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TREAARSEXPEDITIONEN TIL CHRISTIAN DEN X'S LAND 1931-34
UNDER LEDELSE AF LAUGE KOCH

THE UPPER JURASSIC INVERTEBRATE FAUNAS OF CAPE LESLIE, MILNE LAND

II. UPPER KIMMERIDGIAN AND PORTLANDIAN

BY

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WITH 2 FIGURES IN THE TEXT AND 50 PLATES

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I. INTRODUCTION

To what has already been said in the Introduction to the first part of this memoir I may add that the magnitude of the material was not fully appreciated when that Introduction was written. Dr. Aldinger's large collection consisted essentially of ammonites; and the reader who peruses the present part will see at once that the beauty of the preservation of these ammonites of which I spoke is in striking contrast to the general defectiveness of the Oxfordian and Lower Kimmeridgian invertebrates illustrated in the first part. Compared with the ammonites, the few other mollusca in the collection were so negligible that I did not hesitate to include them in the account, partly because their description by specialists would have meant a long delay. Since February, however, and as the other invertebrates in Mr. Rosenkrantz's collections were gradually being unpacked, there accumulated such a mass of material that in spite of much of it being named by Rosenkrantz, I began to regret having included fossils other than cephalopoda in my account. The pelecypods, of which there are 52 species, as against 53 cephalopods, especially may be held to include a large proportion of doubtful or cautious identifications, not always due to defective preservation. Whether long continued and more intensive study of these by a specialist would have yielded different results, however, is doubtful. Considering that the ammonites are mostly new, it is almost certain that I have not recognised a proportionate number of new species among the other mollusca. But I have at least attempted to give adequate illustrations of those forms that on account of their abundant occurrence in certain beds or their more favourable preservation may be thought to be of some interest. By general consent, however, a Jurassic fauna will stand or fall by its ammonites and I can only hope that my colleagues working on other groups will not think that a slight is implied in devoting the great majority of plates to the illustration of the ammonites.

Since I wrote the first part there has also appeared an important

paper by Messrs. Parat and Drach[1]) on the geography and geology of Milne Land. Their stratigraphical results will be discussed in later chapters (III, IV); here it may suffice to refer to a point of nomenclature. Since Dr. Aldinger's paper, referred to in my first account, has not yet appeared[2]), I am unable to say whether he is accepting the name Chatton Bay, used by Messrs. Parat and Drach for what I had called Charcot Bay. But the names Charcot Bay and Charcot Bay Sandstone taken from Dr. Aldinger's information and map were not published by me till April 1935, while Chatton Bay dates from 1934. It is thus possible that the lowest (unfossiliferous) formation in the Upper Jurassic succession of Milne Land will in future be known as Chatton Bay Sandstone instead of Charcot Bay Sandstone.

To the acknowledgements already made in part I, I would gratefully add special thanks to Dr. Lauge Koch for allowing me a free hand with the illustrations and to Mr. A. Rosenkrantz for giving me the benefit of his preliminary preparation and determinations of many of the pelecypoda of his own collection. I also gratefully acknowledge the help given in past years by the Royal Society Committee in the way of grants for investigating the type successions of the Kimmeridge Clay and Portland Sands in Dorset. I am incorporating in the present account the results of my detailed collecting, already briefly referred to between 1931 and 1933 in connection with the Perisphinctids of Kachh, India. Additional material has been obtained in the summers of 1933 and 1934 and with the Greenland ammonites here described it has enabled me to get a far better idea than I had in 1931 of the perplexing succession of more or less biplicate Perisphinctids during these lengthy periods. I have also had the advantage of studying a large collection of Kimmeridgian and Portlandian ammonites from England and the Boulonnais kindly made over to me by Mr. C. H. Waddington. The comparison of the standard succession with the sequence in Milne Land, thus, it is hoped, will prove of more than local interest. Unfortunately, many problems still remain to be solved.

London, September 1935.

[1]) Rapport sur les observations d'histoire naturelle et de géographie physique. Annales hydrographiques, Paris, 1934, pp. 1—17.

[2]) This paper, entitled: Geologische Beobachtungen im oberen Jura des Scoresbysundes (Ostgrönland) has now appeared (as No. 1 of present volume), but could only be referred to in footnotes; likewise another paper, by J. W. Arkell: The Portland Beds of the Dorset Mainland (Proc. Geol. Ass. vol. XLVI, pt. 3, pp. 301—347, pls. XIX—XXVI), published after the present memoir was in page proof, could not be adequately criticised. Since my interpretation of the English Portlandian ammonites differs considerably from that of Dr. Arkell, it is hoped that the footnotes will be found helpful.

II. SPECIFIC DESCRIPTIONS

Phylum Mollusca.

1. Class *Cephalopoda.*

a. Order *AMMONOIDEA.*

Super-family *Stephanoceratida.*

Family *PERISPHINCTIDAE.*

Sub-family *Virgatosphinctinae.*

This sub-family was only recently[1]) discussed, chiefly in connexion with Mediterranean faunas, but I am under no illusion as to the possibility of classifying these variable Perisphinctids in a manner acceptable to all workers. No forms of Virgatosphinctinae have so far been described from Arctic regions, apart from what I would include in Virgatitids and Pavlovids, and even the Virgatosphinctid ammonites of the English Kimmeridge Clay remain almost unknown or at least unpublished. There are three ammonites, however, from the band with crushed Perisphinctids, already referred to in part I (p. 66) that on account of their poor preservation offer particular difficulty and thus may justify the present review.

I ought to mention that from the Upper Oxfordian part of the succession, probably from the shelly sandstone, just below the *Pecten* Sandstone, i. e. Rosenkrantz's section IV, there is now a fragment of a Perisphinctid, perhaps a true *Perisphinctes* s. s., which was discovered in the matrix of a very large *Pecten*, doubtfully identified by Rosenkrantz with the much later *P. præcinctus* here described (p. 104). No normal Perisphinctids have yet been found in the *Rasenia-Amoebites* beds of East Greenland, but only the aberrant Pictoninae. These are characteristic of the uppermost Oxfordian and Lower Kimmeridgian of northern and north-western Europe, as *Ataxioceras* and *Planites* are the dominant elements in corresponding beds in more southern latitudes. The fifty metres of shales that succeed the *Rasenia-Amoebites* beds are

[1]) Spath, Revision of the Jurassic Cephalopod Fauna of Kachh (Cutch). Pal. Indica, N. S., vol. IX, no. 2, pt. 4, 1931, p. 463; pt. 6, 1933, p. 688.

entirely unfossiliferous, according to Dr. H. Aldinger, but it is perhaps from there that Parat and Drach recorded *Perisphinctes bleicheri*, a species of the *Gravesia* beds. In any case the *Aulacostephanus*[1]) beds are incompletely explored, yet even in Dorset, in about 140 feet of clays teeming with *Aulacostephanus* I have only seen a single fragment of a *Perisphinctes*. They occur sparingly, however, in the *Aulacostephanus* beds of Yorkshire (*Subdichotomoceras lamplughi* and *S. speetonensis*) and the *Ringsteadia* beds of Pomerania, and more abundantly in Russia (Volga and Southern Urals) associated with many examples of *Aulacostephanus*, but they are mostly stragglers of the Perisphinctid groups, notably Ataxioceratids[2]), that swarmed in the Lower Kimmeridgian seas of more southern latitudes.

Conversely, in *Gravesia* times, there began, with the disappearance of *Aulacostephanus*, at least in the English Kimmeridge Clay, an expansion of normal Perisphinctids that lasted for an unusually long period and that is perhaps unequalled in so far as numbers of individuals are concerned. There is no other locality in the world where so complete a succession, with ammonites throughout, up to the Portlandian, is available.

The difficulty of identifying the Greenland and Spitsbergen Kimmeridgian ammonites so far recorded, in fact, is due largely to the uncertainty that still exists with regard to the exact dating of the very fragmentary European deposits of Middle and Upper Kimmeridgian age hitherto described. In attempting to name such Kimmeridgian Perisphinctids, it is thus only the (hitherto almost undescribed) English faunas that one can turn to, just as the first record of the ammonites of the next higher Cape Leslie Formation (by Parat and Drach) consisted almost entirely of names of English species.

The three Greenland forms figured in Plate 1 are known to be of post-*Rasenia* age; and they come from shales underlying sandstones

[1]) For interpretation of *Aulacostephanus* see p. 143.

[2]) According to Arkell (Geol. Mag., vol. LXXII, 1935, p. 255) the "study of the Ataxioceratidae at present lags far behind that of the Perisphinctidae and this partly accounts for the much smaller number of genera recognised in the Ataxioceratidae". This pronouncement echoes views which I cannot commend. *Ataxioceras*, like any other ammonite genus, may have to be 'interpreted' by a single species, the type, but it includes far more than that. It takes a long time, however, to become acquainted with the many forms of a group like the *polyploci*. To me, species like *Perisphinctes* cf. *inconditus* (?Fontannes) Simionescu, *P. leiocymon*, Waagen, or the similar Kachh form I figured, are species of *Ataxioceras*, in spite of their Argovian age. There are many forms intermediate between *Ataxioceras* and related genera like *Planites*, *Discosphinctes*, *Lithacoceras*, and others. It would be easy to give these new generic or sub-generic names, but this would only make the determination of an average collection of Perisphinctids from any part of the world extremely artificial, if not impossible.

that have yielded a fauna referred to the *pectinatus* zone. Their approximate age is thus known; but, on the Dorset Coast, there are over 350 feet of Kimmeridge Clay between the highest *Aulacostephanus*-bearing beds and the lower limit of the range of *Pectinatites*, as mentioned already in part I (p. 73). In deciding which age to assign to the three Greenland Perisphinctids, comparison must thus be made with the Perisphinctids that teem in these 350 feet, but that are generally in as poor a state of preservation as the Greenland examples. A knowledge of this succession is of as much importance to the systematist as to the stratigrapher; for a natural classification of these Perisphinctids must take into account their vertical distribution, as represented for example in a table I[1]) recently published. Many smaller branches could have been added and, of course, it is always easier to separate than to unite. But the giving of new names does not solve the difficulty of classifying the enormous number of species of *Perisphinctes*. As they are a particularly homogeneous group of ammonites (with a majority of passage-forms between the rarer extremes that are comparatively easy to pick out) their classification has to be elastic; neither a purely morphological grouping, based for example on the presence of parabolae, or on biplicate ribbing, nor a hypothetical genetic classification with imaginary lineages is practicable.

In the Virgatosphinctinae, as in some earlier groups of Perisphinctids, I thus recognise the conservative "*biplex*" type, some of which are leading to the Pavlovids, and the more elegant *contiguus* type, probably leading to certain Pseudovirgatitids and Virgatitids, but persisting itself alongside the first. Both develop virgatotomous ribbing and they are not sharply separated, even from *Lithacoceras*, for the spacing of the ribs may vary much in the same individual and, like inflation of whorl-shape or differences in the earlier volutions, may depend on local habitat.

I have shown why the Virgatosphinctids of, for example, Kachh are different from those of Spiti, and the absence or rarity of Portlandian and post-Portlandian deposits in many areas increases the difficulty of correlation. But the difference in the ammonite faunas is not always due to a difference in age of the deposits, as is shown by the absence of Perisphinctids from the *Aulacostephanus* or *Cardioceras* beds, already referred to. In trying to place the three badly preserved Greenland forms, however, in an elastic scheme, based on the two types that existed in the open seas of the period, it is impossible to do more than suggest the most likely relations; to find a specific name on the basis of a purely morphological resemblance would be futile. Unfortunately, even the generic names offered below have to be considered as provisional.

[1]) Spath, *loc. cit.* (Pal. Indica, N. S., vol. IX, no. 2), pt. 6, 1933, p. 850.

Genus *SUBDICHOTOMOCERAS*, Spath, 1925.

Sub-genus *Sphinctoceras*, Neaverson, 1925.

Subdichotomoceras? (*Sphinctoceras*?) sp. ind.

Plate 1, fig. 1.

There are two single ribs, with a constriction between them, on the larger whorl-portion shown in the photograph, but rather distantly spaced, bifurcating ribs over the greater part of this as well as the smaller impression below which may be assumed to have belonged to the same individual. Another constriction is indicated by the single rib and abrupt depression at the left-hand end of the lower impression. This type of ribbing — the only feature to be relied on in the present case — is found in various Perisphinctid groups, besides *Subdichotomoceras*, but the provisional reference to this genus is prompted by the post-*Rasenia* age of the fossil. *Sphinctoceras crassum*, Neaverson[1]) the holotype of which is before me (B. M., no. C 26900), is particularly close to the Greenland form which differs from corresponding whorl-portions of *S. crassum* merely in having the ribs slightly more distantly spaced.

But *Sphinctoceras* is based on the inner volutions of a large form, the outer whorls of which probably could not be satisfactorily distinguished from the body-chamber fragment figured by Neaverson[2]) as *Virgatosphinctoides nodiferus*. The coarse ornamentation of these body-chambers is very irregular and not the same in two individuals, and in appraising the suture-line of one of these "*Sphinctoceras*" fragments from Wheatley (Plate 10, fig. 6) it must not be forgotten that this is merely the suture-line of one individual while some half-dozen other examples before me show suture-lines that differ widely in the width of the saddles and similar details. Moreover, Neaverson's[3]) second species of *Sphinctoceras* (*S. distans*) was included by Buckman[4]) in the genus *Allovirgatites* which has the "inner whorls always finely ribbed" and is thus in my opinion inseparable from *Virgatosphinctoides*. These three "genera", however, are not only closely connected by transitions, but they come from the same beds, the *nodiferus* zone of Neaverson having no reality, so far as I can see.

Sphinctoceras, thus, is retained only as a sub-genus of the persisting *Subdichotomoceras*, just as the finely ornamented *Virgatosphinctoides* may be accepted as a sub-genus of *Subplanites*. *Sphinctoceras* leads to the still larger forms of *Paravirgatites* of the next higher zone and thus to the

[1]) Ammonites from the Upper Kimmeridge Clay. Pap. Geol. Dept. Univ. Liverpool, 1925, p. 22, pl. II, fig. 1.

