MEDDELELSER OM GRØNLAND
UDGIVNE AF
KOMMISSIONEN FOR VIDENSKABELIGE UNDERSØGELSER I GRØNLAND
Bd. 149 · Nr. 6

DE DANSKE EKSPEDITIONER TIL ØSTGRØNLAND 1936–38
Under Ledelse af Lauge Koch

NOTE ON MIDDLE DEVONIAN CROSSOPTERYGIANS FROM THE EASTERN PART OF GAUSS HALVÖ, EAST GREENLAND

WITH AN APPENDIX:

AN ATTEMPT AT A CORRELATION OF THE UPPER OLD RED SANDSTONE OF EAST GREENLAND WITH THE MARINE SEQUENCE

BY

ERIK JARVIK

WITH 3 FIGURES AND 2 TABLES IN THE TEXT

KØBENHAVN
C. A. REITZELS FORLAG
BIANCO LUNOS BOGTRYKKERI
1950

I. INTRODUCTION

In the area of Kap Franklin in the eastern part of Gauss Halvö there is a series of continental deposits consisting mainly of brownish-grey, greenish-grey or red sandstones, arkoses and conglomerates (see BACKLUND & MALMQVIST 1935, pp. 12—13; pl. 8; MAYNC 1940, pp. 8—11; STAUBER 1942; Tafel 1; BÜTLER 1948a; pl. 3; 1948b, fig. 1, profile III; 1948c). These deposits, which together with igneous rocks build up the southern and south-eastern parts of the Giesecke Bjærge, are overlain by Permian and Mesozoic rocks. Accordingly they are pre-Permian, but their exact age has remained unknown.

According to BACKLUND (BACKLUND & MALMQVIST 1935) the sandstones differ clearly from the sediments of Upper Old Red Sandstone age in the central parts of Gauss Halvö, to the west of the valley Margrethedal (cf. SÄVE-SÖDERBERGH 1934), but agree fairly well with the Carboniferous sediments occurring in Passagehøje (Passage Hills) some distance to the north of the Giesecke Bjærge (see SÄVE-SÖDERBERGH 1934; Appendix). For these reasons and since the shaly beds occurring in the lower part of the series and the arkoses contain fossil plants (indeterminable), BACKLUND concluded that the deposits in question are almost certainly Carboniferous (Namurian) in age. MAYNC (1940), on the other hand, maintained that in their lithologic characters the continental sediments in the Kap Franklin area agree with the sediments of Upper Old Red Sandstone age on the western side of Margrethedal and arrived at the conclusion that at least partly they are contemporaneous with the upper, fossiliferous part of the *Phyllolepis* Series (the Kap Graah Series of BÜTLER) of the Upper Old Red Sandstone, which means that they would be Upper Upper Devonian in age (cf. Appendix and JARVIK 1948b). However, as evidenced by fossil fishes recently found in this area, the deposits at least partly are Middle Devonian in age, and whether sediments of Upper Devonian or Carboniferous age really are represented remains to be proved.

These fishes were detected by Dr. H. BÜTLER of Schaffhausen in the valley Randbøldalen, near Kap Franklin in the south-eastern part of the Giesecke Bjærge, during the Danish East Greenland Expedition

in 1948 under the leadership of Dr. LAUGE KOCH. The interesting collection of fossil fishes from this locality brought together by Dr. BÜTLER and his assistants has kindly been handed to me by Dr. KOCH for determination and description. However, since a new visit to the Kap Franklin area is planned, the following description of the fossils is preliminary and my intention is mainly to give the data necessary for a determination of the geological age of the fossiliferous division of the deposits. The geological conditions at the locality will be described by Dr. BÜTLER in a forthcoming paper (BÜTLER 1949).

The fossils belong to the University of Copenhagen.

II. BRIEF DESCRIPTION OF THE FOSSILS

As far as could be determined with certainty the material of fossil fishes from the Kap Franklin area consists of detached scales, cleithra and cranial remains of Crossopterygians. No traces of *Antiarchi* or other Placoderms are represented. The fossils are black or—if they were exposed when collected—light blue to greyish white in colour. They are embedded in a grey to almost black flagstone with a light yellowish or reddish weathering hue. The rock closely resembles and is macroscopically indistinguishable from the richly fossiliferous flagstone of the horizon at 210—234 m. in the NW. part of Hesteskoen in Canning Land and other horizons in Canning Land and Wegeners Halvö with *Gyroptychius groenlandicus* (= *Canningius*; SÄVE-SÖDERBERGH 1937; JARVIK 1949a).

1. Gyroptychius groenlandicus JARVIK.

(figs. 1, 2).

Most of the Crossopterygian remains belong to an Osteolepid which, as shall now see, is indistinguishable from *Gyroptychius groenlandicus* JARVIK from the southern East Greenland Middle Devonian district in Canning Land and Wegeners Halvö (JARVIK 1949a) and which must therefore be included in that species.

The material of *Gyroptychius groenlandicus* from the Kap Franklin area consists of a number of fronto-ethmoidal and parietal shields, remains of the external cheek plate, several lower jaws, and some principal gular plates; in addition some dermal bones (the lateral extrascapular, the opercular, the subopercular and the cleithrum were identified) and numerous scales which are of little interest from a taxonomic point of view are represented. In the following brief description of the fossils only the best preserved specimens, mainly those shown in figs. 1 and 2, will be considered.

