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THE EOTRIASSIC INVERTEBRATE FAUNA OF EAST GREENLAND

BY

L. F. SPATH
D. Sc., F. G. S.

WITH 12 PLATES

KØBENHAVN
C. A. REITZELS FORLAG
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CONTENTS

A. INTRODUCTION

Most of the Triassic material which forms the subject of the present memoir, was collected by the Danish Expedition to Greenland in 1929. In his Preliminary Report[1]) the leader of this expedition, Dr. Lauge Koch, already announced that this material had been sent to me for description. The scientific members of Dr. Koch's expedition who made these collections included Sigurd Hansen, Oskar Kulling, Arne Noe-Nygaard, Christian Poulsen and Alfred Rosenkrantz, the latter being responsible for the labelling of the bulk of the 1929 collections. The Preliminary Report just mentioned also contained a summary by A. Rosenkrantz of his investigations of the Mesozoic strata on the East coast of Greenland. The account of the Wordie Creek Formation (pp. 359—364) included a short description of the Triassic material which had been collected at three localities, namely:— (a) Clavering Island; (b) the north coast of Hold-with-Hope, especially near Cape Stosch; and (c) west of Cape Franklin. In addition to the collections made by the Danish Expedition of 1929, I have before me the material collected by Dr. Lauge Koch in 1927 and already referred to in these memoirs[2]), further the collections brought home by Mr. J. M. Wordie in 1926 and kindly handed over to me for study. These were briefly referred to in Mr. Wordie's account of the "Cambridge Expedition to East Greenland in 1926"[3]). A preliminary note by the writer on the Lower Eotriassic ammonites collected by Mr. Wordie at three localities near Cape Stosch appeared soon after[4]), but some new forms, especially of the genus *Vishnuites*, have remained unfigured and undescribed and the present opportunity is taken of dealing with these also, especially since they have not been rediscovered by the Danish Expedition. Com-

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[1]) Meddelelser om Grønland, vol. LXXIV, 1930.

[2]) Meddelelser om Grønland, vol. LXXIII, pt. 2, 1929, p. 117.

[3]) Geographical Journal, vol. LXX, no. 3, Sept. 1927; Appendix V:— Geology, p. 253.

[4]) Spath, Geol. Mag., vol. LXIV, October, 1927, pp. 474—5.

pared with the Ammonites, of which there are available many hundreds of well-preserved specimens, mostly from the *Ophiceras* horizon, the pelecypods, often sandstone casts, and the few other invertebrates, at first, did not seem to require detailed treatment; they are now included in the account not only for the sake of completeness, but for their stratigraphical interest, as mentioned in a later chapter. A discussion of the affinities of the Greenland fauna as a whole with known Eotriassic assemblages from other parts of the world will also follow the specific descriptions, but attention may here already be directed to the importance of the discovery by A. Rosenkrantz, in the Eotriassic of Greenland, of the genus *Otoceras*, hitherto known only from the Himalayas and from Armenia, if we exclude the very doubtful records from Madagascar and Timor. The importance to geologists and palaeogeographers of the discovery of the original *Ophiceras* fauna is enhanced by the study of the new material and I am very grateful to Dr. Lauge Koch for having entrusted me with its description. My acknowledgements are also due to the Keeper of the Geological Department of the British Museum for giving me all facilities in connection with the working out of the Greenland collections and for allowing me to quote from my MS volume IV of the Catalogue of Fossil Cephalopoda in the British Museum, now in course of preparation.

B. SPECIFIC DESCRIPTIONS

I. *Phylum Mollusca.*

a. Class *Cephalopoda.*

Order *Ammonoidea.*

Family *Otoceratidae*, Hyatt, 1900, emend.

The discovery by Rosenkrantz of the rare *Otoceras* in the Eotriassic of Greenland may justify a detailed discussion of this genus as well as of its family; for it has been questioned whether the Himalayan forms, generally taken to indicate the base of the Eotrias, are really younger than the Armenian species which coexisted with Productids and which have always been believed to be of Permian age. Moreover, in Greenland, *Otoceras* has been found above a bed crowded with fragments of *Ophiceras*. Although these latter are too badly preserved to allow of specific identification, they do not seem to be early types, and while they are comparable to the numerous, well-preserved, forms of the *sakuntala* group, described below, from other localities in East Greenland, they show no resemblance whatever to *Xenodiscus* or *Xenaspis*, as here restricted.

Hyatt[1]) included in Otoceratidae, which he evidently regarded as derivatives of the Glyphioceratids, in addition to *Otoceras* itself, the genus *Anotoceras*, based on "*Prosphingites*" *nala*, Diener[2]).

Hyatt did not define his new genus, and Diener in 1915[3]) listed it as a subgenus of *Prosphingites*. It may, however, be retained, in the present family, for Otoceratids with open umbilicus and rounded or bluntly fastigate venter[4]). Another form of this genus is *Anotoceras*

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[1]) In Zittel's Text-book of Palaeontology. 1st English edition (transl. Eastman), 1900, p. 553.

[2]) Cephalopoda of the Lower Trias. Mem. Geol. Surv. India, Pal. Indica, ser. xv, Himalayan Fossils, vol. II, pt. 1, 1897, p. 54, pl. i, fig. 4 only.

[3]) Fossilium Catalogus i, pt. 8, Cephalopoda triadica, 1915, pp. 36, and 233.

[4]) See *A. kama*, Diener, *loc. cit.* (1897), p. 56, pl. i, fig. 5.

intermedium n. nov. = *Prosphingites nala*, Diener (*loc. cit.*, 1897, *pars*, pl. vii, fig. 13, *non* pl. i, fig. 4) with wider whorl-section and a different umbilical rim.

For the involute, discoidal forms with the periphery and suture-line of the typical *Otoceras*, but without umbilical rim, a new subgenus (***Metotoceras***) is proposed, based on ***M. dieneri***, nom. nov. = *Hungarites* sp. ind. in Diener (*loc. cit.*, 1897, p. 150, pl. xxiii, figs. 5 a—c; *loc. cit.* [1915], p. 154). The separation of this form from *Otoceras* by Diener already in 1897 indicates its peculiar position; and in spite of the doubts thrown upon the affinities of the Armenian forms by Bonnet[1]) I consider it advisable to separate as independent genera ***Prototoceras***, gen. nov.[2]) (genotype *Ceratites trochoides* Abich[3]), as figured by Arthaber, in Frech and Arthaber, "Palaozoicum in Hocharmenien und Persien etc.". Beitr. Pal. Geol. Österr.-Ung., vol. xii, 1900, p. 241, pl. xix, figs. 1 a—d) and ***Discotoceras***[4]), gen. nov. (genotype: — *Hungarites raddei*, Arthaber, *loc. cit.*, 1900, p. 234, pl. xviii, figs. 6 a, b). Their association in the same bed with numerous *Productus* etc., not to mention the persistent *Gastrioceras* (***Pseudogastrioceras***, gen. nov.)[5]) *abichianum* Moeller (as figured in Arthaber, *loc. cit.*, 1900, pl. xviii, figs. 5 a—d) and a fauna entirely different from that of the true *Otoceras* — *Ophiceras* beds of the Lowest Trias, makes it probable that Bonnet[6]) did not sufficiently differentiate between the small Permian forms of

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[1]) "Sur les relations entre les couches à *Otoceras* de l'Arménie et celles de l'Himalaya". C. R. Acad. Sci. Paris, vol. 169, 1919, p. 288.

[2]) Diagnosis:— "More or less involute, smooth, subdiscoidal shells with flared umbilical rim and fastigate venter. Suture-line with undivided external lobe, as in *Anderssonoceras*, but ceratitic lateral lobes and irregularly divided auxiliaries". This genus is morphologically intermediate between *Anderssonoceras* Grabau (which seems to connect Otoceratidae with the Goniatitid main stock) and the more specialised *Otoceras* of the lowest Trias. In the latter the external saddles become modified and the lobes all individualised and toothed.

[3]) "Bergkalk-Fauna aus der Araxes-Enge bei Djoulfa in Armenien". Geol. Forsch. i. d. Kaukas. Länd. pt. i, 1878, p. 14, pl. i, figs. 6, 6 a: pl. xi, figs. 3, 3 a.

[4]) Diagnosis:— "More or less involute, smooth, platycones, with fastigate periphery and sharply marked umbilical rim, and ceratitic suture-line, with broad and low saddles and narrow lobes". The resemblance of *Discotoceras* to the Ceratitid true *Hungarites* is a case of homoeomorphy. *Noetlingites strombecki* Griepenkerl sp. from the lowest Wellenkalk (Mesotrias) is perhaps the species of *Hungarites* in the wider sense that comes closest to *Discotoceras*, but its suture-line has more elements and the inner whorls in the two stocks may safely be assumed to be entirely different.

[5]) Diagnosis:— "Involute, smooth, subglobose goniatites with *Gastrioceras* suture-line, but rounded umbilical border". The absence of coronate inner whorls distinguishes this genus from the true *Gastrioceras*, which also belongs to much earlier beds; it is not connected with *Pseudogastrioceras* by transitional forms.

[6]) "Sur le Permien et le Trias du Daralagöz". C. R. Acad. Sci. Paris, vol. 154, 1912, p. 1741.

his bed 2a and the megalomorph *Otoceras woodwardi* and allies of the Lower Trias.

Hyatt was probably wrong in assuming the ancestor of *Otoceras* to have been an *Anotoceras*-like form, with a rounded venter on which the median keel appeared gradually. The young of *Otoceras woodwardi* and its allies are compressed, discoidal, and have the three keels already well developed at very small diameters; and *Discotoceras* and *Metotoceras* are probably closer to the persisting root-stock than the more specialised *Prototoceras* and *Otoceras*, or the "degenerate" *Anotoceras*. It is therefore probable that Otoceratidae are more correctly placed with the totally different Medlicottids and Sageceratids, as descendants of Prolecanitidae, rather than with a globose "Nannitid" stock. Frech, in including *Otoceras* in the family Xenodiscinae, and J. Perrin Smith, in deriving it from "*Lecanites*", also dissociated the forms here discussed from the involute Glyphioceratid offshoots.

Moreover, it is important to note that *Pseudogastrioceras*, the last goniatite (family Gastrioceratidae) is neither related to Otoceratids nor is it the ancestor of the Paranannitids which are the only Eotriassic stock that could be taken to connect the later Triassic involute stocks with the corresponding developments in the Palaeozoic. Complete involution is probably not a primitive character, nor is a very loose (*Gaudryceras*-like) mode of coiling, although the two dominant stocks that survive the critical periods at the beginning and the end of the Trias (*Ophiceras* and *Psiloceras*), are serpenticones. It is true that the less conspicuous involute *Phylloceras* coexisted with the evolute *Psiloceras*[1]) stock, but its Triassic ancestors, like the persisting and fecund Rhacophyllitids were also evolute, as were those of Otoceratids, and we may thus be justified in dissociating the involute Triassic stocks from similar goniatites.

Genus *OTOCERAS*, Griesbach, 1880.

The genotype is *O. woodwardi* Griesbach[2]) and his diagnosis (in the description of the genotype) well covers the Greenland forms:— "Shell involute, with very deep umbilicus and rapidly increasing outer whorls. The parts of the shell nearest the umbilicus bulged out into an ear-like shape, giving the section of the shell a more or less rhomboidal aspect".

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[1]) Not the direct descendant of *Mojsvarites planorboides* (Gümbel) = ***Eopsiloceras***, gen. nov. (genotype:— *M. planorboides* in Pompeckj, "Ammoniten des Rhät", N. Jb. f. Min. 1895, II, pl. I, fig. 1) as I pointed out in 1914 (Quart. Journ. Geol. Soc. vol. LXXI, p. 352).

[2]) Palaeontological Notes on the Lower Trias of the Himalayas. Rec. Geol. Surv. India, vol. XIII, 1880, p. 106, pl. I, fig. 4.

The *Otoceras* sp. recorded by Welter[1]) from Timor is probably a somewhat homoeomorphous offshoot of the family Columbitidae. The identification of the Madagascan forms recorded by H. Douvillé[2]), which, as Arthaber[3]) has insisted, would not, if rightly interpreted, occur in the same bed with *Tirolites*, seems to require confirmation.

Otoceras aff. *fissisellatum*, Diener.

(Plate I, figs. 1 a—d).

1930. *Otoceras* sp. nov. Rosenkrantz, in Lauge Koch, Preliminary Report etc., p. 360.

The genus *Otoceras* is represented by about a dozen individuals but they are all fragmentary or impressions of body-chambers, and it is not certain that they all belong to one species. The most favourably preserved example, figured in Plate I, figs. 1 c, d, has the following dimensions:—

Diameter in mm.	(90?)	73
Height of the outer whorl (in °/₀ of diameter)		53
Thickness of the outer whorl (in °/₀ of diameter)		37
Umbilicus (in °/₀ of diameter)		14

It consists largely of crystalline calcite, but towards the end of the shell the argillaceous limestone-matrix, replacing the sparry infilling of the septate inner whorls, suggests the presence of the earliest part of the body-chamber. The larger fragment, represented in Plate I, fig. 1 a, consists of the living-chamber only. It is nearly complete, occupying exactly half of the last whorl, and the sigmoidal mouth-border is clearly visible. The umbilicus, at the probable diameter of 170 mm., seems to be smaller than in the first example, amounting to only 12 °/₀; but since the body-chamber is crushed, which also accounts for the flattening of the umbilical ridge, the difference is not considered important, although it is probable that the Arctic species-group of *Otoceras* was as variable as its Himalayan allies. In other words it is possible that if better specimens were available they might be referable to a number of "species", as *Otoceras* species go.

The suture-line is partly visible in the smaller specimen here figured (Plate I, figs. 1 c, d), but the second lateral saddle is incompletely pre-

[1]) "Ammoniten der Unteren Trias von Timor". Pal. Timor, Lief. XI, 1922, p. 149.

[2]) "Sur la découverte du Trias marin à Madagascar". Bull. Soc. Géol. France (4) X, 1911, pp. 125, 660.

[3]) "Trias von Albanien". Beitr. Pal.-Geol. Österr.-Ung., vol. XXIV, 1911, p. 272.

served, although in another example (Plate I, fig. 1 b) it shows the characteristic subdivision found in *O. fissisellatum*, Diener[1]). Unfortunately in this (unfigured) specimen, the outer whorl-side, with the principal elements of the suture-line, is not preserved, but in the first example the main lobes and saddles are in sufficient agreement with those of the Himalayan species to justify provisional reference of the Greenland fragments to Diener's species.

In the sigmoidal course of the radial line and the occasional presence of more distinct striae or obscure bulges there is perfect agreement with the Himalayan forms, but the shape is more compressed than that of *O. woodwardi*, Griesbach[2]). In the smaller example here figured, there are two more spiral ridges than in any of the species figured by Diener, one bordering the depression just outside the umbilical rim and the other accompanying the bevelled ventro-lateral edge on the outer quarter of the whorl-side. This, however, is probably only a matter of preservation and in any case these additional spiral lines are visible on a small example of *O. fissisellatum* in the British Museum (No. C 28503) from Kashmir. It should also be mentioned that the flared umbilical rim is more prominent where the test is preserved and measurements of thickness therefore vary with preservation as well as with size. In the most favourably preserved specimens before me, the configuration of umbilicus as well as of its rim is that found in the holotype of *O. fissisellatum*, but at larger diameters the less raised edge suggests comparison with *O. draupadi*[3]), another member of Diener's *fissisellatum* group.

It will be seen that while it is inadvisable to name the Greenland *Otoceras* or to select any one of the fragments as type of a new species, it is not impossible that on the discovery of better material, the Arctic forms may turn out to represent a species-group of *Otoceras* with its own, local characteristics.

The fragment of the periphery of apparently a large *Otoceras*, listed below from Cape Stosch, is comparable to the fully grown *O. woodwardi* figured by Diener[4]) in having no lateral ridges accompanying the keel and suggesting a similarly inflated whorl-section. The Clavering Island specimen figured in Plate I, fig. 1 a, has the keel far more distinctly separated and the ventral shoulders are marked to the end.

Horizon:— Lower Eotrias, *Otoceras* beds.

Locality:— Hird's Fox Farm, Clavering Island. Danish Ex-

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[1]) "Cephalopoda of the Lower Trias". Mem. Geol. Surv. India, Pal Indica, ser. xv, vol. ii, 1897, p. 163, pl. iii, figs. 3 a—c.

[2]) See Diener, *loc. cit.*, 1897, pl. ii, figs. 1 a—c; pl. iii, figs. 1 a, b.

[3]) Diener, *loc. cit.* (Pal. Indica, ser. xv, vol. ii, no. 1), 1897, p. 164, pl. iv, figs. 3 a, b.

[4]) *Loc. cit.* (Pal. Indica, ser. xv, vol. ii, no. 1), 1897, pl. ii, fig. 1 b, pl. v, fig. 1 b.

pedition, 1929. East of Cape Stosch, in a loose block of the micaceous *Bellerophon*-sandstone, discussed below (Lauge Koch Colln., 1927).

Family *Ophiceratidae*, Arthaber, 1911, emend.

This family includes typical primitive ophiocones, like Prolecanitidae, more rarely platycones, with compressed elliptical whorl-section and usually rounded venters. The ornamentation is generally feeble and the suture-lines are simple, ceratitic, with but few elements.

Of the genera included in this family, *Ophiceras* (with *Acanthophiceras*, Diener, not then separated) and *Vishnuites* were referred by Hyatt[1]) to the family Prionitidae but this must be restricted to the true *Prionites*, Waagen, and some related genera of Upper Eotriassic age.

Glyptophiceras gen. nov., discussed below, including what the writer had previously[2]) referred to as "the second wave of *Xenodiscus*", comprises ribbed *Ophiceras* and is believed to be merely homoeomorphous with the true Permian *Xenodiscus* and the Upper Eotriassic Spitsbergen forms that had also been recorded as "*Xenodiscus? (Danubites?)*". The latter are being dealt with in volume IV of the British Museum Catalogue of Cephalopoda, but since Dr. Hans Frebold[3]) has recently figured some of the commonest species of this group, one of them may be selected as the genotype of the new genus ***Xenoceltites,*** gen. nov. (genotype:— ***subevolutus,*** nom. nov. = *Xenodiscus* cf. *comptoni* Diener, in Frebold, *loc. cit.* 1930, p. 14, pl. III, figs. 1—3)[4]). The opportunity may also be taken of naming yet another heterochronous homoeomorph of *Xenodiscus*, namely the group of forms ranging itself round *Xenodiscus perplicatus*, Frech, for which the new name ***Xenodiscoides,*** gen. nov.[5]) is suggested. This is referred to the family Flemingitidae in which similar suture-lines are found. It should be added that the differences in these ceratitic suture-lines are far less obvious than in the later ammonites; also that the acquisition of ribbing by different stocks is no indication of genetic affinity.

[1]) In Zittel, *loc. cit.* (Text-Book), 1900, p. 556.

[2]) Ammonites from Spitsbergen, Geol. Mag., vol. LVIII, 1921, p. 305.

[3]) "Altersstellung des Fischhorizontes, des Grippianiveaus und des unteren Saurierhorizontes in Spitzbergen". Skrifter om Svalbard og Ishavet, no. 28, 1930.

[4]) *Lecanites* cf. *ophioneus* (non Waagen) and *Danubites* cf. *evolutus* (non Waagen) in Frebold (*loc. cit.*, pl. III, figs. 4—6) also belong to the genus *Xenoceltites* and are discussed in detail in my Trias Catalogue.

[5]) Genotype:— *Xenodiscus perplicatus*, Frech, Lethaea Geognostica Trias, 1905, pl. XXII, fig. 4 (as represented by B. M. No. C 10425) from the Upper Eotrias (Ceratite Marls) of the Salt Range.

Diagnosis:— Discoidal, strongly ribbed shells with rounded or subtabulate venters, resembling inner whorls of *Flemingites*, but without strigation. Suture-line ceratitic, slightly simpler than in *Flemingites*, with entire (lituid) internal lobe.

The genus *Lytophiceras*, gen. nov., instituted for the discoidal forms of the group of "*Ophiceras*" *chamunda* Diener, is separated from the typical serpenticone shells, partly on account of the discovery of a number of new species in East Greenland, partly because *Lytophiceras* is connected with *Prionolobus* on the one hand and *Koninckites* on the other by forms like "*Meekoceras*" *hodgsoni* and "*M.*" *kyoktikum* Diener. It is thus the radical of the two families Gyronitidae (with Kymatitinae, Waagen) and ***Paranoritidae***[1]), fam. nov. with tabulation of the periphery and elaboration of the suture-line respectively.

The Ophiceratidae were probably direct developments of that Prolecanitid stock that also gave rise to the three Upper Permian families ***Paralecanitidae***, fam. nov.[2]) ***Paraceltitidae***, nov.[3]) and Xenodiscidae, Frech. The latter is restricted to what Kittl[4]) included in "*Proceratites*", namely the two genera *Xenodiscus*, Waagen, 1879 (genotype:— *X. plicatus*, Waagen) and *Xenaspis*, Waagen, 1895 (genotype:— *X. carbonarius*, Waagen). The rarity of these Permian genera

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[1]) Substituted for "*Aspiditinae*" Waagen (including *Meekoceratinae*, pars, of Waagen), "*Aspidites*" (= *Clypeoceras*) being preoccupied.

[2]) Diagnosis:— "Smooth ophiocones, with numerous rounded, elliptical whorls and goniatitic suture-line. Ventral lobe divided, but only a single, deep lateral lobe". Based on the genus *Paralecanites* Diener, 1897. This family appears to persist throughout the Permian, and is a forerunner of Ophiceratidae, Arthaber. It has no connexion with Lecanitidae, Arthaber emend. (based on the Neotriassic genus *Lecanites*, Mojsisovics), to which *Paralecanites* has been referred by Arthaber, or with the Eotriassic so-called "*Lecanites*". (See e. g. *Hemilecanites*, gen. nov, p. 89).

[3]) Diagnosis:— "Striate and costate ophiocones, with compressed elliptical whorl-section and with simple suture-line". Includes the genera:— *Paraceltites* Gemmellaro: *Atsabites*, Haniel: ***Epiglyphioceras*** gen. nov. (Genotype:— *Glyphioceras meneghinii*, Gemmellaro: "Fauna dei calcari con Fusulina etc." Giorn. Sci. Nat., ed. Econ. vol. XIX, 1888, p. 92, pl. X, figs. 39—40) and, doubtfully, *Clinolobus*, Gemmellaro.

This family is a specialised branch of the Paralecanitidae and may include in addition to the genera listed, a number of forms that (with our present incomplete knowledge of Permian ammonoids) are wrongly associated with evolute Gastrioceratids or even Agathiceratids. *Clinolobus* included by Diener (1921, p. 10) in Pronoritidae seems to represent an oxynote development of the same stock.

Epiglyphioceras includes compressed ophiocones with elliptical whorl-section, striation or costation and simple gastrioceratid suture-line. This genus is taken to include also *Paralegoceras pseudo-meneghinii*, Haniel (1917, p. 65, pl. XLIX, figs. 4 a—c, 5, 6) which has an additional lobe, and *Glyphioceras gracile* Meneghini (1887, pl. 93, pl. X, figs. 34—38), wrongly referred by Diener (1921, p. 14) to *Nomismoceras*, which connects with *Paraceltites* and *Atsabites*. The resemblance to *Neoicoceras*, Hyatt, apparently a degenerate Gastrioceratid, is believed to be a case of homoeomorphy, the ornamented Paraceltitids being taken to be specialised offshoots of the persisting, smooth Paralecanitids.

[4]) "Cephalopoden d. Ob. Werfener Schichten von Muč in Dalmatien etc.". Abh. K. K. Geol. Reichsanst., vol. XX, 1903, p. 28.

makes comparison difficult but judging by two specimens before me from the Middle *Productus* Limestone (upper zone) of the Salt Range the proportions of the elements of the suture-lines in these flattened forms are different from those of Ophiceratids.

Genus *OPHICERAS*, Griesbach, 1880.

Genotype:— *O. tibeticum*, Griesbach, *loc. cit.*, 1880, p. 109, pl. III, fig. 4 (lectotype): Diener, *loc. cit.*, 1897, p. 105, pl. VIII, fig. 1. (Diener, Catalogue, 1915, p. 211).

Diagnosis:— Compressed, evolute shells with rounded or somewhat sharpened venter, sigmoidal striae of growth, sometimes bundling into ribs, and ceratitic suture-lines.

A genus *Ophiceras* had been proposed by E. Suess in June 1865 (Anzeiger K. K. Akad. Wiss. Wien, p. 112) for the "*fimbriati*" (i. e. the group of *Ammonites fimbriatus*, Sowerby) but it was afterwards thought to clash with *Ophioceras*, Barrande (May, 1865, in explanation to plates = *Ophidioceras*, Barr., in text 1867) and was replaced later in 1865 by *Lytoceras*, Suess (Sitz. B. Akad. Wiss. Wien, LII, p. 78). This last has ever since been in universal use.

The second *Ophiceras* was proposed in 1880 (Griesbach, Rec. Geol. S. India, vol. XIII, p. 109) for a Triassic group of ammonites, and Suess's original *O.* being forgotten, has now also become universally accepted.

The resuscitation of the original *Ophiceras* according to the rules of nomenclature would cause great palaeontological confusion. *Lytoceras* and the family Lytoceratidae are now quoted in every text-book, *Lytoceras* being one of the two fundamental ammonite genera, persisting from the base of the Lias to the Upper Cretaceous. *Ophiceras*, also recorded in most text-books, is Lower Triassic in age, so that from stratigraphical considerations, also, it would be advisable to secure stabilisation of the present use of these two genera. I have therefore applied to the International Commission to standardise the two genera as follows:—

Genus *Lytoceras*, Suess, 1865 (genotype: *Ammonites fimbriatus*, Sowerby, Min. Conchol., vol. II, 1818, pl. CLXIV).

Genus *Ophiceras*, Griesbach, 1880 (genotype: *O. tibeticum*, Griesbach, 1880, p. 109, pl. III, fig. 4).

Metophiceras subdemissum Spath

1. *Ophiceras* aff. *demissum* (Oppel).

(Plate II, figs. 1—7; Plate XII, fig. 1).

1865. *Ammonites demissus*, Oppel: "Über ostindische Fossilreste etc." Pal. Mitteil., IV, 2, p. 290, pl. LXXXVI figs. 1 a—c.

1915. *Ophiceras demissum* (Oppel) Diener, *loc. cit.* (Catalogue), p. 211 (see there for synonymy).
1927. *Ophiceras* aff. *demissum* (Oppel) Spath, *loc. cit.*, Geol. Mag. p. 474.

Oppel's species was based on a small example of somewhat uncertain affinities and I am not satisfied that Diener[1]) was right in considering such forms as the originals of his figs. 1 and 4 (pl. XIV), to represent the adult of the same species. On the other hand the examples figured in Diener's figs. 5 and 6, perhaps also fig. 3, seem to belong to *O. demissum* and there are many Greenland specimens that are apparently referable to the same, micromorph, form.

Going back to Oppel's original figure, especially the enlarged fig. 1 c, which may be taken to show the characteristic features somewhat idealised, it is noticed that apart from the ornamentation, there is a characteristic large lateral lobe, placed nearly at the middle of the side. These two features alone indicate affinity of *O. demissum* with *Glyptophiceras* rather than the *sakuntala*-group and it may be surmised that the transitional example figured in Diener's fig. 1 belongs to one of the more evolute forms of *Ophiceras* like *O. medium*, Griesbach, but not to *O. demissum*. Likewise the two Kashmir examples figured by Diener in 1913[2]) do not belong to Oppel's species, as I interpret it, and are probably specifically distinct or at least transitional in different ways between *O. demissum* and the forms of the *sakuntala*-group.

With the exception of fig. 3, all the specimens here illustrated show part of the body-chamber, the largest example (fig. 1) including exactly half a whorl. There is some variability in the ornamentation, distinctness of the characteristic umbilical slope, and lateral flattening, due to weathering or mode of preservation, but there are no true ribs, and the falciform striation, shown in fig. 2 a, represents about the maximum of ornamentation. The inner whorls are smooth, but occasionally show obscure bulges (fig. 7 a) and it seems to me that the differences in ornamentation among the examples here illustrated are unimportant. Similarly there are slight variations in the dimensions; for example the original of fig. 5, with a diameter of 21 mm., like Oppel's holotype, has a whorl-height of 6.5 mm. and a thickness of 5 mm., instead of 6 and 4 mm. respectively in the Spiti original. By means of graphs these differences could be exaggerated sufficiently to justify the creation of different "species", but I prefer to consider them all as belonging to one form.

The projection of the striation at the periphery suggests comparison

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[1]) *Loc. cit.* (Pal. Indica, Ser. XV, vol. II, no. 1), 1897, p. 121.
[2]) *Loc. cit.* (Pal. Indica, New Ser., vol. V, no. 1), p. 17, pl. I, figs. 8—9.

of this form with *Protophiceras nicolai*, Diener sp.[1]), but this species has not only stronger ribs which are thickened at the umbilical end, but its suture-line shows different proportions.

Horizon:— Lower Eotrias, *Ophiceras wordiei* beds.

Localities:— South-south-west of Cape Stosch (altitude 220—280 m.) and about 4 km. east of Little Finsch Island (altitude about 50 m.) Danish Expedition, 1929. In addition to fourteen isolated specimens there are also some rock-fragments (see Plate XII, fig. 1) crowded with small and therefore somewhat doubtful examples of the present form, many of them converted into white calcite.

2. *Ophiceras greenlandicum* sp. nov.

(Plate I, figs. 2 a, b; Pl. II, figs. 12 a, b; Pl. IV, figs. 5, 12 a, b).

This species may be identical with the Kashmir *Ophiceras* cf. *tibeticum*, figured by Diener[2]). It similarly differs from Griesbach's type in having less numerous volutions and a more rapid increase in whorl-height. The less angular whorl-section, however, with loss of the sharp umbilical edge, at least on the outer whorls, makes it advisable definitely to separate the Greenland form from Griesbach's species, especially since it is represented by a number of specimens. The holotype here figured (Plate II, fig. 12) has the following dimensions:—

Diameter in mm.	85
Height of last whorl (in °/₀ of diameter)	.34
Thickness of last whorl (in °/₀ of diameter)	.26
Umbilicus (in °/₀ of diameter)	.41

It will be seen that the width of the umbilicus is slightly less than that (45 °/₀) of the variety of *O. tibeticum* figured by Diener in 1897[3]), whereas in his later Kashmir example, above cited, it is only 36 °/₀, as in some of the more involute species discussed below. The finely striate, rursiradiate ornamentation also seems to be as variable as in the Himalayan form and in at least one example, with the test partly preserved, there are spiral lines at the umbilical edge. In several examples, the blunt inner nodes of the ribs are as distinctly developed as in Griesbach's type specimen, refigured by Diener, or in a Kashmir example in the British Museum (No. C 28533). The inner whorls of the Greenland form, however, are thin and involute, suggesting affinity to *O. sakuntala*, with which the present species is, indeed, connected by transitions.

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[1]) *Loc. cit.* (Mém. Com. Géol. St. Pétersb., vol. XIV), 1895, p. 19, pl. II, fig. 1

[2]) Triassic Faunae of Kashmir. Mem. Geol. Surv. India, Pal. Indica, N. S. vol. V, no. 1, 1913, pl. I, figs. 4 a, b.

[3]) *Loc. cit.* (Pal. Indica, Ser. XV, vol. II, no. 1), pl. VIII, fig. 5.

The example figured in Plate I, fig. 2 represents one of these passage-forms. Its dimensions are:—

Diameter in mm.	67
Height of last whorl (in °/₀ of diameter)	.37
Thickness of last whorl (in °/₀ of diameter)	.24
Umbilicus (in °/₀ of diameter)	.37

These are almost the same as the proportions of the form here referred to *O. evolutum*, but the absence of a marked umbilical edge in the latter species is characteristic. The sectional view of this example shows the involute inner whorls, with sharpened periphery, and in another example the following dimensions could be obtained:—

Diameter in mm.	11.25
Height of last whorl (in °/₀ of diameter)	.44
Thickness of last whorl (in °/₀ of diameter)	.27
Umbilicus (in °/₀ of diameter)	.24

The narrowly arched ventral area in this specimen persists to a diameter of about 30—35 mm. and then the whorl-section becomes more cordate, as in the typical *O. tibeticum*, the serpenticone inner whorls of which, however, are much more inflated and less flattened[1]). In yet another example, figured in Plate IV, figs. 12 a, b, the cordate, whorl-section, however, is already typically developed at 20—25 mm. diameter.

Horizon:— Lower Eotrias, *Ophiceras wordiei* beds.

Localities:— Most of the typical examples of this species and numerous, more doubtful fragments, are from S. S. W. of Cape Stosch (altitude 220—280 m.). Some impressions from Loc. 4, East of Cape Stosch (altitude 270 m.) may also belong to the present form, further fragments from Mr. Wordie's locality 59.