[2]) *Ibid.*, pl. IV, figs. 1 a, b.

[3]) *Ibid.*, p. 23, pl. IV, fig. 3.

[4]) Type Ammonites, vol. VI, 1926, pl. DCXXXVIII, A, B, C, D.

Pavlovidae which are also dominant in more northern areas, as mentioned below (p. 26).

A supposed earlier Kimmeridgian species that shows some resemblance to the form here discussed is *Perisphinctes bleicheri* (de Loriol)[1]), said to be from the beds with *Gravesia portlandica*[2]). I previously referred this species to *Subdichotomoceras*, but I am not satisfied that it can be recognised from the figure any better now than in Waagen's time; and although *P. bleicheri* has been recorded from England[3]) the multitude of Perisphinctids that I collected in the *Gravesia* beds of Kimmeridge includes nothing that even distantly resembles de Loriol's figure. Since Siemiradzki[4]) also considered *P. bleicheri* closely allied to two much later ammonites figured by de Loriol that are now known to belong to *Pavlovia* and *Crendonites*, respectively, it is not a satisfactory species with which to compare the Greenland impression, except in so far as it rather confirms the higher horizon here suggested for the ammonites from the band with crushed Perisphinctids.

Horizon:— Middle or Upper Kimmeridgian? Band with crushed Perisphinctids, about 36 m below *pectinatus* horizon and 44 m above *Hoplocardioceras* bed.

Locality:— Astarte Valley (C), marked "at 130 m loose, but probably from only a few metres higher". No. 169 a.

Genus *SUBPLANITES*, Spath, 1925.

Subplanites? sp. ind.

Plate 1, fig. 3.

The specimen here figured is poorly preserved and crushed; and the only feature of diagnostic value is the presence of a deep constriction preceded by a triplicate rib and succeeded by an apparently single rib. Two more constrictions, less distinct merely on account of preservation, can be seen; the intervening ribs are simply biplicate. The anterior, lower branch of the triplicate rib branches off at about the inner third of the whorl-height; but as the periphery is too badly crushed, it is impossible to state whether the outer branches owe their apparent length of a third of the whorl-height merely to this crushing. The secon-

[1]) In de Loriol and Pellat: Monographie de l'étage portlandien de Boulogne-sur-Mer. II. Mém. Soc. Phys. & Hist. Nat. Genève, vol. XXIII, 1874, p. 21, pl. IV, fig. 1 only.

[2]) Pruvost: Les subdivisions du Portlandien boulonnais d'après les Ammonites. Ann. Soc. géol. Nord, vol. XLIX, 1925, p. 204.

[3]) Lamplugh, Kitchin and Pringle: Concealed Mesozoic Rocks in Kent. Mem. Geol. Survey, 1923, p. 221.

[4]) Monographische Beschreibung der Ammoniten-Gattung *Perisphinctes*. Palaeontographica, vol. XLV, 1898, p. 174.

daries are as straight as the primaries before the constriction; afterwards the anterior branch seems to continue the direction of the primary stem and the posterior secondary appears to be coming off behind. The ribbing of the inner whorls is quite unrecognisable.

Perisphinctids with triplicate ribs preceding a constriction occur at all horizons in the Kimmeridgian. There is some resemblance between the Greenland form and the ammonite from the Russian *Aulacostephanus* beds figured by Pavlow[1]) as *Perisphinctes virguloides*, Waagen; but the Indian original of this species, recently refigured[2]), is entirely different. At least equally similar to the Greenland example, however, are forms from much higher horizons, up to the *wheatleyensis* zone, and a comparison of Plate 1, fig. 3 with Plate 7, fig. 5 (*Pectinatites* [*Keratinites*] *groenlandicus*) will show that the latter has much the same type of ribbing.

When Uhlig[3]) spoke of the peculiar branching of the triplicate ribs as the simplest form of virgatotomy, characterising his genus *Virgatosphinctes*, he was, of course, unaware of the numbers of successive Perisphinctid faunas in the Upper Jurassic that include forms with virgatotomous ribbing. Moreover, there was only one name in existence (*Lithacoceras*, Hyatt, 1900)[4]) that clashed with his *Virgatosphinctes*; and Uhlig merely rejected it. Since Cossmann restricted the genus *Virgatosphinctes* to the group of *V. broilii*, Uhlig, it is clear that the Greenland form cannot be included in either *Virgatosphinctes* or *Lithacoceras*, both of which are characterised by developing bundled secondaries and rather distantly spaced, swollen primary ribs at larger diameters. There remain the group of *Pachysphinctes major*, Spath[5]) which has a simple type of virgatotomy, with constrictions, and the genus *Subplanites*, in which outer and inner whorls may have almost only virgatotomous ribbing. There is no regularity about the appearance of this virgatotomy. The earlier *S. rüppelianus* (Quenstedt)[6]) is more advanced than the later *S. reisi* (Schneid)[7]) and it would be unsafe to conclude that the simple Greenland form must be earlier than e. g. *S. vicinus* (Schneid)[8])

[1]) Les Ammonites de la zone à *Aspidoceras acanthicum* de l'est de la Russie. Mém. Com. géol. St. Pétersb., vol. II, no. 3, 1886, p. 85, pl. VII, figs. 3 a, b.

[2]) The Jurassic and Cretaceous Ammonites and Belemnites of the Attock District. Pal. Indica, N. S., vol. XX, no. 4, 1934, p. 12, pl. I, fig. 6; pl. II, fig. 3.

[3]) Fauna of the Spiti Shales. Pal. Indica, Ser. XV, Himalayan Fossils, vol. IV, fasc. 3, 1910, p. 307.

[4]) Apart from some forms included by Siemiradzki (1899) in *Biplices*.

[5]) *Loc. cit.* (Pal. Indica, N. S., vol. IX, no. 2), pt. 4, 1931, p. 489, pl. LXXV, figs. 1 a, b.

[6]) See Schneid: Geologie der Fränkischen Alb zwischen Eichstätt und Neuburg a. D. Geogn. Jahresh., vol. XXVII (1914) 1915, pl. III, fig. 3.

[7]) *Ibid.*, pl. VIII, fig. 1.

[8]) *Ibid.*, pl. III, fig. 2.

which leads directly to the degenerate *Virgatosphinctoides*, with numerous single ribs. It is possible to match the Greenland form with Kachh fragments of *Pachysphinctes* and especially *Subplanites* far more easily than with contemporaneous forms described from more northern regions; but, as already mentioned, the resemblance to species from the *pectinatus* zone is sufficiently great to prevent a definite identification with the early Kimmeridgian forms rather than the later.

Horizon:— Middle or Upper Kimmeridgian? Band with crushed Perisphinctids, about 36 m below *pectinatus* horizon and 44 m above *Hoplocardioceras* bed.

Locality:— Astarte Valley (C), marked "at 130 m, loose, but probably from only a few metres higher". No. 169b.

Sub-genus *Virgatosphinctoides*, Neaverson, 1925.
Subplanites? (*Virgatosphinctoides*?) sp. ind.
Plate 1, fig. 2.

This is the least favourably preserved of the three examples from locality 169, showing merely the crushed remains of three whorls, the inner of which is finely and closely ribbed. The point of bifurcation of at least some of the ribs is seen to be outside the umbilical suture, as it is also on the next larger whorl. On the upper part of this whorl (in fig. 2) where it is not covered by the outer whorl, the secondaries are regularly bifid; they are slightly projected branches of the primary stem, but neither of them is in direct line with the latter. On the largest whorl-portion the ribbing is still the same, though scarcely recognisable in the photograph, but there may have been an occasional single rib. There are no constrictions or other features of diagnostic value.

This example is perhaps more closely comparable to forms from the Lower Kimmeridgian (*pseudomutabilis* or *Aulacostephanus* zones) than the two associated Perisphinctids, but again it can equally well be attached to species from the *wheatleyensis* zone. Among many examples of the less finely ribbed species of *Virgatosphinctoides* (= "*Allovirgatites*") before me from the English Kimmeridge Clay as well as from the La Rochette nodule bed of the Boulonnais, there are several that, if crushed, may not be distinguishable from the impression here figured. In the absence of the characteristic constrictions and single ribs, however, it is impossible to carry the comparison any further.

The rather rapid change from the fine and close ribbing of the inner whorls to the distant costation of the next larger whorl is similar to that illustrated by Neaverson[1]) in his "*Allovirgatites*" *robustus* and "*A.*" *versicostatus*, the originals of which are before me and which, in my opinion,

[1]) *Loc. cit.* (Papers Geol. Dept. University Liverpool), 1925, p. 32, pl. III, figs. 3 and 4.

are merely more coarsely ribbed forms of the same author's *Virgatosphinctoides*. The inadequately figured *Perisphinctes bleicheri* (de Loriol), already referred to (p. 15) may also be deemed to be comparable, but there are yet other Perisphictids with similar biplicate ribbing.

Horizon:— Middle or Upper Kimmeridgian? Band with crushed Perisphinctids, about 36 m below *pectinatus* horizon and 44 m above *Hoplocardioceras* bed.

Locality:— Astarte Valley (C), marked "at 130 m loose, but probably only a few metres higher". No. 169 c.

Sub-family *Pseudovirgatitinae*.

When I discussed this family in 1930[1]), I included in it a number of genera, characterised by generally close and fine, but always irregular costation, especially at later stages. The final body-chamber, however, may also be smooth, so that Pseudovirgatitinae may be looked upon as extreme offshoots of the conservative and less irregular *Lithacoceras* somewhat simulating the true Virgatitids. A morphological diagnosis, however, cannot yet be attempted; the difficulties may be realised on perusal of Schneid's[2]) discussion of the genus *Pseudovirgatites*. The exact range of some elements also is still doubtful; and if *Pseudovirgatites* itself should be less closely allied to *Pectinatites* than I think, a different grouping may become necessary. *Anavirgatites* and *Pseudovirgatites*, however, occur together in Bavaria and in Somaliland, associated in the former region with numerous species of *Sublithacoceras* of the *senex* group, in the latter country with *Pseudinvoluticeras*. These five genera, then, form a natural group, but *Parapallasiceras* is as yet doubtful. It includes what Schneid[3]) diagnosed as his "small group of *Berriasella ciliata*", but the appearance of a very distinct ventral groove in the Upper Kimmeridgian *Pectinatites aulacophorus*, Buckman, indicates that the resemblance between *Parapallasiceras* and the true Tithonian *Aulacosphinctes* may be purely accidental. *Parapallasiceras* also connects with *Subplanites* of the *danubiensis* group and its simple suture-line might be taken to indicate affinity with Pavlovinae as much as with any other Perisphinctid group. The equally uncertain *Pectiniformites*, Buckman, which, with Neaverson[4]), I had considered to be a synonym of *Pectinatites*, I now believe to represent merely the inner whorls of some group of *Subplanites*, fore-runners of *Virgatosphinctoides*, as well as of some Pseudovirgatitids, but still very close to *Lithacoceras*

[1]) Spath, *loc. cit.* (Pal. Indica, N. S., vol. IX, No. 2), pt. 4, 1931, p. 468.

[2]) Die Ammonitenfauna der Obertithonischen Kalke von Neuburg a. D. Geol. & Pal. Abh., N. F., vol. XIII, 1915, pp. 72—75.

[3]) *Ibid.*, pp. 62—64.

[4]) *Op. cit.* (Ammonites from the Upper Kimmeridge Clay), 1925, p. 15.

of the beds immediately below. As in other groups of Perisphinctids, there are so many transitional forms between the extremes and the persisting, simpler types that it is impossible to classify them satisfactorily. It may also seem inconsistent to unite *Pectinatites*, *Keratinites* and *Wheatleyites*, the extremes of which are distinct enough, into one genus (*Pectinatites*), even if as sub-genera, yet to separate the Pseudovirgatitinae from the Virgatosphinctinae, when, for example, *Subplanites* develops almost as irregular ribbing on the outer whorl as *Pseudovirgatites* itself (see fig. 2 on p. 173). The classification into sub-families, thus, is prompted merely by the ever increasing number of genera. A return to the single genus *Perisphinctes* (with thousands of species) would not be so convenient to the systematist as the stratigrapher may think; yet when some species-groups like the three mentioned are closely interconnected by passage-forms and are associated in the same bed, generic separation seems unnecessary. It is different with forms that are either incompletely known, or not dated with certainty. If *Perisphinctes quenstedti*, Michalski[1]) is as close to "*Virgatites*" *scythicus* as its author held, then it must be entirely distinct from *Pseudovirgatites seorsus* (Oppel), contrary to the opinion of Schneid[2]). Also, the identification of the English "*Virgatites*" *scythicus*[3]) must be erroneous; for the two forms are believed to occur at different levels. Even if Pseudovirgatitinae and Virgatitinae, however, are approximately contemporaneous, their separation into two distinct sub-families may still be justified on account of the distinctiveness of the true *Virgatites* and *Zaraïskites* (= "*Provirgatites*").

Genus *PECTINATITES*, S. S. Buckman, 1922.

Pectinatites aff. *eastlecottensis* (Salfeld).

(Plate 2, fig. 1).

1913. *Perisphinctes eastlecottensis*, Salfeld: "Die Gliederung des oberen Jura in Nordwesteuropa". N. Jahrb. f. Min. etc., Beil. Bd. XXXVII, p. 130.

1913. — — Salfeld: "Certain Upper Jurassic Strata of England". Quart. Journ. Geol. Soc., vol. LXIX, p. 429, pls. XLI—XLII.

1922. *Wheatleyites eastlecottensis* (Salfeld) Buckman: Type Ammonites, vol. IV, p. 28.

1925. — — (Salfeld) Neaverson: "Ammonites from the Upper Kimmeridge Clay", *loc. cit.*, p. 37.

The inner whorls of the only example available are crushed and show merely very fine and close ribbing. On the flattened last half of the

[1]) Die Ammoniten der unteren Wolga-Stufe. Mém. Com. géol. St. Pétersb., vol. VIII, no. 2, Lief. 2, 1894, p. 433, pl. IX, figs. 6—7.

