DET KONGELIGE INDUSTRI-, HÅNDVERK-
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NORSK POLARINSTITUTT

SKRIFTER

Nr. 108

LATE-PLEISTOCENE DEPOSITS AT KAPP WIJK, VESTSPITSBERGEN

BY

ROLF W. FEYLING-HANSSEN

WITH 8 TEXT FIGURES, 1 TABLE AND 3 PLATES

I KOMMISJON HOS
BRØGGERS BOKTRYKKERIS FORLAG
OSLO 1955

NORSK POLARINSTITUTT

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SKRIFTER

Skrifter 1—50, see numbers of Skrifter previous to No. 100.

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A. W. BRØGGERS BOKTRYKKERI A/S

Contents.

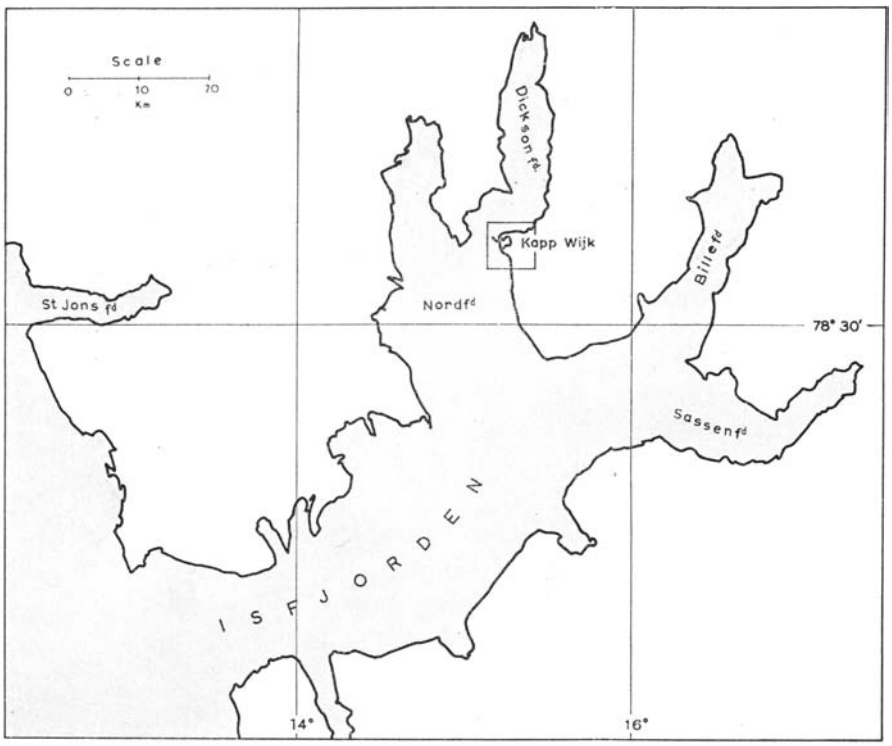

Fig. 1. Isfjorden with Kapp Wijk.

Introduction.

Kapp Wijk (78°36' N.lat., 15°9' E.long. at the point) is situated at the east side of the entrance to Dicksonfjorden, the eastern branch of Nordfjorden which branches off from Isfjorden in Vestspitsbergen. It comprises a complex constructional foreland to the west of the mouth of Idodalen. Idoelva, the river of Idodalen, debouches at present in the bight northeast of the foreland. A small islet at the very point of the cape is tied to the southern part of the foreland by a single tombolo (JOHNSON 1919, p. 311) which is bent at almost right angles in its middle part, the south-running part of the tombolo enclosing a large lagoon. Spirifer limestone outcrops in the islet. The large foreland of Kapp Wijk has been prograded in various directions as demonstrated by the trends of the beach ridges. (Cf. fig. 3 and pl. III).

From a plane-table survey of the area, made by GUNNAR ISACHSEN in 1906, it appears that the WNW—ESE-running part of the tombolo was then separated from the NNW—SSE-running part so that an opening into the lagoon existed at the bend of the tombolo (fig. 2). Air photographs, taken by BERNHARD LUNCKE in 1938, and the chart nr. 503 of Norsk Polarinstitutt, issued in 1932, show that this opening has later been closed (fig. 3). We could, in 1950, walk from the mainland right out to the end of the tombolo. Another entrance to the lagoon was in 1906 situated at the north side of the tombolo, between this and a curved spit from the northern branch of the foreland. The air photographs of 1938 show that this spit, or bar, has migrated southwards, having been detached from the northern branch of the foreland so that a new opening has been formed between the bar and the northern branch of the foreland. A new recurved spit is being formed to the north of the bar, prograding in a SW direction, and new land has appeared in the northwestern part of the inner lagoon (cf. figs. 2 and 3). On the whole, slight progradation has taken place along the shores of the foreland of Kapp Wijk and on the west and southwest sides of the tombolo, even at its very point (fig. 3).

Kapp Wijk was visited by the author, together with JOHN A. S. ADAMS, Ph. D., and Cand. philol. ODD CHR. FEYLING-HANSSEN, at the end of August 1950 at the expenses of Norsk Polarinstitutt. On account of the short time at our disposal there only a reconnaissance of the Late-Pleistocene deposits could be made and many details were left uninvestigated.

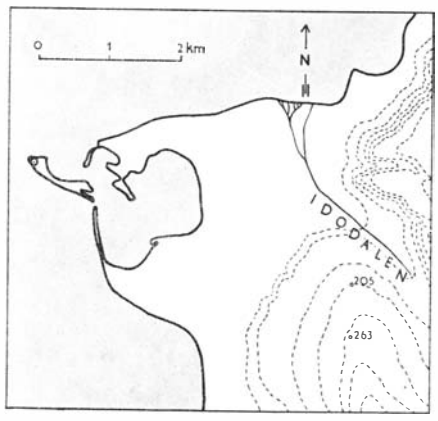

Fig. 2.

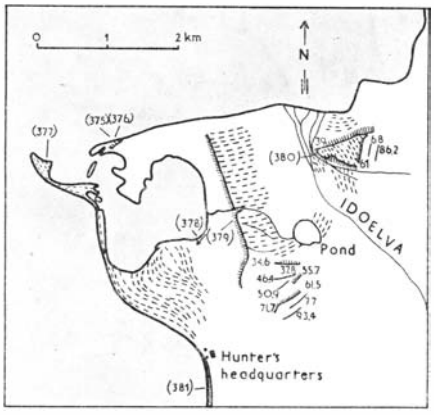

Fig. 3.

Fig. 2. Kapp Wijk; from a plane-table survey by Gunnar Isachsen in 1906.
Fig. 3. Kapp Wijk with the raised marine features and the trend of the beach ridges indicated; from air photographs taken by Bernhard Luncke in 1938. The numbers in brackets refer to samples collected in the different localities, the other numbers indicate elevations of raised shorelines and terraces. (Cf. plate III). The arrow at the southeast corner of the lagoon indicates the direction of glacial striae.

Raised Marine Features and their Fossil Faunas.

