlig ekspedisjon til Svalbard, som foregikk 22/4—1/7. Etter ekspedisjonen bearbeidet han innsamlet materiale og gjorde forberedelser for ekspedisjonen til Antarktis, dit han reiste 5. november. For Årbok 1967 skrev han artikkelen "Stratigraphical correlation of Hecla Hoek successions north and south of Bellsund" og notisen "Comparison of chemical and modal analyses of granitic rocks from Svalbard".

BOYE FLOOD fortsatte bearbeidelsen av feltmateriale fra sørsiden av Bellsund og førte tilsyn med ordning av prøver, kartmateriale og typesamling. Mot slutten av året overtok han arbeidet med det geologiske kart over Svalbard (sørvestre del) 1:500 000 etter T. S. WINSNES. For Årbok 1967 skrev han artikkelen "Sulphide mineralizations within the Hecla Hoek complex in Vestspitsbergen and Bjørnøya".

JENÖ NAGY deltok i behandlingen av spørsmål vedrørende oljeundersøkelser på Svalbard. Han skrev ferdig sin hovedfagsoppgave til embetseksamen («Øvre del av underkritt og dens albiske ammonittfaunaer på det sørlige Spitsbergen») og avla eksamen ved Universitetet i Oslo i geologi hovedfag.

Geofysikk

OLAV LIESTØL bearbeidet innsamlet observasjonsmateriale. På grunnlag av flyfotografier, tatt august 1968 av breer i Jotunheimen, konstruerte han nye kart i målestokk 1:10 000 over Storbreen og Tverråbreen. For Årbok 1967 skrev han artikkelen "Bremålinger i 1967".

VIDAR HISDAL fortsatte bearbeidelsen av høydevinden over Maudheim og fullførte en sammenlignende undersøkelse av sol- og himmelstrålingens spektralfordeling på høye og midlere breddegrader (publisert i Årbok 1967 under tittelen: "A comparative study of the spectral composition of the zenith sky radiation"). Apparaturen for strålingsmålingene ble forbedret og komplettert. For årboka utarbeidet han også en beskrivelse av værforholdene på Svalbard i 1967.

TORGNY VINJE utarbeidet ukentlige isoversikter på grunnlag av innsamlete observasjoner av havisen. Fra våren 1968 har Meteorologisk Institutt oversendt satellittbilder, noe som har økt vårt kjennskap til havisens utbredelse i vesentlig grad. Det ble utarbeidet nytt kart til bruk under observasjonsarbeidet. For månedene mars—september blir nå isgrensen bestemt fra Novaja Zemlja i øst til Island i vest, vesentlig på grunnlag av satellittbildene, som ikke er brukbare til dette formål i den mørke årstid. Oversiktene sendes på anmodning til en rekke norske og utenlandske interessenter. For årboka utarbeidet VINJE en beskrivelse av isforholdene ved Svalbard i 1967.

Biologi

MAGNAR NORDERHAUG tok seg av henvendelser vedrørende arktisk dyreliv og planlagte biologekspedisjoner til Svalbard, og hadde en god del saksbehandling i tilknytning til SCARs virksomhet. Han samlet inn og bearbeidet biologisk observasjonsmateriale fra feltgrupper på Svalbard, og tilrettela et program om natur og dyreliv på Bjørnøya for Skolekringkastingen. Han utarbeidet et foredrag, "Present status of the Svalbard–Franz Josef Land population of the Light-bellied Brent Goose (*Branta bernicla hrota*)", førte videre andre arbeider om svalbardgjessenes status og bearbeidet et større materiale om bestandsstørrelse og produksjonsforhold hos ærfugl på Spitsbergen. Videre begynte han på et arbeid om svalbardreinen. For Årbok 1967 skrev han to artikler: «Hvalrossens (*Odobenus rosmarus*) forekomst i Svalbardområdet 1960–1967» og «Iakttagelser over dyrelivet på Svalbard 1967».

Arbeidsgruppen for viltstell og naturvern på Svalbard med NORDERHAUG som formann fremmet i april–mai «Utkast til bestemmelser om jakt på isbjørn» for myndighetene. Den tok deretter opp to andre spørsmål til vurdering: revisjon av de øvrige jaktbestemmelsene for Svalbard og planlegging av nasjonalparker og naturreservater på øygruppen.

Biblioteket

I årets løp ble det katalogisert 180 nye bøker, hvorav 49 var innkjøpt. Av serier og tidsskrifter abonnerer instituttet på 32 publikasjoner, derav ble to nytegnet, mens to ble forandret til bytte. Over 430 serier ble mottatt i bytte. Alle sovjetiske serier ble registrert. Seks nye bytteforbindelser ble opprettet, og ti ble oppsagt eller overført til andre institusjoner. Småskriftsamlingen steg med 200 nummer til 5300. På grunnlag av katalogkortene, som nå xerox-kopieres, utarbeides det tilvekstlister, som distribueres til interesserte. Katalogiseringen av gammel bestand, som har foregått ved ekstrahjelp, ble ikke fullført, idet atlas, biografier og de fleste av tidsskriftene gjenstår. Biblioteket har formidlet 70 lån fra andre biblioteker. Den stadig voksende kartsamlingen ble det heller ikke i 1968 tid til å ordne og katalogisere. Fru VIBEKE EEG-HENRIKSEN utførte en del av det daglige rutinearbeidet, idet SØREN RICHTER hadde fått i oppdrag å bearbeide materiale om nordmenns innsats på Øst-Grønland.

Konsulent- og informasjonstjeneste

Administrasjonen og de forskjellige fagavdelinger tok seg av konsulent- og informasjonstjenesten innenfor sine fagområder.

PETER HAGEVOLD arbeidet med Årbok 1967, gjennomgikk innkommen russisk faglitteratur og oversatte for instituttets medarbeidere.

SØREN RICHTER ble konsultert i spørsmål om polaregnenes arkeologi, etnografi, geografi og historie.

Instituttets billedtjeneste har ikke kunnet varetas forsvarlig på grunn av manglende arbeidshjelp.

ELI HOLMSEN har fortsatt hatt den tekniske bearbeidelsen av publikasjoner til trykking og vært redaksjonssekretær for instituttets årbok.

Forskningsstasjonen på Svalbard

I juli inngikk Norsk Polarinstitutt en leieavtale med Kings Bay Kull Company A/S om å disponere selskapets kontorsjefbygning og gruveverksted til den vitenskapelige stasjon. Kontrakten gir også instituttet rett til å disponere et naust. Norges Teknisk-Naturvitenskapelige Forskningsråd tok på seg etter regning å legge inn vann, kloakk, lys og varme i kontorbygningen. Oppussings- og reparasjonsarbeider på bygningene ble utført av personalet ved NTNFs telemetristasjon med materialer fraktet til Ny-Ålesund med ekspedisjonsfartøyet «Signalhorn». En del utstyr til bygningene ble sendt opp med «Signalhorn» og M/S «Polarbjørn». Arbeidet med oppretting av den vitenskapelige forskningsstasjonen i Ny-Ålesund var til årets utgang kommet så langt at den var i brukbar stand.

For vinteren 1968–69 er konstruktør JENS ANGARD, som tidligere har arbeidet i Ny-Ålesund for Det norske institutt for kosmisk fysikk (Nordlysobservatoriet), ansatt til å passe stasjonen og drive det registreringsarbeid som nå foregår der (vinteren 1968/69): seismiske registreringer for Jordskjelvstasjonen ved Universitetet i Bergen, ionosfæreundersøkelser, magnetiske registreringer og osonmålinger for Det norske institutt for kosmisk fysikk, Blindern, nordlysstudier for Nordlysobservatoriet i Tromsø, solarimetermålinger og glasiologiske målinger for Norsk Polarinstitutt.