[2]) *Loc. cit.* (Geol. Pal. Abhandl.), 1915, p. 74.

[3]) See Buckman, Type Ammonites, vol. VI, 1926, pl. 676.

outer whorl the characteristic bundling of the ribs into thickened primary stems and irregularly branching, secondary costae, begins, but it is uncertain whether any part of the body-chamber was included in this outer whorl. There are several indistinct constrictions, but there is no trace of the suture-line.

Owing to the fact that Salfeld's original figures were reduced, the resemblance to the Greenland specimen here illustrated may not seem to be particularly striking; but I have the holotype before me, together with numerous examples of closely related forms from the same bed, and there is, indeed, good agreement. The allied "*Wheatleyites*" figured by Buckman[1]), namely *W. tricostulatus* and *W. rarescens* are also too much reduced (and too poorly preserved) to show this resemblance, while "*Wheatleyites*" *pringlei*, Pruvost[2]), recorded by Parat and Drach[3]) from East Greenland, is a form of *Subplanites* (*Virgatosphinctoides*). The comparison by Ilovaïsky[4]), of *P. eastlecottensis* to certain *Pavlovia*(?) must also be due to some misidentification.

P. pectinatus (Phillips) as figured by Buckman[5]) is also very close to the present form, but has less finely ribbed inner whorls.

Horizon:— Indurated shales, about 90—100 m below Glauconitic Series. Upper Kimmeridgian, *pectinatus* zone.

Locality:— North-western side of Hartz Mtn. (Loc. M.) at 390 m. loose (No. 242).

Pectinatites sp. ind.

(Plate 2, figs. 3 a—c; Plate 3, figs. 1 a—c).

The two fragments under discussion may not have belonged to the same species, because the ribbing of the larger (Plate 2, fig. 3) is more delicate than that of the smaller specimen. A squeeze of the ribbing in the dorsal area, however, shows that the faintness of the ribbing on the outer whorl of the larger example may be due merely to the poor preservation; there is also accidental deformation and crushing in a ventro-dorsal direction at the larger end. The smaller specimen shows long, single or bifurcating costae on the inner whorls and similar, but peripherally more projected, costae near the end. There is no trace of the suture-line to indicate whether this portion of the outer whorl was body-chamber. The larger specimen, also may or may not have been part of

[1]) Type Ammonites, vol. IV, 1923, pl. 365 and vol. V, 1925, pl. 561 A (and 561 B?).

[2]) Les subdivisions du Portlandien boulonnais d'après les Ammonites. Ann. Soc. géol. du Nord, vol. XLIV (1924), 1925, p. 211, pl. II.

[3]) Le Portlandien du Cap Leslie dans le Scoresby Sund (Groenland). C. R. Acad. Sci. Paris, vol. 196, 1933, p. 1910.

[4]) "*Pavlovia*, un nouveau genre d'Ammonites" Bull. Soc. Nat. Moscou N. S. vol. XXXII, 1924, p. 339.

[5]) Type Ammonites, vol. IV, 1922, pl. 354 A, B.

the septate whorls. The section is apparently more compressed in the smaller specimen, but this probably is the result of deformation in the soft sandstone.

The ribbing is too coarse and too distantly spaced in the two Greenland examples for comparison with the true *P. pectinatus* (Phillips), above discussed, but they can be matched by examples of "*Keratinites*", Buckman, e. g. *K. cornutifer*, *K. naso*, and *K. nasutus*[1]). An example of the last in the Buckman Collection (B. M., no. 4326) labelled "*Wheatleyites*" by Buckman himself, is very similar, but there are many other examples from the Shotover Grit Sands that are equally close.

Horizon:— Sandy Clays with concretions, below horizon β. Upper Kimmeridgian, upper *pectinatus* zone. In Dorset, *Keratinites* of the *nasutus* type occur at 15 feet below the Upper White Stone band (Blake's bed 10), but *Pectinatites* like the smaller example here figured are very abundant 25 feet higher.

Locality:— North-western side of Hartz Mtn. (loc. N), at 395 m. (No. 248 a, b).

Pectinatites(?) sp. nov.

(Plate 3, fig. 4).

The body-chamber fragment here figured also retains the last air-chamber and the suture-line is well enough preserved for comparison with that of, for example, *P. eastlecottensis* (Salfeld). Unfortunately it is similar, again, in such an apparently widely different form as *Dorsoplanites flavus*, sp. nov., figured in Plate 34, fig. 1, and thus is not really helpful; and the ornamentation has to be relied on when attempting to elucidate the affinities of this ammonite. In the dorsal area, the impression of the ribbing of the penultimate whorl is seen to be comparatively coarse (about 38 ribs altogether) and the ribs were sharp, not blunt as in the *panderi* group. At the beginning of the body-chamber, the primary ribs are still fairly distinct, but the secondaries (bifurcating or with an occasional, short, intervening rib) are much weakened and later, the wide and evenly arched periphery is smooth, but oblique primaries re-appear. They are rather irregular, one of them going almost over the periphery and causing a pseudo-constriction (before the rib).

The Greenland form is attached to *Pectinatites*, because it resembles the outer whorl of an example of *P. eastlecottensis* before me (B. M. no. 88659), with the young and finely ribbed (= *Pectinatites*) stage ending at a comparatively small diameter (about 100 mm, as against 130—140 mm in Salfeld's type). *P. eastlecottensis* is a very variable species, attaining a diameter much larger than the holotype (which is entirely septate) and it is connected by many transitions with *P. aula-*

[1]) Buckman: Type Ammonites, vol. VI, pls. 602, 652, and 664.

cophorus (Buckman)[1]), which has a smaller umbilicus on the inner whorls, but which, at larger diameters, is very similar to *P. eastlecottensis*, as is the fully grown *P. pectinatus* (Phillips)[2]). *Keratinites proboscide*, Buckman[3]) probably represents a rostrate, dwarf-form of the *aulacophorus* group; and judging by an example in the British Museum, previously referred to[4]), it is possible that the repeated collars are merely the vestiges of partly resorbed, former mouth-borders, as in the similar *Pseudovirgatites*.

Since the inner whorl of the Greenland form was coarsely ribbed, it is probable that the latter is more closely related to the forms included by Buckman in "*Keratinites*" than to "*Wheatleyites*" of the *eastlecottensis* type. These "*Keratinites*", again, are merely cornute, small examples of much larger species, differing from *Pectinatites* merely in the more distant spacing of the ribs. Like *Paravirgatites* (including "*Shotoverites*") from the same beds, with still coarser ribbing, the forms of the *naso* group, however, develop an irregularly and very coarsely ornamented outer whorl (compare *Pectinatites scalariformis* and *Wheatleyites rarescens*, Buckman[5]) so that they are less like the fragment here figured than the example of *P. eastlecottensis*, above referred to. There is no English species, however, with which the present form could be identified.

Horizon:— Out of a nodule bed (probably below β) in the upper part of the sandy clays and marls. Upper Kimmeridgian, *pectinatus* zone.

Locality:— North-western side of Hartz Mtn. (loc. N) at 395 m, loose (No. 215).

Pectinatites aff. *tricostulatus* (S. S. Buckman).

(Plate 3, fig. 5).

1923. *Wheatleyites tricostulatus*, Buckman, Type Ammonites, vol. IV, pl. 365.
1925. — — Buckman; Neaverson: Ammonites from the Upper Kimmeridge Clay, *loc. cit.*, p. 37.

The septate fragment represented in Plate 3, fig. 5 is too small to be definitely identified with Buckman's species, but an example before me (B. M., no. 4710, Buckman Coll., from Wheatley) shows very good agreement, at a corresponding diameter. The suture-line resembles that of *P. eastlecottensis*, above discussed, especially in the very slender, second lateral saddle, but the first auxiliary saddle is broader in the present form and followed by only one more saddle on the smooth and high umbilical wall.

Equally large examples of *Virgatosphinctoides* ("*Allovirgatites*") of the *woodwardi* group differ not only in their far less regular and sharper

[1]) Type Ammonites, vol. IV, 1923, pl. 381 (inner whorls).
[2]) See Buckman, *ibid.*, vol. IV, 1922, pl. 354 A, B; pl. VI, 1926, pl. 354.
[3]) *Ibid.*, vol. VI, 1926, pl. 651.
[4]) Spath, *loc. cit.* (Pal. Indica, N. S., vol. IX, Mem. no. 2), pt. VI, p. 845.
[5]) Type Ammonites, vol. VI, 1927, pl. 705 and vol. V, 1925, pl. 561 B.

ribbing, but also in their simpler suture-line. To *Virgatosphinctoides* also belongs "*Wheatleyites*" *pringlei*, Pruvost[1]); and if this author claims[2]) to have found the present species together with "*W*". *eastlecottensis*, I suspect that he has been misled by the reduced figures; for among many ammonites and fragments in the C. H. Waddington Collection from the La Rochette nodule bed, there is nothing that indicates a higher horizon than the *wheatleyensis* zone.

Horizon:— Out of a nodule bed (probably below β) in the (upper part? of the) sandy clays and marls. Upper Kimmeridgian, *pectinatus* zone.

Locality:— North-western side of Hartz Mtn. (loc. N), at 395 m, loose. (No. 248 C).

Sub-genus *Keratinites*, S. S. Buckman, 1926.

Pectinatites (*Keratinites*) aff. *devillei* (P. de Loriol).

(Plate 7, figs. 2 a, b).

1874. *Ammonites devillei*, P. de Loriol, in de Loriol & Pellat: Monographie paléontologique et géologique des étages supérieurs de la formation Jurassique des Environs de Boulogne-sur-Mer. I. Moll. Céph. et Gastr. Mém. Soc. Phys. et Hist. Nat. Genève, vol. XXIII, p. 18, pl. I, figs. 13—14.
1924. — — P. de Loriol: Ilovaïsky, *loc. cit.* (Bull. Soc. Nat. Moscou, N. S., vol. XXXII), p. 343.

The small Greenland ammonite may not be identical with P. de Loriol's species, but it is provisionally attached to this form. It is broken off at the last septum and represents only the inner whorls of a larger form. The (unfigured) body-chamber portion shows more distantly spaced but strongly inclined ribs. But although the specimen cannot be definitely identified, yet it may be described separately on account of its stratigraphical interest. The ammonite differs from *P.* (*K.*) *devillei* chiefly in having shorter secondaries. Judging by many Tour Croi examples before me, the forward inclination is not always so pronounced as in de Loriol's figure, and there may occasionally occur single or triplicate ribs, as in the closely allied *P.* (*K.*) *leblondi*, Dutertre[3]) (= *Olcostephanus lomonossowi*, *non* Michalski, in Sauvage[4])). On the whole, however, the species can easily be recognised from de Loriol's figure. There is apparently more rigid ribbing in the present

[1]) Les subdivisions du Portlandien boulonnais d'après les Ammonites. Ann. Soc. géol. Nord, vol. XLIV, 1925, p. 211, pl. II.
[2]) *Ibid.*, p. 212.
[3]) Remarques sur la faune du terrain portlandien du Boulonnais et ses rapports avec la fauna volgienne. Bull. Soc. Acad. Boulogne, vol. XI, 1926, p. 13.
[4]) Sur quelques Ammonites du Jurassique supérieur du Boulonnais. Bull. Soc. géol. France, sér. IV, vol. XI, 1912, p. 457, pl. IX, fig. 3.

form, combined with a flatter whorl-side; and the greatest thickness is at the nodate point of bifurcation of the ribs, whereas in the phosphatic casts from the Boulonnais, the whorl-section is more rounded and most inflated at about the middle of the side.

The suture-line is rather simple and similar to that of the form described below as *P.* (*K.*) cf. *boidini*. It differs from the suture-lines of the Boulonnais examples of *P.* (*K.*) *devillei*, before me, only in unimportant details, but, in both, the trifid first lateral lobe is much narrower than the external saddle, and almost as wide as the ventral lobe, as stated by Sauvage[1]).

Horizon:— Out of a nodule bed (labelled β, but at least 85 m below Glauconitic Series) in the sandy clays and marls. Upper Kimmeridgian, *pectinatus* zone.

Locality:— Crab Valley, uppermost part (loc. D), at 200 m. (No. 171).

Pectinatites (*Keratinites*) cf. *boidini* (P. de Loriol).

(Plate 13, figs. 2 a, b).

1874. *Ammonites boidini*, P. de Loriol, in de Loriol & Pellat, *loc. cit.* (Mém. Soc. Phys. & Hist. Nat. Genève, vol. XXIII), p. 22, pl. VII, fig. 1 (and pl. IV, fig. 3?).

1924. *Pavlovia boidini* (P. de Loriol): Ilovaïsky, *loc. cit.* Bull. Soc. Nat. Moscou, N.S., vol. XXXII), p. 342.

This form stands in the same relationship to the true *P.* (*K.*) *boidini*, as the species last described does to *P.* (*K.*) *devillei*, i. e. the ribbing is straighter, with the point of branching of the ribs nearer the periphery, and the sides are flatter. The umbilical wall is perpendicular and there is a distinct sinus forward in the peripheral ribbing. The suture-line is simple and, compared with that of Boulonnais examples of *P.* (*K.*) *boidini*, seems to show fairly good agreement, but the second lateral lobe is trifid, not bifid, as stated by Sauvage[2]). In the Shotover examples of *Keratinites* of the *boidini* group figured in Plate 6, figs. 4 a, b and Plate 15, figs. 2 a, b the peripheral ribbing is less projected than in the Greenland specimen.

The inner whorls of *Keratinites naso*, Buckman[3]) seem to be closely comparable to the species here described and the provisional identification of Buckman's form with *Amm. devillei*, de Loriol, suggests the generic attribution of the present form as well as of that last described, to *Keratinites*. Since other *Keratinites*, however, like *K. proboscide*, Buckman[4])

[1]) Sur quelques Ammonites du Jurassique supérieur du Boulonnais. Bull. Soc. géol. France, sér. IV, vol. IX, 1912, p. 459.

