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THE STRATIGRAPHY OF THE JURASSIC AND CRETACEOUS ROCKS OF GEOGRAPHICAL SOCIETY Ø, EAST GREENLAND

BY

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WITH 9 FIGURES IN THE TEXT AND 2 PLATES

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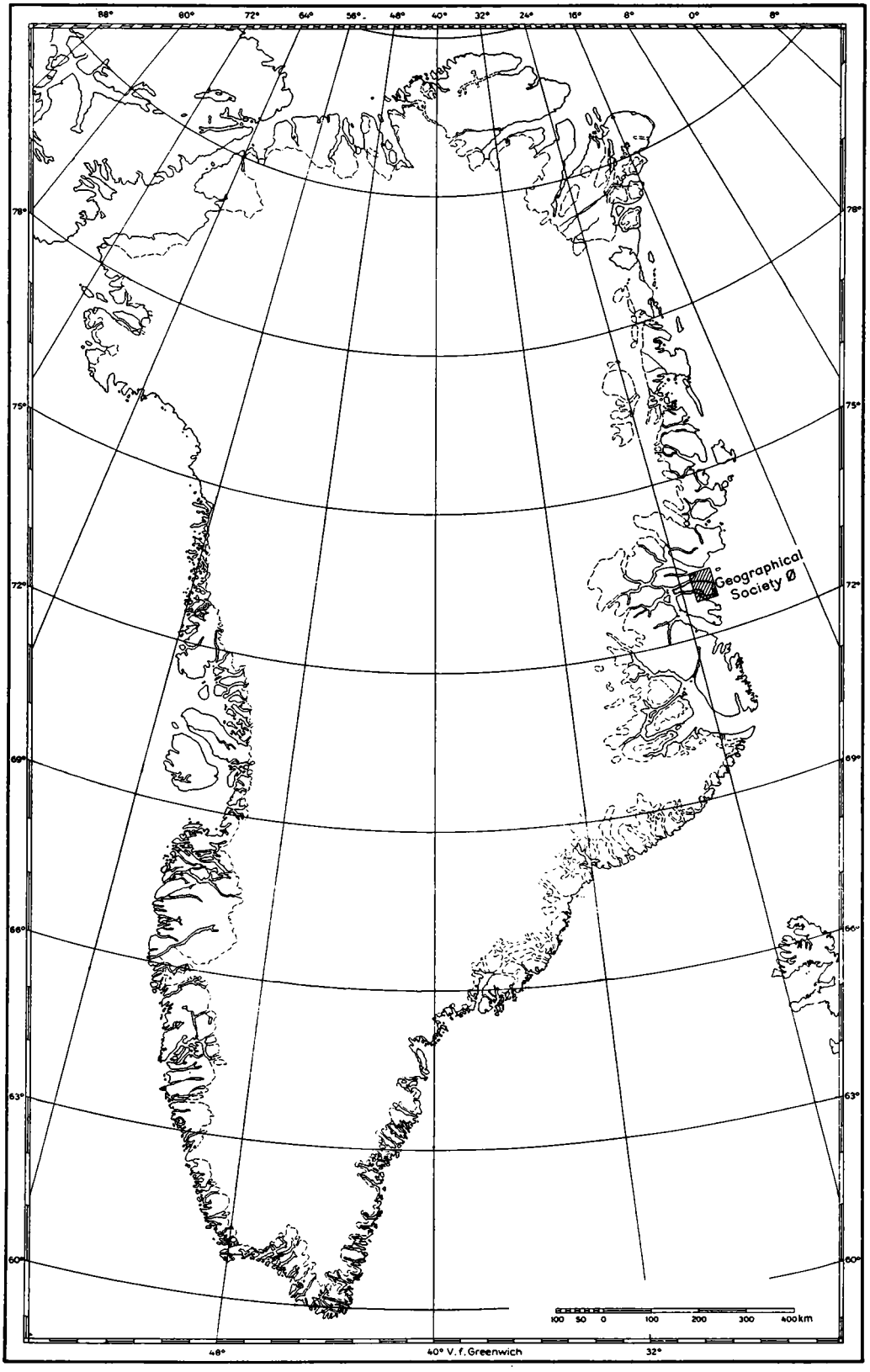
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PREFACE

The following publication is an account of field-work carried out from July 26th to August 28th, 1952, as a member of the Lauge Koch Expedition to East Greenland. During this period I had the use of a motor-boat which greatly facilitated the examination of the area to be covered, namely the eastern part of Vega Sund, with its many islands and irregular shoreline, and the north-eastern and eastern coasts of Geographical Society Ø. Despite the loss of several days due to bad weather, the use of the boat enabled a good general idea of the geology to be obtained, and many points of stratigraphy and structure were clarified. The work forms a northward continuation of my investigations in Traill Ø, the results of which have been recently published in M. o. G. vol. 111, no. 4, 1953.

I wish to thank Dr. Lauge Koch for inviting me to join the expedition in 1952, and for providing all the necessary facilities as well as for interesting information and discussion during his subsequent visits to Bristol. My assistants on the expedition were Flt. Lt. S. L. Page, R.A.F., a graduate of Bristol University and a companion on a former expedition (1949), and Messrs. J. Johnson and C. E. Periam, then students at Bristol University. In addition I had the help, from the 1st to the 8th of August, of Mr. A. J. Standring and Mr. E. W. Roberts who had been prevented by bad weather conditions from reaching their objective at Kap Brewster. My Danish assistant, in charge of the motor-boat, was Mr. Vagn Kroman, whose skill contributed much to the successful prosecution of the work.

The laboratory work has been carried out in the Geology Department of Bristol University, and some palaeontological results have already been published (M. o. G. Bd. 72, 2 Afd., nr. 6, 1954). The examination of the Valanginian faunas, discovered in 1950 and already reported, but materially increased in 1952, is not yet complete and will form the subject of a future communication. I should like to thank my colleagues, Dr. F. Coles Phillips and Dr. I. S. Loupekine, for examining certain mineral and rock specimens, and for help in the matter of igneous and sedimentary petrology. Dr. W. J. Arkell and Mr. C. W. Wright have helped me with a number of questions concerning Jurassic and Cretaceous

stratigraphy and palaeontology, and I am grateful to them for their continued interest.

As far as can be foreseen, the season of 1952 completed my work on the Jurassic and Cretaceous areas of Traill and Geographical Society Øer. The results are in some respects disappointing: the extraordinary paucity of fossils, except at a very few horizons, constantly frustrates any attempt at detailed palaeontological and stratigraphical comparison, and the existence, in contrast to most neighbouring parts of East Greenland, of extensive unexposed areas makes mapping sometimes a matter of guesswork. Nevertheless some advance in the structural and stratigraphical knowledge of the area has been achieved, and while I believe that additional work could fill in many details, it is doubtful whether the expense of carrying it out would be justified by any major additions to knowledge. The affection which I feel, at the moment of writing, for this sometimes unresponsive area is not wholly unconnected with the hope that I shall never visit it again.

Bristol, March, 1954.

Note on Geographical Names.

The following additional names in Geographical Society Ø have been introduced by the writer to facilitate description:

Name	*Translation*	*Position*
Tværdal	Transverse Valley	The valley which traverses Geographical Society Ø from N.N.E. to S.S.W., crossing the line of 23° W. Longitude.
William Smith Dal	William Smith Valley	The valley extending east and west between Leitch Bjerg, on the north, and Freycinet Bjerg, on the south.
John Phillips Dal	John Phillips Valley	The valley trending north and south immediately east of Laplace Bjerg.

The following equivalents may be useful for English-speaking readers:

Bjerg	= Mountain	Fjeld	= Mountain
Bugt	= Bay	Kap	= Cape
Dal	= Valley	Ø, Øer	= Island, Islands

I. INTRODUCTION

The location of the area described in this paper is shown on page 4. The country investigated comprises the eastern part of Geographical Society Ø and neighbouring small islands, the islands in Vega Sund, and part of northeast Traill Ø which had not previously been examined. The outlines of the region and the names of the principal topographic features, are shown in figure 1, together with the extent of the Mesozoic rocks and the principal faults which traverse the area.

The historical survey of earlier knowledge recently given by the writer for Traill Ø (Donovan, 1953, pp. 7—9) is applicable, in general, to the area described in the present paper. The only specific examination of the area prior to that of the writer was carried out by Stauber in 1936—37, and his results have been published in several papers (Stauber 1938, 1939, 1940, 1942) and were incorporated in the geological map published by Koch (1950, pl. 3). Spath (1946) published identifications of some Cretaceous ammonite faunas collected by Stauber, and recognised Lower Albian, Middle Albian and Lower Cenomanian assemblages. The writer paid a visit to the southern coast of Geographical Society Ø in 1947, resulting in a few more fossil records (Donovan, 1949).

No detailed information has hitherto been available on the Jurassic and Cretaceous formations which are the principal subject of the present paper. Geographical Society and Traill Øer form a unit as far as the Mesozoic rocks are concerned, and the stratigraphic subdivisions established by the writer in Traill Ø, to the south (Donovan, 1953, table on p. 148) have now been shown to be valid for both islands.

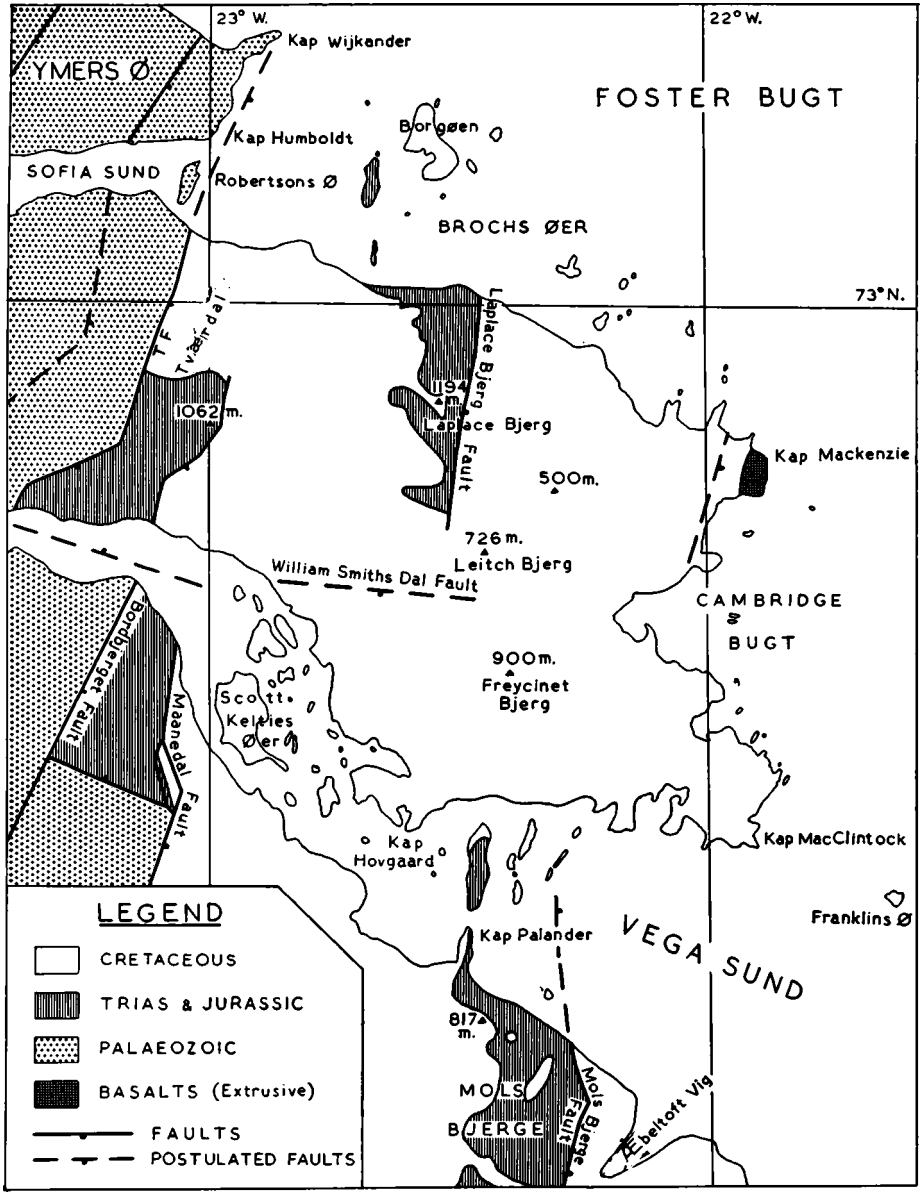

Fig. 1. Map of eastern Geographical Society Ø and neighbouring areas showing the outlines of the geology and the principal topographic names referred to in the text. Scale: 1 : 500,000. The intrusive igneous rocks are not shown. TF = Tværdal Fault.

II. TRIASSIC ROCKS

The Triassic rocks which occur, in the Mols Bjerge on Traill Ø, and in Tværdal and at Laplace Bjerg in Geographical Society Ø, were not specially studied during the writer's visit to the area in 1952, but a few facts may be recorded and some comments made on previous description.

No fossils have been found in the rocks below the Yellow Series, which are therefore not at all accurately dated. A lower limit is provided by the cephalopod-bearing marine Eotriassic rocks, which occur in the Rold Bjerge (Donovan, 1953, p. 15) and at the southern end of Tværdal, if Stauber's indistinct impressions (1942, p. 50, bed 10) were indeed marine shells. Stauber divides the beds above the Eotrias into two formations, the Continental Series below and the Bunte Series above, which he regards as the equivalents of the Mt Nordenskiøld Formation and the Kap Biot Formation respectively in Jameson Land. Stauber also recognises Rhaetic beds in the area (*e. g.* 1942, pl. 3, sections 6, 14, and pl. 3 in Koch, 1950) and if this was established the Continental Series and the Bunte Series could be regarded as undoubtedly triassic. The writer has recently (Donovan, 1953, pp. 17—18) pointed out, however, that none of the beds below the Yellow Series can be confidently allotted to the Rhaetic or the Lias, and the recent investigations have produced no further evidence to suggest that the Kap Stewart Formation, which carries a Rhaetic-Lias flora in Jameson Land, extends northwards into Traill and Geographical Society Øer.

Mols Bjerge.

The distribution of the pre-Jurassic rocks has been shown by Stauber in a small sketch-map (1942, text-fig. 5, p. 64) and agrees with that mapped by Mr. A. J. Standring and here published (fig. 2, p. 13) except for the position of the faulted eastern boundary. The following section was observed beneath the Yellow Series about 2 km south-east of Kap Palander:

	m
(Scree above)	
Grey, sandy micaceous shales, with thin bands of grey and white sandstone, and beds of red and green marl	20
Dolerite Sill	26
Hard, light grey, thin-bedded sandstone	2
Massive white sandstone below, passing up into massive grey, micaceous and pyritic sandstone	18
Yellow and brown weathering grey sandstones, shales and shaly limestones, passing up into alternating beds of sandstone and shale	38
(Scree down to sea-level)	

The base of this section is at an altitude of 126 m. It is separated from the outcrops of the Yellow Series above by screes which obscure the sequence for a vertical distance of over 200 m, so that the lower limit of the Yellow Series cannot be drawn with accuracy.

Stauber (1942, pp. 64—78) has recorded three detailed sections from the same neighbourhood, and identifies the rocks as Triassic on the basis of the lithology, recognising his Bunte Series above and Continental Series below. His map marks the lowest beds exposed as Eotrias (due south of Læsø) and shows the line of his section no. 7 crossing this outcrop, but no mention is made in the text of the Eotrias having been identified. In his diagrammatic vertical sections in the same publication Stauber (1942, pl. 3) shows pre-Triassic rocks in the lower part of the same section, but there is no explanation in the text of these discrepancies.