Reiser, møte- og kursvirksomhet

Direktør GJELSVIK deltok i tiden 3.–15. juni i Tokyo i det 10. SCAR-møte, i geologisk arbeidskomité under SCAR og i ekspertmøte for logistikk. I Finland deltok han 23.–26. september i det nordiske geologiske direktørmøte. Han var deltaker i den norske delegasjon til det 5. konsultative møte om antarktistraktaten i Paris 18.–29. november, og på Voksenåsen (Oslo) møtte han 6.–7. desember i Nordisk Maringeologisk Kommisjon.

Underdirektør LUNDQUIST representerte Norsk Polarinstitutt ved ekspressrutens åpningstur til Svalbard med M/S «Harald Jarl» 8.–20. juni etter innbydelse fra Nordenfjeldske Dampskibsselskab. Den 17.–18. desember deltok han som rådgiver i forhandlinger mellom det norske og det danske utenriksdepartement i København om billighetserstatning til norske eiere av fangsthytter og hus på Øst-Grønland.

HÅKON HILL representerte Norsk Polarinstitutt ved Den XI internasjonale kongress for fotogrammetri i Lausanne, Sveits, i tiden 8.–20. juli.

OLA STEINE besøkte Det Danske Meteorologiske Institut, København, 25.–27. september for kalibrering av magnetometre.

I Det 8. nordiske geologiske vintermøte i Lund 8.–10. januar deltok THOR SIGGERUD, AUDUN HJELLE og BOYE FLOOD, der de holdt foredragene henholdsvis «Om Svalbards fjorder og deres dannelse», «Nyere undersøkelser i metasuprakrustal-migmatitt-området på Nordvest-Svalbard» og «Sulfidmineraliseringer innen Hecla Hoek-komplekset på Vestspitsbergen».

I mars deltok SIGGERUD i møte i Freiberg, Øst-Tyskland, i Underkommisjonen for det tektoniske europakart, der han holdt foredrag om «Orogene Hauptzüge des Svalbardgebietes».

Geologene HARALD MAJOR, THORE S. WINSNES, THOR SIGGERUD og BOYE FLOOD var i august i Tsjekkoslovakia for å delta i Den 23. internasjonale geologkongress, som ble avbrutt ved invasjonen av landet. Før kongressens åpning deltok MAJOR i en 9 dagers ekskursjon gjennom sedimentområder i landet.

OLAV LIESTØL deltok i tiden 2.–13. september i to symposier i Amerika: 1) om glasiologi i Antarktis (Hanover, New Hampshire, USA), arrangert av SCAR, og 2) om "surging glaciers" (Montreal, Canada). På det sistnevnte symposium holdt han et foredrag om breframstøt på Spitsbergen.

VIDAR HISDAL og TORGNY VINJE deltok i IUGG/WMO Radiation Symposium i Bergen 22.–28. august og i et symposium om lokal- og mikrometeorologi, arrangert samme sted 7.–8. oktober av Norsk Geofysisk Forening. På sistnevnte symposium holdt VINJE foredrag om "En hvirvelmodell for turbulent transport".

MAGNAR NORDERHAUG deltok sammen med THOR LARSEN fra Universitetet i Oslo etter invitasjon av The International Union for Conservation of Nature and Natural Resources (IUCN) i møte om isbjørnspørsmål i Morges, Sveits, i tiden 29.–31. januar. Utgiftene til deltakelse i møtet ble dekket av World Wildlife Fund. Møtet anbefalte dannelse av en egen isbjørngruppe (som nå er etablert) under IUCN's Survival Service Commission. På møtet la NORDERHAUG fram rapport om "Present situation of the harvest and management of the Polar bear in Norway". Han deltok også i SCAR Symposium on Antarctic Ecology i Cambridge, England, i månedsskiftet juli–august, der han holdt foredrag om "The Little Auk (*Plautus alle*) in Arctic Ecosystems". I oktober deltok han i Nordisk viltbiologmøte på Voksenåsen, Oslo.

BJØRN ARNESEN var på studiereise til Stockholm i tiden 27/5–9/6 og besøkte der flere institusjoner som framstiller kart, for å gjøre seg kjent med nyere metoder i kartframstilling.

Ved instituttet ble det i februar–mars arrangert et kurs i førstehjelp for ekspedisjonspersonellet. Kurset ble ledet av instruktører fra Norsk Folkehjelp. Dessuten gav på vårparten representanter for leverandører av ekspedisjonsutstyr instruksjon i bruk og reparasjon av snøscootere og påhengsmotorer for ekspedisjonsdeltakere.

Forelesnings- og foredragsvirksomhet

(Se også foregående avsnitt)

Direktør GJELSVIK holdt ved Forsvarets Høgskole forelesninger om «Svalbard i den aktuelle situasjon» og «Andre norske interesser i Arktis». I Svenska Sällskapet för Antropologi och Geografi holdt han foredrag om «60-tallets intensive utforskning av Svalbardområdet», i Det Norske Geografiske Selskab om «Norsk og internasjonal forskning på Svalbard» og i Norges Tekniske Vitenskapsakademi «Om norsk polarforskning».

Glasiolog OLAV LIESTØL holdt i vårsemesteret ved Universitetet i Oslo en forelesningsrekke i glasiologi, og han veiledet også i 1968 fire hovedfagsstudenter.

Operasjonssjef SIGGERUD holdt i løpet av året to foredrag om Svalbard i Folke-akademiet.

Publikasjoner

Skrifter:

Nr. 143 – ALASDAIR H. NEILSON: Vascular plants from the northern part of Nordaustlandet, Svalbard.

Nr. 144 – HILDUR KROG: The macrolichens of Alaska.

Meddelelser:

Nr. 96 — MAGNAR NORDERHAUG: Trekkforhold, stedstrohet og pardannelse hos alkekonge på Svalbard. (Særtrykk av «Fauna», Årgang 20, 1967, hefte 4.)

Nr. 97 — SVEIN MOLAUG: Hvalfangst på 1600-tallets Svalbard.

Årbok:

Årbok 1966.

Sjøkart:

504 Fra Sørkapp til Bellsund, 1:200 000 (ny utgave).

505 Norge—Svalbard, nordre blad, 1:750 000 (ny utgave).

510 Fra Kapp Linné med Isfjorden til Sorgfjorden, 1:350 000 (ny utgave).

Landkart:

Svalbard 1:500 000:

Blad 1 – Vestspitsbergen, søre del (ny utgave).

Blad 3 – Vestspitsbergen, nordre del (ny utgave).

Dronning Maud Land, 1:250 000:

L5 Humboldtfjella.

M5 Wohlthatmassivet.

Instituttets medarbeidere har utenom instituttets serier publisert:

BOYE FLOOD: Et tilfelle av oljedød på Svalbard. *Polarposten.* Nr. 4/1968.

TORE GJELSVIK: Distribution of Major Elements in the Wall Rocks and the Silicate Fraction of the Skorovass Pyrite Deposit, Grong Area, Norway. *Economic Geology,* Vol. 63, 1968.

HELGE HORNBÆK: Fransk flyhavari på Svalbard. *Polarboken* 1967–1968.

OLAV LIESTØL skrev bidrag til Glasiologiske undersøkelser i Norge 1967. *Rapport nr. 4/68. Vassdragsdirektoratet, Hydrologisk avdeling,* Oslo 1968.

— Breer i Breheimen og Jotunheimen. I «Til fots i Jotunheimen og tilgrensende fjellområder» (*Gyldendals ferie- og fritidsbøker*). Oslo 1968.

