

# QUARTERNARY FAUNAS IN THE ST. JONSFJORD—EIDEMBUKTA REGION, VESTSPITSBERGEN

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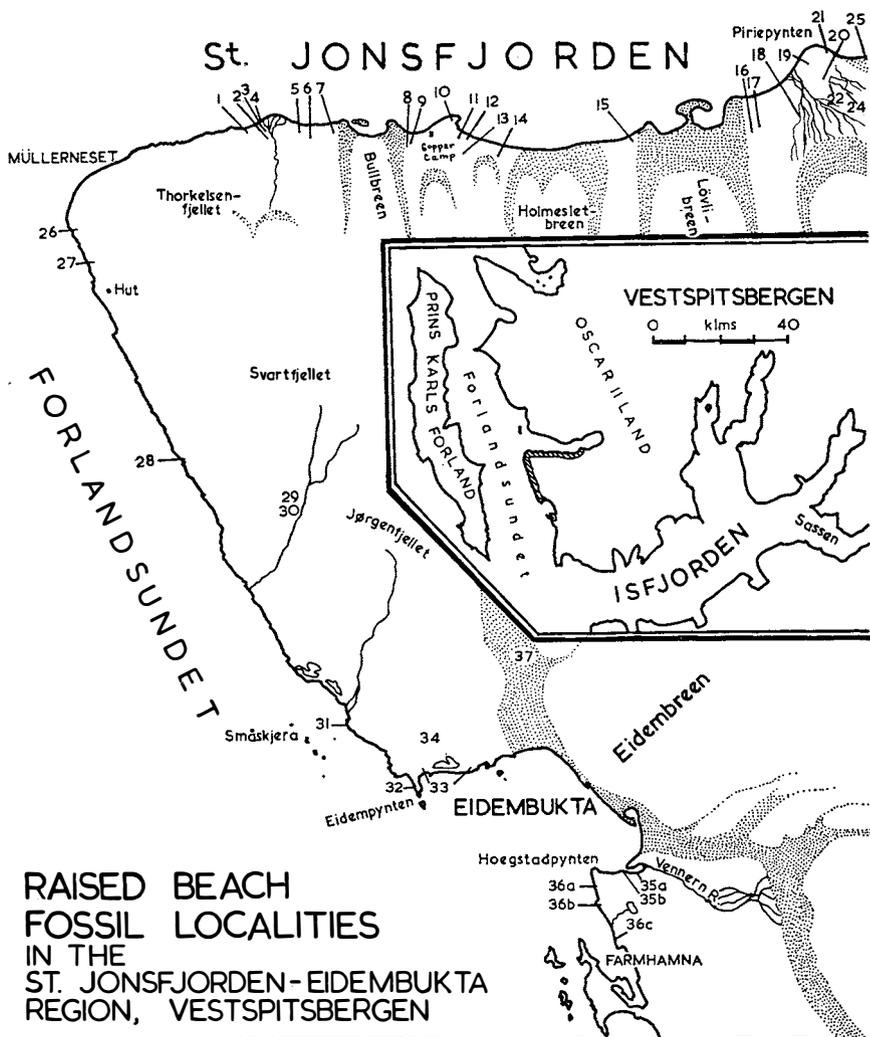
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**Abstract.** The paper lists occurrences of Quarternary faunas in raised beach deposits from the St. Jonsfjord-Eidembukta region of Vestspitsbergen. The faunas from the deposits in the fjord are, in some respects, different from those of the west coast. The vertical distribution of species shows some approximation to that recorded by FEYLING-HANSSSEN and JØRSTAD (1950) in the Sassen area. *Mytilus edulis* in abundance is recorded from the lower levels of the west coast.

## **Acknowledgment**

The author is indebted to MR. G. BRACE for his untiring and cheerful assistance in the field and to MR. P. A. GARRETT for assistance in this country. MR. R. W. FEYLING-HANSSSEN kindly read the manuscript and offered helpful criticism and advice.