The fronto-ethmoidal shield (fig. 1 A), which is of moderate size (in the specimen figured it measures 20 mm. in length), is in all respects exactly as in the specimens from the southern district (Canning

Land and Wegeners Halvö; JARVIK 1949a, pp. 56—66; Table 1). The cranial roof thus curves only a little downwards in the region above the lachrymo-maxillary notch (*i. La + Mx*). The snout is broad, the ratio *d/b* in the specimen figured being ca. 1.05, that is as in the holotype of the species. The orbital notches (*i. o*) are short and deep (on the right side of the specimen figured the ratios *l. i. o/b* and *l. i. o/dp. i. o* are ca. 0.28 and 1.90 respectively) and situated close together (*e/b* ca. 0.56). The postorbital division of the fronto-ethmoidal shield is fairly short (*t/r + s* ca. 0.37). The pineal foramen is situated in the foremost part of that division, the pineal fenestra (*fe. pin*) extending forwards to or, as in the specimen figured, a little in advance of the transverse line running through the postorbital corner. The ratio *c/b* in the specimen figured is about 0.23. The short frontal pit-line (*pl. Fr*) in this specimen is situated antero-medially to the postorbital corner, between the posterior parts of the orbital notches, as it sometimes is in specimens from the southern district. As is often the case in specimens from the latter area the dermosphenotic is missing.

The parietal shield (fig. 1 B; cf. JARVIK 1949a, pp. 59—66; Table 1) is of moderate size or relatively large. In the specimen shown in fig. 1 B it measures 17 and in the largest specimen available no less than 32 mm. in length. As in the specimens from the southern district it is short and broad. In the specimen figured the ratios *f/a* and *g/a* are about 1.06 and 1.52 respectively, that is about as in the broadest specimens from the southern district. In some specimens it is a little narrower, proportionately, whereas in others it is broader, the corresponding ratios in the two broadest specimens (these specimens are strongly flattened) being about 1.25 and 1.58. The pit-lines of the parietal shield (*pl. St*, *pl. po. Pa*, *pl. tr. Pa*), have the usual course and extent. The extratemporal is missing, leaving a notch (*i. Et*) in the margin of the shield.

Parts of the external cheek plate (fig. 2; cf. JARVIK 1949a, pp. 68—77; Tables 2 and 3) are represented in three specimens, one showing the jugal (fig. 2 A), one the squamosal and the quadratojugal (fig. 2 B), and one the latter bone alone (fig. 2 C). The jugal, which is 17 mm. long (it is thus comparatively large) and about 1.42 times as long as high, closely resembles the corresponding bone in some of the specimens from the southern district. The same is true of the quadratojugal, which is 10—13 mm. long and about 1.50 times as long as high. The vertical portion of the quadratojugal pit-line (*pl. Qj*) is found a little behind the middle of the bone. The squamosal is 15 mm. long and about 1.32 times as long as high and agrees in these and other respects well with that in the specimens previously described. The dorsal margin presents a shallow notch (*i$_1$spir*), apparently bordering the spiracular fenestra ventro-laterally (cf. JARVIK 1949b, fig. 6 E).

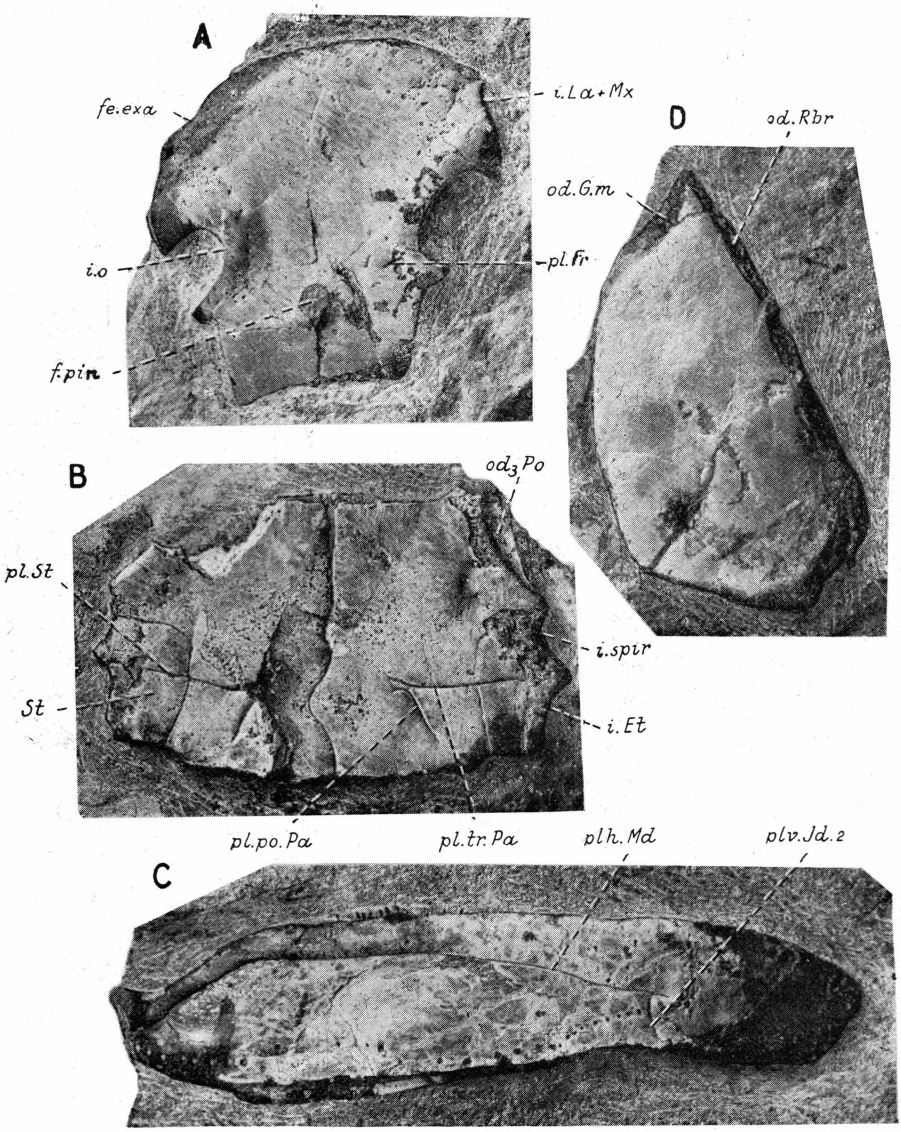

Fig. 1. *Gyroptychius groenlandicus* JARVIK. *A*, fronto-ethmoidal shield, *B*, parietal shield, *C*, lower jaw, and, *D*, principal gular plate. External view. Specimens Nos. P. 1462—P. 1465. From Randbøldalen in the south-eastern part of the Giesecke Bjærge (the area of Kap Franklin), Gauss Halvö, East Greenland. $^9/_4$.