KAARE Z. LUNDQUIST utarbeidet artikkelen «Is og isuttrykk. Norsk og engelsk» til «Båtkalenderen 1968», som han også redigerte, og til «Fiskaralmanakk 1969».

MAGNAR NORDERHAUG: Nåværende bestand av ringgjess (*Branta bernicla hrota* (Müll.)) på Svalbard og Frans Josefs Land. *Sterna* 2/1968.

— Ornitologisk feltarbeid på Svalbard 1968. *Sterna* 4/1968.

SØREN RICHTER forfattet avsnittet *Historie* i «Ottar»s nr. 56 (1968 nr. 2), som omhandler Jan Mayen.

— Arni Gudmundson Eylands. Fremtredende islending og god norsk venn. *Polarposten.* Nr. 2/1968.

TORGNY VINJE: Some features of the turbulence over a snow field. *Polar meteorology, WMO Technical Note,* No. 87: 80–88, Geneve 1967.

The activities of Norsk Polarinstitutt in 1968

Extract of the annual report

BY

TORE GJELSVIK

The staff of the institute in 1968 numbered 32 persons, the same as in the previous year. Twelve persons worked for longer or shorter periods on short-term contracts.

Field work

NORWAY

Glaciology

On Hardangerjøkulen, accumulation was measured several times in the course of the winter, the last time in the beginning of May. During the summer, ablation was measured once a week, special measurements of heat exchange above the glacier surface and continous glaciometeorological registrations were made by J. LAND. The last observations on Hardangerjøkulen were taken on 8 October.

On Storbreen, accumulation was measured on 8/8–9/8, and the last time on 20 October.

S. MESSEL continued investigations of the mass balance of Omnsbreen, north of Finse.

Aerial photography was made of three glaciers in Jotunheimen for detailed mapping.

Results of the glaciological investigations are given in a separate note by O. LIESTØL (p. 81).

SVALBARD

The summer expedition of Norsk Polarinstitutt, led by T. SIGGERUD, comprised 41 persons and two ships with crews of 9 and 33, respectively, were engaged in the expedition. The first group went to Svalbard by aeroplane on 22 April, while the last participants returned on 13 September. The summer in Svalbard was rather cool, and the ice situation was abnormal. The north coast of the archipelago was impassable to ships even during the summer. Several attempts were made to penetrate the ice along this coast, but the most north-easterly point the expedition vessel M/S «Signalhorn» reached was 79°54'N, 12°50'E. Thus it was possible for the expedition to put out a depot for WALLY HERBERT's Transpolar Expedition only at Biskayerhuken, the westernmost of four selected places on the north coast. Sea ice did not seriously hamper the ship traffic on the west coast and in the waters between Spitsbergen, Hopen, and Bjørnøya. On the other hand, the ice was packed around Edgeøya in the east. The difficult ice conditions in some places necessitated a few changes of expedition plans, but all expedition parties succeeded in carrying out adequate field work.

Hydrography

In July and August, H. HORNBÆK, using the surveying-boat M/S«Svalis», continued detailed soundings in Krossfjorden, around Kapp Mitra, and northwards along the coast of Fjerdebreen. Afterwards, he took up soundings along the western shore of Prins Karls Forland, between Kapp Sietoe and Fuglehuken.

For two months from 12 July, J. H. CHRISTIANSEN with E. NETELAND in charge of the electronics, on board O/S «Andenes», surveyed in the area between Sørkapp –Hopen–Bjørnøya with one slave station of the HI-FIX electronic positioning system on Sørkappøya and the other at Kapp Posadowsky, Bjørnøya. Some 5200 naut. miles, covering an area of about 3600 square miles, were sounded.

Topography

O. STEINE led two field parties in Svalbard: one in May–June and the other in July. His first party started from Ny-Ålesund by snow scooter for supplementary triangulation work in James I Land, east of Kongsfjorden. Topographical field work in Svalbard had not been attempted so early in the spring before, and the result turned out better than expected. The summer party, with «Signalhorn», measured control points around Dicksonfjorden, Kongsfjorden, and, at last, Bjørnfjorden, where the ship was stopped by the drift ice.

Geology

Director T. GJELSVIK investigated Hecla Hoek rocks in the Kongsfjorden area and in the northern part of Prins Karls Forland for some three weeks in August.

In March, H. MAJOR visited the Longyear coal mine VII in Adventdalen.

A. HJELLE and B. FLOOD continued mapping of Hecla Hoek rocks in Wedel Jarlsberg Land in May and June.

E. TVETEN continued his investigations of the geology of the Kapp Mitra peninsula in the southern part of Albert I Land. Later he mapped an area in Oscar II Land.

Dr. Y. OHTA worked in the migmatite gneiss complex in the area Sørgattet–Magdalenefjorden in Albert I Land.

Geophysics

O. LIESTØL, who led a party in Svalbard in May–June, examined glaciers at Van Keulenfjorden, particularly Finsterwalderbreen. He made mass balance studies and carried out triangulation and levelling work.

For the all-year investigation of Austre Brøggerbreen and Midre Lovénbreen measurements were taken every two weeks by J. ANGARD.

In the middle of August R. PYTTE carried out special observations and triangulation on the same glaciers.

In Ny-Ålesund V. HISDAL and T. VINJE carried out radiation measurements for one month from the end of May. In addition to the spectral distribution of the global solar radiation and the sky radiation, the different components of the net radiation, including direct solar radiation and surface albedo, were measured. The average of about 500 readings of the vertical temperature distribution in the lowermost one half meter above the snow surface had a characteristic zigzag form.

In September VINJE took part in an aerial reconnaissance of the sea ice around Svalbard at the invitation of US Naval Oceanographic Office ("Birds Eye" Project).

Biology

M. NORDERHAUG made ornithological investigations in Spitsbergen (Nordenskiöld Land, Kongsfjorden, Krossfjorden), and on Prins Karls Forland from the middle of June till the end of August. His party examined production and predation in eiders and mapped breeding localities of eiders and geese in connection with the planning of nature reserves in Svalbard. Samples of insects were collected, and 1013 sea-birds (Fulmars, Brünnich's Guillemots, and Kittiwakes) were ringed. A new species for Svalbard, Steller's eider, was registered.

A. H. NEILSON, working as an assistant with FLOOD's and HJELLE's geological parties in Wedel Jarlsberg Land, made observations of the vegetation in the spring and the early part of the summer. Later on, in July and August, ha led a party carrying out botanical investigations in Spitsbergen (Kongsfjorden, Hornsund) and in the northern part of Edgeøya. Four new plant species were registered. Samples of soil and algae were collected from a number of places.

Associated expeditions

A zoological expedition led by cand. real. THOR LARSEN from Institute of Marine Biology, University of Oslo, with two assistants came to the area Storfjorden/Hopen in July on board M/S «Polstjerna» to continue the marking and study of polar bears as a link in a cooperative research project supported by the University of Oslo and Norsk Polarinstitutt. The expedition was mainly financed by World Wildlife Fund. Additional members of the expedition were Dr. CHARLES JONKEL, Canadian Wildlife Service, Dr. ALBERT W. ERICKSON, University of Minnesota, two photographers from World Wildlife Fund, who all left Svalbard before the winter, and E. FLIPSE, member of the Dutch winter expedition, who participated as an observer. In the autumn cand. real. NILS ARE ØRITSLAND joined the expedition, which established winter-quarters at Andréetangen, Edgeøya.

Dr. JOANNES KJENSMO and cand. real. ANDERS BØYUM from Limnological Institute, University of Oslo, studied the lake Linnévatnet in August with financial and logistic assistance from Norsk Polarinstitutt.