3. *Ophiceras transitorium* sp. nov.

(Plate II, figs. 10 a, b).

1927. *Ophiceras* sp. nov., Spath, *loc. cit.*, Geol. Mag., p. 474.

The holotype here figured is septate to the end, but, judging by the change in the matrix, the air-chamber at the anterior end (black in the illustration) was the last one, before the body-chamber. The dimensions of this example are as follows:—

Diameter in mm.	48
Height of the outer whorl (in °/₀ of diameter)	.40

[1]) See Diener, *loc. cit.* (1897), pl. VIII, fig. 1 b.

Thickness of the outer whorl (in °/₀ of diameter)	.30
Umbilicus (in °/₀ of diameter)	.35

In a fragmentary, but larger paratype, of about 60 mm. diameter, the dimensions could be obtained at two stages. They are:—

Diameter in mm.	35	50
Height of the outer whorl (in °/₀ of diameter)	.40	.41
Thickness of the outer whorl (in °/₀ of diameter)	.27	.26
Umbilicus (in °/₀ of diameter)	.32	.33

The whorl-section is first compressed, elliptical, later more cordate, on account of the development of a high umbilical slope. The venter is evenly arched but after about 35 mm. diameter, there is a suggestion of sharpening of the periphery. The ventral area of the holotype, shown in Plate II, fig. 10 b, has suffered from corrosion; but there are several fragments and transitions to the more compressed and more definitely fastigate form described below as *Vishnuites decipiens*, that make it probable that in the holotype of the present species the periphery tended to sharpen. It seems possible that the body-chamber became rounded once more, before the end, and in any case, in the more typical forms of *Vishnuites* the inner whorls are at least as strongly keeled as the outer. We know that carination in any given stock of ammonites does not appear first on the body-chamber and then affect successively earlier whorls, as was once believed; but the keel is formed in the young and does not, at first, persist to the adult stage.

The suture-line has small external and large lateral saddles, also a deep first lateral lobe. It is comparable to that of *O. greenlandicum* and that of the *Ophiceras* fragment figured by Diener[1]) as *Prionolobus* (?) sp. ind.

A densiseptate half of an example with greater compression than the type, represents a transition to *Vishnuites decipiens*, but the periphery is even less fastigate than in the more typical specimens. It is further evidence in favour of including the present form in the genus *Ophiceras*.

It is probable that the densiseptate, immature example figured in Plate V, fig. 10 represents the young of the present species. At first sight it seems to be more nearly allied to the more compressed and more involute *O. wordei*, but the umbilical suture bisects the first lateral saddle so that it belongs to a more loosely coiled form. The other species here described are more sparsiseptate, especially at that stage, and thus less closely comparable.

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[1]) *Loc. cit.* (Pal. Indica, 1897), pl. vii, figs. 14 a—c.

Horizon:— Lower Eotrias, *Ophiceras* (*Vishnuites*) beds.

Localities:— East of Cape Stosch (*loc.* 59, J. M. Wordie Colln., and *loc.* 4, Danish Exp., 1929).

Subgenus *Lytophiceras*, nov.

Genotype:— *Ophiceras chamunda*, Diener, *loc. cit.* (Pal. Indica, Ser. xv, vol. II, no. 1), 1897, p. 123, pl. XII, figs. 3 a, b.

Diagnosis:— Compressed, more or less involute, discoidal developments of *Ophiceras*, without its high umbilical rim and tending towards *Koninckites*. Suture-line as in *Ophiceras*, without conspicuous auxiliaries. Lower Eotrias, *Otoceras* beds.

Lytophiceras evolutum and allies, described below, are somewhat transitional between the restricted genus *Ophiceras* and *Lytophiceras*, and even *L. sakuntala*, on account of its distinct umbilical rim, might still be included in *Ophiceras*. On the other hand there are several new and rather distinct species from East Greenland which make it desirable to give the discoidal offshoots a separate subgeneric name. Waagen's *Gyronites vermiformis* (Salt Range Fossils, vol. II, Pal. Indica, Ser. XIII), 1895, p. 305, pl. XXXIX, figs. 1 a—d) and "*Lecanites*" *planorbis* (*ibid.*, p. 278, pl. XXXIX, figs. 3 a—c, which may be only a worn example of the former species) might be thought to be degenerate derivatives of the present genus, but on account of their later age are referred (with *Prionolobus*) to the family Gyronitidae.

1. *Ophiceras* (*Lytophiceras*) *sakuntala*, Diener.

(Plate II, fig. 8: Pl. IV, figs. 7 a, b).

1897.	*Ophiceras*	*sakuntala*,	Diener,	*loc. cit.* (Pal. Indica, Ser. XV, vol. II), p. 114, pl. X, figs. 1—7, pl. XI, figs. 1, 2, 4.
1915.	—	—	—	*loc. cit.* (Catalogue), p. 212 (see there for synonymy).
1927.	— aff.	—	—	Spath, *loc. cit.*, Geol. Mag., p. 474.
1929.	—	—	—	Lauge Koch, *loc. cit.* (Geol. of East Greenland), p. 113.
1930.	—	—	—	Rosenkrantz, *loc. cit.* (Prelim. Report), p. 361.

This well-known species is not nearly so common in the Greenland collections before me as the very similar *O. commune*, described below, which differs chiefly in its involute, compressed, inner whorls, with a narrow, almost sharpened, periphery and smooth and flat whorl-sides.

Such examples of the present form as that figured by Diener in fig. 7 (pl. x) indeed suggest affinity with *O. commune* or its allies rather than *O. sakuntala*, for in a metatype from the Shalshal Cliff (British Museum No. C 28526), at that diameter, the characteristic umbilical slope is already very distinct. On comparison of Plate II, fig. 8 and Plate IV, fig. 3 a, it will be seen that the absence of this high umbilical slope in *O. commune* causes its whorl-sides to appear as high and as flat as those of *O. evolutum*.

The example figured in Plate IV, figs. 7a, b, is a transition to *O. ptychodes*, in having a less distinct umbilical edge, but the folds are as yet very obscure. It leads directly to the specimens represented in Pl. IV, fig. 4 and Pl. V, fig. 3. In other examples, the loss of the characteristic umbilical slope causes transitions to the species here described as *O. commune* and *O. evolutum* and the numerous passage-forms between these and *O. greenlandicum* (Pl. III, fig. 4).

The two examples figured in Plate VIII, figs. 11, 12, may be provisionally attached to *O. sakuntala*, since they resemble the form figured by Diener (1897) in his figs. 5a, b. The folds are unusually pronounced and the constrictions between them are almost as distinct as in the much later Spitsbergen *Xenoceltites*, or in the Ussuri form that Diener[1]) compared to Waagen's *Dinarites minutus*[2]). The high, umbilical slope, however, and the *Ophiceras* suture-line show that the two Greenland examples belong to the *sakuntala* group, even if the smaller umbilicus (like Diener's fig. 3) may also suggest reference to *O. chamunda*, as here restricted. The two specimens came out of a concretion, found loose at Cape Stosch (altitude 300 m.), but there are other fragments of the present form in the same rock (with *Otoceras*? and *Bellerophon*) and it is clear that its horizon is within the *Otoceras* beds.

Horizon:— Lower Eotrias, *Otoceras*? beds (*Bellerophon* Sandstone) and *Ophiceras wordiei* beds.

Localities:— S. S. W. of Cape Stosch (*loc.* no. 47, J. M. Wordie Coll., and altitude 220—280 m., Danish Exp. 1929); also from Cape Stosch (loose block, Lauge Koch Coll. 1927).

2. *Ophiceras* (*Lytophiceras*) *chamunda*, Diener.

(Plate IV, figs. 1 a, b, 8 a, b).

1897. *Ophiceras chamunda*, Diener, *loc. cit.* (Pal. Indica, ser. xv, vol. II), p. 123, pl. XII, figs. 1—4.
1915. — — — *loc. cit.* (Catalogue), p. 211.

[1]) *Loc. cit.* (Mém. Com. Géol. St. Pétersb.), 1895, p. 15, pl. II, fig. 6.

[2]) Fossils from the Ceratite Formation. Salt Range Fossils, vol. II, Pal. Indica, Ser. XIII, 1895, p. 31, pl. VII a, figs. 1—2.

This species was originally based on the elliptical shape of the conch, but Diener expressly stated that in the typical form, the whorl-sides passed quite regularly and with a gradually increasing curve into the low umbilical wall. Diener repeated in 1913[1]) that this species might be considered as an elliptical variety of *O. sakuntala*, but the Kashmir example then figured (pl. I, fig. 7) agrees neither with what I would consider the type of *O. chamunda* (Diener's figs. 3a, b, perhaps also fig. 4 of his pl. XII) from the Shalshal Cliff, nor with the transitions to *O. sakuntala*, like his fig. 1 and especially fig. 2. At least, judging by a typical Spiti example of *O. chamunda* before me (British Museum No. C 28529), intermediate in size between Diener's figs. 3 and 4 (diameter = 62 mm.), the species seems separable from *O. sakuntala* on account of its more compressed, more discoidal whorl-shape, and its flatter sides, apart from the elliptical distortion which is found in other Himalayan species of *Ophiceras* and even other genera.

The example figured in Plate IV, figs. 1a, b, shows unusually distinct striae of growth crossing the rounded umbilical slope, exactly as in Diener's fig. 2a (pl. XII), and it similarly includes almost half a whorl of body-chamber. But its suture-line has a less deep first lateral lobe and the two branches of the external lobe end in single points. In other examples, however, including the specimen figured in Plate IV, fig. 8, there is good agreement with the suture-lines illustrated by Diener, although the resemblance is equally close in the case of *O. commune*, especially in the tendency to broaden the saddles.

Horizon:— Lower Eotrias, *Ophiceras wordiei* beds.

Locality:— S. S. W. of Cape Stosch (altitude 220—280 m., Danish Exp., 1929).

3. *Ophiceras* (*Lytophiceras*) *ptychodes*, Diener.

(Plate IV, figs. 4 a, b; Pl. V, figs. 3 a, b).

1897. *Ophiceras ptychodes*, Diener, *loc. cit.* (Pal. Indica, ser. XV, vol. II), p. 120, pl. XI, figs. 3, 5, 6.
1915. — — — *loc. cit.* (Catalogue), p. 212.

This species was aptly characterised as perhaps only a variety of *O. sakuntala*, with stronger, falciform ribs, continuous across the periphery. In the example figured in Pl. IV, figs. 4a, b, the peripheral ribbing is as distinct as in Diener's fig. 3b, but the umbilicus is only slightly smaller whan the whorl-height. It appears, moreover, that excentrumbilication is common in this species (see Diener's fig. 6a) and in a typical Kashmir example of *O. ptychodes* (British Museum, No. C 28531), the

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[1]) *Loc. cit.* (Pal. Indica, N. S., vol. V, no. I), p. 17.

width of the umbilicus is considerably in excess of the whorl-height. Diener's[1]) statement that the diameter of the umbilicus was considerably inferior to the height of the last whorl, is thus applicable only to the original of his pl. xi, fig. 3, and to his later Kashmir example (pl. i, fig. 6), while the majority of specimens seem to be merely coarser or more strongly ribbed examples of the Kashmir variety of *O. sakuntala*, represented in Diener's fig. 2 (1913). It ought to be added that, while, as Diener says, transitional forms connecting *O. sakuntala* and *O. ptychodes* are commoner in Kashmir than the typical forms, the Pastannah example already referred to (No. C 28531), in the unusual strength of its ribs, might almost be compared to *Glyptophiceras aequicostatus*, Diener sp.[2]).

The example figured in Plate V, figs. 3a, b, is one of the passage-forms to *O. sakuntala*, and connects directly with the specimen illustrated in Plate IV, figs. 7a, b. The periphery tends to widen and the outer whorl of *O. ptychodes* may be comparatively inflated ventrally, so that the separation of even fragments from the more trigonal-whorled *O. greenlandicum* may be easy, if they are sufficiently well preserved.

The suture-line of the Greenland example figured in Plate V, fig. 3 agrees with that given by Diener (pl. xi, fig. 6c), even to the presence of an extra notch on the siphonal side of the external saddle.

Horizon:— Lower Eotrias, *Ophiceras wordiei* and *Vishnuites* beds.

Localities:— S. S. W. of Cape Stosch (altitude 220—280 m., Danish Exp., 1929) and 10 miles East of Cape Stosch (*loc.* 59, J. M. Wordie Colln.).

4. *Ophiceras* (*Lytophiceras*) aff. *evolutum*, Frech and Noetling.

(Plate III, figs. 1, 4 a, b).

1903. *Ophiceras sakuntala*, Diener, var. *evoluta*, Frech and Noetling, *loc. cit* (Lethaea palaeoz.), p. 634 f, figs. 1 a, b.

1913. — — — var. *evoluta*, Frech; Diener, *loc. cit.* (Pal. Indica, N. S., vol. v, no. 1), p. 15.

1915. — — — var. *evoluta*, Frech; Diener, *loc. cit.* (Catalogue), p. 212.

1927. — aff. *evolutum*, Frech; Spath, *loc. cit.* (Geol. Mag., vol. LXIV), p. 474.

The dimensions of the large example here figured in Plate III, fig. 1 and of Frech and Noetling's holotype are as follows:—

[1]) *Loc. cit.* (Pal. Indica, N. S., vol. v, no. 1), p. 16.

[2]) *Loc. cit.* (Pal. Indica, N. S., vol. v, no. 1), pl. ii, figs. 10 a, b.

	Pl. III, fig. 1.	Holotype
Diameter in mm.	96	93 (62)
Whorl-height (in $^0/_0$ of diameter)	.38	.35
Whorl-thickness (in $^0/_0$ of diameter)	.23	.15 (?)
Umbilicus (in $^0/_0$ of diameter)	.36	.40

Apart from the slightly smaller umbilicus, the Greenland example shows a greater whorl-thickness, but it seems probable that the original drawing in the Lethaea is diagrammatic. In any case the absence of a distinct umbilical edge, the less trigonal whorl-section, and the correspondingly broader periphery link the species here discussed with *O. evolutum*, but the radial line of this as well as of *O. sakuntala* (in Frech and Noetling, *loc. cit.*, 1901, p. 634 f., fig. 2) has been wrongly drawn by the artist (and the ribbing exaggerated).

On the other hand, the Greenland form here described is connected with *O. commune* by numerous transitions of which the example figured in Plate III, figs. 4a, b, is one. Its umbilical width is still 36 $^0/_0$ of the diameter, but the edge is distinct. Its inner whorls show perfect agreement with the immature *O. commune* figured in Plate II, fig. 9a (enlarged × $2^1/_2$). Since the umbilical slope is more conspicuous, it may also be held to be a transition to *O. greenlandicum*, but this is much more inflated. In *O. sakuntala* the whorl-sides are also narrower and less flattened but in thickness it is intermediate between *O. greenlandicum* and the transitional example here discussed.

Horizon:— Lower Eotrias, *Ophiceras wordiei* beds.

Locality:— S. S. W. of Cape Stosch (altitude 220—280 m., Danish Exp., 1929, and J. M. Wordie Colln., no. 47).

5. *Ophiceras* (*Lytophiceras*) *kochi* sp. nov.

(Plate IV, figs. 10 a, b).

The complete holotype of this species here figured shows over half a whorl of body-chamber and a sinuous mouth-border, with the rim slightly expanding. The specimen is crushed on the matrix so that the thickness cannot be accurately determined, and the inner whorls are missing; but by its narrowly arched, compressed periphery, combined with unusually distinct ribbing, this species is easily distinguished from all other described Ophiceratids.

The dimensions of the holotype are as follows:—

Diameter in mm.	84
Height of the outer whorl (in $^0/_0$ of diameter)	.36
Thickness of the outer whorl (in $^0/_0$ of diameter)	.18 (?)
Umbilicus (in $^0/_0$ of diameter)	.39

The whorl-sides are almost flat, with a low umbilical wall and obscure folds, as in *O. ptychodes*, but confined to the outer half. These ribs are gently sigmoidal and are continued across the almost acute venter by irregular striae. The periphery is partly crushed but, where intact, it shows the original sharpness except near the aperture where the venter tends to widen, as in *O. ptychodes*.

The suture-line is essentially the same as that of *O. commune*, with the auxiliary lobe similarly confined to the umbilical wall.

There is superficial resemblance to some "*Ophiceras*" described from Timor, but belonging to a later stock. These ***Pseudoflemingites***, gen. nov. based on ***P. timorensis***, nom. nov.[1]) (= *Ophiceras nopcsanum*, Welter, pars, p. 104, pl. IV, figs. 4—5 only, non figs. 1—3)[2]) are more nearly related to the contemporary Flemingitids and the Timor "*Xenodiscus*" also are partly *Xenodiscoides*, partly Kashmiritids.

Horizon:— Lower Eotrias, *Ophiceras wordiei* beds.

Locality:— S. S. W. of Cape Stosch (altitude 220—280 m., Danish Exp., 1929).

6. *Ophiceras* (*Lytophiceras*) *commune* sp. nov.

(Plate II, figs. 9 a—d, 13—14; Pl. III, figs. 3 a, b; Pl. IV, figs. 3 a, b, 11 a, b).

1927. *Ophiceras* aff. *sakuntala*, Diener; Spath, *loc. cit.* (Geol. Mag.), p. 474 (pars).

This species is the commonest ammonite in the Greenland collections before me, being represented by hundreds of well preserved specimens and fragments. It may be briefly defined as differing from the well-known *O. sakuntala* in its discoidal, compressed and involute inner whorls, without umbilical rim, and in the appearance of the latter only on the outer whorl. The complete example with body-chamber and apertural rim, figured in Plate III, figs. 3a, b, may be taken as the holotype. It compares as follows with the lectotype of *O. sakuntala* (Diener's, pl. x, figs. 1, 1a) discussed above:—

	Pl. III, figs. 3 a, b	*O. sakuntala*
Diameter in mm.	73	69
Height of outer whorl in mm.	30 (= 41 %)	30 (= 43 %)
Thickness of outer whorl in mm.	18 (= 24 %)	15.5 (= 22 %)
Umbilicus in mm.	21 (= 29 %)	21 (= 30 %)

The Himalayan form is thus slightly more compressed, but the difference is only apparent, not real, for the mouth-border is often

[1]) Diagnosis:— Serpenticone, discoidal, shells with costation as in *Xenodiscoides*, or strigation as in megalomorph *Flemingites*, but with very evolute, smooth inner whorls and simple Flemingitid suture-line. Family Flemingitidae.

[2]) Palaeontologie von Timor, Lief. XI, 1922, "Ammoniten der Unteren Trias".

slightly "flared", i. e. the aperture widens out suddenly. The peristome may be plain, or it may be preceded by a faint constriction, or by one or two indistinct folds, but nothing so extreme has been observed as in the case of *O. stricturatum* Frech and Noetling[1]). It is probable, however, that the constricted aperture of even this form does not constitute a specific character.

In the smaller example, figured in Plate IV, fig. 3, the proportions have been measured on successive whorls, as shown in the following table:—

At diameter of (mm.)	6	10	17.5	27	38	55
Whorl-height (in % of diameter) ...	.38	.43	.45	.45	.45	.40
Thickness (in % of diameter)	.30	.27	.25	.27	.27	.26
Umbilicus (in % of diameter)	.30	.27	.25	.27	.29	.32

The inner whorls of this example are figured separately in Plate II, fig. 9 (enlarged $\times 2^{1}/_{2}$), to show the suture-lines which are still goniatitic, the very fine toothing of the lobes not being distinct until a diameter of between 20 and 25 mm. is reached. The septa are very distantly spaced on the inner whorls, there being only 7 at 3 mm. and 9 at 6 mm. diameter. They have increased to 16 at 12 mm. and to 22 at 17.5 mm., whilst there are 26 on the last septate whorl, up to the beginning of the body-chamber. If young examples like that figured in Plate IV, figs. 11a, b are correctly referred to the present species, then there is the greatest variability in this spacing of the septa, but it is impossible in the absence of the outer whorls, definitely to assign these immature specimens to the various forms of *Lytophiceras* here described.

The suture-line is very simple at small diameters (see Plate II, figs. 9b, c, taken at diameters of 3 and 7 mm. respectively). In the adult, the rise of the siphonal saddle (in the external lobe) and the contraction of the first lateral lobe are the only notable changes; there is fine toothing of all the lobes, except the dorsal (internal) lobe, which is bifid. In some of the examples the umbilical lobe tends to become angular, the serrated crest which includes the low auxiliary saddle (across the umbilical suture) ending in two sharp points where it joins the bases of the second lateral saddle on the one hand and of the dorsal saddle on the other (see Plate II, fig. 14).

Horizon:— Lower Eotrias, *Ophiceras wordiei* beds.

Localities:— S. S. W. and East of Cape Stosch (Lauge Koch Colln., 1927, Danish Exp., 1929, and J. M. Wordie Colln., localities 47 and 59). The poorly preserved *Ophiceras* from Clavering Island and from west of Cape Franklin probably also include the present species.

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[1]) Lethaea palaeozoica, vol. II, pt. III, 1901, p. 634 f., fig. 3.

7. *Ophiceras* (*Lytophiceras*) *wordiei* sp. nov.

(Plate V, figs. 1, 2, 9; Pl. VI, figs. 1—2).

1927. *Ophiceras* sp. nov., Spath, *loc. cit.* (Geol. Mag.), p. 474, pars.

This form, which may be briefly characterised as a compressed, discoidal, more involute, development of *O. commune* is almost equally abundantly represented. As holotype may be taken the example figured in Plate V, figs. 2a, b, of the following dimensions:—

Diameter in mm.	77
Height of the outer whorl (in °/₀ of diameter)	.43
Thickness of the outer whorl (in °/₀ of diameter)	.22
Umbilicus (in °/₀ of diameter)	.25

It is complete to the aperture and the body-chamber comprises almost exactly half of the outer whorl. The section is compressed, with its greatest thickness at about the middle of the side. The umbilical slope is well rounded and the edge not distinct. Before reaching the narrowly-arched periphery, the flattened sides are distinctly compressed so as to form almost a spiral depression. This can be seen at the lower end of fig. 2b, but the aperture, on account of the matrix present, seems more elliptical in the same figure, and the venter appears too broad. There are only faint traces of sigmoidal lines of growth on the holotype-cast, but examples with the test preserved show the extremely fine lineation somewhat more distinctly. The peristome follows the course of these lines of growth, but it may be flared or accompanied by faint constrictions or folds. There is evidence of excentrumbilication, as in the more inflated variety figured in Plate V, fig. 1 which also shows considerable irregularities in the peripheral curve. The inner whorls, thus, are comparatively more involute than the outer, so that smaller examples like those figured in Plate VI, figs. 1—2, appear to be transitional to the still more involute form described below as *O. subkyokticum*.

The suture-line is similar to that of *O. commune* but correlative with the higher whorls, the second lateral saddle and the auxiliary lobe tend to widen. In the umbilicus, only these two elements are visible, with, perhaps, the second lateral lobe where the umbilicus becomes excentric, or in such transitions to *O. commune*, as that figured in Plate V, figs. 9a, b. In the other forms of *Ophiceras* described above, the first lateral saddle is also visible in the umbilicus.

Horizon:— Lower Eotrias, *Ophiceras* beds.

Localities:— S. S. W. of Cape Stosch (altitude 220—280 m., Danish Exp., 1929, and J. M. Wordie Colln., locality 47), also 10 miles east of Cape Stosch (J. M. Wordie Colln., loc. 59).

8. *Ophiceras* (*Lytophiceras*) *sybkyokticum* sp. nov.
(Plate V, figs. 4—8; Pl. VI, figs. 3—8).

1927. *Koninckites* sp. nov. aff. *kyokticus* (Krafft); Spath, *loc. cit.* (Geol. Mag.), p. 474.

This species, formerly referred to *Koninckites*, is still more compressed, discoidal, and more involute than *O. wordiei*; there is only one (true) lateral saddle, the second being already inside the line of involution, and typically only the auxiliary lobe is visible in the umbilicus. The dimensions of three typical examples are as follows:—

	Pl. V, fig. 4	Pl. V, fig. 5	Pl. VI, fig. 7
Diameter in mm.	22	33	50
Height of the outer whorl (in % of diameter)	.51	.51	.52
Thickness of the outher whorl (in % of diameter)	.23	.24	.24
Umbilicus (in % of diameter)	.12	.12	.14

The whorl-section is greatly compressed, with flat sides and a low umbilical wall having a rounded edge. The periphery is so narrowly arched as to appear almost acute, but there is no sign of flattening or truncation in any of the numerous examples available. The sides of casts are smooth, but fine striae of growth may be present on the test. The inner whorls are very involute but show fine concentric coiling in the umbilicus (see Plate V, fig. 5a). At a still smaller diameter, the coiling is comparatively less close and the septa are very distantly spaced. The nucleus represented in Plate V, fig. 8 (enlarged × $2^1/_2$) shows the irregularities in the septation, but it includes already part of a (temporary) body-chamber. In larger examples the umbilicus may begin to open out again (20 % in the examples represented in Plate VI, figs. 4 and 6) or especially on the body-chamber, and there are then produced passage-forms to *O. wordiei* (Plate VI, fig. 3). In two other transitional examples (Plate V, fig. 6 and pl. VI, fig. 8) the umbilicus is less excentric, but wider than in the type. These two specimens, on account of their increased whorl-thickness connect directly with *O. wordiei* and not with the compressed transitional varieties figured in Pl. VI, figs. 1 and 2. In the specimen represented in Pl. V, figs. 7a, b, there are unusually pronounced sigmoidal folds, almost as in *O. ptychodes*.

The suture-line has the peculiar, depressed second lateral (or first auxiliary) saddle, with a flat top, found in *Meekoceras kyokticum*, v. Krafft[1]) and in *M. hodgsoni*, Diener[2]). The latter species, with its truncate periphery, belongs to a different stock, but *M. kyokticum* is

[1]) In Krafft and Diener, *loc. cit.* (Pal. Indica, Ser. xv, vol. vi, no. 1), pl. ii, fig. 8.
[2]) See *ibid.*, fig. 9.

so closely similar that I at first compared the Greenland form to this Himalayan species. After examining many specimens of the latter form, however, and the numerous transitions by which it is linked to *O. wordiei* I think it best to separate the Greenland species, even generically, since *M. kyokticum* seems to belong to the group of *Koninckites* ***kraffti*** nom. nov. (= *Meekoceras varaha*, Diener, in Krafft and Diener)[1]) in which the individualised teeth in the auxiliary series or else the tabulation of the periphery already indicate affinity with the typical *Koninckites* of the Lower Ceratite Limestone.

Horizon:— Lower Eotrias, *Ophiceras wordiei* beds.

Localities:— S. S. W. of Cape Stosch (altitude 220—280 m., Danish Exp., 1929 and J. M. Wordie Colln., locality 47), also 10 miles east of Cape Stosch (J. M. Wordie Colln., no. 59).

Sub-genus *Acanthophiceras*, Diener, 1916.

Genotype:— *Trachyceras* (?) *gibbosum*, Griesbach, 1880, *loc. cit.* (Rec. Geol. Surv. India), p. 111, pl. III, fig. 10.

Diagnosis:— Compressed, round-ventered shells, with suture-lines like *Ophiceras*, but with a tendency to blunt lateral tuberculation. Lower Eotrias (Upper Otoceratan).

There is superficial resemblance, especially of the outer whorls, to certain forms usually referred to "*Xenodiscus*", but *Acanthophiceras* is connected by transitions with the more typical, smooth, *Ophiceras*, and there is no direct genetic connexion with such genera as the later *Xenodiscoides* or *Prionites*. Some forms from the *Ophiceras*-layer of Pastannah also seem to connect the genus here discussed with *Glyptophiceras*; and Diener's examples of *Ophiceras* cf. *gibbosum*[2]) represent such transitional forms.

Ophiceras (*Acanthophiceras*?) sp. juv. aff. *gibbosum*, Griesbach.

(Plate IV, figs. 6 a, b; 9 a, b).

1880. *Trachyceras* (?) *gibbosum*, Griesbach, *loc. cit.* (Rec. Geol. Surv. India), p. 111, pl. III, fig. 10.
1915. *Ophiceras gibbosum* (Griesbach) Diener, *loc. cit.* (Catalogue), p. 211 (see there for synonymy).
1916. *Acanthophiceras gibbosum* (Griesbach) Diener, Centralblatt für Mineral. etc., p. 101.

The example here figured (in Plate IV, fig. 6) is perhaps too compressed peripherally, to be definitely identified with Griesbach's species

[1]) *Loc. cit.* (Pal. Indica, Ser. XV, vol. VI, no. 1), pl. II, fig. 4 a—c.
[2]) *Loc. cit.* (Pal. Indica, N. S., vol. V, no. 1), 1913, p. 18, pl. I, figs. 3 and 10).

and in any case it represents merely the septate inner whorls of a larger form. The still more immature form represented in fig. 9 is even less satisfactorily determinable and shows distinct folds already at a diameter at which the Himalayan form is still entirely smooth. On the other hand as these two specimens differ from the other Greenland species here described it seems advisable to record them separately.

The proportions of the larger example show, perhaps, better agreement with those of the compressed inner whorls of an example figured by Diener[1]) than with those of the slightly more inflated holotype, but like the latter the Greenland example is distinctly ribbed already at an early stage. The suture-line is almost exactly the same as that of the Himalayan specimen figured by Diener in his fig. 5b (also 3c), but the auxiliary lobe is dependent as in Diener's fig. 7c. The variation in the shape of lobes and saddles and the number of denticulations in the external lobe, moreover, is considerable in the Himalayan examples.

The two transitional Kashmir specimens figured by Diener and already referred to in the generic discussion are less closely comparable to the Greenland form.

Horizon:— Lower Eotrias, *Ophiceras wordiei* beds.

Locality:— S. S. W. of Cape Stosch (altitude 220—280 m., Danish Exp., 1929).

Genus *VISHNUITES*, Diener, 1897.

Genotype:— *V. pralambha*, Diener, *loc. cit.* (Pal. Indica, Ser. xv, vol. II, no. 1), 1897, p. 88, pl. VII, figs. 4a—d.

Diagnosis:— Compressed, evolute, generally smooth, Ophiceratidae, with the suture-line of *Ophiceras*, but with an acute venter.

There are only two described forms of true *Vishnuites*, but the discovery of at least two more new species in Mr. Wordie's East Greenland collection has made it possible definitely to characterise *Vishnuites* as including merely keeled offshoots of various forms of *Ophiceras*. The majority show greater resemblance to the associated discoidal and smooth species of *Ophiceras*, of the *sakuntala* group, rather than to the typical *O. tibeticum*, but the genus *Vishnuites*, as here understood, is perhaps not strictly monophyletic.

"*Vishnuites*" *discoidalis*, Welter (*loc. cit.*, 1922, [Pal. Timor], p. 138, pl. XIII, figs. 1—2) for which the new genus ***Metinyoites*** gen. nov.[2])

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[1]) *Loc. cit.* (Pal. Indica, Ser. XV, vol. II, p. 1), 1897, pl. IX, fig. 3.

[2]) Diagnosis:— Discoidal, highly keeled shells, with radial striation, as in *Inyoites*, but more specialised suture-line. Upper Eotrias, Timor.

The resemblance of this genus, known at present in only one Timor example, to the earlier *Vishnuites*, is superficial and the differences in the striation alone are sufficient for separation. In this respect, there is great similarity to the peculiar is proposed, and ***Subvishnuites*** gen. nov.[1]) (for *S. welteri* sp. nov. = "*Vishnuites*" sp., Welter, *loc. cit.*, 1922, p. 137, pl. VIII, figs. 3—5) are not related to the Lower Eotriassic stock here discussed. The former is provisionally included in *Inyoitinae* nov. considered to be a sub-family of Xenoceltitidae; *Subvishnuites* resembles *Pseudoflemingites*, already mentioned[2]), based on *P. timorense* nom. nov. [= *Ophiceras nopcsanum*, Welter, *loc. cit.*, (Pal. Timor, 1922), pars, p. 104, pl. IV, figs. 4—5 only (non 1—3)], but has a tendency to fastigation of the periphery. The suture-lines of these Timor forms are more advanced than those of the true Ophiceratids and since *Pseudoflemingites* is connected by transitions with undoubted Flemingitids and is later than the Ophiceratids, its probable keeled offshoot *Subvishnuites* is also removed from the present family.

On the other hand, the genus ***Subinyoites***, gen. nov.[3]) (for *Inyoites kashmiricus*, Diener, *loc. cit.* (Pal. Indica), 1913, p. 21, pl. III, figs. 8a—c) is obviously closely related to *Vishnuites* and represents an acute development of a coarsely ribbed member of the Ophiceratidae. The true *Inyoites*, Hyatt, with a very different ornamentation and suture-line, and a high, hollow, keel bears only superficial resemblance to the genus here discussed.