The bedrock of Spirifer limestone of the small, elongated „islet" at the end of the tombolo (fig. 7) was overlain by beach gravel the surface of which sloped southwards from 3.0 to 2.2 m a.s.l. with beach ridges at right angles to the direction of slope. Higher parts of this sloping beach plain, which have existed to the north of the remaining part, have been removed by wave erosion. In the upper part of the northern cliff of the remaining beach plain the following collection was made[5] (see p. 7, Sample No. 377).

With reference to the relative frequencies of *Astarte borealis* and *Mytilus edulis* this fauna had much in common with that of sample II (4 m a.s.l.) of the lower part of the large beach plain of Brucebyen in Billefjorden (FEYLING-HANSSEN 1955, p. 89). 100 valves of *Astarte borealis* have been measured (fig. 4) the largest having a length of 41.5 mm and a height of 36.5 mm. Many valves of *Mytilus edulis* were broken; two of the largest complete valves measured, L=60 mm, H=29 mm and L=59 mm, H=30 mm. The valves of *Saxicava arctica* were small and irregular, and *Macoma calcarea* and *Mya truncata* were also represented by small specimens. The shell of *Sipho togatus*

[1] The method used in analysing the faunas is the same as described by FEYLING-HANSSEN and JØRSTAD (1950, p. 12) and by FEYLING-HANSSEN (1955, p. 18); of gastropods whole shells and summits of broken shells were counted and of pelecypods valves and umbonal fragments, whose number was divided by two. Plates of chitonids, when calculated, were divided by 8, and of balanids carinae or rostra were counted.

3 m a.s.l. «Islet» at the end of the tombolo. Gravel. (Sample No. 377).

Species	Frequency	Percentage
Astarte borealis (CHEMNITZ)	87.5	43.8
Mytilus edulis LINNÉ	78.0	39.0
Saxicava arctica (LINNÉ)	10.0	5.0
Littorina saxatilis (OLIVI)	9.0	4.5
Astarte montagui (DILLWYN)	7.0	3.5
Mya truncata LINNÉ	2.5	1.3
Macoma calcarea (CHEMNITZ)	1.0	0.5
Emarginula fissura (LINNÉ)	1.0	0.5
Margarites groenlandicus (CHEMNITZ)	1.0	0.5
Sipho togatus (MÖRCH)	1.0	0.5
Balanus balanoides (LINNÉ)	1.0	0.5
Crennella decussata (MONTAGU)	0.5	0.2
Astarte elliptica (BROWN)	0.5	0.2
Strongylocentrotus cf. *droebachiensis* (MÜLLER) spines.		
Lithothamnion sp. clods and fragments.		
	200.0	100.0

had a length of 50 mm and a greatest breadth of 22 mm. Three of the species of this sample belong to the mid-arctic faunal element (FEYLING-HANSSEN 1955, p. 30), viz. *Mytilus edulis, Littorina saxatilis* and *Balanus balanoides,* and one to the low-arctic or, rather boreal, element, viz. *Emarginula fissura.* The latter and, as far as known, also *Mytilus edulis* are now extinct in Spitsbergen. Some foraminiferal tests of *Cibicides lobatulus* were observed in the sample.

At the northeast side of the entrance to the lagoon the height of two terraces situated one above the other were measured; the front edge of the lowest had an elevation of 4 m a.s.l. and the front edge of the highest was situated 7.2 m a.s.l. (fig. 3). Bedrock outcropped in the cliff of the lowest terrace, and silty material underlay the gravel of the terraces. From the lowest terrace, or bench, the following shells were collected:

4 m a.s.l. NE of the entrance to the lagoon. Sandy gravel. (Sample No. 375).

Species	Frequency	Percentage
Astarte borealis (CHEMNITZ)	80.5	55.7
Astarte montagui (DILLWYN)	33.5	23.2
Saxicava arctica (LINNÉ)	12.5	8.6
Mytilus edulis LINNÉ	6.0	4.2
Mya truncata LINNÉ	4.0	2.8
Natica clausa BRODERIP and SOWERBY	3.0	2.1
Macoma calcarea (CHEMNITZ)	2.5	1.7
Cingula castanea (MÖLLER)	1.0	0.7
Buccinum glaciale LINNÉ	1.0	0.7
Cyprina islandica (LINNÉ)	0.5	0.3
Lithothamnion, common.		
	144.5	100.0

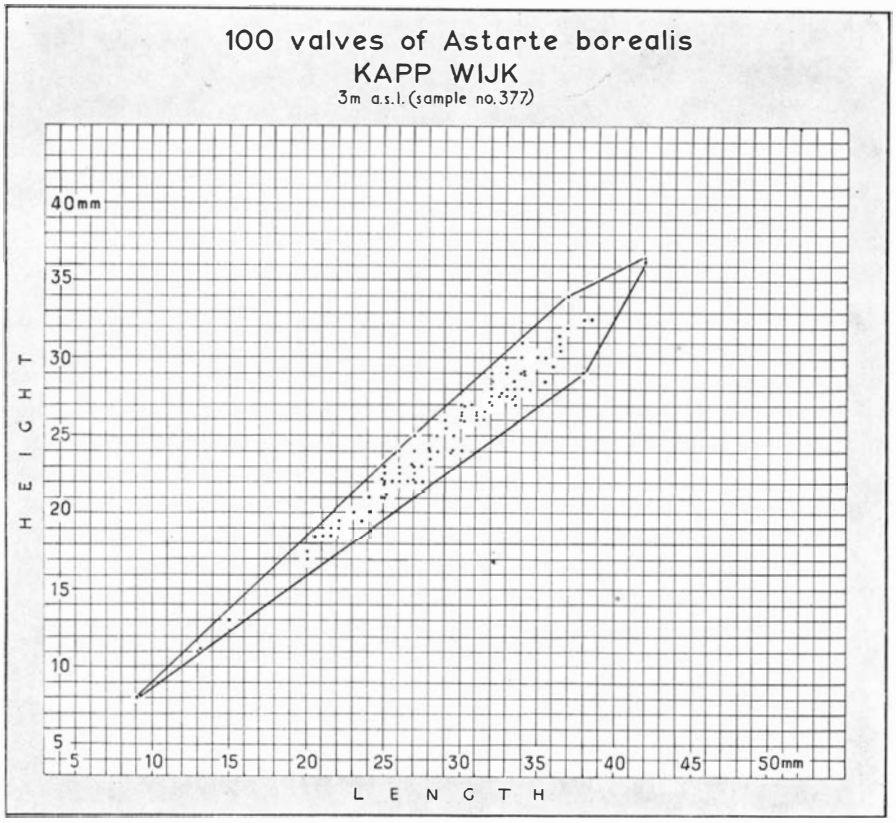

Fig. 4. Shell measurements of *Astarte borealis*.

Additionally some Foraminifera were observed in the sample, viz. *Quinqueloculina seminulum* (LINNÉ), *Elphidium clavatum* CUSHMAN, *Elphidium incertum* (WILLIAMSON) and *Cibicides lobatulus* (WALKER and JACOB).