A Dutch zoological winter expedition was brought to Kapp Lee, Edgeøya, by the expedition vessel of Norsk Polarinstitutt, «Signalhorn», in the middle of August together with the leader of the Dutch polar bear research programme, Dr. A. VAN WIJNGAARDEN, State Institute for Nature Conservation Research, who returned from Svalbard in September. The expedition, which initiated cooperation with T. LARSEN's and N. A. ØRITSLAND's expedition in the study of polar bears, consisted of four persons.

Astrogeoproject Spitsbergen 1968–1970 was initiated by professor PAUL MELCHIOR from International Center of Earth Tides, Brussels, assistant professor MANFRED BONATZ, University of Bonn, and geodesist JAN CHR. BLANKENBURGH, Geographical Survey of Norway, who visited Longyearbyen for ten days in the middle of June to study the possibilities of installing measuring instruments in the coal mines of Store Norske Spitsbergen Kulkompani A/S to register crustal tide waves. Norsk Polarinstitutt provided geological information for the project and advised on practical matters.

ANTARCTICA

Y. GJESSING returned on 24 February after having taken part in leg III of the American "South Pole–Queen Maud Land Traverse".

The Norwegian Antarctic Expedition 1968/69 left for Vestfjella, western Dronning Maud Land, at the turn of the month October–November. The field work comprised: topography, geology, glaciology, and observations on meteorology, magnetic field, and bird and plant life. The members of the expedition were: geologists T. S. WINSNES (leader) and A. HJELLE, glaciologist T. LUNDE, topographer D. NORBERG, geodesist O. STEINE, and K. M. BRATLIEN, radio operator and mechanic. (Report on the expedition on p. 55.)

Preparation of data

Hydrography

The charts 504, 505, and 510 were modernized and corrected, especially for glacier fronts, in accordance with the latest aerial photographs. The compilation of a new edition of chart 503 was completed, and a revision of chart 507 was initiated.

Topography–geodesy

Constructions of parts of sheet 2 in the 1:500 000 series of *Svalbard* were made. New editions of sheet 1, Spitsbergen, Søre del, and sheet 3, Spitsbergen, Nordre del, were issued. Sheet B8, St. Jonsfjorden, in the 1:100 000 series was compiled. Acquisition of a new A7 Wild Autograph made it possible to start aerotriangulation on the vertical air photos.

Assistance in construction of maps of various glaciers in Norway and Svalbard was given.

The toponymy of *Dronning Maud Land* was dealt with, and so was the map series Dronning Maud Land 1:500 000/1:250 000. Two sheets on the latter scale were issued: L5 Humboldtfjella and M5 Wohlthatmassivet.

Geology

H. MAJOR continued description of the geological map Adventdalen, 1:100 000, and investigations of coal beds.

T. S. WINSNES prepared field data from 1967–68 with the object of finding oil structures, and compiled material for a geological map on the scale of 1:500 000 of the southern part of Spitsbergen. In addition he prepared for an expedition to Antarctica. For Årbok 1967 he wrote the article "What is 'Mumiyo' from Antarctica?".

A. HJELLE worked on material collected in the Bellsund area in 1967 and 1968. For Årbok 1967 he wrote two papers: "Stratigraphical correlation of Hecla Hoek successions north and south of Bellsund" and "Comparison of chemical and modal analyses of granitic rocks from Svalbard".

B. FLOOD also worked on material collected south of Bellsund. At the end of the year he took over the compilation of the geological map 1:500 000. For Årbok 1967 he wrote the article: "Sulphide mineralizations within the Hecla Hoek complex in Vestspitsbergen and Bjørnøya".

J. NAGY prepared maps and reports related to oil investigations. He wrote a paper, "Øvre del av underkritt og dens albiske ammonittfaunaer på det sørlige Spitsbergen" (Upper part of Lower Cretaceous and its Albian ammonite faunas in southern Spitsbergen), which was submitted for the cand. real. degree at the University of Oslo.

Geophysics

O. LIESTØL analysed data collected during the previous years. For Årbok 1967 he wrote an article entitled "Bremålinger i 1967" (Glaciological measurements in 1967). On the basis of air photographs, taken in August 1968, of the glaciers Storbreen and Tverråbreen in Jotunheimen, he compiled new maps on the scale of 1:10 000.

V. HISDAL continued to prepare for publication the results of the upper wind measurements from Maudheim (Antarctica) and finished an investigation of the spectral distribution of the diffuse solar radiation, the results of which were published in Årbok 1967 under the title "A comparative study of the spectral composition of the zenith sky radiation". An account of the weather conditions in Svalbard during 1967 was prepared for the same publication.

T. VINJE prepared weekly charts of the distribution of the sea ice, covering the Greenland Sea and the Barents Sea. The charts were based on observations from different sources, including satellite pictures. For the months March–September the ice edge is now determined from Novaja Zemlja to the west of Iceland. For Årbok 1967 VINJE wrote an account of the sea ice distribution in Svalbard.

Biology

M. NORDERHAUG prepared a report on "The present status of the Brent Goose (*Branta bernicla hrota*) in Svalbard". For Årbok 1967 he wrote two papers: "Hvalrossens (*Odobenus rosmarus*) forekomst i Svalbardområdet 1960–1967"

(The walrus (*Odobenus rosmarus*) in Svalbard 1960–1967) and "Iakttagelser over dyrelivet på Svalbard 1967" (Observations of the animal life in Svalbard 1967).

The working group for wildlife management and conservation in Svalbard, of which NORDERHAUG is the chairman, prepared a draft for the regulation of polar bear hunting for the authorities. It took up two questions: revision of the hunting regulation and planning of national parks and nature reserves in Svalbard.

The Svalbard research station

Work on the establishment of the scientific research station at Ny-Ålesund had by the end of the year proceeded so far that the station came into operation. During the winter 1968–69 following observation work was carried out at the station: seismic registrations for the Seismological Observatory, University of Bergen; ionospheric investigations, magnetic registrations, and ozone measurements for the Norwegian Institute of Cosmic Physics, Oslo; studies of aurora for the Auroral Observatory, Tromsø; radiation observations and glaciological measurements for Norsk Polarinstitutt.

Other field activity in Svalbard, 1968

BY
TORE GJELSVIK

Besides the expedition of Norsk Polarinstitutt (p. 109) and its associated expeditions, the following expeditions, groups, and persons visited Svalbard in 1968 with the object of carrying out field work of scientific or economic interest:

An expedition of three men headed by sous-directeur LOUIS-JACQUES LAURENT from the Belgian oil company, Petrofina, Brussels, on board M/S «Havella» operated in Svalbard for three weeks in August to obtain general geological information on oil possibilities in the archipelago.

The Cambridge Spitsbergen Expedition 1968, comprising twenty persons under the leadership of professor W. BRIAN HARLAND, Department of Geology, University of Cambridge, stayed in Svalbard from end of June till end of August. The expedition studied geology, gravity and magnetic field effects at Kongsfjorden and Forlandsundet. A group of four members from this expedition carried out geological investigations for Norsk Polar Navigasjon A/S in Stormbukta and Hornsund.

The Oxford Expedition to Svalbard 1968, consisting of five persons under the leadership of medical student KEITH VAUGHTON, studied the food of the Pink-footed geese, took blood samples of geese and ringed them in Reindalen in July and August.

Curator of birds J. J. YEALLAND from The Zoological Society of London with one assistant stayed in Svalbard for half a month from the end of June, carrying out ornithological investigations at Kapp Linné.