The work was carried out on the second Birmingham University Spitsbergen Expedition which was made possible through the generosity of that university, the Foyle Trust, the Royal Society and many other scientific and industrial bodies. The assistance of the Governor of Svalbard, Sysselman H. Balstad, and of the master and crew of M. V. Sysla in transporting the expedition in Spitsbergen waters is gratefully acknowledged.



### Introduction

As a result of their work in the Sassen area of Isfjorden, Vestspitsbergen, R. W. FEYLING-HANSSSEN, and F. A. JØRSTAD suggested (1950) that there may be a real possibility of correlating raised beaches by their included faunas. In the Sassen area several horizons within

the raised Quarternary marine (littoral) deposits are marked by the dominance of certain fossils. PEACH (1916) had noted the abundance of *Saxicava arctica* in deposits between 15 and 21 m. above sea level on Prins Karls Forland and gave them the name «Saxicava Beach», but the fossil is by no means limited to the deposits between these two levels. The common fossils in the Sassen region are *Astarte borealis* (Chemnitz), *Mya truncata* Linne, *Saxicava arctica* Linne, and *Mytilus edulis* Linne. They are present at almost all levels, but their frequency varies so as to make possible the recognition of certain faunal horizons:

- |  |     |         |
|--|-----|---------|
| 4. <i>Saxicava-Mya</i> horizon, average height above sea level |     | 45 m.   |
| 3. Upper <i>Astarte</i> horizon,                               | —«— | 20.5 m. |
| 2. Lower <i>Astarte</i> horizon,                               | —«— | 7 m.    |
| 1. <i>Mytilus</i> horizon,                                     | —«— | 3.6 m.  |

Grouped broadly into: — *Astarte* division, 7.0 m. to 20.5 m.  
*Mya* division, 20.5 m. to just below 45.0 m.<sup>1</sup>

A semi-recent level with abundant *Saxicava arctica* and *Lithothamnion* was identified and it was noted that whale bone was found between (but not below) 2 and 5 m. above sea level. FEYLLING-HANSEN and JØRSTAD remarked that the conditions which prevailed within the reaches of Isfjorden during post-glacial times may not have been operative on the western coast of Vestspitsbergen, and that the nature and sequence of the raised beach faunas in the west might be different from those within the fjord.

The Birmingham University Spitsbergen Expedition of 1951 collected raised beach fossils from the southern side of St. Jonsfjord and between Müllerneset and Farmhamna. The preservation of the raised features in the fjord is poor; distinct shore-lines or terraces on the strandflat are rare, the very gentle slope of the platform being covered with an almost continuous spread of shingle. A brief account of the raised marine features of this region has been given by the present writer (DINELEY, D. L., 1953). Time did not allow extensive collecting of the

<sup>1</sup> In a letter dated 10 October, 1953, FEYLLING-HANSEN tells me that later investigations in the inner parts of Isfjorden showed that the *Astarte* division should be extended to somewhere above 30 m. and the *Mya* division to about 60 m.

molluscan faunas from these deposits and the present treatment of the evidence cannot be regarded as statistical, but certain conclusions concerning the raised beach faunas of this area seem to be warranted.

There are numerous references in literature to the raised deposits of the west coast of Vestspitsbergen, but only PEACH (1916) has made a study of the raised deposits and Quarternary faunas of the Forlandsund region. There is no general synthesis known to the writer which gives an account of the raised faunas of the entire west coast, and FEYLING-HANSEN and JØRSTAD'S work appears to be the only attempt on a detailed scale to establish palaeontological zones in the Quarternary sediments.

### List of fossil localities

Height above m.s.l. is shown before each locality listed.

a = species abundant: more than 50 specimens collected from a few square yards of deposit within a few minutes' searching.

c = species common: about 25 specimens collected as above.

r = species rare: about 10 specimens collected as above.

Where very rare, the number of specimens found is given.

#### A. St. Jonsfjorden.

1. 18 m., 117 m. west of river gorge to east of Thorkelsenfjellet, in fine shingle.

*Mya truncata* a

2. 24 m., 27 m. west of river gorge in loc. 1.