About 5 km further east, rocks of presumed Triassic age are exposed in the upper reaches of the first valley to the west of Æbeltoft Vig. This valley intersects the Mols Bjerge Fault, which lies about 3 km east of the position given for it on Stauber's maps. On crossing the fault, about 2.8 km inland from the valley mouth, dark grey micaceous sandstones are exposed for a distance of several hundred metres along the stream. They are often false-bedded and ripplemarked, and some of the bedding planes carry pieces of dark grey shale up to 6 cm across. A dip of 12° to the west was measured. The cirque at the head of the valley exposes in its walls further sandstones which appear to follow conformably those in the stream. They were not examined closely but were observed to include browhish- as well as greenish-grey beds, with some purple-brown horizons. It was estimated that between 600 and 700 m of these sandstones are exposed in the valley and the cirque. They are capped, on the western rim of the cirque, by more irregularly bedded, brown and grey sandstones, which yielded no fossils but are assumed to mark the base of the Yellow Series of the Jurassic.

In the Mols Bjerge, therefore, at least 600 m of sandstones are present below the Jurassic. The upper part of this series is characterised by

green and purple or red beds and agrees with the rocks underlying the Yellow Series of the Jurassic in the southern part of the Mols Bjerge and on the south coast of Traill Ø (Donovan, 1953, p. 15).

Tværdal.

The Triassic outcrops at the southern end of this valley have also been studied by Stauber. The Eotrias is proved by *Claraia* and fish-remains recorded from Stauber's section no. 2, in which a thickness of 170 m, extending down to shore-level, is allotted to the "Marine Series" (Stauber, 1942, pp. 49—51). The Eotrias is succeeded by 115 m of beds allotted to the Continental Series, mainly light-coloured, sometimes greenish and greyish sandstones and conglomerates. Above this about 40 m of beds are ascribed by Stauber to the Bunte Series.

Immediately beneath the Yellow Series is a series of thin-bedded, red and green ripple-marked sandstones, which the writer in 1949 (p. 4) assigned to the Rhaetic-Liassic Kap Stewart Series. This correlation is now regarded as doubtful. An extensive outcrop of Rhaetic-Lias has been shown in Tværdal by Stauber in his latest map (pl. 3 in Koch, 1950), but the southern part of the outcrop has been shown by the writer's investigation to be occupied by the Yellow Series of the Jurassic, and the northern part by Upper Cretaceous rocks, so that Stauber's map cannot be regarded as a reliable guide in this area.

Laplace Bjerg.

Below the sandstones assigned to the Yellow Series in this area (see page 16) lie about 500 m of beds which may be regarded as Triassic by virtue of their position in the sequence, although they are not positively dated in any way. They have their widest outcrop near the coast (fig. 3, p. 15) and consist predominantly of green sandstones and shales, well-bedded and often strongly micaceous, with subsidiary whitish and yellow sandstones, and conglomerates. They appear to be capped by red and green thinly bedded sandstones which are correlated with the similar beds found in Tværdal and mentioned above, and these beds are in turn succeeded by the sandstones attributed to the Yellow Series. No fossils were found in the green sandstones. They are tentatively regarded as belonging to the part of the Triassic succession above the marine Eotrias in Tværdal, to which they bear some lithological resemblance and to which they correspond in stratigraphical position. Closer correlation with well-established formations is not possible at present.

III. JURASSIC ROCKS

A. Yellow Series (Bathonian? and Callovian).

Jurassic rocks were examined in the northern part of the Mols Bjerge, in Traill Ø, and in the Tværdal and Laplace Bjerg areas in Geographical Society Ø. Fossils are scarce and it is not possible to correlate the sections in different places or to fix the boundary with the underlying Trias, but the faunas recovered suggest that the age range of the rocks is the same as in southern Traill Ø and Jameson Land (Donovan, 1953, pp. 47—48). Further results would probably emerge from a careful lithological study of the sections.

All the Jurassic outcrops in the area are predominantly sandy, and belong to the Yellow Series of Maync (see Donovan, 1953, p. 18), except for a small occurrence of Kimmeridgian shales on Nordenskiølds Ø. Elsewhere the Black Series, of Oxfordian-Kimmeridgian age, and a variable amount of the Yellow Series, was removed by denudation before the succeeding Cretaceous rocks were laid down.

Mols Bjerge.

The outcrop of the Jurassic and earlier rocks extends north and south from Vega Sund to Mountnorris Fjord, dipping westward beneath Cretaceous strata and bounded to the east by the Mols Bjerge Fault which brings in Cretaceous two or three kilometres west of Begtrup Vig and Æbeltoft Vig. In the southern part of the Mols Bjerge the Yellow Series has recently been recorded by the writer (Donovan, 1953, pp. 19—20). Along the northern flanks of these mountains (fig. 2, p. 13), overlooking Vega Sund, an impressive thickness of sandstones, probably more than 1000 m, is exposed. The upper part of the succession is proved to be of Jurassic age by the finding of poor specimens of *Cranocephalites* not far from the shore in the angle made by the eastern side of Kap Palander with the north flank of the Mols Bjerge. The rocks here, of typical Yellow Series lithology, are grey sandstones, sometimes current bedded, with pebbly beds and a little shale. To the east the Series is intermittently exposed beneath the major basic sill which caps the sec-

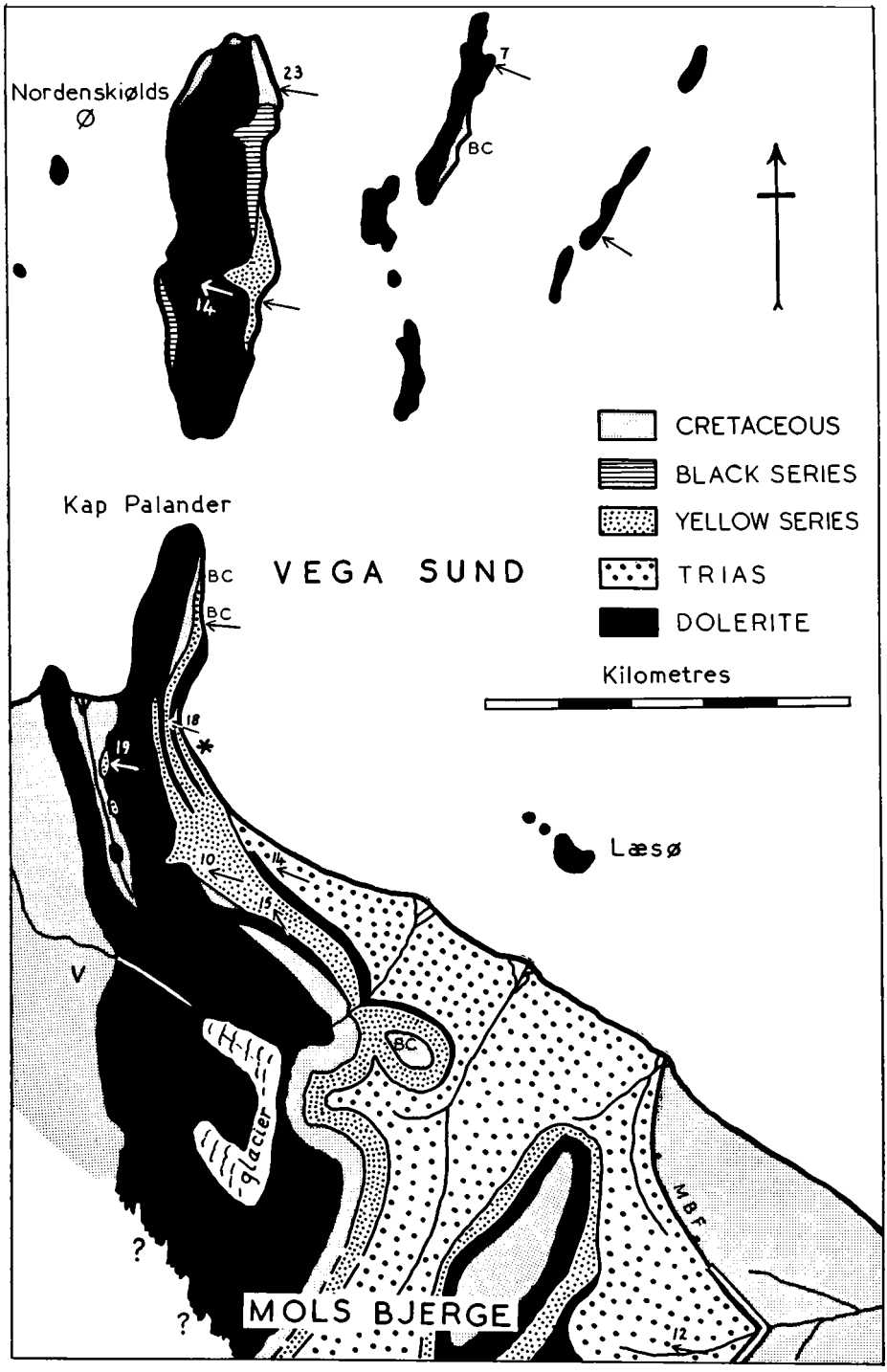

Fig. 2. Geological sketch-map of the neighbourhood of Kap Palander, Traill Ø, by A. J. Standring with additions by the writer. Scale: 1 : 100,000. Explanation of abbreviations: BC = Basal Cretaceous conglomerate exposure. MBF = Mols Bjerge Fault. V = Valanginian exposure. * = occurrence of *Cranocephalites*.

tion, and is well seen about 2 km south-east of Kap Palander. Here black shales occur as well as the grey sandstones and conglomerates, and some of the sandstones bear unidentifiable plant fossils and black, bituminous material. The beds are similar to the Plant Beds at the base of the Yellow Series in Bjørnedal, about 35 km to the south (Donovan, 1953, p. 22). The lower limit of the Yellow Series is drawn above the uppermost purple and green marls which occur in the lower part of the section, and which are assigned to the Trias. The thickness of the Yellow Series on the north face of the Mols Bjerge is between 250 and 300 m. The *Cranocephalites* mentioned above were found near the top of the succession, which suggests that higher beds, present in Bjørnedal, have been removed by denudation prior to the deposition of the Cretaceous, although this cannot be proved as the Yellow Series has yielded no fossils at the places where it is actually exposed beneath later formations.

The easternmost occurrence of the Yellow Series in the Mols Bjerge is believed to be a series of irregularly bedded, brown- and grey-weathering sandstones, which outcrop at an altitude of about 800 m above the head of the valley which descends to the coast about one kilometre west of Æbeltoft Vig. These sandstones, which succeed a series of greenish sandstones with purple horizons (see page 10), yielded no fossils to a rapid search, but probably mark the base of the Yellow Series.

Along the eastern shore of Kap Palander the Yellow Series consists of white sandstones, sometimes spotted with brown, strongly false-bedded and with many bands of quartz conglomerate bearing pebbles up to a diameter of 5 cm and more. Here is visible the eroded top of the series, succeeded unconformably by the Cretaceous conglomerates and shales described below (p. 23).

Nordenskiølds Ø.

The Yellow Series is represented by 50 m to 60 m of sandstones exposed for a distance of about one kilometre along the east coast (fig. 2), and rising from shore level up to the base of the thick basic sill which forms the backbone of the island. The lowest beds seen, near the shore, are coarse sandstones with angular quartz fragments up to several millimetres across, and with seams of quartz pebbles. Above are finer grained, grey sandstones, and the top 25 m of the section consists of thin-bedded black sandstones, which weather pink and sometimes bear a greenish-yellow encrustation on the surface. All the sandstones are false-bedded.

The sandstones on Nordenskiølds Ø have yielded no fossils. The upper part of the section resembles the uppermost part of the Yellow Series in the Bjørnedal area, as exposed immediately beneath the Black

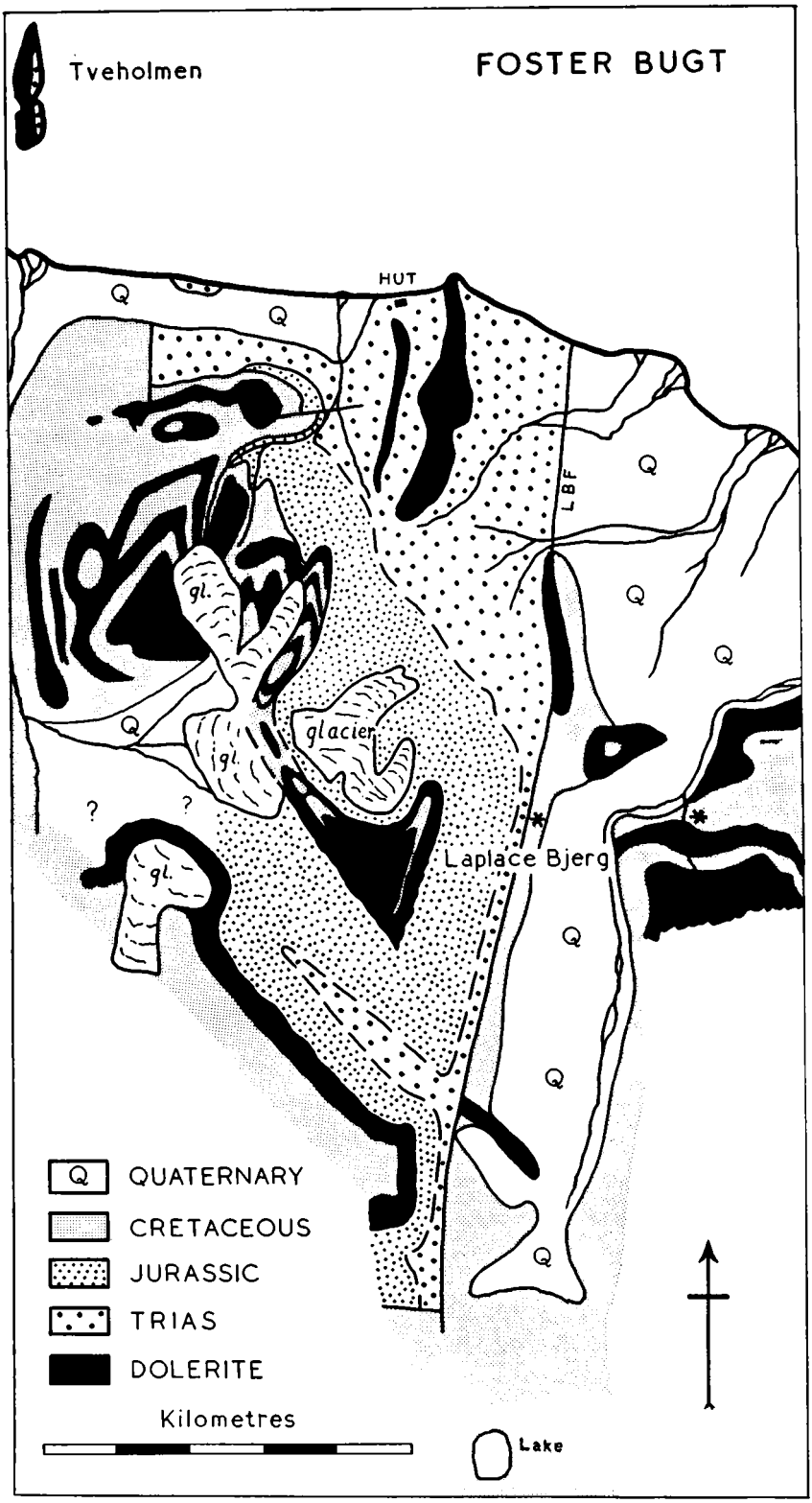

Fig. 3. Geological sketch-map of the neighbourhood of Laplace Bjerg, Geographical Society Ø, by J. Johnson and C. E. Periam. Scale: 1 : 100,000. Explanation of abbreviations: LBF = Laplace Bjerg Fault. * = occurrence of Upper Campanian fossils.

Series in Morris Bjerg, which is likewise composed of black-hearted sandstones weathering to a pink or light grey colour. The presence of the Black Series a short distance to the north, described below, lends support to this lithological correlation.

Geographical Society Ø.