From the upper terrace were collected:

7.2 m a.s.l. NE of the entrance to the lagoon. Sandy gravel. (Sample No.376).

Species	Frequency	Percentage
Astarte borealis (CHEMNITZ)	118.0	66.9
Astarte montagui (DILLWYN)	33.0	18.7
Saxicava arctica (LINNÉ)	7.5	4.2
Mya truncata LINNÉ	6.0	3.4
Mytilus edulis LINNÉ	4.5	2.5
Lora bicarinata (COUTHOUY)	2.0	1.1
Astarte elliptica (BROWN)	1.0	0.6
Emarginula fissura (LINNÉ)	1.0	0.6
Omalogyra atomus (PHILIPPI)	1.0	0.6
Balanus balanoides (LINNÉ)	1.0	0.6
Heteranomia squamula (LINNÉ)	0.5	0.3
Volsella modiola (LINNÉ)	0.5	0.3
Macoma calcarea (CHEMNITZ)	0.5	0.3
Strongylocentrotus sp. present.		
Lithothamnion sp. present.		
	176.5	100.1

Quinqueloculina seminulum and *Cibicides lobatulus* were also observed in the sample.

The lower terrace, or bench, at 4 m a.s.l. has been cut into the cliff of the higher terrace by wave erosion, the two levels being formations of one and the same deposit. The two samples, no. 375 and no. 376, can therefore be treated together, and they are both representative of the *Lower Astarte terraces* of the *Post-Glacial Warm period* of Inner Isfjorden (FEYLING-HANSSEN 1955, p. 41). Three of the species were of the mid-arctic element, viz. *Mytilus edulis, Omalogyra atomus* and *Balanus balanoides,* and four were of the low-arctic element, viz. *Heteranomia squamula, Volsella modiola, Cyprina islandica* and *Emarginula fissura.* The largest specimen of *Astarte borealis* (sample no. 376) measured, L=39 mm, H=34 mm, and had united valves. Some of the *Saxicava* shells were of *pholadis* form, but most of them were small and irregular; the largest valve of *Mya truncata* (sample no. 375) measured, L=52 mm, H=37 mm, and was quite thick-shelled.

Another Lower *Astarte* terrace was found to the south of the hunters headquarters, (fig. 3) and from the silty gravel of its sea cliff, 6—3 m a.s.l., the following shells were collected:

6—3 m a.s.l. Sea cliff S of the foreland. Gravel. (Sample No. 381).

Species	Frequency	Percentage
Astarte borealis (CHEMNITZ)	61.5	78.3
Mya truncata LINNÉ	9.5	12.1
Mytilus edulis LINNÉ	4.0	5.2
Astarte montagui (DILLWYN)	2.5	3.2
Cyprina islandica (LINNÉ)	0.5	0.6
Macoma calcarea (CHEMNITZ)	0.5	0.6
	78.5	100.0

50 valves of *Astarte borealis* have been measured, (fig. 5), the largest having a length of 42.5 mm and a height of 38.0 mm. The other species were mostly represented only by shell fragments.

Along the southern shore of the large lagoon bedrock outcropped, in some places carrying glacial striae in the direction S 36° E (fig. 3). The eastern shore had been eroded in extended silty deposits carrying vast quantities of *Lithothamnion.* The cliff of this *Lithothamnion* silt had a maximum height of approx. 2.5 m at the lagoon, and a large collection of shells were made from it at 2.5—0.5 m a.s.l., many of the shells having been washed from the silt down on the beach (see p. 11, sample No. 378).

In addition some Foraminifera were observed in the sample, viz. *Quinqueloculina seminulum, Elphidium clavatum, Elphidium* sp. and *Cibicides lobatulus.* Four of the mollusk species belong to the mid-arctic faunal element, viz. *Mytilus edulis, Lacuna vincta, Littorina saxatilis* and *Omalogyra atomus.* 18 plates of *Tonicella marmorea* occurred in the sample, and, on the whole, the specimens were very well preserved. This sample contained almost the

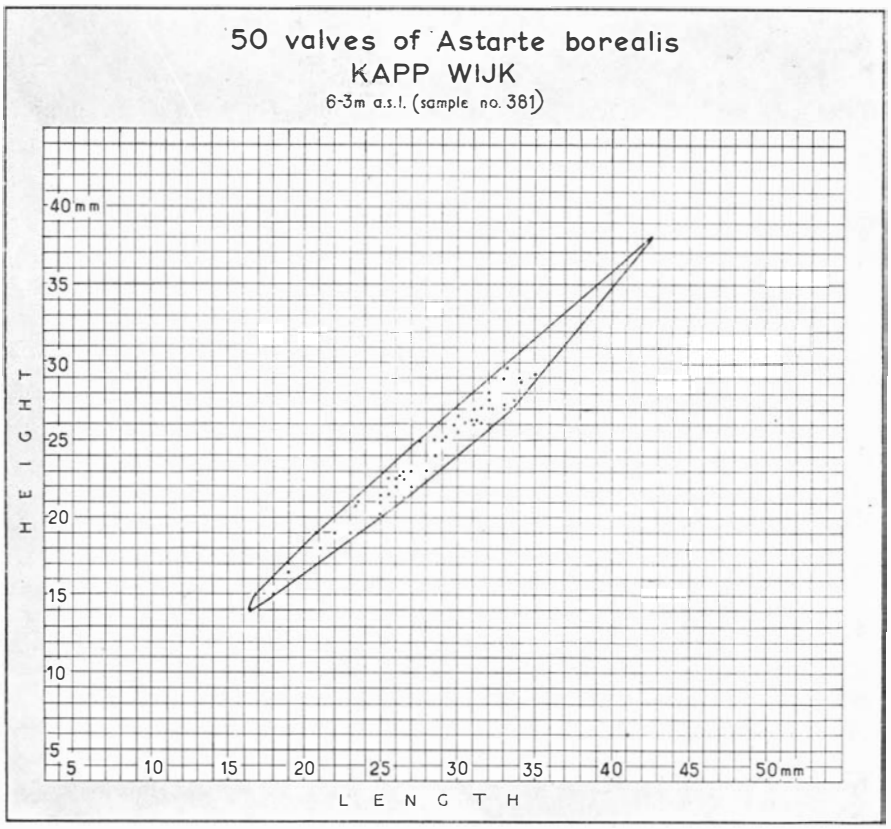

Fig. 5. Shell measurements of *Astarte borealis*.

same species as the sample (no. 356) from the *Lithothamnion* silt at Sentabukta, Billefjorden, 2 m a.s.l. though *Astarte borealis* was the most frequent species there (FEYLING-HANSSEN 1955, p. 91).