*Mya truncata* a

*Astarte sp.* c

3. 13.5—15 m. at foot of bank of fine shingle below loc. 2.

*Mya truncata* c

*Astarte borealis* c

4. 19.8 m. bank of coarse shingle 18 m. north of loc. 3.

*Mya truncata* c

*Saxicava arctica* c

*Astarte borealis* r

*Gastropod indet.* 1 specimen.

5. 9—10.5 m. several bands of shingle between river delta and loc. 7.  
*Mya truncata* c  
*Saxicava arctica* c  
*Astarte borealis* r
6. 15—18 m. several banks of shingle above loc. 5.  
*Mya truncata* c
7. 10.5—12 m., 18—22.5 m. west of lateral moraine of Bullbreen.  
*Mya truncata* a  
*Saxicava arctica* c  
*Astarte borealis* c  
*Astarte montagui* r  
*Chlamys islandicus* 4 specimens.
8. 30 m. bank of fine shingle in stream section immediately east of eastern lateral moraine of Bullbreen.  
*Mya truncata* a  
*Saxicava arctica* r
9. 28.5 m. immediately below loc. 6.  
*Mya truncata* a  
*Saxicava arctica* c  
*Astarte elliptica* r  
*Balanus balanus* 3 specimens.
10. 4.5 m. bank of gravel due north-east of Copper Camp.  
*Mytilus edulis* 10 specimens  
*Cyprina islandica* 3 specimens
11. 4.5 m., 90 m. south south-east of loc. 10 (several exposures).  
*Astarte borealis* c  
*Mya truncata* r  
*Astarte elliptica* r  
*Cyprina islandica* 5 specimens
12. 6 m. sand bank 9 m. due east of loc. 11.  
*Mya truncata* c
13. 7.5 m. mud polygons at top of cliffs due north of copper mine.  
*Mya truncata* c  
*Saxicava arctica* r

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14. 15 m. shingle with large boulders immediately east of large corrie west of Holmesletbreen.  
*Mya truncata* c
15. 3.6—4.5 m. shingle beneath moraine at northern tip of western Løvlibreen lateral moraine.  
*Mya truncata* c  
*Saxicava arctica* r  
*Mytilus edulis* 2 specimens  
*Astarte sp.* 1 specimen.
16. 27 m. shingle bank emerging from beneath eastern lateral moraine of Løvlibreen.  
*Mya truncata* c  
*Saxicava arctica* r
17. 24 m. immediately below loc. 16.  
*Mya truncata* c  
*Astarte borealis* r  
*Saxicava arctica* 6 specimens
18. 24 m. gravel bank on western side of large outwash fan to south of Piriepynten.  
*Mya truncata* c  
*Gastropod indet.* 1 specimen.
19. 18 m. shingle on western slope of Piriepynten.  
*Mya truncata* c  
*Chlamys islandicus* 1 specimen
20. 4.5 m. gravel on the southern side of Piriepynten.  
*Astarte borealis* a  
*Astarte montagui* c  
*Mya truncata* c  
*Saxicava arctica* c  
*Astarte elliptica* r  
*Lithothamnion sp.* r  
*Annelid tubes* r
21. 3 m. gravel on eastern side of Piriepynten.  
*Mya truncata* c
22. 3 m. shingle at south-western corner of small lake south of Piriepynten.  
*Mya truncata* c

23. 3—4.5 m. fine shingle in dry stream course, 4.5 m. north of loc. 22.
- |                         |              |
|-------------------------|--------------|
| <i>Mya truncata</i>     | c            |
| <i>Astarte borealis</i> | c            |
| <i>Astarte montagui</i> | 7 specimens. |
24. 3 m. shingle at south-eastern corner of lake mentioned as loc. 22.
- |                          |   |
|--------------------------|---|
| <i>Astarte borealis</i>  | a |
| <i>Mya truncata</i>      | c |
| <i>Saxicava arctica</i>  | c |
| <i>Astarte montagui</i>  | r |
| <i>Cyprina islandica</i> | r |
| <i>Annelid tubes</i>     | r |
25. Up to 9.5 m. black shingly mud at northern extremity of western lateral moraine of Charlesbreen.
- |                          |   |
|--------------------------|---|
| <i>Astarte borealis</i>  | a |
| <i>Astarte montagui</i>  | c |
| <i>Mya truncata</i>      | c |
| <i>Saxicava arctica</i>  | c |
| <i>Astarte elliptica</i> | r |
| <i>Lithothamnion sp.</i> | r |

