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DE DANSKE EKSPEDITIONER TIL ØSTGRØNLAND 1947–58
UNDER LEDELSE AF LAUGE KOCH

GEOLOGICAL MAP OF CARLSBERG FJORD – FOSSILBJERGET AREA

BY

J. H. CALLOMON

WITH 1 MAP

KØBENHAVN
C. A. REITZELS FORLAG
BIANCO LUNOS BOGTRYKKERI A/S
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INTRODUCTION

The Observations on which the map are based were made during the last week of the summer field season of 1958. They were intended as a reconnaissance for subsequent expeditions to be led by LAUGE KOCH in which the aim was to explore systematically for the first time the Mesozoic geology of northern Jameson Land. This region had been traversed a number of times by previous expeditions which brought back small collections of Jurassic material from scattered localities, but no serious work had yet been done because of logistic difficulties. The region is readily reached by sledge in winter, but is then wholly snow-covered; and in summer the only nearby access by sea through Carlsberg Fjord is almost always blocked by ice. Nevertheless the material that had accumulated, collected *i. a.* by NORDENSKJÖLD in 1900 and ROSENKRANTZ in 1927 and described by MADSEN (1909) and SPATH (1932), showed that Jurassic rocks occurred widely, were locally highly fossiliferous, and differed considerably in faunas and facies from their development in the much better-known area round Hurry Inlet in southern Jameson Land. At the same time there were now to be found in the literature the names of places such as Fossilbjerget, Mikaels Bjerg, Umingmakbjerg, Hjørnefjeldet, Skansen, Depotelv, Lejrelv and Lepidopteriselv whose exact locations and extent were only indicated on sketch-maps in the vaguest way. One of these had in turn given its name to a whole geological unit, the Fossilbjerget Formation, whose age, extent and relationship to other formations was undetermined. A regional map by STAUBER (in KOCH, 1950) was of little help. Lastly, there were repeated and intriguing references to a Jurassic Eldorado, plateaux on which "thousands of ammonites lie spread over the ground" (ROSENKRANTZ, 1929, p. 146). It seemed therefore that in the limited time available it would be best to try to resolve as many of these outstanding uncertainties as possible; so that the fossil material that had already been described, and which bore in part new names that will through the rules of nomenclatural priority persist and become classical, would have the stratigraphical basis needed to make it fully useable and useful. In the event this decision was fortunate for the 1958 expedition was KOCH's last and it was to be many years before work could be resu-

med. Also, the conditions of snow-cover were so favourable that the results obtained exceeded all expectations.

A total of six working days were spent on the ground. Base camp was established on the shore of Carlsberg Fjord at the southern end of the Juradal delta, reached and supplied by seaplane in moderately open water at the foot of the fjord even although the head was blocked by ice all summer. A second camp was carried up Juradal inland to a point on Depotelv 1 km north of the summit of Centralbjerg. Sections were measured and recorded as follows: (a) from base camp on Carlsberg Fjord via points 760 m and 840 m to the summit of Trefjord Bjerg (nos. 20–22); (b) from Juradal due east to point 920 m at the west end of Trefjord Bjerg (28); (c) from Depotelv to the summit of Centralbjerg (23, 24); (d) up the long western slope of Centralbjerg (25); (e) from Depotelv up the N-E slopes of Mikaels Bjerg (27); and (f) up the S-E spur of Fossilbjerget, starting at the northernmost tip of Lower Vardekløft Formation marked in grey on the map in the valley-bottom of the unnamed river on its east side, 2 km N of its junction with Depotelv (26). I was accompanied in the field-work by R. L. MAKIN and J. C. WIGGLESWORTH, whose untiring assistance is gratefully acknowledged.

The map was then drawn on a preliminary topographic base of 1:100,000 prepared in manuscript by the Geodetic Institute, Copenhagen. It showed the principal rivers and spot-heights. The contouring was however very incomplete and it seemed sufficient therefore to indicate relief on the present map by hachures. As the beds are almost horizontal and free of folds and faults, the geological boundaries between units on the map are all governed only by the topographic relief and vice-versa; and there may even be advantages in this way of bringing out most clearly the relations between geology and topography. The map was filled in with the aid of continuous series of excellent oblique aerial photographs made by Catalina in 1950 from 4000 m. There is little permanent snow or vegetative cover, and as the formations are of variable hardness and feature-forming, this gave little difficulty in the area covered by the map.