The *Lithothamnion* silt extended to the east of the lagoon forming a large, swampy flat, with vegetation, very gently rising from 2.5 m a.s.l. at the lagoon to 8.6 m at the foot of a gravel cliff running for nearly 2 km in a SSE—NNW direction. The cliff was eroded in the deposits of a large beach plain sloping towards the NNW with close-set, slightly curved, beach ridges at right angles to the direction of slope. Towards the bight at the north side of the main foreland of Kapp Wijk the height of the beach plain approached the present-day sea level, at the middle part, at the stream from the pond on fig. 3, the scarp of the cliff of the plain was situated 15.6 m a.s.l. rising southwards to 22.3, 29.4 and 34.6 m a.s.l. Topographically this beach plain corresponds to the large, sloping beach plains of Billefjorden and Bjonapynten which were formed during the Post-Glacial Warm period, even though the rear edge of the beach plain at Kapp Wijk was found at a lesser

2.5—0.5 m a.s.l. Lithothamnion silt at the lagoon. (Sample No. 378).

Species	Frequency	Percentage
Astarte montagui (DILLWYN)	413.5	42.1
Astarte borealis (CHEMNITZ)	209.0	21.3
Saxicava arctica (LINNÉ)	201.5	20.5
Mya truncata LINNÉ	52.5	5.3
Macoma calcarea (CHEMNITZ)	45.5	4.6
Astarte elliptica (BROWN)	9.5	1.0
Puncturella noachina (LINNÉ)	9.0	0.9
Mytilus edulis LINNÉ	6.0	0.6
Littorina saxatilis (OLIVI)	6.0	0.6
Chlamys islandica (MÜLLER)	5.0	0.5
Margarites groenlandicus (CHEMNITZ)	5.0	0.5
Tonicella marmorea (FABRICIUS)	3.0	0.3
Acmaea rubella (FABRICIUS)	3.0	0.3
Lacuna vincta (MONTAGU)	3.0	0.3
Crenella decussata (MONTAGU)	2.0	0.2
Margarites helicinus (PHIPPS)	2.0	0.2
Moelleria costulata (MÖLLER)	2.0	0.2
Natica clausa BRODERIP and SOWERBY	2.0	0.2
Omalogyra atomus (PHILIPPI)	1.0	0.1
Balanus balanus (LINNÉ)	1.0	0.1
Balanus crenatus BRUGUIÈRE	1.0	0.1
Thracia myopsis (BECK) MÖLLER	0.5	0.1
Strongylocentrotus cf. *droebachiensis* plates and spines.		
Lithothamnion sp. vast quantities.		
	983.0	100.0

elevation than were the rear edges of the contemporary beach plains of Inner Isfjorden (FEYLING-HANSSEN 1955, p. 41).

A collection of fossils were made from the cliff at approx. 20 m a.s.l., the following species being found:

20 m a.s.l. Cliff of large beach plain. Silty-sandy gravel. (Sample No. 379).

Species	Frequency	Percentage
Mya truncata LINNÉ	42.0	41.6
Macoma calcarea (CHEMNITZ)	40.0	39.6
Mytilus edulis LINNÉ	11.5	11.4
Cyprina islandica (LINNÉ)	4.0	3.9
Astarte borealis (CHEMNITZ)	1.0	1.0
Saxicava arctica (LINNÉ)	1.0	1.0
Balanus balanus (LINNÉ)	1.0	1.0
Axinopsis orbiculata G. O. SARS	0.5	0.5
Strongylocentrotus sp. spines.		
	101.0	100.0

Two species of Foraminifera were also observed in the sample, viz. *Elphidium incertum* and *Cibicides lobatulus*. This fauna has much in common with a fauna from Ledalen in Sassenfjorden, collected from clayey-silty material at 6—0 m a.s.l. (FEYLING-HANSSEN and JØRSTAD 1950, p. 64). The frequency

of *Mytilus edulis* together with the fairly common occurrence of *Cyprina islandica* indicate that this sloping beach plain of Kapp Wijk was formed during the Post-Glacial Warm period. The scarcity of *Astarte borealis* must be due to some local environmental condition. *Axinopsis orbiculata* was found in the Late-Pleistocene of the Sassen area but not in the Billefjorden area.

Another terrace, with its cliff at the rear edge of the large beach plain mentioned above, rose from 37.8 m a.s.l. at its front edge to 46.4 m at its rear edge. A shoreline was found at 50.9 m a.s.l. and a narrow terrace at 55.7 m rising to 61.5 m a.s.l. No fossils were found at these levels, but with reference to their heights they correspond fairly well with the marine formations of the *Post-Glacial Temperate period* of the Inner Isfjorden Area (FEYLING-HANSSEN 1955, p. 38).

Above and to the south of these features a prominent shoreline had been eroded in bedrock and was now situated at an altitude of 71.7 m a.s.l. Another shoreline, or rather bench, was found at 77.0 m a.s.l. and an indistinct line at 93.4 m a.s.l. These ancient levels correspond to the marine features of the *Late-Glacial Cold period* of Inner Isfjorden, and 93.4 m a.s.l. is considered to be the upper marine limit of Kapp Wijk.

2 km NNE of this locality, on the east side of the river from Idodalen, other raised marine features from the Temperate and Cold period were found. A ridged beach plain with a WSW—ENE-running cliff rose from 39.0 to 61.1 m a.s.l. The direction of its parallel, close-set beach ridges was N 30°W—S 30°E, the plain sloping W 30°S. A tributary stream from the east had eroded the beach plain deposits, revealing continuous incline-bedding of the gravel in the erosion cliff, the strata dipping 20—25° in the same direction as the slope of the ridged surface of the beach plain. A remnant of the same formation was found at 34.8 m a.s.l. on the SW side of the tributary stream.

A small collection of fossils was made from the cliff of the beach plain at approx. 15 m a.s.l.:

15 m a.s.l. Cliff of sloping beach plain 61—39 m a.s.l. Silty sand. (Sample No. 380):

Species	Frequency	Percentage
Mya truncata LINNÉ	22.0	80.0
Macoma calcarea (CHEMNITZ)	3.0	10.9
Saxicava arctica (LINNÉ)	1.5	5.5
Buccinum glaciale LINNÉ	1.0	3.6
	27.5	100.0

The composition of this population compares well with the average composition of the fauna of the *Mya* terraces of the Post-Glacial Temperate period of Inner Isfjorden, especially with that of their sublittoral deposits (FEYLING-HANSSEN 1955, p. 40, fig. 10).

Above the *Mya* beach plain there was a small terrace rising from 61.2 to 66.9 m a.s.l., a shoreline in the rocks of the mountain side at 68.5 m a.s.l. representing its rear edge. This terrace corresponds to the Cold period beach plain rising from 62.1 to 73.5 m a.s.l. at the SW side of Skansbukta in the Billefjorden area and to terraces from the same period at Tjosåsdalen, Bjonahamna and the Sassen Hut (FEYLING-HANSSEN 1955, p. 36 and fig. 55). The highest marine shoreline on the NE side of the river from Idodalen had been eroded in the rocks of the mountain side above the *Mya* beach plain and was now situated at an elevation of 86.2 m a.s.l. It probably corresponds to the shoreline at Ekholmvika, 84.5, and Sveltihel, 85.7 m a.s.l. of the Inner Isfjorden Area.

Summarized Classification of the Raised Features.

Post-Glacial Warm period.