*B. Müllerneset to Farnhamna.*

26. 2.4—3 m. flaky gravel on crags at southern end of Müllerneset beach.
- |                       |   |
|-----------------------|---|
| <i>Mytilus edulis</i> | a |
| <i>Mya truncata</i>   | r |
27. 3—4.5 m. several exposures of gravel on top of crags between loc. 26 and Müllerneset Hut.
- |                         |             |
|-------------------------|-------------|
| <i>Mytilus edulis</i>   | a           |
| <i>Mya truncata</i>     | r           |
| <i>Gastropod indet.</i> | 1 specimen. |
28. 6.4 m. gravel on top of cliffs due south-west of Svartfjellet.
- |                       |   |
|-----------------------|---|
| <i>Mytilus edulis</i> | c |
| <i>Mya truncata</i>   | r |
29. 30—36 m. banks of braided stream flowing from large corrie between Svartfjellet and Jørgenfjellet, fine shingle.
- |                         |                      |
|-------------------------|----------------------|
| <i>Mya truncata</i>     | c                    |
| <i>Saxicava arctica</i> | c                    |
| <i>Astarte montagui</i> | r                    |
| <i>Mytilus edulis</i>   | r                    |
| <i>Balanus sp.</i>      | 1 specimen.          |
| <i>Whalebone</i>        | several large bones. |

30. 24—27 m. same section as loc. 29.
- |                          |             |
|--------------------------|-------------|
| <i>Mya truncata</i>      | c           |
| <i>Saxicava arctica</i>  | c           |
| <i>Mytilus edulis</i>    | r           |
| <i>Buccinum glaciale</i> | 1 specimen. |
| <i>Gastropod indet.</i>  | 1 specimen. |
31. 3.6—6.4 m. gravels above shore immediately opposite Småskjera.
- |                       |                          |
|-----------------------|--------------------------|
| <i>Mytilus edulis</i> | a                        |
| <i>Whalebone</i>      | several large fragments. |
32. 4.5—6 m. gravels on wave-cut bench immediately north of and on Eidem-pynten. Several exposures.
- |                       |                    |
|-----------------------|--------------------|
| <i>Mytilus edulis</i> | a                  |
| <i>Mya truncata</i>   | r                  |
| <i>Astarte spp.</i>   | several fragments. |
33. 3.6—6.4 m. gravels along north-west coastline of Eidembukta.
- |                       |   |
|-----------------------|---|
| <i>Mytilus edulis</i> | c |
| <i>Mya truncata</i>   | r |
| <i>Astarte spp.</i>   | r |
34. 7.5—10 m. fine shingle west of Eidem moraine.
- |                       |                    |
|-----------------------|--------------------|
| <i>Mytilus edulis</i> | c                  |
| <i>Mya truncata</i>   | r                  |
| <i>Whalebone</i>      | several fragments. |
35. 4.5—6.4 m. gravels resting on wave-cut bench between mouth of Vennern river and Hoegstadpynten (a. and b.)
- |                          |                    |
|--------------------------|--------------------|
| <i>Mytilus edulis</i>    | a                  |
| <i>Saxicava arctica</i>  | c                  |
| <i>Astarte borealis</i>  | r                  |
| ? <i>Balanus balanus</i> | r                  |
| <i>Mya truncata</i>      | r                  |
| <i>Astarte sp.</i>       | several specimens. |
36. 4.5—6.4 m. thick gravels resting on wave-cut bench on eastern side of Farmhamna (a, b, c).
- |                          |   |
|--------------------------|---|
| <i>Astarte borealis</i>  | c |
| <i>Lithothamnion sp.</i> | c |
| <i>Mytilus edulis</i>    | c |
| <i>Saxicava arctica</i>  | c |
| <i>Mya truncata</i>      | r |
| <i>Spirorbis sp.</i>     | r |

? <i>Balanus balanus</i>	several specimens.
<i>Gastropod indet.</i>	4 fragments.
<i>Chlamys islandicus</i>	3 specimens.