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striation shown in those specimens of *Inyoites oweni* in which the primary ribs are indistinct, but the pointed saddles of the suture-line of *Metinyoites* indicate specialisation in quite a different direction. Compared with the suture-line of an immature *Inyoites oweni* (see Hyatt and Smith, 1905, pl. LXXVIII, fig. 1) the difference in the size of the external saddle is important and prevents definite reference of *Metinyoites* to the subfamily Inyoitinae; but in larger specimens of *Inyoites oweni* (Hyatt and Smith, 1905, pl. VI, fig. 2, pl. LXIX, fig. 1) this difference is far less pronounced. Moreover in forms of Paranoritids (e. g. *Clypeoceras*) and Proptychitids, etc., similar pointing of the saddles has been noticed and in *Lanceolites* specialisation is still more extreme.

[1]) Diagnosis:— Evolute, discoidal, smooth shells, like inner whorls of Pseudoflemingites, and with similar Flemingitid suture-line, but tendency of the periphery to become fastigate. Upper Eotrias of Timor.

The reference to Flemingitidae is provisional, pending the discovery of derivatives of *Subvishnuites*. It certainly seems impossible to connect this genus with *Inyoites*, which is much closer to forms like *Danubites strongi*, Hyatt and Smith (*loc. cit.* 1905, p. 165, pl. IX, figs. 4—6, 7—10).

[2]) See p. 24. Upper Eotrias, Timor. This genus is connected with *Flemingites* by such forms as ***P. rotuliforme***, nom. nov. (= *Xenodiscus rotula*, Welter, 1922, p. 106, pl. VI, figs. 3, 4, non Waagen); and *P. molengraffi* (Welter, 1922, p. 108, pl. IV, figs. 10—13) is transitional to *Xenodiscoides* and *Kashmirites*. *Xenoceltites* may also have sprung from the same stock which though later in date than the supposed primitive *Flemingites praenuntius*, Frech, and even the specialised large *Flemingites* of the *flemingianus* group, retains the ancestral evolute inner whorls.

[3]) Diagnosis:— Compressed, subangustumbilicate, with blunt radial folds and acute venter. Suture-line ceratitic, with high first and low second lateral saddles and auxiliaries forming a serrated line, as in many *Ophiceras*.

1. *Vishnuites wordiei* sp. nov.
(Plate II, figs. 11 a, b).

1927. *Vishnuites* sp. nov. I, Spath, *loc. cit.* (Geol. Mag.), p. 474.
1929. — — I, Lauge Koch, *loc. cit.* (Geology of Greenland), p. 113.

This interesting species is based on the unique example here figured, of the following dimensions:—

Diameter in mm.	57
Whorl-height (in °/₀ of diameter)	.40
Whorl-thickness (in °/₀ of diameter)	.27
Umbilicus (in °/₀ of diameter)	.33

Its lateral aspect is that of a typical *Ophiceras* with the characteristic, high, umbilical slope and conspicuous edge. There are indistinct folds, on the inner half of the whorl-side, as in *O. tibeticum*, but the specimen consists only of an internal cast, with, apparently, just the beginning of the (crushed) body-chamber. The whorl-section is cordate, with the greatest thickness at the umbilical edge and a fastigate periphery. There is a distinct, median keel and the ventro-lateral edges that accompany it on each side give the periphery an *Otoceras*-aspect.

The suture-line has a wide external lobe, with a comparatively high median saddle. It does not differ in any essential from that of typical *Ophiceras*, e. g. the variety of *O. tibeticum* figured by Diener[1]), except that the siphonal saddle (in the external lobe) has parallel sides. The irregular spacing of the septa is noticeable. They are distant on the inner whorls, then, at intervals, they become more closely spaced, rather suddenly the second time, to separate again near the end. The variability in the spacing of the septa is particularly apparent in these internal casts from the *Ophiceras* beds and confirms the doubts I expressed in 1919[2]) with regard to the constancy of the "normal septal intervals".

The present species is distinguishable from all the described forms of *Vishnuites* by its sub-tricarinate periphery.

Horizon:— Lower Eotrias, *Ophiceras* (*Vishnuites*) beds.

Locality:— 10 miles East of Cape Stosch (J. M. Wordie Colln., locality 59).

2. *Vishnuites decipiens* sp. nov.
(Plate III, figs. 2 a—g; Pl. IV, figs. 2 a, b).

1927. *Vishnuites* sp. nov. II Spath, *loc. cit.* (Geol. Mag.), p. 474.
1929. — — II, Lauge Koch, *loc. cit.* (Geology of East Greenland), p. 113.

[1]) *Loc. cit.* (Pal. Indica, Ser. XV, vol. II, no. 1), 1897, pl. VIII, fig. 5 c.
[2]) Spath: "Notes on Ammonites". II. Geol. Mag., Dec. VI, vol. VI, 1919, p. 67.

This species, with its periphery fastigate but not yet acute, is a passage-form between *Ophiceras transitorium*, above described, and the genotype of *Vishnuites*, the oxynote *V. pralambha*, Diener. As holotype of the present species may be taken the example figured in Plate III, figs. 2a, b of the following proportions:—

Diameter in mm.	44
Whorl-height (in °/₀ of diameter)	.45
Thickness (in °/₀ of diameter)	.29
Umbilicus (in °/₀ of diameter)	.27

It includes a small portion of the body-chamber and the last (approximate) septal edge is incompletely formed. Being an internal cast, the specimen shows no trace of the striae of growth, but there are very faint folds on the earlier half of the outer whorl. The whorl-section is sub-trigonal, with the greatest thickness at the (rounded) umbilical edge and with an acute, fastigate, periphery. The high and steep umbilical wall is more conspicuous in the holotype than in a number of paratypes, four of which are here figured. But while being far less compressed and oxynote than the type of *V. pralambha*, the Greenland examples may be compared to the Kashmir *V.* aff. *pralambha*, figured by Diener in 1913[1]). This differs from the typical *V. pralambha* in its wider umbilicus and the more prounounced umbilical border, but the venter is still slightly more acute than in *V. decipiens*.

The suture-line agrees with that of *V. wordiei* but, in the holotype, the external lobe is narrower and the external saddle shows that peculiar dent on the siphonal side that characterises the first lateral saddle of the suture-line of *Otoceras woodwardi*, Griesbach[2]). The second lateral saddle is wide and reaches to just beyond the umbilical edge, so that the auxiliary lobe is scarcely visible in the side-view. The narrowness of the lateral lobes forms another distinctive feature, compared with the Himalayan *V. pralambha*.

The more densely septate example figured in Plate III, figs. 2c, d, connects the typical forms of the present species not only with *O. transitorium* but also with the variety figured in Plate IV, figs. 2a, b. This is the form previously recorded as *V.* aff. *pralambha*, Diener, which, however, is still more oxynote. There is good agreement in the suture-line except in the width of the auxiliary lobe, which is probably correlated with the different conformation of the umbilical slope. Pending the discovery of further material, it may be advisable to retain this

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[1]) *Loc. cit.* (Pal. Indica, N. S., vol. v, no. 1), pl. III, figs. 4 a, b.

[2]) As figured in Diener, *loc. cit.* (Pal. Indica, Ser. xv, vol. II, no. 1), 1897, pl. II, fig. 1 c.

form with its narrowly-spaced septa in *V. decipiens* as a var. ***flexiseptata***, nov.

Horizon:— Lower Eotrias, *Ophiceras* (*Vishnuites*) beds.

Localities:— 10 miles east of Cape Stosch (J. M. Wordie Colln., locality 59).

Genus *GLYPTOPHICERAS* nov.

Genotype:— *Xenodiscus aequicostatus*, Diener, *loc. cit.* (Pal. Indica, N. S., vol. v, no. 1), 1913, p. 6, pl. II, figs. 10a, b.

Diagnosis:— More or less evolute, round-ventered shells with suture-line like *Ophiceras*, but with coarse sigmoidal costation, tending to degenerate into striation. Lower Eotrias (Otoceratan).

This genus is connected by numerous transitions with the genera *Ophiceras* and *Acanthophiceras*, but is less close to *Xenodiscoides* nov., mentioned above (for *Xenodiscus perplicatus*, Frech), which, in any case, is already to be included in the family Flemingitidae. The resemblance of forms like *G. himalayanum* (Griesbach) to the true rectiradiate *Xenodiscus* of Middle Productus Limestone age is believed to be purely superficial.

1. *Glyptophiceras minor* sp. nov.

(Plate VII, figs. 7—8; Pl. VIII, figs. 14—15).

1927. *Ophiceras* aff. *demissum* (Oppel) Spath, *loc. cit.* (Geol. Mag.), p. 474.

This form is close to *O. demissum*, described above, and I at first included the example figured in Plate VII, figs. 7a, b in Oppel's species; but the study of the far more abundant Greenland material obtained by the Danish Expedition of 1929 has shown that it is advisable to keep the two forms distinct. The figured example just cited may be taken as the type of the present species, although it is fragmentary. It shows the aperture; and the half of the outer whorl that remains is all body-chamber. The dimensions are:—

Diameter in mm.	36
Height of the last whorl (in % of diameter)	.32
Thickness of the last whorl (in % of diameter)	.25
Umbilicus (in % of diameter)	.46

The whorl-section is compressed, elliptical, with the greatest thickness at the rounded umbilical border, as in *G. himalayanum* (Griesbach) or in *G. lissarense*, Diener[1]) although in thickness the present species is more comparable to the latter form. The venter is evenly arched and

[1]) *Loc. cit.* (Pal. Indica, Ser. XV, vol. II, no. 1), 1897, pl. XIV, figs. 11 b and 14 b.

flattened rather than compressed, as it is in Griesbach's species. The inner whorls appear almost smooth, but develop irregular blunt folds at an early stage. These are replaced on the body-chamber by delicate sigmoidal and closely-spaced ribs, indistinctly continuous across the periphery. Near the aperture of the holotype there are only striae of growth, but two obscure collars precede the actual peristome. The latter is projected peripherally but somewhat worn.

The suture-line resembles that of *O. demissum* and has the second lateral saddle already on the umbilical slope. In most of the smaller examples that show the septal edges there is no room for an auxiliary lobe, outside the umbilical suture (see fig. 7c), but even in the adult, the auxiliary (or umbilical) lobe, bisected by the umbilical suture, is followed directly by the dorsal saddle. The development of the suture-line in young examples that may belong to the present species is illustrated in Plate IX, fig. 10, and discussed below under *G. pseudellipticum.*

G. gracile, with similar striation on the body-chamber, has definite ribbing on the inner whorls. *G. pseudellipticum*, on the other hand, is first smooth and then costate; it also has flatter whorl-sides. In the case of such inner whorls as are figured in Plate VII, fig. 8, or Pl. VIII, fig. 15, specific separation from the other forms of *Glyptophiceras* may be impossible. There are many dozens of these immature examples and they occur in nests. One of the more typical specimens is associated on the same slab with many impressions of *Pseudomonotis* (*Claraia*), while the example figured in Plate VIII, fig. 14, attached to a left valve of *Claraia stachei*, includes also *Gervillia exporrecta*, and, in its body-chamber, bears an *Anaptychus*-like body that, however, may merely represent a portion of some corrugated pelecypod shell.

Horizon:— Lower Eotrias, *Ophiceras wordiei* beds.

Locality:— S. S. W. of Cape Stosch (altitude 220—280 m., Danish Expedition, 1929) and 10 miles S. E. of Cape Stosch (J. M. Wordie Colln.).

2. *Glyptophiceras gracile* sp. nov.

(Plate VII, figs. 3—6; Pl. VIII, figs. 10 a, b).

1930. *Xenodiscus* sp. nov. (1) Rosenkrantz, in Lauge Koch, *loc. cit.* (Preliminary Report), p. 361.

The example figured in Plate VII, fig. 5, being the most favourably preserved, is taken as holotype of this new species. The larger paratype, represented in Plate VII, fig. 3, also shows the aperture, but part of the outer whorl is missing and it is not certain that its body-chamber, as in the holotype, occupied just over half a whorl. The dimensions of the two examples are as follows:—

	Pl. VII, fig. 5	Pl. VII, fig. 3
Diameter in mm.	47	75
Height of last whorl (in % of diameter)	.32	.27
Thickness of last whorl (in % of diameter)	.26	(?)
Umbilicus (in % of diameter)	.47	.50

The whorl-section is elliptical, slightly compressed, with gently convex sides and an evenly arched venter. The umbilical slope is high but rounded and, where the extremely delicate test is preserved, was provided with fine spiral striation. This strigation is seen also on the body-chamber cast figured in Plate VII, fig. 4a, but the spiral lines near the periphery are pathological, two distinct ridges or keels being visible (on one side only) already on the earlier, septate, portion.

The ornamentation consists of blunt sigmoidal ribs, appearing gradually and being rather distantly and irregularly spaced. At the end of the septate stage there is a change to closer ribbing and near the aperture only striae remain. The ribs are pronounced only on the whorl-sides and very faint on the umbilical slope and on the periphery. The body-chamber of the impression from the *Otoceras* bed of Clavering Island, represented in Plate VII, fig. 6 (the photograph of a squeeze) seems unusually smooth but this is merely a matter of preservation, as is the apparent absence of strong ribs on the earlier whorl-fragment of the pathological specimen illustrated in fig. 4. On the other hand, the smaller example figured in Plate VIII, fig. 10, retains a few strong ribs even on the body-chamber, which makes it transitional to the species described below as *G. pascoei.*

The suture-line is characterised by its narrow, pointed, second lateral lobe which may be goniatitic or end in only two prongs. There is general similarity to the suture-line of *G. himalayanum* (Griesbach), but this species differs in coiling and whorl-shape.

This species differs from *G. aequicostatum* (Diener)[1]) in whorl-section and in showing greater contrast between the ornamentation of the inner and outer whorls.

"*Celtites*" *fortis*, Koken[2]) from the Lower Ceratite Limestone of the Salt Range is still less closely comparable and like its companion species "*Celtites*" *radiosus*, Koken (which simulates *Glyptophiceras pascoei*) it is already transitional to ***Anakashmirites***, gen. nov.[3]) created for the group of *Danubites nivalis*, Diener[4]).

[1]) *Loc. cit.* (Pal. Indica. N. S., vol. v, no. 1), 1913, p. 6, pl. II, figs. 10 a, b.

[2]) In Frech: Lethaea geognostica, II, I, Trias, 1905, pl. XXII, figs. 2 a, b.

[3]) Diagnosis:— Evolute serpenticones, with ribs tending to thicken towards ventro-lateral borders and with widely arched peripheries. Suture-line with low external lobe and large external saddle. Family Kashmiritidae, nov.

[4]) *Loc. cit.* (Pal. Indica, Ser. XV, vol. II, I, 1897), p. 51, pl. XV, figs. 19 a—c.

Horizon:— Lower Eotrias, *Otoceras* and *Ophiceras wordiei* beds.
Localities:— Clavering Island (*Otoceras* beds) and S. S. W. of Cape Stosch (altitude 220—280 m.), Danish Expedition, 1929.

3. *Glyptophiceras pascoei* nom. nov.

(Plate VIII, figs. 1—7, 16).

1913. *Xenodiscus himalayanus* (non Griesbach) Diener, *loc. cit.* (Pal. Indica, N. S., vol. v, no. 1), p. 4, pl. II, fig. 4 (?).

1930. *Xenodiscus* sp. nov., Rosenkrantz, in Lauge Koch, *loc. cit.* (Preliminary Report), p. 362 (?).

This species which differs from the well-known *G. himalayanum* (Griesbach) merely in coiling and whorl-shape, is represented by about fifteen examples of which the original of fig. 1 may be chosen as type. Its dimensions and those of a paratype are as follows:—

	Pl VIII, fig. 1	fig. 5
Diameter in mm.	54	44
Height of last whorl (in °/₀ of diameter)	.33	.31
Thickness of last whorl (in °/₀ of diameter)	.25	.25
Umbilicus (in °/₀ of diameter)	.48	.48

The whorl-section is slightly compressed, almost circular, but with the greatest thickness at the rounded umbilical wall and the sides slightly flattened and convergent. The periphery is evenly arched. The sigmoidal ribs may appear gradually, but in the holotype they are prominent already at 15 mm. diameter. They are distantly spaced and where favourably preserved may be seen to break up into prorsoradiate striae across the periphery, as in a Kashmir form figured by Diener[1]) and doubtfully attached to Waagen's "*Gyronites*" *rotula*. On the body-chamber the ribs become first more closely spaced and then, near the aperture, reduced to mere striae. The mouth-border follows the curve of the lines of growth and has a distinct ventral lappet.

The suture-line (fig. 16) has the general appearance of that of the less coarsely ornamented *G. gracile* and a similarly pointed, second lateral lobe.

G. lissarense (Diener)[2]) is somewhat intermediate between the present species and *G. gracile* and has the coarsely-ribbed inner whorls of the examples here figured in Plate VIII, figs. 2 and 6. The former (fig. 2) in fact, differs merely in looser coiling and minute differences

[1]) *Loc. cit.* (Pal. Indica, N. S., vol. v, no. 1), 1913, pl. III, fig. 2 b.
[2]) *Loc. cit.* (Pal. Indica, Ser. xv, vol. II, no. 1), 1897, pl. XIV, figs. 8—9, 11.

of ribbing, but it seems advisable not to identify the Greenland examples with Diener's species. I have before me a specimen of the Kashmir form that Diener, in 1913, provisionally attached to his *G. lissarense*, and which requires a new name (*G. kashmiricum*, nom. nov.)[1]). If this constricted form (refigured in the British Museum Catalogue of Fossil Cephalopoda, vol. IV, pl. I, figs. 3a, b) has any resemblance to the original *G. lissarense*, the specific separation of the Greenland examples is well justified.

On the other hand, one of the Kashmir forms attached by Diener[2]) to *G. himalayanum* (Griesbach) is much closer to the present species and might, indeed, be identified with the example here illustrated in Plate VIII, fig. 4. A fragment of *G. pascoei* before me, with the example of *G. kashmiricum*, already mentioned, and another form, comparable to *G. ellipticum* (Diener), from the *Ophiceras* layer of Pastannah, had in fact all been identified with *G. himalayanum*.

Celtites radiosus, Koken[3]) already referred to, is similar in side-view, but has a different suture-line.

Horizon:— Lower Eotrias, *Otoceras* and *Ophiceras wordiei* beds.

Localities:— Clavering Island (*Otoceras* beds) and S. S.W. of Cape Stosch (altitude 220—280 m.).

4. *Glyptophiceras pseudellipticum* sp. nov.

(Plate VIII, figs. 8 a, b).

The holotype of this species, here figured, is the only adult example so far found, but some of the immature nuclei referred to under *G. minor* may represent inner whorls of the same form. The dimensions of the type at two stages are the following:—

Diameter in mm.	50	35
Height of the last whorl (in °/₀ of diameter)	.30	.31
Thickness of the last whorl (in °/₀ of diameter)	.24	.23
Umbilicus (in °/₀ of diameter)	.51	.46

The species may be briefly defined as being more or less homoeomorphous with the Permian *Xenaspis*, just as *G. pascoei* (and the group of *G. himalayanum* generally) simulates the true *Xenodiscus*. The whorl-section is compressed, elliptical, with flattened sides, an evenly arched venter, and a gentle, rounded, umbilical slope. There is an attempt at costation on the innermost volutions, but to a diameter of at least 20 mm. the whorls are almost smooth. Then sigmoidal folds appear,

[1]) *Loc. cit.* (Pal. Indica, N. S., vol. v, no. 1), 1913, p. 5, pl. I, fig. 11.

[2]) *Ibid.*, pl. II, fig. 4.

[3]) In Frech: Lethaea geognostica, II, Trias, 1905, pl. XXII, figs. 1 a, b.

indistinct at first, rather distant, and confined to the inner half of the whorl-side. Later the ribbing becomes stronger and it persists on the body-chamber. It is possible that the last, septal, surface (shown in the peripheral view, Pl. VIII, fig. 8b) marks the end of the septate stage, since the last two suture-lines approximate. In any case, judging by the preservation, there can have been only a few more septa and at least half a whorl of body-chamber, since the present end of the shell apparently coincides with the (incompletely preserved) mouth-border. There are distinct costae (on the side not figured) almost to the end, but the final portion is worn at the sides.

The suture-line has a high external lobe, with minutely bifid branches, as in Plate VIII, fig. 16, and a more coarsely bifid, second lateral lobe. Only half of the auxiliary lobe (really umbilical lobe Ui) is visible outside the umbilical suture. I have been able to study the development of the lobes in a number of those immature specimens that may belong to *G. minor* or to the present species, but since they are generally preserved in crystalline calcite, sometimes clear as glass, no protoconch could be isolated. Considering our ignorance of the earliest stages of Eotriassic ammonites, it is regrettable that this mode of preservation made it impossible to dissect these immature *Glyptophiceras* to beyond 1.5 mm. diameter and to trace the development back to the presumably latisellate first suture-line, with only one lateral lobe. The figures (10a—c) given in Plate IX show how the lobes Ui and Uii originate from the original umbilical lobe.

Horizon:— Lower Eotrias, *Ophiceras wordiei* beds.

Locality:— S. S. W. of Cape Stosch (altitude 220—280 m.).

5. *Glyptophiceras* sp. ind.

(Plate VII, figs. 9 a, b; 10 a, b; Pl. VIII, figs. 9 a, b).

In addition to the species of *Glyptophiceras*, above described, there are probably several other forms, judging by the three immature examples here figured. That represented in Plate VIII, figs. 9a, b, has a more clearly rursiradiate costation than *G. gracile*, of which it might otherwise have been taken to be a small example. More than a third of its outer whorl belongs to the body-chamber.

The smaller example illustrated in Plate VII, figs. 10a, b, is flattened, like *G. pseudellipticum*, but has close and delicate ribs, distinct only on the inner whorl-side. This resembles the type of ornamentation found in the Himalayan form attributed by Krafft and Diener[1]) to "*Xenodiscus*" *radians* (Waagen). This, however, has not only a more highly developed suture-line, but a truncate periphery, and is thus transitional to *Xenodiscoides*.

[1]) *Loc. cit.* (Pal. Indica, Ser. xv, vol. vi, no. 1), 1909, pl. xxv, figs. 1—3.

The smallest specimen represented in Plate VII, figs. 9a, b, again differs from *G. minor* in its more flattened whorl-sides, more rectangular section, and stronger costation, flexuous and pronounced on the whorl-side, but not on the periphery. This is reminiscent of the ornamentation of *G. aequicostatum* (Diener), but the specimen includes over half a whorl of body-chamber and does not represent merely the young of the Kashmir species.

Horizon:— Lower Eotrias, *Ophiceras wordiei* beds.

Locality:— S. S. W. of Cape Stosch (altitude 220—280 m.).

Family *Proptychitidae*, Waagen 1895, emend.

Waagen included the genus *Proptychites* in the same family as the genera *Beyrichites*, *Ptychites* and *Sturia* but these, to me, are referable to the families Ceratitidae, Ptychitidae and Cladiscitidae respectively. The Proptychitinae again are not now taken to be subordinate to the Ptychitidae; for it is as yet uncertain whether the Mesotriassic *Ptychites*, with its Arcestid inner whorls, is directly descended from the Eotriassic Proptychitidae, although ***Proptychitoides*** gen. nov.[1]) (created for *Proptychitoides* ***decipiens*** nom. nov. = *Proptychites latifimbriatum*, Arthaber 1911[2]), non de Koninck) seems to be a connecting link. Gymnitinae, still listed by Arthaber (1911) as a sub-family of Ptychitidae, also have no connection with Proptychitidae. In the latter family is now also included the genus *Pachyproptychites*, Diener, based on *Proptychites otoceratoides*, Diener[3]). The reference of this genus to Otoceratidae, with similar pronounced umbilical rim, is shown to be untenable by the suture-line which is clearly that of the Paranoritidae. The tendency to thicken the whorl in the umbilical region is indicated in a number of Paranoritid offshoots, here grouped in Proptychitidae, but none has anything like the infundibuliform umbilicus of Diener's genus, the creation of which was undoubtedly justified.

Waagen divided his species of *Proptychites* into two sections:— *Nudi* and *Plicosi*. Certain species of the former might, perhaps, be referred to other genera; and *P. aberrans*, Waagen, probably, is also separable generically, though doubtful. As regards the second section, *P. obliqueplicatus*, Waagen[4]), unless very incorrectly drawn, must also

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[1]) Diagnosis:— More or less involute, inflated shells, with narrowly rounded periphery and deep umbilicus, differing from *Proptychites* in their advanced, coarsely denticulated lobes and in their club-shaped monophyllic unsymmetrical saddles.

[2]) *Loc. cit.* (Beitr. Pal. Österr.-Ung., vol. XXIV), 1911, p. 223, pl. XIX, figs. 2 a—c (lectotype).

[3]) *Loc. cit.* (Mém. Com. Géol. St. Pétersb., vol. XIV, 1895), p. 36, pl. III, figs. 2 a, b.

[4]) *Loc. cit.* (Pal. Indica, Ser. XIII, no. II), 1895, p. 183, pl. XVII, fig. 3.

be placed in a new genus, ***Eoptychites*** gen. nov.[1]), distinct from the typical *Proptychites*; but a corresponding development of *Proptychitoides* (with *P. **nopcsai***, nom. nov. = Arthaber's *Proptychites obliqueplicatus*, non Waagen)[2]), on account of imperfect preservation, cannot yet be satisfactorily separated from the more typical forms of that genus, and may be provisionally referred to *Proptychitoides*. On the other hand it seems advisable to keep apart, on account of its distinct suture-line, ***Ussuriceras***, gen. nov. (for *Proptychites acutisellatus*, Diener)[3]), a connecting link with Ussuridae.

Genus *PROPTYCHITES*, Waagen, 1895.

Genotype:— *Ceratites lawrencianus*, de Koninck, 1863 ("Description of Fossils discovered in India by A. Fleming". Quart. Journ. Geol. Soc., vol. XIX, pl. 14, pl. VI, fig. 3).

Diagnosis:— More or less involute, discoidal shells, with tendency to inflation, especially of inner half of whorl-sides and consequently deep umbilicus. Venter arched, suture-line subceratitic, more advanced than that of *Ophiceras* or even *Koninckites* (a parallel stock, tending towards compression and sharpening or truncation of the periphery.

Proptychites rosenkrantzi sp. nov.

(Plate VII, figs. 1 a, b; 2 a—h).

1927. *Proptychites* sp. ind., Spath, *loc. cit.* (Geol. Mag.), p. 474.
1929. — — Lauge Koch, *loc. cit.* (Geology of East Greenland), pp. 113, 118.
1930. — — Rosenkrantz, in Lauge Koch, *loc. cit.* (Preliminary Report), p. 362.

Apart from the thirty-six examples previously recorded, there are only a few fragmentary specimens from neighbouring localities, but

[1]) Diagnosis:— More or less involute, discoidal, somewhat inflated shells with rursiradiate, bifurcating, blunt, costae and arched venter. Suture-line, so far as is known, like that of other Proptychitids or Paranoritids. *Flemingites* Beds, Ceratite Sandstone, Salt Range.

[2]) *Loc. cit.* (Beitr. Pal. Geol. Österr.-Ung., vol. XXIV), 1911, p. 226, pl. XX, fig. 1.

[3]) *Loc. cit.* (Mém. Com. Géol. St. Pétersb., vol. XIV), 1895, p. 33, pl. II, fig. 3. Diagnosis:— Discoidal, involute shells, with flattened whorl-sides, arched venter and high umbilical wall; traces of blunt, distant, rectiradiatecostae. Suture-line subammonitic, with high, linguiform saddles. The very distinct suture-line indicates that Ussuridae probably have resulted from specialisation of a Paranoritid stock, closely allied to *Proptychitids*. *Proptychites hiemalis*, Diener, the suture-line of which shows only a slight advance compared with that of *P. markhami*, Diener, may be considered a connecting link between the present genus and the typical *Proptychites*, but suggests that Monophyllitidae and Gymnitidae, have also sprung from the same root-stock.

the largest of these, figured in Plate VII, fig. 1, is now taken as holotype of this new species. Its dimensions (restored) are as follows:—

Diameter in mm.	100
Height of the last whorl (in °/₀ of diameter)	.51
Thickness of the last whorl (in °/₀ of diameter)	.38
Umbilicus (in °/₀ of diameter)	.17

The whorl-section is trigonal, with a narrowly-arched periphery and a very high, perpendicular umbilical wall. The inner whorls are more rounded, but the preservation of the holotype is so poor that it is impossible to compare its early stages with the four immature examples figured in figs. 2a—h. These have also suffered from corrosion, and accidental deformation, but the whorl-shape is essentially that characteristic of *Proptychites*. In the holotype there are traces of ribs, most pronounced near the periphery, and projected forward. In *P. ammonoides*, Waagen[1]), which has similar faint ribs, they seem more radial, while *P. undatus*, Waagen[2]) has the costae more pronounced at the middle of the side.

The suture-line is characterised by its very shallow external lobe with bifid to subtrifid branches, and an unsymmetrical, second lateral saddle, followed by an irregular auxiliary series. There is, on the whole, less specialisation than in the typical forms of *Proptychites* from the Ceratite Marls of the Salt Range or in *P. typicus*, v. Krafft[3]), from corresponding beds in the Himalayas.

P. scheibleri, Diener[4]) of the *Otoceras* beds, differs not only in its suture-line, with slender saddles, but in its less trigonal whorl-shape, likewise *P. hiemalis*, Diener[5]). On the other hand *Pachyproptychites otoceratoides*, Diener sp.[6]) has only the external lobe more indented, but it differs in its flared umbilical rim.

Horizon:— Lower Eotrias, *Proptychites* beds.

Localities:— East of Cape Stosch (altitude 560 m., locality 3, Danish Exped., 1929, and locality 52, J. M. Wordie Colln.). The latter yielded the thirty-six specimens previously recorded, from an altitude of 600 ft. Dr. Koch thinks that they must have come out of a loose block, but Mr. Wordie assures me that they were in place.

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[1]) *Loc. cit.* (Salt Range Fossils, vol. II), 1895, pl. XVII, fig. 1, pl. XIX, fig. 2.

[2]) *Ibid.*, pl. XXIV, fig. 4.

[3]) In Krafft and Diener, *loc. cit.* (Pal. Indica, Ser. XV, vol. VI, no. 1), 1909, pl. XXI, figs. 2—3.

[4]) *Loc. cit.* (Pal. Indica, Ser. XV, vol. II, pt. 1), 1897, p. 79, pl. VI, fig. 3.

[5]) *Loc. cit.* (Mém. Com. Géol. St. Pétersb.), 1895, p. 34, pl. II, figs. 2 and 4.

[6]) *Ibid.*, p. 36, pl. III, figs. 2 a, b.

b. Class *Gastropoda*.

Order *Prosobranchia*.

Family *Bellerophontidae*, M'Coy.

Genus *BELLEROPHON*, Montfort, 1808.

1. *Bellerophon* cf. *vaceki*, Bittner.

(Plate IX, fig. 3).

1899. *Bellerophon vaceki*, Bittner:	"Trias Brachiopoda and Lamellibranchiata": Himalayan Fossils, vol. III, pt. 2 (Pal. Indica, ser. XV), p. 9, pl. I, figs. 13—14.
1907. — — —	Frech, "Leitfossilien der Werfener Schichten": Result. Wiss. Erforsch. Balatonsees, vol. I, pt. 1, Pal. Anh., p. 44.
1926. — — —	Diener: Fossilium Catalogus, I, pt. 34, Glossophora triadica, p. 12.

The example here figured seems to have an even more depressed outer whorl than the strongly inflated Werfen species, especially as refigured by Arthaber[1]), but the preservation is unfavourable. Fragments of thick test remain, but do not show any lines of growth, and the corroded cast is entirely smooth. It is probable that the specimen is complete, since the median sinus in the aperture is just visible. The lateral processes of the aperture, however, are broken off. There is no indication of an umbilical rim, as in the Himalayan form recorded by Bittner.

Frech called this typical Werfen species a "crippled dwarf-form, the last survivor of the highly developed, large and beautiful Bellerophontids which in the Alps and the Salt Range characterise the upper limit of the Permian". The species, however, with which Frech compared the present form, are not very close to the Greenland example here figured and *B. peregrinus*, Laube[2]), especially, differs in its larger umbilicus and distinctive aperture.

Horizon:— Lower Eotrias, *Ophiceras wordiei* beds.

Locality:— S. S. W. of Cape Stosch (locality 47, J. M. Wordie Colln., 1100 ft. altitude).

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[1]) In Lethaea geognostica, II, I, 1905, pl. XXXIV, figs. 1—2.

[2]) See in Frech: Lethaea geognostica, I, Bd. 2, Lief. 3, 1901, pl. LXVII, figs. 11 a-e.

2. *Bellerophon borealis* sp. nov.

(Plate IX, figs. 5, 6 a—c).

1929. *Bellerophon* sp., Lauge Koch, *loc. cit.* (Geology of East Greenland), p. 117.

As type of this species may be taken the example figured in Plate IX, fig. 5, which has the following dimensions:—

Height of shell	16 mm.
Height of whorl at mouth	8.5 mm.
Greatest width of mouth	18 mm.
Greatest width of umbilicus (cast only)	3.5 mm.