Jurassic Rocks outcrop in two areas in Geographical Society Ø: Laplace Bjerg and Tværdal. When the writer previously wrote very brief remarks on these occurrences (1949, pp. 3—5) no Jurassic fossils had been found in the island and the age was determined on lithological grounds only. The finding of a few fossils in 1952 has since proved the Jurassic age of the sediments.

Laplace Bjerg (Fig. 3).

The thick pile of sandstones exposed at Laplace Bjerg can be roughly divided into two principal formations, the lower characterised by a greenish colour throughout, while the upper consists of yellow and brown sandstones with red horizons. The upper group is attributed to the Yellow Series by analogy with Tværdal where fossils have been found. At Laplace Bjerg the series is well exposed on the spur which extends northwards from the summit, where it was examined by the writer's party, and on the forbidding eastern face of the mountain which was not closely studied. At the top of the spur, at an altitude of about 900 m, thinly bedded, fine-grained, ripplemarked sandstones, becoming almost shaly in places, are exposed, and below them, at 817 m, orange-stained sandstones. Below a prominent sill, whose top lies at 787 m, the exposures are mainly covered by screes whose constituents indicate the presence of a very variable series of sandstones, ranging from greenish to red-brown and dark mauve in colour. They are very soft and fissile. Pieces of micaceous chocolate-brown sandstones were also seen. Below the screes, which continue down to an altitude of about 600 m, are exposed about 60 m of dark red-brown sandstones. These succeed a sill, below which is an unexposed interval. When exposures are next met with on this flank, at an altitude of about 300 m, they are of grey and greenish, thinly-bedded, fissile sandstones. The unexposed interval is assumed to be partly occupied by the red and green, ripple-marked and current bedded series, well-exposed below the Yellow Series in Tværdal (see page 11). The red and green ripplemarked beds are also exposed near the eastern bank of the stream to the west of the Laplace Bjerg hut, between 1 and 1.5 km inland. A short distance to the north, but probably separated from these last exposures by a minor fault, soft, reddish-

brown, highly micaceous, fissile sandstones begin to be exposed at an altitude of 130 m. They are succeeded by grey-green micaceous sandstone, and then, above a thin sill, massive, coarse-grained, yellow, micaceous sandstones are poorly exposed up to an altitude of 206 m. Above this, the slopes are covered with debris of grey and brownish-red micaceous sandstone, with bands of quartz pebbles, up to an altitude of 290 m. At three levels, namely 248 m, 271 m, 288 m there are beds or lenticles of limestone, up to about 1 m thick, projecting through the scree, which appear to be interbedded in the sandstones. The limestone is hard, grey, and structureless, and weathers in a rubbly fashion without breaking up along joints or bedding planes. These beds probably belong to the lower part of the Yellow Series. The presence of limestone in the series is exceptional, but a possible comparison is provided by the occurrence of a similar limestone in association with sandstones and quartz conglomerates in Maanedal, in Traill Ø, which probably belong to the Yellow Series (Donovan, 1953, p. 28).

The only Jurassic fossils found near Laplace Bjerg were collected from a boulder derived from the Yellow Series, in the Cretaceous basal conglomerate near the exposures just described. A general account of the locality is given below (page 26). The fossiliferous boulder contained quartz pebbles up to 4 cm in length in a coarse, micaceous, sandy matrix, and was crowded with shells. The fauna recovered is as follows:

Cadoceras aff. *frearsi* (d'Orbigny)
C. simulans Spath
Arcticoceras sp.
Astarte squamula (d'Archiac)
?*Cucullaea* sp.
Entolium corneolum (Young and Bird)
Lima sp.
Meleagrinella sp.
Ostrea sp.
Oxytoma cf. *expansa* (Phillips)
Oxytoma sp.
Parallelodon sp.
Pleuromya sp.
3 lamellibranch spp. indet.
Indeterminate belemnites

The fauna is probably more extensive than is indicated by the list, but the preservation of the lamellibranchs, largely as internal moulds, is not favourable for the identification of species or, in some cases, of genera. The two species of *Cadoceras* are both Arctic species whose exact stratigraphical position is unknown, but *C. simulans* is close to the English *C. tolype* S. Buckman, supposed to be from the Kellaways Clay, that is, low down in the Callovian, about the zone of *Proplanulites*

koenigi. The fossiliferous boulder, together with other sandstone boulders in the basal conglomerate, must have been derived from Jurassic outcrop in the neighbourhood at the end of the period of denudation which preceded the reneval of Cretaceous deposition in the Albian. A considerable thickness of the Yellow Series is believed to have been removed in the north-western part of Laplace Bjerg where, in contrast to the minimum thickness of 400 m present at the summit, there is less than 100 m present. A short distance to the west the Yellow Series is completely cut out by the Cretaceous overstep.

The Yellow Series is exposed around the rim of the cirque north of the summit of Laplace Bjerg, above the glacier and below the basic sills which cap the ridge, but is here difficult of access and was not closely examined. From the summit the Yellow Series was seen to be exposed beneath a thick basic sill on the south-western side of the valley which bounds the Laplace massif to the south.

Further south still, the Yellow Series was examined by the writer in 1947 in a small valley about 6 km south of the summit of Laplace Bjerg (Donovan, 1949, p. 5), and consists of false-bedded sandstones with some conglomerates. No fossils were found.

Tværdal.

The Jurassic outcrops in this valley are drawn quite erroneously by Stauber in his latest map (in Koch, 1950, pl. 3), which shows them as extending for some distance along either side of the valley. In fact, the sandstones of the Yellow Series outcrop in a belt from two to three kilometres wide which crosses the valley floor between eight and eleven kilometres from the south coast of the island. The lower part of the Series was examined by the writer in 1947 and some lithological notes were published (Donovan, 1949, pp. 3—5), but no fossils were found on that occasion, the beds being assigned to the Yellow Series on the basis of their lithology. This correlation has now been confirmed by the finding of Jurassic fossils in the upper part of the formation, at an exposure about 500 m west of the stream at an altitude of about 280 m, 10 km from the south, and 9 km from the north coast of the island. Here white, poorly cemented sands, with horizons of quartz pebbles up to 5 or 6 cm in diameter, stained red in places, are capped by brown sandstones interbedded with white and grey sands, the latter predominating. The sandstone beds yielded lamellibranchs, brachiopods, and a few fragmentary ammonites. The following species have been determined:

?*Arcticoceras* sp. indet.
Astarte ovata Wm. Smith
Entolium corneolum (Young and Bird)

Mactromya aceste (Cottreau *ex* d'Orbigny)
Pholadomya aff. *aequalis* (J. de C. Sowerby)
Pinna cf. *lanceolata* (J. Sowerby)
Pinna sp.
Pleuromya cf. *calceiformis* (Phillips)
Brachiopods (not yet studied).

On the basis of the fragments recovered it is not possible to be absolutely certain that the ammonites are *Arcticoceras* and not *Arctocephalites*, but in either case the placing of the sandstones in the Yellow Series is confirmed. The exposure lies near the top of the Yellow Series, but an unknown thickness of the Series as originally deposited may have been removed by pre-Albian denudation, by analogy with the Laplace Bjerg area described above.

The Yellow Series forms the most prominent summit on the eastern side of Tværdal (named Julekagen by Stauber, 1942, pl. 2), and almost the whole thickness of the series is exposed on its slopes beneath the thick basic sill which caps the mountain. The colour of the sandstones is predominantly yellow, but red horizons occur at a number of levels. The thickness is estimated at 500 m. There is a dip of about 10° to the north or north-north-west. Unfortunately time did not allow the section on this mountain to be studied in detail, but the lower part of the succession on the southern flank, visited in 1947, includes yellow and grey fine and coarse sandstones, with beds of quartz conglomerate (Donovan, 1949, p. 5). These sandstones crop out at intervals on the mountainside and are probably separated by less well cemented sands. Yellow and dark green sands are exposed on the opposite side of the valley, and were seen in 1947 at a point about 3 km south-west of the fossiliferous locality, where they are associated with white, yellow and brown sandstones with many beds of quartz conglomerate (Donovan, 1949, p. 5).

Red and green sandstones, thinly bedded, ripple-marked and current bedded, outcrop below the Yellow Series and were previously attributed by the writer (Donovan, 1949, p. 4) to the Rhaetic-Lias beds, following Stauber (in Koch, 1950, pl. 3). Subsequent examination of Traill and Geographical Society Øer has failed to establish the presence of beds of this age and the red and green ripple-marked series must now be regarded as undated. For further remarks on the pre-Jurassic beds see page 11.

B. Black Series (Eo-Kimmeridgian).

Nordenskiølds Ø (Fig. 2, p. 13).

At a distance of 1.5 km from the northern extremity of the island, just under the dolerite scarp on the eastern side, screes and poor exposures of baked shale yielded impressions of *Amoeboceras (Amoebites)* sp.

indet. which prove them to be of Lower Kimmeridgian age and thus attributable to the Black Series, well known from Morris Bjerg in Traill Ø (Donovan, 1953, pp. 28—29). Not more than about 30 m thickness is exposed. The lithology is the typical thinly bedded shale, becoming slaty when baked by intrusions, which characterises the Black Series in the Bjørnedal area. Exposures of black shales along the southern part of the west coast of Nordenskiølds Ø yielded no fossils but their texture suggests that they represent the Black Series rather than the Cretaceous shales which outcrop at the northern end of the island.

The Nordenskiølds Ø outcrops of the Black Series form an isolated occurrence, since in the Mols Bjerge to the south and in Geographical Society Ø to the north the Series has been completely removed by late Jurassic or early Cretaceous denudation.

IV. CRETACEOUS ROCKS

A. Valanginian.

Mols Bjerge.

Valanginian rocks were first discovered in Traill Ø by two members of the writer's party in 1950 (Donovan, 1953, pp. 33—34). During the expedition of 1952, when the manuscript of the original account had been sent for printing, the writer revisited the locality discovered in 1950, and also found a new occurrence of Valanginian fossils. Both outcrops lie on the western flanks of the Mols Bjerge. The position of the new discovery is indicated in figure 2 (p. 13). In the following discussion the old and new localities will be referred to as the southern and northern outcrops respectively.

At neither outcrop are the underlying rocks seen, nor is the relationship of the later Cretaceous rocks to the Valanginian clear. At the northern locality the fossils occur in a bed of fine-grained grey limestone, about 30 cm thick, in a series of dark shales. When the rock is fresh they can hardly be extracted; where it lies near the surface they weather out as excellent internal moulds. At the southern locality the Valanginian rocks are not seen *in situ* at all, but the lithology is probably the same. Here, most of the fossils are red due to the baking of the sediments by intrusions; a few unaltered pieces of rock were found, however, and are similar in lithology to the northern occurrence.

The existence of more than one fossiliferous limestone bed is possible, but unproved. The shales below the limestone yield specifically unidentifiable fragments of *Buchia*. At the southern outcrop westerly dipping black shales, with sandstone beds up to 1 m thick, are exposed a short distance north of the bank on which the Valanginian fossils occur, and may represent the Infravalanginian series recognised by the writer in Bjørnedal and the Rold Bjerge (Donovan, 1953, p. 32), as they appear to dip under the Valanginian; their age is unproved by fossils.

The Valanginian fauna has been increased by the collecting in 1952, and abundant material is now available for study. In addition to the list previously published (*op. cit.* pp. 33—34) the ammonite genus *Leopoldia* has been found, fragments of a baculitid, and the nautiloid *Paracymato-*

ceras. At least one genus, and probably several species of belemnites have been recognised additional to the published list, and at the northern locality rare brachiopods were found, including an example of *Pygope* unique in the boreal Valanginian. An account of the additions to the fauna will be published separately.

The age assigned to the fauna may have to be revised in the light of the new material; this question will be discussed in the forthcoming account of the fossils. It is also possible that the occurrences represent a condensed deposit derived from more than one horizon, although the uniform preservation of all the material does not support this hypothesis.

At the southern locality were found very hard nodules of ironstone containing *Buchia crassicollis* (Keyserling), similar to those already reported elsewhere in the Mols Bjerge and at Lycett Bjerg, near Bjørnedal (Donovan, 1953, p. 30). Unfortunately there is still no good evidence as to their age and stratigraphical significance, but they may be Cretaceous and not Portlandian as was previously thought on the basis of a brachiopod which came from a similar, but possibly not identical, rock, having been found loose. The nodules may occur in the shales above or below the fossiliferous limestone, but they have not been observed *in situ*.

The extremely restricted distribution of the Valanginian fauna may be due partly to the fact that it occurs in only one or two thin beds of limestone, but is attributed principally to extensive destruction of the deposits during the period of erosion which preceded and accompanied the middle Cretaceous transgression (p. 53).

B. Middle Cretaceous (Albian and Cenomanian).

Basal unconformity and associated deposits.

Eastern Vega Sund Region.

In this area the unconformable relationship of the Cretaceous rocks to the underlying Jurassic is well displayed. The principal transgression occurred in late Albian times, and the Cretaceous rocks, with conglomerates at and near the base, rest in most places on the Yellow Series of the Jurassic. There are traces of an earlier transgression in the Valanginian (see p. 21), but the deposits then laid down were almost completely removed by denudation before the Middle Cretaceous transgression took place.

1. *North side of the Mols Bjerge* (Fig. 2, p. 13).

The northern face of the Mols Bjerge, overlooking Vega Sund, for about 8 km southeast from Kap Palander, is formed by westward dipping Triassic and Jurassic sandstones with a thin capping of Cretaceous shales.

The shales have been intruded by a thick dolerite sill (see Stauber, 1942, fig. 6), a conspicuous feature in the landscape which also forms the backbone of Kap Palander and Nordenskiølds Ø. Above the sill the Cretaceous has been largely removed by denudation, but below, although the slopes are in many places covered by scree, the base is sometimes exposed.

About half-way between Kap Palander and Æbeltoft Vig, the unconformity lies at an altitude of about 750 m, but becomes steadily lower to the west and lies at about 50 m above sea level on the western flank of the Mols Bjerge. The unconformity is exposed on a knoll, capped by a small Cretaceous outlier, which lies between the first and second valleys south-east of Kap Palander (see fig. 2). Here a basal conglomerate 1 m thick, containing pebbles of sandstone, rests on yellow sandstones of the Jurassic Yellow Series and is succeeded by black shales. The shales yielded fragments of *Inoceramus* which are probably either Albian or Cenomanian in age.

The unconformity was not seen between the last-mentioned locality and Kap Palander, but debris and occasional exposures of black shale betray the presence of the Cretaceous under the main sill. No fossils were found except for occasional fragments of *Inoceramus* sp. indet. Black shales with plant impressions are also found, and are thought to belong to the Jurassic (cf. the Plant Beds of Bjørnedal, Donovan, 1953, p. 22), but unfortunately the exposures do not reveal the relationship of these beds to the Cretaceous shales.

2. *Kap Palander* (Fig. 2, p. 13. Plate 1).

The eastern side of Kap Palander is an important locality for the study of the Cretaceous unconformity. At the southern end, the base of the main sill descends into the Jurassic sandstones with *Cranocephalites*, already described. About half-way along the promontory, however, the base of the sill ascends in the succession and Cretaceous beds are again exposed beneath it. Jurassic sandstones and conglomerates are succeeded, at an altitude of about 15 m, by the Cretaceous basal conglomerate. The contact is obscured by debris. The constituents of the conglomerate are pebbles of sandstone presumably derived from the subjacent Jurassic beds, and quartz pebbles which could have been derived from the Jurassic conglomerates. The average thickness of the basal conglomerate is 4 m, but the upper surface is very irregular. It is succeeded by dark shales, punctuated at intervals by beds of conglomerate similar to the basal one. A maximum thickness of about 30 m of Cretaceous shales and conglomerates are exposed beneath the sill. About 400 m further north the base of the Cretaceous has descended to a few metres above sea level and the unconformity itself is well exposed (Plate 1). The base of the Cretaceous

conglomerate is seen to be discordant with the Jurassic sandstones, although it does not appear strongly so as the section is nearly parallel to the strike. The conglomerate is similar to that of the previous section but the shales above do not carry conglomerates. The Cretaceous shales here yield *Inoceramus anglicus*, which demonstrates that the basal beds belong to the Albian stage.