3.0 m a.s.l., *Mytilus* terrace at the end of the tombolo (Sample No. 377).
3.0— 6.0 —»— , Lower *Astarte* terrace, sea cliff south of the hunters headquarters (Sample No. 381).
7.2 —»— , Lower *Astarte* terrace at the northeast side of the entrance to the lagoon, a bench at 4 m a.s.l. being eroded in its cliff (Samples Nos. 375, 376).
0.5— 2.5 —»— , *Lithothamnion* silt at the eastern end of the lagoon, rising to 8.6 m a.s.l. (Sample No. 378).
15.6—34.6 —»— , Sloping beach plain between the lagoon and the pond (fig. 3).

Post-Glacial Temperate period.

37.8—46.4 m a.s.l., Terrace SW of the pond.
50.9 —»— , Shoreline SW of the pond.
55.7—61.5 —»— , Narrow terrace SSW of the pond.
34.8 —»— , Terrace remnant at the NE side of the river from Idodalen.
39.0—61.1 —»— , Sloping *Mya* beach plain at the NE side of the river from Idodalen (Sample No. 380).

Late-Glacial Cold period.

61.2—68.5 m a.s.l., Terrace and shoreline above the *Mya* beach plain at the NE side of the river from Idodalen.
71.7 —»— , Prominent shoreline SSW of the pond.
77.0 —»— , Shoreline SSW of the pond.
86.2 —»— , Highest shoreline observed at the NE side of the river from Idodalen.
93.4 —»— , Indistinct shoreline SSW of the pond.

Previous Records of Late-Pleistocene Fossils from Dicksonfjorden.

Fossils were collected from Late-Pleistocene deposits in this area by early Swedish expeditions. *Mytilus edulis* and *Cyprina islandica* were found at the head of Dicksonfjorden, on the west side (HÄGG 1950, p. 333), and from red clay at the east side of the fjord NATHORST collected in 1882 the following species (HÄGG 1950, p. 333; cf. also KNIPOWITSCH 1903 IV, p. 138):

Nucula tenuis (MONTAGU), 2 valves,
Mytilus edulis LINNÉ, 5 valves,
Chlamys islandica [=*Pecten islandicus* (MÜLLER)], 1 spec.,
Cyprina islandica (LINNÉ), 20 valves,
Macoma calcarea (CHEMNITZ), 11 valves,
Mya truncata LINNÉ, 4 valves,
Littorina littorea (LINNÉ), 4 specimens.

Another collection from the east side of the fjord contained (HÄGG 1950, p. 334):

Mytilus edulis LINNÉ, 6 valves,
Volsella modiola [=*Modiola modiolus* (LINNÉ)], 1 valve,
Chlamys islandica (MÜLLER), 2 valves,
Cyprina islandica (LINNÉ), 2 valves,
Clinocardium ciliatum [=*Cardium ciliatum* FABRICIUS], 7 valves,
Serripes groenlandicus [=*Cardium groenlandicum* CHEMNITZ], 4 valves,
Macoma calcarea (CHEMNITZ), 8 valves,
Saxicava arctica (LINNÉ), 3 valves,
Mya truncata LINNÉ, 5 valves,
Margarites cinereus (COUTHOUY), 1 specimen,
Lunatia pallida (BRODERIP and SOWERBY), 3 specimens,
Lunatia tenuistriata (DAUTZENBERG and FISCHER), 1 specimen,
Littorina littorea (LINNÉ), 3 specimens,
Littorina saxatilis (OLIVI), 6 specimens,
Buccinum glaciale LINNÉ, 5 specimens,
Buccinum groenlandicum CHEMNITZ, 2 specimens,
Balanus sp.,
Lithothamnion.

At Kapp Wijk were, in 1868, found (HÄGG 1950, p. 337) *Mytilus edulis* and *Astarte borealis*. In 1872 ÖBERG collected in Dicksonfjorden (HÄGG 1951, p. 232):

Mytilus edulis LINNÉ, 7 valves,
Volsella modiola (LINNÉ), 1 valve,
Chlamys islandica (MÜLLER), 5 valves,
Astarte borealis (CHEMNITZ), 4 valves,
Cyprina islandica (LINNÉ), 50 valves,
Saxicava arctica (LINNÉ), 3 valves,
Mya truncata LINNÉ, 12 valves,
Littorina littorea (LINNÉ), 1 specimen.

Many valves of *Mytilus edulis* were found by NATHORST in 1872 at the west side of the fjord (HÄGG 1951, p. 238), and WIMAN found, in 1908, one valve of *Cyprina islandica* northwest of Kapp Wijk. HOEL (1911, p. 252) found *Mytilus edulis* at Lykta on the east side of the fjord in a 40 m high terrace the rear edge of which was situated at 60 m a.s.l.

18 species of marine invertebrates have thus been recorded from the Late-Pleistocene of Dicksonfjorden by early Swedish expeditions; in addition they found *Balanus* sp. and *Lithothamnion* sp.

Remarks on the Fossil Fauna.

41 species of marine invertebrates have been recorded from the Late-Pleistocene of Dicksonfjorden; 35 of these were found by the author, 6 only by other investigators. As mentioned above, 18 species had previously been recorded from the raised deposits in the area so that the number of fossil species has been augmented by 23. In addition *Lithothamnion,* specific identification of which has not been undertaken, occurred quite frequently and some species of Foraminifera were also observed. The species of fossil marine invertebrates, the Foraminifera precluded, have been listed in table I, in which the occurrence in the Late-Pleistocene of the Billefjorden area and the Sassen area has also been indicated.

Five of the species were not found in the Late-Pleistocene of Billefjorden (FEYLING-HANSSEN 1955), viz.

Nucula tenuis
Axinopsis orbiculata
Thracia myopsis
Lunatia pallida
Lunatia tenuistriata,

and six were not found in the Late-Pleistocene of the Sassen area (FEYLING-HANSSEN and JØRSTAD 1950), viz.

Emarginula fissura
Acmaea rubella
Margarites cinereus
Omalogyra atomus
Lunatia tenuistriata
Lora bicarinata.

Table I.