[2]) *Loc. cit.* (Bull. Soc. géol. France, IV, vol. XI), 1912, p. 460.

[3]) Type Ammonites, vol. VI, 1926, pl. 652; vol. VII, 1928, pl. 652 A.

[4]) *Ibid.*, vol. VI, 1926, pl. 651.

are merely rostrate forms of *Pectinatites*, it seems preferable to accept *Keratinites* only as a sub-genus within *Pectinatites*.

Horizon:— Out of a nodule bed (probably below β) in (the upper? part of) the sandy clays and marls. Upper Kimmeridgian, *pectinatus* zone. Labelled "β, probably repeated by fault", but about 65 m below *Pallasiceras* nodules (β).

Locality:— North-east of Mt. Hennig (loc. E), at 235 m (corrected). No. 220.

Pectinatites (*Keratinites*?) *groenlandicus*, sp. nov.

(Plate 6, fig. 1; Plate 7, fig. 5; Plate 8, fig. 4).

Diagnosis:— Inner whorls (figured separately in Plate 7, fig. 5) rather high-whorled (subplatygyral), rather compressed (subleptogyral), rather widely umbilicate. Whorl-section oval, with greatest thickness near umbilical slope and evenly arched venter. Umbilical wall steep, but well rounded into sides. Ribs bi- and tri-furcating, oblique forward, and with occasional constrictions, bordered by single or branching ribs. The ribbing does not change much on the outer whorl, except that the secondaries are longer; but the whorl-section becomes more inflated and the umbilicus opens out. At the end the whorl-sides are strongly bulging outwards, with overhanging umbilical wall; the suture-line is visible only in disconnected portions.

Measurements:—

	Inner whorls	Adult
Diameter	130 mm	270 mm
Height	37 %	34 %
Thickness	34 %	—
Umbilicus	35 %	40 %

Remarks:— The outer whorl of the present species resembles that of certain equally large "*Wheatleyites*", e. g. "*W*". *reductus*, Buckman[1]), but their inner whorls are less involute. These earlier volutions, in *P. groenlandicus*, are more of the "*Keratinites*" type, so that this species is another illustration of the manner in which the "*Keratinites*" and "*Wheatleyites*" characters overlap. The resemblance of *P. groenlandicus* to certain large *Paravirgatites* is confined to the outer whorl, but there are transitions such as "*Shotoverites*" *pringlei* (Buckman, pars)[2]), between *Pectinatites* and the coarsely ribbed *Paravirgatites*, so that their separation into two different sub-families reflects no more than the inadequacy of all attempts to subdivide the Perisphinctids. The resemblance of the present species to many large Portlandian ammonites, especially those

[1]) Type Ammonites, vol. IV, 1923, pl. 384 (reduced by half).

[2]) *Ibid.*, vol. VI, 1926, pl. 562 A only.

of the Portland Sands, is also superficial, since no Portlandian ammonite has inner whorls comparable to those figured in Plate 7, fig. 5.

Horizon:— Out of a nodule bed (probably below β) in (the upper? part of) the sandy clays and marls. Upper Kimmeridgian, *pectinatus* zone.

Locality:— North-western side of Hartz Mtn. (loc. N) at 395 m, loose. (No. 217).

Sub-family *Pavlovinae*, Spath 1931.

This is not quite identical with Ilovaïsky's genus *Pavlovia*, just as the Virgatosphinctinae include more than Uhlig's equally comprehensive genus *Virgatosphinctes*. Ilovaïsky overlooked the existence of the genus *Dorsoplanites*, Semenow, which dates from 1898, and such names as *Paravirgatites* and *Lydistratites*, Buckman, 1922, *Pallasiceras*, Spath, 1923, and *Holcosphinctes*, *Aposphinctoceras* and *Episphinctoceras*, Neaverson, 1925, were given in ignorance of the existence of *Pavlovia* (1924)[1]. Yet since *Pavlovia* must be interpreted by *P. iatriensis*, var. *primaria*, Ilovaïsky, there we have already five or six local groups of ammonites, with a large number of species, some of them undoubtedly very similar, but so, indeed, are most Perisphinctids. What seems to me significant is that in addition to these developments with their local peculiarities, the persisting *colubrinus* stock of Perisphinctids gave rise to *Pavlovia* forms even in the open oceans of the time. These spread from the Himalayas (*Ammonites biplex*, Blanford, undescribed[2]) to the Andes (*Aulacosphinctes windhauseni*, Weaver)[3]) but among the rich ammonite faunas of the southern areas these *Pavlovia* forms are an inconspicuous element. Conversely, in the impoverished northern and boreal faunas, *Pavlovia* is often the only ammonite genus present but with enormous numbers of individuals, and therefore has always attracted attention.

With regard to systematics, I would now provisionally include in *Pavlovia*, as a sub-genus, *Pallasiceras*, because some Russian examples before me[4]), including *P. nana* (= *P. iatriensis*, var *nana* D, Ilovaïsky)[5]) are indistinguishable from English examples (C. H. Waddington Coll.) from the *rotunda* zone (group of *P. concinna*, Neaverson sp.). To my mind

[1]) First published in Russian in 1917. There appears to be no copy of this paper in England.

[2]) *Perisphinctes* (*Aulacosphinctes*) *kossmati*, Uhlig (Fauna of the Spiti Shales. Mem. Geol. Surv. India, Pal. Indica, Ser. XV, vol. IV, fasc. 2, 1910, p. 360, pl. XXXVII, figs. 3 a—d) is one of the few comparable forms so far described.

[3]) Palaeontology of the Jurassic and Cretaceous of West Central Argentina. Mem. Univ. Washington, vol. I, 1931, p. 412, pl. XLIV, fig. 300.

[4]) B. M., nos. C 19601, C. 22620 &c.

[5]) Ilovaïsky: "Les Ammonites du Jurassique supérieur du pays de Liapine". Ouvrages de la section géologique de la Société Imp. Amis Sci. Nat. Moscou, I, 1—2, 1917, pl. IX, figs. 3 a, b. My identifications were made when Prof. Salfeld kindly lent me his copy of this paper for a short time, some years ago.

Episphinctoceras, Neaverson[1]) based on *E. inflatum*, Neaverson, owes its great whorl-thickness largely to swelling of the iron pyrites in the body-chamber; and since it was stated to have coarsely ornamented inner whorls (not seen in the holotype before me, B. M. no. C. 26902) it may be nearer to *Aposphinctoceras*, Neaverson, than to the same author's *Holcosphinctes*, with crowded and delicate ribs on the early volutions. But separation of all these on the basis of the costation of the inner whorls does not seem to me possible; most of the young are intermediate between the two extremes and the outer whorls are so similar in all that even specific separation is often impossible (compare *Aposphinctoceras variabile* and *Holcosphinctes flexicostatus*, Neaverson[2])). Buckman's[3]) separation of *H. pallasioides* from his *Lydistratites lyditicus*, also, was based merely on a presumed difference in their stratigraphical position. *Holcosphinctes* and probably *Aposphinctoceras* as well as *Episphinctoceras*, Neaverson, thus fall partly within *Lydistratites*, Buckman[4]), similarly considered for the present to be a sub-genus of *Pavlovia*. It is somewhat intermediate between *Pallasiceras* and the bluntly ribbed *Behemoth*, and other Portlandian genera, as defined below, but retains the sharp and low bifurcation of most of the ribs. It is later in date than *Pallasiceras*, but does not include those Chapman's Pool forms that Buckman subsequently assigned to *Lydistratites*, nor the small examples referred below to *Progalbanites*, nov.

Not only do the three genera of Neaverson occur in the same beds as *Lydistratites* and *Pallasiceras*, but if we recognise them as distinct it will be necessary to create still more genera or sub-genera for other ammonites that occur in the Hartwell and Crendon Clays but were not studied by Neaverson or Buckman. These include forms with closely ribbed inner whorls (Plate 5, figs. 6a, b), perhaps transitional between *Pallasiceras* and *Lydistratites*, and others with triplicate ribs (Plate 9, figs. 6a, b), i. e. still greater resemblance to typical *Pallasiceras*. Taking the Hartwell assemblage as a whole, it is distinct from the fauna of the *rotunda* nodule-bed and shows resemblance to that of the Portland Sands. And neither *Pallasiceras* nor *Lydistratites* closely resembles the var. *primaria* of *Pavlovia iatriensis* to which group the genus *Pavlovia*

[1]) *Op. cit.* (Ammonites from the Upper Kimmeridge Clay), 1925, p. 24.

[2]) *Ibid.*, pl. II, fig. 5, pl. III, fig. 6.

[3]) Type Ammonites, vol. V, 1925, pl. DLXIX.

[4]) This must be interpreted by the genotype *L. lyditicus*, Buckman, Type Ammonites, vol. IV, 1922, pl. 353 A only, *non* 353 B (malformation), *nec* 353 C, D, the last two, like *L. gibbosus* and *L. trigonalis*, Buckman (vol. VI, 1926, pls. 639 A—D and 674 A, B) being typical *Pallasiceras*. In some *Lydistratites* (e. g. Plate 22, fig. 4a, b) there is a tendency for the pairs of secondaries to be closer together than the intervening spaces, a feature that is more typically developed in *Acuticostites* of the *pallasianus* group (Plate 25, fig. 3).

should be restricted, with its bifurcating and single ribs, combined with a depressed whorl-section.

There seems to be no doubt that the fifty varieties of *P. iatriensis*, Ilovaïsky, include representatives of even more groups than those mentioned, and, personally, I can see no real resemblance between, for example, a Russian ammonite I identified with *Pavlovia strajevskyi*, var. *exoricus*, Ilovaïsky (B. M., no. C 2370a), but which suggests a transition to *P. pavlovi* (Michalski), and the young *Katroliceras pottingeri* from Kachh, India[1]). *Pavlovia panderi* (Eichwald) Michalski or *P. boidini* (de Loriol), both cited by Ilovaïsky, are to me so widely different from the typical *P. iatriensis*, var. *primaria* that they can well be attached even to different sub-families. *P. panderi*, however, is connected by perfect transitions with *Dorsoplanites dorsoplanus* on the one hand and with *Perisphinctes stschurovskii*, Nikitin (and Michalski) on the other; the latter (genus *Kochina*, nov. see p. 81) and its allies from East Greenland differ from most of the other Pavlovids here described in having smooth outer whorls.

The Greenland material supports the common origin of *Dorsoplanites* and *Pavlovia* (*Pallasiceras*), although there is nothing exactly like the Russian forms except, perhaps, in suture-line (compare e. g. Plate 33, fig. 1a and Plate 34, fig. 6). It was not until the description of the species was nearly finished that I discovered *Pavlovia jubilans* to be distinct from the inner whorls of the many *Dorsoplanites* with which I had at first confused it; and the transitional forms between *Pallasiceras* and *Dorsoplanites* (e. g. Plate 26, fig. 3) clearly show that they must be closely allied. But it seems preferable not to include *Dorsoplanites*, as a sub-genus, in *Pavlovia*, for the latter is too unwieldy already and it gives rise to groups of Portlandian Perisphinctids quite different from the descendents of *Dorsoplanites*.

Ammonites pallasianus, d'Orbigny, belongs to another, distinctive group. The example of *Lydistratites* (B. M., no. 88622, Plate 22, fig. 4) cited by Miss Healey[2]) as a link between her var. nov. of *Olcostephanus pallasianus* (d'Orbigny) and the Russian species, is indeed so much like one of Vischniakoff's[3]) specimens of that form that specific identity might almost be claimed. Yet Michalski[4]) included the Russian ammonite

[1]) See Spath, *loc. cit.* (Pal. Indica, N. S., vol. IX, no. 2), pt. IV, 1931, pl. XCV, fig. 6. The East African form cited by Ilovaïsky as *Pavlovia strajevskyi*(?) var. nov. was there refigured in Plate CII, fig. 5.

[2]) Notes on Upper Jurassic Ammonites &c. Quart. Journ. Geol. Soc., vol. LX, 1904, p. 61, non pl. XII, figs. 1—2.

[3]) Description des Planulati (*Perisphinctes*) jurassiques de Moscou. I, 1882, pl. I, fig. 5.

[4]) Die Ammoniten der Unteren Wolga-Stufe. Mém. Com. géol. St. Pétersb., vol. VIII, no. 2, 1890, p. 71.

in his *Olcostephanus acuticostatus*, the genotype of *Acuticostites*, Semenow 1898 (= "*Paravirgatites*", Ilovaïsky, 1924 = "*Holcostephanoides*", Spath, 1924), but its close ally *Amm. pallasianus*, d'Orbigny, was left by Ilovaïsky in the genus *Virgatites* s. s. There are yet other species of "*Virgatites*" showing resemblance to Pavlovinae; but since *Aulacosphinctoides* also often resembles *Dorsoplanites*, and since some South American species that have been described as "*Virgatites*" could equally well be included in *Virgatosphinctes*[1]), there is little significance in this existence of passage-forms between the different sub-families of Perisphinctidae.

With Ilovaïsky, I would look upon the original of Michalski's pl. IV, fig. 4 as representing the true *Amm. pallasianus*, but this is connected by transitions with all the forms figured by Vischniakoff[2]) as *Amm. pallasianus* so that it is inseparable from the genus *Acuticostites*. It is as distinct from *Virgatites* as it is from the group of *Pavlovia pseudaperta* nov., here separated as a new sub-genus, *Epipallasiceras*, nov. This may be defined as including Pavlovids similar to *Pallasiceras*, but with the fine costation of the inner whorls retained to a much later stage and changing very slowly instead of abruptly; also having the sides flattened instead of bulging as in *Lydistratites* and the comparatively short secondary ribs generally arranged in pairs, with wider intervals. Suture-line simple, as in other Pavlovids.