St, supratemporal.

fe. exa, notch indicating position of fenestra exonarina anterior; *f. pin*, pineal fenestra; *i. Et*, notch for extratemporal bone; *i. La+Mx*, lachrymo-maxillary notch; *i. spir*, spiracular notch; *od. G. m*, area overlapped by median gular plate; *od. Rbr*, area overlapped by branchiostegal rays; $od_3 Po$, area overlapped by postorbital; *pl. Fr*, frontal pit-line; *plh. Md*, horizontal part of mandibular pit-line; *pl. po. Pa*, posterior oblique parietal pitline; *pl. St*, supratemporal pit-line; *pl. tr. Pa*, transverse parietal pit-line; *plv. Id. 2*, vertical pit-line of infradentary 2.

In the specimen shown in fig. 2 B the dentine and enamel layers of the squamosal and quadratojugal are partly missing, so that the ornamentation-like bony ridges and tubercles of the trabecular layer are exposed. A similar ornamentation is found in several other dermal bones and in scales. In this connection it may be mentioned that blisters are fairly common in the material available (cf. JARVIK 1949a, pp.

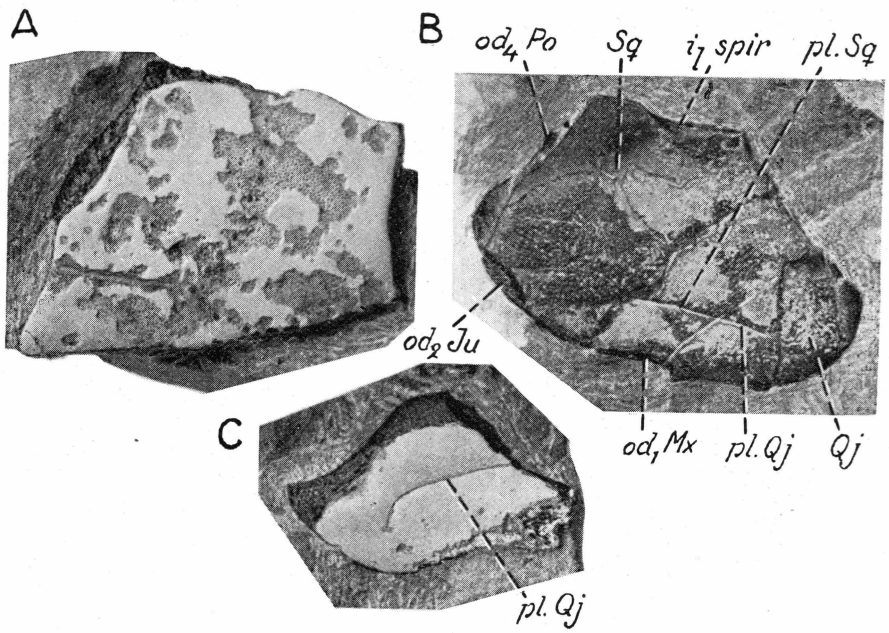

Fig. 2. *Gyroptychius groenlandicus* JARVIK. *A*, right jugal, *B*, left squamosal and quadratojugal, and, *C*, right quadratojugal. External view. Specimens Nos. P. 1470—P. 1472. From Randbøldalen in the south-eastern part of the Giesecke Bjærge, Gauss Halvö, East Greenland. $^3/_1$.

Qj, quadratojugal; *Sq*, squamosal.

^{i}*lspir*, notch probably forming the ventro-lateral margin of spiracular fenestra; $od_1 Mx$, area of squamosal overlapped by maxillary; $od_2 Ju$, area of squamosal overlapped by jugal; $od_4 Po$, area of squamosal overlapped by postorbital; *pl. Qj*, *pl. Sq*, quadratojugal and squamosal pit-lines.

16—24) and in many specimens systems of concentric rings in the dentine layer similar to those found in the Scottish Osteolepids (JARVIK 1948a, p. 33) are clearly seen.

The lower jaw (fig. 1 C; cf. JARVIK 1949a, pp. 77—78; Table 4) is of the ordinary Osteolepid type. The specimen figured measures 45 mm., but considerably larger specimens are represented. As in the specimens from the southern district the vertical pit-line of infradentary 2 (*plv. Id. 2*) is situated far forwards, the ratio k/m being about 2.50.

The principal gular plate (fig. 1 D; cf. JARVIK 1949a, pp. 83—90; Table 6) in the specimen figured is 27 mm. long and about 1.95 times as long as broad. It is thus of the broad type characteristic of the specimens from the southern district and also in other respects it agrees well with the principal gular in the specimens from the latter area. The pit-line of the bone could not be identified with certainty in the specimen figured, but judging from other specimens it is situated about midway between the anterior and posterior ends of the non-overlapped part of the bone.

The remaining dermal bones in the material available (the lateral extrascapular, the opercular, the subopercular, and the cleithrum) agree well with the corresponding bones in the specimens from Canning Land and Wegeners Halvö. The same is true of the numerous scales represented in the material as well.

Remarks.—As may be gathered from the brief description now given some of the specimens of *Gyroptychius groenlandicus* from the area of Kap Franklin are fairly large as compared with those from Canning Land and Wegeners Halvö, and in addition some of the parietal shields are a little broader, proportionately, which, however, mainly seems to be due to flattening. In all other respects the agreement between the specimens from the two districts is very close, and they cannot possibly be referred to different species.

2. Specimens not referable to Gyroptychius groenlandicus.

In addition to the specimens of *Gyroptychius groenlandicus* now described, and some indeterminable remains, the material from the area of Kap Franklin only contains some cleithra, which, however, represent two different types.