3. *Nordenskiølds Ø* (Fig. 2, p. 13).

The Cretaceous unconformity is not exposed on the island, which consists principally of Jurassic rocks and of dolerite, but the presence of Cretaceous was proved at an exposure by the shore on the west coast of the island, about 1 km from the northern end. Here well-bedded shales, bearing flattened ferruginous concretions, up to about 20 cm in length, in the bedding-planes, yielded *Inoceramus crippsi* and are therefore of Cenomanian date. The principal feature of interest on the island is the presence of the Jurassic Black Series exposed on the eastern side under the scarp face of the dolerite (see page 19). The Cretaceous has therefore overstepped northwards from the Yellow Series, in the Mols Bjerge, into the Black Series in Nordenskiølds Ø.

Eastwards and northwards from Nordenskiølds Ø the base of the Cretaceous falls below sea-level, but evidence that it lies at no great depth is supplied by the presence of conglomerates in the Cenomanian shales in coastal exposures on an island east of Nordenskiølds Ø and on the coast of Geographical Society Ø to the north.

4. *The islands east of Nordenskiølds Ø* (Fig. 2, p. 13).

Two groups of small islands owe their presence to westerly dipping sills, striking nearly north and south in the western group, and approximately north-north-east in the eastern. The islands are composed entirely of dolerite except for the northernmost one of the western group where Cretaceous sediments are exposed under the dolerite along the eastern shore. The base of the Cretaceous is not seen, but the character of the beds suggests that it lies not more than a few metres below sea-level. The beds, which are exposed to a maximum thickness of about 10 metres, consist of black shales with beds of banded sandstone and lenses of conglomerate. The shales yield *Inoceramus crippsi* and are therefore of Cenomanian age. The conglomerates, very irregular in their occurrence, are often mere "nests" of pebbles and boulders in the shale, and at one place the shale has boulders scattered through it at random. Where, as is more usual, the pebbles are concentrated into lenses, the matrix is invariably shale, indistinguishable from that of the remainder of the

section. The constituents of the conglomerate lenses are sandstone, quartz, quartz-conglomerate and clay-ironstone. The pebbles often reach a length of 20 cm, and near the southern end of the section there are boulders of sandstone about 60 cm in length. All the constituents, with the exception of the clay-ironstone, were probably derived from the underlying Yellow Series of the Jurassic. The rounding of the material suggests the presence of an island of Jurassic rocks along whose shores wave action produced beach gravels. The island is believed to have been formed by the eastern edge of the Mols Block (see p. 55).

5. *Southern Geographical Society Ø.*

Cenomanian rocks are exposed on the shores of a small bay about 3.5 km north-east of Kap Hovgaard. The rocks are shales with coarser ingredients. On the west side of the bay, sandstones and shales are interbedded, and the shales carry occasional pebbles of quartz up to over 3 cm in diameter. There is also a bed of conglomerate about 10 cm thick, with pebbles of quartz and of argillaceous rocks, and at the east end of the exposure the shales, at one level, contain oval masses of sandstone up to 20 or 30 cm long. The age of the beds here is not definitely proved, but some lamellibranch fragments found probably belong to Cenomanian species, and the facies is similar to the other Cenomanian boulder-bearing shales in the neighbourhood, described above.

To the east of the stream mouths which lie in the centre of the bay, a steep slope leads to another exposure in the Cenomanian, sandwiched between two basic sills. About 30 m of baked shales are underlain by a few metres of finely alternating shales and sandstones, the individual beds being often only a few millimetres thick. Occasional quartz pebbles, up to a diameter of several centimetres, occur in the lower part of the section. The shales yielded *Inoceramus crippsi* and some echinoid impressions which are probably to be referred to the genus *Epiaster*, but have not so far proved more closely identifiable.

Laplace Bjerg (Fig. 3, p. 15. Plate 2, fig. 1).

Here, as in the Mols Bjerge, the pre-Cretaceous rocks have been elevated above sea-level and the basal Cretaceous unconformity can be traced. As in the Mols Bjerge, the earliest Cretaceous beds present belong to the Albian stage, and a basal conglomerate is present.

Only one exposure of the unconformity was found, on the west side of the valley immediately west of the Laplace hut, about 2 km inland from the coast (Plate 2, fig. 1). The section exposed here is:

		m
Cretaceous	Black shales with thin bands of sandstone, as below	—
	Conglomerate with quartz pebbles up to 10 cm, in diameter, and blocks of orange sandstone	0.45
	Black shales with bands of fine-grained sandstone, 1—2 cm thick. *Aucellina* aff. *gryphaeoides* (J. de C. Sowerby)	4.00
	Basal conglomerate, with quartz pebbles up to 15 cm in diameter and blocks of sandstone, up to about 1 m in size, derived from the underlying beds. Rare pebbles of limestone and of shale	1.50
Jurassic	White sandstones, fissile and false-bedded, sometimes stained orange and red	5.00 seen

The base of the Cretaceous lies at an altitude of 195 m. The basal conglomerate is roughly divisible into a lower portion, with both sandstone and quartz pebbles, and an upper bed, about 30 cm thick, made up almost exclusively of quartz pebbles. The lower part carries, in addition to sandstone boulders clearly derived from the series which underlies the conglomerate, a boulder of fossiliferous Jurassic conglomerate described on page 17. The junction of the basal conglomerate with the overlying shales is abrupt, and the presence of a conglomerate at a higher horizon within the shales calls to mind the conditions at Kap Palander (p. 23).

A few hundred metres to the south-west of the last exposure, on the same side of the valley, boulders including a wide variety of types of sandstone are scattered on the hillside, but there are no exposures of the solid rock. The boulders, some of which are several metres across, suggests the presence of a basal conglomerate here on a larger scale than the one actually seen, but this is only a tentative explanation, and other explanations, for instance glacial transport, cannot be definitely excluded. None of the boulders carried any fossils to indicate their age; many could have been derived from the Yellow Series of the Jurassic.

The exposures described above are limited to the north by a small gully, which must mark the position of a fault, for on the northern side of it the Jurassic sandstones (described on p. 17) can be traced up to an altitude of about 290 m.

Although further exposures of the contact were not found, the position of the base of the Cretaceous may be easily traced in the side of the ridge which descends to the north-west from the summit of Laplace Bjerg. The ridge is capped by basic sills intruded into the Cretaceous shales just above their base, and sometimes descending into the Jurassic sandstones below. At the summit the base of the Cretaceous lies at an altitude of about 930 m, and remains approximately horizontal from here

north-westwards to a col about 1700 m north-west of the summit, where black shales with *Inoceramus crippsi* succeed the Jurassic sandstones at 940 m. Eastwards and northwards from this point the base of the Cretaceous falls rapidly, and is estimated to have a slope of about 9°. This fact is broadly reflected in the topography, for the summits of the Laplace massif are generally formed by the basic sills which, as usual, invade the Cretaceous shales in force, although they are thin and unimportant in the underlying sandstones. The base of the Cretaceous also falls, gently, southwards from the summit. The final disappearance of the pre-Cretaceous sandstones in this direction appears to be due to a fault, but this area could not be examined as fully as the northern part of the massif.

Middle Cretaceous Shale Series.

The Cretaceous transgression whose deposits have already been described initiated a period of deposition which, commencing in most places in the Upper Albian, continued during the earlier part of the Cenomanian stage. The deposits laid down were shales, sometimes with subsidiary sandstones. Where fossils are found, an arbitrary division of this formation can be made, into a lower (Albian) portion and an upper (Cenomanian) part, but there is no lithological change nor any evidence of any interruption of deposition throughout the series.

Eastern Vega Sund Region.

1. *Northern Traill Ø.*

The basal deposits, of Albian age, have already been described. The remainder of the series consists of black shales, sometimes with subsidiary sandstones. On the spur between Æbeltoft Vig and the first valley to the north-west, black shales of Albian age are exposed between 300 and 365 m altitude. They carry subsidiary bands of sandstone which have a maximum thickness of about 15 cm at 345 m altitude, and become thinner above and below. In addition there are a few bands of small pebbles in the succession. The lithology here is similar to that of the shale and sandstone facies of the Albian of Lycett Bjerg (Donovan, 1953, p. 36), except for the presence at Æbeltoft Vig of the pebble beds which are probably due to the proximity of Triassic and Jurassic sandstones, at present exposed only 3 km to the west, which include many quartz conglomerates.

Shales with occasional thin (1—2 cm) sandy lenses form the summit of the mountain 6 km south of Læsø (see fig. 2), where they cap a basic sill. *Aucellina* aff. *gryphaeoides* (J. de C. Sowerby) was found here and probably denotes a Middle or Upper Albian age. Westwards from this

point dark Albian shales are seen in some places above the basal Cretaceous deposits of the north-western Mols Bjerge and Kap Palander.

In the vicinity of Æbeltoft Vig Cenomanian shales occur in addition to the Albian, though their thickness could not be established. Between here and Kap Palander the stage has probably been removed by denudation; at least its presence has not been proved. Between Kap Palander and the headland opposite Kap Hovgaard the presence of the Cenomanian has been demonstrated at a few places by the finding of *Inoceramus crippsi* at coastal exposures. The beds are shales with subsidiary sandstones, usually cemented by silica and in bands only about 1 cm thick. No estimate of the thickness could be made. Rocks of the Middle Cretaceous Shale Series probably underlie the low ground between the Mols Bjerge and the Skelhöje.

The sandstones exposed near the mouth of the stream which descends from Maanedal, originally discovered in 1950 and previously described by the writer as undated (1953, p. 31, localities 55 and 56; shown as Infravalanginian in the map on pl. 3), have been proved to be Cenomanian by the finding of *Inoceramus crippsi* on a second visit to the locality in 1952. About 50 m of beds are exposed, the lower part of the succession consisting of even-bedded, banded sandstones, the upper of more irregular sandstones with intercalations of dark shale. The predominance of sandstone at this locality is attributed to the denudation of sandstones of Jurassic and earlier age which lie only a few kilometres to the west in the Rold Bjerge. The significance of the occurrence is discussed below (page 30).

2. *South-eastern Geographical Society Ø.*

The only exposure proved to be of Albian date in the southern part of Geographical Society Ø is south of Freycinet Bjerg, at an altitude of 410 m and about 5 km from the coast, where black, micaceous shales with bands of cone-in-cone structure yielded *Inoceramus anglicus*. The Albian presumably forms an inlier in the surrounding Cenomanian and higher beds, but exposures were too few to enable the relationship to be determined.

The conglomerate-bearing beds of Cenomanian age have already been described. The remainder of the stage in the Vega Sund area chiefly consists of shales with occasional beds of sandstone. The south coast of Geographical Society Ø from Kap Hovgaard to Kap MacClintock is composed entirely of Cenomanian rocks, which dip west or west-north-west at an average angle of perhaps 15° and are intruded by numerous basic sills. Exposures along the coast are, for the most part, very poor and it is only here and there that sediments are seen *in situ* between the dolerite sills and the screes therefrom. The thickness of the sediments of the stage

here may easily be of the order of 1000 m, but owing to the probability of repetition by strike faults no close estimate can be made. One exposure is worthy of individual description, four km west-north-west of Kap MacClintock, where about 20 m of sandstones are exposed beneath a dolerite sill. The sandstones are grey, often thickly-bedded, and bear ripple marks and trails on the bedding-planes. No fossils were found in them but they are apparently underlain by shales, not exposed but present in the scree, which contain *Inoceramus crippsi*. The age of the sandstones is, therefore, not proved, but is assumed to be Cenomanian as this is the simplest interpretation[1]). If it is correct the proximity of Jurassic sandstones undergoing erosion during the Cenomanian is suggested in this area as well as farther west.

Inland the Cenomanian forms the lower part of Freycinet Bjerg and may well underlie the area between that mountain and Cambridge Bugt, but unfortunately shales exposed along the south-western shore of Cambridge Bugt did not yield any fossils, and the conditions of ice and fog under which Cambridge Bugt was visited did not allow a longer stay to search for exposures inland.

North-eastern Geographical Society Ø.

The basal deposits of Albian age have already been described (page 25). As in the Vega Sund area, the Albian is the lowest Cretaceous horizon known in this area, and probably underlies the country between Laplace Bjerg and Tværdal. On the western slopes of Laplace Bjerg the basal conglomerate is succeeded by black shales with thin bands of sandstone, which carry *Aucellina* aff. *gryphaeoides*, of which a few metres are exposed. The only other fossiliferous exposure of Albian is on the eastern side of the northern end of Tværdal, where fragmentary *Inoceramus* was obtained from ironstone nodules in a barren series of black shales, with a few sandstone bands, up to 20 cm thick, at about 350 m altitude. More than 200 m higher up *Inoceramus crippsi* was found. There are at least 350 m of black shales hereabouts, of which the lower part is Albian and the upper Cenomanian, but no more precise subdivision can be established.

Shales with *Inoceramus crippsi*, intruded by dolerite sills, form the summit of Laplace Bjerg and it seems that here, as in the Vega Sund area to the south (see p. 55) the Cenomanian overlaps the Upper Albian and rests on the pre-Cretaceous rocks.

The Middle Cretaceous Shale Series was found by the writer in the mountains further south (Donovan, 1949) and so far as available infor-

[1]) A pre-Cretaceous date for these sandstones, which would then be faulted into their present position, cannot be ruled out.

mation, admittedly inadequate, goes it extends across Geographical Society Ø from north to south in this region.

Cenomanian shales have been found on Borgøen, the largest of the Brochs Øer off the north coast of Geographical Society Ø. The island, like its neighbours, is mainly composed of dolerite, but shales are exposed between the intrusions and at the southern tip of the island were found *Schloenbachia* aff. *subplana* (Mantell), *Inoceramus crippsi* Mantell, *Lucina tenera* (J. de C. Sowerby), and *Nuculana* sp. indet., while another coastal exposure 2 km north-east yielded remains of an echinoid provisionally identified as *Epiaster* sp. indet.

Marginal Facies of the Middle Cretaceous.

The western boundary of the Middle Cretaceous transgression lay near 23° West longitude and here some deposits of marginal facies are found. In this category may be grouped the sandstones exposed in the Maanedal stream east of the Rold Bjerge, Traill Ø, described as undated in 1953 (Donovan, 1953, p. 31) but now proved to be approximately Cenomanian in age by the finding, in 1952, of *Inoceramus* of *I. crippsi* type. The reader is referred to the publication cited for a description of the section. The sandstones may reflect an episode of tectonic activity at some period during the Cenomanian, for both Albian (localities 69, 74, 75) and Cenomanian (locality 91) are found in shale facies in the same neighbourhood (See Donovan, 1953, pp. 35, 38, pl. 3). It is unfortunate that in the neighbourhood of the Rold Bjerge the great extent of superficial deposits makes the elucidation of the detailed stratigraphy of the Middle Cretaceous impossible.

Tværdal, Geographical Society Ø.

The western side of the valley is formed by a fault scarp of Carboniferous sandstones, rising at the present day to an altitude of over 1000 m, which was already in existence in Mesozoic times when it constituted the western coastline of the Middle Jurassic and Upper Cretaceous seas in this region. The Cenomanian is developed in a marginal facies along the foot of the fault-scarp, exposed where it is cut through by two small valleys about 4 and 7 km respectively inland from the north coast of the island. The deposit is made up of alternations of shale and soft, uncemented sand in bands often no more than about 1 cm thick, interrupted at intervals by beds of sandstone up to about 30 cm thick, and bearing occasional horizons of ironstone in nodules or thin bands. The sandstone bands include coarser material than occurs in the remainder of the succession. They are composed mainly of coarse, subangular

quartz grains, but sometimes flat pellets of shale, up to more than 1 cm across, are abundant. Grains of muscovite and of a green, chloritic mineral are scattered throughout the rock. Fragments of carbonaceous material also occur. The sandstone bands, especially at the northern exposure. are very fossiliferous and have yielded almost the only uncrushed fossils so far found in the Cenomanian of East Greenland. The fauna is as follows:

Lytoceras sp. nov. cf. *vicinum* H. Douvillé
Phylloceras cf. *velledae* (Michelin)
Schloenbachia subtuberculata (Sharpe)
S. subvarians Spath
S. cf. *varians* (J. Sowerby)
S. varians var. *tetrammata* (J. de C. Sowerby)
Indeterminate baculitid ammonoid
Inoceramus crippsi Mantell
Nuculana sp. indet.
Oxytoma pectinata (J. de C. Sowerby)
"*Turbo*" sp. indet.