As by way of *Perisphinctes tschernyschovi*, Michalski[3]) *Acuticostites* connects up with *Pavlovia* (*Pallasiceras*) *inflata*, while *Pavlovia* (*Epipallasiceras*) *pseudaperta* is transitional to *Lydistratites* and *Crendonites* on the one hand and to *Virgatites* (*Zaraïskites*) *apertus* on the other, it is clear that Pavlovinae and Virgatitinae are closely allied. It seems possible, in fact, to assign not only *Epipallasiceras*, but even *Acuticostites* and, perhaps, also *Epivirgatites* to the sub-family Pavlovinae. The still imperfectly understood Virgatitinae would then include only the typical genus *Virgatites*, Pavlow (= *Euvirgatites*, Lewinski) and *Zaraïskites*, Semenow (= *Provirgatites*, Lewinski), which although said to be different in age, could well be united into one genus. For with Pavlow and Ilovaïsky[4]), I attach little value to the so-called "olcostephanid" young stage observable in certain *Virgatites*, and in my opinion the young *Virgatites* figured in Michalski's pl. IV, fig. 2 has nothing to do with the original of fig. 4.

Paravirgatites, Buckman, 1922[5]) (non *Paravirgatites*, Ilovaïsky, 1924)

[1]) See Burckhardt: Beiträge zur Kenntnis der Jura- und Kreide-Formation der Cordillere. Palaeontographica, vol. L, 1903, pl. VII, etc.

[2]) Description des Planulati (Perisphinctes) jurassiques de Moscou. I. 1882, pl. I.

[3]) *Loc. cit.* (Mém. Com. géol. St. Pétersb., vol. VIII) 1890, p. 139, pl. VIII, figs. 2—3.

[4]) *Loc. cit.* (Bull. Soc. Nat. Moscou), 1924, p. 348.

[5]) Type Ammonites, vol. IV, 1922, pl. 308 only.

which includes *Shotoverites*, Buckman, 1925[1]), is distinguished from its successor *Pallasiceras* by acquiring very coarse ornamentation on the body-chamber, thus still showing resemblance to the earlier and equally megalomorph genus *Sphinctoceras*. But while *Paravirgatites infrequens*, Buckman[2]), is unrecognisable and the small example of *P. paravirgatus*[3]) is doubtful, *P. desideratus*, Buckman[4]) is either a *Pallasiceras* or a *Lydistratites*. Since *Pallasiceras* and *Lydistratites* also occasionally reach gigantic dimensions, there is no reason why *Paravirgatites* should not be included as a sub-genus in *Pavlovia*; for the four groups here discussed will often be impossible to distinguish, unless the material is not only well preserved, but complete to the mouth-border.

In the Portland Sands, *Pavlovia* of the type of *P.* (*Lydistratites*?) **worthensis**, nov. (Plate 18, fig. 6) and other ammonites resembling *P.* (*L.*?) *bipliciformis* (Nikitin)[5]) are dominant, associated with *Crendonites* **pregorei** (Plate 22, fig. 2), also some ammonites described as Virgatitids[6]). I have myself collected these forms which are always crushed and I have referred to some of them as *Provirgatites* (or rather *Zaraïskites*) *scythicus*[7]), but I now believe that the identification with *Virgatites* was erroneous, as in the case of Lamplugh, Kitchin and Pringle's *V.* cf. *zarajskensis*[8]) (*non* Vischniakoff-Michalski). The examples figured in Plate 20, fig. 2, and Plate 24, fig. 2 will show that the resemblance to the true Russian *Virgatites scythicus* (e. g., B. M., no. 74212) is superficial, the inner whorls being entirely different, while the projection of the secondary ribs and their virgatoid bundling are due partly to the compression. These ammonites, in fact, are probably merely crushed "*Lydistratites*" of the *biformis* and *cunctator* group, but since this name cannot be used (for the reasons given on p. 27), I am now proposing *Progalbanites*, gen. nov., type to be *P. albani*, Arkell sp. (1935, pl. XXVI, fig. 2), which I take to comprise *Virgatites scythicus*, Buckman[9]) *non* Michalski, and possibly *Olcostephanus apertus*, Sauvage,

[1]) *Ibid.*, vol. V, 1925, pl. 562.

[2]) *Ibid.*, vol. VI, 1925, pl. 603.

[3]) *Ibid.*, vol. IV, 1922, pl. 308 B only.

[4]) *Ibid.*, vol. IV, 1923, pl. 382.

[5]) Die Jura-Ablagerungen zwischen Rybinsk, Mologa, und Myschkin. Mém. Acad. Imp. Sci. St. Pétersb. (VII), vol. XXVIII, no. 5, 1881, pl. VI, fig. 52. The biplex ammonites recorded by Arkell (*op. cit.*, 1935, p. 310) from the Emmit Hill Marts (beds 11 and 9) probably belong here.

[6]) Buckman, Type Ammonites, vol. VI, 1926, pls. 675 and 693.

[7]) *Loc. cit.* (Revision of the Jurassic Cephalopod Fauna of Kachh), pt. VI, 1933, pp. 844, 864.

[8]) The Concealed Mesozoic Rocks in Kent. Mem. Geol. Survey, 1923, p. 222 (see fig. 2, p. 173).

[9]) Type Ammonites, vol. VI, 1926, pl. DCLXXV.

non Vischniakoff[1]). The last, however, like the same author's *Virgatites triplicatus* (*non* Pavlow)[2]) and *Virgatites scythicus*, Sauvage (*non* Vischniakoff[3])) is said by Pruvost[4]) to have come from a higher level. *Progalbanites* is very close to the inner whorls of *Crendonites* and also foreshadows certain *Kerberites*, so that it is included in the present family, especially as it is also connected by transitions with *Lydistratites*, such as *P.* (*L.*) *vulgaris*, nov. (Plate 17, fig. 5) and allies, i. e. the group that perhaps includes *Perisphinctes nikitini*, Sauvage (non Michalski)[5]).

The same beds in the Portland Sands yield the first representatives of *Crendonites*[6]) which genus, however, attains its maximum development only at higher levels. The inner whorls of *Crendonites* are extremely variable; I am figuring a few to show how the ribbing also resembles that of Virgatitids at an early stage, while the evolute outer whorls, with their characteristic biplicate and single ribs and smooth collars are much like certain earlier Pavlovinae. I am using the name *Crendonites*, Buckman, 1923, because *C. leptolobatus*, Buckman, with its simple suture-line and final collar is an undoubted ally of the true *C. gorei*, whilst *Glaucolithites*[7]) by its suture-line, is closer to some (more finely ribbed) forms of the genus *Behemoth*, discussed below. *Gyromegalites*, Buckman[8]) is probably only a large *Crendonites*, but the small *Perisphinctes colubrinoides*, Burckhardt[9]), probably does not belong to this genus, contrary to my previous view[10]).

The second group of (often gigantic) ammonites of the Portland Sands for which I would adopt the name *Behemoth*, Buckman, 1922,

[1]) Sur quelques Ammonites du Jurassique supérieur du Boulonnais. Bull. Soc. géol. France, (4), vol. XI, 1911 (1912), p. 460, pl. IX, fig. 4.

[2]) *Loc. cit.*, p. 461, pl. IX, fig. 6. Probably a young *Kerberites*, but connected with *Progalbanites* by passage-forms.

[3]) *Ibid.*, p. 462, pl. IX, fig. 5 (as represented by examples in Mr. Waddington's colln.).

[4]) Les subdivisions du Portlandien boulonnais d'après les Ammonites. Ann. Soc. géol. Nord, vol. XLIX (1924), 1925, p. 193.

[5]) *Loc. cit.* (1912), p. 456, pl. IX, fig. 1.

[6]) E. g. *C. pregorei*, sp. nov. (Plate 22, fig. 2), with short and approximate secondaries, as compared with the contemporary *Lydistratites* (Plate 18, fig. 6; compare also *Virgatites pallasianus* (*non* d'Orbigny) Buckman, Type Ammonites, vol. VI, 1926, pl. DCXCIII).

[7]) In 1931 (*loc. cit.* Pal. Indica, N. S., vol. IX, no. 2, pt. V, p. 472) I suggested that *Glaucolithites*, dating from 1922, might have to be used, instead of *Crendonites* (1923), but I had not then seen the specimens in the Buckman Collection, labelled *Glaucolithites*. I cannot accept Arkell's reading (1935, p. 338).

[8]) Type Ammonites, vol. VI, 1925, pl. 620 A, B only. What Buckman called the "*Lydistratites*" stage is the unstable, virgatoid early stage above referred to.

[9]) Beiträge zur Kenntniss der Jura- und Kreideformation der Cordillere. Palaeontogr. vol. L, 1903, p. 57, pl. X, fig. 9 (lectotype).

[10]) Ammonites and Aptychi (from Somaliland). Monogr. Hunter. Mus. Univ. Glasgow, vol. I, 1925, p. 145.

simply because it is the earliest, may also be referred to Pavlovinae; but it includes forms with more complicated suture-lines and therefore considerable resemblance to the contemporary persistent stocks (such as *Aulacosphinctoides*) of the Mediterranean Province. The genotype of *Behemoth* (*B. megasthenes*, Buckman)[1]) is almost unrecognisable, but *B. lapideus*, Buckman[2]) (also 1922), which is merely a green "*Leucopetrites*", Buckman[3]), enables us to discover what group of ammonites its author may have had in mind when creating the genus *Behemoth*. The inner whorls of *Behemoth* (figured as "*Leucopetrites*" *leucus*, Buckman)[4]) represent a typical Pavlovid, but one at least of my own examples of "*L.*" *caementarius*, Buckman[5]) has the subvirgatoid inner whorls of *Kerberites*, discussed below. *Behemoth*, thus must not be taken to be sharply separated from the later *Kerberites* and *Titanites*, just as *Crendonites* is connected with the latter by passage-forms, as mentioned below. *Hydrostratites*, Buckman[6]), based on the poorly preserved outer whorls of a single specimen, appears to be synonymous with "*Glaucolithites*" and therefore *Behemoth*, but *Aquistratites aquatus*, Buckman[7]) from the same beds cannot yet be definitely placed with any known group, and may be the precursor of a constricted group of Portland Stone ammonites, discussed below. But Buckman cannot have known what were the real affinities of the ammonites to which he gave these generic names, and such differentiation as "lack of constrictions" is not very helpful. As in the case of the still more poorly preserved *Simotoichites*, Buckman[8]), picked off a heap of stones, the bestowal of a new name was unjustified. Of course it is not impossible that in time fresh finds may show that there existed a group of ammonites to which the generic name *Simotoichites* might be applied, but meanwhile nobody can possibly derive benefit from the figuration of such a despicable object as "*Simotoichites simus*", especially since there is not the slightest evidence for connecting with it the doubtful *Kerberites* inner whorls figured by Buckman on another plate[9]).

There remains another large group of ammonites to discuss, namely

[1]) Type Ammonites, vol. IV, 1922, pl. 305 A, A*, B. The difficulty of recognising this is reflected in Arkell (*op. cit.*, 1935, p. 336) who applied *Behemoth* to what I should include in *Titanites* and *Kerberites*.

[2]) *Ibid.*, pl. 342 A, B.

[3]) *Ibid.*, pl. 307 A, B.

[4]) *Ibid.*, pl. 307 C, vol. V, 1925.

[5]) *Ibid.*, vol. VI, 1926, pl. 677. Buckman stressed the stratigraphical significance of his species, quite rightly, so far as we can see at present. But Mr. C. H. Waddington informs me that Buckman mixed up the data supplied to him.

[6]) Type Ammonites, vol. VI, 1926, pl. 676.

[7]) *Ibid.*, vol. V, 1924, pl. 534 A, B.

[8]) *Ibid.*, vol. IV, 1923, pl. 402 A.

[9]) *Ibid.*, pl. 402 B.

the group of *Perisphinctes giganteus*, recorded from Cape Leslie by both Rosenkrantz and Parat and Drach. I previously thought that the large number of often unjustifiable genera created by Buckman for the apparently very diverse members of this group could be reduced to two genera, namely *Titanites* and *Trophonites* (or *Kerberites*). The latter dates from 1922[1]) but is based on a large specimen (*T. trophon*, Buckman), the earlier whorls of which are not exposed. Smaller examples (e. g. 2958) from the Creamy Limestones of Barrel Hill, Long Crendon, in the Buckman Collection (B. M.) are what I consider to be normal *Titanites*, being intermediate between "*Gigantites*" *zeta*[2]) and a Haddenham specimen (labelled "*Galbanites*", but not agreeing with any figured species of this genus) in the Buckman Collection (no. 3901). "*Trophonites*" *pseudogigas*, figured in 1923[3]), is only an inflated form of the same group (of *Titanites*), so that *Kerberites*, 1924, will have to be used instead of *Trophonites* for the second group, above mentioned.

But since I discussed these two groups, I have been attempting to collect inner whorls and small examples of these Portlandian types; for not only was the original division based more on a stratigraphical than a palaeontological basis, but the constant handling of such ammonites had not shown this twofold division to be particularly practicable.

A large form like *Trophonites trophon*, Buckman[4]) may look rather different from a smaller ammonite like "*Kerberites*" *okusensis* (Salfeld MS) Buckman[5]), in a figure that is necessarily (but all the same misleadingly) reduced to a quarter of the natural size. But I have now collected from the highest *Titanites* beds of both Dancing Ledge and Sheepslights Quarry (Isle of Purbeck) small examples of *Titanites* that cannot be satisfactorily distinguished from the inner whorls of "*Kerberites*" *okusensis* so common in the Cockly Bed of Swindon, Wiltshire. Clearly this type of "*Kerberites*" is not separable generically from *Titanites* nor is there any time significance attached to the two groups.

It may be remembered that the thickness of the Portland Stone Beds that have yielded all these giants is only just over 100 ft or 30 m (i. e. a thickness of beds during which the *Pallasiceras* faunas of England or Greenland persisted apparently unchanged). I am not attempting to prove that there may not be large gaps in the sequence, but while *Ammonites bononiensis*, de Loriol[6]), may perhaps be specifically distinct

[1]) *Ibid.*, vol. IV, pl. 325.

[2]) *Ibid.*, vol. V, 1923, pl. 452.