The following names on the map are new: Juradal; Gule Horn; Parnas; and Trefjord Bjerg, so named because its summit is the watershed between Scoresby Sund, Hurry Inlet and Carlsberg Fjord.

The Tertiary basalt dykes shown are those visible on the air photographs. Ground control indicates that this accounts for by far the majority, for minor ones seem to be rare. Sills are absent except in the N. W. corner of the map: the small plateau around point 140 m near the edge of the map in the northern part of Pingel Dal reflects an extensive sill not visible as such in the photographs. The many sills shown in his map by STAUBER do not exist and doubtlessly arose from confusion with the ex-

tensive sandstone cliffs formed by the harder members of the Yellow Series. Similarly, there is no evidence for the fault shown as running down the west coast of Carlsberg Fjord.

The area around Pingel Dal between Fossilbjerget and Parnas was visited in 1964 by an expedition under the leadership of R. MARRIS. Geological observations were made by R. C. WHATLEY and D. BROWN, who measured a number of sections on the map; but these were taken after the map had already been printed.

SUMMARY OF THE FORMATIONS

Trias: Kap Biot Formation

Kap Seaforth Beds (170 m +). These form the base of the exposed sediments round Carlsberg Fjord. They appear to rest directly on the crystalline rocks of Liverpool Land, but the contact has not been examined. The beds consist of sandstones ranging from arkose to siltstones and the predominant colour is greenish grey. There are subsidiary red beds and some gypsum.

Ørsted Dal and Fleming Fjord Beds (ca. 150 m). Dark red well-bedded fine-grained mudstones with strong ripple-marking on the bedding planes.

The Triassic beds were not closely examined, and are described in more detail by GRASMÜCK and TRÜMPY (1969).

Rhaetic – Lower Lias: Kap Stewart Formation (260 m).

The red-beds of the Trias are followed after a sharp break by more soft arenaceous beds of grey, greenish or white colour, ranging in texture from shales to arkoses. The lowest 150 m are barren, and may include beds elsewhere still classified as Ørsted Dal Beds in the Kap Biot Formation. The next 90 m are more shaly and yield remains of plants. They have not been examined in detail, but the general lithological resemblance to the beds round Hurry Inlet is clear. At the top are 15 m of barren black paper-shales which seem to have no reported equivalents elsewhere.

Lias: Neill Klinter Formation (240 m)

Sandstones and shales or silts, the former predominating in the lower half, well-bedded, colours ranging from brown to white. The only fossils found were oyster fragments about 180 m above the base, and plant remains near the top, so correlation with the beds round Hurry Inlet is again by general inference. The two Pliensbachian horizons with marine fossils found in the south do not seem to extend further north than the top of Hurry Inlet.

Upper Lias: Oyster Bed (Toarcian) (100 m)

The name Oyster Bed has come to be used for the whole of the thick fossiliferous top part of the Lias after NATHORST who discovered it in 1899 at the top of Nathorsts Fjeld on the west coast of Hurry Inlet. The beds consist of alternating members a few metres thick of silty shales with concretions, some phosphatic, and sandstones some of which grade up into fine conglomerates of well-rounded quartz pebbles. They are particularly well exposed and fossiliferous in the Carlsberg Fjord area, which may be the best region for studying them anywhere. The fossils include ammonites (*Pseudolioceras*), profuse belemnites and bivalves including the oysters, brachiopods, crinoids, crustaceans, and occasional vertebrate remains. The top bed is usually a hard sandstone that forms extensive platforms. Near the southern edge of the map, in the valleys of Ryders Elv and Lejrelv, the points at which ROSENKRANTZ's fossil collections were made can now be fairly closely located with the aid of the photographs he published (1934, pp. 89–92). From here he recorded, besides *Pseudolioceras*, *Dactylioceras* and *Catacoeloceras* and so it may be possible in this area to establish a more detailed zonal stratigraphy of the Upper Lias than we have at present.