One of these cleithra (fig. 3 A) is of the same general type as the cleithra of the *Porolepiformes* known from the Middle Devonian in Wegeners Halvö, Scotland and western Norway (JARVIK 1949a, pp. 116—120; figs. 21 B, 35 A, 36, 37; pl. 21:5; 1949b, fig. 9 A, B; pl. 7:3, 4) and very likely it originates from a form belonging to the *Porolepiformes*. It is higher and slenderer than the cleithrum from Wegeners Halvö (*Porolepiformes?*; see JARVIK 1949 a, p. 120) and as a whole suggestive of those from Scotland and Norway.

The other type of cleithrum (fig. 3 B, C), represented by five specimens, differs from all Crossopterygian cleithra hitherto known, inter alia in having a strong ascending process (*prd. Clm*) at the dorsal end, suggestive of that found in *Polypterus* and in some Actinopterygians (JARVIK 1944, fig. 1). The external face of the bone bears an ornamentation of ridges and tubercles. Along the dorsal part of the anterior margin

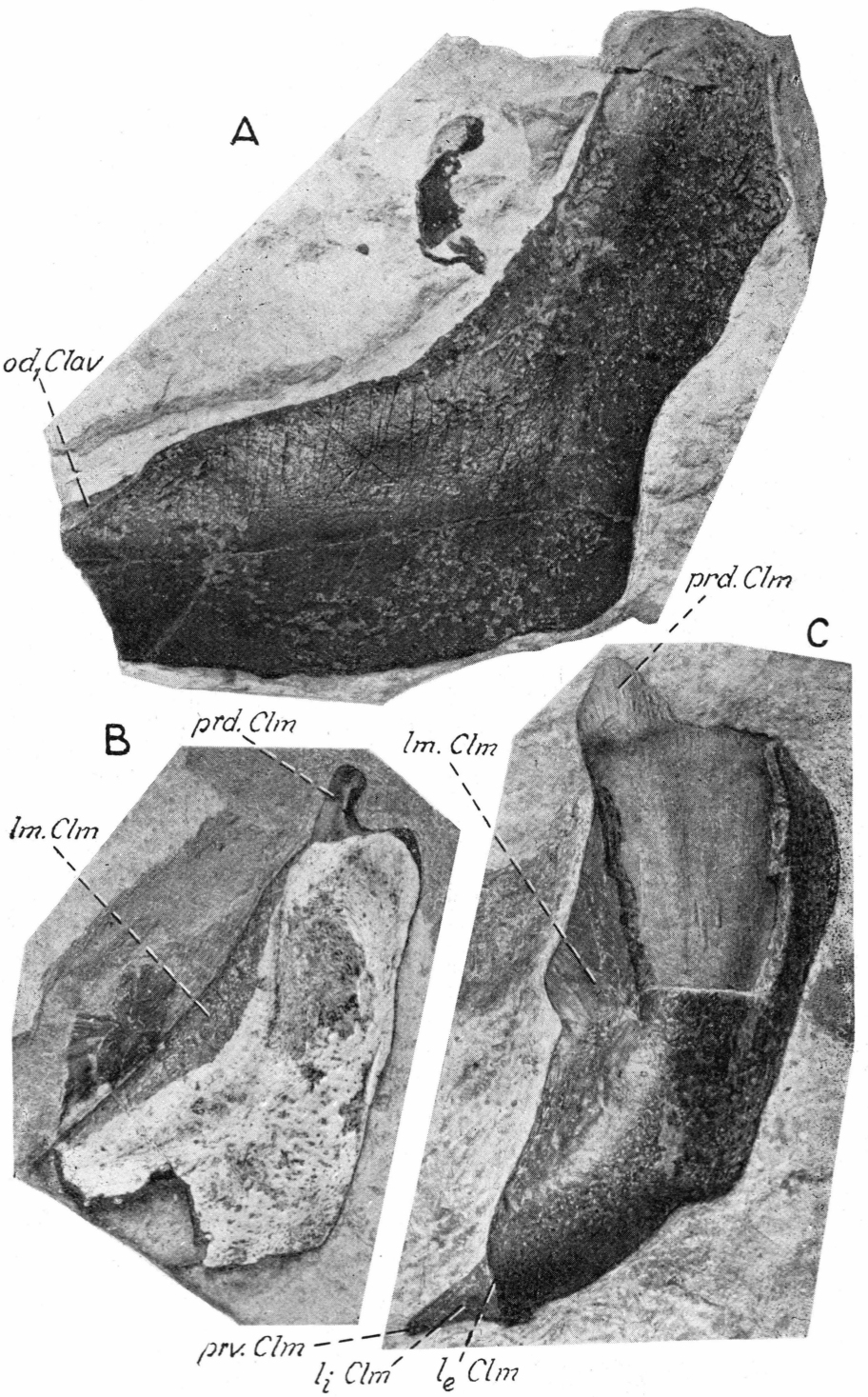

Fig. 3.

is a thin medially directed lamina (*lm. Clm*) which no doubt took part in the formation of the posterior wall of the branchial cavity (cf. loc. cit.). Ventrally to this lamina the anterior part of the bone is split into two laminae, external (l_eClm) and internal (l_iClm). The internal lamina, which was overlapped by the clavicle projects beyond the non-overlapped part of the bone and forms a pointed process (*prv. Clm*; cf. *Polypterus*, JARVIK 1944, fig. 1). Obviously part of the posterior margin of the clavicle was inserted in the groove in the anterior margin of the cleithrum formed between the external and internal laminae. In this respect the conditions are thus exactly opposite to those found in the *Porolepiformes* (JARVIK 1944, fig. 9 A, C, D; 1949a, figs. 36, 37), in which the ventral part of the anterior margin of the cleithrum is received in a groove in the posterior margin of the clavicle.

The peculiar cleithrum just described, which is of a new type, obviously originates from a Teleostomian fish, but it is uncertain whether it belongs to a Crossopterygian.