The fossils indicate the Lower Cenomanian, *varians* zone. The fauna has been recently described and figured (Donovan, 1954).

C. Turonian.

The Turonian is represented by the *Inoceramus lamarcki* Beds which consist of shales with subsidiary thin banded sandstones and occasional thicker beds of sandstone. A number of exposures of conglomerate in the eastern Vega Sund area are likely to be of Turonian age, but there is no direct and conclusive evidence as to their date. These will be described first.

The Conglomerates.

The principal occurrences of conglomerate referred to the Turonian lie between 3 and 4 km north-east of Kap Hovgaard. There are two sections in this area. The first (Fig. 4, 1) is exposed on the western side of a stream (not marked on the Geodetic Institute map) which flows out of the western end of the elongated lake and into the small bay about 3.5 km east-north-east of Kap Hovgaard. Near the mouth of the stream the exposure is bounded by a fault which brings in another series of conglomerates, of Cenomanian age (p. 25). The section measured along the stream is as follows:

	m
8. Rubbly conglomerate	6.0
7. Massive, impure quartzite	1.5
6. Grey sandstone, passing laterally into phosphate breccia	1.75
5. Breccia with slabs of shale, quartz pebbles and other ingredients	2.0 max.
4. Coarse grained grey sandstone, with shaly partings	2.0
3. Coarse quartz conglomerate, passing laterally into phosphate breccia	0.5
2. Grey sandstone, sometimes micaceous and pyritic, with thin shaly partings and several bands of phosphate breccia	4.0
1. Conglomerate, consisting predominantly of quartzite pebles up to 1.5 cm in diameter, in a matrix of grey, micaceous sandstone	1.0
Total thickness exposed	18.75 m.

The rock described (for brevity) in the section as "phosphate breccia" (beds 2, 3, 6) is an unusual type. The most conspicuous constituent is a white or greyish substance occurring occasionally as irregular masses, but usually as thin, roughly ellipsoidal or flattened fragments up to 5 cm long, with their long axes roughly aligned parallel to the bedding. This material is seen in thin section to be isotropic and is associated with finely disseminated calcite. Chemical analysis proved a considerable proportion of phosphate, but the composition has not been more exactly determined. In one instance cellular structure, presumably of fossil wood, was observed under the microscope, replaced by calcite and the phosphatic material. No trace of organic structure could be found in the other phosphatic masses. The phosphatic substance is abundant, but other constituents, not always easily distinguishable from it with the naked eye, are also present, and comprise slabs of finegrained siliceous sedimentary rock, and rarer pebbles of sandstone. Occasional pieces of *Inoceramus* shell can be recognised. The finer fraction of the rock consists of quartz grains and argillaceous material, cemented by calcite. The whole has been baked by the neighbouring basic intrusions.

About 1.5 km to the north-north-west, sandstones and conglomerates are exposed along the eastern side of a north-south ridge, capped by a dolerite sill, which faces the eastern end of the lake already referred to (fig. 4, 2). The section is a good deal obscured by scree and was not measured in detail, but its vertical extent is at least 30 m. A series of well-bedded sandstones bears several horizons of rustyweathering conglomerates, consisting of a sandstone matrix with well-rounded quartz pebbles up to 25 cm in diameter, and smaller pebbles of sandstone, limestone and a fine-grained white substance which is probably identical with the phosphatic substance at the last section. There are also some bands of small pebbles in a shaly matrix. The rocks at this locality are reminiscent

of the conglomerate in Maanedal, on Traill Ø, described by the writer (Donovan, 1953, pp. 41—42) in the alternation of conglomerate and sandstone horizons, and in the presence of limestone and of large pebbles of quartz, constituents absent from the Albian-Cenomanian basal conglomerates.

Neither of these occurrences is dated, but rocks of Turonian age are proved to the west and the conglomerates may form the basal member of the Turonian deposits. The age and relationships of the conglomerates are further discussed below.

The third occurrence of conglomerate, which seems to belong to the same series as those just described, is merely a lenticle in a series of shales with subsidiary thin banded sandstones, at an exposure on the eastern side of the large island about 5 km west of Kap Hovgaard (fig. 4, 3). The lateral extent of the lens was only about 30 cm. The conglomerate includes well rounded pebbles of quartz and quartzite, one of the latter 7 cm long, and pieces of finer-grained rocks which have been altered by the intrusion of nearby dolerite sills and have not so far been more closely identified. There are also subangular quartz grains of sand grade. Another constituent is a homogeneous white substance which appears under the microscope to be identical with the phosphatic material in the breccia near Kap Hovgaard, and which in some cases appears to replace belemnites. The whole is set in a fine-grained greenish-grey matrix, probably argillaceous material altered by the neighbouring intrusions. Both Turonian and Senonian sediments have been found on the island, which consists largely of dolerite, and the relationships of the sediments could not be made out.

Discussion of the Conglomerates.

The three occurrences of conglomerate described above do not fall readily into the series of basal and near-basal conglomerates of late Albian and early Cenomanian age, which are known from a number of places within the area. The basal conglomerates consist exclusively of constituents derived from the underlying Jurassic rocks, embedded commonly in an argillaceous matrix. In the present case the ingredients are more varied, and the matrix is normally sandy. Although there is wide lithological variation from bed to bed at the two more extensive exposures, there is a similarity between all three occurrences, especially in the presence of the white phosphatic substance and in the prominance of quartz and quartzite pebbles.

There is no evidence that these rocks are earlier than the Albian and Cenomanian conglomerates, and their occurrence is on the margin of and within the area occupied by Turonian and Senonian sediments. A post-Cenomanian date is therefore probable. In the neighbourhood of

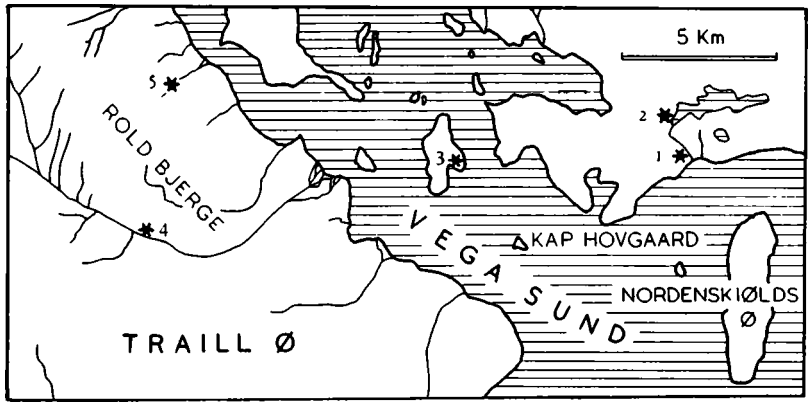

Fig. 4. Map of part of Vega Sund and neighbouring areas to show the distribution of the outcrops of conglomerate believed to be of Turonian age. Scale: 1 : 250,000. The stars mark the occurrences of conglomerate. The numbers refer to the descriptions in the text.

Kap Hovgaard, as far as the structure can be interpreted (assuming the simplest interpretation, which is unlikely to be correct) the conglomerates fall readily into place as a basal formation of the Turonian shales (*Inoceramus lamarcki* Beds) which form the summits to the north, capped, on the peak east of Freycinet Bjerg, by the *Sphenoceramus* Beds of the Senonian.

A Turonian date for the conglomerates is in harmony with the fact that the two other known occurrences of Upper Cretaceous conglomerate (fig. 4, 4 and 5), both in the Rold Bjerge (Donovan, 1953, pp. 39—42) are associated with the *Inoceramus lamarcki* Beds, and one is dated by species of *Scaphites* as mid-Turonian; these two occurrences resemble the three exposures described here in the variety of their constituents, and are in contrast, in this respect, with the basal conglomerates of the Cretaceous, as already emphasised. The important series of conglomerates and sandstones in Maanedal (fig. 4, 4) must have been the result of a strong elevation of the Upper Palaeozoic and Triassic block to the west, and the hypothesis is here adopted that all these conglomerates in the Vega Sund region were the results of an episode of movement of the major boundary faults along the western margin of the area of Upper Cretaceous sedimentation, which occurred about the middle of the Turonian stage.

The composition of the individual conglomerates varies considerably, but this is no serious obstacle to assigning them all to the same episode, as it may be imagined that a wide variety of palaeozoic rocks were undergoing denudation along and to the west of the fault-zone which bounds the Cretaceous area. The structure of this region is com-

plex at the present day and was probably already developed, in its essentials, in the Upper Cretaceous. The abundance of phosphatic material in several of the conglomerates cannot at present be fully explained; it may be penecontemporaneous, having been formed in intervals of little sedimentation during the deposition of the conglomerates and slightly re-arranged during the subsequent incomings of coarse debris, or it may be derived from earlier phosphatic deposits.

The most easterly occurrence of conglomerate is about 15 km from the nearest palaeozoic rocks, but this does not seem an excessive distance for transport of pebbles down a possibly steep submarine slope, perhaps aided by sliding of the sediments. The isolated lenticle on the island west of Kap Hovgaard, surrounded by shales, may have reached its final position in this way, perhaps detached from a pre-existing bed of conglomerate during further earth movements, after formation of conglomerates had ceased and had been succeeded by shale deposition.

Inoceramus lamarcki Beds.

The *Inoceramus lamarcki* Beds are shales with thin beds, not usually more than about 1 cm thick, of banded sandstone. In one place, on a small island in the north-eastern part of the Scott Keltie group, thicker bands of coarse, white sandstone were seen in a coastal section, but otherwise there is little variation in lithology. The beds occur throughout the Gaaseøen and the Scott Kelties Øer in Vega Sund, except for the belt of Senonian rocks (p. 36), and underlie the area in Geographical Society Ø extending northwards and westwards from Kap Hovgaard, including the western part of Freycinet Bjerg, as far as William Smith Dal. There is no means of making any close estimate of the thickness, but the writer believes that, taking the distribution of the rocks into account, it must be between 400 and 500 m, at the least. The beds are usually barren of fossils, apart from occasional fragments of *I. lamarcki.*

Turonian rocks occur in northern Geographical Society Ø, but extremely little is known regarding their distribution and characters. *Inoceramus lamarcki* was found at an altitude of about 450 m on the north-west spur of the Laplace Bjerg massif, about 5.5 km from the summit, associated with a small ammonite which is identified as *?Colligoniceras* sp. indet. This is the only Turonian ammonite which has been recovered from Geographical Society Ø. The find indicates that the *I. lamarcki* Beds succeed the Cenomanian shales of Laplace Bjerg. The only other place where Turonian rocks have been proved to exist is at the northern end of Tværdal, where westwardly dipping shales associated with dolerite sills in the valley floor yield *I. lamarcki.*

D. Senonian.

Sphenoceramus Beds.

The *Sphenoceramus* Beds consist mainly of shales. Thin, banded sandstones, similar to those in the *Inoceramus lamarcki* Beds, are also found, but although they seem to be fewer in the *Sphenoceramus* Beds the two formations cannot be safely distinguished on the basis of lithology. As in the underlying formation, fossils are uncommon, and the only identifiable shell, apart from fragments of *Sphenoceramus*, is *Oxytoma tenuicostata* which occasionally covers bedding planes in some quantity. The slender spines of irregular echinoids are sometimes abundant on bedding planes, but no identifiable remains of these creatures have been found.

In the eastern Vega Sund and southern Geographical Society Ø area the beds have been proved on two of the Scott Kelties Øer, and near the summits of Freycinet Bjerg and the unnamed mountain to the west. On account of the rarity of fossils, and the impossibility of separating the upper Cretaceous formations on lithology, the formation cannot be mapped accurately, but the writer believes that the *Sphenoceramus* Beds have been preserved as small outliers on the underlying *Inoceramus lamarcki* Beds.

The only other exposure proved by fossils to belong to the *Sphenoceramus* Beds is on an island off the north coast of Geographical Society Ø, 14 km north-west of Kap Mackenzie. Along the eastern shore of the island a few metres of thinly alternating shales and sandstones are exposed. The beds may occur on the adjacent part of Geographical Society Ø, but no fossils have been found to prove this; the area is largely mantled by Quaternary deposits.

At a point 7 km inland from the north coast of Geographical Society Ø, at an altitude of 600 m on the western slopes of Tværdal, the surface debris yields fairly abundant belemnite guards. No complete examples were found and so far as it has been possible to identify them all belong to one species, *Belemnitella*(?) sp. indet., except for one fragment identified with reservations as *Actinocamax verus* Miller (identifications by Dr. J. A. Jeletzky; see Donovan, 1954, pp. 13—14). The only other fossil found was an indeterminate *Inoceramus*. The belemnites are believed to indicate a date within the range Upper Coniacian to Lower Campanian, and they may therefore have come from the *Sphenoceramus* Beds. There is, however, no other evidence for the presence of this formation in Tværdal, and the belemnites could conceivably belong to a high horizon in the *I. lamarcki* series. Further speculation seems unprofitable without additional field work in Tværdal, which might yield interesting information on the Upper Cretaceous stratigraphy.

Scaphites Beds.

The *Scaphites* Beds, of Upper Campanian age, previously known only from a single locality in the Rold Bjerge in Traill Ø (Donovan, 1953, p. 44), have now been found on Geographical Society Ø, in the down-faulted area of Cretaceous rocks east of the Laplace Bjerg Fault. Fossils were found on both sides of John Phillips Dal which lies east of Laplace Bjerg, at the places indicated in text-figure 3. The eastern locality was the more prolific in fossils, and supplied a number of crushed body-chambers of *Scaphites greenlandicus* as well as *Lucina laminosa* (Reuss) and *Nuculana panda* (Nilsson). The western locality yielded the same fauna, and also *Dentalium* sp. indet., but *Scaphites* was represented by rare fragments only. The lithology at both these localities is shale.

The *Scaphites greenlandicus* Beds were also found on the small headland on the northern side of Cambridge Bugt, 7.5 km south of Kap Mackenzie. The headland is composed principally of two basic intrusions, but an area of baked shale debris between them must have been derived from the rocks into which they are intruded, and yielded *Lucina laminosa* and small fragments bearing the characteristic shell ornament of ammonoids of the group of *S. greenlandicus*. The headland forms an island of solid rock in an area mantled by Quaternary debris, but is valuable as evidence of the lateral extent of the Upper Campanian deposits and as as indication of the structure of this part of Geographical Society Ø (see p. 50).

Information regarding the *Scaphites* Beds is still very meagre, and they have probably been removed by denudation over the greater part of the area of Geographical Society and Traill Øer, so that the present outcrops give little idea of the original extent of the formation. North-eastern Geographical Society Ø seems to be the most promising area to search if at any time it is desired to investigate these beds further.

V. IGNEOUS ROCKS

No special study of igneous rocks was made, except for some rapid observations on the lavas of Bontekoe Ø and of Kap Mackenzie on Geographical Society Ø. The latter are recorded here, together with a few incidental observations on other parts of the area.

Intrusive Igneous.