Middle Jurassic

At the southern end of Hurry Inlet the Middle Jurassic consists wholly of a series of silty shales 180 m thick with horizons of concretions called the Vardekløft Formation (ROSENKRANTZ, 1929). On closer inspection it shows minor variations in lithology which allow it to be subdivided into Lower, Middle and Upper Vardekløft Formations. North of Kong Oscars Fjord the Middle Jurassic consists of up to 600 m of more or less massive yellow sandstones called the Yellow Series (MAYNC, 1940). The development in the intermediate region of the present map is in a shale—sandstone—shale sandwich. Ammonites occur at numerous horizons so that the lateral lithostratigraphic relations between formations can be chronostratigraphically carefully controlled. The scheme of standard ammonite zones is as follows:

Lower Callovian

Zone of *Sigaloceras calloviense*
– – *Kepplerites tychonis* (3)

Boreal Bathonian

Zone of *Cadoceras variabile*
– – *Arcticoceras kochi* (2)
– – *Arctocephalites greenlandicus*
– – – *nudus* (1)
– – *Cranocephalites pompeckji*
– – – *indistinctus*
– – – *borealis*

(1) *A. nudus* SPATH is probably only a variety of the more familiar *A. arcticus* (WHITFIELD), with which it occurs.

(2) *A. kochi* SPATH is a precursor of *A. ishmae* (KEYSERLING) which also occurs in the Zone as understood here.

(3) Index may have to be changed for there is now reason to believe that *K. tychonis* RAVN occurs only in the Variabile Zone.

Lower Vardekløft Formation. This, the lowest member of the sandwich, is a remarkably uniform unit resting on the Oyster Bed and extending almost unchanged from Hurry Inlet to Kong Oscars Fjord. It consists of fine dense black shales with characteristic dark claret-coloured ironstone concretions. The only fossils so far found in it are oyster fragments, rare belemnites, and plants. The age is therefore uncertain, but the lithology is reminiscent of Aalenian "Opalinus-Ton". Thickness varies between 60 and 110 m.

The Yellow Series. In southern Hurry Inlet, near Vardekløft, this formation is either totally absent, or is represented by a layer of phosphatic concretions yielding *Cranocephalites borealis*, or thickens locally in lenticles to a massive sandstone up to 40 m thick. It is immediately overlain by Middle Vardekløft Formation beginning with the Nudus Zone, so that two ammonite zones are missing. Going north, the formation rapidly thickens, and does so in three ways: the missing zones come in; the zones thicken; and the facies rises zonally so that on Trefjord Bjerg and Fossilbjerget the Yellow Series extends up to and includes the Kochi Zone, *i. e.* all the beds equivalent to the Middle Vardekløft Formation further south. The maximum thickness so far recorded in the area of the map is 415 m near point 880 m, 8 km north of Fossilbjerget. Some of the sandstones are well-bedded, with minor shales, but typically it consists of beds up to 30 m thick with no signs of stratification whatever. Such beds form extensive cliffs which could be mistaken on photographs for basalt sills. Beds become noticeably more shaly and thinner southwards. Fossils are confined to isolated horizons, some of which can be followed

for considerable distances. The Borealis Zone is found almost everywhere and makes a fine marker. The Indistinctus Zone has not been recognized in the area. The Pompeckji Zone is superlatively developed on the east side of Trefjord Bjerg, but becomes poorer westwards. The Nudus, Greenlandicus and Kochi Zones are well-developed locally, but ammonites are scarce in the more massive developments of the facies. (The types of *A. nudus* and *A. kochi* came from Hjørnefjeldet and Mikaels Bjerg respectively). Besides ammonites, bivalves and belemnites are locally common.