37. 49.5 m. Eidembreen moraine below Jørgenfjellet.

<i>Mya truncata</i>	c
<i>Astarte borealis</i>	c
<i>Astarte sp.</i>	r
<i>Buccinum glaciale</i>	8 specimens.
<i>Gastropod indet.</i>	2 specimens.

## Discussion

### (a). St. Jonsfjorden.

The raised features within the fjord fall topographically into five groups, at 3.6—4.5 m., 7.5—10 m., 12—21 m., 30 m. and at about 45 m. above sea level (see DINELEY, D. L., 1953, p. 505). The highest level at which fossils have been found is 30 m., which is low in comparison with other parts of Vestspitsbergen but not surprising in view of the poor state of preservation of the raised features within the fjord. Of the localities listed all except numbers 13 and 25 are upon marine shingle or silty mud. In the western lateral moraine of Charlesbreen (locality 25) fossils occur in a black plastic mud. It is clear that the glacier here has incorporated into its moraine marine deposits that lay in its path during its last major readvance, though whether these deposits were then ancient or recent (i. e. were raised or not prior to the last readvance of the ice) has not been determined. (See LAMPLUGH, G. H., 1911, and HEINTZ, A., 1953).

The number of fossil types discovered in the raised sediments during the present work is not great. Further searching would doubtless have extended the lists of species found. The fjord faunas are dominated by *Mya truncata* with *Saxicava arctica* second in importance; the other forms are much less frequent. *Mytilus edulis* is notably absent from most of the deposits, being found at only two low horizons. The *Mya* communities are interesting, several thousand individuals occurring together in a good state of preservation, usually in a fine grey or black silt. Presumably this is the sediment in which the animals burrowed. Many of the *Mya* shells are encrusted with annelid tubes and algal

St. Jonsfjorden.

Table I.

	above m.s.l.				
	3.6— 4.5 m.	7.5— 10 m.	12— 21 m.	30 m.	45 m.
<i>Astarte borealis</i> (Chemnitz)	c	a	c	r	—
<i>Astarte elliptica</i> (Brown) ..	r	r	r	r	—
<i>Astarte montagui</i> (Dillwyn)	r	r	r	—	—
? <i>Balanus balanus</i> (Linne) ..	r	r	—	3	—
<i>Buccinum glaciale</i> (Linne)	—	r	—	—	—
<i>Chlamys islandica</i> (Müller)	r	—	—	—	—
<i>Cyprina islandica</i> (Linne)	r	r	—	—	—
<i>Mya truncata</i> (Linne) . . . . .	a	a	a	c	—
<i>Mytilus edulis</i> (Linne) . . . .	r	r	—	—	—
<i>Saxicava arctica</i> (Linne) ..	r	c	r	r	—

r = rare, c = common, a = abundant (as indicated previously).

Frequency of molluscs in the raised marine deposits of St. Jonsfjorden.

growths, many have suffered extensively the ravages of shell-boring organisms, and many show an enormous thickening. The latter is common enough to appear almost as a pathological feature. Some specimens still retain traces of the periostracum and ligament. The adult specimens often attain great size (8 cms by 5.25 cms being recorded) and show a considerable variation in shape, with a tendency for the variety *uddevalensis* to predominate, although the whole range from *ovata* Jensen to *uddevalensis* Hancock is represented.