Intrusive basic rocks are ubiquitous throughout the area described in the present paper, and occur as sills and as intrusions of irregular form, more rarely as dykes. They are most strongly developed in the Cretaceous shale areas, where their occurrence and characters are essentially the same as in Traill Ø (Donovan, 1953, pp. 60—62). The major sill which caps the dipslope of the northern Mols Bjerge has already been mentioned (p. 23). In eastern Vega Sund, almost all the islands owe their presence to intrusions, and in the case of Nordenskiølds Ø and the smaller islands to the east the north-south elongation reflects the strike of the sills, which here have a consistent westerly dip. Eastern Geographical Society Ø shows typical shale and dolerite topography with innumerable intrusions, ranging in thickness from a few metres to over 50 m, and often showing columnar structure (plate 2, fig. 2). Usually the intrusions are sills, more or less conformable with the bedding of the sediments, but irregular intrusions are found here, as in Traill Ø (Donovan, *op. cit.* p. 61).

The summit of Laplace Bjerg is formed of several basic sills with very little shale between them, having a combined thickness of about 300 m. An intrusion has invaded the Laplace Bjerg fault between Laplace Bjerg and the north coast of Geographical Society Ø.

In the Triassic and Jurassic sandstones, by contrast with the Cretaceous shale areas, intrusions are unimportant, and although they are fairly generally distributed throughout the sandstones they are thin and widely-spaced in comparison with those of the shale country.

A later stage of intrusion is represented by a dyke which cuts the thick dolerite sill which caps the south coast of Geographical Society Ø

immediately east of Nordenskiølds Ø. The dyke has a distinctive appearance in the field and has been determined as a zeolitic olivine dolerite. It is very coarse-textured in places and the zeolites are prominent.

An intrusion of granophyre was noticed near the summit of Freycinet Bjerg, and this also appeared to be later than the principal dolerite intrusions.

Extrusive Igneous.

A day was spent in August, 1952, examining the coast of Bontekoe Ø, which is formed entirely of lavas. On the following day the presence of lavas was also established at Kap Mackenzie, the north-eastern point of Geographical Society Ø, and sections were measured there. This is believed to be the first record of extrusive igneous rocks in Geographical Society Ø. Both occurrences of lavas, like the intrusive igneous rocks, are believed to belong to the Tertiary igneous province.

Bontekoe Ø (Fig. 5).

Coastal sections only were examined and they will be described, as they were studied, in a clockwise direction round the island, starting at the western end. The west coast of the island, and the adjoining parts of the north and south coasts, are made of a series of tough black-hearted, brown-weathering basalts, sometimes with amygdales, but usually even-textured and homogeneous in the hand-specimen. This series was examined in the cliffs south-west of the figure "250" on the 1 : 250,000 Geodetic Institute map (sheet 73 Ö. 1), the point labelled "Locality 198" in figure 6. Here a total thickness of 175 m of lavas was measured, comprising 13 successive flows. Time did not permit the measurement of the thicknesses of individual flows, but they are fairly sharply divided into a lower group of five, averaging 19 m in thickness, and an upper group of eight averaging 10 m for each flow. The upper surfaces of the flows are slightly more slaggy and less compact than the rest of the flow, but interbasaltic horizons are not prominent. These lavas will be referred to as the Compact Series.

The Compact Series continues round on to the north coast of the island and form its western part. About half-way along the north coast their outcrop ceases and beds of very different superficial appearance take their place, the junction being probably faulted. This second series is exposed for a distance of about one and a half kilometres along the central part of the north coast ("Locality 199" in figure 5). Whereas the first series is hard and resistant, so that fresh surfaces are seldom exposed and the brown-weathered skin is characteristic, the second group is soft and friable, so that fresh surfaces are constantly being exposed

in the cliffs, revealing a variety of colours in the different flows. The predominant hues are greenish-grey and pink, but yellow and red horizons are also present, the latter perhaps lateritic layers. These highly-coloured lavas often carry abundant amygdales, both the ordinary kind and the vertically elongated "pipe-amygdales". Stratification is well-marked in the cliff section, and the individual flows appear to be thin, but the cliffs were so insecure that it was not possible to measure or collect from a section in the time available. These beds will be referred to as the Coloured Series.

A thickness of about 100 m of the Coloured Series is visible at the occurrence just described, dipping to the east or south-east at an angle of about 20°, succeeded abruptly and conformably by the Compact Series. The contact was not examined at close quarters.

Further east, the cliffs are again built up of the Compact Series, the relationship to the Coloured Series just described being possibly faulted. About 250 m of the Compact Series is exposed here; the greater part of this thickness, from shore-level up, is composed of thick flows, probably between 15 and 20 m thick on the average, of which 13 were counted from the boat. These thick flows were seen to be capped near the top of the cliffs by much thinner flows, the transition being abrupt. To the east the Coloured Series again reappears, dipping at about 25° to the east or south-east and faulted against the Compact Series to the west. A thickness of at least 200 m was estimated to be present here.

The second occurrence of the Coloured Series does not continue quite to the eastern end of the north coast, for the Compact Series reappears to form the eastern point of the island and the whole of the short east coast, the strike being north-east and south-west and the dip about 30° to the south-east. This outcrop of the Compact Series is presumed to be bounded to the west by a fault which intersects with the coast at the south-eastern corner of the island. For a distance of about 3 km from here, forming the eastern half of the south coast, the cliffs are again formed by the Coloured Series. At the eastern end of this line of cliffs the dip is of the order of 30° to the east, but it flattens out further west. The lowest part of the Coloured Series exposed here, at the western end of the cliffs, includes a few flows which differ from the normal ones of the series in being more massive and in displaying columnar jointing. The projecting western part of the south coast appears to be composed of the Compact Series, which continues round to the occurrence already described at locality 198, but by the time this part was reached it was getting dark and a close examination was not made.

The examination of Bontekoe Ø described above shows that two contrasted types of extrusive rock are present, the Coloured Series,

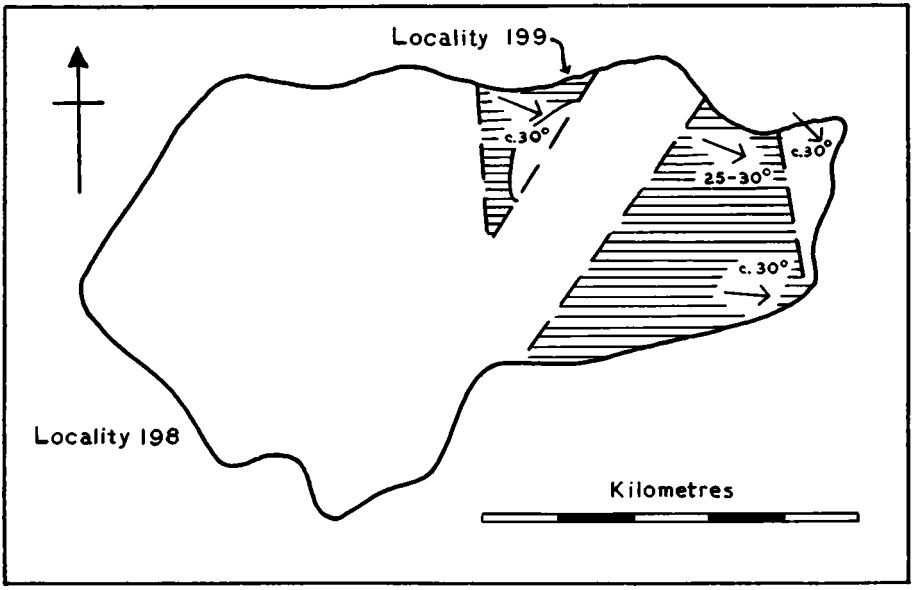

Fig. 5. Geological sketch map of Bontekoe Ø. Scale: 1 : 100,000. The Compact Series of lavas are shown unshaded, the Coloured Series by horizontal ruling. Faults are indicated by broken lines; their course inland is conjectural. The outline of the island is taken from the Geodetic Institute map, but appears to require correction.

whose minimum thickness is 200 m, and the Compact Series which probably attains a thickness of at least 250 m. Both series may, in fact, be much thicker. On the north coast of the island the Compact Series is seen to succeed the Coloured Series. It cannot be proved, of course, that only two groups of lavas are present, and it is possible that major outpourings of lavas of one or both types occurred more than once in the igneous history of the area. The strong similarity in general appearance between the several outcrops of each of the two types lends some support to the provisional interpretation that only two series are present, but of course a detailed petrological examination is desirable.

Kap Mackenzie (Fig. 6).

Kap Mackenzie is formed of an outcrop of lavas extending for about 2.5 km from north to south, about 1 km wide, and rising to an altitude of about 150 m at the highest point. These are the only extrusive igneous rocks known from eastern Geographical Society Ø, and were recognised for the first time during the writer's visit in 1952. At the southern end of the outcrop the following section was recorded by Flt. Lt. Page:

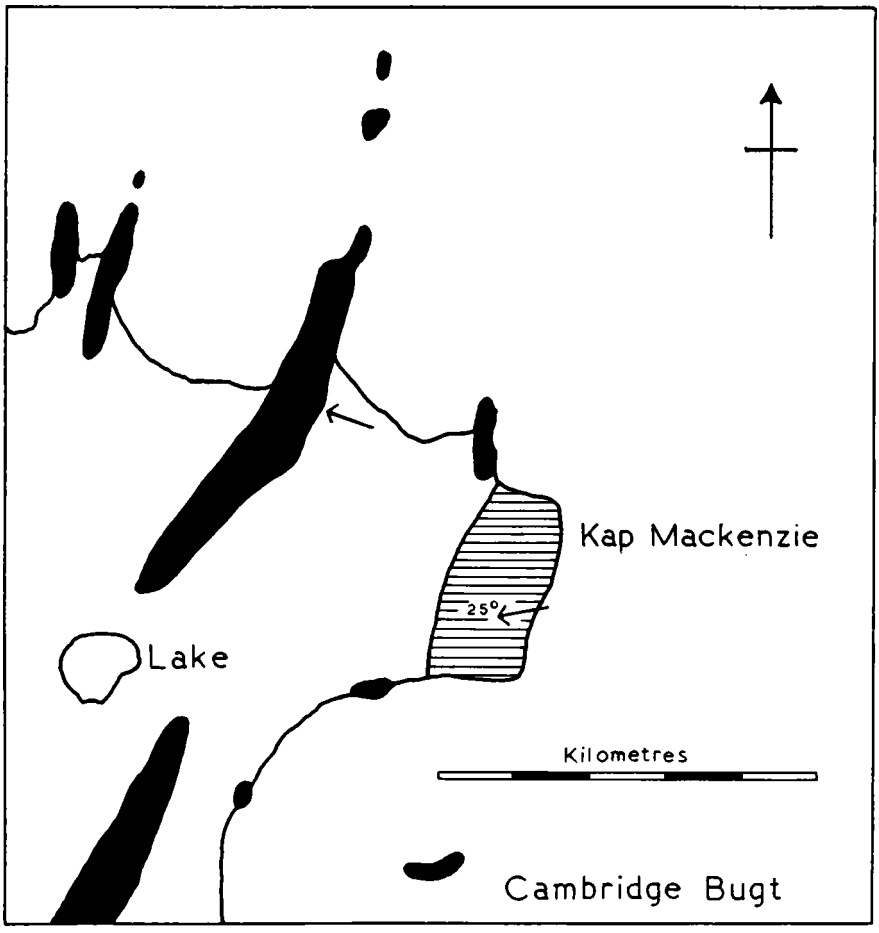

Fig. 6. Geological sketch map of the neighbourhood of Kap Mackenzie, Geographical Society Ø, showing the outcrop of the lavas. Scale: 1 : 100,000. Black = basic intrusions. Horizontal ruling = lavas. Unshaded = quaternary deposits, glacial and wind-blown.

	m
Dark green lava with tabular structure	4
Lava with scattered amygdales, weathered amygdaloidal horizon at the top	4
Amygdaloidal lava with amygdales of different sizes. Red-weathering horizon at the top	25
Lava with elongated phenocrysts, vesicular horizon at the top	4
Lava with alternating bands of fine-grained and amygdaloidal texture, each about 30—60 cm thick. Coarser-grained towards the top, with larger amygdales. Red stained layer at the top	—
Amygdaloidal lava with a tendency towards columnar jointing, red-weathered horizon 1 m thick at the top	15

	m
Lava with small amygdales	4
Coarse-grained, amygdaloidal lava, red-weathered band 30 cm thick at the top	10
Fine-grained, black lava with small phenocrysts	7
Lava with scattered amygdales	4
Very fine-grained, columnar jointed lava	5
(section obscured by scree; about 4 m)	
Lava with poorly developed columnar jointing	6
Fine-grained lava, with black phenocrysts, tending to weather to a tabular form	18
Lava with abundant amygdales	6
Fine-grained black lava, with phenocrysts in the upper part.	5
(section obscured by scree; about 3 m)	
Rotten, amygdaloidal lava, with abundant small amygdales	13
Fine-grained lava with small phenocrysts	12 seen
(Sea-Level)	

The total thickness exposed in this section is 143 m. The dip is about 25° to the south-west, the strike varying from west-north-west to north-north-west.

The series described above was also observed at the northern end of the cape, where, however, it is less easily studied. The beds correspond with the Coloured Series of Bontekoe Ø. The relationship of the lavas to the other rocks of the island cannot be observed, as the outcrop is bounded to the west by a belt of blown sand.

VI. STRUCTURE

The Mesozoic outcrops of Geographical Society Ø are bounded to the west by a fault-scarp of Carboniferous rocks, which was in existence probably in Jurassic, and certainly in Upper Cretaceous times, forming the western limit of the Mesozoic transgressions in this area. This fault line, which lies between 6 and 7 km east of the post-Devonian Main Fault, may be named the Tværdal Fault. It runs in a straight line from the north coast, at a point due south of Robertsons Ø, in a direction 15° west of south to a point 5 or 6 km from the south coast of the island. Its course from here southwards has not been observed by the writer, but according to verbal information kindly supplied by E. Witzig it swings westward and meets the coast at a point opposite the unnamed headland on the north coast of Traill Ø which lies 7 km west of Østernæs. Its course is probably represented correctly by the eastern boundary of the pre-Triassic rocks in one of Stauber's maps (1942, pl. 2), but Stauber's later version (pl. 3 in Koch, 1950), where the fault is shown as continuing in a straight line to the south coast of the island, is certainly wrong.

The writer believes that the northward continuation of the Carboniferous fault-scarp is represented by the east coast of Robertsons Ø and the east coast of Ymers Ø from Kap Humboldt to Kap Wijkander. The southward continuation of the fault line into Traill Ø has not been mapped. There appears to be an east-west fault hereabouts in the neighbourhood of Vega Sund, as the writer has recently suggested (Donovan, 1953, p. 58, pl. 1[1]), but the structure in this area will not be understood until the country west of the Rold Bjerge in Traill Ø has been mapped geologically. There is no evidence for any substantial movement along this fault line since Mesozoic times, but late Mesozoic or Tertiary faulting has certainly occurred along parallel lines a short distance east of the main fault. The Triassic and Jurassic rocks of the southern part of Tværdal are bounded to the east by a fault, shown by Stauber (1942, pl. 2), which brings Cretaceous (Albian) rocks down to sea level along the south coast of the island. This fault may have a downthrow to the east of the

[1]) In this map the southern end of the Tværdal Fault was incorrectly shown, following Stauber's 1950 map.

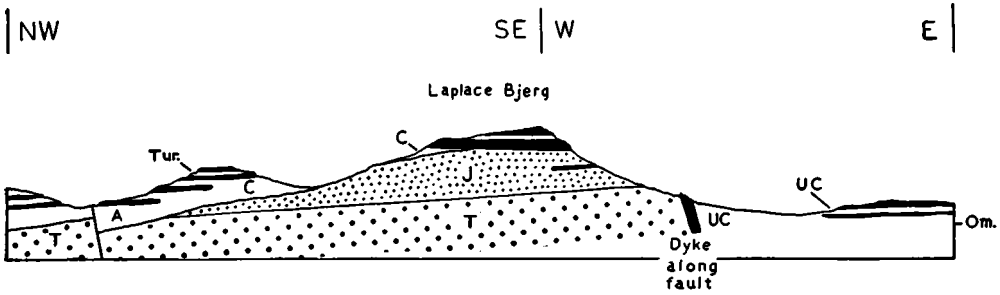

Fig. 7. Geological Section through Laplace Bjerg. Vertical and horizontal scale: 1 : 100,000. Abbreviations: T = Trias. J = Jurassic (Yellow Series). A = Albian C = Cenomanian. Tur. = Turonian. UC = Upper Campanian. Cretaceous rocks are shown uncoloured, basic intrusions solid black. The dyke marks the position of the Laplace Bjerg Fault.

order of 1000 m. As the Trias and Jurassic dip northwards and are succeeded by Cretaceous rocks in Tværdal, the fault can no longer be traced and may die out, or at least become much reduced in throw, before reaching the north coast of the island; Stauber's later map (pl. 3 in Koch, 1950) is incorrect in this respect, the area coloured by him as Rhaetic-Lias and Jurassic in the northern half of Tværdal being in fact occupied by Upper Cretaceous rocks (see pages 29, 30, 33).