Fig. 3. *A*, imperfect cleithrum of undetermined *Porolepiformes* in external view. $^2/_1$. *B*, *C*, two imperfect cleithra of Teleostomian fish, at present indeterminable as to group. External view. $^3/_1$. *A*, specimen No. P. 1467; *B*, *C*, specimens Nos. P. 1468, P. 1469. From Randbøldalen in the south-eastern part of the Giesecke Bjærge (the area of Kap Franklin), Gauss Halvö, East Greenland.

l_eClm, l_iClm, external and internal laminae of cleithrum; *lm. Clm*, medially directed lamina of cleithrum, taking part in formation of posterior wall of branchial cavity; od_1Clav, area overlapped by clavicle; *prd. Clm*, *prv. Clm*, dorsal and ventral processes of cleithrum.

III. SUMMARY AND CONCLUSIONS

As may be gathered from the descriptions of fossils now given the continental deposits in the area of Kap Franklin in the south-eastern part of the Giesecke Bjærge contain scales and well preserved and representative cranial remains of *Gyroptychius groenlandicus* JARVIK, a Porolepiform cleithrum of a type known from the Middle Old Red Sandstone in other areas, and several cleithra of a new type.

The presence of unquestionable remains of *Gyroptychius groenlandicus* definitively proves that the continental deposits in the area of Kap Franklin—at any rate the beds which have yielded the fishes now described—are of Middle Old Red Sandstone age and equivalent to the Series with *Gyroptychius groenlandicus* in Canning Land and Wegeners Halvö. Thence it follows that they most probably correspond to the lower part of the Upper Middle Devonian in the marine sequence (cf. JARVIK 1949b; Table 5).

Middle Devonian deposits are consequently now known with certainty from two districts in East Greenland, one southern (Canning Land and Wegeners Halvö) and one northern (the area of Kap Franklin), both situated to the east of the strong fault or zone of disturbances (the Highland Boundary Fault; BÜTLER 1948b; cf. 1948a; pl. 3 and SÄVE-SÖDERBERGH 1934; pls. 5, 9) that forms the eastern boundary of the main Devonian field.

APPENDIX

An Attempt at a Correlation of the Upper Old Red Sandstone of East Greenland with the Marine Sequence.

According to the decision of the Deuxième Congrès pour L'Avancement des Études de Stratigraphie Carbonifère in Heerlen (1935; see JONGMANS & GOTHAN 1937, pp. 4—6) the boundary between the Devonian and the Carboniferous in western Europe was fixed as shown in the following table (Table 1; the boundary marked by double lines).

As demonstrated by this table the uppermost part of the marine Devonian is formed by the Strunien or Etroeungt (the *Wocklumeria* stage; cf. PAECKELMANN & SCHINDEWOLF 1937), which in many areas rests conformably on the Famennien beds and passes over without any break into the overlying Carboniferous (Tournaisien) rocks. Besides in the Rhineland (see also PAUL 1939; BRINKMANN 1948, p. 70, Table), France (Etroeungt) and Belgium (Comblain-au-Pont; cf. GIGNOUX 1943, p. 180; fig. 22), beds of Etroeungt age are known inter alia in England and Wales (the *Cleistopora* zone or zone K, the Lower Pilton beds; EVANS and others 1929; DEWEY 1948, pp. 27—28; KELLAWAY & WELCH, 1948, pp. 19—21; PRINGLE & GEORGE 1948, pp. 51—52), central and eastern U.S.S.R. (e. g. the Upa and Malevko-Murayevnia beds in the Moscow Basin; see Table 2 and SHVETZOV 1937, pp. 6—7; cf. NALIVKIN 1936, p. 581; ROTAI 1937, p. 42; GIGNOUX 1943, pp. 211—214; BRINKMANN 1948, p. 71, Table) and Novaya Zemlya (ALFEROV 1937, pp. 19—20; YERMOLAEV 1937, p. 114). The Etroeungt beds may attain a considerable thickness. The *Cleistopora* zone in England thus exceeds 200 m. in thickness and in Novaya Zemlya the series of strata at least mainly consisting of Etroeungt beds measures almost 500 m.

The fact that the Famennien rocks are overlain by a marine fairly thick sedimentary series of indisputable Devonian age is of considerable interest and we shall now see that this series probably corresponds to the upper part of the Upper Old Red Sandstone of East Greenland (cf. BRINKMANN 1948, p. 71, Table).

The East Greenland Upper Old Red Sandstone has yielded a rich Vertebrate fauna, which, as recently demonstrated (JARVIK 1948b), is clearly of an Upper Devonian type indicating that the deposits, at

Table 1. The position of the Devonian-Carboniferous boundary (double lines) according to the decision of the congress in Heerlen 1935. From JONGMANS & GOTHAN (1937, p. 5).

Historische Gliederung in Deutschland	Neuere Gliederung der deutschen Cephalopodenfazies	Stufenfolge der Cephalopodenfazies	Heerlener Einteilung (1927)	Einstufung des belgisch-französisch-englischen Kohlenkalkes
Kulm bezw. Kohlenkalk	Schichten mit *Pericyclus*, *Münsteroceras* usw.	*Pericyclus*-Stufe	DINANTIEN: Zone à *Pericyclus* = TOURNAISIEN	BASIS DES VISÉEN = C_2
Oberer Clymenienkalk Münsters = Gonioclymenien-Zone Frechs	Hangenberg-Kalk mit *Gattendorfia*, *Protocanites*, *Pseudarietites*, *Paralytoceras* usw.	*Gattendorfia*-Stufe		TOURNAISIEN Z_1-C_1
	Hangenberg-Schiefer mit *Wocklumeria*, *Kalloclymenia* usw	*Wocklumeria*-*Kalloclymenia*-Stufe		STRUNIEN (Ass. d'Etroeungt) = K
	Wocklumer Kalk mit *Wocklumeria*, *Parawocklumeria*, *Kalloclymenia*, *Glatsiella* usw.		DÉVONIEN (au sommet Zone à *Gonioclymenia*)	FAMENNIEN
	Dasberg-Kalk mit *Orthoclymenia*, *Gonioclymenia* usw.	*Orthoclymenia*-*Gonioclymenia*-Stufe		