[3]) *Ibid.*, vol. IV, pl. 385.

[4]) *Ibid.*, vol. IV, 1922, pl. 325 A, B.

[5]) *Ibid.*, vol. V, 1925, pl. 570 A, B (the species grows to a much larger size). It is not the genotype of *Kerberites*, Buckman, as Arkell (*op. cit.*, 1935, p. 336) asserts.

[6]) *Loc. cit.* (Mém. Soc. Phys. & Hist. Nat. Genève, vol. XXIII), 1874, p. 20, pl. III.

from such similar types as "*Galbanites*" *galbanus*, Buckman[1]) and "*Galbanites*" *cretarius*, Buckman[2]), their outer whorls are so similar that a single genus for all might seem the only practical possibility, at least for the present.

The palaeontologist will find it impossible to match these large ammonites satisfactorily, apart from the limits imposed by defective preservation or absence of earlier stages. There are good collections of these Portlandian ammonites in the British Museum, including many from the Buckman Collection; and the figured specimens are in the Museum of the Geological Survey, but scarcely two of these giants are alike, even in measurements which, in any case, are valueless. The inner whorls, however, may vary still more considerably. Some are of what may be called the *triplicatus* type, illustrated by *Kerberites kerberus*, Buckman[3]) and its allies (see Plate 18, figs. 2a, b) and *K. portlandensis*, Cox (Plate 7, fig. 6 = *Amm. triplicatus*, Blake *non* Sowerby)[4]). I am now figuring what must be Blake's[5]) original (Plate 16, fig. 2), but its preservation (and especially the beautiful irridescence of the shell) is entirely different from that of the ammonites of Cox's basal shell-bed of the Portland Stone. There is no reason to believe these small *Kerberites* to be fully grown ammonites. The inner whorls of forms like that figured in Plate 18, fig. 2 (*K. kerberus*) are indistinguishable from Blake's *Amm. triplicatus* and the early volutions of *K. trikranus*, Buckman[6]), and the ammonites figured in Plate 20, figs. 4a, b; Plate 21, figs. 4a, b; and Plate 27, figs. 4a, b, show that *K. swindonensis* (Pavlow)[7]) and the extreme "*Galbanites*" *fasciger* (Buckman)[8]) and perhaps "*Simotoichites*" *simus*, Buckman, *partim*[9]), all belong to the same group.

Now, however difficult it may be to identify imperfect specimens or the similar outer whorls of the *bononiensis* type, if it could be shown that there is a more or less well defined group (*Kerberites*), characterised by these triplicate inner whorls, the problem would be greatly simplified. For while passage-forms to *Titanites*, like *Pleuromegalites forticosta*

[1]) Type Ammonites, vol. IV, 1922, pl. 355 A, B.

[2]) *Ibid.*, vol. VI, 1925, pl. 621.

[3]) Type Ammonites, vol. V, 1924, pl. 520 only (*non* 520 A).

[4]) The Fauna of the Basal Shell-Bed of the Portland Stone. Isle of Portland. Proc. Dorset Field Cl., vol. XLIV, 1925, p. 163.

[5]) On the Portland Rocks of England. Quart. J. Geol. Soc., vol. XXXVI, 1880, p. 228, pl. x, fig. 7.

[6]) Type Ammonites, vol. V, 1924, pl. 535.

[7]) Études sur les couches Jurassiques et Crétacées de la Russie. I. Bull. Soc. Imp. Nat. Moscou, 1889, no. 1, p. 58, pl. II, fig. 6.

[8]) Type Ammonites, vol. V, 1923, pl. 451.

[9]) *Ibid.*, vol. IV, 1923, pl. 402 B only (*non* A which ought never to have been figured).

Buckman, *partim*[1]), *Glottoptychinites audax*, Buckman[2]), and *Vaumegalites vau*, Buckman[3]) may look generically different from the extremes like the compressed *Kerberites fasciger* or the allied form figured in Plate 20, figs. 4a, b, the existence of so many transitional forms would justify their inclusion in one genus. This, in fact, is how I understood *Kerberites* (or "*Trophonites*") when I referred to it previously.

There are, however, various other types of young ammonites in the Portland Stone Beds. One such, characterised by serpenticone coiling and rounded whorls, is represented in Plate 29, fig. 4 and it may be said to continue the Pavlovid type of *Perisphinctes*, while *Kerberites*, as here understood, is the 'olcostephanid' branch, foreshadowing *Virgatites* and *Craspedites*, as does the earlier *Progalbanites*. I am attaching the small example here figured (Plate 29, fig. 4) to *Titanites*, partly on account of what has already been said about the resemblance between the highest *Titanites* collected and the forms of the *okusensis* type (including such 'species' as '*Crendonina*' *subrotundata*, Buckman)[4]); but by way of forms like *Glottoptychinites glottodes*, Buckman[5]) and *Gigantites zeta*, Buckman, already referred to, also a host of unfigured passage-forms, these are intimately connected with the "*Trophonites*" and "*Galbanites*" that can be referred to *Kerberites*. Buckman[6]) himself, in 1926 figured one of these forms as *Kerberites kerberus* (*non* 1924), but in spite of the presence of some triplicate ribs, it is clearly a member of the *okusensis* group.[7])

It is interesting to note that the evolute, pavlovid type of inner whorls figured in Plate 29, fig. 4, is found in many of these forms, here referred to *Titanites*, but not in the loosely coiled *Crendonites*, in which Buckman[8]) already had noticed the "*Lydistratites*-stage inner whorls". These, however, may be finely ribbed, as in the new species of which the suture-line is figured in Plate 7, fig. 7, or in the immature example represented in Plate 28, fig. 4, or it may be comparatively coarse (Plate 8, fig. 6, Plate 9, fig. 5, Plate 14, fig. 2); and like the inner whorls of some *Kerberites* (Plate 21, fig. 4) the virgatoid young of *Crendonites* may be taken to foreshadow later (Volgian?) types. There are forms that may be

[1]) *Ibid.*, vol. V, 1923, pl. 513 A only (*non* 513, which is probably only a large *Titanites* of the type of *T. zeta*).

[2]) *Ibid.*, vol. VI, 1927, pl. 717.

[3]) *Ibid.*, vol. V, 1924, pl. 536.

[4]) *Ibid.*, vol. VI, 1925, pl. 607.

[5]) *Ibid.*, vol. IV, 1923, pl. 403.

[6]) Type Ammonites, vol. VI, 1926, pl. 520 A. A specimen in the Buckman Collection from the Okus Quarry (B. M., no. 4389, labelled "Gigantite") shows it to be scarcely a variety of *T. okusensis*, if this variable species is interpreted in Salfeld's original connotation.

[7]) Compare the suture-line of *Titanites okusensis* (Plate 23, fig. 3) with that of *Pavlovia* (*Pallasiceras*) *rotunda* (Plate 18, fig. 4).

[8]) Type Ammonites, vol. VI, 1925, pl. 620 A ("*Gyromegalites*" *polygyralis*).

considered to be transitions between *Crendonites* and *Titanites*, e. g. "*Galbanites*" *mikrolobus*, Buckman[1]) which has loose coiling. In reality this is connected with "*Gigantites*" *zeta*, already referred to, and similar *Titanites* of the same beds, and as in the case of the equally defective types of *Briareites*, Buckman[2]) and *Polymegalites*, Buckman[3]), the inner whorls may be assumed to be of the *Titanites* type. In the case of *Hippostratites*, Buckman[4]), also, the presence of cadiconic inner whorls (of *Teloceras* aspect) shows that it is probably merely a large *Titanites* of the *pseudogigas* group.

It ought to be added that the name *Titanites*, Buckman[5]) itself is based on a large form of unknown affinities and it is used here merely because it is the oldest (1921). *Gigantites*, Buckman[6]) as first figured (1921) is almost certainly a synonym of *Titanites*, but it may be doubted whether his species, *T. giganteus*, is the same as J. Sowerby's *Ammonites giganteus*[7]). For the septate whorls of Buckman's "*G.*" *giganteus* are unknown and interpreted by "*G.*" *pachymeres*[8]), Buckman's *Gigantites* again turns out to be one of the Buckinghamshire *Titanites* assemblage of which he figured so many, while neglecting other stocks that occur in the Portland Stone elsewhere. One such stock, possibly including the true *Ammonites giganteus*, J. Sowerby, ranges from the Waterstone of Long Crendon, up into the *Titanites* beds of Portland, and while it is constricted, like *Aquistratites aquator*, Buckman[9]) its most typical forms[10]) are less evolute and altogether more like the southern *Pachysphinctes* and allied Perisphinctids than the other Portland Stone genera *Titanites*, *Kerberites*, and *Crendonites*.

This treatment of the ammonites of the Portland Stone may seem inconsistent with that of their fore-runners in the Kimmeridgian and it would be easy to establish a distinct family for all the genera above discussed and on the basis of the tri- or multiplicate inner whorls, separate them from the Pavlovinae. This, however, in my opinion, would not work in practice, and it seems to me that Buckman himself was constantly altering the range or definition of his genera, when contradictory material was obtained. There are new and distinct ammonites from the Portland

[1]) *Ibid.*, vol. V, 1923, pl. 439.
[2]) *Ibid.*, vol. III, 1921, pl. 257.
[3]) *Ibid.*, vol. VI, 1925, pl. 591.
[4]) *Ibid.*, vol. V, 1924, pl. 495.
[5]) *Ibid.*, vol. III, pl. 231.
[6]) *Ibid.*, vol. III, pl. 256. A slightly more involute variety was figured (vol. IV, 1922, pl. 343) as *Trophonites imperator*, Buckman.
[7]) Mineral Conchology, vol. II, 1816, pl. CXXVI.
[8]) Type Ammonites, vol. VI, 1925, pl. 592.
[9]) *Ibid.*, vol. V, 1924, pl. 534.
[10]) Some of these, in the Buckman Collection, are labelled *Glaucolithites*.

beds before me, some over a foot in diameter, showing all the growth-stages, and quite different from any that Buckman figured; but even if it were possible to figure them now, I should hesitate to name them in view of the uncertain status of so many of Buckman's genera. When the ammonites of, for example, the Spiti Shales or the Upper Jurassic of Mexico, are more accurately correlated than I have been able to do in a recent table[1]), it may be possible to appraise the real affinities of the Portlandian Perisphinctids; meanwhile I prefer to consider them as merely a local and rather homogeneous assemblage of Pavlovid derivatives not strikingly different from their fore-runners in the Upper Kimmeridge Clay and the Portland Sands, and therefore well grouped in only a few genera. They are referred to Pavlovinae in spite of the fact that Ilovaïsky would not have included Pavlow's *Perisphinctes triplicatus* or *P. swindonensis* in the genus *Pavlovia*; for, as in the Virgatitids, while the inner whorls may foreshadow the succeeding Craspeditids, they are no guide to the undoubted Pavlovid ancestry of the group.

The family Pavlovinae then includes the following genera:—

Genus **Pavlovia*, Ilovaïsky.
  Sub-genus **Paravirgatites*, Buckman.
  — **Pallasiceras*, Spath.
  — *Lydistratites*, Buckman.
  — **Epipallasiceras*, nov.
— **Behemoth*, Buckman.
— **Crendonites*, Buckman.
— *Kerberites*, Buckman.
— **Titanites*, Buckman.
— *Progalbanites*, nov.
— **Dorsoplanites*, Semenov.
— **Kochina*, nov.
— *Acuticostites*, Semenov.

Those marked with an asterisk (*) are represented from East Greenland.

Genus *PAVLOVIA*, Ilovaïsky, 1917.

Pavlovia allovirgatoides, sp. nov.

(Plate 7, figs. 4a, b; Plate 14, figs. 3a—c).

Diagnosis:— Rather narrow whorls (substenogyral), slightly wider than high (subleptogyral), with rather open umbilicus (sublatumbilicate). Whorl-section nearly circular, with steep umbilical wall but rounded edge. Ribbing at first fine and close, mostly bifurcating, but with oc-

[1]) *Loc. cit.* (Pal. Indica, N. S., vol. IX, Mem. no. 2), pt. VI, 1933, p. 864.

casional single ribs which increase in number with size. One trifid rib on body-chamber and four constrictions to the outer whorl, two bordered by single ribs each way. Suture-line simple, with low and broad saddles (see Plate 14, fig. 3c).

Measurements:—	Holotype	Plate 7, fig. 4
Diameter	94	57 mm
Height of outer whorl	30	31 %
Thickness of outer whorl	33	35 %
Umbilicus	51	44 %

Remarks:— This species shows a striking resemblance to those more coarsely-ribbed varieties of his *Virgatosphinctoides* that Neaverson described as *Allovirgatites*, e. g. the holotype of *A. versicostatus*[1]), now before me (B. M. no. C 26899). There seems to be almost specific identity, even in the simple suture-line, but if the smaller example (Plate 7, fig. 4) is correctly assigned to the present species, this is distinguished not only by its longer and projected secondary ribs in the adult, but by a different early stage. This smaller example, in fact, differs from an immature *Pallasiceras* figured in Plate 8, fig. 5 or from *P.* (*P.*) *gracilis*, Neaverson[2]) merely in delaying the change in ribbing and developing single ribs already at a small diameter, though these are generally confined to one side at that stage. An undescribed English form, almost identical with the present species and apparently from the *rotunda* nodule bed (B. M. no. C 6638), has still longer secondaries, but a smaller umbilicus; it connects the form here described with the sub-genus *Pallasiceras*, but the reference of the present species to *Pavlovia* s. s. is based less on its resemblance to the typical *P. iatriensis*, Ilovaïsky, var. *primaria*, than on the obvious differences from *Pallasiceras rotundum*. An example of *P.* (*Lydistratites*) *variabilis* (Neaverson) before me (L. F. S., 714), very similar to the smaller example of *P. allovirgatoides* here figured, differs in its much sharper and laterally projecting costation.