Marine invertebrates in the Late-Pleistocene of Dicksonfjorden.	Found by the author	Billefjorden area	Sassen area
Tonicella marmorea (FABRICIUS 1780)	+	+	+
Nucula tenuis (MONTAGU 1808)	.	.	+
Heteranomia squamula (LINNÉ 1767)	+	+	+
Chlamys islandica (MÜLLER 1776)	+	+	+
Crenella decussata (MONTAGU 1808)	+	+	+
Mytilus edulis LINNÉ 1758	+	+	+
Volsella modiola (LINNÉ 1758)	+	+	+
Astarte borealis (CHEMNITZ 1784)	+	+	+
Astarte montagui (DILLWYN 1817)	+	+	+
Astarte elliptica (BROWN 1827)	+	+	+
Axinopsis orbiculata G. O. SARS 1878	+	+	+
Clinocardium ciliatum (FABRICIUS 1780)	.	+	+
Serripes groenlandicus (CHEMNITZ 1782)	.	+	+
Cyprina islandica (LINNÉ 1767)	+	+	+
Macoma calcarea (CHEMNITZ 1782)	+	+	+
Saxicava arctica (LINNÉ 1767)	+	+	+
Mya truncata LINNÉ 1758	+	+	+
Thracia myopsis BECK (MÖLLER 1842)	+	.	+
Emarginula fissura (LINNÉ 1766)	+	+	.
Puncturella noachina (LINNÉ 1771)	+	+	+
Acmaea rubella (FABRICIUS 1780)	+	+	.
Margarites groenlandicus (CHEMNITZ 1781)	+	+	+
Margarites helicinus (PHIPPS 1774)	+	+	+
Margarites cinereus (COUTHOUY 1839)	.	+	.
Moelleria costulata (MÖLLER 1842)	+	+	+
Lacuna vincta (MONTAGU 1803)	+	+	+
Littorina saxatilis (OLIVI 1792)	+	+	+
Littorina littorea (LINNÉ 1758)	.	+	+
Cingula castanea (MÖLLER 1842)	+	+	+
Omalogyra atomus (PHILIPPI 1841)	+	+	.
Lunatia pallida (BRODERIP and SOWERBY 1829)	+	.	+
Lunatia tenuistriata (DAUTZENBERG and FISCHER 1911)	.	.	.
Natica clausa BRODERIP and SOWERBY 1829	+	+	+
Sipho togatus (MÖRCH 1869)	+	+	+
Buccinum groenlandicum (CHEMNITZ 1788)	.	+	+
Buccinum glaciale LINNÉ 1761	+	+	+
Lora bicarinata (COUTHOUY 1838)	+	+	.
Balanus balanus (LINNÉ 1758)	+	+	+
Balanus crenatus BRUGUIÈRE 1789	+	+	+
Balanus balanoides (LINNÉ 1767)	+	+	+
Strongylocentrotus cf. *droebachiensis* (MÖLLER 1776)	+	+	.

With reference to their Recent distribution 31 of the species extend into the high-arctic subregion, thus belonging to the high-arctic faunal element (FEYLING-HANSSEN 1955, fig. 5 and p. 30), 5 occur in the mid-arctic subregion but not in the high-arctic, thus belonging to the mid-arctic element, viz.

Mytilus edulis
Lacuna vincta
Littorina saxatilis
Omalogyra atomus
Balanus balanoides,

and 5 do not occur north of the low-arctic subregion, thus belonging to the low-arctic element, viz.

Heteranomia squamula
Volsella modiola
Cyprina islandica
Emarginula fissura
Littorina littorea.

Cyprina islandica seems to be more frequent in Warm period deposits of Dicksonfjorden than in corresponding deposits of Billefjorden.

A Collection of Shells from the Recent Shore of Kapp Wijk.

From the Recent beach and storm ridge at the hunters headquarters at Kapp Wijk a large collection of shells containing the following species were made:

0—1 m a.s.l. Recent beach and storm ridge. Gravel. (Sample No. 382).

Species	Frequency	Percentage
Astarte borealis (CHEMNITZ)	585.0	85.8
Saxicava arctica (LINNÉ)	26.5	3.9
Serripes groenlandicus (CHEMNITZ)	12.5	1.8
Macoma calcarea (CHEMNITZ)	10.0	1.5
Mya truncata LINNÉ	9.5	1.4
Astarte montagui (DILLWYN)	8.5	1.2
Liocyma fluctuosa (GOULD)	7.5	1.1
Mytilus edulis LINNÉ	6.5	0.9
Astarte elliptica (BROWN)	3.0	0.4
Buccinum glaciale LINNÉ	3.0	0.4
Thracia septentrionalis JEFFREYS	2.0	0.3
Natica clausa BRODERIP and SOWERBY	2.0	0.3
Lunatia pallida BRODERIP and SOWERBY	2.0	0.3
Clinocardium ciliatum (FABRICIUS)	1.0	0.2
Cyrtodaria siliqua (SPENGLER)	1.0	0.2
Lacuna crassior (MONTAGU)	1.0	0.2
Cyprina islandica (LINNÉ)	0.5	0.1
Lithothamnion sp. common.		
	681.5	100.0

Crab carapaces were also common. The shells were picked up from the surface of the beach and storm ridge; they have been washed ashore during Recent times. The pelecypod valves which rested on their exterior had their periostracum preserved, whereas those which rested on their interior in general had their periostracum worn off. 200 valves of *Astarte borealis* have been measured (fig. 6), the largest having a length of 53.0 mm and a height of 41.5 mm. The largest specimen obtained by ODHNER (1915, p. 89) had a length of 46 mm and was dredged in Gronfjorden, whereas the largest

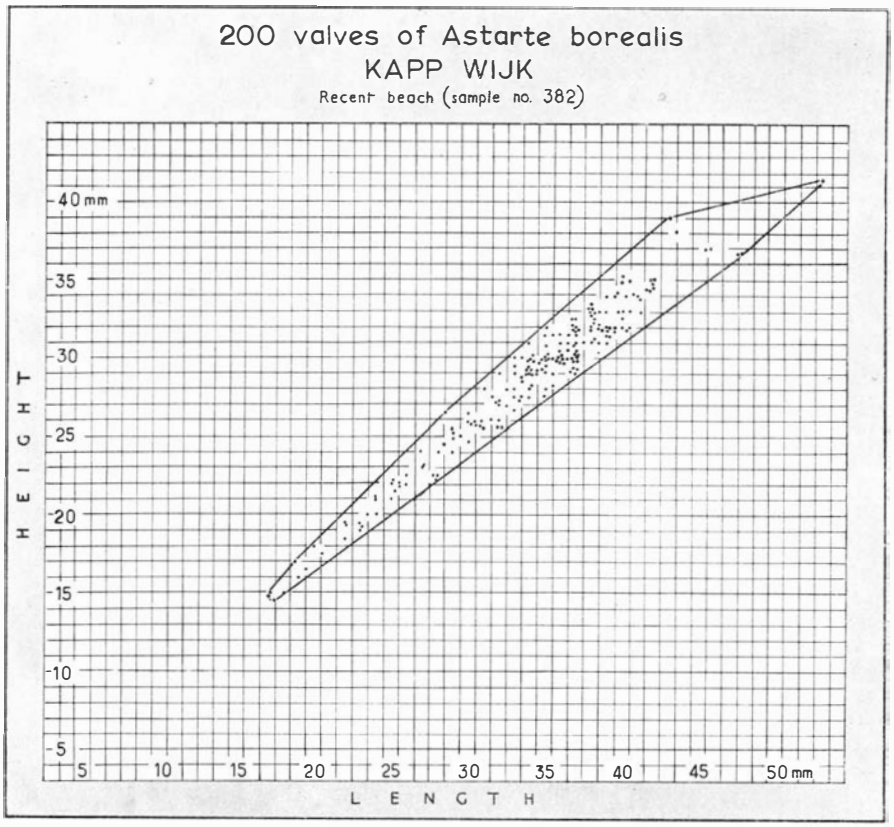

Fig. 6. Shell measurements of *Astarte borealis*.