A fault is postulated at the northern end of Tværdal along its eastern flank, with a westerly downthrow, to account for the observed distribution of the Cretaceous rocks, but it has not been traced in the field as the valley is largely obscured by glacial and alluvial deposits.

The most conspicuous structure within the Mesozoic outcrops of Geographical Society Ø is the Laplace Bjerg Fault, which runs parallel to the Tværdal Fault and about 22 km to the east (fig. 1, p. 8; fig. 3, p. 15). First noted by Stauber (1938, pl. 1), it can be traced inland for a distance of about 15 km from the north coast of the island. To the west of the fault a block of westerly dipping Triassic and Jurassic sandstones has been raised to an elevation of about 1000 m above sea-level, and is capped by unconformable Cretaceous; to the east, Upper Cretaceous rocks of the highest stage known in East Greenland, the Upper Campanian, lie at a low altitude at the foot of the fault scarp, and on this side of the fault the base of the Cretaceous must lie at a considerable depth below sea-level (fig. 7). The displacement of the Laplace Bjerg Fault must be at least 1500 m at its northern end. The fault has not been traced southwards beyond the end of the Trias and Jurassic outcrop, but it may continue through the Cretaceous country which has not been examined closely. The southerly termination of the outcrop of the Trias and Jurassic sandstones is mainly due to the fall in the level of the Cretaceous unconformity in this direction, although a small east-west

fault is probably present. The Laplace Bjerg Fault must already have been active in late Jurassic or early Cretaceous times, for the sandstone block which was elevated on its western side suffered extensive denudation prior to the deposition of the Albian. Post-Cretaceous movement is also believed to have occurred, for the Upper Campanian deposits lying immediately east of the fault consist only of shales, and if they had been deposited in their present position with respect to the fault scarp one may assume that a coarse clastic facies would be found at its foot, as with the Cenomanian of Tværdal (page 30). The inference is that by the Upper Campanian the sandstone ridge, still partly exposed when Albian beds were being deposited on its flanks, had been buried under the increasing thickness of Cretaceous deposits. On this hypothesis a displacement of at least 800 m has occurred along the Laplace Bjerg fault since the Cretaceous.

The Laplace Bjerg Fault is aligned with the fault which forms the eastern boundary of the Giesecke Bjerge on Gauss Halvø, and Laplace Bjerg, although different in stratigraphical details, may be structurally regarded as the southern extension and termination of the Giesecke Bjerge, forming part of a larger tilted block lying between the Laplace—Giesecke Bjerge Fault on the east and the Tværdal Fault on the west.

The major east-west valley between Freycinet Bjerg and Leitch Bjerg, here named William Smith Dal, which runs from the head of Cambridge Bugt to Vega Sund, may mark the line of a fault or monoclinal flexure which is postulated in this neighbourhood, forming the northern boundary of the synclinal or downfaulted zone centred on the Scott Kelties Øer, in which Senonian rocks are preserved. To the north of the valley lie Albian and Cenomanian rocks, to the south Turonian and Senonian. The valley itself has not been examined in detail, but the country is much obscured by Quaternary deposits and screes and it is unlikely that the structure can be determined accurately.

In the easternmost part of Geographical Society Ø the Cretaceous rocks have a general westerly dip, not always obvious in the sediments, which are poorly exposed, but often exhibited by the sills which have intruded them. This structure is well displayed along the south coast between Kap Hovgaard and Kap MacClintock, where a succession of basic sills dip westwards at angles which are commonly between 7° and 15°. The strike is usually from 15° to 30° east of north and is reflected by the topography, the ridge which crosses the island 4 km west of Kap MacClintock, the numerous headlands, and the islands east of Nordenskiølds Ø being all formed of basic sills. North of Cambridge Bugt the same structure is found, the predominant strike being expressed by the ridges, headlands and islands. This structure does not occur in Leitch

Bjerg and Freycinet Bjerg, where the rocks may, on the average, be approximately horizontal, although local dips are much affected by intrusions and these mountains have not yet been investigated fully. To the south-west of Cambridge Bugt the strike of the dolerite sills swings through 90° from north-south to east-west, as is well shown on the Geodetic Institute's map by the course of two ridges which start as headlands on the southern side of Cambridge Bugt and swing round into the western end of Freycinet Bjerg.

In the Scott Kelties Øer shoreline exposures mostly show the rocks to be horizontal or very low-dipping. The structure could not be determined by observation, but the observed distribution of rocks, Turonian to the north-east and Senonian to the south-west, necessitates a south-westerly dip, unless the relationship be faulted. A fault, trending from north-west to south-east, must certainly be postulated to account for the appearance of Infravalanginian, succeeded by Cenomanian and Turonian, on the coastal side of the Rold Bjerge in Traill Ø (Donovan, 1953, pl. 3).

The neighbourhood of Kap Palander, together with Nordenskiølds Ø to the north and the northern part of the Mols Bjerge to the south, was visited in 1952 and the observations of earlier workers on the structure were confirmed. Wordie (1927, p. 239) noticed the "steep dip of a few extremely massive sills" and remarked that Nordenskiølds Ø is formed principally by one of these. After the Lauge Koch Expedition of 1936—38 the essential outlines of the geology of the area were shown by Stauber (1938, pl. 1, 1942, text-fig. 5), who observed the westward-dipping Triassic and Jurassic rocks which appear beneath the Cretaceous in the Mols Bjerge (fig. 8), and the thick basic sill which extends northward to form Kap Palander and Nordenskiølds Ø. The Trias and Jurassic outcrops are bounded to the east by the Mols Bjerge Fault, which lies a short distance to the west of Æbeltoft Vig and Begtrup Vig. Stauber has this fault as straight (1938, pl. 1, and later maps), but the work in 1952 showed that the northern part of its course is sinuous (fig. 2, p. 13), consequent upon its dip, and lies to the east of the position given by Stauber. Where it crosses the valley which reaches the coast about 1.5 km west of Æbeltoft Vig, the fault plane, marked by an igneous intrusion, dips to the east at about 40°. The Mols Bjerge Fault may continue across Vega Sund into Geographical Society Ø, but no positive evidence for it was obtained by the writer. Stauber shows an outcrop of Jurassic rocks, bounded to the east by a fault, on the south coast of Geographical Society Ø about 13 km west of Kap MacClintock (pl. 3 in Koch, 1950). This would fit in with a northerly extension of the Mols Bjerge structure. The sediments along this part of the coast are all black shales, and no fossils could be found by the writer's party in the neighbourhood of Stauber's Jurassic outcrop, but it is quite possible that an unobserved

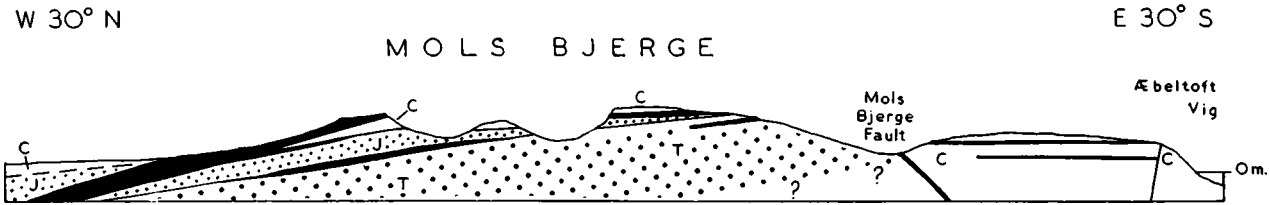

Fig. 8. Geological Section through the northern part of the Mols Bjerge. Vertical and horizontal scale: 1 : 100,000. Abbreviations: T = Trias. J = Jurassic (Yellow Series). C = Cretaceous. Basic intrusions are shown in solid black.

strike fault may exist. The maximum throw of the Mols Bjerge Fault is less than that of the Laplace Bjerg Fault. It may be of the order of 900 m.

Interpretation of Structures.

The major structural elements of eastern Geographical Society Ø and the northern side of eastern Traill Ø are tilted blocks of sediments, dipping to the west or west-north-west, and bounded by the major fault lines which traverse the area. The following blocks are recognised (fig. 9):

1) The Laplace Block, bounded on the west by the Tværdal Fault and on the east by the Laplace Bjerg Fault. This block is regarded as the southerly continuation of the Giesecke Block (Maync, 1949, p. 151). South of Laplace Bjerg the Laplace Bjerg Fault may die out, but the termination of the Triassic and Jurassic outcrops of the block in this direction is partly due to early Cretaceous denudation.

2) The Mols Block, bounded on the east by the Mols Bjerge Fault, on the west by the Maanedal Fault. In the neighbourhood of Vega Sund a northerly component in the dip brings the pre-Cretaceous rocks of the block down below sea-level. The block is possibly terminated to the north against the postulated William Smith Dal Fault. Southwards, the Mols Bjerge Fault can be traced across Mountnorris Fjord into Prospektfjeld (see Donovan, 1953, pl. 2), but is then lost in the syenitic complex of south-eastern Traill Ø. The Mols Block cannot be recognised in the Bjørnedal area, where the present structure is due chiefly to post-Cretaceous faulting. It may originally have terminated against the postulated Kong Oscars Fjord Fault (see Donovan, 1953, p. 59). Turonian and Senonian rocks are preserved in the depressed north-western part of the Mols Block, which is affected by local faulting.

3) The Cambridge Block. The presence of a tilted block to the east of the Laplace Block is deduced from the prevalent westerly dip of the rocks at the eastern end of Geographical Society Ø. This block is named the Cambridge Block after Cambridge Bugt. North of Cambridge Bugt the block is bounded to the west by the Laplace Bjerg Fault. The westerly dips also occur in south-east Geographical Society Ø and the Cambridge Block may be continued southwards to this area, but the structure here is not known in detail on account of the impossibility of detecting strike faults in the poorly fossiliferous Cretaceous shales. Eastern Geographical Society Ø is largely obscured by Quaternary debris and insufficient stratigraphical evidence is to hand to determine the detailed structure. The eastern limit of the Cambridge Block can only be surmised; it may lie wholly beyond the present eastward extent of Geographical Society Ø. The slender evidence of the presence of Upper Campanian rocks on the

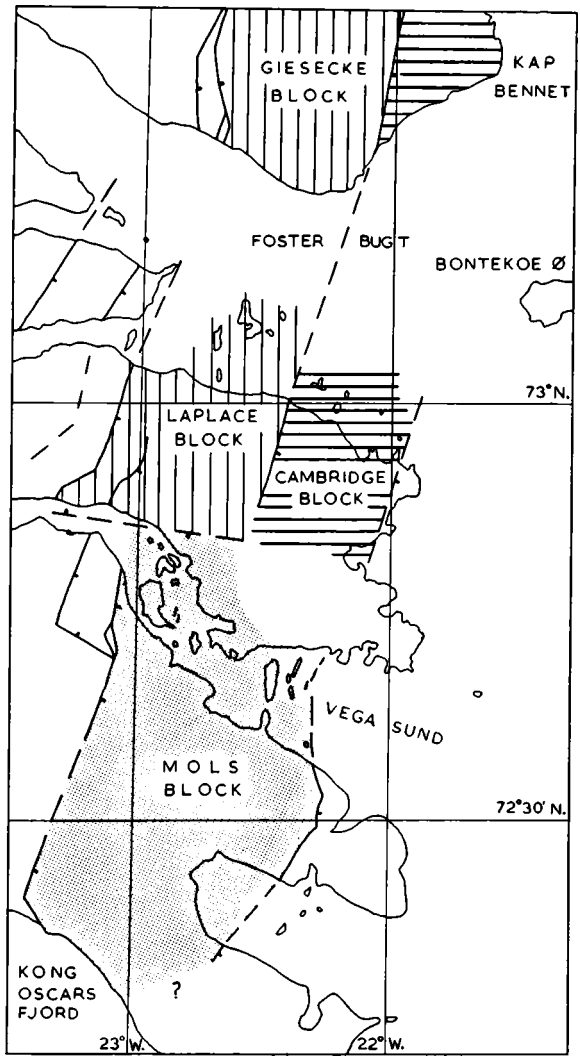

Fig. 9. Structural map of eastern Traill and Geographical Society Øer and the southern part of Gauss Halvø. Scale: 1 : 1000,000.

headland 7 km south-south-west of Kap Mackenzie, and of the still younger Tertiary lavas at Kap Mackenzie itself, suggests the existence of a strike fault a little to the west of Kap Mackenzie, downthrowing on its eastern side and bringing in these young rocks. It is possible that this fault forms the eastern margin of the Cambridge Block, and that the Kap Mackenzie lavas mark the depressed western side of yet another block; in view of the scarcity of evidence in this area, however, a positive interpretation of the structure cannot be proposed.

North of the Cambridge Block lies Foster Bugt, 30 km across at its inner end and 70 km at its mouth, and only the broadest suggestions can be made as to structural correlations across it. A firm starting point is fortunately provided by the correlation of the Giesecke Block on the north with the Laplace Block to the south, and no doubt the downfaulted areas east of the eastern boundary faults of these blocks correspond in a general way. On the northern side of Foster Bugt, it may be that the whole of the southern part of Hold with Hope is underlain by a single tilted block, but the solid geology is largely obscured by Quaternary deposits. However, Cretaceous (Albian and ?later) sediments at Kap Broer Ruys dip to the north-west (Maync, 1949, p. 149) and are succeeded at an altitude of 480 m by a breccia of probable Tertiary age; further west, the country appears to be entirely made up of flows of Tertiary Basalt which appear to dip to the west and come nearly down to sea-level near Kap Bennet (Koch, 1950, pl. 5). This evidence, so far as it goes, is in accordance with a westerly or north-westerly tilt of the basement in this region.

The postulated fault west of Kap Mackenzie may be merely a minor feature in the extensive depressed area lying east of the Giesecke Bjerge and Laplace Bjerg Faults, although Bontekoe Ø, where Tertiary lavas extend to below sea-level, appears to link up with Kap Mackenzie where the same state of affairs prevails, and lends further support to the belief in a belt which is downfaulted with respect to the remainder of eastern Geographical Society Ø, and which is almost wholly submerged.

Age of the faulting.

The deposition of the Yellow Series during the Callovian stage was probably the result of active displacement along the series of faults (Tværdal Fault, Maanedal Fault, Svinhufvuds Bjerge Faults) which were subsequently to form the western boundary of the area of late Jurassic and Cretaceous sedimentation. An important renewal of tectonic activity occurred about the middle of the Turonian stage, resulting in the formation of the conglomerates in Maanedal, on Traill Ø, and elsewhere. It is likely that all the faults within the area were rejuvenated from time to time, but it is impossible to trace their history in detail. Once the tilted blocks had been established the gradual transgression of the Middle Cretaceous over them could have occurred by simple subsidence of the whole coastal belt, but in fact faulting may well have occurred at the same time. Movement occurred again in the Tertiary or very late Cretaceous and considerable displacements are postulated along the Maanedal Fault and Laplace Bjerg Faults to bring the Upper Campanian rocks down to their present level. There is still little evidence for any important

displacement along the faults after the Tertiary igneous activity (see Donovan, 1953, pp. 62—63), but the preservation of the lavas at Kap Mackenzie may be due to faulting subsequent to their extrusion.