The small example figured in Plate 16, figs. 3a, b is perhaps too immature to be definitely assigned to the present species; it does not differ in any essential from the inner whorls of *P. pseudaperta* (Plate 9 fig. 4) but young *Pectinatites* of the *boidini* group (Plate 6, fig. 4; Pl. 15 fig. 2) may also be similar.

Horizon:— Glauconitic Series, apparently lowest part; Upper Kimmeridgian.

Locality:— Hartz Mtn., N.W. Ridge, Loc. N. No. 213.

[1]) Neaverson, *op. cit.* (Ammonites from the Upper Kimmeridge Clay), 1925 p. 32, pl. III, fig. 4.

[2]) *Op. cit.* (Ammonites from the Upper Kimmeridge Clay), 1925, p. 20, pl. fig. 9.

Pavlovia jubilans, sp. nov.

(Plate 35, figs. 4a, b; Plate 39, figs. 1a, b).

Diagnosis:— Rather narrow whorls (substenogyral), rather thin (subleptogyral), with fairly open umbilicus (sublatumbilicate). Whorl-section circular, with rounded umbilical wall and greatest thickness at middle of side. Ribbing rather fine and close, bifurcate and single, with occasional irregularities, caused by indistinct constrictions. Suture-line simple.

Measurements:—	Holotype Plate 39, fig. 1	Paratype Plate 35, fig. 4
Diameter	60	76 mm
Height of outer whorl	30	29 %
Thickness of outer whorl	32	30 %
Umbilicus	45	49 %

Remarks:— The holotype has over half a whorl of body-chamber; the paratype nearly three-quarters, but both may be incomplete. The latter shows approximation of the ribbing towards the end and is therefore the more complete; the holotype, however, has the earliest whorls preserved, at least as an impression in the rock, and they are seen to be very finely ribbed, the ribs being inclined forward.

This form seems to be very close to *P. iatriensis*, var. *primaria*, Ilovaïsky[1]) which is taken as the type of *Pavlovia* in the restricted sense. It differs in having a less depressed whorl-section than the Russian form, i. e. in having more cylindrical whorls, but otherwise the proportions are not very different, if both text and figure be compared.

P. allovirgatoides, nov., is less loosely coiled at the same diameter, less slender and less flexicostate, the ribs being also less recurved. *Aulacosphinctoides perrinsmithi* (Uhlig)[2]) is more evolute and has more regular ribbing.

Horizon:— Sandy Clays, 10 m below Glauconitic Series, Upper Kimmeridgian.

Locality:— Perna Ridge, Sandstensfjaeld (Nos. 234, 235).

Sub-genus *PARAVIRGATITES*, Buckman, 1922.

Pavlovia (*Paravirgatites*?) sp. ind.

(Plate 4, figs. 5a, b).

The large specimen figured in Plate 4, fig. 5 is poorly preserved and partly crushed, so that the diagrammatic whorl-section (fig. 5b), taken at about the middle of the outer volution, may be incorrectly re-

[1]) *Loc. cit.* (Soc. Amis Sci. Nat. Moscou, I), 1917, p. 93, pl. I, figs. 1a—d.

[2]) *Loc. cit.* (Fauna of the Spiti Shales, fasc. 3), 1910, p. 362, pl. LXX, figs. 2a—c.

stored. There is a high and perpendicular umbilical wall, evenly rounding off into the sides; and the general roundness of the section is beyond question, but the gentle flattening of the sides shown in the outline drawing is not observed on the last half whorl where the ribs are most prominent at the middle of the lateral areas. The whole of what is left of the outer whorl belonged to the body-chamber, since its beginning marks the end of the septate stage. The last suture-line is unrecognisable and the earlier whorls are too poorly preserved to show suture-lines.

The ribs are very sharp and mostly bifurcating, at about three-fifths of the length from the umbilical suture, so that the point of bifurcation is visible on the inner whorls. There is one triplicate rib near the end of the shell and incompletely quadruplicate ribs, followed by a constriction and a single rib, occur at about a third and again at two-thirds of the length of the body-chamber.

This form is attached to *Paravirgatites* chiefly on account of its association with *Keratinites* aff. *devillei* and *K.* cf. *boidini*; but it may be equally close to *Pallasiceras*. The genotype of *Paravirgatites*, namely *P. paravirgatus*, Buckman[1]) (another individual variation of which was subsequently figured as "*Shotoverites*" *pringlei*, Buckman[2])) is characterised by the slowness with which the ribbing becomes less and less closely spaced, as compared with the genus *Pallasiceras* (see Plate 10, fig. 2a and "*Paravirgatites*" *desideratus*, Buckman)[3]). Unfortunately, in the absence of the inner whorls, it is not possible to give a definite identification, but it could be suggested that the body-chamber was only temporary, i e. that the animal was not fully grown, so that separation of the ribs at a later stage could still have taken place. On the other hand, while the typical forms of *Paravirgatites* are confined to the *pectinatus* zone, those very large examples, unfortunately mostly fragmentary, that characterise the nodules in Blake's bed 7, immediately above, do not modify their ornamentation so distinctly on the outer whorls and are therefore much more like large examples of *Pallasiceras*, except in the retained sharpness of the ribbing.

If I am right in associating the present form with these large *Paravirgatites*, then it is less close to *Pavlovia* (*Pallasiceras*) *rotunda*, J. Sowerby sp.[4]), having in any case sharper and more projected secondary ribs and rather different coiling at the same diameter. The ribs of the inner whorls, so far as they can be seen in the larger Greenland example, are also more closely spaced than in similarly-sized specimens of *P.* (*P.*)

[1]) Type Ammonites, vol. IV, 1922, pl. 308 (*non* 308b).
[2]) *Ibid.*, vol. V, 1925, pl. 562.
[3]) *Ibid.*, vol. IV, 1923, pl. 382.
[4]) See Neaverson, *op. cit.* (Ammonites from the Upper Kimmeridge Clay), 1925, p. 18, pl. 1, fig. 6.

rotunda, but the doubtful example figured in Plate 8, figs. 2 a, b could not be distinguished from equally imperfect specimens of *Pallasiceras* and is recorded here only because it is from the same bed as the larger example. The Greenland form described below as *P.* (*P.*) *rugosa*, nov. (Plate 12, fig. 1) differs from the present species in the coiling of the inner whorls, its irregular ribbing, and its whorl-section, the greatest thickness being lower down on the whorl-side in the form here discussed.

Horizon:— Sandy Clays, 65 m below β (but labelled "perhaps β repeated by faulting"), Upper Kimmeridgian, *pectinatus* zone.

Locality:— Ridge south of Crab Valley, Hartz Mtn. Loc. E. No. 220.

Sub-genus *PALLASICERAS*, Spath, 1923.

Pavlovia (*Pallasiceras*) *communis*, sp. nov.

(Plate 4, figs. 1a, b; 3, 6a, b; Plate 5, figs. 4a, b; 7a, b).

1929. *Pavlovia pavlovi* (Michalski) Rosenkrantz, in Lauge Koch: Geology of East Greenland, *loc. cit.*, p. 147.

Diagnosis:— Rather high whorls (subplatygyral), rather inflated (subpachygyral), rather widely umbilicate (sublatumbilicate). Whorl-section circular, sometimes slightly flattened laterally in the young; periphery evenly arched; umbilical wall vertical only near the suture, but gently rounding into sides. Ribs first irregular, with long secondaries or occasional single or intercalated costae; later the ribs are nearly all bifurcating and unusually sharp and prominent. Occasional constrictions, not very conspicuous. Mouth-border apparently plain (Plate 4, fig. 1a); length of body-chamber just over half a whorl. Suture-line (Plate 4, fig. 3) simple, with trifid first lateral lobe, about as deep and as wide as external lobe, but second lateral lobe very short; two lateral saddles, about same width but second only half as high. Simple auxiliary lobe or lobes near umbilical suture.

Measurements:—	Holotype (Plate 4, fig. 1)	No. 183 m	Plate 5, fig. 7	Plate 4, fig. 6
Diameter	62	69	40	26 mm
Height of outer whorl	36	33	39	37 %
Thickness of outer whorl	37	38	38	40 %
Umbilicus	42	43	39	39 %

Remarks:— This species is represented by a considerable number of well-preserved specimens and fragments, and it is therefore interpreted rather widely. There are various slight differences in whorl-section, in proportions and in coiling, as well as individual variations in the ribbing, especially when occasional single or triplicate ribs interfere with the regularity of the biplicate costation. For obvious reasons, however, it is impossible to illustrate all these variations. The form is close

to an English ammonite figured by Buckman[1]) as *Paravirgatites desideratus*, but, in my opinion, generically different from the holotype of *Paravirgatites*. That ammonite (in the Survey Collection, no. 45934) is undoubtedly a *Pavlovia* (*Pallasiceras*) of the *rotunda* group, but the peripheral view is very misleading and could scarcely be recognised by those who examine the actual specimen.

The other forms of *Pallasiceras* of the *rotundum* group, figured by Neaverson[2]), are also closely comparable, but not identical. I am figuring in Plate 10, fig. 2 an example of *P.* (*P.*) *concinna* (Neaverson), from Chapman's Pool, and I have a large number of similar young before me (C. H. Waddington and my own collections); but they are all still finely ribbed to a larger diameter and rather different in general appearance (compare Plate 4, fig. 6 and Plate 5, fig. 5). Fragments of medium-sized whorls may be similar, especially if they do not show the deep constrictions, bordered by exaggerated single costae, that characterise the English species. The final whorls are again different, for in the present species the ribs move farther and farther apart, the extreme being reached in the variety figured in Plate 5, fig. 4. The maximum size of the present form, moreover, is only about 75 mm, whereas the English *Pallasiceras* of the *rotundum* group reach a large size, a specimen from Potterne, Wilts., in the British Museum (No. 88597) being over 500 mm in diameter.

One example (182c), unfortunately poorly preserved, represents a variety with triplicate ribs on the last whorl, but not in the septate stage. The resulting resemblance to *Dorsoplanites dorsoplanus* (Vischniakoff)[3]) is superficial, but if the inner whorls happened to be missing, the affinity of this example with the present species might not have been noticed.

Horizon:— About 36 m below base of Glauconitic Series; nodule bed β; Upper Kimmeridgian.

Localities:— Ridge south of Crab Valley; Loc. E, Nos. 182, 183.

Pavlovia (*Pallasiceras*) *regularis*, sp. nov.

(Plate 3, figs. 3a, b; Plate 4, figs. 2a—c).

Diagnosis:— Like *P.* (*P.*) *communis*, but more loosely coiled, with wider umbilicus and lower whorls, and costation very gradually becoming less closely spaced, not suddenly. Ribs on body-chamber also more numerous than in *P.* (*P.*) *communis*. Suture-line similarly simple (see Plate 4, fig. 2c). Body-chamber almost a whole whorl in length; aperture apparently plain, as in *P.* (*P.*) *communis*.

[1]) Type Ammonites, vol. IV, 1923, pl. 382. The stratigraphical significance of this (derived?) specimen is nil.

[2]) *Op. cit.* (Ammonites of the Upper Kimmeridge Clay), 1925, pl. I, figs. 7—10.

[3]) See Michalski, *loc. cit.* (Mém. Com. géol., vol. VIII), 1890, pl. XI, fig. 2*a*.

Measurements:—	Holotype (Plate 4, fig. 2)	No. 238b	Plate 3, fig. 3
Diameter	63	60	39 mm
Height of last whorl	32	30	36 %
Thickness of last whorl	42	40	41 %
Umbilicus	48	48	41 %

Remarks:— The small example last listed is probably a transition to one of the other species here described from the same bed, since it has the finely-ribbed inner whorls of *P.* (*P.*) *communis*. Its resemblance to the present form is confined to the rather close spacing of the ribs on the last whorl. The loose coiling of *P.* (*P.*) *regularis* suggests comparison with the still more evolute *P.* (*P.*) *kimmeridiensis*, Seebach sp. which was wrongly referred by Buckman[1]) to the genus "*Holcosphinctes*". The largest example of Seebach's species in the British Museum (No. C 4868 from Wootton Bassett, Wilts, of 55 mm diameter) shows that the original drawing (in Damon)[2]) is rather inaccurate; and while the inner whorls (Plate 25, fig. 2) are somewhat like those of the much more involute original of Plate 3, fig. 3, the point of bifurcation of the ribs is also represented as being too low on the whorl-side. In the present species, with more coarsely-ribbed inner whorls, the primary costae are more projecting (laterally) than in either *P.* (*P.*) *kimmeridiensis* or *P.* (*P.*) *rotunda*. The proportions of *P.* (*P.*) *kimmeridiensis* (55—.27—.33—.50) are also different from those of the species here described.

The example figured in Plate 10, fig. 3 is perhaps too small to be definitely included in the present species rather than in one of the allied forms, but it is interesting on account of the *Anomia* (or *Placunopsis*?) attached to its earlier whorls (now partly pyritised). The portion of the outer whorl visible in fig. 3a is all body-chamber, and the *Anomia* (*Placunopsis*?) covered by it is attached only to the figured side, as the regular spiral of the umbilical suture on the opposite side is only slightly disturbed at the beginning and again beyond the middle of the body-chamber. The *Anomia* (*Placunopsis*?) again grew to a fair size before becoming sealed up by the growth of the ammonite shell; and its lateral attachment may be taken to indicate that the ammonite led a crawling mode of life, with the shell lying on its side, rather than a free-swimming existence, in an upright position, as has been suggested for oxynote shells. In the case of the *Chamoussetia*, I recorded[3]), however, the *Placunopsis* valves also were attached to one side of the venter, although

[1]) Type Ammonites, vol. VI, 1926, pl. 673.

[2]) Geology of Weymouth, Suppl. 1860, pl. IX, fig. 9.

[3]) Invertebrate Faunas of the Bathonian-Callovian Deposits of Jameson Land (East Greenland). Medd. om Grønland, vol. 87, no. 7, 1932, p. 51.

probably causing less disturbance of the equilibrium on account of the much larger size of the ammonite. It will be noticed that although normal coiling in the *Pavlovia* here figured is not resumed until near the end of the body-chamber, the ornamentation has scarcely been affected by the irregularity.