least mainly, are Upper Devonian in age. This fauna includes Ichthyostegid Stegocephalians, Porolepiform and Osteolepiform Crossopterygians, Dipnoans, Rhynchodipterids, and various Placoderms (*Phyllolepis*, *Bothriolepis*, *Remigolepis*, and *Grönlandaspis*). However, for various reasons most of these forms cannot be used at present for the correlation with the marine Devonian and the determination of the precise geological age of the deposits. In fact, for these purposes we have to rely almost entirely upon the representatives of the genera *Phyllolepis* and *Bothriolepis*, which genera, together with scales of the *Holoptychius*-type (cf. JARVIK 1948b, p. 5), are represented in deposits in other areas, viz. the Psammites et Schistes d'Evieux in Belgium

Table 2. Tentative correlation of the Upper Old Red Sandstone of East Greenland with the marine and continental Upper Devonian in Belgium (mainly after LERICHE 1931), Russia and the Baltic area (after GROSS 1940; 1942; SHVETZOV 1937).

		East Greenland		Belgium and France		U.S.S.R. Moscow Basin, Orel-Woronesch, N.W. part	Baltic area
CARBON.	Tournaisien						
UPPER UPPER DEVONIAN	Strunien		*Grönlandaspis* Series	Ass. d'Etroeungt (France) et de Comblain-au Pont (Belgium)		Upa beds Malevko-Murayevnia beds	
	Famennien	*Phyllolepis* beds *Remigolepis* Series	Upper division	Schistes de la Famenne	Macignos d'Ouffet	Upper variegated series with *Phyllolepis* sp. and *Bothriolepis ornata*.	h beds
			Middle division		Psammites et Schistes d' Evieux: *Phyllolepis undulata*, *Ph. koninckii*, *Bothriolepis lohesti*, etc.		
			Lower division: *Phyllolepis nielseni*, *Bothriolepis nielseni*, etc.		Schistes de Sains	Dankow-Lebedjan beds	
		Phyllolepis Series	Beds with *Phyllolepis orvini*, *Bothriolepis grönlandica*, etc.		Psammites du Condroz: Psammites de Monfort		
					Macignos de Souverain-Pré		
					Psammites d'Esneux		
			Beds with *Bothriolepis jarviki*		Schistes de Mariembourg	Jeletz beds	
					Schistes de Senzeille		

(LERICHE 1931) and the upper part of the Upper Old Red Sandstone (upper variegated series; see Table 2) in the Russian-Baltic Devonian area (JARVIK 1937, pp. 121—122; GROSS 1940; 1942), the geological age of which has been established by correlation with the marine sequence.

In East Greenland the species of *Phyllolepis* and *Bothriolepis* have the following zonal distribution (Table 2; cf. SÄVE-SÖDERBERGH 1934; STENSIÖ 1939; 1948; JARVIK 1948b). The highest beds in which these genera occur are the lower division of the *Remigolepis* Series of SÄVE-SÖDERBERGH, which has yielded *Ph. nielseni* STENSIÖ and *B. nielseni* STENSIÖ[1]). In the upper part of the *Phyllolepis* Series of SÄVE-SÖDERBERGH, about 200—400 m. below the base of the *Remigolepis* Series, there occur beds with *Ph. orvini* HEINTZ and *B. grönlandica* HEINTZ, and somewhat lower beds have yielded *B. jarviki* STENSIÖ[2]).

According to STENSIÖ (1939, p. 25), "*Ph. nielseni* is in certain of its characters somewhat suggestive of *Ph. undulata*", from the Evieux beds in Belgium. It is likely, therefore, that the Evieux beds should be correlated with the lower division of the *Remigolepis* Series rather than with the beds with *Ph. orvini* and *B. grönlandica*, which latter beds, mainly because of the presence of the genera *Phyllolepis* and *Bothriolepis*, were equated to the Evieux beds by SÄVE-SÖDERBERGH (1934, p. 49). The new evidence thus indicates that the *Phyllolepis*-bearing beds in East

[1]) *Ph. nielseni* was described by STENSIÖ (1939) on the basis of material collected by SÄVE-SÖDERBERGH in 1936 in one of the lower horizons of the lower division of the *Remigolepis* Series in Sederholm Bjærg in Paralleldal (cf. SÄVE-SÖDERBERGH 1934). However, in 1948, during the Danish East Greenland Expedition under the leadership of Dr. LAUGE KOCH, I found the species in three localities along the northern coast of Kejser Franz Josephs Fjord, viz. in local talus from the fossiliferous horizon at 372 m. in Nathorsts Bjærg; in local talus near the top of the lower division of the *Remigolepis* Series in the S. W. corner of Wimans Bjærg; and in talus below the eastern part of the Bottom Terrace in Stensiös Bjærg (cf. SÄVE-SÖDERBERGH 1933, pp. 33—35; 1934, pp. 23—25). As evidenced by these new findings, *Ph. nielseni* occurs also in the highest horizons of the lower division of the *Remigolepis* Series. *B. nielseni* (STENSIÖ 1948) is founded on a single specimen obtained from the lower division of the *Remigolepis* Series in Wimans Bjærg. However, additional remains of this form have now been identified in old material from the horizon at 372 m. in Nathorsts Bjærg and accordingly this form as well extends to the top of the lower division of the *Remigolepis* Series.