The Finnish Zoological Svalbard Expedition 1968–1969, consisting of Dr. ERIK S. NYHOLM, leader, and two assistants, arrived in Svalbard on August 22, where it ringed birds for a month. On September 26, the expedition settled at Sveagruva for the winter.

Professor ULRICH LEHMAN from Germany with one assistant spent nearly a month (from July 11) in Svalbard, searching for fossils in De Geerdalen.

Conservator, Dr. ULRICH GLASER from Geographisches Institut der Universität Würzburg led in the period July 11–August 24 an expedition of five members to Svalbard, where he studied the land rise in the Bellsund area.

In July and August Norsk Polar Navigasjon A/S continued oil exploration in the Bellsund area, started the previous year, where some drilling was carried out in Berzeliusdalen by a group of 8–10 men led by GUNNAR SVERRE PEDERSEN. Another group, consisting of four members of the Cambridge Spitsbergen Expedition 1968, carried out geological investigations for the company in Stormbukta and Hornsund.

The Soviet Spitsbergen Expedition from Scientific Research Institute of Geology of the Arctic (Leningrad), was led by Dr. V. N. SOKOLOV (scientific leader) and Dr. D. V. SEMEVSKIJ (expedition leader), and consisted of 25 members, split up into seven field parties, each consisting of 2–4 members and led by JU. P. BUROV, V. D. DIBNER, A. A. KRASIL'ŠČIKOV, JA. JU. LIVŠIC, A. I. PANOV, T. M. PČELINA, and D. V. SEMEVSKIJ respectively. The expedition examined deposits of the Hecla Hoek Formation and formations of Devonian, Lower Carboniferous, Mesozoic, Paleogene and Quaternary. Bottom deposits of the coastal waters were studied by V. D. DIBNER. The following areas were visited: Woodfjorden, Prins Karls Forland, Lundströmdalen, Van Keulenfjorden, Hornsund, Sørkappøya, Wahlbergøya, and Nordaustlandet (Lady Franklinfjorden and Wahlenbergfjorden). For transport the expedition had at its disposal four helicopters stationed at Barentsburg.

Assistant Professor HARALD SVENSSON from the Geographical Institution of the University of Lund, Sweden, with one assistant, studied permafrost phenomena and tundras in the outer parts of Adventdalen for two weeks from July 27.

Another Swede, STIG WOLDMAR, collected and studied fungi from the environments of Longyearbyen for about one month in July–August.

Notiser

Collemboler som næring for vadere på Svalbard

Abstract. In Svalbard in 1968, the Purple Sandpiper (*Calidris maritima*) was seen eating collembola on the surface of upwelled algae along the coast. Collembola were also eaten from the water edge of small ponds, to which the collembola were blown if they happened to reach the water surface.

I sammenheng med Norsk Polarinstitutts biologiske virksomhet ble det ved to anledninger sommeren 1968 observert at vadere spiste collemboler på Svalbard. I begge tilfellene forekom collembolene i meget stor tetthet, slik at fuglene selv ved å plukke bare ett eller få dyr om gangen likevel kunne gjøre seg nytte av disse små dyrene.

I individmengde er collembolene på Svalbard en langt mere dominerende dyregruppe i jordbunnen enn i Norge. Også den absolutte tettheten i jordbunnen er ofte meget høy. Det er derfor interessant at enkelte fuglearter ved visse anledninger, der konsentrasjonen av collemboler er høy, kan spise collemboler i store mengder. Spesielt karakteristisk synes dette å være for fjæreplytten på Svalbard.

1. På Prins Karls Forland ble flere fjæreplytter i juli stadig observert på oppskyllet tare, der det var en høy konsentrasjon av collemboler. Ved raske bevegelser ble dyrene plukket opp. Andre mulige næringsdyr ble ikke observert oppe på tarelaget. Fig. 1 viser fordelingen av antall individer på 100 stk. 10 × 10 cm ruter, tilfeldig valgt på tareoverflaten. En enda større individtetthet enn denne ble også observert, uten at opptelling ble gjort. De svarte collembolene var lette å se mot den lysebrune bakgrunnen. Den spesielt høye individtettheten i noen av rutene skyldtes at det her lå litt vann, som virket som en felle på dyrene.

Fjæreplyttene holdt seg også mye i littoralsonen, der de plukket små krepsdyr som ble skyllet i land ved hvert bølgeslag. Ved flo var imidlertid mange steder denne veien til næring stengt p.g.a. landkalven som opptok bølgeslags-området

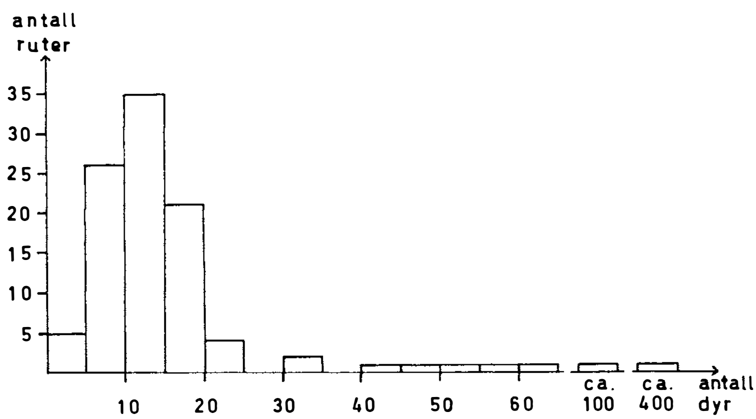

Fig. 1. *Tettheten av collemboler i 100 stk. 10 × 10 cm tilfeldig valgte ruter på overflaten av oppskyllet tare. Levinhamna, Prins Karls Forland, 1/7.1968.*

på stranden. Kanskje nettopp på disse tider av døgnet kan collembolene på den oppskyllete taren innpå strandbrinken gi et verdifullt tilskudd av mat for fuglene. Nede i selve tarelaget fantes dessuten en del oligochaeter, og ved å stikke nebbet ned i taren fikk fuglene også tak i disse. Oligochaetene var imidlertid meget små (vekt av 100 stk.: 0,6 g, eller 6 mg pr. oligochaet). Dette betyr at collembolene på overflaten kan utgjøre et like godt næringsgrunnlag som oligochaetene.

Den næringskjeden som collembolene (og oligochaetene) her deltar i, er fra et økologisk synspunkt interessant. Første ledd i næringskjeden, nemlig primærproduksjonen av taren, skjer i havet, mens videreføringen av energien skjer på land. Dette er typisk for mange næringskjeder i Arktis, der primærproduksjonen på land oftest er av meget liten målestokk.

Ved Isfjord Radio i juni ble polarsvømmesniper stadig observert på de oppskyllete tarevollene, og det er ikke urimelig at også denne arten kan benytte seg av de lett tilgjengelige collembolmengdene her.

2. På Hermansenøya i Forlandsundet såes 9/7 flere fjæreplytt og en myrsnipe som plukket collemboler langs kanten av små ferskvannspytter. Fordi øya var godt gjødslet av ender og gjess, var vegetasjonen relativt frodig, og det var et yrende og dominerende liv av collemboler i jordbunnen. De collembolene som i sin stadige bevegelse havnet ute på vannflaten, kom ikke i land igjen og ble blåst inn mot den ene bredden, der de flere steder lå tettpakket i store mengder. Andre mulige næringsdyr var det ikke mulig å observere. Ved hvert plukk kunne fuglene her tydeligvis få med en hel del collemboler.

På Forlandsøyene ble det i juli observert vannpytter, der overflaten så å si var sammenhengende dekket av collemboler.