specimen from Greenland had a length of 44 mm and from Iceland 52—56 mm (JENSEN 1912, p. 95)[1]. The valves of *Saxicava arctica* were small and often irregular, the largest measuring L=34.5 mm, H=16.5 mm. The shells of *Serripes groenlandicus* were large but generally broken, the largest complete valve measuring L=65.5 mm, H=55.0 mm. The *Macoma* shells were small and the *Mya* shells thin. 13 valves and umbonal fragments of

[1] ELTON and BADEN-POWELL (1931, p. 387) and BADEN-POWELL (1939, p. 339) made use of what they called «Jensen's method», which, especially for *Astarte*, should be to measure the height of the shell as a percentage of the length and to put this percentage in relation to the climate in which the shell lived. Thus a high form of *Astarte borealis*, percentage over 80, should indicate warm conditions, whereas a low form, percentage under 80, should indicate cold conditions. Comparing, however, the measurements of the valves of *Astarte borealis* from the Recent shore of Kapp Wijk (fig. 6) with those of the valves from the Post-Glacial Warm period (figs. 4 and 5), such a difference in the shape of the shells cannot be observed. Many Recent shells were larger than those from the Warm period but, in general, not more depressed. JENSEN (1912, p. 96) himself did not relate the shape of *Astarte borealis* so closely to its environment as did ELTON and BADEN-POWELL.

Mytilus edulis were found, some of them with the periostracum partly preserved; as this species, however, has not been found living in Spitsbergen waters up to now, we must, for the present, assume that the valves and fragments of *Mytilus edulis* on the beach of Kapp Wijk originate from Late-Pleistocene *Mytilus*-bearing deposits at the locality (cf. FEYLING-HANSSEN and JORSTAD 1950 pp. 35—37; FEYLING-HANSSEN 1955, p. 132). The fragment of the ventral margin of a valve of *Cyprina islandica,* which was also found on the beach, has certainly been derived from deposits from the Post-Glacial Warm period. The shells of *Thracia septentrionalis* were quite thick, the largest measuring L=28.5 mm, H=21.3 mm. The largest specimen of *Natica clausa* had a length of 20 mm, and the largest *Lunatia pallida* (=*Polynices pallidus* (BRODERIP and SOWERBY)=*Lunatia groenlandica* BECK) a length of 21.0 mm. The specimen of *Lacuna crassior* (MONTAGU) (=L. *pallida* (DONOVAN)=*L. glacialis* MÖLLER) had a length of 18.5 mm and a breadth of 9.0 mm; the shell was solid, opaque and somewhat glossy with yellowish colour, 6 whorls, deeply depressed sutures and rather wide and indistinct canal or groove (JEFFREYS 1865, pp. 344—346; cf. also KNIPOWITSCH 1901, pp. 451—453 and DAUTZENBERG and FISCHER 1912, pp. 206—208). The largest specimen of *L. glacialis* recorded from Spitsbergen by KNIPOWITSCH (1901, p. 451) was 16.5 mm long.

Evidence of a Positive Shift of the Shoreline in Recent Times?

At the WNW end of the tombolo (fig. 2) progradation towards the WSW is taking place to the south of the „islet" of outcropping bedrock. The direction of the successively added beach ridges is NNW—SSE (fig. 7). Crest altitudes of the beach ridges were measured along the line A—A (fig. 7) and the result has been illustrated in fig. 8, showing a pronounced decrease in crest altitudes towards the older ridges. Similar conditions were observed both in the Sassen area and in the Billefjorden area, and they most probably indicate a slight positive shift of the shoreline to be taking place in Recent times.

Inside the Recent storm ridge (fig. 8) a sparse vegetation was found in the swales of the beach plain, but in the lowest swales this vegetation is now being destroyed be seawater which occasionally occupies such swales. Old drift wood was found on the plain, becoming younger towards the Recent shore, and all over the beach plain pieces of drift wood affected by man could be found.[1]

In the broad bight on the south side of the foreland of Kapp Wijk the huts of the hunting headquarters of A. OKSÅS are situated (fig. 3), and north-

[1] On the elongated, elevated part of the «islet» with outcropping bedrock, a ruin was observed.

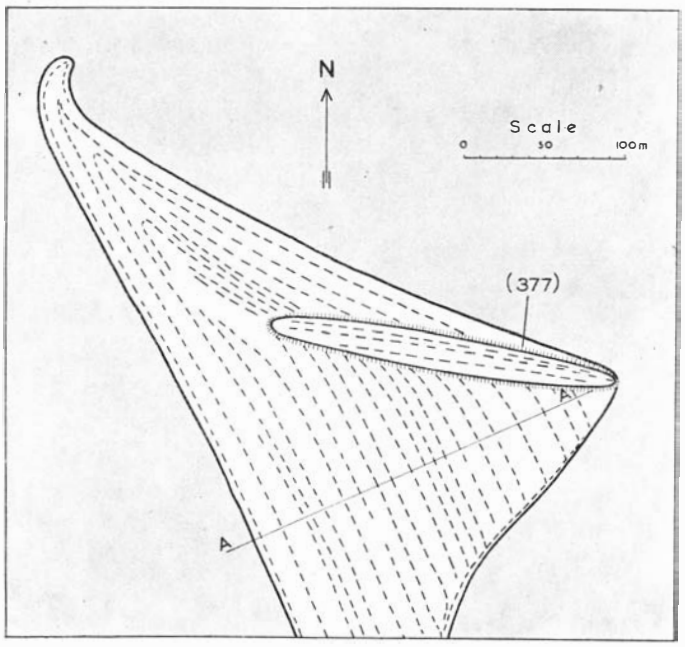

Fig. 7. The outermost point of Kapp Wijk with the «islet» of outcropping bedrock, and the beach ridges indicated by dotted lines.

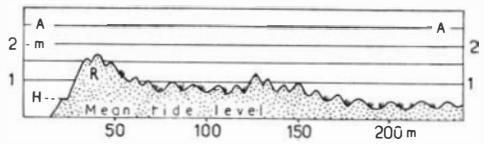

Fig. 8. Profile along the line A—A on fig. 7 showing landward decrease in ridge crest height; vegetation in the swales indicated. H=high-water line, R=Recent ridge.

west of these huts the ruins or, rather the vestiges, of another hut were found on the beach. Its area was 6×3 m² with length direction S 25°W. It was situated 11 m from the high-water line and 1.25 m above it. The ruin was completely surrounded by beach gravel which continued 17 m landwards behind the ruin. The floor of this old hut was found to be situated 80 cm below the crest of the Recent storm ridge, and a humus layer 10 cm thick, appeared in the beach gravel. This hut probably represents an old Russian hunting station (oral communication with Dr. A. K. ORVIN of Norsk Polarinstitutt). Oldfashioned bricks were found at the hut and round logs have been used in the corners and at the middle of the long walls. The present-day conditions at the ruin of the hut at Kapp Wijk most probably point to a positive shift of the shoreline in Recent times. More definite results could not be obtained because only a very short visit was paid to the locality.

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Plate I.