[2]) The type-locality of *Bothriolepis jarviki* is the Bothriolepis mt. on the north coast of Gunnar Anderssons Land (Ymers Ø) to the west of Zoologdalen (see STENSIÖ 1948, pp. 535, 601). The fossils originate from the lowermost part of the mainly reddish division of the *Phyllolepis* Series of SÄVE-SÖDERBERGH distinguished by BÜTLER (1935; cf. BÜTLER 1948b) as the Kap Graah Series. The horizon with *B. grönlandica* and *Ph. orvini* is in the upper part of the same division. *B. jarviki*, in addition, is known from the following localities (STENSIÖ 1948, pp. 600—601): 1. South coast of Gauss Halvö, about 4 km. to the west of Paralleldal. 2. Bothriolepis cleft, farther to the west. 3. North side of Dusén Fjord, Blaskbjærg. 4. North side of Dusén Fjord, to the west of Zoologdalen. 5. Kongeborgen, Traill Ø.

Greenland are probably a little older than SÄVE-SÖDERBERGH had reason to assume in 1934. This view is supported by the fact that, according to STENSIÖ (1948, p. 606), *Bothriolepis nielseni*, which occurs together with *Ph. nielseni* (cf. footnote 1 on p. 16), among the *Bothriolepis* species hitherto known most closely agrees with *B. cellulosa* and *B. canadensis* from the lowermost Upper Devonian. *Bothriolepis lohesti* from the Evieux beds is too incompletely known to be compared with the other species of the genus (STENSIÖ 1948, p. 515) and therefore of no value in this connection.

Phyllolepis orvini is closely akin to *Ph. woodwardi* from Dura Den in Fifeshire in the Midland Valley of Scotland (STENSIÖ 1939, pp. 8—9), which suggests that the *Phyllolepis orvini* beds in East Greenland and the Dura Den beds are probably about contemporaneous (*B. hydrophila* from Dura Den is of no significance in this connection; cf. STENSIÖ 1948, pp. 504—510). However, since the precise geological age of the Dura Den horizon is unknown[1]), this condition is of no importance for the determination of the age of the East Greenland Upper Old Red.

Among the *Bothriolepis* species known to us at present, *B. grönlandica* seems to be nearest akin to *B. ornata* (STENSIÖ 1948, pp. 585—586), which together with *Phyllolepis* sp. occurs in the upper part of the Upper Old Red Sandstone (upper variegated series) and (?) in the lower part of the h-beds in the Russian-Baltic Devonian area (GROSS 1942, pp. 405, 408; cf. Table 2 and JARVIK 1937, p. 121).

In some respects *Bothriolepis jarviki* resembles *B. grönlandica*, *B. ornata*, *B. panderi* (from the lower part of the Upper Old Red of the Russian-Baltic area), and *B. leptocheira* (from the Heads of Ayr, Scotland), but it is uncertain whether it is related to any of these species (STENSIÖ 1948, p. 600).

On the basis of the facts now set forth, it may be concluded that the lower division of the East Greenland *Remigolepis* Series, which besides *Ph. nielseni* and *B. nielseni* has yielded inter alia the oldest known Ichthyostegids, is probably broadly contemporaneous with the Evieux beds in Belgium

[1]) According to WESTOLL (1940), "the Dura Den horizon is only a little below the accepted base of the Carboniferous" (cf. JARVIK 1948b, p. 3). However, as pointed out by several writers (see MACGREGOR and others 1940; MACGREGOR & MACGREGOR 1948, p. 33; BRINKMANN 1948, pp. 71, 96, tables) it is difficult to decide where the boundary line between the Devonian and Carboniferous should be drawn in the Midland Valley of Scotland, and, as far as I can find (cf. EVANS and others 1929; MACGREGOR & MACGREGOR 1948), it has not yet been definitely established that the fresh-water deposits which in this area form the lowermost part of the "accepted Carboniferous" (the Cementstone Group) really are Carboniferous in age and contemporaneous with the lowermost Carboniferous in the marine sequence given in Table 1.

and that the beds with *Ph. orvini* and *B. grönlandica* correspond approximately to the beds with *B. ornata* and *Phyllolepis* sp. in the Russian-Baltic Devonian. Thence it follows that the lower division of the *Remigolepis* Series in East Greenland is probably Upper Famennien in age. As is then readily seen, the middle and upper divisions of the *Remigolepis* Series and the overlying *Grönlandaspis* Series may very well correspond to the part of the Famennien overlying the Evieux beds, and to the Etroeungt beds, which form the top of the Devonian in the marine sequence. Of course it is possible that the *Grönlandaspis* Series may extend into the Carboniferous, but since evidence for such an assumption is completely lacking, the whole Upper Old Red Sandstone sequence in East Greenland—with reservation for the lower unfossiliferous parts of the *Phyllolepis* Series of SÄVE-SÖDERBERGH—must at present be regarded as Upper Devonian in age.

REFERENCES

Alferov, B. A. 1937. Geological Description of the South-Western Coast of Novaya Zemlya (Kostin Char—Chernaya Gulf). USSR, Int. 17 Geol. Congr. The Novaya Zemlya Exc. Part II, routes.

Backlund, H. G. & Malmqvist, D. 1935. Zur Geologie und Petrographie der nordostgrönländischen Basaltformation. II. Die sauren Ergussgesteine von Kap Franklin. København, Medd. om Grønland, Bd. 95.

Brinkmann, R. 1948. Emanuel Kayser's Abriss der Geologie. II. Historische Geologie. Stuttgart 1948.

Bütler, H. 1935. Die Mächtigkeit der kaledonischen Molasse in Ostgrönland. Mitt. d. Naturf. Ges. Schaffhausen, Bd. 12.

— 1948a. Notes on the Geological Map of Canning Land (East Greenland). København, Medd. om Grønland, Bd. 133.

— 1948b. Die Westgrenze des Devons am Kejser Franz Joseph Fjord in Ostgrönland. Profilkonstruktionen durch das Strindberg Land und den westlichen Teil der Ymer Insel. Mitt. d. Naturf. Ges. Schaffhausen, Bd. 22.

— 1948c. Geological Map of East Greenland (Parts of Ole Römer Land, Hudson Land, Gauss Peninsula, Strindberg Land and Ymer Island). Geodaetisk Institut, København 1948.