The shell is depressed, the whorl embracing and semicircular in cross-section, rapidly increasing in thickness which is greatest at the rounded umbilical edge. The outer whorl completely envelops all the earlier volutions but the presumably overhanging base of the expanded aperture is not preserved. The lateral margins are strongly sinuous and the median sinus in the dorsal margin is deep and its lip slightly raised at the base. The lines of growth of the test are parallel to this apertural margin, but the cast is entirely smooth. The umbilicus is small and completely closed by a callus. There are two indistinct spiral ridges, and a plane or slightly depressed median zone between them, along the dorsum of the outer whorl of the holotype. Towards the interior this is lost and on the cast the dorsal zone is, perhaps, less marked than on the test. But in most of the other examples which are only casts in a micaceous sandstone, the depressed periphery with its median, flat, zone, can be recognised (Plate IX, figs. 6b, c). In one example (6c) the lip of the dorsal sinus is unusually strongly raised.

B. vaceki differs in having an evenly rounded periphery and less depressed inner whorls. The form described below as *B.* sp. ind. has a median ridge rather than a depressed zone.

Among the Permian species, *B. ulrici*, Stache[1]) has a somewhat similar dorsal band, but the keels are more pronounced and much closer together on the test. The Salt Range forms figured by Waagen are even less closely comparable, but *B. impressus* (Waagen)[2]) shows flattening of the periphery, like the sandstone casts above referred to.

Horizon:— Lower Eotrias, *Otoceras?* and *Ophiceras wordiei* beds.

Localities:— S. S. W. of Cape Stosch (loose, in micaceous sandstone concretions, Lauge Koch colln., 1927) and from *Ophiceras* layer (220—280 m. altitude), Danish Expedition, 1929.

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[1]) "Beiträge zur Fauna der *Bellerophon*-Kalke Südtirols". No. 1. Jahrb. K. K. Geol. Reichsanst., vol. XXVII, 1877, p. 303, pl. VI, fig. 4.

[2]) *Loc. cit.* (Salt Range Fossils, vol. I), 1887, p. 139, pl. XII, figs. 5 a—c.

3. *Bellerophon* sp. ind.

(Plate IX, fig. 4).

The presence of yet another species of *Bellerophon* seems indicated by the internal cast figured in Plate IX, fig. 4, which is associated in the same block with *Ophiceras* (*Lytophiceras*) *subkyokticum* and *Pseudomonotis* (*Claraia*) etc. The periphery towards the latter half of the outer whorl tends to be raised in the median line, as in the Carboniferous *B. apertus* (J. de C. Sowerby) but there is no distinct keel. The general shape is also more compressed than in the forms described above and resembles that of the Permian *B. timorensis*, Wanner[1]). This, however, has a distinct dorsal band. In the Ussuri form figured by Bittner[2]) as *Bellerophon* sp. ind. there is a distinct keel or rather raised, median band, which may be less conspicuous on an internal cast than it is on the test. The shape, however, is more flaring in this form than in the Greenland example here described.

Horizon:— Lower Eotrias, *Ophiceras wordiei* beds.

Locality:— S. S. W. of Cape Stosch (altitude 220—280 m.).

Family *Pleurotomaridae*, d'Orbigny.

Genus *WORTHENIA*, de Koninck, 1883.

1. *Worthenia* cf. *humilis*, J. Boehm.

(Plate X, fig. 3).

1895. *Worthenia humilis*, J. Boehm, "Gastropoden des Marmolatakalkes", Palaeontographica, vol. XLII, p. 219, pl. IX, figs. 20, 20a—d.

It is doubtful whether the relations of the minute gastropod here discussed are really with *Worthenia humilis*, but what little is preserved of the calcified test shows very fine, spiral striation and a pronounced edge, as in Boehm's form from the Anisian Marmolata Kalk. There are five whorls, but the total height of the spire is only 5 mm. The drawing (enlarged × 3) is diagrammatic, but shows the spiral striation and prominent edge. In the similar *Pleurotomaria* (*Worthenia*) *escheri*, Stoppani, var. *timorensis*, Krumbeck[3]), which is of still later (Norian) age, the upper edge is less projecting and there is no strong, spiral lineation.

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[1]) Palaeontologie von Timor, Lief. XI (no. XVIII. C. Wanner, Gastropod und Lamellibranchiaten der Dyas von Timor), 1922, p. 15, pl. CLI, figs. 2—4.

[2]) "Versteinerungen der Trias Ablagerungen etc.". Mém. Com. Géol. St. Pétersb., vol. VII, no. 4, 1899, p. 28, pl. IV, figs. 26—28.

[3]) Palaeontologie von Timor, Lief. XIII, no. XXII (Krumbeck: Brach. Lamellibr. & Gastrop. d. Trias. II), 1924, p. 185, pl. CLXXXII, figs. 4 a—c.

Horizon:— Lower Eotrias, *Otoceras*? beds.
Locality:— Cape Stosch (loose block of micaceous sandstone; Lauge Koch Colln., 1927).

2. *Worthenia* ? sp. ind.

(Plate X, fig. 4).

The microscopic form here figured (and enlarged four diameters) is too poorly preserved to be discussed in detail, but it shows the spiral band bordered by two ridges. The general shape is that of the last form, with an apical angle of about 95—100 degrees and five whorls, but the spiral band is not nearly so prominent and the whorls thus less angular. Its position is also lower on the whorl-side, somewhat as in *Pleurotomaria* (*Sisenna*) *turbinata* (Hoernes) var. *timorica*, Krumbeck)[1]) from a slightly higher horizon in the Lower Trias. In *Pleurotomaria subhaueri*, Krumbeck[2]) from the Upper Trias of Timor, the two ridges of the spiral band are much lower and the shape is therefore different. *Pleurotomaria koatensis*[3]), Krumbeck has a more elongated spire and the two spiral ridges are considerably farther apart.
Horizon:— Lower Eotrias, *Otoceras*? beds.
Locality:— Cape Stosch (loose block of micaceous sandstone: Lauge Koch Colln., 1927).

Family *Neritopsidae*, Fischer.

Genus *NATICOPSIS*, M'Coy, 1844.

Naticopsis arctica sp. nov.

(Plate IX. figs. 2 a—e).

1930. *Naticopsis* sp. nov, Rosenkrantz, *loc. cit.* (Preliminary Report), pp. 361—2.

The three examples here figured (of which a, b, may be taken as type) are of average size, i. e. about 20 mm. high and 25 mm. wide; but in the case of a few of the fifty specimens available these dimensions reach 25 and 30 mm. respectively. The coiling is rapid, there being only about two and a half whorls, with the initial whorl flat and low and the last whorl widening out rapidly. The basis is evenly arched, the suture sharply defined and the outer whorl may be depressed, just below the suture, so that the sutural rim (accômpanying the spiral depression) becomes attached to the previous whorl. The outer lip of the very thin shell is sharp, the inner thickened and strongly curved

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[1]) *Loc. cit.* (Pal. v. Timor, Lief. XIII, 1924), p. 187, pl. CLXXXII, figs. 8 a—d.
[2]) *Ibid.*, figs. 1—3.
[3]) *Loc. cit.* (1924), p. 183, pl. CLXXXI, figs. 21 a, b.

inwards. The striae of growth are greatly protracted and at intervals there are more pronounced, lamellar, folds, giving the ornamentation an irregular appearance. The holotype distinctly shows colour-markings, as in the Oligocene *Neritina concava* (J. de C. Sowerby). These can be seen on the right hand half of the last whorl in fig. 2a and are of quite a different type from those of e. g. the Devonian *Naticopsis harpula* (J. de C. Sowerby) figured by Newton[1]).

In its rursiradiate, almost tangential striation, the present species does not differ much even from the Carboniferous *N. plicistria* (Phillips) but this lacks the stronger "flares" and has a different whorl-shape. In the strength of this ornamentation again, there is superficial resemblance to *Naticella costata* (Münster), one of the typical fossils of the Alpine Upper Werfen Beds, but in whorl-shape *N.* (?) *lateaperta*, Krumbeck[2]) is perhaps closest to the Greenland species. The micromorph Timor form, however, has striation of a different type and direction. *Trachynerita gaillardoti* (Lefroy) and its allies[3]) have similar irregular and reflected striation, but the absence of the umbilical callosity and of internal resorption separate the Greenland species from the *gaillardoti*-group.

Horizon:— Lower Eotrias, *Proptychites* and *Ophiceras wordiei* beds.

Localities:— S. S. W. of Cape Stosch (altitude 240—260 m.); East of Cape Stosch (locality 3, altitude 560 m.; locality 4, altitude 270 m.) Danish Expedition, 1929; also one loose example from Cape Stosch, of the same mode of preservation (Lauge Koch Colln. 1927).

c. Class *Pelecypoda.*

1. Order *Anisomyaria.*

Family *Aviculidae*, Lamarck.

Genus *PSEUDOMONOTIS*, Beyrich, 1862.

Sub-genus *Claraia*, Bittner, 1900.

Claraia stachei, Bittner.

(Plate IX, figs. 1 a—d; Pl. X, figs. 5 a, b).

1901. *Pseudomonotis* (*Claraia*) *stachei*, Bittner, "Ueber *Pseudomonotis telleri* etc.". Jahrb. K. K. Geol. Reichsanst., vol. L, p. 587.

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1) Proc. Malacol. Soc., vol. VII, 1907, p. 291.

2) *Loc. cit.* (Pal. v. Timor, Lief. XIII), 1924, p. 207, pl. CLXXXIII, figs. 14 a—c.

3) See Martin Schmidt (Lebewelt unserer Trias, 1928), pp. 239—240, figs. 612—614.

1923. *Claraia stachei*, Bittner: Diener, Fossilium Catalogus, I, no. 19, Lamellibranchiata triadica, p. 39.

This species was described but not figured and must be interpreted to cover forms like *Avicula clarai* in Lepsius[1]), but with very pronounced ribbing, the radial costae being stronger than the concentric. *C. intermedia*, Bittner, and its var. *cancellata*, which are half-way between the concentrically-ribbed *C. aurita* (Hauer) and the radially ornamented *C. clarai* (Emmrich) are less extreme forms, but, as a comparison of figs. 1b-d of Plate IX, with Wittenburg's illustrations of *C. intermedia*[2]) will show, it may not be easy to decide whether there is actually predominance of one set of costation. If instead of a hundred or so of specimens there had been only a few extremes, like the almost smooth convex (left) valve figured in fig. 1a or the coarsely-ribbed impression of the inside of another convex valve, represented in fig. 1d, it is possible that they might have been referred to distinct species; but the extremes can be matched by typical examples and are believed to represent different modes of preservation of one single species rather than several contemporaneous species.

There may be a few concentric folds, in addition to the concentric and often frilled striae, but these folds are generally confined to the posterior and anterior margins and are not conspicuous in the middle, as in *C. clarai*. One or two examples, however, might well have been attached to this species. The byssal ear is preserved in many of the specimens and in the examples that include both valves (Plate IX, fig. 1b, Pl. X, fig. 5b) it can be seen that the left valve is far more convex than the right.

C. intermediaeformis, Krumbeck[3]), from the Anisian of Timor, differs considerably in shape, but *C. griesbachi*, Bittner[4]) is perhaps nearer to some of the smoother examples, although this form has scarcely any radial ribbing.

There is no difference, so far as I can see, between the examples from the *Ophiceras* beds and those from the *Proptychites* horizon in the Cape Stosch sections, but no example has yet been seen from Clavering Island or Cape Franklin.

Horizon:— Lower Eotrias, *Ophiceras* and *Proptychites* beds.

Localities:— S. S. W. and E. of Cape Stosch (Danish Exp., 1929, and localities 47 and 59 of J. M. Wordie's Colln.).

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[1]) Das westliche Südtirol, 1878, pl. I, fig. 1 a, p. 348.

[2]) "Beitr. z. Kenntnis d. Werfener Schichten Südtirols". Geol. Pal. Abh., N. F., vol. VIII, 1908, p. 274, pl. XXXVIII, figs. 3—6.

[3]) *Loc. cit.* (Pal. v. Timor, Lief. XIII, 1924), p. 238, pl. CXCVIII, fig. 4.

[4]) *Loc. cit.* (Pal. Indica, Ser. XV, vol. III, no. 2), 1899, p. 2, pl. I, figs. 1—4.

Sub-genus *Eumorphotis*, Bittner, 1900.

Eumorphotis? sp. ind. cf. *venetiana* (Hauer)

1899. *Avicula* aff. *venetianae*, Hauer; Bittner, *loc. cit.* (Pal. Indica, ser. xv, vol. III, no. 2), p. 6, pl. I, fig. 8.
1923. *Eumorphotis* sp. ind. aff. *venetianae* (Hauer) Diener, *loc. cit.* (Catalogue), p. 43.

A single cast of a convex left valve, like that figured by Bittner is doubtfully attached to the same species on account of the similar radial ornamentation, more distant and less distinct than that of the *Claraia* above described. There are fragments of the calcitic test, but the surface is corroded and the radial striation is even less distinct than on the cast. Since the whole of the anterior wing and the hinge of the posterior portion are missing, identification must remain provisional, but *Eu. multiformis* (Bittner)[1]) and *Eu. shikokuensis*, Yehara[2]) seem less close in ornamentation.

Horizon:— Lower Eotrias, *Otoceras* beds.

Locality:— Cape Stosch (in a loose block of the micaceous *Bellerophon* Sandstone, in which no example of *Claraia* has been found).

Family *Pernidae*, Zittel.

Genus *GERVILLEIA*, Defrance, em., 1820.

Gervilleia aff. *exporrecta* (Lepsius?) Bittner.

(Plate IX, fig. 7; Pl. X, figs. 11 a, b; Pl. XII, fig. 4).

1899. *Gervilleia* cf. *exporrecta*, Lepsius; Bittner, *loc. cit.* (Mém. Com. Géol. St. Pétersb., VII, no. 4), p. 16, pl. III, figs. 1—16.
1923. — — — Diener, *loc. cit.* (Fossilium Catalogus, I, 19), p. 91.
1927. — sp., Spath, *loc. cit.* (Geol. Mag.), p. 474.
1929. — sp., Lauge Koch, *loc. cit.* (Geology Greenland), p. 117.
1930. — sp., Rosenkrantz, *loc. cit.* (Preliminary Report), p. 361.

On a label accompanying some of the numerous examples of the small form of *Gervilleia* that occurs in the *Pseudomonotis* shales, Rosenkrantz identified it with the *Gervilleia* (?) sp. figured by Bittner[3]) from the *Otoceras* beds of the Himalayas. This variable form has lately been

[1]) *Loc. cit.* (Mém. Com. Géol. St. Pétersb., vol. VII, no. 4), 1899, p. 10, pl. I, figs. 15—22.

[2]) "Lower Triassic Cephalopod and Bivalve Fauna of Shikoku". Jap. Jl. of Geol. & Geogr., vol. V, no. 4, 1928, p. 168, pl. XVI, figs. 8—11.

[3]) *Loc. cit.* (Pal. Indica, Ser. XV, vol. III, no. 2), 1899, p. 8, pl. I, figs. 6—7.

considered to belong perhaps to *G.* (?) *scythica*, Krumbeck[1]), but since the latter has apparently a more cónspicuous and longer radial furrow, separating the rather large anterior wing, it seems to me preferable to attach the Greenland examples to the *Ussuri* form figured by Bittner. This is equally variable and differs from Lepsius's type[2]), or the example figured by Wittenburg[3]) in having a less blunt umbo and a smaller and more distinctly separated anterior wing at least in immature examples. The larger specimens, however, associated with Bellerophontids and a different assemblage, are essentially of the same shape, and there is nothing comparable to Bittner's fig. 12 which seems to be closest to the true *G. exporrecta*, listed by Frech[4]) as a species with a large anterior ear. In these larger examples (Plate X, figs. 11a, b, Plate XII, fig. 4) the left valve is decidedly more convex, than the right one, the difference being more conspicuous than in Bittner's fig. 9, which also represents a more elongated form. When the brown test is preserved, the striation is that of Bittner's fig. 2.

G. koatensis, Krumbeck[5]) has an entirely different hinge-line and in *G. subpannonica*, Krumbeck[6]) the posterior portion is much shorter than in the Greenland form. The original *G. pannonica*, Bittner (= *G. murchisonae*, Geinitz, var. *pannonica* in Frech)[7]) differs chiefly in its less straight anterior margin. There are yet other species of *Gervilleia* from the Lower Trias to which some of the individuals before me might have been compared, but I cannot convince myself that the *Gervilleia* spawn from the *Claraia* shales or the casts from the micaceous *Bellerophon* sandstone represent more than, at most, once species each. I now unite them in the absence of any recognisable specific difference.

The Japanese *Gervilleia* sp. recently recorded by S. Yehara[8]) and also compared to the Ussuri and Shalshal forms may be close to the Greenland species here discussed, but the figures are scarcely distinct enough for definite identification.

Whether the larger form, represented in Plate IX, fig. 8, belongs to yet a different species of *Gervilleia* is very doubtful. It is damaged beyond recognition, but it is perhaps less likely to belong to any of the other species here described, e. g. *Myalina*.

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[1]) *Loc. cit.* (Pal. Timor, Lief. XIII), 1924, p. 323.

[2]) "Das westliche Südtirol", 1878, p. 352, pl. I, fig. 6.

[3]) *Loc. cit.* (Geol. Pal. Abhandl., N. F., vol. VIII), 1908, pl. XXXIX, fig. 10.

[4]) Leitfossilien d. Werfener Schichten, *loc. cit.* (1907), p. 11.

[5]) *Loc. cit.* (Pal. v. Timor, Lief. XIII), 1924, p. 323, pl. CXCI, figs. 29—31.

[6]) *Ibid.*, p. 321, pl. CXCI, figs. 24—26.

[7]) *Loc. cit.* (1912), p. 11, text-figs. 1 a, b.

[8]) "Lower Triassic Cephalopod and Bivalve Fauna of Shikoku". Jap. Jl. Geol. & Geogr., vol. V, no. 4, March, 1928, p. 171, pl. XVI, figs. 15—16.

Horizon:— Lower Eotrias, *Otoceras?* and *Ophiceras* beds.
Localities:— S. S. W. and East of Cape Stosch (J. M. Wordie and Lauge Koch collns. and Danish Expedition, 1929).

Family *Ostreidae*, Lamarck.

Genus *ENANTIOSTREON*, Bittner, 1901.

Enantiostreon cf. *difforme* (Schlotheim).

(Plate X, figs. 6, 7).

1923. *Enantiostreon difforme* (Schlotheim), Diener, *loc. cit.* (Fossilium Catalogus, I, 19), p. 128 (See there for synonymy).
1929. — — — M. Schmidt: "Lebewelt unserer Trias", p. 166.

Portions of the plicated part of this well-known species, like that figured in Plate X, fig. 6, seem definite enough, but it is perhaps doubtful whether the unique specimen represented in fig. 7 should be attributed to the same form. The initial portion is comparable to that of the Esino specimen figured by Solomon[1]), or of Frech's var. *septemcostata*[2]), except that in the Greenland specimen the ornamentation of the underlying *Pseudomonotis* (*Claraia*) *stachei* became faintly impressed on the smooth oyster. The costate part is missing, but some fourteen bases of irregular pleats remain, and form a zigzagging margin. There are several less definite, oyster-like shells in the *Claraia* shales, as well as in the micaceous *Bellerophon*-Sandstone.
Horizon:— Lower Eotrias, *Otoceras?* and *Ophiceras* beds.
Localities:— S. S. W. of Cape Stosch (altitude 220—280 m., Danish Expedition, 1929), and in loose block of micaceous sandstone (Lauge Koch Colln. 1927).

Family *Anomiidae*, Gray.

Genus *ANOMIA*, Linnaeus, 1767.

Anomia ? (*Placunopsis?*) sp. ind.

(Plate VIII, fig. 13).

An unique example of a smooth oyster, attached to the umbilicus of a specimen of *Ophiceras* (*Lytophiceras*) *wordiei*, retains the impress of the earlier whorls on the convex valve, but the lower valve is not visible. The general appearance is that of the Lower Lias oysters that

[1]) *Loc. cit.* (Verst. d. Marmolata K.), 1895, p. 107, pl. IV, fig. 113.
[2]) *Loc. cit.* (Leitfossilien d. Werf. Schichten), 1907, pl. V, fig. 2 b.

are often found in similar positions, in the umbilicus of ammonites, e. g. the *Ostrea* figured by Quenstedt[1]) from the upper *bucklandi* beds. The Greenland form could also be compared to the larger example of *Anomia triadica* figured by Diener[2]) from the Middle Trias of Kashmir, but in the absence of the generic features, definite identification of the specimen here figured is not attempted. Since it seems to be attached by its flat, smaller, lower valve and since true oysters are as yet unknown from the Lower Trias, reference to *Anomia*, or the imperforate *Placunopsis*, appears more likely to prove correct.

Horison:— Lower Eotrias, *Ophiceras wordiei* beds.

Locality:— S. S. W. of Cape Stosch (altitude 220—280 m.), Danish Expedition, 1929.

Family *Myalinidae*, Frech.

Genus *MYALINA*, de Koninck, 1842.

1. *Myalina* aff. *schamarae*, Bittner.

(Plate X, fig. 10, Pl. XII, figs. 2, 3).

1899. *Myalina schamarae*, Bittner, *loc. cit.* (Mém. Com. Géol. St. Pétersb., vol. VII, no. 4), p. 19, pl. IV, figs. 20—25.

1923. — — — Diener, *loc. cit.* (Catalogue), p. 134.

The example here figured consists of the two valves of which the left (not shown) is the more convex. The straight hinge is longer than in *M. vetusta* (Benecke) figured by Bittner[3]) and the whole shape is more rhomboidal, but the sharp umbo, projecting posteriorly, again points to *M. vetusta* rather than *M. schamarae*, so that the identification must remain doubtful. There are only a few examples from the *Pseudomonotis* Shales, but a number of casts of *Myalina*, from the micaceous *Bellerophon* Sandstone, may also belong to this species. In the example figured in Plate XII, fig. 2 (top) the straight hinge of the posterior wing is missing, but it is preserved in some of the other specimens, occasionally with a fragment of thick, brown, test. The umbones in these sandstone casts are blunter and more separated from each other than in the first example (Plate X, fig. 10).

Horizon:— Lower Eotrias, *Otoceras*? and *Ophiceras wordiei* beds.

Localities:— S. S. W. of Cape Stosch (altitude 220—280 m. = *Pseudomonotis* Shales) Danish Expedition, 1929; also J. M. Wordie Collection (locality 47); loose block of micaceous sandstone (with *Otoceras*? and Bellerophontids), Lauge Koch Colln. 1927.

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[1]) Der Jura, 1858, p. 90, pl. XI, fig. 9.

[2]) *Loc. cit.* (Pal. Indica, N. S., vol. V, no. 1), 1913, p. 94, pl. XII, fig. 16.

[3]) *Loc. cit.* (1899), p. 17, pl. IV, figs. 17—19.

2. *Myalina kochi* sp. nov.

(Plate XI, figs. 1 a—e).

1930. *Myalina* sp. nov. II, Rosenkrantz, *loc. cit.* (Preliminary Report), p. 362.

This form is represented by a large number of examples, four of which are here figured to show the great variability in the external aspect. They all include both valves, the original of fig. 1e showing them to be more or less identical and equally convex, but other examples (see fig. 1c) have the right valve less well preserved than the left. In the typical Carboniferous forms, the right valve is smaller than the left, but *M.* (*Aviculomyalina*) *lata* from the Lower Muschelkalk of Silesia[1]) has been described as equi-valved.

The general shape is that of *Myalina eduliformis* (Schlotheim) var. *praecursor*, Frech[2]), but with a long and straight hinge, so that the posterior part forms almost a "wing". The angle between the hinge and posterior margin, rarely preserved, is nearly a right angle, but the corner is rounded; the umbo, not quite terminal, also lies in a right angle formed by the hinge and anterior margin. The diagonal ridge, with its steeper slope facing forward, and a gentle slope backward to the (generally crushed) wing, forms typically a smaller angle with the anterior margin than it does in *A. lata*, in which it is at about 45°. The similar lines of growth, also, curve inwards, not outwards, as they do in Assmann's species, so that the posterior extension in *M. kochi* is not a true "wing". The acute umbones and the incurved anterior margin below resemble those of *M. blezingeri*, Philippi[3]) of the Upper Muschelkalk, but the lines of growth indicate a less oblique shape. The cardinal area is not clearly visible in any of the specimens which all retain the test, but it is straight and apparently quite flat, no striation being preserved, as in the Palestine specimen of *Myalina tommasii* var. *obtusa* (Solomon) described by L. R. Cox[4]).

M. schamarae (Bittner), above described, differs only slightly in being less inflated, with less prominent umbones, a shorter hinge and in being altogether less coarse and robust, probably also in remaining comparatively micromorph.

Small examples of the present form, however, many of them encrusted with *Spirorbis*, occur with *Proptychites* and immediately above

[1]) Assmann "Brachiop. & Lamellibr. d. Oberschles. Trias". Jahrb. Preuss. Geol. L. A., vol. xxxvi, i, Heft 3, 1916, p. 608, pl. xxxiii, figs. 4—5.

[2]) "Neue Zweischaler und Brachiopoden aus der Bakonyer Trias". Res. Wiss. Erf. Balaton Sees, i, 2. Anhang. Pal. vol. ii, 1904, p. 20, text-figs. 23—5.

[3]) See M. Schmidt: Lebewelt unserer Trias, 1928, p. 167, text-fig. 365.

[4]) Triassic Fauna from the Jordan Valley. Ann. Mag. Nat. Hist., (9) xiv, 1924, p. 73, pl. i, figs. 17 a, b.

the larger, typical, examples occur in a very shallow-water deposit, with mud-cracks, worm-tracks, etc., but without ammonites.

Horizon:— Lower Eotrias, *Proptychites* beds and above.

Localities:— East of Cape Stosch (locality 2, altitude 470 m.; locality 3, altitude 560 m., East of Little Finsch Island (locality 5, altitudes 375 and 392 m.), Danish Expedition, 1929.

2. Order *Homomyaria.*

I. Sub-Order *Taxodonta.*

Family *Nuculidae*, Gray.

Genus *NUCULA*, Lamarck, 1799.

Nucula sp. juv. ind.

(Plate XII, fig. 12).

1930. *Nucula* sp. Rosenkrantz, *loc. cit.* (Preliminary Report), p. 361.

The microscopic internal cast of a *Nucula*, here figured (and enlarged × 4.5), shows little beyond the taxodont hinge and general shape, and no specific identification is possible. It is less elongated than the Spitsbergen *N. elongata*, Öberg[1]) and differs in shape from the well-known *N. goldfussi*, v. Alberti[2]), but there are Permian and Upper Triassic species to which it might be compared. Since the specific determination of even fully grown forms of *Nucula* is difficult, it would be impossible to venture a name for this nucleus, although no early Eotriassic species seem as yet to have been described.

Horizon:— Lower Eotrias, *Ophiceras wordiei* beds.

Locality:— S. S. W. of Cape Stosch (altitude 220—280 m.), Danish Expedition, 1929.

II. Sub-Order *Desmodonta.*

Family *Anthr osiidae*, Amalitzky.

Genus *ANODONTOPHORA*, Cossmann, 1897.

1. *Anodontophora* sp. nov. cf. *subrecta* (Bittner).

(Plate X, figs. 12 a, b).

1907? *Anoplophora subrecta*, Bittner; Frech, *loc. cit.* (Wiss. Erf. Balatonsees, I, I, no. 6), p. 56, pl. VII, figs. 5a, b.

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[1]) Trias. Försteningar från Spetsbergen, K. Sv. Vet. Akad. Handl., vol. XIV, no. 14, 1877, p. 18, pl. V, figs. 6 a, b.

[2]) For list of figures see Diener's Catalogue, 1923, p. 147.

1911? *Anoplophora* n. sp. ex aff. *subrecta*, Bittner; Wittenburg, Bull. Acad. Imp. Sci. St. Pétersb. (VI), vol. V, p. 1084.

The Greenland species here illustrated differs from Bittner's original (refigured by Frech) in having the umbo placed still more forward and in the transverse edge ending in a more conspicuous point. There is thus at least as much resemblance to *A. münsteri* (Wissmann) Münster sp.[1]) which differs chiefly in being shorter, and the internal cast, figured by Bittner (fig. 22) seems to show particularly good agreement with the more elongated Greenland example represented in Plate X, fig. 12b. It is a similar internal cast of the two valves, but the other example (fig. 12a) is a cast of only the right valve, with portions of the thick shell attached. The anterior region is damaged in both and there are only very few additional impressions of portions of single valves, as in the block figured in Plate X, fig. 13 (in the shadow, on the right). Although the species is thus probably new, I am not venturing to name it, especially since Wittenburg has already recorded what appears to be a similar or identical new form from the Lower Trias of the River Teplaja, Province of Yeniseisk, Central Siberia.

Horizon:— Lower Eotrias, *Otoceras*? beds.

Locality:— Cape Stosch (loose block of micaceous sandstone, with Bellerophontids); Lauge Koch Colln. 1927.

2. *Anodontophora* aff. *canalensis* (Catullo).

(Plate XII, figs. 10, 11, 13).

1907. *Anoplophora canalensis* (Catullo); Frech, *loc. cit.* (Wiss. Erf. Balatonsees, I, I, no. 6), p. 41, pl. VII, figs. 2a, b.

1923. *Anodontophora canalensis* (Catullo); Diener, *loc. cit.* (Catalogue), p. 230 (see there for full synonymy).

The small internal casts of single valves found in Greenland seem to show a more pronounced transverse edge than the Alpine species but they agree well with the Ussuri examples figured by Bittner[2]). There is some variability, in respect of this transverse ridge, as well as in convexity and shape. Some casts retain portions of the test and then show fine concentric lineation, like Bittner's fig. 36. In other casts,

[1]) See Bittner ("Lamellibranchiaten der alpinen Trias" I, Abh. K. K. Geol. Reichsanstalt, vol. XVIII), 1895, p. 9, pl. I, figs. 22—25.

[2]) *Loc. cit.* (Mém. Com. Géol. St. Pétersb., vol. VII, no. 4), 1899, p. 23, pl. II, figs. 34—38.

there are stronger folds, not confined to the lower half, as in Bittner's fig. 38. It is even possible that the unique *Pleuromya*-like example here figured in Plate XII, fig. 13, is merely an unusually strongly ribbed extreme form of the present species. The projecting umbo, however, also gives it a rather distinct aspect.

The Greenland species referred below with doubt to *A. fassaensis* differs apparently only in having less symmetrical valves, i. e. a less central umbo.

Horizon:— Lower Eotrias, *Otoceras*? beds.

Locality:— Cape Stosch (loose block of micaceous sandstone, with Bellerophontids); Lauge Koch Colln. 1927.

3. *Anodontophora* cf. *fassaensis* (Wissmann) Münster sp.

(Plate XI, fig. 2).

1907. *Anoplophora fassaensis* (Wissmann); Frech, *loc. cit.* (Wiss. Erf. Balatonsees, I, I, no. 6), p. 40, pl. VII, figs. 3a-f.

1923. *Anodontophora fassaensis* (Wissmann) Münster sp.; Diener, *loc. cit.* (Catalogue), p. 231 (see there for full synonymy).

The sandstone casts on the slab here figured are perhaps unidentifiable definitely, and some in any case seem to be more equilateral, like the specimen of *A. canalensis* figured by Wittenburg[1]). The larger slab illustrated (Plate XI, fig. 2) is a grey sandstone, but in similar red beds only 5 m. higher an identical assemblage occurs, associated with red slabs (Plate XII, fig. 15) in which the shells are small and almost unrecognisable. In the Alpine Eotrias, *A. fassaensis* and its companion species *A. canalensis* occur in the lower Seis Beds as well as in the upper Campile Beds.

Horizon:— Lower Eotrias.

Locality:— East of Little Finsch Island Locality 5, altitudes 400—410 and 415 m., Danish Expedition, 1929.

4. *Anodontophora* sp. ind.

(Plate X, figs. 8, 9; Pl. XI, figs. 3 a—e; Pl. XII, figs. 6 a, b).

1930. *Myophoria* ? (*Schizodus* ?), Rosenkrantz, *loc. cit.* (Preliminary Report), p. 362.

A large number of internal casts of this form, largely on account of being worn, superficially resemble similarly preserved specimens of

[1]) *Loc. cit.* (Geol. Pal. Abhandl., N. F., vol. VIII), 1908, p. 281, pl. XI., fig. 6.

the common smooth *Myophoria* of the type of *M. orbicularis* and *M. ovata*[1]), but the position of the adductors is different and the hinge area is that of *Anodontophora*, as far as can be seen. In a few specimens with the actual shell, the shape is rather like that of *Trigonodus orientalis*, Bittner[2]), except that the transverse edge is still more curved (making the umbonal region very rounded), also slightly more distinct, and the posterior area, bordered by this edge, is smaller. There is also greater inflation, the thickness of the two valves being nearly half the length in the Greenland form, whereas it is less than a third in *T. orientalis*. The left valve is noticeably larger than the right.