Page

Figs. 1, 2. *Serripes groenlandicus* (CHEMNITZ) 18
1, external, 2, internal view of a valve from the Recent shore at the hunters headquarters (Sample No. 382), ×1.

Figs. 3, 4. *Thracia septentrionalis* JEFFREYS 19
1, external view of the left valve, 2 internal view of the right valve of a specimen from the Recent shore at the headquarters (Sample No. 382), ×1.

Fig. 5. *Axinopsis orbiculata* G. O. SARS 11
external view of a valve from the cliff of the large, ridged beach plain, 20 m a.s.l. (Sample No. 379), ×15.

Fig. 6. *Cyrtodaria siliqua* (SPENGLER) 17
a broken valve, with partly preserved periostracum, from the Recent shore at the headquarters (Sample No. 382), ×1.

Fig. 7. *Crenella decussata* (MONTAGU) 11
external view of a valve from *Lithothamnion* silt at the east side of the lagoon, 2.5—0.5 m a.s.l. (Sample No. 378), ×12.

Figs. 8, 9. *Puncturella noachina* (LINNÉ) 11
8, side view, 9, apical view of a specimen from *Lithothamnion* silt at the east side of the lagoon, 2.5—0.5 m a.s.l. (Sample No. 378), ×2.

Fig. 10. *Lunatia pallida* BRODERIP and SOWERBY 19
apertural view of a specimen from the Recent shore at the headquarters (Sample No. 382), ×1.

Fig. 11. *Lacuna crassior* (MONTAGU) 19
apertural view of a specimen from the Recent shore at the headquarters (Sample No. 382), ×2.

Figs. 12, 13. *Margarites groenlandicus* (CHEMNITZ) 11
12, oblique view showing umbilicus and aperture, 13, oblique view showing the apex of a specimen from *Lithothamnion* silt at the east side of the lagoon, 2.5—0.5 m a.s.l. (Sample No. 378), ×2.

Fig. 14. *Sipho togatus* (MÖRCH) 7
side view of a specimen from the northern cliff of the «islet» at the end of the tombolo, 3 m a.s.l. (Sample No. 377), ×1.

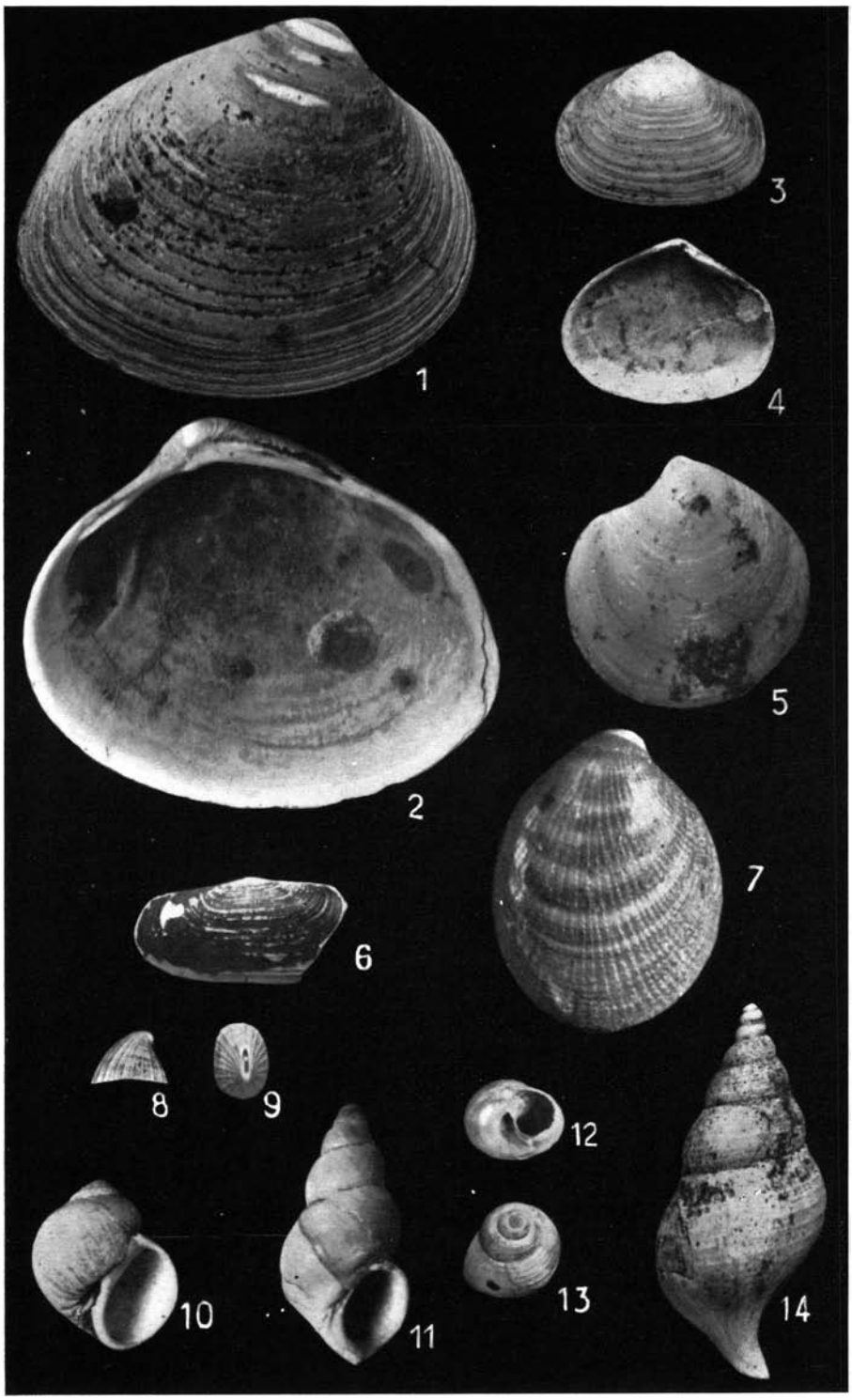
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Plate II. Dicksonfjorden with Kapp Wijk to the right in the foreground. (cf. fig. 1). B. Luncke photo, 1938.

Plate III. Lagoon and ridges of Kapp Wijk. (cf. fig. 3, p. 6). B. Luncke photo, 1938.

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MAPS AND CHARTS

The following topographical maps and charts have been published separately:

Maps:

Bjørnøya. 1:25 000. 1925. New edition 1944. Kr. 3,00.
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Preliminary topographical maps [1:50 000] covering claims to land in Svalbard and a preliminary map of Hopen 1:100 000 may be obtained separately.

In addition, Norsk Polarinstitutt has prepared a wall map: Norden og Norskehavet, in 4 sheets. This map is to be obtained through H. Aschehoug & Co. (W. Nygaard), Oslo, at a price of kr. 27,80.

Charts

No. 501. Bjørnøya. 1:40 000. 1932. Kr. 4,00.
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Norsk Polarinstitutt. Skrifter Nr. 108. Rolf W. Feyling-Hanssen: Late-Pleistocene Deposits at Kapp Wijk, Vestspitsbergen.