Disse store, gunstige konsentrasjoner av collemboler synes å mangle sidestykke i Norge. Spesielt i de tilfellene når fjæreplytten ruger et stykke inne i landet, vil collembolansamlinger på overflaten av små ferskvannspytter sikkert kunne representere en brukbar næringskilde i de ellers meget næringsfattige omgivelser på Svalbard. Slike ansamlinger av collemboler på små dammer ble ofte observert på vegetasjonsfattig tundra, der den absolutte tettheten av collemboler i jordbunnen var langt lavere enn på den rikt gjødslete Hermansenøya. Spesielt effektivt virket denne konsentrasjonsmekanismen der flere sakteflytende småbekker samlet seg i områder med mindre strømhastighet og helst litt hvirveldannelse langs land. Her ble collemboler fra relativt store områder samlet opp og konsentrert så mye at f. eks. fjæreplytt ville kunne nyttegjøre seg dem som næring.

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Observasjoner av pukkellaks *(Oncorhynchus gorbuscha)* på Svalbard i tiden 1960–65

Observations of Pink Salmon (Oncorhynchus gorbuscha) in Svalbard in the period 1960–65

Abstract. – Five catches of pink salmon in Svalbard have been made in the period 1961–65 (Table 1). Details of length and weight of the catch in Mossellaguna are given. No observations have been made of ascent or spawning in fresh water.

I 1956 startet russerne forsøk med overføring av pukkellaks fra den nordlige Stillehavskyst til områdene ved Murmansk og Kvitsjøen. Fram til 1960 var ca.

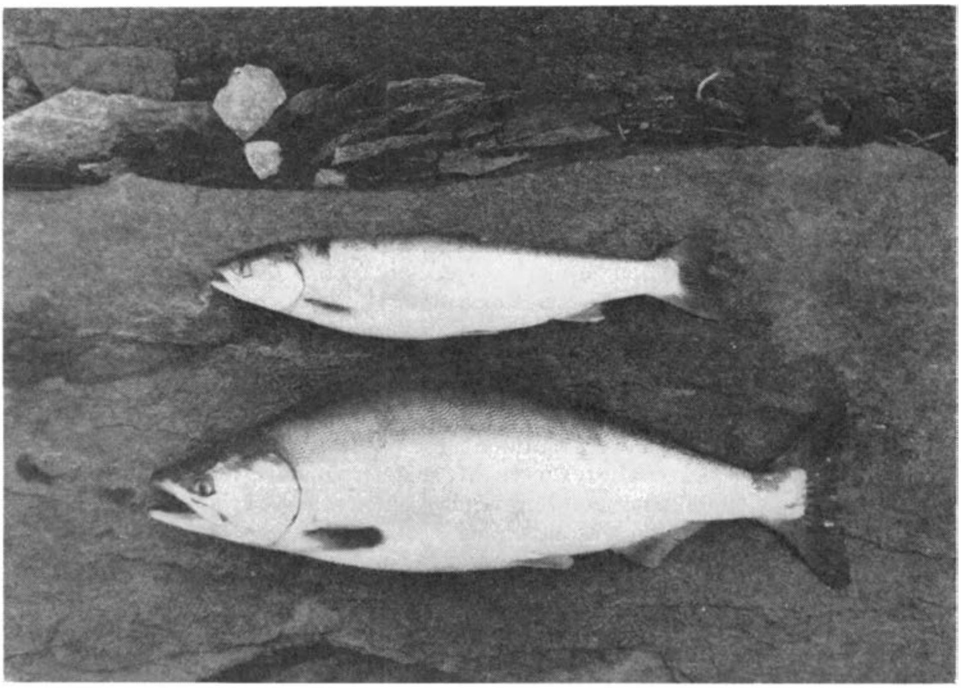

Fig. 1. *Sjørøye (øverst) og pukkellaks (♂) fanget i Mossellaguna 18. august 1965.*
Sea-char (top) and pink salmon (♂) caught in Mossellaguna August 18, 1965.

57 millioner egg overført, men i de senere år er utsetningene begrenset for å avvente nærmere resultater. Som et resultat av disse overføringene ble det i 1960 tatt et større antall pukkellaks langs norskekysten, anslått til omkring 20–25 000 kilo (BERG 1961). I 1961 ble det tatt bare omkring 3 000 kilo, og de tre derpå følgende år ble det knapt registrert noen fangster. Først i 1965 kom pukkellaksen tilbake i større antall.

I tidsrommet 1960–65 ble det på Svalbard prøvd å registrere eventuelle fangster av pukkellaks for om mulig å få et begrep om hvorvidt den ville etablere en fast bestand der. Grunnet sin spesielle biologi – yngelen går til sjøs tidlig om våren kort tid etter klekking og er tilbake allerede neste høst for gyting – vil den egne seg ypperlig i farvannet ved Svalbard.

Tidligere fantes bare sjørøye (*Salvelinus alpinus* (L.)) der oppe, så den nye arten skulle være forholdsvis enkel å skille ut (Fig. 1).

I tre sommersesonger (juli/august), 1963–65, har en ferskvannsbiologisk gruppe arbeidet på Spitsbergen i Norsk Polarinstitutts regi for å undersøke sjørøyens biologi.

Opptreden. – Samtlige registrerte pukkellaks på Svalbard ble tatt i sjøen under sportsfiske etter sjørøyer, som var på vei til sine respektive elver for å gyte og overvintre. Fisket etter sjørøye foregår i ca. en måned fra midten av juli, og er hovedsakelig konsentrert omkring de bebodde steder på Spitsbergen. I fjernere områder foregår bare sporadisk fiske ved tilfeldige sommer-ekspedisjoner. Tabell 1 viser de enkelte observasjoner.

Om størrelsen på fangsten fra Kapp Linné har det ikke vært mulig å få nærmere opplysninger, men det ble tatt flere individer i løpet av sesongen. Om eksemplaret fra Krossfjorden i 1965 sies det bare at den tydelig skilte seg ut fra røya, spesielt

Tabell 1
Observasjoner av pukkellaks – *Observations of pink salmon*

Lokalitet *Locality*		År *Year*	Dato *Date*	Antall *Number*
Kapp Linné,	78°03′N, 13°40′Ø	1961	juli/aug.	flere *several*
Krossfjorden,	79°10′N, 11°30′Ø	1961	ca. 20 aug.	1
Krossfjorden,	79°10′N, 11°30′Ø	1965	aug.	1
Mushamna,	79°40′N, 14°30′Ø	1965	5 aug.	2
Mossellaguna,	79°50′N, 16° 0′Ø	1965	18—24 aug.	10

ved større skjell. Den liknet mer en vanlig norsk sjø-ørret. Siden pukkelen som er opphavet til navnet pukkellaks, er karakteristisk for hannfisken i parringsdrakt, mens hunnfisken mangler den fullstendig, er dette eksemplaret sannsynligvis en hunn.

Fangsten i Mossellaguna. – Mossellaguna er avgrenset fra sjøen med en lang sandvoll som gjennomskjæres av en 8–10 m bred åpning. Vannstanden er omkring 2 m på det dypeste ved fjære sjø. En 2 km lang elv forbinder laguna med Mosselvatnet hvor alt tilsig er brevann. På vannet gikk isen opp først omkring 10. august. I laguna er det store mengder krepsdyr, som gir god næring for fisk.