— 1949. Über das Vorkommen von Mitteldevon im südlichen Teil der Giesecke-Berge. Vorläufige Mitteilung über Untersuchungen in der östlichen Gauss Halbinsel in Ostgrönland im Sommer 1948. København, Medd. om Grønland, Bd. 150, Nr. 4.

Dewey, H. 1948. British Regional Geology. South-West England. London.

Evans, J. W., and others. 1929. Handbook of the Geology of Great Britain. London.

Gignoux, M. 1943. Géologie Stratigraphique. Troisième Ed. Paris.

Gross, W. 1940. Über das Devon der russischen Tafel. Geol. Rundschau, Bd. 31.

— 1942. Die Fischfaunen des baltischen Devons und ihre biostratigraphische Bedeutung. Korrespondenzbl. d. Naturf.-Ver. zu Riga, Bd. 64.

Jarvik, E. 1937. On the Species of *Eusthenopteron* found in Russia and the Baltic States. Bull. Geol. Inst. of Uppsala, vol. 27.

— 1944. On the Exoskeletal Shoulder-Girdle of Teleostomian Fishes, with special reference to *Eusthenopteron foordi* Whiteaves. Stockholm, K. Vet. Akad. Handl., ser. 3, bd. 21.

— 1948a. On the Morphology and Taxonomy of the Middle Devonian Osteolepid Fishes of Scotland. Stockholm, K. Vet. Akad. Handl., ser. 3, bd. 25.

— 1948b. Note on the Upper Devonian Vertebrate Fauna of East Greenland and on the Age of the Ichthyostegid Stegocephalians. Stockholm, K. Vet. Akad., Arkiv f. Zool.

— 1949a. Middle Devonian Vertebrates from Canning Land and Wegeners Halvö, East Greenland. Part II. *Crossopterygii*. København, Medd. om Grønland, Bd. 96.

JARVIK, E. 1949b. On the Middle Devonian Crossopterygians from the Hornelen Field in Western Norway (In press).

JONGMANS, W. J. & GOTHAN, W. 1937. Betrachtungen über die Ergebnisse des zweiten Kongresses för Karbonstratigraphie. Deuxième Congr. p. l'Avanc. d. Ét. de Strat. Carb. Heerlen 1935. Compte Rendu, T. I. Maestricht.

KELLAWAY, G. A. & WELCH, F. B. A. 1948. British Regional Geology. Bristol and Gloucester District. London.

LERICHE, M. 1931. Les poissons Famenniens de la Belgique. Les facies du Famennien dans la région Gallo-Belge. Les relations entre les formations marines et les formations continentales du Dévonien supérieur sur la bordure méridionale du Continent Nord-Atlantique. Bruxelles, Acad. R. de Belg., Classe de Sci. ser. 2, t. 10.

MACGREGOR, M., and others. 1940. Discussion on the Boundary between the Old Red Sandstone and the Carboniferous. The Advancement of Sci., vol. 1.

MACGREGOR, M. & MACGREGOR, A. G. 1948. British Regional Geology. The Midland Valley of Scotland. London.

MAYNC, W. 1940. Stratigraphie des Küstengebietes von Ostgrönland zwischen 73—75° N. Lat. København, Medd. om Grønland, Bd. 114.

NALIVKIN, D. 1936. Major Divisions of the Paleozoic of the Union of Soviet Socialist Republics. Int. Geol. Congr. Rep. of the 16 Sess., United States of Amer. 1933, Vol. 1. Washington.

PAECKELMANN, W. & SCHINDEWOLF, O. H. 1937. Die Devon-Karbon-Grenze. Deuxième Congr. p. l'Avanc. d. Étud. de Strat. Carb. Heerlen 1935. Compte Rendu, T. 2. Maestricht.

PAUL, H. 1939. Die Etroeungt-Schichten des Bergischen Landes. Berlin, preuss. geol. Landesanst., Jb., Bd. 59.

PRINGLE, J. & GEORGE, T. N. 1948. British Regional Geology. South Wales. London.

ROTAI, A. P. 1937. The Lower Carboniferous of the Donetz Basin and the Position of the Namurian Stage in the Carboniferous System. USSR, Int. 17 Geol. Congr. Abstracts of papers. Moscow.

SHVETZOV, M. S. 1937. Stratigraphy. USSR, Int. 17 Geol. Congr. Exc. to the Moscow Coal Basin. Moscow.

STAUBER, H. 1942. Die Triasablagerungen von Ostgrönland. København, Medd. om Grønland, Bd. 132.

STENSIÖ, E. 1939. On the *Placodermi* of the Upper Devonian of East Greenland. Sec. Suppl. to part 1. København, Medd. om Grønland, Bd. 97.

— 1948. On the *Placodermi* of the Upper Devonian of East Greenland. Part II. *Antiarchi*: Subfamily *Bothriolepinae*, etc. København, Palaeozoologica Groenlandica, Vol. 2.

SÄVE-SÖDERBERGH, G. 1933. Further Contributions to the Devonian Stratigraphy of East Greenland. I. København, Medd. om Grønland, Bd. 96.

— 1934. Further Contributions to the Devonian Stratigraphy of East Greenland. II. Investigations on Gauss Peninsula during the Summer of 1933. With an Appendix: Notes on the Geology of the Passage Hills (East Greenland). København, Medd. om Grønland, Bd. 96.

— 1937. On the Palaeozoic Stratigraphy of Canning Land, Wegener Peninsula and Depot Island (East Greenland). København, Medd. om Grønland, Bd. 96.

WESTOLL, T. S. 1940. In MACGREGOR, M., and others 1940.

YERMOLAEV, M. M. 1937. Stratigraphy of Palaeozoic Deposits on Novaya Zemlya. USSR, Int. 17 Geol. Congr. The Novaya Zemlya Exc. Part I, general. Leningrad.

Færdig fra trykkeriet den 8. februar 1950.