The abundance of *Mya truncata* in the raised deposits of the fjord and the comparative scarcity of this fossil in those on the strandflat seems to suggest that it found, as would be expected, a more favourable environment in the quiet waters of the fjord than in the more agitated sea of Forelandsundet. FEYLING-HANSEN and JØRSTAD (1950, p. 49) suggested that the ecological conditions on the west coast of Vestspitsbergen are quite different from those in Isfjorden and thus different from those in similar fjords, and this must have been so during the formation of the raised beach deposits also. The fjord waters today, while generally calm, are muddy, and the influx of glacial mud at the time when those deposits were accumulating was probably much the same as it is today: on the other hand, the sea in Forlandsundet is

more free from suspended matter. The distribution of the fossils *Mya truncata* and *Mytilus edulis* may have been affected by such conditions. NATHORST (1901) has stated that *Mytilus* cannot possibly live in the immediate neighbourhood of a productive (= calving?) glacier, and the presence of that fossil in the lower raised sediments has been taken to indicate that they accumulated under warmer conditions than those of today. (FEYLING-HANSSSEN and JØRSTAD have discussed the inadvisability of retaining the term «*Mytilus* period», at least while our knowledge is in its present state). Since *Mytilus* is replaced by *Mya* in the fjord deposits, one may assume that the fjord waters were at least as muddy and probably as cold or colder than they are at present.

(b). The East coast of Forlandsundet (Müllerneset to Farmhamna).

The raised deposits below about 45 m. on the strandflat of the eastern side of Forlandsundet consist of shingles, sands, muddy silts and gravels. Above 45 m. in this area they are poorly preserved, and occur as isolated patches of pebbles or coarse shingle from which no faunas have been obtained. Here even more than in the fjord there is a serious difficulty in ascribing the fauna to a particular level or terrace. This arises from the redeposition of sediments and fossils from terraces at greater heights. As FEYLING-HANSSSEN and JØRSTAD (1950, p. 11.) point out, the upper terraces have produced the greater part of the material from which those beneath are composed: faunas may in this way become mixed and confusion in correlation may result. They quote the instance of *Mytilus edulis* which is now found on the modern shore in Isfjorden — as it is in Forlandsundet — yet this mollusc does not live in Isfjorden today; its shells have been washed down from the raised deposits.

The striking characteristic of the lowest deposits in the present region is the dominance of *Mytilus edulis* in the included fauna. *Mytilus* occurs in great numbers in the thick deposits of shingle and sub-angular gravel resting on the cliff tops, often to a height of 12 m. or more. The gravels in which the fossils occur are different from those above in that they consist largely of locally derived Hecla Hook slaty material, not quartzitic shingle. The shells themselves are very broken and comminuted and are so numerous that a shell sand often results; comparatively

Müllersneset to Farmhamna.

Table II.

	above m.s.l.				
	3.6— 4.5 m.	7.5— 10 m.	12— 21 m.	30 m.	45 m.
<i>Astarte borealis</i> (Chemnitz)	c	c	r	r	—
<i>Astarte elliptica</i> (Brown) ..	r	r	—	—	—
<i>Astarte montagui</i> (Dillwyn)	c	r	r	—	—
? <i>Balanus balanus</i> (Linne) ..	c	r	r	r	—
<i>Buccinum glaciale</i> (Linne)	r	r	r	—	—
<i>Buccinum sp.</i> .....	r	—	—	—	r
<i>Chlamys islandica</i> (Müller)	r	r	r	—	—
<i>Cyprina islandica</i> (Linne)	r	r	r	—	—
<i>Mya truncata</i> (Linne).....	c	c	c	c	c
<i>Mytilus edulis</i> (Linne) ....	a	a	c	r	—
<i>Saxicava arctica</i> (Linne) ..	c	c	c	c	r
<i>Lithothamnion sp.</i> .....	a	c	r	—	—
<i>Spirorbis sp.</i> .....	a	a	c	c	r

r = rare, c = common, a = abundant (as indicated previously).