Under garnfiske etter sjørøye 18. og 24. august ble det fisket både i laguna, elven og vannet. Ti pukkellaks ble fanget, 6 hanner og 4 hunner, samtlige i laguna ut for elvemunningen. Lengde og vekt ble målt, og resultatene fremgår av Fig. 2. De viser stort sett samme mål og vekt som de 47 pukkellaksene målt utenfor Finnmark i august 1960 (Berg 1961). Minste individ nevnt av Berg (1961) er på ca. 1 kg, mens det på Murmanskkysten er registrert eksemplarer helt ned i 30 cm og 0,5 kg. I fangsten fra Mossellaguna var minste fisk en hann på 34 cm og 0,525 kg. Den manglet fullstendig de ytre kjennetegn som karakteriserer hannene i parringsdrakt, men testes indikerte kommende gyting. Samtlige av de andre var meget fete og hadde velutviklede kjønnsorganer, mens mavesekkene enten var tomme eller sparsomt fylt.

Skjellstudiene viste at som normalt hadde alle vært bare en vinter i sjøen.

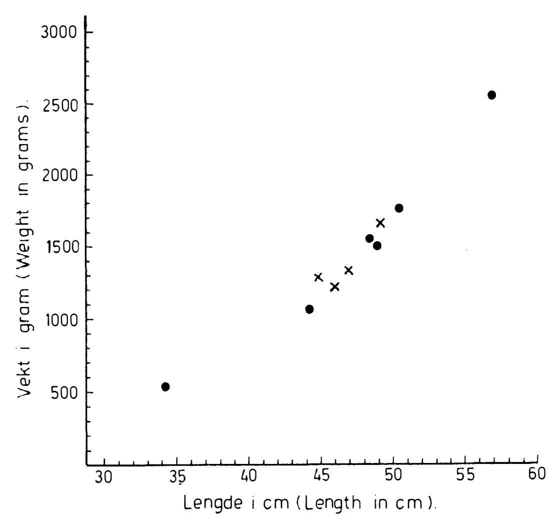

Fig. 2. *Lengde/vekt-forholdet hos 10 pukkellaks fanget i Mossellaguna 18. og 24. august 1965.*
● = ♂♂, X = ♀♀

Length/weight relation of 10 pink salmons caught in Mossellaguna August 18 and 24, 1965.

Diskusjon. – Intensiteten i fisket etter sjørøye på Svalbard er stort sett den samme hvert år. Fangster av pukkellaks er bare registrert i 1961 og 1965, noe som stemmer godt overens med fangsttoppene i Norge. Fra 1960 foreligger imidlertid ingen opplysninger fra Svalbard, men det er lite sannsynlig at fangster er gjort, da slike begivenheter raskt ville bli kjent blant folk.

I nord-norske elver er både oppgang og gyting påvist, men om noe lignende har forekommet på Svalbard er vanskelig å si. Fangstene fra ferskvann i Norge skriver seg hovedsakelig fra august og utover, og spesielt i september–oktober er gytende og utgytt fisk påtruffet. Etter oppgang hadde de heller intet maveinnhold. På Svalbard stopper alt fiske i slutten av august når sjørøya har gått opp i ferskvann. Dette medfører at det er ingen muligheter for senere observasjoner av pukkellaks. Materialet fra Mossellaguna indikerer imidlertid kommende oppgang og gyting p.g.a. oppholdssted rett ut for elvemunningen, velutviklede kjønnsorganer, sekundære kjønnskarakterer og tomme eller sparsomt fylte mavesekker til tross for rikelig næring i området.

En videreføring av registreringene av pukkellaks er ønskelig for nøyaktig å kunne fastslå pukkellaksens opptreden og en eventuell bestandsetablering på Svalbard.

Litteratur

BERG, MAGNUS, 1961: Pink Salmon (*Oncorhynchus gorbuscha*) in Northern Norway in the year 1960. *Acta Borealia.* A. **17**. 1–23.

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Merking av røye (*Salvelinus alpinus (L.)*) på Svalbard 1963–65

Abstract. In the period 1963—65, 76 chars were marked in Spitsbergen in four localities (Fig. 1). So far 8 chars have been recaptured, all from Revvatnet and very close to the place where they were marked.

I tre sommersesonger har en gruppe fra Norsk Polarinstitutt drevet ferskvannsbiologiske studier på Spitsbergen. I 1963 og 1964 foregikk undersøkelsene i Hornsundområdet, 77°N, 15°30′Ø, og i 1965 på Bangenhukhalvøya, 79°50′N, 15°30′Ø.

Hensikten var å studere biologien til røyen *Salvelinus alpinus* (L.). Som et ledd i dette ble det leilighetsvis merket et mindre antall fisk for nærmere utredning av vandringsforholdene.

Det følgende gir en kort oversikt over hvor og hvordan arbeidet har foregått.

Områdebeskrivelse. – Det er merket fisk på 4 lokaliteter, 1 i Hornsund og 3 på Bangenhukhalvøya (Fig. 1):

Revvatnet. – God elveforbindelse mellom vatnet og sjøen.

Mosselvatnet. – God elveforbindelse.

Røyetjørna. – Dårlig forbindelse til sjøen. Sannsynligvis mulig for ned- eller oppgang av røye bare under større flomperioder.

Strøen. – Fullstendig avstengt fra sjøen.

Fangst- og merkemetodikk. – Innsamlingen av merkefisk foregikk på flere måter. I Revvatnet og Røyetjørna ble nedre del av elven stengt med en sperring i hvilken det var plassert ruser for henholdsvis oppad- og nedadgående fisk. I Strøen og Mosselvatnet ble hovedsakelig garn brukt, et mindre antall fisk ble tatt på sluk i Strøen.

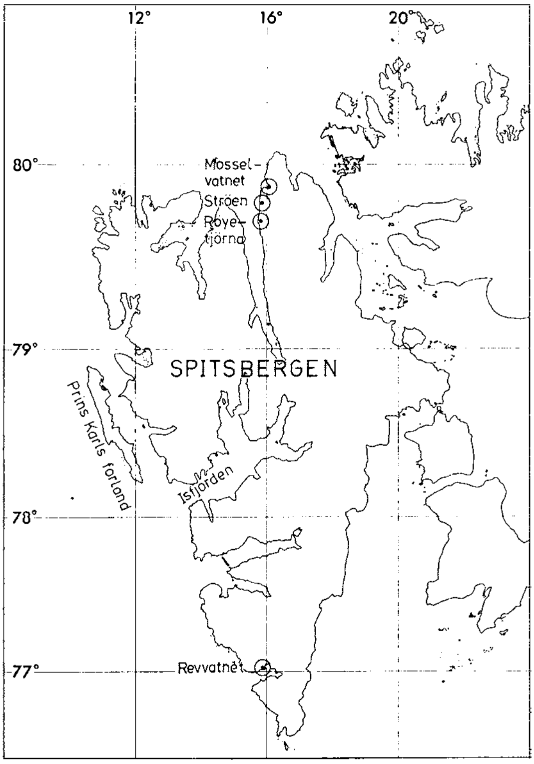

Fig. 1. *Svalbardområdet. Merkesteder for røye (Salvelinus alpinus (L.)) innsirklet.*

The Svalbard area. Marking places for char encircled.

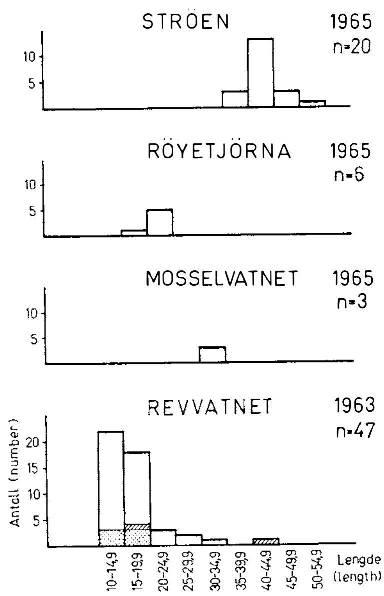

Fig. 2. *År, antall og størrelsesfordeling på merkefisken, Revvatnet. Gjenfangsten 1963 – prikket felt. Gjenfangsten 1964 – skråstreket felt.*

Year, number, and size distribution of the marked fish. Revvatnet. Recaptures 1963 – *dotted area*. Recaptures 1964 – *crosshatched area*.