A. fassaensis var. *brevis*, Bittner[3]), is decidedly closer. The external aspect of specimens with the test is that of Bittner's fig. 17, but the shape is more like that of the original of his fig. 16, i. e. the umbonal region is not quite so inflated. Frech, who unnecessarily altered the varietal name into "mut. *bittneri*", figured two more examples[4]), which are, however, less comparable. *A. brevis* (Schauroth)[5]) also has a different shape. In the stratigraphical account I shall refer to this species as a "breviform" *Anodontophora*, without, however, using this name in a specific sense, until better material is available.

The examples figured in Plate X, figs. 8, 9, from a white, micaceous sandstone, do not seem separable specifically from the specimens preserved in a red rock. Mr. Wordie collected the latter forms at 1250 ft. altitude and the former at 1080 ft., both in situ; in the material collected by the Danish Expedition of 1929, however, the two matrices are represented from locality 2, East of Cape Stosch, at the same level (445 m.). It may be added that the radial depression seen near the anterior end of the left valve represented in Plate X, fig. 8 is believed to be accidental since other examples are deformed in various ways in the coarse sandstone matrix.

Horizon:— Lower Trias.

Localities:— Cape Stosch (altitude 300—320 m., Lauge Koch Colln., 1927) and East of Cape Stosch (localities 1, altitude 290 m.; 2, altitude 445 m.; 3, altitude 600—610 m., loose, Danish Expedition, 1929; no. 51, J. M. Wordie Colln.).

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[1]) See Rübenstrunk: "Beitr. z. Kenntn. d. deutschen Trias-Myophorien". Mitt. grossh. bad. Geol. Landesanstalt, vol. VI, 1912, pl. VII, figs. 1—4.

[2]) *Loc. cit.* (Mém. Com. Géol. St. Pétersb., vol. VII, no. 4), 1899, p. 22, pl. III, fig. 27.

[3]) "Lamellibranchiaten aus der Trias des Bakonyer Waldes". Res. Wiss. Erf. Balatonsees, I, I, Anhang, No. III, 1901, p. 84, pl. IX, figs. 13—17.

[4]) *Loc. cit.* (Res. Wiss. Erf. Balatonsees, I, I 1907), p. 41, pl. VII, figs. 1 a, b.

[5]) See M. Schmidt: Lebewelt unserer Trias, 1928, p. 178, text-fig. 400.

5. *Anodontophora* (?) sp. nov.

(Plate XII, figs. 7—8).

1929. *Myophoria* sp., Lauge Koch, *loc. cit.* (Preliminary Report), p. 117.

In a considerable number of casts in sandstone, a vertical ridge under the high posterior adductor, and a slight pallial sinus below are the most conspicuous features, as in the cast of *A. münsteri* (Wissmann) figured by Bittner (fig. 22) and already referred to above. A corresponding ridge under the smaller anterior adductor is less noticeable. This adductor lies between the rounded anterior margin and a deep groove, below the umbones, as in *Myophoria*. The test, apparently, was very thick, especially near the umbones, and smooth. On the casts, however, there are two faint ridges, bordering the triangular umbones, in the form of two inverted V's, one inside the other. This again points to the integri-palliate *Myophoria*, as does the excavation of the anterior, cardinal side of the umbones. The transverse edge to the posterior border, however, is faint and the shape as a whole is only slightly more ovate than that of *Myophoria* (*Heminajas*) *balatonis*, Frech[1]). The dentition cannot be exposed, but the umbones are rather high above the broken-off hinge, especially on the undercut anterior side.

This species is probably new, but since only sandstone casts are available, it may be advisable to await the discovery of better material. It cannot be attached to the sinupalliate genus *Allorisma*, King, known from the Permian and, doubtfully, from the Ladinian, and there is lack of comparable material from the Lower Trias. The form is now tentatively referred to *Anodontophora* because it seems to group itself more naturally with the other *Myophoria*-like species of *Anodontophora* above described.

Horizon:— Lower Trias, *Otoceras*? beds.

Locality:— Cape Stosch (loose block of micaceous sandstone, with *Otoceras*? and *Bellerophon*); Lauge Koch Colln., 1927.

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[1]) See Arthaber, Lethaea geognostica, II, I, Lief. 3, 1905, pl. XXXIV, figs. 8 a, b.

II. *Phylum Molluscoidea.*

Class *Brachiopoda.*

Order *Atremata.*

Family *Lingulidae,* Cuvier.

Genus *LINGULA*, Bruguière, 1797.

Lingula borealis, Bittner.

(Plate XII, fig. 9).

1899. *Lingula borealis*, Bittner: "Versteinerungen aus den Trias-Ablagerungen des Süd-Ussuri Gebietes etc.". Mém. Com. Géol. St. Pétersb. vol. VII, no. 4, p. 25, pl. IV, figs. 1—7.
1929. — sp., Lauge Koch, *loc. cit.* (Geology of East Greenland). p. 117.

The Greenland examples are not so large as the Siberian types, the figured specimen (Plate XII, fig. 9) being only 7 mm. long and 3.66 mm. wide, while a second specimen is 5 mm. long. The brown, horny, test is preserved in the first specimen but flaked off during the preparation of the second, so that the micaceous sandstone cast is scarcely recognisable as a *Lingula.*

L. tenuissima, Bronn, which has been found in the Muschelkalk as well as in various horizons of the Lower Trias does not seem to differ greatly. According to Bittner, the more parallel sides of *L. borealis* necessitated separation from Bronn's species which seemed constantly to show a narrowing towards the umbo. If Bittner's example of *L.* cf. *tenuissima*[1]) is typical, the shape of the Greenland specimens would, indeed, indicate affinity with *L. borealis* rather than *L. tenuissima*; but Martin Schmidt's[2]) drawings of the latter species and the allied

[1]) *Loc. cit.* (Mém. Com. Géol. St. Pétersb., vol. VII, no. 4), 1899, pl. IV, fig.
[2]) "Die Lebewelt unserer Trias", 1928, p. 137, fig. 271.

or identical *L. zenkeri*, Alberti, do not seem to me to warrant specific separation of the boreal form. Bittner's *L.* cf. *tenuissima* in fact, recalls in external shape the wider *L. deitersensis*, Pflücker[1]) (= *L. cloacina*, Quenstedt) of the Rhaetic. If I now adopt Bittner's name for the Greenland specimens it is done chiefly because the Hungarian specimens of *L. tenuissima* from the Eotrias (Lower Seis and Upper Campile beds) figured by Frech[2]) also do not show the parallel sides of *L. borealis*.

Horizon:— Lower Eotrias, *Otoceras*? beds.

Locality:— Cape Stosch (loose block of micaceous sandstone, with Bellerophontids), Lauge Koch Colln., 1927).

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[1]) »Die Lebewelt unserer Trias«, 1928, p. 137, fig. 272.

[2]) *Loc. cit.* (Leitfossilien der Werfener Schichten), 1907, p. 45, pl. I, figs. 12—13.

III. *Phylum Vermes.*

Class *Annelida.*

Order *Polychaeta.*

Genus *SERPULA*, Linnaeus, 1758.

Serpula sp. nov? ind.

(Plate X, fig. 2).

The specimen of a flaggy, micaceous sandstone here figured is crowded with annelid tubes that may show an open or closed spiral beginning and often resemble *Spirorbis*, when the uncoiled, later part of the tube is missing; but they are not attached to other organisms although casts of pelecypod shells occur elsewhere in the same rock. The general appearance, suggests comparison with *Vermetus triadicus*, Grupe[1]), rather than with any of the Muschelkalk species of *Serpula* figured by Schmidt[2]), but it should be added that this author thought *Vermetus triadicus* to be probably an aberrant form of *Spirorbis*, and in view of the delicate, transverse striation, perhaps of *Spirorbis aberrans*, Hohenstein. The much larger Greenland tubes, however, almost smooth and occasionally without a spiral beginning, are, perhaps, more closely comparable to *Vermilia obscura*, King[3]), although this is still more irregular in shape.

I thought at first that yet another species of *Serpula* was represented by curious, nodular, accumulations of many hundreds of small tubes, more or less straight and sometimes tapering, but rather too irregular to be anything but *Serpula*-tubes. These accumulations form pseudo-concretionary masses in the *Myalina* flags where they are associated with large worm-tracks and ripple-marks. But where the tubes are less closely packed they are more like the examples here figured, so that I am now including them in the same new species. It is probable that the occurrence, in such enormous numbers, accounts for the different appearance in the mass and the general straightness of the broken

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[1]) See in Martin Schmidt: "Lebewelt unserer Trias, 1928, p. 223, fig. 556.

[2]) *Ibid.*, p. 119, figs. 225—227.

[3]) *Loc. cit.* (Monogr. Brit. Perm. Fossils), 1850, p. 56, pl. VI, fig. 14.

tubes. I am indebted to Mr. T. H. Withers of the British Museum (Natural History) for drawing my attention to similar masses of *Serpula advena*, Salter, that occur in the Upper Old Red Sandstone of Caldy Island, Pembrokeshire.

Horizon:— Eotrias.

Locality:— East of Cape Stosch (locality 2, altitude 445 m.), and East of Little Finsch Island (locality 5, altitude 375 m.); Danish Expedition, 1929.

Genus *SPIRORBIS*, Daudin, 1800.

Spirorbis valvata (Goldfuss) Berger sp.

(Plate IX, fig. 9).

1907. *Spirorbis valvata* (Goldfuss) Frech, *loc. cit.* Leitfossil. d. Werfener Schicht.), p. 45, pl. I, figs. 1a—c.

1928. — — (Berger) Martin Schmidt, Lebewelt unserer Trias, p. 120, fig. 228.

1930. — sp. (attached to *Pseudomonotis*), Rosenkrantz, *loc. cit.* (Preliminary Report), p. 361.

There are a number of colonies of this form, a few on valves of *Pseudomonotis*, many on *Myalina*. The upper surface is highly arched and shows a narrow umbilicus; the lower flat side by which the shells are attached shows two to three *Planorbis*-like whorls. On splitting some of the specimens of *Pseudomonotis*-flags, faint impressions of the *Spirorbis* coils may be exposed on the pelecypod valves; the entire shells, as seen in Plate IX, fig. 9, seem to occur only on weathered surfaces.

Frech recorded this Muschelkalk species from the Lower Trias (Campile beds of Hungary) and stated that since the spiral annelids changed but little from the Devonian to the present day, the persistence of one species through several horizons in the Trias was scarcely remarkable. The Permian *S. helix*, King[1]) which has also been recorded from the Middle and Upper Productus Limestone of the Salt Range, is apparently distinguished by a smaller umbilicus of the upper surface and a more elevated shape with a narrower base, but it may be doubted whether these differences are really specific.

Horizon:— Eotrias, *Ophiceras* beds and higher.

Localities:— S. S. W. of Cape Stosch (*Ophiceras wordiei* beds, altitude 220—280 m.) and East of Cape Stosch, locality 3, at 615 m. (*Myalina* beds); Danish Expedition, 1929.

[1]) Monogr. Brit. Permian Fossils, Pal. Soc., 1850, p. 54, pl. VI, figs. 10, 11.

C. LISTS OF LOCALITIES, AND STRATIGRAPHY.

It is advisable to list the assemblages from the different localities, partly for stratigraphical purposes, partly in order to discover whether the different faunas indicate deposits of different date or merely different facies. There is some disagreement in the heights given by the different collectors and correlation is thus often difficult, even in the case of the cliff-sections W and E of Cape Stosch. The actual distance along this part of the coast is about 30 km. or less than 20 miles, while the section at Hird's farm on Clavering Island is only just across the bay, but Cape Franklin is some 95 km. (60 miles) south of Cape Stosch in a straight line. The lists given below are instructive, however, for comparison with the Buntsandstein deposits of the Germanic Basin, with its rare *Gervilleia* beds, between non-marine or very shallow-water or shore deposits, and with the Alpine Seis and Campile Beds. When looking at a section in these Werfen beds with their repetition of red and green micaceous shales and marls and ripple-marked calcareous sandstones[1]), one is struck by their similarity to the Scythian deposits of Greenland. There is general absence of calcareous rocks and even the fragment of the impure *Ophiceras* limestone of Clavering Island, represented in Plate X, fig. 1, on the side not figured has passed into a coarse micaceous sandstone.

As regards the material collected by Mr. Wordie in 1926, only little can be added to the lists already published, but the names are now revised. The sections are arranged more or less geographically, starting with the neighbourhood of Cape Stosch, and where sequences are given they read in descending order. It may be recalled from Mr. Rosenkrantz's Report that the dip of the beds as a whole is to the west, so that the basal, conglomeratic, beds would be high up in the cliff sections to the east. At the same time, the beds of the "lower brown

[1]) See Wittenburg, *loc. cit.* (Beitr. z. Kenntn. der Werfener Schichten), 190[?], pp. 14—15, profile no. v (Sojal).

and green series", from 250—350 m. thick and rather variable, thin gradually towards the east until they disappear entirely west of Little Finsch Island.

I. South-south-west of Cape Stosch. The great majority of the ammonites described in the present paper and collected by the Danish Expedition of 1929 came from this locality, near to and east of the Norwegian Hut, but there is no detailed section. The *Ophiceras* beds are stated to be at a height of from 220—280 m., with the principal, fossiliferous horizon about 5 m. thick, but apparently much covered by scree. From the Preliminary Report it appears that this horizon is some 140 m. above the base of the Wordie Creek Formation. Some examples of *Claraia* and *Naticopsis* are labelled 240—260 m. or 240—280 m., and there is also a sample of loose, greenish, micaceous, shaly marl, from the 240 m. level, but the facies is essentially the same and this is obviously the "clayey horizon with marly concretions", rich in beautifully preserved ammonites, referred to by Rosenkrantz. This "*Ophiceras wordiei* bed" has yielded the following species:—

Ophiceras aff. *demissum* (Oppel).
— *greenlandicum* sp. nov.
— (*Lytophiceras*) *sakuntala*, Diener.
— — *chamunda*, Diener.
— — *ptychodes*, Diener
— — aff. *evolutum*, Frech and Noetling.
— — *kochi* sp. nov.
— — *commune* sp. nov.
— — *wordiei* sp. nov.
— — *subkyokticum* sp. nov.
— (*Acanthophiceras* ?) sp. juv. aff. *gibbosum*, Griesbach.
Glyptophiceras minor sp. nov.
— *gracile* sp. nov.
— *pascoei* sp. nov.
— *pseudellipticum* sp. nov.
— *sp. ind.*
Bellerophon borealis sp. nov.
— sp. ind.
Naticopsis arctica sp. nov.
Claraia stachei, Bittner.
Gervilleia aff. *exporrecta* (Lepsius ?) Bittner.
Enantiostreon ? sp. ind.
Anomia ? (*Placunopsis* ?) sp. ind.
Myalina aff. *schamarae*, Bittner.

Spirorbis valvata (Goldfuss) Berger sp.
Nucula sp. juv. ind.

This list is not complete and in Plate XII, fig. 14, I have figured a fragment of the rock containing a number of microscopic gastropods.

II. South-south-west of Cape Stosch. — Mr. Wordie's first assemblage (No. 47) labelled 1100 ft. (335 m.) altitude is apparently not from quite the same spot as (I), although there can be no doubt that it is from the same *Ophiceras* bed. The greenish micaceous matrix is identical and there are the same *Claraia* nodules, but this assemblage is followed, at 1600 ft. (408 m.) by a conglomerate (20 ft.) containing blocks of red sandstone with pelecypod shells (badly preserved) in white calcite and slightly different from anything collected by the Danish Expedition. The only recognisable pelecypods in this higher assemblage are a *Myalina*, not distinguishable so far as can be seen from *M. kochi* described above, and perhaps a *Gervilleia*. The assemblage of the "*Ophiceras wordiei* bed" is as follows:—

Ophiceras (*Lytophiceras*) aff. *evolutum*, Frech and Noetling.
— — aff. *ptychodes*, Diener.
— — aff. *sakuntala*, Diener.
— — *commune* sp. nov.
— — *wordiei* sp. nov.
— — *subkyokticum* sp. nov.
— — spp. juv. ind.
Bellerophon cf. *vaceki*, Bittner.
Claraia stachei, Bittner.
Gervilleia aff. *exporrecta* (Lepsius ?) Bittner.
Myalina aff. *schamarae*, Bittner.
Platysomus sp.

III. Cape Stosch. — There are various fossils collected loose by Dr. Lauge Koch on his 1927 expedition, but they can be matched by others from known horizons and need not be discussed separately. On the other hand he found at 300—320 m., in situ, a greenish grey, micaceous, sandstone, with the white calcite shells or internal casts of the breviform *Anodontophora* above discussed, which corresponds with the "*Schizodus*-horizon" (at 445 m.) of locality 2, mentioned below. At 300 m. altitude also, east of Cape Stosch, Dr. Koch found the loose block of greenish-grey micaceous sandstone, teeming with fossils, that he recorded already in 1929. The most important of the fossils then listed was "an *Otoceras*[1])-like ammonite", although occurring only in fragments; but I have not been able to find these. There is however, another piece of the same rock in the collection with fragments of *Otoceras* ?, only this bears a label: "Lejr I [fr. Kap Stoch] 560 m., 27.7, 1929. A. Noe-Nygaard". This is the *Proptychites* horizon of locality 3 and since the matrix is quite different, there may have been confusion of labels. The first block on the other hand, possibly transported up the cliff by ice pressure, seems to be out of place at an altitude of 300 m. It contains the following species, and in view of the importance of this fauna it is to be hoped that the rock may be found in situ by this year's expedition.

Otoceras ? sp. ind.
Ophiceras sp. nov. aff. *sakuntala*, Diener (pars).
Glyptophiceras sp. ind.
Bellerophon borealis sp. nov.
Worthenia cf. *humilis*, J. Boehm.
— ? sp. ind.
Eumorphotis ? sp. ind. cf. *venetiana* (Hauer).
Gervilleia aff. *exporrecta* (Lepsius ?) Bittner.
Enantiostreon cf. *difforme* (Schlotheim).
Myalina aff. *schamarae*, Bittner.
Anodontophora sp. nov. cf. *subrecta*, Bittner.
— aff. *canalensis* (Catullo).
— sp. ind.
— (?) sp. nov.
Lingula borealis, Bittner.

IV. East of Cape Stosch (locality 1, Danish Expedition of 1929). There are only pieces of a fine-grained, and of a somewhat coarser, grey micaceous sandstone, with the breviform *Anodontophora*, already mentioned, also loose internal casts of the same shell; further unfossiliferous red sandstones and pebbly grits, with fragments of probably the same *Anodontophora*. They are all from altitude 290 m. i. e. nearly the same level as the corresponding 300—320 m. horizon discussed under III.

V. East of Cape Stosch (J. M. Wordie Colln., nos. 48--52). Mr. Wordie's second locality, from which came the *Proptychites* previously recorded, has also yielded pelecypods at higher levels which can be matched by specimens from known horizons in other sections.

[1]) The rendering of this as *Orthoceras* was obviously due to a misprint.

(c) Altitude about 380 m. (1250 ft.). *Anodontophora* sp. (breviform) Red micaceous sandstone, with badly preserved, calcitic shells and internal casts (Plate XII, figs. 6a, b).
(b) — — 330 m. (1080 ft.). *Anodontophora* sp. (breviform) Grey micaceous sandstone with white shells.
(a) — — 183 m. (600 ft.). *Proptychites* aff. *rosenkrantzi* sp. nov. (Plate VIII, figs. 2a-h).

I am listing this locality here because the heights seem to indicate a position close to Cape Stosch and west of locality 2 (No. VI) recorded below. Dr. Koch, in his Geology of East Greenland (p. 118) mentioned that since the Permian conglomerates occurred everywhere at this height, south-south-west of Cape Stosch, Wordie's *Proptychites* must have been collected from a loose block and not in situ. The ammonites are, indeed, all isolated and weathered but Mr. Wordie tells me that they were in situ. There is one example among the new material from No. VII (locality 3, Danish Expedition, 1929) in a similar preservation that shows that we are probably dealing with the same *Proptychites* horizon.

Again it should be pointed out that the red and the grey micaceous sandstones (with white shells of the breviform *Anodontophora*) occur together at locality 2, at the same level. The shells of (b) may not have been collected in place; but I am assured by Mr. Wordie that the *Anodontophora* were in situ at 1080 ft.

VI. East of Cape Stosch (locality 2, Danish Expedition, 1929). Fossils were collected at four levels, as follows:—

(d) Altitude 470 m. Hard, grey, flaggy sandstone, with impressions of *Myalina*, probably *M. kochi.*
(c) — 445 m. "*Schizodus* horizon" of Rosenkrantz. Red and grey micaceous sandstones with the breviform *Anodontophora*, above discussed (Plate XI, fig. 3); also *Serpula* sp. nov.? ind. (Plate X, fig. 2).
(b) — 410 m. Calcareous grit, with mica, and weathering with a very rough surface, enclosing *Myalina* sp., *Anodontophora* of *canalensis*-type, and fragments of other shells.
(a) — 260 m. *Ophiceras* bed. Typical *Claraia* nodules, also *Myalina*, and although no *Ophiceras* seems to have been collected, this appears to be the same bed as the *Ophiceras wordiei* bed in I.

VII. East of Cape Stosch (locality 3, Danish Expedition, 1929). Although this is a fairly complete section, as represented by the material before me, it does not include the *Ophiceras wordiei* horizon, nor the sandstone with the breviform *Anodontophora*, which in the last section (I) occured 185 m. above the *Ophiceras* horizon.

(g) Altitude 700 m. Coarse, friable, micaceous sandstone (unfossiliferous).

(f) — 615 m. Purplish micaceous marl or shale, with numerous *Myalina kochi*, many of them coated with *Spirorbis*; also *Anodontophora* aff. *fassaensis*, and one doubtful, worn, internal cast of the breviform *Anodontophora*.

(e) — 605 m. Fine, micaceous, flags, with ripple-marks and worm-tracks, also the slab with fucoid markings figured in Plate XII, fig. 5.

(d) — 560 m. Purplish shale, like (f) above, but also greenish-grey, micaceous shale with nodules containing *Claraia stachei*, indistinguishable from those of *Ophiceras wordiei*-bed in I and II, also *Proptychites rosenkrantzi*, numerous *Naticopsis arctica* sp. nov., and *Myalina* sp. (some coated with *Spirorbis*, like *Claraia* valves).

(c) — 450 m. Thin-bedded, flaggy sandstone, with impressions of *Myalina* sp.

(b) — 440 m. Ripple-marked, fine-grained, micaceous flaggy sandstone, with concretionary casts.

(a) — 370 m. Coarse, white, pebbly sandstone (without fossils).

There is also a slab of a hard, micaceous, calcareous sandstone, found loose at altitude 600—610 m., with numerous casts of *Anodontophora* of the breviform and *canalensis-fassaensis* types.

VIII. East of Cape Stosch (locality 4, Danish Expedition, 1929). In addition to a specimen of a flaggy, micaceous rock, with ripple-marks and worm tracks (found loose at altitude 140 m.), comparable to that from (e) above, there are specimens from only two levels. The upper (altitude 360 m.) yielded a coarse, micaceous sandstone, without fossils, but the lower horizon (altitude 270 m.) is important since there *Proptychites rosenkrantzi* antl the *Ophiceras transitorium* assemblage have been found together. The preservation of the former is identical with that of the *Proptychites* in Mr. Wordie's second assemblage; the *Ophiceras* and *Claraia* nodules agree with those of Mr. Wordie's *Vishnuites* locality, at which, however, the typical *Ophiceras wordiei* assemblage also occurs, possibly at a slightly different level. The assemblage consists of:—

Ophiceras transitorium sp. nov.
— aff. *greenlandicum* sp. nov.
Proptychites rosenkrantzi sp. nov.
Naticopsis arctica sp. nov.
Claraia stachei, Bittner.
Myalina aff. *schamarae*, Bittner.

This makes it probable that the so-called "*Proptychites* horizon" forms only a subzone within the "*Ophiceras* beds" and is still of Otoceratan or Lowest Eotriassic age.

There are also from the same altitude (270 m.) blocks of a coarse, calcareous, micaceous grit, with obscure shells and fossil wood, different from the matrix of the fossils just listed. On the other hand, in a piece of a similar, impure, calcareous rock, apparently from the same level, *Ophiceras* and *Proptychites* are again associated; together with some doubtful examples of *Gervilleia* (Plate IX, fig. 8) and *Anodontophora* (?) sp. nov.

IX. 10 Miles (16 km.) East of Cape Stosch (a little west of Little Finsch Island). J. M. Wordie Colln., Nos. 57-59. A fuller list of the *Ophiceras* fauna, previously recorded, from an altitude of 1350—1500 feet (410—457 m.) can now be given:—

Ophiceras transitorium sp. nov.
— *greenlandicum* sp. nov.
— (*Lytophiceras*) *commune* sp. nov.
— — aff. *sakuntala*, Diener.
— — aff. *ptychodes*, Diener.
— — *wordiei* sp. nov.
— — *subkyokticum* sp. nov.
Glyptophiceras minor sp. nov.
Vishnuites wordiei sp. nov.
— *decipiens* sp. nov.
Claraia stachei, Bittner.
Spirorbis valvata (Goldfuss) Berger sp.

There is also a *Productus* marked as coming from the same altitude, but this may be out of the Drift. The limestone with brachiopods, from the same section, and another, different limestone, also with brachiopoda and numerous polyzoans, are marked "800 ft." and they are followed below (at 700—750 ft.) by the Carboniferous *Posidonomya* Shales. Here again, Mr. Wordie informs me, the fossils were collected in situ.

X. **East of Little Finsch Island** (locality 5, Danish Expedition, 1929). This section is the most complete, but there are various unfossiliferous sandstones and shallow-water rocks and no ammonites whatever, so that correlation with the other sections is as yet very doubtful.

(o)	Altitude 615 m.	Decomposed, ochreous, friable sandstone, with fibrous gypsum, and light, coarse, flaggy sandstone, without fossils.
(n)	— 600 m.	Coarse, pebbly sandstone, with fragments of greenish shale.
(m)	— 515 m.	Loose, grayish-green sand, very fine and very micaceous.
(l)	— 510 m.	Loose, red, earthy, haematitic sandstone.
(k)	— 480 m.	Sandstone, with pebbles of green shale, and coarse, micaceous, flaggy sandstone, without fossils.
(j)	— 465 m.	Red, flaggy sandstone, thin bedded and unfossiliferous.
(i)	— 450 m.	Red, micaceous sandstone slabs, with ripple marks and no fossils.
(h)	— 435 m.	Coarse, micaceous sandstone flags with *Anodontophora* sp., like that figured in Plate XI, fig. 2.
(g)	— 415 m.	Fine-grained, red, flaggy sandstone, same as figured in Plate XI, fig. 2, with *Anodontophora*, but red; also red slabs with smaller shells (Plate XII, fig. 15), occasionally green on the oposite side (and bearing *Myalina*).
(f)	— 400-410 m.	Grey sandstone-slabs with *Anodontophora canalensis* and *fassaensis* (Plate XI, fig. 2); but some blocks less flaggy, coarse, with pebbles and *Myalina* sp.
(e)	— 395 m.	Thin-bedded, gray, micaceous sandstone-flags.
(d)	— 392 m.	Greenish, micaceous, calcareous sandstone, with some *Myalina* (and *Spirorbis* attached) like those of the purplish *Proptychites* Bed of section VII.
(c)	— 375 m.	*Myalina kochi* horizon. Micaceous, greenish to purplish, fine-grained sandstones or shales, with numerous *Myalina kochi* (Plate XI, figs. 1a-e), but also with various types of worm-tracks, mud-

cracks, and concretionary masses, caused by accumulations of the small *Serpula*-tubes mentioned in the descriptions above.

(b) Altitude 360 m. Slab of fine-grained, greenish, micaceous sandstone, with wind-blown mud-pellets or concretions.

(a) — 275 m. Worm-tracks on a fissile, green, fine-grained, micaceous shale.

The similarity of the matrix might suggest correlation of the *Myalina* horizons (d and c) with the *Proptychites* bed of vii, but at locality 2 (No. vi, above) probably the same *Myalina* occurs in a sandstone 210 m. higher than the *Claraia* nodules (confined to the *Ophiceras* and *Proptychites* horizons), so that Rosenkrantz has taken the *Myalina* beds to form the middle division of his "Variegated Series". In any case they indicate a very shallow water phase, but the occurrence of *Ophiceras* still farther east shows that the absence of ammonites in this section x is probably due only to accidents of collection, e. g. covering of the lower beds by scree.

XI. About 4 km. East of Little Finsch Island (locality 6, Danish Expedition, 1929). At an altitude of about 50 m., the following ammonites were collected (by Norwegian hunters):—

Ophiceras cf. *demissum* (Oppel).
— (*Lytophiceras*) *wordiei* sp. nov.

XII. Hird's Fox Farm on Clavering Island (Danish Expedition, 1929). There are examples of conglomerate and ripple-marked, red, sandstone, apparently from Rosenkrantz's lower sandstone series (about 20 m. in thickness), following unconformably on the Brachiopod Limestone below. The altitude of the succeeding, thin, *Ophiceras* limestone is not given. One of the most favourably preserved pieces of this impure limestone is here illustrated (Plate X, fig. 1) and it will be seen that specific determination of the ammonites is impossible. The narrow peripheries, however, not entirely due to deformation in the rock, suggest comparison with the species of *Ophiceras* (*Lytophiceras*) of the typical Cape Stosch sections. This thin *Ophiceras* band is followed by a series of brown, unctuous clays, 25 m. in thickness, with red concretions, resembling the clay ironstone nodules of the Aptian Atherfield Clay of the Isle of Wight, or of the Lower Liassic *Caprarius* Shales of Pabay, Inner Hebrides. These concretions, with blue centres, where unweathered, and banded and calcareous, include:—

Otoceras aff. *fissisellatum*, Diener.
Glyptophiceras gracile sp. nov.
— *pascoei* sp. nov.

There are also samples of a hard, sandy, and two softer types of marl, from altitudes of 320 m., 330 m. and 351 m. (the last two with gypsum), but they are unfossiliferous and their position in the sequence (apparently above the *Otoceras* clays) is doubtful and in any case of little help for correlation.

XIII. West of Cape Franklin (Danish Expedition, 1929). This section is again of considerable interest since it includes an *Ophiceras* horizon apparently high up in the basal series:—

(f)	Altitude	600 m.	Micaceous, flaggy sandstone, without fossils.
(e)	—	550 m.	Micaceous, sandy shale, with numerous *Ophiceras*, all badly crushed, but of the *sakuntala* group.
(d)	—	540 m.	Ripple-marked sandstone, yellowish-grey, and with comparatively large flakes of mica.
(c)	—	350 m.	Red, flaggy micaceous sandstone, with fossil wood and obscure shell remains.
(b)	—	140-200 m.	Concretionary, flaggy, sandstone.
(a)	—	100 m.	Concretionary, micaceous, sandstone.

There are also fragments of a micaceous, sandy, limestone, with badly preserved *Ophiceras*, found loose at 150 m. altitude, and of a micaceous sandstone, more flaggy than the shale (e) above, containing poor impressions of *Ophiceras* and *Glyptophiceras* (found loose at 400 m.). These two types of rock are thus not derived from the *Ophiceras* horizon (e) and show that at this locality also the "*Ophiceras* beds" include a varied congeries of sediments and probably a considerable thickness.

D. THE AGE OF THE FAUNA.

When I first discussed the age of the Eotriassic ammonites found by Mr. Wordie in East Greenland I stated that the *Ophiceras* assemblage represented an early Eotriassic fauna, later than the typical *Ophiceras* (*tibeticum*) beds of the Himalayas, but earlier than the lowest (*Gyronites*) beds of the Salt Range succession. This opinion was based on the presence in the Greenland fauna of many examples of those discoidal ammonites that in general appearance resemble *Koninckites*, but as yet do not show the advanced auxiliary series characteristic of this genus. On the other hand, there was a complete absence of forms with truncate venters, and there were no examples of *Otoceras*, a genus which still occurs in the *tibeticum* "zone" of the Himalayan Trias, or even of "*Xenodiscus*", so common in the beds with *Ophiceras sakuntala* of Kashmir. The discovery of *Otoceras* in Greenland, however, now necessitates a review of the evidence as regards the age of these Eotriassic beds, especially since Rosenkrantz has shown that *Otoceras* occurred not below, but above a limestone band with numerous, though badly preserved *Ophiceras*.

Diener[1]) put forward good reasons for rejecting Noetling's three "zones" of

Ophiceras tibeticum, Griesbach.
Episageceras dalailamae, Diener.
Otoceras woodwardi, Griesbach.