Upper Vardekløft Formation. This consists of soft silty shales with horizons of concretions ("doggers") and only subsidiary sandstones. In the lower part the beds are glauconitic and locally form thin but rich greensands. Because of their softness they are only preserved as scattered outliers on the high flat plateaux formed by the hard top sandstones of the Yellow Series, and tend to be poorly exposed. The south-eastern slopes of Fossilbjerget are particularly fossiliferous. The ammonites indicate that there are several distinguishable faunal horizons in the Variabile Zone. One of these is characterized by species of *Cadoceras* transitional to *Arcticoceras* ascribed by MADSEN to the Neocomian genus *Olcostephanus* on the basis of material brought back from Fossilbjerget in 1900 by NORDENSKJÖLD. There is however no doubt that it is still Middle Jurassic. The highest fauna on Fossilbjerget below the J. P. Koch Fjeld Formation belongs to the Calloviense Zone, and includes typical European forms of *Proplanulites*, *Kepplerites* (*Gowericeras*) and *Cadoceras* including *C. sublaeve*. The thicknesses of the Upper Vardekløft Formation have been measured to be 106 m on Mikaels Bjerg, 102 m on Fossilbjerget, and 94 m on Parnas (1970).

J. P. Koch Fjeld Formation

This name is used for a series of up to 300 m of sandstones, partly massive, partly shaly, sometimes cross-bedded or doggery, varying in colour from light blue to yellow, brown and white, which cap the outliers of Mikaels Bjerg, Fossilbjerget, Parnas, and further west, Olympen. They are totally barren and lie usually with sharp contact somewhat unconformably on the Vardekløft Formation below. They were ascribed to the Lower Cretaceous by analogy with the main body of the J. P. Koch Fjeld Formation in southern Jameson Land, at least the upper part of which has yielded Lower Cretaceous ammonites (*Hectoroceras*). They may however still be in part or even wholly Upper Jurassic: the top beds on Mikaels Bjerg have yielded a barely recognizable imprint of an ammonite reminiscent of *Cardioceras* (*Vertebriceras*) of the Oxfordian.

Note added in proof. (September 1970). New discoveries of ammonites in 1968 (BIRKELUND, HÅKANSSON and SURLYK, in press) and 1970 (BIRKELUND and CALLOMON) confirm beyond doubt that on Olympen

and Parnas at least the lower half, and hence on Mikael Bjerg probably most, of the Koch Fjeld Formation is not younger than Middle Oxfordian, Plicatilis Zone.

Quaternary: Jameson Land Plateau Gravels

These occur in the region of the present map as remnants forming a thin capping on Fossilbjerget. As in the main sheet on the heights west of Hurry Inlet (see ALDINGER, 1935, p. 28), they consist of a partly sorted assemblage of small to medium-sized well-rounded boulders of far-travelled rocks of all kinds, with a high proportion of granitic gneiss and quartzites. The latter include occasional blocks of *Scolithus* quartzite ("pipe rock") known from Drift in many widely scattered parts of the region (see COWIE and ADAMS, 1957, p. 149) but apparently so far not found *in situ*. Basalt is significantly inconspicuous or absent. The boulders lie almost loose with little binding material, certainly nothing resembling the "clay" of tillites or morainic boulder-clays. The general impression of the deposit serves to support NORDENSKJÖLD's view (1907, p. 253) that it was water-laid, the gravel of a large glacial river rather than an ice-born moraine. A detailed study of this interesting deposit remains to be done.

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Færdig fra trykkeriet den 20. oktober 1970.

Map of Carlsberg Fjord

DIP SECTION along the line shown on the map, NE to SW.
Horizontal scale 1:100, 000; vertical scale 10 times horizontal.
A number of hills on which control sections were measured on either side of the line have been projected unto the section.
Three widespread ammonite marker horizons shown dashed:

B: Borealis Zone
P: Pompeckji Zone
V: Variabile Zone

CORRIGENDUM. The Koch Fjeld Formation (green) is in major part of Upper Jurassic, Oxfordian age (see text).

23°20'

23° W

22°20'

71°20'

71°10'