Ved merkingene ble brukt de såkalte Carlins merker. De har lyseblå, flate plater av tynn kartong med et solid overtrekk av celluloid. På den ene siden er skrevet et nummer, på den andre en instruks til vedkommende fisker og adressen hvor merket ønskes sendt. Merkene er festet under ryggfinnens forkant med en dobbel, rustfri ståltråd.

Etter merkingen ble fisken sluppet ut med en gang. De som var tatt i ruser, ble satt ut på motsatt side av sperringen.

Størrelsesfordeling av merkefisken. – Antall og størrelse på den fisken som er merket er vist på Fig. 2.

Resultater og diskusjon. – Hittil er det gjenfanget 8 fisk, samtlige er fra Revvatnet og er tatt av forfatteren selv (Fig. 2). Fra 1963 foreligger 6 gjenfangster, hvorav 3 ble kontrollert og sluppet ut igjen. Alle var merket i rusen for nedadgående fisk og ble tatt igjen i rusen for oppadgående. Fem stykker ble tatt i løpet av de første 6 dager etter merkingen. og den sjette etter 11 dager.

Fra 1964 foreligger 2 gjenfangster. Merket til det minste individet hang igjen i et garn, satt i sjøen rett ut for elvemunningen. Den andre fisken ble tatt igjen i selve Revvatnet, hvor den også var merket som gytefisk.

Av 76 merkete fisk er 8 fanget igjen, samtlige på det sted hvor de ble merket. Disse resultater gir således ingen opplysninger om vandringsdistanser. Derfor er det ønskelig at merkingene blir fortsatt i større målestokk i de kommende år.

Personer som fisker i nærheten av merkelokalitetene bes være på vakt, da det fremdeles er muligheter for gjenfangst.

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The earthquakes of the Arctic and the tide-generating forces

The correlation between tidal forces and the energy released from shallow earthquakes (with $M \geqslant 5$) in the Arctic during the period 1908–1959 is investigated (see Figs. 1 and 2).

The distribution of the shallow earthquakes is shown in Table 1. As can be seen, the 14 earthquakes with magnitude $M \geqslant 6\frac{1}{2}$ are responsible for 88% of the energy and thus dominate the seismic picture of the Arctic during the period considered. The released seismic energy amounts to almost 2×10^{23}erg.

Table 1
Energy distribution of shallow earthquakes ($M \geqslant 5$) *in the Arctic in the period 1908-1959.*

Magnitude (M)	No. of earthquakes		Energy (%)	
$7\frac{1}{4}$	1	4	27.3	61.9
7	3		34.6	
$6\frac{3}{4}$	2	26	9.7	33.1
$6\frac{1}{2}$	8		16.1	
$6\frac{1}{4}$	3		2.6	
6	13		4.7	
$5\frac{3}{4}$	10	126	1.5	5.0
$5\frac{1}{2}$	33		2.1	
$5\frac{1}{4}$	30		0.8	
5	53		0.6	

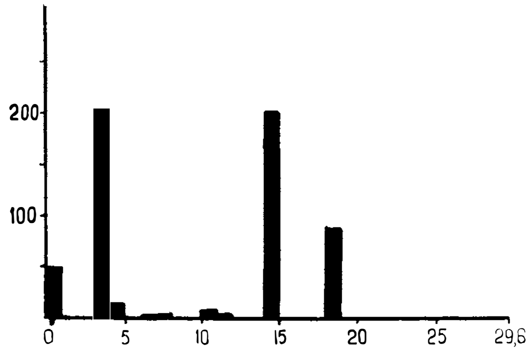

Fig. 1. *Distribution in the course of a synodic month of the earthquake energy ($M \geqslant 5$) of the Arctic during the period 1908–1959. Only earthquakes occurring during the passage of the Moon through perigee ± 4 days are considered.*

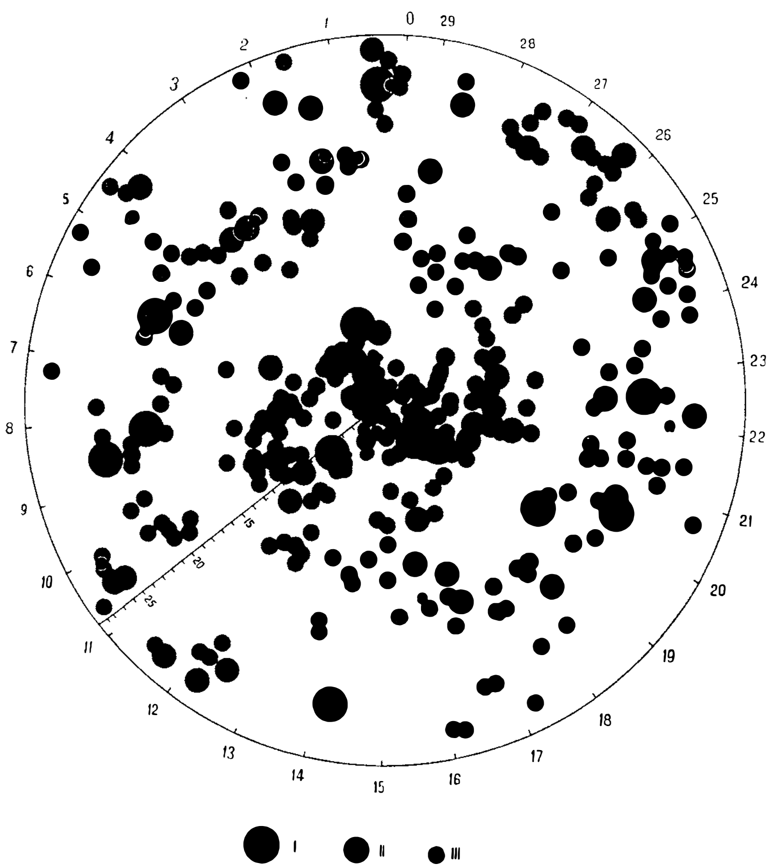

Fig. 2. *A spiral diagram showing the dependence of the seismic activity in the Arctic during 1908–1959 on the change of the tide-generating forces.*
On the circumference: days of the average synodic month.
On the radius: days of the reduced anomalistic month.
I: 6½–7¼
II: 5½–6¼
III: 5–5¼

The distribution in the course of a synodic month of all earthquakes in the Arctic occurring during the passage of the Moon through perigee $\pm$ 4 days is shown in Fig. 1. The influence of the tide-generatig forces on the earthquakes is clearly revealed.

The distribution of the energy of the earthquakes during a synodic month shows interesting details. The major part (91%) of the energy was released during four days after a new Moon (day 0–4), and during the day of full Moon and the four following days (day 14–19). Thus, the remaining 20.6 days account for only 9% of the seismic energy during the period 1908–1959.

The release of seismic energy during 4–5 days after a new Moon and a full Moon (60.6×10^{20}erg/day) was, on the average, 24 times greater than during the remaining days (2.5×10^{20}erg/day). This strongly supports the view that tide-generating forces are of importance for the release of seismic energy in the Arctic.

On the whole, the energy of earthquakes seems to change systematically in the course of a synodic month. In accordance with this, the earthquakes in Fig. 2 tend to be concentrated in definite patterns.

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