He quite rightly concluded that what had been termed "zone" by Noetling was "a minute subdivision of the *Otoceras* beds, of local value only", and had nothing whatever to do with true palaeontological zones. The subzones in the Gault of Folkestone, or the Lower Lias of Dorset, are similar divisions of purely local value; they are of some use to collectors (since, unlike many so-called "hemerae", these subzones

[1]) In Krafft and Diener, *loc. cit.*, (Pal. Indica, 1909), p. 165.

are based on observation, not surmise) but their insertion in an ideal time-scale would be most misleading. The stratigraphical unimportance of these local subzones that overlap in so many ways is realised as soon as an attempt at wider correlation is made. That is to say the restricted occurrence, at any particular locality, of a certain species has nothing to do with its universal range (or hemera) which is incomparably longer and, elsewhere, the same fossil may be associated with a different fauna in another subzone.

Episageceras dalailamae is as unsuitable a zonal index as is the Lower Liassic *Coeloceras pettos*, which may occur above *Uptonia jamesoni* in one place and below elsewhere. Vagaries of distribution, of course, have always been allowed for, until, after Buckman, we thought we had to disbelieve all records that stood in the way of an increase, at all costs, in the number of "zones". In other words the application of the axiom of William Smith, that dissimilar faunas indicate dissimilar dates of existence, was vitiated for a time by lack of a sense of proportion and a naive belief that ammonites — with a wide range from benthonic to nectonic types — were entirely different from other mollusca. While rejecting Buckman's views, however, and returning to the older zones, I am pinning my faith to ammonites more than ever before. Those who are sceptical may ponder over the results of recent work on the Jurassic belemnites of Timor and the Trigonias of the Africo-Indian Upper Jurassic and Lower Cretaceous.

In the case of the Greenland *Otoceras*, we then find confirmation of the opinion that this genus is really contemporaneous with *Ophiceras*, and not of earlier age. Diener[1]) has shown that in the *Otoceras* fauna of the Shalshal Cliff the genus *Ophiceras* decidedly predominated among the cephalopoda, both in the number of species and of individuals, but that in Kashmir, the genus "*Xenodiscus*" played an equally important part. A few years ago I should have concluded that the reputed absence of *Otoceras* in Kashmir alone indicated that the *Ophiceras* layer of Pastannah was of later age than the *tibeticum* bed of the Shalshal Cliff, but now it seems to me quite possible that *Otoceras* may yet be found at an even higher level, in spite of the fact that Diener himself thought that it might be restricted to the (unexplored) lowest horizon of the *Ophiceras* beds.

The only ammonites apart from *Otoceras* found in the nodules of the *Otoceras*-bed of Clavering Island were two impressions of the forms described above as *Glyptophiceras pascoei* and *G. gracile*. But these occur also in the *Ophiceras wordiei*-beds at Cape Stosch. The thickness of the latter is stated to be about 50 metres, with the fossils more or

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[1]) *Loc. cit.* (Pal. Indica, N. S., vol. v, no. 1), 1913, p. 117.

less concentrated in a bed 5 metres thick; the total for the *Otoceras* clays, with red concretions, is given as 25 metres. It is unfortunate that the stratigraphical information is so scanty, but since the *Ophiceras* layer is about 140 metres above the base of the Lower Trias, and the *Proptychites* horizon (elsewhere) in the upper part of Rosenkrantz's "Brown and Green Series", at about 250 m., there must be a very considerable thickness of Lower Eotrias assignable to the basal *Otoceras* zone. It has been shown, however, in the last chapter, that there are so many beds of ripple-marked or coarse sandstones and even conglomerates in the lower half that the great total thickness probably does not indicate a very lengthy period of time. Since we have also seen that at locality 4 (No. VIII) *Proptychites* and *Ophiceras* occur together, it is probable that the whole of the "Lower Brown and Green Series" is assignable to the lowest Eotrias.

A fragment of *Otoceras* ? again was found in a block of micaceous sandstone which is obviously the same rock as that recorded by Dr. Lauge Koch (in 1929, p. 117) as teeming with fossils and "undoubtedly" derived from the *Ophiceras* beds. But the examples of *Ophiceras* in this sandstone (rich in Bellerophontids) are all of the constricted *sakuntala* type, and rather distinct from those of the main *Ophiceras wordiei* layer, while there is complete absence of the discoidal forms, *O. wordiei* and *O. pseudokyokticum*, or of the allied *Glyptophiceras*. This *Bellerophon*-Sandstone may then be taken to indicate probably a third horizon within the "*Ophiceras* beds", but I am unable to state whether it should be placed above the *Ophiceras* layer of Cape Stosch or below the *Ophiceras* limestone of Clavering Island. The local subdivisions in the "*Ophiceras* beds" of East Greenland have yet to be worked out, but there is clearly no evidence for considering *Ophiceras* and *Otoceras* as anything but contemporaneous.

It may be added that while there are only ammonites in the *Otoceras* bed of Clavering Island, the micaceous sandstone with *Otoceras* ? and Bellerophontids just discussed is crowded with pelecypods, but it contains no examples of *Claraia*. These all come from the *Ophiceras wordiei* and *Proptychites* beds, often associated with the ammonites, but I am unable to say whether there is a definite layer of shale that is characterised by these examples of *Claraia*, as in the Himalayas *C. griesbachi* is abundant in distinct layers in the *Otoceras* and *Ophiceras* beds.

Proptychites rosenkrantzi is associated with *Pseudomonotis* (*Claraia*) and other invertebrates mentioned above that do not differ from their presumed fore-runners in the *Ophiceras wordiei*-beds. The matrix of the fossils of this "*Proptychites* bed" is also not strikingly different from that of the *Ophiceras* layer. It is true that the colour is purplish, rather than greenish-grey, and that the fossils are less favourably preserved in the *Proptychites* bed. But the same applies to the *Ophiceras transitorium* assemblage from locality 4 (No. VIII of section C above) and in some examples of *Ophiceras greenlandicum*, from the main *Ophiceras* layer, the originally greyish-green, slightly micaceous, matrix, may be seen to pass into a purplish or pinkish colour where it is weathered. It would be easy to assume that the *O. transitorium* assemblage (with *Vishnuites*) forms yet another (fourth) horizon within the *Otoceras* beds, transitional to a (next higher) *Proptychites* horizon. But there have been too many of these assumptions in Mesozoic stratigraphy and the stratigraphical evidence now is insufficient even to affirm that the *Proptychites* beds must be above the *Ophiceras* beds, although palaeontological considerations and our knowledge of the Salt Range and Himalayan successions suggest it.

It will be seen, then, that all the Triassic ammonites so far found in Greenland belong to the lowest Eotrias and that there is as yet nothing to indicate a horizon as high as the *Meekoceras* beds of California or Timor, not to mention the still later Eotriassic faunas known from Spitsbergen and Siberia.

The next higher beds of the Greenland succession, i. e. Rosenkrantz's "Variegated Series" unfortunately have so far yielded only indefinite pelecypods. It has been shown that *Myalina kochi* still has the same pinkish-brown matrix that characterised the *Proptychites* beds, but its range does not seem to be sufficiently restricted to make it of use for correlation. Numerous *Myalina*, in any case, occur only 55 m. above the *Proptychites* horizon at locality 3 (No. VII), or even in it, while Rosenkrantz's "*Schizodus* horizon", taken to be the lowest of the three divisions in his "Variegated series", is as much as 185 m. above the equivalent of the *Ophiceras* bed at locality 2 (No. VI). On the other hand the species of *Anodontophora* of his "youngest, fossil horizon" in the Wordie Creek formation are forms of the type of *A. fassaensis* and *A. canalensis*, so common in the Alpine Seis Beds as well as in the Campile Beds. There is no trace of any Mesotriassic species and although these poorly preserved pelecypods are scarcely definite enough to support the conclusion, I am in favour of regarding the whole of the "Variegated Series" as also of Eotriassic age.

It ought to be added that the divisions of the Eotriassic recognised by the writer, and given in the following table, provide more than sufficient accomodation for all the shallow-water deposits of East Greenland. The scheme may also serve as the basis of the correlation attempted in the next chapter.

Subdivisions of the Lower Trias (Scythian).

		Ages	*Zones* (India)	*Some Equivalents*
EOTRIAS	Upper	Stephanitan	*superbus* ?	*Arctoceras* Beds, Spitsbergen; *Olenikites* beds N. Siberia.
		Columbitan		*Columbites* Beds, Albania; *Anasibirites* beds, Spitsbergen, Utah, Timor; *Tirolites* beds, Werfen.
		Owenitan		*Meekoceras* beds, California.
	Lower	Flemingitan	*flemingianus* *volutus*	*Meekoceras* beds, Timor; *Hedenstroemia* beds, Himalayas (lower part).
			fallax	"*Ophiceras*" beds, Timor.
		Gyronitan	*rotundatus* *radiosus*	"*Meekoceras*" beds, Himalayas. *Proptychites* beds, Ussuri.
		Otoceratan	*woodwardi*	*Proptychites* beds, Greenland. *Otoceras* beds, Greenland.

The uppermost beds ("Yellow Series" of Rosenkrantz) to which belong the beds (o) and (n) of the section x, listed above, are as yet too incompletely known to be discussed. This series was provisionally referred to the Wordie Creek Formation and was considered very probably to be Triassic throughout, but so far, no fossils have been collected from this series estimated to include 350 m. of deposits.

E. COMPARISON WITH EOTRIASSIC FAUNAS OF OTHER AREAS.

It has been shown in the last chapter that the Triassic deposits of Greenland, at least in so far as they can be definitely dated, are of early Scythian age. The number of comparable faunas, thus, is very small; for marine deposits of lower Eotriassic age are known from only a few parts of the world. As I mentioned in my first note, the only non-Himalayan locality that has yielded anything like a similar assemblage is in Ussuri Bay (Sea of Japan), but there is as yet disagreement as to the exact position in the time-scale of other Eotriassic deposits and it seems advisable to review the evidence. In this connexion I may first of all recall what has been mentioned above (in the generic discussion of *Otoceras*) concerning the doubtful forms of *Otoceras* recorded from Timor and Madagascar. The British Museum has lately acquired very extensive collections of Triassic fossils from Timor and during this last year I have worked out all the Lower Triassic ammonites in preparation for the forthcoming Part IV of the Catalogue of Fossil Cephalopoda in the British Museum. There is, so far, nothing known from Timor to indicate early Scythian deposits and reference has already been made to the *Pseudoflemingites*, which were confused by Welter with the true *Ophiceras*. There is, of course, no reason why the lower Eotriassic should not be found in Timor, only the record of *Otoceras* is apparently based on a misidentification, as the associated "*Prenkites*"[1]) really belongs to another group of the Columbitidae and is of Upper Eotriassic age. In any case I do not in the least agree with Welter and Krumbeck that

[1]) "*Prenkites*" *sundaicus*; Welter, in whorl-shape resembles *Columbites*, but in suture-line it is closer to ***Subcolumbites***, gen. nov. (based on *Columbites perrin-smithi*, Arthaber, "Unter-Trias in Albanien", Mitt. Geol. Ges. Wien, I, 1908, p. 277, pl. XII, figs. 1 a—c). *Columbites* nov. sp. ind. in Welter (1922, p. 150, pl. CLXVIII, figs. 12—13) is a *Prenkites* ***timorensis***, nom. nov.).

the representation of the Himalayan *Otoceras* fauna in Timor may be accepted as an established fact.

Before discussing the Eotriassic faunas of India and the Ussuri district, it may be useful to state the writer's view on some general points. First, the lower Trias, in his opinion, in most of the different areas follows on different portions of an incomplete Permian succession. There is need to emphasise also that this Eotrias itself is believed to be fragmentary, even in the most representative localities so far known, such as the Salt Range, or California. It follows from this that incomplete knowledge of the cephalopod-bearing beds of the Lower Trias and Permian and their feeble representation in the well-explored countries of Europe, or else the common occurrence of non-marine sediments, have wrongly suggested short duration and comparative unimportance of these Permian and Eotriassic periods compared with the Carboniferous below and the Middle and Upper Trias above. The marine Permian, of course, is only just beginning to be more completely understood, not least by the excellent work of the late Drs. C. A. Haniel and E. Böse on the Dyas of Timor and the Glass Mountains in Texas[1]). The periodic attempts to belittle the Permian, thus, will be taken less and less seriously as knowledge of its marine equivalents increases, and by these alone a system will ultimately stand or fall.

Then, with regard to the subdivisions of the Lower Trias here adopted, it may be recalled that as late as 1886, Mojsisovics[2]) listed as equivalents of the Alpine Werfener Schichten the Lower Triassic "*Xenodiscus*" Beds of India, the *Meekoceras* formation of Idaho, and the Olenek Beds of Siberia, really entirely heterochronous formations. Even ten years later[3]), in spite of the subdivision of the Scythian series into stages and substages, and apart from the incorporation of Waagen's classification of the beds of the Salt Range, Mojsisovics's tables showed a very feeble representation of the Lower Trias. In the correlation scheme by Prof. J. Perrin Smith (1914)[4]) the recognition of *Columbites* and *Tirolites* faunas in the Upper Scythian, and of *Meekoceras* and *Otoceras* faunas, characterising the two substages below, marks an advance, but the various supposed equivalents of the *Meekoceras* and *Columbites* beds are still believed to include heterochronous faunas.

The table does not show the three horizons, said to be distinguishable

[1]) "The Permo-Carboniferous Ammonoids of the Glass Mountains, W. Texas etc.". Univ. Texas Bull., no. 1762 (1917).

[2]) "Arktische Triasfaunen". Mém. Acad. Imp. Sci. St. Pétersb., Ser. VII, vol. XXXIII, no. 6, 1886, p. 152.

[3]) *Loc. cit.* (Denkschr. K. Akad. Wiss. Wien, vol. LXIII, 1896); see also Pal. Indica, Ser. XV, vol. III, no. 1, 1899, pp. 154—5.

[4]) "Middle Triassic Marine Invertebrate Faunas of N. America". U. S. Geol. Surv., Prof. Pap. 83, 1914, table to p. 4.

in the Otoceratan age, because these have already been mentioned to be of only local value. The fact that the faunas are restricted to thin beds does not influence the question as to their existence at three successive periods, but at present they do not seem to be faunas sufficiently distinct to be recognised even in subzones, any more than the possible subdivisions of the Greenland *Otoceras* beds would be applicable to other areas.

If we analyse the fauna of the *Ophiceras* layer or highest of these "zones" we find, however, that there is only a single species common to the *Proptychites*-beds of the Ussuri district which had at first been correlated by Diener[1]) with the Himalayan *Otoceras* beds. It is even possible that the *Ophiceras* layer of Pastannah in Kashmir is not synchronous with the zone of *Ophiceras tibeticum* at Painkhanda; for Diener[2]) stated that the typical form of *O. sakuntala*, Diener, the commonest ammonite of the *tibeticum* zone of the Himalayas was very rare in Kashmir. Since, however, *Xenodiscus himalayanus* is said to be rather common in Kashmir and since Diener states that Griesbach's type from the Shalshal Cliff is preserved in the same slab of limestone as an example of *Otoceras woodwardi* (Griesbach), it is as yet impossible to separate smaller horizons; for in Greenland, *O. sakuntala* occurs at the *Otoceras* ? horizon as well as below, and in any case *Otoceras* has now also been found in Kashmir.

"*Xenodiscus*" *radians*, Waagen, again, a form with a subtabulate venter, has been found by Krafft in the *tibeticum* ("*sakuntala*") zone of Spiti, but it is recorded chiefly from the overlying "*Meekoceras*" beds. There appears to be no doubt that these beds, belonging to the Gyronitan age, are not separated from the Otoceratan by any great break, but they similarly include a number of local horizons that cannot yet be definitely listed. In the *Proptychites* beds of Ussuri, *Proptychites hiemalis* and "*Meekoceras*" *varaha* have been described by Diener as the leading fossils, the former being particularly abundant. A comparable *Proptychites* has been found in the *Ophiceras* beds, but other species of this genus occur in the Ceratite Marls of the Salt Range, above the Lower Ceratite Limestone, which last corresponds to the zone of *Gyronites frequens*, probably immediately succeeding the *Otoceras* beds. "*Dinarites*" *minutus*, Waagen, also is said to be common to the Ussuri beds and the Ceratite Marls but it is a doubtful form. Frech[3]) already had assumed that two horizons were represented in the Ussuri fauna, namely forms belonging to the *Ophiceras* zone and a younger fauna which he correlated with the Indian "*Meekoceras*" beds. *Pachy-*

[1]) *Loc. cit.* (Mém. Com. Géol. St. Pétersb., vol. XIV, no. 3, 1895), p. 59.
[2]) *Loc. cit.* (Pal. Indica, N. S., vol. V, no. 1), 1913, p. 15.
[3]) *Loc. cit.* (Lethaea palaeoz.), 1901, p. 660.

proptychites otoceratoides, Diener may be special to this area, and like *Ophiceras sakuntala*, belong to the Otoceratan age, but the various horizons of Ussuri may not be consecutive. In Timor, at least, an example of *Ussuria* comparable to the Siberian form has been found in the *Owenites* beds of Upper Eotriassic age; and there is one form[1]), with broadening venter, which appears to be a true *Meekoceras* of about the same horizon.

With regard to the Salt Range succession, I agree that it does not include the lowest Trias (Otoceratan age). Forms with differentiated (tabulate) peripheries, dominant in the Gyronitan age, are as yet extremely rare in the lowest beds, and are unknown from the *Ophiceras* beds of Greenland and (with one exception, an example of the rare *Pseudosageceras*) from Kashmir. Of course, it is unsafe to assume that because a certain fauna seems — to an individual observer — more advanced than a comparable one from a different locality, it must be later. In the Jurassic some very puzzling cases of repetition of even supposed "zonal" ammonites have been recorded, and it is well to remember that *Prodromites* is as much out of place in the Kinderhook group (Aganidan age of the Lower Carboniferous) as *Flickia*, with goniatitic sutures, is in the Lower Cenomanian. If "biological order" does not agree with observed stratigraphical succession there can be no doubt that the views of what constitutes "biological order" must be erroneous. Tschernyschew[2]) and Stojanow[3]) have pointed out how unsatisfactory are arguments based on the principle that the stage of evolution attained by certain fossils can be used for exact dating of the beds in which they occur. Thus in applying the increasing complexity of the suture-line and differentiation of the periphery of the Eotriassic Ceratites as a criterion of age, we must be careful not to go to extremes and, of course, always consider the fauna as a whole.

Now in the Salt Range, the basal member, the Lower Ceratite Limestone, was considered by Noetling to represent one zone (zone of "*Celtites*" *radiosus*) and with the zone of *Prionolobus rotundatus*, equivalent to the Lower Ceratite Marls and also characterised by Gyronitids, was correlated with the so-called "*Meekoceras*" beds (zone of "*M.*" *markhami*) of the Himalayas. This correlation is probably correct: but while it is possible to compare the Greenland *Ophiceras subkyokticum* to the early *Koninckites* (which may be assumed to mark the lower part of the *markhami* beds) there is nothing from the corresponding

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[1]) *Meekoceras* sp. ind. ex aff. *boreali*, Diener, *loc. cit.*, 1895, pl. I, figs. 5 a b.

[2]) "Die oberkarbonischen Brachiopoden des Ural und des Timan". Mem. Com. Géol. St. Petersb., vol. XVI, no. 2, 1902, pp. 668, 716, 720.

[3]) "On the Character of the Boundary of Palaeozoic and Mesozoic near Djulfa". Verh. K. Russ. Min. Ges., vol. XLVII, pt. 1, 1909, pp. 64, 113.

zone of the Salt Range that resembles any Greenland species here recorded. It is important to note that *Flemingites praenuntius*, Frech, has already been found in the *rotundatus* zone and that it leads directly to the forms of the next higher *fallax* and *volutus* zones, with Flemingitids dominant. As there is thus a perfect transition by way of *Ophiceras obtuso-angulatum*, Diener[1]), from the rounded Ophiceratids of the Upper Otoceratan, to the tabulate Gyronitids of the next higher age, there is an equally striking passage from the small Gyronitids to the megalomorph Flemingitids of the succeeding age. Thus the succession of the three lower ages (Otoceratan, Gyronitan, and Flemingitan) seems fairly well established.

Although, then, there are some Greenland forms identical with, or comparable to, Ussuri species, it is not known whether they all came from the lower beds[2]). In any case correlation is more satisfactory with the Himalayan Eotrias and it may be useful to list the species of the Greenland fauna that come into consideration:—

Greenland.	Himalayas.	Ussuri.
Otoceras aff. *fissisellatum*	*O. fissisellatum*	
Ophiceras aff. *demissum*	*O. demissum*	
— *sakuntala*	*O. sakuntala*	*O. sakuntala*
— *chamunda*	*O. chamunda*	
— *ptychodes*	*O. ptychodes*	
— aff. *evolutum*	*O. evolutum*	
Glyptophiceras pascoei	*G. pascoei*	
Bellerophon cf. *vaceki*	*B.* cf. *vaceki*	*B.* sp.
Claraia stachei	*C. griesbachi* (?)	
Gervilleia aff. *exporrecta*	*G.* sp. ind.	*G.* cf. *exporrecta*
Myalina aff. *schamarae*		*M. schamarae*
Nucula sp. juv. ind.	*Nucula* (?) sp.	
Anodontophora fassaensis		*A. fassaensis*
A. canalensis		*A. canalensis*
Lingula borealis		*L. borealis*

It will be seen at once that it is again only by the ammonites that the East Greenland Eotrias is linked to the Himalayan deposits, for the other fossils can be equally well (or even better) matched by European forms, especially of the Alpine Werfen Beds. Also there is only a single

[1]) In Krafft and Diener, *loc. cit.* (Pal. Indica, Ser. xv, vol. vi, no. 1), 1909, p. 82, pl. xxvii, fig. 6.

[2]) The insufficiency of our knowledge of the Ussuri Trias has recently been emphasised by Obrutschew "Geologie von Sibirien". Fortschr. d. Geol. und Pal. (Soergel), no. 15, 1926, p. 284.

ammonite common with the Ussuri Beds, for the species of *Proptychites*, found in the *Proptychites* beds of Eastern Siberia are distinct from the Greenland *P. rosenkrantzi*. This is also at least as closely comparable to *P. oldhamianus*, Waagen, from the Lower Ceratite Limestone of the Salt Range, as to any Himalayan species.

Before comparing the Greenland fauna with assemblages described from other Eotriassic deposits, it is necessary to indicate the evidence for placing them as high in the sequence as was done in the table on p. 76, and for recognising three distinct ages (Owenitan, Columbitan, and Stephanitan) in the upper half alone. A full discussion of the Lower Triassic beds of the Arctic regions has lately been published by Dr. Hans Frebold[1]), but it seems to me that he takes the early Triassic deposits of Spitsbergen to be far more representative of the Scythian period than they are. I shall have to revert to the Spitsbergen succession, but considering first the subdivisions of the Upper Eotrias, given in the table on p. 76, I may recall that Noetling listed from his *superbus* zone, the highest in the Eotrias of the Salt Range, corresponding to the Upper Ceratite Limestone, such genera as *Prionites* and *Anasibirites* (wrongly "*Sibirites*"). This zone had even been referred to the Middle Trias, in spite of the fact that it does not contain a single Mesotriassic ammonite. In reality the *superbus* zone may be separated from the *flemingianus* bed by a considerable break. Waagen recorded his "*Dinarites*" *evolutus* from the topmost beds of the Ceratite Sandstone, transitional to the Upper Ceratite Limestone, and when describing some Spitsbergen Ammonites[2]) the writer wrongly referred numerous comparable examples (*Xenoceltites*) to the *flemingianus* zone. *Anasibirites* and *Prionites*, there, were confined to the same Nodule Bed, but *Arctoceras* ranged up into the Lower *Posidonomya*, Shales. But forms resembling the Spitsbergen *Xenoceltites*, also a doubtful *Keyserlingites*, have been recorded from the Californian *Parapopanoceras* beds (with *Acrochordiceras*) of the base of the Middle Trias, 800 ft. above the *Meekoceras* beds. There is a probability that the various *Anasibirites*- and *Prionites*-bearing beds of different localities are not contemperaneous and that a number of local horizons will eventually be recognised in the Stephanitan, Columbitan, and Owenitan ages. For the present purpose it may suffice to point out that there may be a considerable gap between the Ceratite sandstone and the Upper Ceratite Limestone, or at least the beds with "*Acrochordiceras*" (= *Parastephanites*) which are definitely below the *Parapopanoceras* beds of the base of the Anisian. *Anasibirites* ranges from the *Olenikites* zone down into the Columbitan

[1]) "Untersuchungen über die Fauna, die Stratigraphie, und Palaeogeographie der Trias Spitzbergens". Skrifter om Svalbard og Ishavet, no. 26, 1929.

[2]) *Loc. cit.* (Geol. Mag.), 1921, pp. 302, 350.

and Owenitan ages below, though *Kashmirites* is predominant in the latter age.

The occurrences of *Ussuria* and of *Meekoceras mushbachianum* (White) in the *Owenites* beds of Timor, also of *Tirolites* a few feet below the *Columbites* beds of Idaho and about 100 ft. above the *Meekoceras* beds are also important. The true *Tirolites* and *Dinarites* of the Alpine Werfen Beds do not seem to have been rediscovered beyond the Balkans and "*Tirolites*" *meridianus*, Welter[1]), from the *Owenites* (*Kashmirites*) beds of Timor, certainly is quite different, while the Kashmir fragment of a *Stephanites* sp. ind. aff. *superbo*, Waagen, recorded by Diener[2]), may represent the same stock. *Stephanites* has also been recorded by Stojanow[3]) from the *Paratirolites* beds of Djulfa. These were correlated with the *Hedenstroemia* stage and the *Paratirolites* were considered by Arthaber[4]) to be on the evolutionary level of the Muč fauna (*Tirolites* beds) of the Alpine Werfen Beds; but exact correlation of these Eotriassic beds is as yet impossible. For, while the Triassic represents a period probably considerably longer than the whole of the Jurassic, it is actually less completely known than the Jura Formation was when Oppel divided it into some thirty zones. The fauna of Kčira in Albania, described by Arthaber and obviously different from the faunas previously known, was considered to show greater resemblance to the Asiatic Trias because it was rich and varied, as compared with the impoverished fauna of Muč in Dalmatia. This latter was taken to represent a shallow water facies with possibly decreasing salinity of the sea, causing extinction of most of the species. In the writer's opinion, however, the two faunas are largely different simply because they are of different ages. Similarly Diener[5]), though he pointed out that the identity of a number of the Albanian species with their Indian prototypes was questionable, yet considered the Kčira fauna to be homotaxial with the *Hedenstroemia* stage of India, but showing a distinct, provincial character. The "impoverished Werfen fauna" was also described as showing a strictly local habit, and stress was laid on the "facies of red limestones" of the Kčira fauna, which, however, like the red marbles

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[1]) *Loc. cit.* (Pal. v. Timor, Lief. XI, 1922), p. 149, pl. XIV, figs. 14—17 = ***Anastephanites*** gen. nov. (Diagnosis:— Evolute, coronate shells with depressed whorl-section, prominent lateral tubercles and irregularly ribbed, broad venter. Suture-line with large external saddle and two small lobes. Family Stephanitidae Arthaber emend.

[2]) *Loc. cit.* (Pal. Indica, N. S., vol. V, no. 1), 1913, p. 38, pl. V, fig. 4.

[3]) "On the Character of the Boundary of Palaeozoic and Mesozoic near Djulfa". Verh. K. Russ. Min. Ges., vol. XLVII, pt. I, 1909, p. 89, pl. VII, figs. 8 a, b; pl. VIII, figs. 3 a, b.

[4]) *Loc. cit.* (Beitr. Geol. Pal. Österr.-Ung., vol. XXIV), 1911, p. 194.

[5]) *Loc. cit.* (Pal. Indica, N. S., vol. V, no. 1), 1913, p. 121.

of Han Bulog and Hallstatt is due to regional metamorphism. It is clear that here there are not distinct geographical provinces. The chronology of the Triassic, now proposed, however, being largely new, must be somewhat tentative.

Basing, however, our correlation on the scheme here given, it will be seen that since nothing of Lower Scythian age has been described from Northern Siberia, the Olenek fauna is at once excluded from comparison. It does not even include true *Meekoceras* (of Owenitan age) and the listing by Diener[1]) of some of these "*Meekoceras*" as *Gyronites* and *Koninckites* is extremely misleading. Whether the fauna (without ammonites) recorded from the junction of the Rivers Teplaja and Uss (Province of Yeniseisk, Central Siberia) is of an equally late Eotriassic age, is doubtful, but is suggested by the occurrence of *Rhynchonella* and *Spiriferina*. Exact comparison with the Greenland species of *Anodontophora* and *Claraia*, here described, in any case, is impossible, but the similar fauna described by Wittenburg[2]) from Axel Island, Spitsbergen, includes a still larger number of comparable pelecypods, like *Anodontophora*, *Gervilleia* and *Pseudomonotis*. Here again lithological similarity of the micaceous, sandy, strata, as of the Alpine Werfen Beds, may suggest a superficial correlation whereas in the absence of ammonites, it is impossible to ascribe these beds to the Lower Scythian, rather than the Upper.

The Spitsbergen ammonites of Eotriassic age, so far recorded, also all indicate the Upper Scythian, with the possible exception of the forms recorded by Frebold[3]) from a stream north of the Aldegonde Glacier (Green Harbour). Unfortunately these are not determinable, even generically, but judging by the illustrations I doubt their Lower Scythian age. The fact that they come from shales lying directly on the Permian, also does not prove anything. Frebold[4]) assumed that his "lowest" ammonite horizon, if present in the Sassendal region, would have to be looked for below the lower Sandstone Series; but this, with its lithological changes and occasional beds with ripple-marks, is at least as comparable to the Eotriassic of East Greenland as the supposed Permian sandstones of the Aldegonde Glacier, with their *Myalina* horizons.

As in the case of the Olenek fauna, a number of other Spitsbergen ammonites have been wrongly recorded under early Scythian names.

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[1]) "Die Marinen Reiche der Trias-Periode". Denkschr. K. Akad. Wiss. Wien, vol. XCII, 1916, p. 416.

[2]) "Über Werfener Schichten von Spitzbergen". Bull. Acad. Imp. Sci. St. Pétersb., 1912, p. 947.

[3]) *Loc. cit.* (Skrifter om Svalbard, no. 26, 1929), p. 7.

[4]) "Die Alterssstellung des Fischhorizontes in Spitzbergen", Skrifter om Svalbard etc., no. 28, 1930, p. 28.

Thus J. Böhm's *Meekoceras* (*Gyronites*) *nathorsti*[1]), significantly compared to a *Wyomingites* of the true *Meekoceras* beds (Owenitan age), and my own *Gyronites* ? (after Stolley compared to the same *Wyomingites aplanatum*, White sp.[2])) have nothing to do with the true *Gyronites*; and I am now taking the opportunity of renaming some of these misidentified forms chiefly in order to avoid the ambiguous names used in previous Spitsbergen literature. "*Xenodiscus*" is another example of these, and even *Pseudosageceras grippi*, recently described by Frebold, seems to me to be a *Tellerites* (family Hedenstroemidae), although *Pseudosageceras* is not confined to the Lower Scythian and has been found in the Columbitan of Albania.

It is unnecessary to discuss in detail this Albanian fauna[3]), which includes several horizons of the Columbitan age, in addition to the *Tirolites* zone of the Alpine Werfen Beds. And since there are no ammonites in the lower (Seis) beds, it is scarcely worth while insisting on such points in common with the Greenland Trias as the presence of a *Lingula*, to the exclusion of *Rhynchonella* which occurs in the Himalayas. The Eotrias of such areas as Tonkin and Palestine, whence only *Claraia* and associated pelecypods are known, also cannot be dated exactly; and the Madagascan and Chinese deposits of presumed Scythian age, even if they were more definitely described, similarly may be left out of account in this correlation. In Tibet on the other hand, whence *Ophiceras* and *Xenodiscus* have been recorded, Lower Scythian is known, although not of so early an age as Frech[4]) suggests. But it connects with the Himalayan Eotrias on the one hand and Ussuri on the other. The forms of the Japanese *Meekoceras* bed, lately described by Yehara[5]) (some wrongly as *Ophiceras*), are still later; and judging by their resemblance to the fauna of the *Anasibirites multiformis*-bed of Timor, they are of an age not earlier than the Stephanitan, as Welter correctly stated, equivalent to the Upper Ceratite Limestone of the Salt Range or the zone of *Anasibirites spiniger* in the Himalayas.

There remain the Eotriassic faunas of the western United States.

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[1]) Über Trias-Versteinerungen vom Bellsunde auf Spitzbergen". Arkiv f. Zoologi (K. Svenska Vet. Akad.) Stockholm, vol. 8, no. 1, 1913, p. 11, pl. I, figs. 17—19.

[2]) See Spath: "Ammonites from Spitsbergen". Geol. Mag., vol. LVIII, 1921, p. 303.

[3]) I am taking this opportunity of renaming four characteristic genera of this Albanian fauna, namely *Eophyllites*, *Hemilecanites*, *Isculitoides*, and *Preflorianites*, the last including such species as *P. sulioticus*, Arthaber, in addition to the genotype (see under G, p. 90).