Summary of Tectonic Activity in Eastern Geographical Society and Traill Øer.

Principal episodes	*Remarks*
Tertiary	Post-Upper Campanian displacement is believed to have occurred along some north-south faults, *i. e.* Laplace Bjerg Fault and Maanedal Fault. Some movement has occurred since the Tertiary igneous activity (*e. g.* at Svinhufvuds Bjerge) but its extent is unknown.
Late Cretaceous	Possible epeirogenetic movements (see p. 56).
Mid-Turonian	Renewal of activity along western boundary faults. Considerable elevation of palaeozoic rocks to west. Deposition of Turonian conglomerates.
Mid-Cenomanian	Slight elevation terminating deposition of Middle Cretaceous Shales.
Upper Aptian to Lower Albian	Commencement of depression of area of Middle Cretaceous deposition.
Hauterivian to Lower Aptian	Elevation and tilting of tectonic blocks. Denudation of Jurassic and Valanginian sediments.
Valanginian	Depression of area resulting in Valanginian transgression.
? Kimmeridgian	Elevation terminating deposition of the Black Series. Denudation of Jurassic rocks.
Late Oxfordian to Early Kimmeridgian	Depression accompanying deposition of Black Series.
? Late Callovian	Elevation of area resulting in regression of sea.
Early Callovian	Downfaulting of area along western boundary faults (Tværdal Fault, Maanedal Fault, Svinhufvuds Bjerge Faults).

VII. GEOLOGICAL HISTORY

The geological history of Traill Ø has been recently summarised by the writer (Donovan, 1953, pp. 64—67) and the remarks then made, which apply equally to Geographical Society Ø, need not be repeated. The work in 1952, however, resulted in a clearer picture being obtained of the Middle Cretaceous transgression. Some details may therefore be added consequent upon the better knowledge of the stratigraphy and structure which is now available.

1. Denudation of the Jurassic rocks.

It has already been pointed out that, prior to the deposition of the Middle Cretaceous shales, the Jurassic rocks had undergone denudation, so that the Cretaceous rests in some places on the Yellow Series. The relationship of the Infravalanginian and Valanginian deposits to the underlying Jurassic is unknown, and the extent of pre-Cretaceous denudation of the Jurassic cannot therefore be estimated; but as the latest Jurassic rocks (apart from a possible record of Upper Portlandian, the significance of which is unknown: Donovan, 1953, p. 30) are Lower Kimmeridgian it is clear that, if sedimentation was indeed terminated at this time by elevation of the area, appreciable denudation could have occurred before the deposition of the earliest Cretaceous rocks. The position of the northern Valanginian outcrop (fig. 2) in relation to nearby occurrences of the Yellow Series of the Jurassic leaves little room for the outcrop of the Black Series, which has not been found in the neighbourhood, and may have been removed before the Valanginian transgression. On the other hand, the possibility of the relationship being faulted cannot be excluded, as it is now very difficult to determine the detailed structure on account of the numerous igneous intrusions.

Renewed denudation certainly occurred in the interval between the Valanginian and the beginning of the Middle Cretaceous transgression, which commenced, at the earliest, in the Upper Aptian. This denudation removed the recently deposited Infravalanginian and Valanginian deposits over considerable areas and may then have proceeded to attack the

underlying Jurassics, but how far this attack proceeded cannot now be determined; it is certain that erosion of the highest parts of the tilted blocks continued right up until the time when they were finally submerged early in the Cenomanian, as indicated by the conglomerates at and near the local base of the Middle Cretaceous Shales in the eastern part of the area.

2. The Middle Cretaceous transgression.

Many details of the progress of the Albian-Cenomanian transgression have been filled in by the field work in 1952. At the beginning of the transgression the area exhibited considerable relief, resulting from the westerly tilting of the tectonic blocks defined in another section of this paper (p. 49). The sea first flooded the depressed western sides of the blocks, but it was a considerable time before the elevated eastern margins were covered, and a progressive overlap of later and later deposits can be traced as one approaches the principal elevated zones, namely the Mols Bjerge and Laplace Bjerg. The whole transgression was bounded to the west by the Carboniferous boundary fault which forms the western limit of the Laplace and Mols Blocks.

The earliest manifestation of the transgression occurred in the Upper Aptian, when the sea flooded a small part, at least, of the southern side of the Mols Block. Whether the transgression was henceforth continuous, or whether a regression occurred before the Lower Albian, cannot be determined, since the Upper Aptian rocks are known only from two localities near Bjørnedal and their relationship to the succeeding rocks is unknown (Donovan, 1953, pp. 34—35). In Lower Albian times the western edges of the Laplace and Mols Blocks were submerged, as demonstrated by the presence of Lower Albian beds in the Rold Bjerge (Donovan, 1953, p. 35) and on the opposite shore of Geographical Society Ø (Donovan, 1949, p. 7), and the southern margin of the Mols Block may also have been covered, if deposition here was continued from the Upper Aptian. On account of the westerly tilt of the blocks the base of the Lower Albian lies mainly below sea-level and is not seen.

The remainder of the Albian stage is not well subdivided palaeontologically, but various observations suggest that the beds containing *Inoceramus anglicus* are later than the Lower Albian with *Arcthoplites* and *Leymeriella*, and that rocks carrying *Aucellina* as their principal fossil are later still, probably late Middle or Upper Albian. Ammonites in all these beds are rare and inconclusive, but fragments whose ornament suggests Middle and Upper Albian age have been found in Geographical Society Ø (Spath, 1946, p. 9) and Traill Ø (Donovan, 1953, p. 35). Although we cannot trace this part of the transgression in detail, it is probable that with the progress of the Albian stage the sea advanced

eastwards up the dipslopes of the tilted blocks, and where, towards the eastern margins of the blocks, the base of the Cretaceous becomes visible, the basal deposits are of probable Upper Albian age. The tilted blocks were not fully submerged by the end of the Albian. In Laplace Bjerg the Jurassic sandstones of the most elevated part of the block are capped by Lower Cenomanian beds, and north of the Mols Bjerge the presence of coarse conglomerates in the Cenomanian (see pp. 23—25) indicates that there also, at this time, pre-Cretaceous rocks were still exposed at, and probably above, the surface of the sea.

East of the Laplace Bjerg and Mols Bjerge Faults lay tilted blocks whose story may have been similar, but these areas lie at a lower level than the blocks to the west and there is insufficient evidence to reconstruct the progress of the transgression, the base of the Cretaceous being nowhere exposed.

Coarse, marginal deposits are found in the Lower Cenomanian along the western edges of the Laplace Block and the Mols Block, and may indicate renewed activity along the boundary faults with elevation of the country to the west, for the exposures of Albian rocks in the same belt are entirely argillaceous. The Cenomanian marginal facies includes the sandstones in Maanedal (see p. 28) and the shales with sandstone and pebbles in the western part of the Sortefjelde (Donovan, 1953, p. 37), both in Traill Ø, and the sandy facies at the northern end of Tværdal, in Geographical Society Ø (p. 30).

The marginal facies is not constant from north to south and may itself have varied laterally—for example, the Maanedal sandstones may mark the position of a river emerging from the land to the west. Further deductions, however, seem unwise on the basis of the present evidence.

During the Middle Cretaceous transgression the coast of East Greenland between 72° and 73° north latitude may be visualised as fringed by islands, striking north and south, formed by the unsubmerged parts of the tilted blocks of Jurassic and older rocks. As the transgression proceeded the islands shrank, and had vanished early in the Cenomanian. The same pattern may well have extended northwards as far as latitude 74° over the area which is now Hold with Hope, and it was developed in similar form during the Lower Cretaceous still further north, in Wollaston Forland (Maync, 1949, figs. 68, 69).

3. The late Cretaceous transgressions.

Whereas the earliest transgressions of the Cretaceous cannot be traced in detail because they are masked by the Middle Cretaceous transgression, those of the late Cretaceous are difficult to reconstruct

because of the limited extent of the outcrops remaining at the present day, and especially because the stratigraphy, depending principally on species of *Inoceramus*, cannot be made sufficiently precise. The complete absence of any fossils or deposits attributable to the late Cenomanian or early Turonian is strongly suggestive of a recession of the sea during this time, and the presence of Turonian conglomerates indicates renewed activity along the main fault lines which may have accompanied a new depression of the tilted blocks. The conglomerates and sandstones along the northern flank of the Rold Bjerge in Traill Ø (Donovan, 1953, p. 39, locs. 51, 59) may well be basal deposits of the new transgression.

It is impossible to be certain whether the three formations recognised above the Cenomanian, namely the *I. lamarcki* Beds, the *Sphenoceramus* Beds, and the *Scaphites* Beds, represent separate transgressions, or whether they are all parts of one continuously deposited series. They have been shown as separate stratigraphical units in the tables published by the writer (1953, p. 148; 1954, p. 4), because the presence of rocks of intermediate age is not proved; on the other hand, such rocks could be represented by some of the many barren outcrops, and it is not possible to come to a satisfactory conclusion one way or the other.

VIII. SUMMARY OF RESULTS

1. The Mesozoic, especially Jurassic and Cretaceous, rocks of eastern Geographical Society Ø, the islands in Vega Sund, and the north-eastern part of Traill Ø, have been investigated and an account of the stratigraphy is given. The formations recently found in Traill Ø are proved to extend northwards into Geographical Society Ø.

2. The Jurassic rocks consist principally of the sandy Yellow Series, of Callovian age, which is generally barren, although a few fossils are recorded. The Lower Kimmeridgian Black Series has been removed by late Jurassic or early Cretaceous denudation, prior to the deposition of the Middle Cretaceous Shales, except for a small patch on Nordenskiølds Ø.

3. Another outcrop of the Valanginian has been found, and an extensive collection made which is to be described later.

4. The Middle Cretaceous Shales, of Albian and Cenomanian age, extend over the area, and their basal deposits are shown to be of progressively later date further and further east, in accordance with the hypothesis of gradual transgression over tilted blocks.

5. The Turonian and Senonian rocks, assigned to the *Inoceramus lamarcki* Beds, the *Sphenoceramus* Beds, and the *Scaphites* Beds, are briefly described, but nothing of importance can be added to our interpretation of these rocks.

6. A brief description is given of the extrusive igneous rocks, of presumed Tertiary age, of Bontekoe Ø, and the discovery is announced of similar rocks at Kap Mackenzie, at the north-eastern point of Geographical Society Ø. No petrographic work has been undertaken, however, and these lavas remain a field for future research.

7. The structure is shown to be dominated by north-south faults, and the existence of several tilted blocks, whose behaviour controlled Cretaceous sedimentation, is postulated. Comparison is made with the structure in Gauss Halvø and Hold with Hope, which is believed to be continuous with that in the present area.

NOTE ON THE STRATIGRAPHICAL TABLE

The table shows the formations at present recognised in the Jurassic and Cretaceous of Traill and Geographical Society Øer, together with their approximate ages in terms of the classical European stages. For further details on the dating and affinities of the formations see previous papers by the writer (Donovan, 1953, pp. 130—138; 1954, pp. 23—28).

The term *Scaphites* Beds for the Upper Campanian deposits (merely called "Shales of Locality 58" in a previous table, 1953, p. 148) is here introduced for the first time. The name *Inoceramus lamarcki* Beds was introduced in a recent publication (Donovan, 1954, p. 4) for the beds of Upper Turonian and possibly later date characterised by this bivalve.

Question-marks have been added to the entries for *Pachyteuthis* Beds (? Infravalanginian) and the nodules of ? Upper Portlandian date, as the correlation of these beds is under review and may have to be revised. They are not treated in the present publication.

Stratigraphical Table.

System	Stage			Formation
CRETACEOUS	SENONIAN	CAMPANIAN	Upper	*Scaphites* Beds
			Lower	
		SANTONIAN	Upper	*Sphenoceramus* Beds
			Lower	
		CONIACIAN	Upper	
			Lower	
	TURONIAN		Upper	*Inoceramus lamarcki* Beds
			Lower	
	CENOMANIAN		Upper	
			Lower	(West) (East)
	ALBIAN		Upper	Middle Cretaceous Shale Series
			Middle	
			Lower	
	APTIAN		Upper	Shales at localities 9, 27 in Bjørnedal, Traill Ø
			Lower	
	BARREMIAN			
	HAUTERIVIAN			
	VALANGINIAN		Upper	Fossiliferous limestones (Albrecht's Bugt Facies) on western flanks of Mols Bjerge, Traill Ø
			Middle	
			Lower	
JURASSIC	INFRAVALANGINIAN		Upper	? *Pachyteuthis* Beds of Rold Bjerge, Traill Ø
			Lower	
	PORTLANDIAN		Upper	? Nodules at localities 104, 121, Traill Ø
			Middle	
			Lower	
	KIMMERIDGIAN		Upper	
			Middle	
			Lower	Black Series (absent in Geographical Society Ø)
	OXFORDIAN		Upper	
			Middle	
			Lower	
	CALLOVIAN		Upper	
			Middle	
			Lower	Yellow Series
	BATHONIAN		Upper	
			Middle	
			Lower	

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Færdig fra trykkeriet den 9. maj 1955.

PLATES

Plate 1.

Fig. 1. Exposure of the basal Cretaceous unconformity above the beach on the east side of Kap Palander, Traill Ø, a short distance to the south of the cape itself. The lower part of the exposure consists of sandstones of the Jurassic Yellow Series, succeeded, at the level marked by the head of the hammer, by the basal conglomerate of the Cretaceous. See page 23.

Fig. 2. A close-up of part of the unconformity shown in figure 1. The base of the Cretaceous lies about 1 cm above the head of the hammer, and rises to the left.



Fig. 1.



Fig. 2.

Plate 2.

Fig. 1. The basal conglomerate of the Cretaceous about 6 km due north of the summit of Laplace Bjerg, Geographical Society Ø, described on page 26. The photograph includes the whole thickness of the conglomerate, but the underlying Jurassic sandstones are obscured by debris. The boulder of fossiliferous Jurassic sandstone (page 17) occurred in the conglomerate a few metres from the place where this photograph was taken.

Fig. 2. A dolerite sill on the coast of Geographical Society Ø, between 2 and 3 km west of Kap MacClintock. The columnar jointing is well shown. See page 38.



Fig. 1.

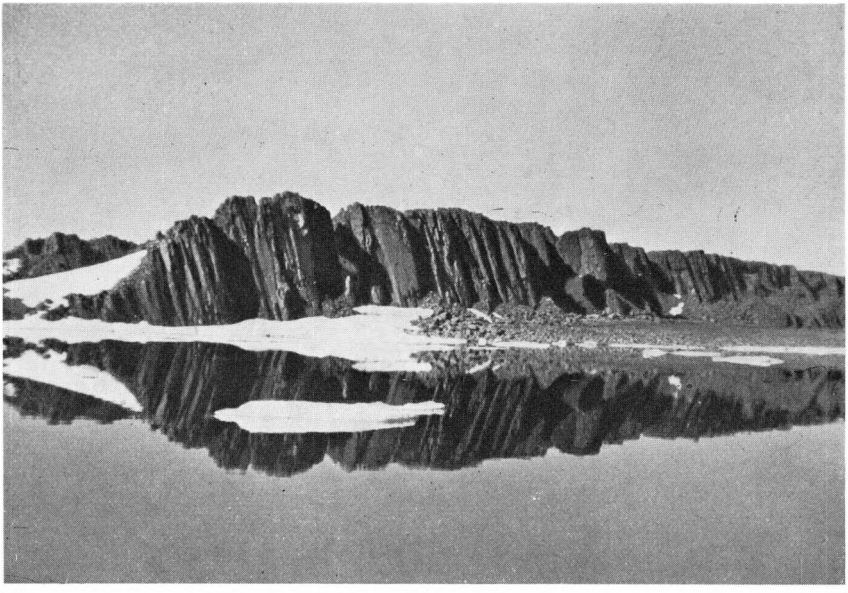

Fig. 2.