PINGELSDAL

PASSAGEN

JURADAL

CARLSBERG FJORD

LIVERPOOL LAND

KLITDAL

Pamas 1249

Fossilbjerget

Gule Horn 960

Trefjord Bjerg 1045

Depotelv

Lejrelv

Legatoriselv

Centralbjerg 630

Hjörne-fjeldet

Mikaels Bjerg 630

Umingmak Bjerg 590

Skansen

Ryders Elv

Paselv

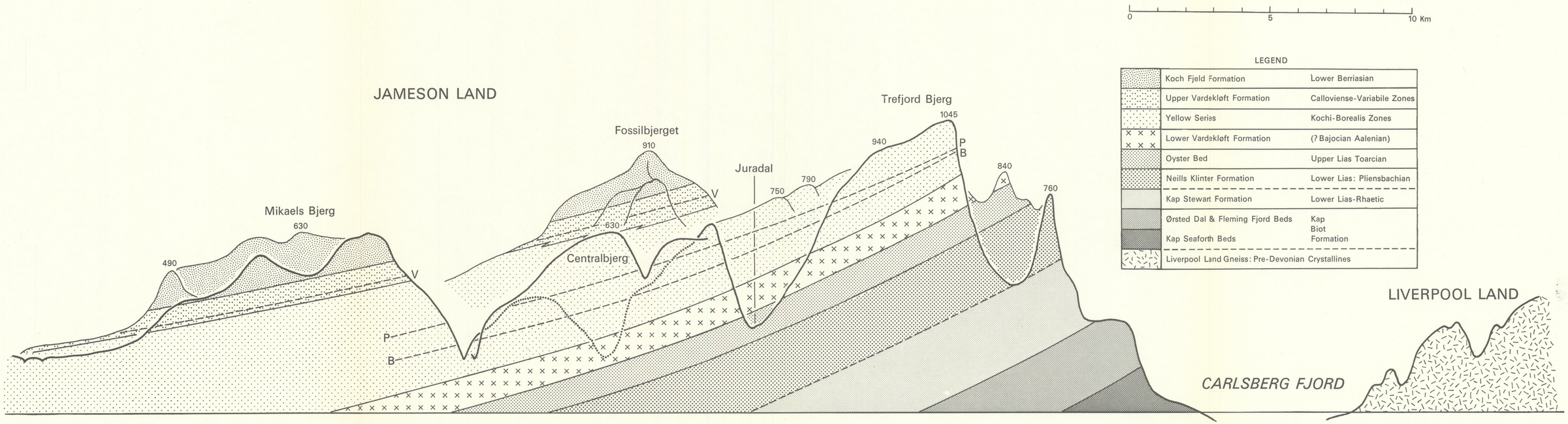
LEGEND

	Recent: Alluvium, River Gravels etc.		
	Jameson Land Plateau Gravels		
	Intrusive Tertiary Basalts		EOCENE
	Koch Fjeld Formation — Lower Berriasian		CRETACEOUS
	Upper Vardeklöft Formation — Callovienese–Variabile Zones	MIDDLE	JURASSIC
	Yellow Series — Kochi–Borealis Zones	MIDDLE	JURASSIC
	Lower Vardeklöft Formation — (? Bajocian Aalenian)	MIDDLE	JURASSIC
	Oyster Bed — Upper Lias Toarcian	LOWER	JURASSIC
	Neills Klinter Formation — Lower Lias: Pliensbachian	LOWER	JURASSIC
	Kap Stewart Formation — Lower Lias–Rhaetic	LOWER	JURASSIC
	Örsted Dal & Fleming Fjord Beds / Kap Seaforth Beds — Kap Biot Formation		TRIAS
	Liverpool Land Gneiss: Pre-Devonian Crystallines		

23°20' 23° W 22°40' 22°20'

0 5 10 15 20

Scale 1:100 000


0
5
10 Km
LEGEND
Koch Fjeld Formation
Lower Berriasian
Upper Vardekløft Formation
Calloviense-Variabile Zones
Yellow Series
Kochi-Borealis Zones
Lower Vardekløft Formation
(? Bajocian Aalenian)
Oyster Bed
Upper Lias Toarcian
Neills Klinter Formation
Lower Lias: Pliensbachian
Kap Stewart Formation
Lower Lias-Rhaetic
Ørsted Dal & Fleming Fjord Beds
Kap Seaforth Beds
Kap Biot Formation
Liverpool Land Gneiss: Pre-Devonian Crystallines
JAMESON LAND
Mikaels Bjerg
630
490
V
P
B
Fossilbjerget
910
630
V
Centralbjerg
Juradal
750
790
Trefjord Bjerg
1045
940
P
B
840
760
CARLSBERG FJORD
LIVERPOOL LAND