[4]) Lethaea geognostica, II, I, Trias, 1905, p. 187.

[5]) Lower Triassic Cephalopod and Bivalve Fauna of Shikoku. Jap. Jl. Geol &. Geog., vol. V, no. 4, 1928.

Prof. J. Perrin Smith has insisted on the close affinity of the Eotriassic deposits in the circum-Pacific regions with those of India, and while *Meekoceras*, *Owenites*, *Columbites* and others certainly are common to the upper Scythian of California and Timor, I can recognise the Japanese *Anasibirites* ("*Meekoceras*") *onoi*, Yehara, and allied forms in an assemblage from Fort Douglas Military Reservation, Salt Lake City, Utah, lately received through the kindness of Drs. Hintze and Matley. But the latter fauna, partly higher in the Upper Scythian than the *Meekoceras* Beds of California, includes a number of types that show a remarkable resemblance to Spitsbergen forms, notably *Hemiprionites* (formerly "*Goniodiscus*") and ***Arctoprionites***[1]). Even if we do not agree with J. P. Smith[2]) that the *Columbites* bed of Idaho has a "boreal" fauna or that the ammonites are comparable to Olenek species, there is clear affinity between the Utah assemblage and the fauna of the Lower *Posidonomya* Shales of Spitsbergen. But since these resemblances are in any case confined to the Upper Scythian and since the *Meekoceras* Beds of California and Idaho contain no ammonites of pre-Flemingitan age, detailed comparison with the early Eotriassic beds of East Greenland is again unnecessary.

There is, then, nothing like the *Otoceras* — *Ophiceras* fauna of Greenland known from anywhere except the Himalayas and possibly from Armenia, if Bonnet's identification of his *Otoceras* of the *woodwardi*-group is correct (as distinct from the well-known *Prototoceras* of the Permian). But this does not make it as improbable as Frebold seems to think it, that there was actually direct marine connexion between the Arctic and the Thetis in Diener's sense[3]). That is to say there may have been a temporary connecting channel east (or west) of the Urals, as well as across Eastern Siberia, from Ussuri (Sea of Japan) to the Olenek region, in addition to the North Atlantic — and, perhaps, Bering Straits — connections, indicated in Frebold's map[4]). On the other hand I have been struck by the extraordinary resemblance of the manganese-coated ammonites of the *Albanites*-fauna of Timor to those from Albania, over 100° longitude apart, and with nothing comparable known from the intervening Eotriassic deposits of e. g. the Himalayas, although

[1]) Gen. nov. for *Goniodiscus nodosus*, Frebold, *loc. cit.* (Skrifter om Svalbard, no. 28), 1930, p. 8, pl. I, fig. 7 (1—6). Diagnosis:— More or less involute, discoidal shells with tabulate venters, tending to develop crenulation of latero-peripheral edges and costation or tuberculation on whorl-sides. Suture-lines as in *Hemiprionites*, but with large external saddle and simple external lobe. Family Sibiritidae, Mojsisovics emend.

[2]) In Hyatt and Smith: The Triassic Cephalopod Genera of America. U. S. Geol. Surv. Prof. Paper, no. 40, p. 19; also *loc. cit.* (Prof. Pap. no. 83), 1914, p. [illegible].

[3]) *Loc. cit.* (Marine Reiche der Trias-periode), 1916, pl. I, fig. II.

[4]) *Loc. cit.* (Skrifter om Svalbard, no. 26), 1929, pl. IV.

the Upper Ceratite Limestone of the Salt Range may yet yield a corresponding assemblage. Ammonite faunas, when they are strictly contemporaneous, are remarkably similar wherever they occur, and, as I stated in my first note, this favours the permanence of the great oceans. Whether *Otoceras* be next discovered in Timor or Texas, Japan or Chili, it will not again come as a surprise, except to some palaeogeographers. The distribution of the continents and seas in Eotriassic times, as Diener has shown, was probably not unlike that of the present day, except for the extended Thetis.

F. SUMMARY OF RESULTS.

The more important points brought out in the detailed study of the Eotriassic fauna of East Greenland may be summed up as follows:—

(1) Only the lowest of three series, in a total thickness of sediments of about 800 m. has yielded ammonites.

(2) All the ammonites may belong to the lowest Eotrias (*Otoceras* and *Ophiceras* beds), the evidence that *Proptychites* came from a higher horizon being as yet inconclusive, since in one locality they have been collected together with *Ophiceras*.

(3) The ammonites can be compared only to Himalayan forms, but a single species has been found also in the Ussuri district (Sea of Japan).

(4) The deposits are nearly all sandy, of shallow water facies, often ripple-marked and with very rare, impure limestones.

(5) Only pelecypods like *Myalina* and *Anodontophora*, still of Werfen facies, occur in the middle series, the upper, with nearly half the total thickness, being unfossiliferous.

(6) Comparison of these pelecypods with unfigured Eotriassic assemblages from Spitsbergen or Central Siberia cannot yet be attempted.

(7) The distribution of seas and continents, in Eotriassic times, as shown by Diener, was probably very similar to that of the present day.

G. LIST OF NEW GENERIC NAMES.[1]

[1]) Some of these are mentioned in order to secure priority, but they are all fully discussed in the forthcoming fascicule I of part IV of the Fossil Cephalopoda in the British Museum.

PLATES

PLATE I

Page

Figs. 1 a-d. *Otoceras* aff. *fissisellatum*, Diener. Side-view of large body-chamber (a); umbilical portion of suture-line of a crushed example (b); side-view (c) and outline whorl-section (d) of another fragmentary specimen. All from *Otoceras* bed of Clavering Island (Danish Exp. 1929) 10

\- 2 a, b. *Ophiceras greenlandicum*, sp. nov. Side- and peripheral views of a fragmentary specimen, transitional to *O. sakuntala*, Diener. *Ophiceras* bed, S. S. W. of Cape Stosch (Danish Exp. 1929) 16

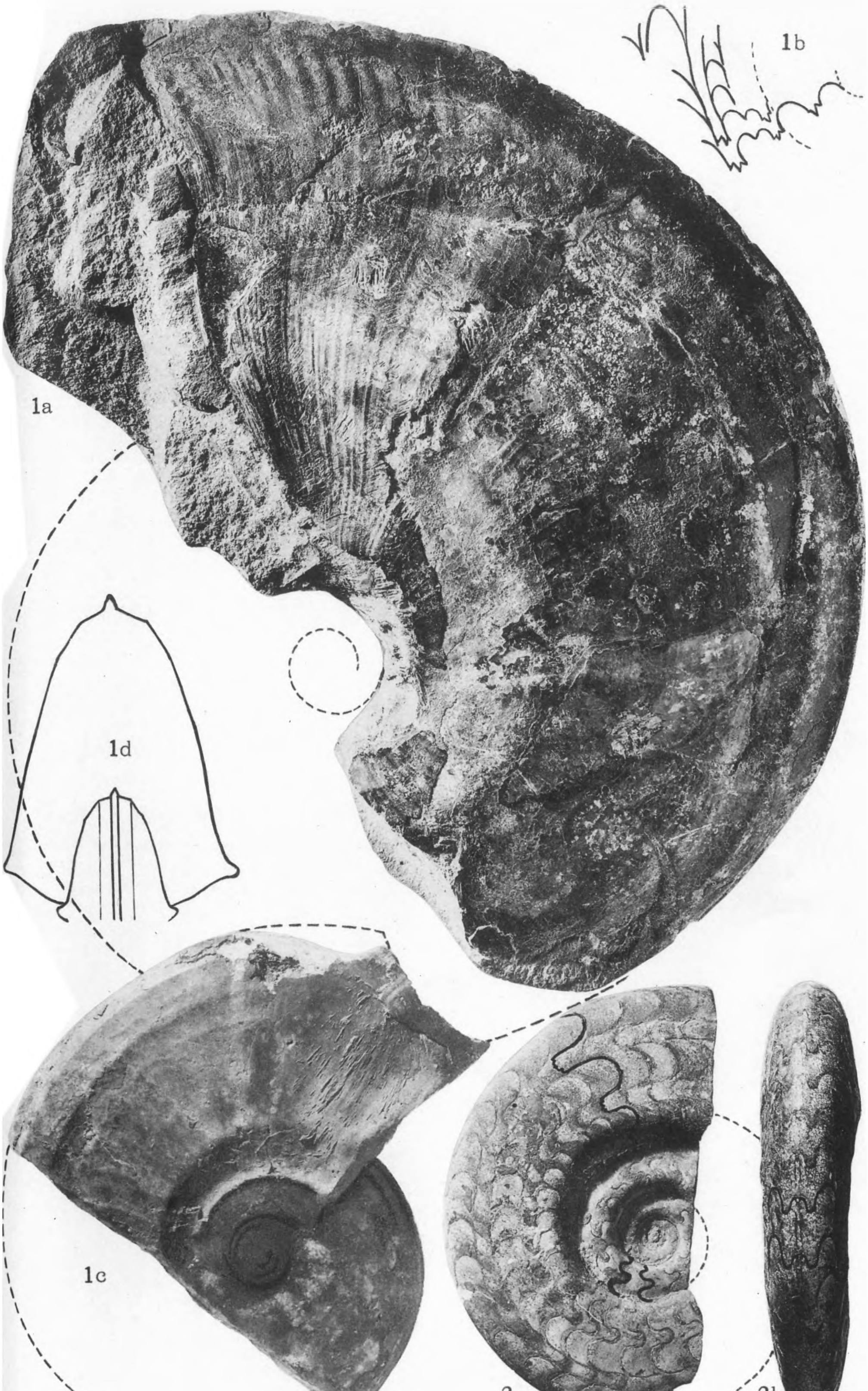
1a
1b
1c
1d
2a
2b

PLATE II

		Page
Figs. 1-7.	*Ophiceras* aff. *demissum* (Oppel). Side- and sectional views of seven examples. 1, 3, 5, from S.S.W. of Cape Stoch; 4 from a block like that figured in Plate XII, fig. 1; 2, 6, 7 from 4 km. east of Little Finsch Island (altitude about 50 m., collected by Norwegian hunters). Danish Exp. 1929	14
- 8.	*Ophiceras* (*Lytophiceras*) *sakuntala*, Diener. Side-view of an example from S. S. W. of Cape Stosch. (Danish Exp. 1929)	19
- 9 a-d.	*Ophiceras* (*Lytophiceras*) *commune*, sp. nov. Side-view (enlarged × $2^1/_2$) of inner whorls of example figured in Plate IV, fig. 3 (a); and suture-lines at 3 mm. (b), 7 mm. (c) and 12 mm. (d), enlarged and somewhat diagrammatic. S. S. W. of Cape Stosch (Danish Exp. 1929)	23
- 10 a, b.	*Ophiceras transitorium*, sp. nov. Side- and peripheral views of holotype. 10 miles E. of Cape Stosch (No. 59, J. M. Wordie Colln.)	17
- 11 a, b.	*Vishnuites wordiei*, sp. nov. Side- and peripheral views of holotype. Same locality and colln.	31
- 12 a, b.	*Ophiceras greenlandicum*, sp. nov. Side-view and sectional outline of holotype. S. S. W. of Cape Stosch (Danish Exp. 1929)	16
- 13-14.	*Ophiceras* (*Lytophiceras*) *commune*, sp. nov. Suture-lines of two fragments from S. S. W. of Cape Stosch (Danish Exp. 1929) ...	24

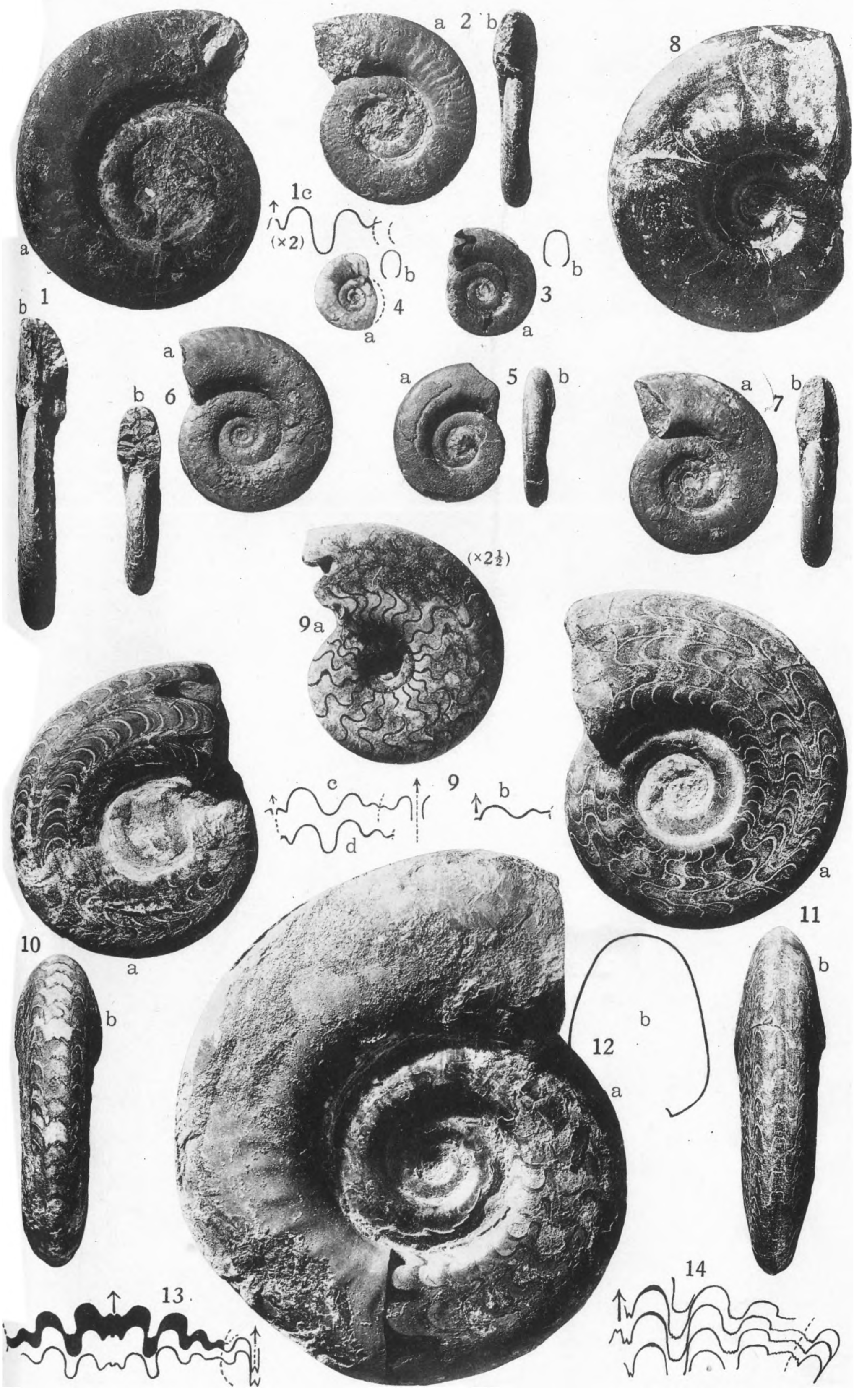
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PLATE III

		Page
Fig. 1.	*Ophiceras* (*Lytophiceras*) aff. *evolutum*, Frech and Noetling Side-view of a large example from S. S. W. of Cape Stosch (Danish Exp. 1929)	22
Figs. 2 a-g.	*Vishnuites decipiens*, sp. nov. Side- and peripheral views of holotype (a, b); and of two paratypes (c, d, e, f); also peripheral view of a fourth example (g). 10 m. E. of Cape Stosch (No. 59, J. M. Wordie Colln.)	31
- 3 a, b.	*Ophiceras commune*, sp. nov. Side- and peripheral views of holotype. S. S. W. of Cape Stosch (Danish Exp. 1929)	24
- 4 a, b.	*Ophiceras* (*Lytophiceras*) aff. *evolutum*, Frech and Noetling. Side- and peripheral views of an example transitional to *O. commune*. Same locality and colln	22


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PLATE IV

		Page
Figs. 1a, b.	*Ophiceras* (*Lytophiceras*) *chamunda*, Diener. Side- and peripheral views of an example from S. S. W. of Cape Stosch (Danish Exp. 1929)	20
- 2a, b.	*Vishnuites decipiens*, sp. nov. Side- and peripheral views of a fissiseptate variety, connecting with the paratype figured in Plate III, figs. 2 c, d. From 10 m. E. of Cape Stosch (J. M. Wordie Colln., no. 59)	31
- 3a, b.	*Ophiceras* (*Lytophiceras*) *commune*, sp. nov. Side- and peripheral views of an example from S. S. W. of Cape Stosch (Danish Exp. 1929). (For inner whorls, see Plate II, fig. 9)	24
- 4a, b.	*Ophiceras* (*Lytophiceras*) *ptychodes*, Diener. Side- and peripheral views of an example from the same locality and colln.	21
- 5.	*Ophiceras greenlandicum*, sp. nov. Side-view of a crushed example. Same locality and colln.	16
- 6a, b.	*Ophiceras* (*Acanthophiceras?*) sp. juv. aff. *gibbosum*, Griesbach. Side- and peripheral views of doubtful septate inner whorls. Same locality and colln.	28
- 7a, b.	*Ophiceras* (*Lytophiceras*) *sakuntala*, Diener. Side- and peripheral views of an example transitional to *O. ptychodes*, Diener. Same locality and colln.	19
- 8a, b.	*Ophiceras* (*Lytophiceras*) *chamunda*, Diener. Side- and pheripheral views of an immature example. Same locality and colln.	20
- 9a, b.	*Ophiceras* (*Acanthophiceras?*) sp. juv. Side- and peripheral views of a doubtful fragment of an immature form. Same locality and colln.	28
- 10a, b.	*Ophiceras* (*Lytophiceras*) *kochi*, sp. nov. Side-view and outline whorl-section of holotype. Same locality and colln.	23
- 11a, b.	*Ophiceras* (*Lytophiceras*) *commune*, sp. nov. Side and peripheral views of immature example. Same locality and colln.	24
- 12a, b.	*Ophiceras greenlandicum*, sp. nov. Side-view of a fragmentary example (a) and peripheral view of its inner whorls (b). Same locality and colln.	16

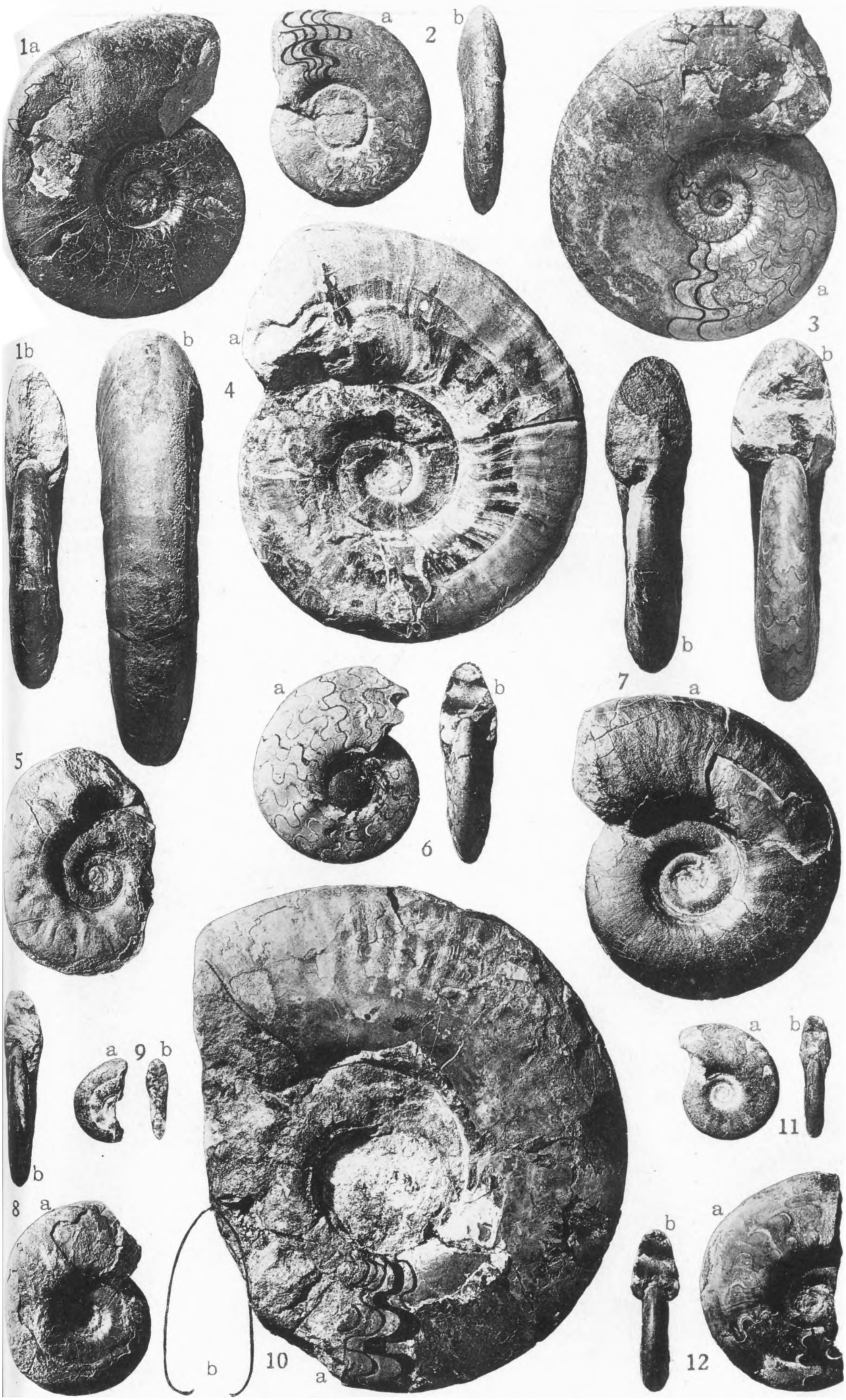
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PLATE V

		Page
Figs. 1a, b.	*Ophiceras* (*Lytophiceras*) *wordiei*, sp. nov. Side- and peripheral views of an inflated variety, with pronounced excentrumbilication and inverse suture-line. S. S. W. of Cape Stosch (Danish Exp. 1929)	26
- 2a, b.	*Ophiceras* (*Lytophiceras*) *wordiei*, sp. nov. Side- and peripheral views of holotype. Same locality (J. M. Wordie Colln., no. 47)....	26
- 3a, b.	*Ophiceras* (*Lytophiceras*) *ptychodes*, Diener. Side- and peripheral views of a passage-form to *O. sakuntala*, Diener. Same locality. Danish Expedition, 1929	21
- 4-8.	*Ophiceras* (*Lytophiceras*) *subkyokticum*, sp. nov. Side- and peripheral views of two typical examples (4, 5), of a transition to *O. wordiei* (6), an unusually strongly ribbed variety (7), and enlarged side-view, $\times 2^1/_2$, of inner whorls (8). Same locality. (4, 5 J. M. Wordie Colln., no. 47; 6—8 Danish Exp., 1929)	27
- 9a, b.	*Ophiceras* (*Lytophiceras*) *wordiei*, sp. nov. Side- and peripheral views of an example transitional to *O. commune*, sp. nov. Same locality (Danish Exp., 1929)	26
- 10.	*Ophiceras*, sp. juv. ind. Inner whorls of probably a variety of *O. transitorium*, sp. nov. Same locality and colln.	18

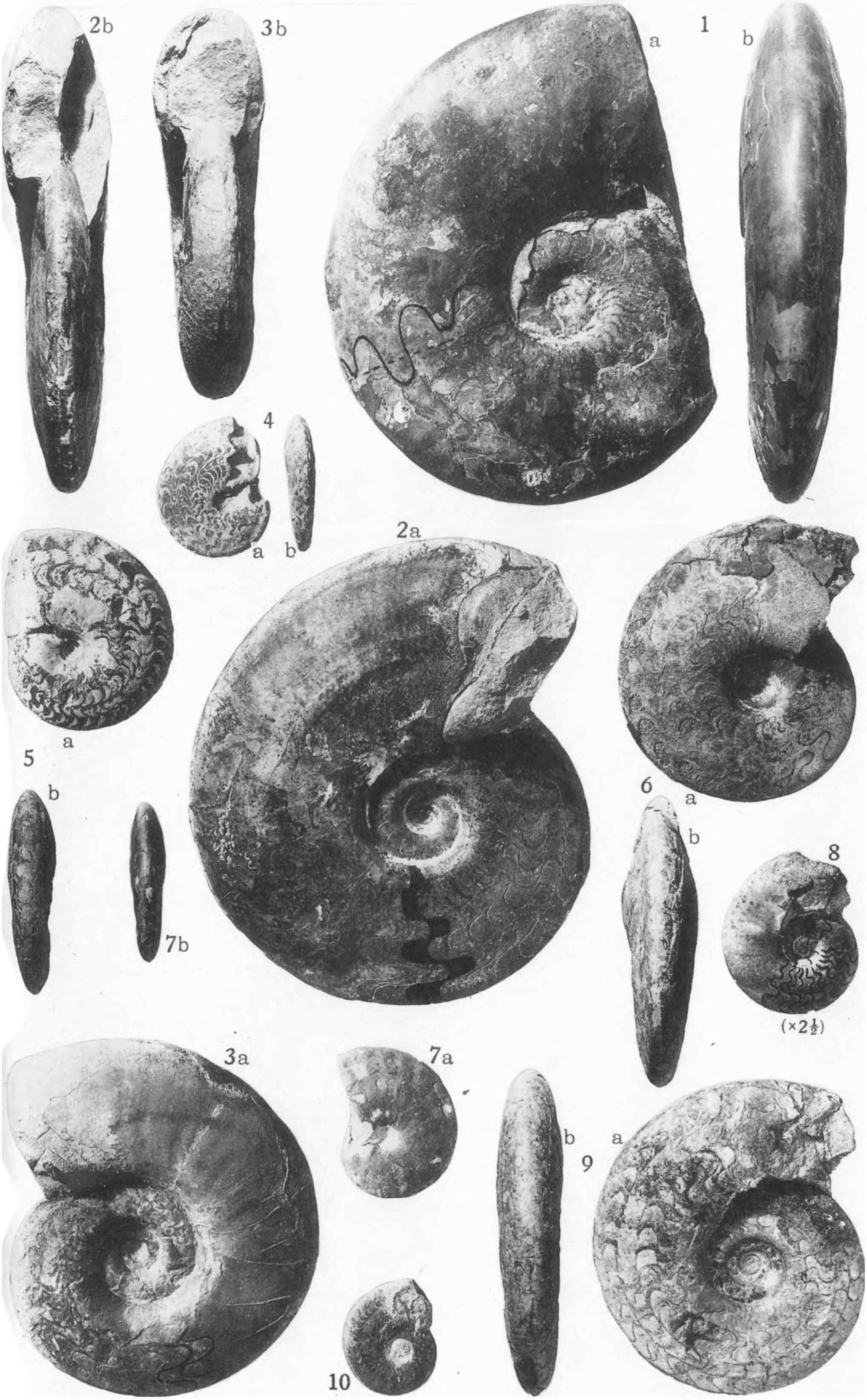
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PLATE VI

Figs. 1-2. *Ophiceras* (*Lytophiceras*) *wordiei*, sp. nov. Side- and peripheral views of two examples from S. S. W. of Cape Stosch (Danish Exp., 1929 [1] and J. M. Wordie Colln., no 47 [2]) 26

- 3-8. *Ophiceras* (*Lytophiceras*) *subkyokticum*, sp. nov. Side- and peripheral views of typical examples (5, 7), transitions to *O. wordiei* (3, 8), and intermediate examples (4, 6). Same locality. (3 and 7 J. M. Wordie Colln., no. 47; 4—6, 8 Danish Exp., 1929)............... 27

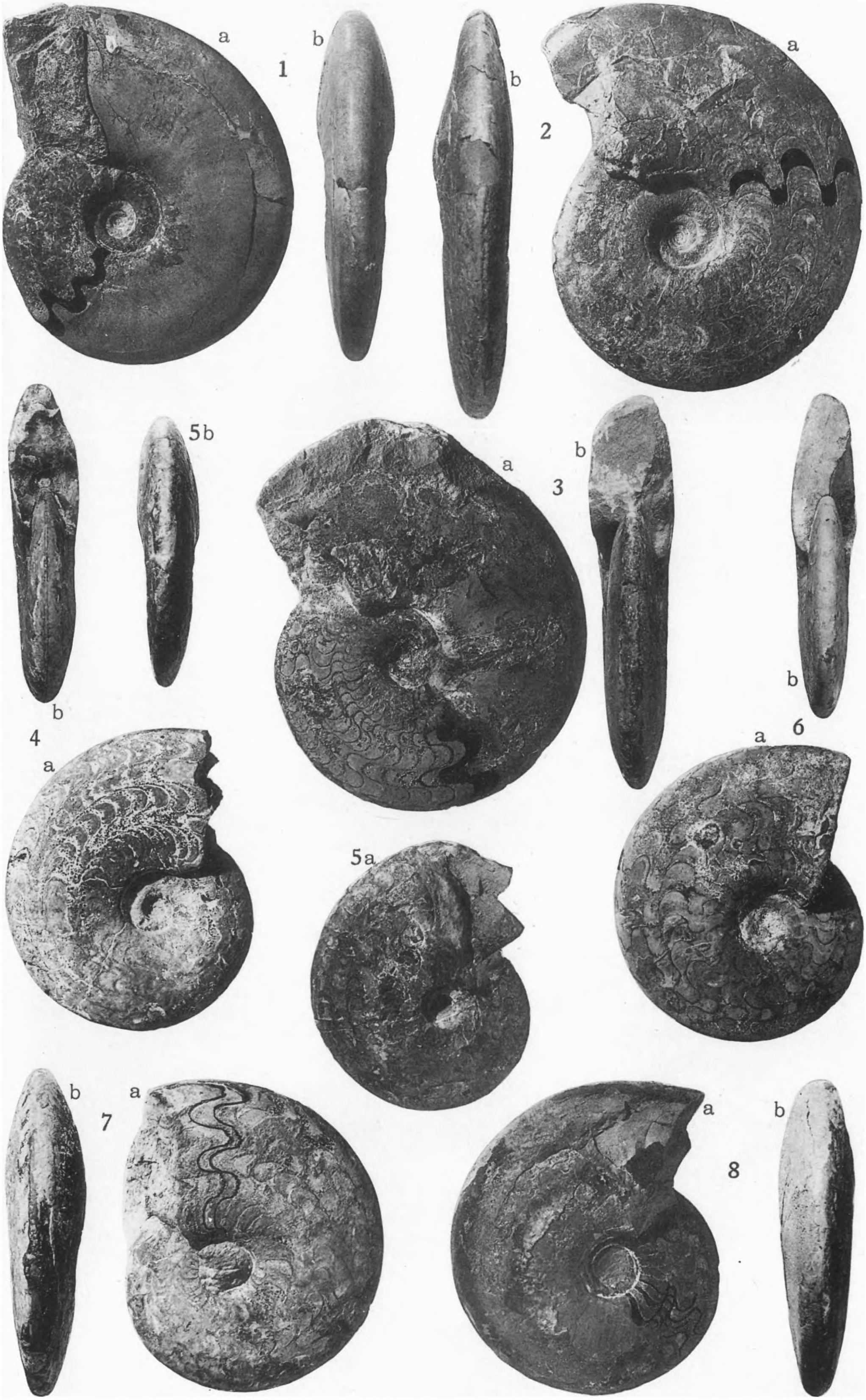
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PLATE VII

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Figs. 1-2.	*Proptychites rosenkrantzi*, sp. nov. Side-view and outline whorl-section of fragmentary holotype (1 a, b) from E. of Cape Stosch (Danish Exp., 1929), and side- and peripheral views of four of the examples from S. S. E. of Cape Stosch (J. M. Wordie Colln., no. 52) recorded in 1927	40
- 3-6.	*Glyptophiceras gracile*, sp. nov. Side- and peripheral views of holotype (5 a, b) and side-view of paratype (3); also side- and peripheral views of a pathological fragment (4 a, b) and cast of an impression on one of the *Otoceras* nodules. 3—5 from S. S. W. of Cape Stosch, 6 from Clavering Island (Danish Exp., 1929)..........	34
- 7-8.	*Glyptophiceras minor*, sp. nov. Side- and peripheral views of holotype from 10 m. S. E. of Cape Stosch (J. M. Wordie Colln., no. 59) and block with immature examples from S. S. W. of Cape Stosch (Danish Exp., 1929)	33
- 9-10.	*Glyptophiceras*, sp. ind. Side- and peripheral views of two doubtful immature examples. S. S. W. of Cape Stosch (Danish Exp., 1929)	38