Frequency of fossil species found in the raised marine deposits between Müllersneset and Farmhamna.

few complete shells were found below 5.4 m. Rapid and turbulent deposition (possibly of material derived from the raised shingles immediately above as well as of fragments thrown up by the waves) followed by rapid uplift is suggested to account for these sediments. The absence of large masses of shingle down-washed from above has been noticed and it seems unlikely that all the *Mytilus* fragments could have been selectively sorted and washed from the higher deposits: the majority of the shells must have been thrown up by the waves, and the application of the term «*Mytilus terrace*» seems to be justified. Prior to FEYLING-HANSSSEN and JØRSTAD'S work in the Sassen area *Mytilus* terraces had not been recorded in Svalbard. In Sassenfjorden the average level of these terraces is 3.6 m. which seems to correspond to the group of levels between 3.6 m. and 6.4 m. near Müllersneset and around Eidembukta. Although (poor) *Mytilus* communities existed at Sassen in the inner reaches of the fjord, conditions on the west coast, with

the prevailing warm westerly currents, must have been more congenial, and it is possible that *Mytilus* terraces will be found extensively on the west coast.

Above the *Mytilus*-crowded sediments that fossil persists to a height of at least 30 m. but becomes increasingly rare. Up to the 30 m. level *Mya truncata* and *Saxicava arctica* are common forms, but above this level fossils are very scarce. Whalebone has, however, been found at 36 m. *Astarte borealis* is rare within the 12—21 m. group of deposits, and extremely rare above it; the scarcity of the fossil above the 21 m. mark seems to correspond to the upward limit of extensive numbers of this shell in the Sassen areas (20.5 m.) and other parts of Vestspitsbergen.

### Conclusions

The collections of raised beach fossils made within the St. Jonsfjord—Eidembukta region could, no doubt, be greatly extended by intensive search, but several features are already worthy of note. In the fjord the thick-walled molluscs predominate: *Mya truncata* is present in abundance in deposits up to 21 m. or so, while *Mytilus edulis* is represented only by a few specimens at only the lowest levels. In the deposits of the strandflat the latter fossil is most prolific in deposits up to 12 m., whereupon *Mya truncata* takes its place. *Saxicava* seems to be common between 12 m. and 21 m., but it is hard to see how a «*Saxicava* beach» could be distinguished in this part of Vestspitsbergen on the evidence collected. (The author has not yet visited Prins Karls Forland where Peach (1916) originally recognised his «*Saxicava* beach». ) *Astarte borealis* is common in both raised fjord and strandflat deposits up to about 12 m.

Discussing PEACH's work, FEYLING-HANSEN and JØRSTAD (p. 43.) comment that if that author had traced really contemporaneous beaches over the wide area that he claimed, (see PEACH, 1916 p. 297) and since his levels seem to agree fairly well with those they record in the Sassen area, the evidence tends to contradict the suggestions of WORDIE (1921) and BALCHIN (1941) that warped shorelines exist in Vestspitsbergen. This does not seem to the writer to be necessarily the case: BALCHIN emphasised that the tilted shorelines which he mapped in Sassenfjorden and Billefjorden were essentially local readjustments to isostatic pressure. The idea of eustatic changes of sea-level postulated by HORN and

ORVIN (1918) is not necessarily excluded. (This idea has been tentatively discussed elsewhere by the present author. DINELEY, 1953, p. 507). The recognition of faunal horizons and limits along the lines initiated by FEYLING-HANSEN and JØRSTAD should be attempted over wide areas before the problem of warped shorelines and eustatic recovery or changes of level can be considered in anything but a local sense.

The observations recorded above, while not on a comparable scale with those published for the Sassen area, do give some measure of support for the scheme of zones outlined by FEYLING-HANSEN and JØRSTAD. In the present area the following table may be said to apply.

3. <i>Saxicava-Mya</i> horizon	21—30 m.
3. <i>Saxicava-Mya-Astarte</i> horizon	10—21 m.
1. <i>Mytilus</i> horizon	up to 12 m.

There does not seem to be sufficient evidence to distinguish an upper and a lower *Astarte* horizon, though a *Mya* division from 10 m. to 30 m. is possible.

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Manuscript received December 21, 1953.