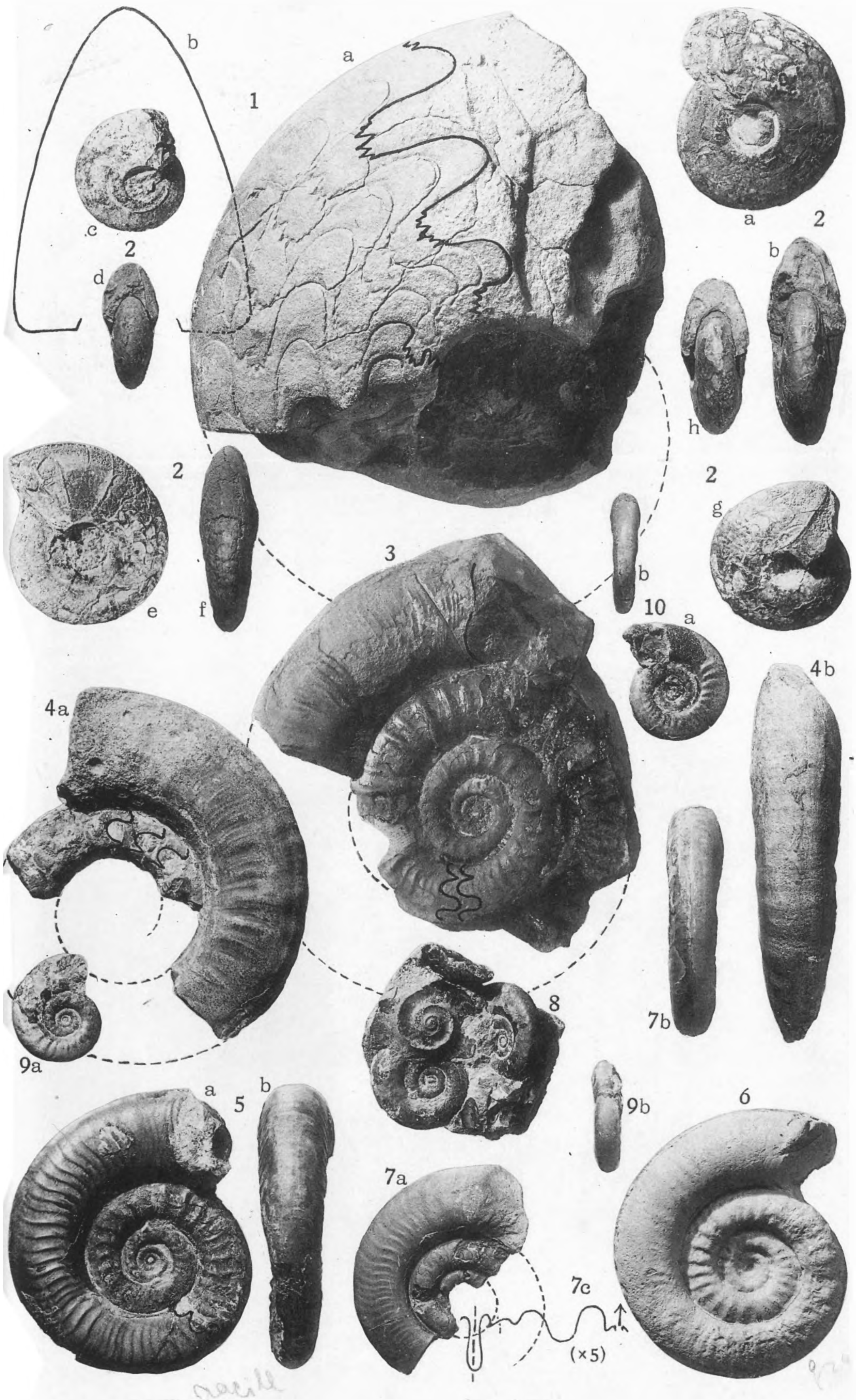
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PLATE VIII

Page

Figs. 1-7. *Glyptophiceras pascoei*, sp. nov. Side-views of holotype (cast, fig. 1) and two paratypes (3, 4); side- and peripheral views of another paratype (5 a, b) and a doubtful immature example (7 a, b); also side-views of two more specimens with coarsely-ribbed inner whorls (2, 6). S. S. W. of Cape Stosch (Danish Exp., 1929) 36

- 8 a, b. *Glyptophiceras pseudellipticum*, sp. nov. Side-view of holotype and peripheral view of its inner whorls. Same locality and colln...... 37

- 9 a, b. *Glyptophiceras*, sp. ind. Side- and peripheral views of a doubtful immature example. Same locality and colln. 38

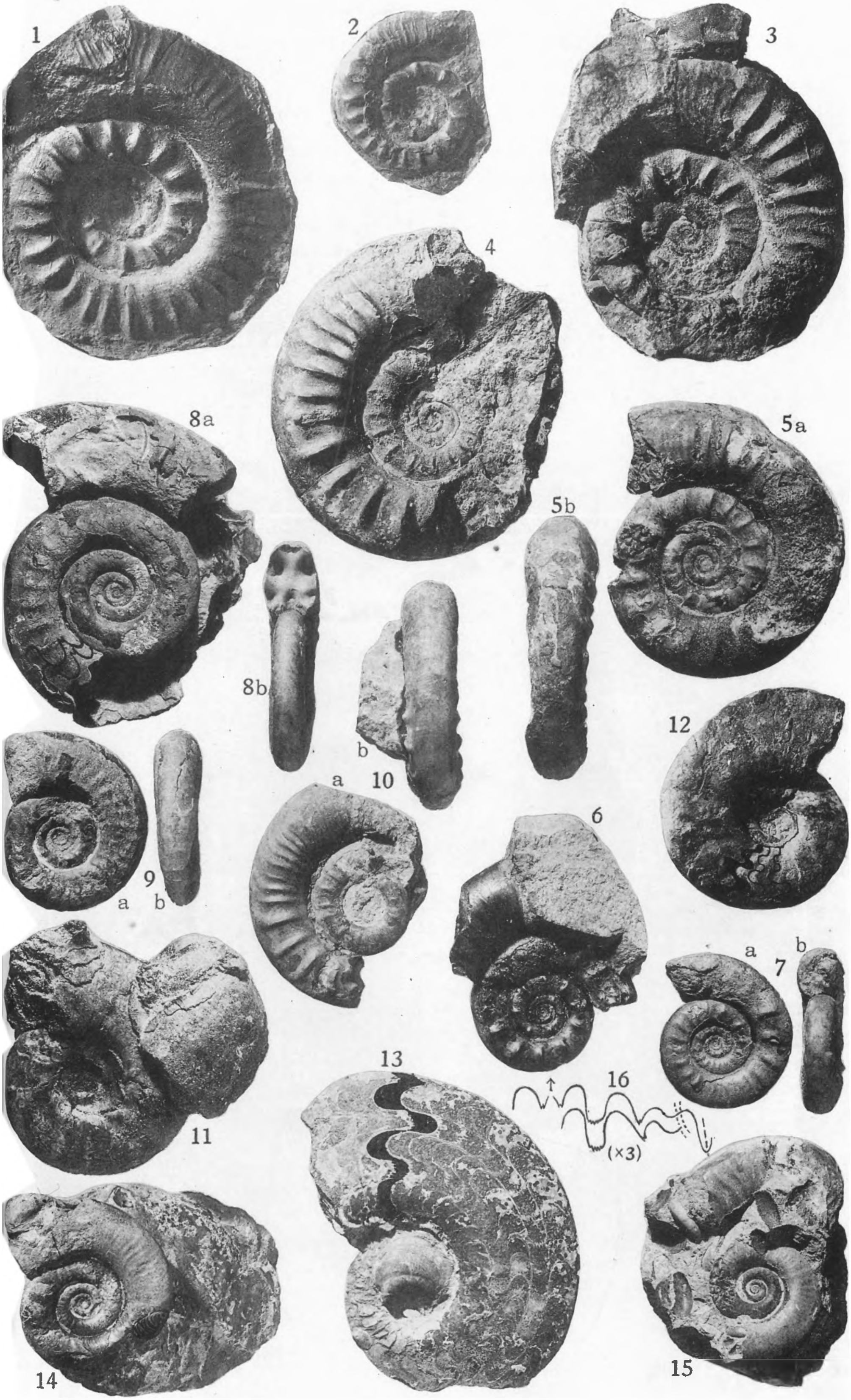
- 10a,b. *Glyptophiceras gracile*, sp. nov. Side- and peripheral views of an example transitional to *G. pascoei*, sp. nov. Same locality and colln. 34

- 11-12. *Ophiceras* (*Lytophiceras*) aff. *sakuntala*, Diener. Side-views of two examples from the micaceous sandstone with *Bellerophon* and *Otoceras?* (11 with *Myalina* aff. *schamarae*, Bittner). Cape Stosch (loose) (Lauge Koch colln., 1927) 20

- 13. *Anomia?* (*Placunopsis?*), sp. ind. attached to umbilicus of an example of *Ophiceras* (*Lytophiceras*) *wordiei*, sp. nov. S. S. W. of Cape Stosch (Danish Exp., 1929) 50

- 14-15. *Glyptophiceras minor*, sp. nov. Two examples in blocks with (14) *Claraia stachei*, *Gervilleia* aff. *exporrecta* and an *Anaptychus*-like body; and (15) with various, immature, specimens of probably the same species. Same locality and colln......................... 33

- 16. *Glyptophiceras pascoei*, sp. nov. Suture-line (diagrammatic and enlarged about 3 diameters). Same locality and colln............. 36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5b
8b
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a
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a b
12
6
a
7
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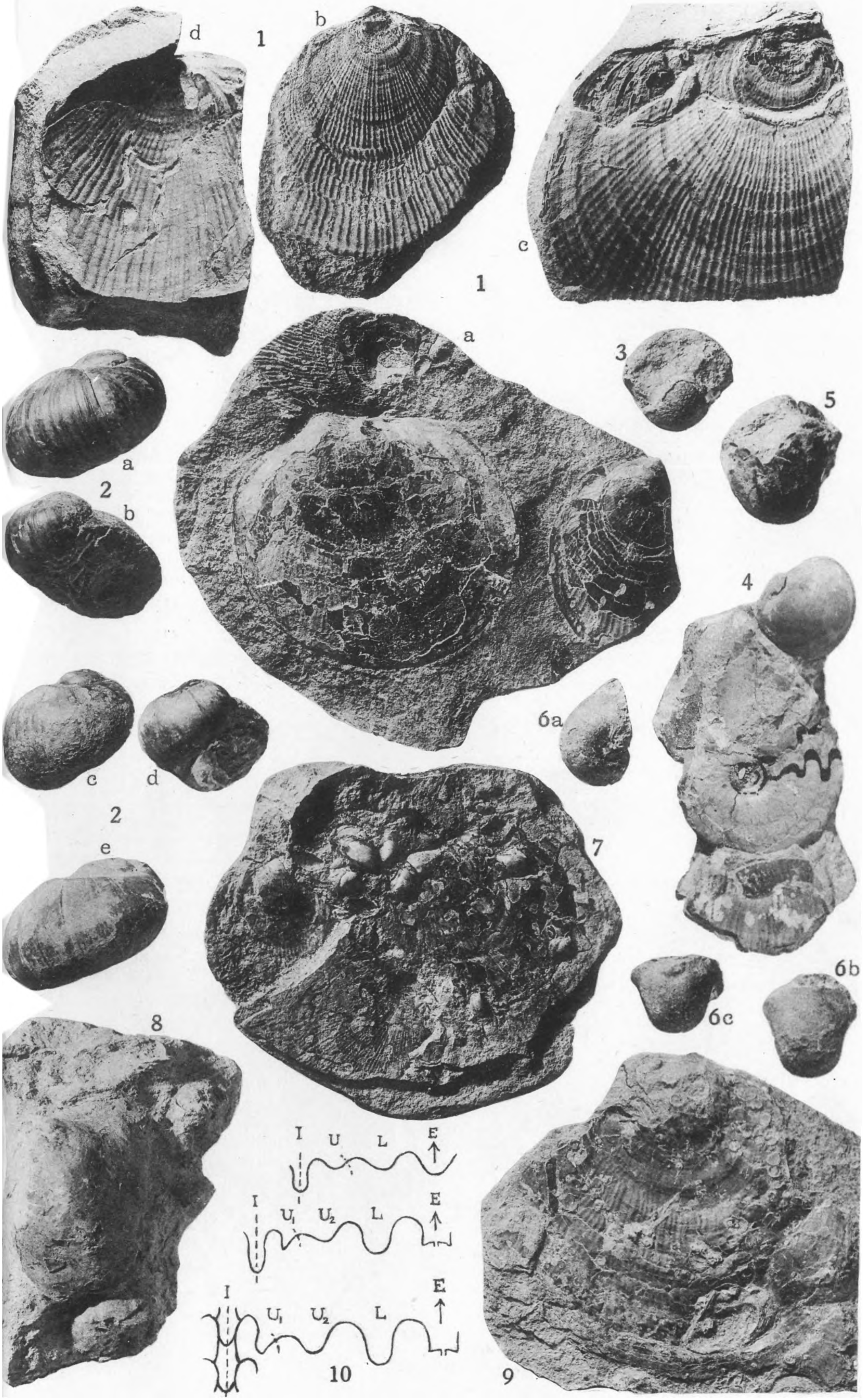
16
(×3)
14
15

PLATE IX

			Page
Figs.	1a-d.	*Claraia stachei* (Bittner). Two convex left valves on slab with portion of a flat right valve, on top (a); two right valves (b, c); and inside of left valve (d). All from *Ophiceras* layer. S. S. W. of Cape Stosch (Danish Exp., 1929)	46
-	2a-e.	*Naticopsis arctica*, sp. nov. Holotype, with colour markings (a, b) and two paratypes, from East of Cape Stosch (locality 3, Danish Exp., 1929, altitude 560 m.)	45
-	3.	*Bellerophon* cf. *vaceki* Bittner. Apertural view of single example. S. S. W. of Cape Stosch (J. M. Wordie Colln., no. 47)	42
-	4.	*Bellerophon*, sp. ind. On block with *Ophiceras* (*Lytophiceras*) *subkyokticum* and *Claraia stachei* etc. S.S.W. of Cape Stosch (altitude 220—280 m.) (Danish Exp., 1929)	44
-	5.	*Bellerophon borealis*, sp. nov. Peripheral view (not central) of holotype. Same locality and colln.	43
-	6a-c.	*Bellerophon borealis*, sp. nov. Two sandstone casts from a loose concretion. Cape Stosch (Lauge Koch colln., 1927). (b = peripheral view of example a)	43
-	7.	*Gervilleia* aff. *exporrecta* (Lepsius?) Bittner. On crushed valves of *Claraia stachei*. S.S.W. of Cape Stosch (J. M. Wordie Colln., no 47)	48
-	8.	*Gervilleia* (?), sp. ind. with *Anodontophora* (?), sp. nov. From a block of impure limestone, with *Proptychites*. East of Cape Stosch (locality 4, altitude 270 m.) (Danish Exp., 1929)	49
-	9.	*Spirorbis valvata* (Goldfuss) Berger sp. On a crushed valve of *Claraia stachei*. S.S.W. of Cape Stosch (altitude 220—280 m.) (Danish Exp., 1929)	61
-	10a-d.	*Glyptophiceras*, sp. juv. aff. *minor*, sp. nov. Development of suture-line. At diameters of 1.5, 3.5, and 6.25 mm. I = internal lobe, U = umbilical lobe, L = lateral lobe, E = external lobe. Same locality and colln.	38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6c
8
I
U
L
E
I
U1
U2
L
E
I
U1
U2
L
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10
9

PLATE X

		Page
Fig. 1.	*Ophiceras* (*Lytophiceras*), sp. ind. Portion of the sandy *Ophiceras* Limestone, underlying the *Otoceras* bed of Clavering Island (Danish Exp., 1929)	62
- 2.	*Serpula* sp. nov.? ind. Surface of a block of micaceous flaggy sandstone, with numerous annelid tubes. East of Cape Stosch, locality 2, altitude 445 m. (Danish Exp., 1929)	60
- 3.	*Worthenia* cf. *humilis*, J. Boehm. Enlarged (× 3) and diagrammatic view of a small cast, with portions of test, from loose block of micaceous sandstone, Cape Stosch (Lauge Koch Colln., 1927)	44
- 4.	*Worthenia?* sp. ind. Enlarged view (× 4) of a similar cast from same block	45
- 5a, b.	*Claraia stachei*, Bittner. Two flat right valves showing byssal sinus. 5 *b*, at back, has convex left valve; *a* from S. S. W. of Cape Stosch (altitude 240—60 m., above Norwegian Hut), *b* from E. of Cape Stosch (locality 2, altitude 260 m.) (Danish Exp., 1929)	46
- 6, 7.	*Enantiostreon* cf. *difforme* (Schlotheim). Portion of the plicated part (6) and doubtful initial portion (on *Claraia stachei*) with frilled edge (7), also an indeterminable plicatuloid shell on left. S. S. W. of Cape Stosch (altitude 220—280 m.) (Danish Exp., 1929)	50
- 8, 9.	*Anodontophora* sp. ind. (*breviform*). Specimens from a loose block of white micaceous sandstone. Camp east of Cape Stosch (Horizon *c* of section VI, p. 66) (Danish Exp., 1929)	55
- 10.	*Myalina* aff. *schamarae*, Bittner. Internal cast of two valves, with fragments of test. Right aspect. S. S. W. of Cape Stosch (altitude 220—280 m.) (Danish Exp., 1929)	51
- 11a, b.	*Gervilleia* aff. *exporrecta* (Lepsius?) Bittner. Casts of right and left valves, from a loose block of micaceous sandstone, with *Otoceras?* Cape Stosch (Lauge Koch Colln., 1927)	48
- 12a, b.	*Anodontophora* sp. n. cf. *subrecta* (Bittner). Cast of right valve (a) and internal cast of the two valves (b), left aspect, with anterior end damaged. Out of same block as last	53
- 13.	*Anodontophora* (?) sp. nov. Fragment of the same block with *A.* sp. n. cf. *subrecta* (right) and *Gervilleia* aff. *exporrecta*, *Myalina* aff. *schamarae* and *Ophiceras* aff. *sakuntala*	53

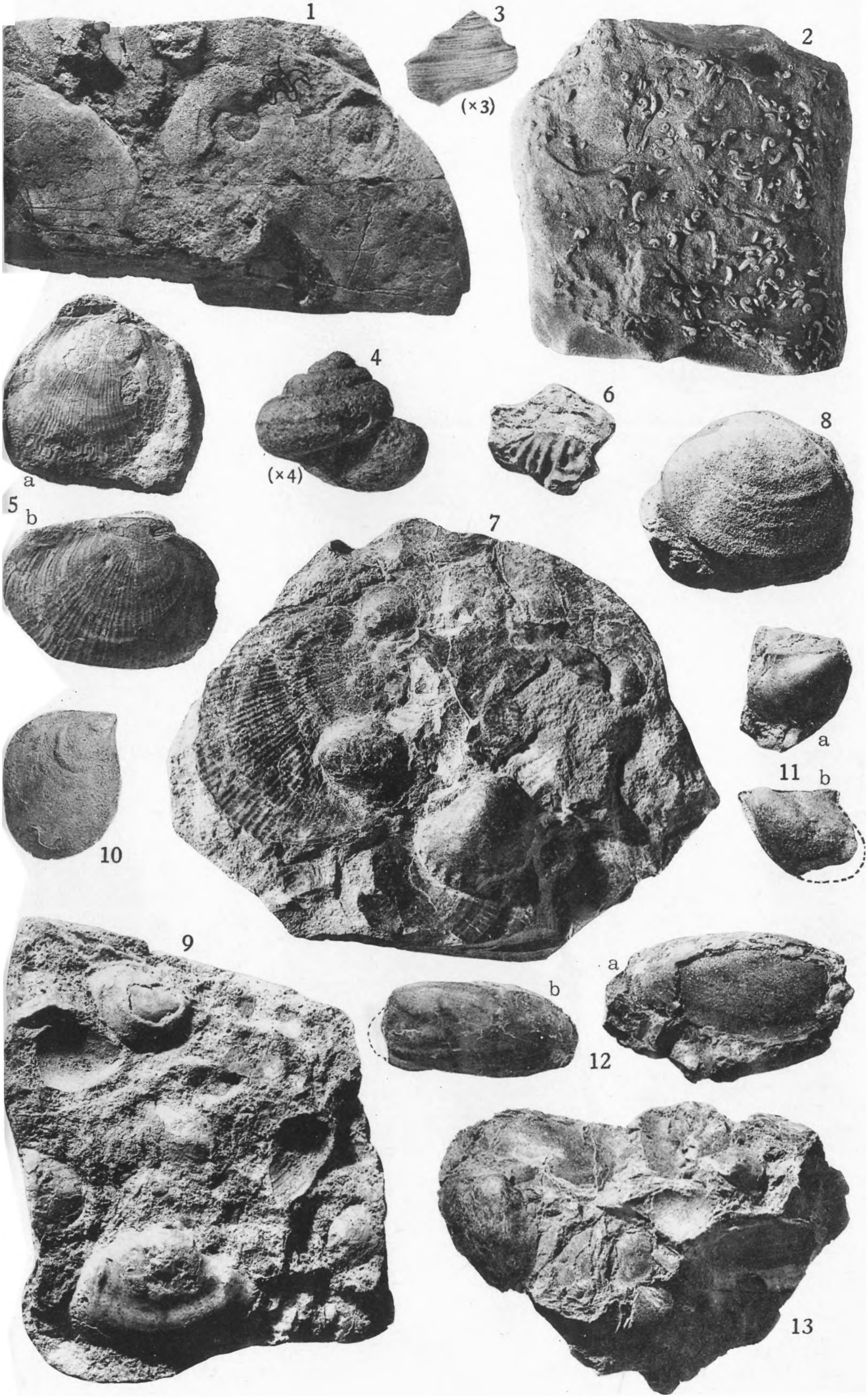
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PLATE XI

Page

Figs. 1a-e. *Myalina kochi*, sp. nov. Four specimens with both valves. Right and left aspects (d, a); left aspect and front-view of another example (b, c); and anterior view of a fourth specimen (e). Locality 5, east of Little Finsch Island (altitude 375 m.) (Danish Exp., 1929).... 52

- 2. *Anodontophora* aff. *fassaensis* (Wissmann) Münster sp. Slab of grey, micaceous sandstone from Locality 5, east of Little Finsch Island (altitude 400—410 m.) (Danish Exp., 1929) 55

- 3a-e. *Anodontophora* sp. ind. (*breviform*). Block with numerous internal casts (a) and two isolated casts of both valves. Right and left aspects, and two anterior aspects. East of Cape Stosch (locality 2, altitude 445 m.) (Danish Exp., 1929) 55

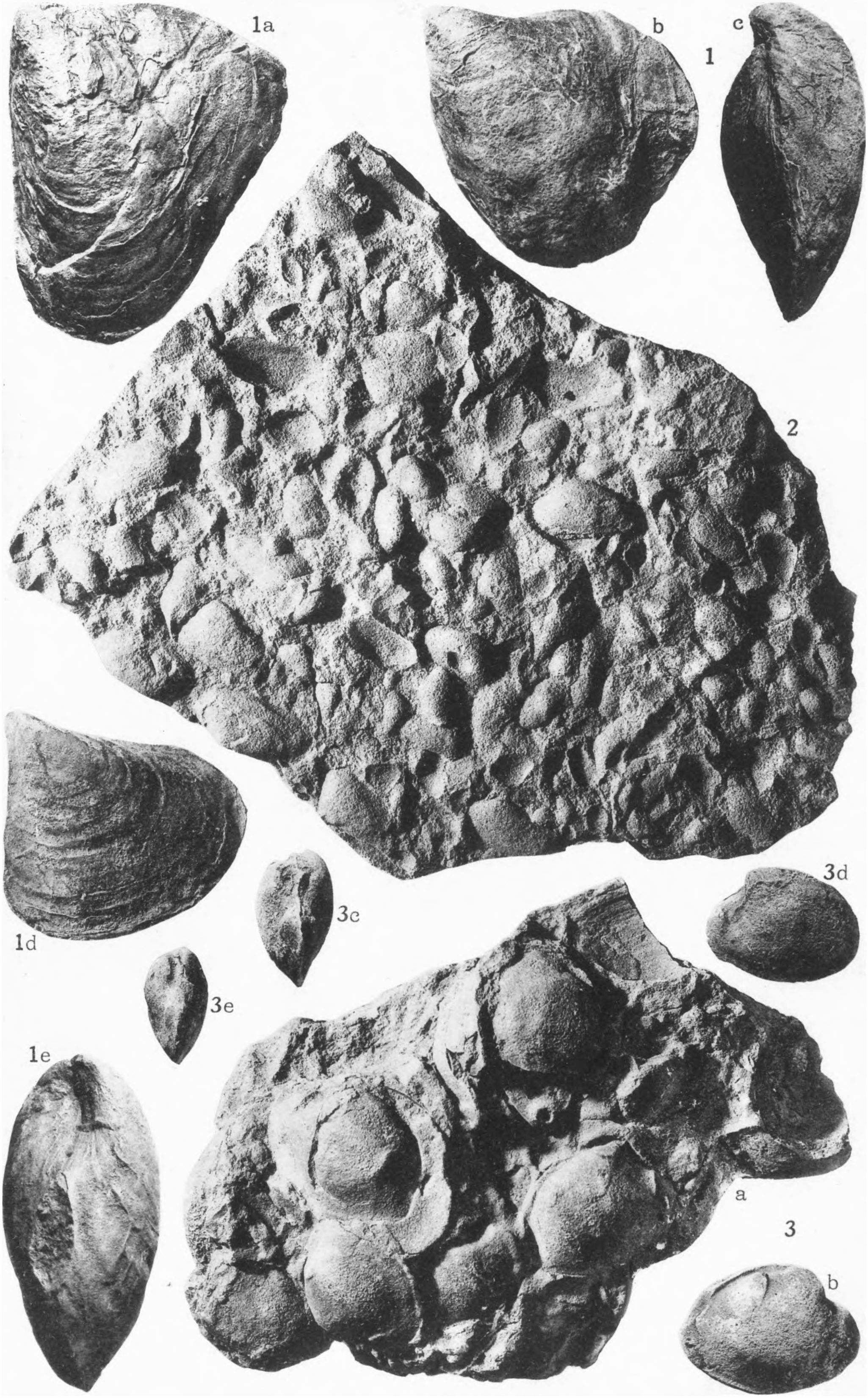

1a
b
1
c
2
1d
3c
3d
3e
1e
a
3
b

PLATE XII

Page

Fig. 1. *Ophiceras* aff. *demissum* (Oppel). Block with numerous badly preserved specimens, converted into white calcite. S.S.W. of Cape Stosch, altitude 220—280 m. (Danish Exp., 1929) 14

- 2, 3. *Myalina* aff. *schamarae*, Bittner. Internal cast of right valve, with *Anodontophora* (?) sp. nov. *Enantiostreon?* etc. (2); and left valve, with test at umbo (3). From loose block of micaceous sandstone, with *Otoceras?* Cape Stosch (Lauge Koch Colln., 1927) 51

Fig. 4. *Gervilleia* aff. *exporrecta* (Lepsius?) Bittner. Right valve, from same block (compare Plate X, figs. 11 a, b) 48

- 5. Fucoid markings and worm casts, on slab of fine, micaceous sandstone, ripple-marked on opposite side. East of Cape Stosch (locality 3, altitude 605 m.) (Danish Exp., 1929) 67

- 6a, b. *Anodontophora* sp. ind. (*breviform*). Left aspect of two worn internal casts of both valves. East of Cape Stosch (altitude 1250 ft., J. M. Wordie Colln., 1926, no. 48) 55

- 7, 8. *Anodontophora* (?) sp. nov. Internal casts of two left valves (8 not quite central) in loose block of micaceous sandstone from Cape Stosch (Lauge Koch Colln., 1927) 57

- 9. *Lingula borealis*, Bittner. Specimen with brown, horny test, broken at pedicle end. From same block 58

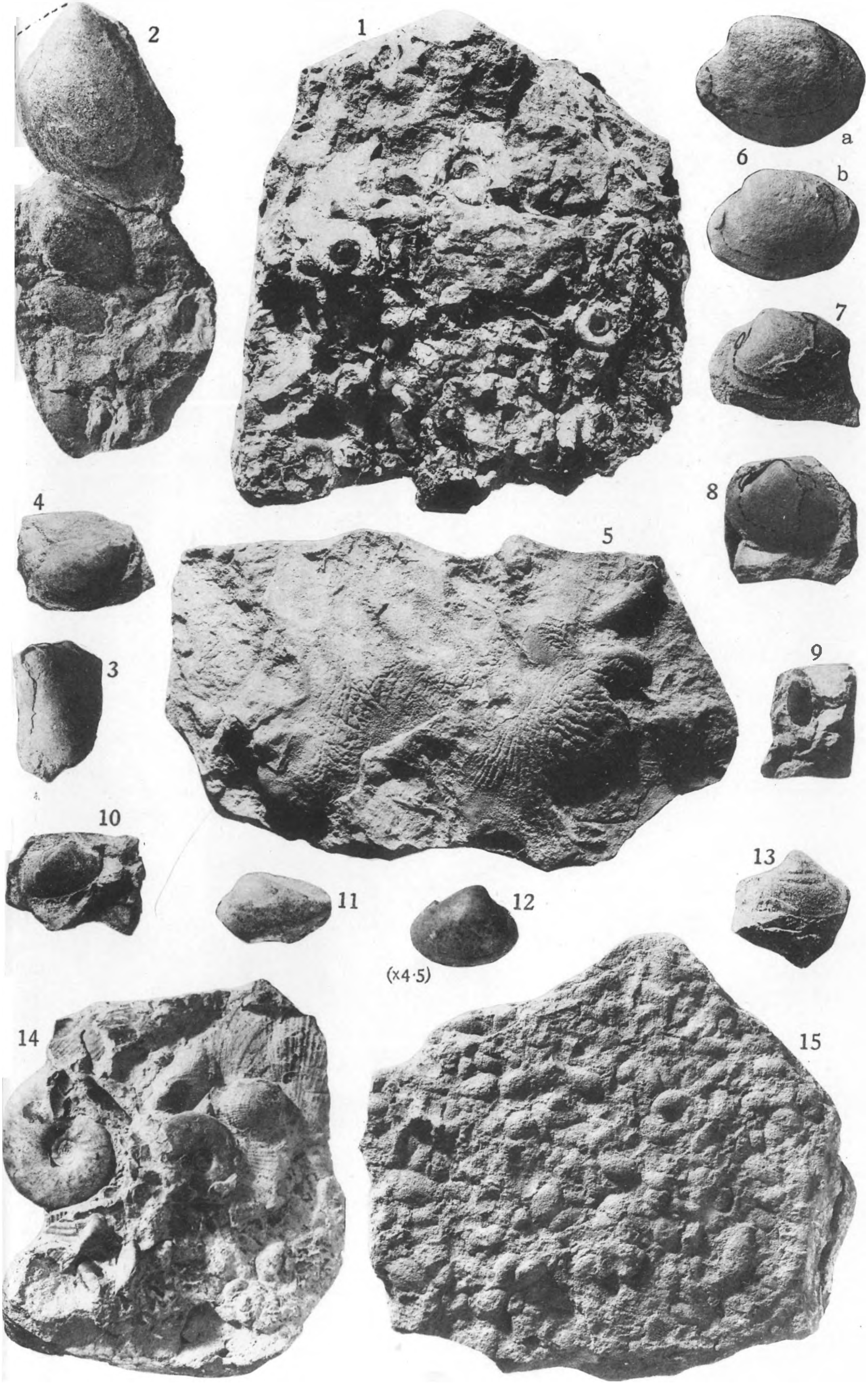
- 10, 11. *Anodontophora* aff. *canalensis* (Catullo) Bittner. Internal casts of right (10) and left (11) valves, from same micaceous sandstone block.. 54

- 12. *Nucula* sp. juv. ind. Enlarged (× 4.5) left aspect of a minute, internal cast from S. S. W. of Cape Stosch (altitude 220—280 m.) (Danish Exp., 1929) 53

- 13. *Anodontophora* (?) sp. ind. Left valve of an unusually strongly ribbed, *Pleuromya*-like variety of probably the same species as figs. 10, 11. Loose Block of micaceous sandstone, Cape Stosch (Lauge Koch Colln., 1927) 54

- 14. *Ophiceras* (*Lytophiceras*) *wordiei*, sp. nov., with *Claraia stachei*, *Gervilleia* aff. *exporrecta* and a microscopic gastropod fauna on an umbilical cast of a large *Ophiceras* (*Lytophiceras*) aff. *evolutum* (at back). S. S. W. of Cape Stosch (altitude 220—280 m.) (Danish Exp., 1929) 64

- 15. *Anodontophora?* sp. ind. cf. *fassaensis* (Wissmann) Münster sp. Slab of red, micaceous sandstone, with small, almost unrecognisable casts. East of Little Finsch Island (locality 5, altitude 415 m.) (Danish Exp , 1929) 55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