The holotype of the present species is almost identical with a Russian ammonite in the Murchison Collection (B. M., no. 33497) which I recorded in 1924[1]) as belonging to an unnamed species of *Pallasiceras*. This form is preserved in a striking bluish-black sandstone with pure white belemnite fragments, so that its horizon and, perhaps, exact locality should be determinable by our Russian colleagues.

Horizon:— Sandy Clays, 36 m and 66 m below Glauconitic Series; nodule bed β; Upper Kimmeridgian.

Localities:— Ridge south of Crab Valley; Loc. E, Nos. 182, 183; also 127 and 225 (Pinna Valley), Loc. A, and doubtfully from Rosenkrantz's Section II, at 62 m.

Pavlovia (*Pallasiceras*) *perinflata*, sp. nov.

(Plate 5, figs. 2a, b; 3a, b; Plate 11, figs. 3a, b).

Diagnosis:— Like *P.* (*P.*) *communis*, but with far more rapid increase in whorl-thickness and less distant spacing of the ribs, after a similar, finely-ribbed early stage. Constrictions and occasional irregularities in the ribbing present. Suture-line very simple, as in other *Pallasiceras*.

Measurements:—	Holotype (Plate 5, fig. 2)	Plate 11, fig. 3
Diameter	95	(at) 33 mm
Height of last whorl	31	38 %
Thickness of last whorl	44	45 %
Umbilicus	44	36 %

Remarks:— The small example figured in Plate 11, fig. 3 is one of a number that include transitions to *P.* (*P.*) *communis* and other species here described, and their definite identification is not always possible; but the larger, typical, examples of the present form are all fragmentary. They are all body-chambers, however, showing that the present species did not attain the gigantic size of *P.* (*Pallasiceras*) *gibbosa* and *P.* (*P.*) *trigonalis* (Buckman)[2]) which have a somewhat similar, depressed whorl-section. The inner whorls of these two species, however,

[1]) On the Blake Collection of Ammonites from Kachh, India. Pal. Indica, N. S., vol. IX, No. 1, 1924, p. 17.

[2]) Type Ammonites, vol. VI, 1926, pl. 639 A—D; pl. 674 A, B (as *Lydistratites*).

are closer to *P.* (*P.*) *rotunda* and to the small *Pallasiceras* wrongly attributed by Buckman[1]) to *Lydistratites lyditicus* (the holotype of which species[2]) in my opinion belongs to the same group as Buckman's "*Holcosphinctes*" *pallasioides*, Neaverson, figured on another plate[3])). There are, however, inflated examples of *P.* (*P.*) *rotunda* (L. F. S., 847—848) that can be distinguished from corresponding fragments of *P.* (*P.*) *perinflata* merely by the (laterally) less projecting primary ribs. As in the species last described, the inner whorls are different, being indistinguishable from those of *P.* (*P.*) *communis*. Neaverson's[4]) "*Aposphinctoceras*" *ailesburiense*, which I would also include in *Pallasiceras*, is less inflated and has less prominent ribs.

The inner whorls resemble a small, pyritised, form of *Pallasiceras* in the British Museum (No. C 89), labelled "*Per. pavlovi*", which was examined by Pavlow himself in 1898. Unfortunately it is unlocalised and I know of such pyritised specimens only from Wiltshire (Wootton Bassett), where their exact horizon is unknown. But while this example is closer to the present species than to *P.* (*P.*) *concinna* (Neaverson), it differs from the holotype of *P. pavlovi* (Michalski)[5]) in its finely-ribbed and more quickly coiled inner whorls. Since, however, Michalski pointed out that these early volutions were much like a young *Dorsoplanites dorsoplanus*, he figured, and since young English forms of *Pallasiceras* are similar, though less regularly bifurcate, the difference may be less great than appears from the drawing, especially since Ilovaïsky[6]) pointed out that Michalski represented only one extreme individual of this variable species. On the other hand, the lower point of bifurcation of the ribs and the obvious resemblance to certain forms of *Acuticostites* make it probable that *P. pavlovi* is quite distinct.

Horizon:— Sandy Clays, about 36 m below base of Glauconitic Series; nodule bed β; Upper Kimmeridgian.

Localities:— Ridge south of Crab Valley, Loc. E, Nos. 182, 183.

Pavlovia (*Pallasiceras*) *subaperta*, sp. nov.

(Plate 3, figs. 2a—c; Plate 6, figs. 2a—b; Plate 8, fig. 7; Plate 11, figs. 4a, b; Plate 26, figs. 4a, b).

Diagnosis:— Rather narrow whorls (substenogyral), with whorl-section wider than high (subpachygyral) and rather open umbilicus (sublatumbilicate). Sides gently flattened, venter evenly arched. Um-

[1]) *Ibid.*, pl. 353 D only.

[2]) *Ibid.*, vol. IV, 1922, pl. 353 A only.

[3]) *Ibid.*, vol. V, 1925, pl. 569.

[4]) *Op. cit.* (Ammonites from the Upper Kimmeridge Clay), 1925, p. 27, pl. II, fig. 3.

[5]) *Loc. cit.* (Mém. Com. géol. St. Pétersb., vol. VIII), 1890, pl. XI, figs. 6a, b.

[6]) *Loc. cit.* (Bull. Soc. Nat. Moscou, N. S. vol. XXXII), 1924, p. 339.

bilical slope rounded, moderately high and tending to be undercut. Ribs at first as in young *P.* (*P.*) *regularis* (see inner whorls of Plate 3, fig. 3a), later the pairs of secondary ribs tend to be close together and the interval between each pair of secondaries is wider (see Plate 3, fig. 2c); but there are irregularities, especially on body-chamber fragments. Suture-line simple, as in *P.* (*P.*) *regularis*.

Measurements:—	Holotype (Plate 11, fig. 4)	Plate 6, fig. 2
Diameter	44	55 mm
Whorl-height	32	33 %
Whorl-thickness	36	35 %
Umbilicus	43	41 %

Remarks:— The specimens on which this species is based seem rather a heterogeneous assemblage, and it is almost certain that the originals of Plate 3, figs. 2a—c and of Plate 6, fig. 2 or Plate 8, fig. 7 belong to different varieties, perhaps not the same species as the holotype; but the latter is now selected merely because it is the most complete, except the transition to *P.* (*Epipallasiceras*) *costata*, sp. nov., figured in Plate 26, figs. 4a, b. Unfortunately the periphery of the larger part of its half-whorl of body-chamber is worn, so that the characteristic approximation of the peripheral pairs of ribs is not seen, except in the case of the last few costae which, however, are more distantly spaced than those in the dorsal area of the body-chamber fragment figured in Plate 3, fig. 2, or the still more densely-ribbed fragment represented in Plate 6, fig. 3 (and Plate 20, fig. 5). The outer whorl of the last, described below, has irregular costation, including some triplicate ribs, but they are finer than those of the other body-chamber fragment (Plate 3, fig. 2) and more projected forwards. A third portion of a body-chamber again has only about nine long and short ribs, but they are all different; although it does not much resemble the other two body-chamber fragments, it is more likely to belong to the same form as the holotype. The cast of an impression figured in Plate 8, fig. 7, again, while resembling the holotype to a corresponding diameter, becomes irregularly costate near the end.

The fragmentary specimen figured in Plate 6, fig. 2 has inner whorls indistinguishable from the small example of *P.* (*P.*) aff. *regularis* figured in Plate 3, fig. 3, but on the body-chamber, both closeness of the secondary rib-pairs and alternation of these across the periphery set in. Towards the end of the shell, where the whorl-section also shows rather flattened sides, the appearance therefore is quite different from that of *P.* (*P.*) *regularis*, but it will be seen that the pairs of secondaries are not as approximate as in the doubtful body-chamber fragments above discussed

or in *P.* (*Epipallasiceras*) *pseudaperta*, sp. nov. and the transition to that species and *P.* (*E.*) *costata* figured in Plate 26, figs. 4a, b.

Perisphinctes miatschkoviensis (Vischniakoff) Michalski[1]) with which the specimen figured in Plate 11, fig. 4 had been compared by Rosenkrantz, shows only very distant resemblance, having deep constrictions, preceded by bidichotomous ribs. Ilovaïsky[2]) did not attempt to place this incompletely known species, but he was right in excluding it from either *Virgatites* or *Zaraïskites*.

Compared with similar-sized specimens of *Pallasiceras* of the type of *P. gracile*, Neaverson[3]), from the *rotunda* nodule bed (e. g. Waddington Coll., no. 926), the resemblance of the inner whorls is striking, but the ribbing in the Greenland form becomes irregular at an early stage.

Virgatites scythicus, Sauvage, *non* Vischniakoff-Michalski, discussed on p. 31 is also comparable to the body-chamber fragment figured in Plate 3, fig. 2; in fact it could almost be identified with one of two examples in Mr. Waddington's Collection (B. M., no. 630), although the ribbing may be less close. Unfortunately the inner whorls of these Boulonnais ammonites are always replaced by crystalline calcite or else corroded, but judging by the allied species of *Progalbanites* (see p. 30) of *Crendonites* and *Kerberites*, they were not of the *Pallasiceras* type (represented in Plate 11, fig. 4a).

Horizon:— Sandy Clays, *subaperta* nodule bed (above β?); Upper Kimmeridgian.

Locality:— Rosenkrantz's section II, at 62 m.

Pavlovia (*Pallasiceras*?) sp. nov.?

(Plate 6, fig. 3; Plate 20, fig. 5).

The small body-chamber fragment here figured (together with a squeeze of its dorsal area) is obviously distinct from *P.* (*P.*) *subaperta*, although probably allied. The periphery is worn and the ribbing thus appears more delicate than in the example figured on Plate 3, fig. 2; but it is very sharp on the inner whorl and differs from that of the specimen of *P.* cf. *subaperta*, just mentioned, merely in being more closely spaced. The costation is also more projected, more distinctly virgatoid, and there is one deep and wide constriction, succeeded by a single rib. The whorl-section is depressed, with rounded sides and evenly arched periphery and the proportion of height to thickness is as 4 : 5.

The fragment is of interest on account of its superficial resemblance

[1]) See *loc. cit.* (Mém. Com. géol. St. Pétersb., vol. VIII, no. 2), 1890, p. 159, pl. IX, figs. 9—10.

[2]) *Loc. cit.* (Bull. Soc. Imp. Nat. Moscou, vol. II, 4), 1924, p. 345.

[3]) *Loc. cit.* (Papers from Geol. Dept., Liverpool University), 1925, p. 20, pl. I, figs. 8—9.

to certain varieties of *Epivirgatites nikitini* (Michalski)[1]), but the sharpness of the ribbing of the inner whorl and the junction of the peripheral costae at the ventral edge prevent closer comparison. In view of its association with *P. subaperta* and the ammonite figured in Plate 3, fig. 2, it is probable that the present form is another member of the group of ammonites that fore-shadow *P. pseudaperta* of the higher Glauconitic beds.

Horizon:— Sandy Clays, *subaperta* nodule bed (above β?), Upper Kimmeridgian.

Locality:— Rosenkrantz's section II, at 62 m.

Pavlovia (*Pallasiceras*) *variabilis*, sp. nov.

(Plate 10, figs. 1a, b; Plate 21, figs. 1a, b).

Diagnosis:— Rather narrow whorls (substenogyral), slightly higher than wide (subleptogyral), with rather open umbilicus (sublatumbilicate). Whorl-section oval, with evenly arched venter, gently rounded sides and perpendicular umbilical wall, but no edge. Ribbing of earlier whorls apparently as in Plate 11, fig. 2; later, ribs are blunter, especially the secondaries, and on the last half of the body-chamber the more or less regular bifurcation tends to be lost entirely. Body-chamber almost a whole whorl in length; aperture plain. Suture-line not seen.

Measurements:—

Diameter	200 mm
Height of last whorl	33 %
Thickness of last whorl	31(?)%
Umbilicus	45 %

Remarks:— The holotype is slightly deformed by pressure so that the whorl-thickness at the end is somewhat doubtful. The form, altogether, may be considered to be insufficiently known to be given a distinct name; but it cannot be included in any of the other Greenland species here described and at the same time it is distinct from the forms of the *rotunda* group. Since Neaverson[2]) and Buckman[3]) figured only small examples of *P.* (*P.*) *rotunda*, I may say that fragments of large individuals up to about 500 mm diameter are very common in the nodule bed at Chapman's Pool, Dorset. At a size corresponding to that of the holotype of *P.* (*P.*) *variabilis*, the dimensions (190—.29—.31—.52)[4])

[1]) *Loc. cit.* (Mém. Com. géol. St. Pétersb., vol. VIII, no. 2), 1890, p. 232, pl. XII, figs. 5—8.

[2]) *Op. cit.* (Ammonites of the Upper Kimmeridge Clay), 1925, pl. I, fig. 6.

[3]) Type Ammonites, vol. VI, 1926, pl. 590a—c.

[4]) Taken from a specimen (P. 44) in Mr. C. H. Waddington's collection.

are different in *P.*(*P.*) *rotunda*, and the sharp ribbing persists to a much larger diameter, while the ribs remain more closely spaced.

P. (*Pallasiceras*) *rugosa*, sp. nov. and *P.* (*Paravirgatites*?) sp. ind., here described, are also distinguished from the present form by their sharp ribbing, while *P.* (*P.*) *similis*, sp. nov. and *P.* (*P.*) *alterneplicata*, sp. nov. have their ribs more closely spaced. The resemblance between *P.* (*P.*) *variabilis* and forms of *Lydistratites* (= "*Holcosphinctes*") or still later genera is superficial.

If the small example figured in Plate 21, figs. 1a, b is correctly interpreted as belonging to the species here described, or at least to a close ally, the whorl-section, at smaller diameters, is rather depressed. The ornamentation, at first, is that of the typical *P.* (*P.*) *rotunda* (Sowerby), with a deep constriction, preceded by a triplicate rib and followed by a single one. The second half of the body-chamber has irregular ribbing and the mouth-border appears to be complete. The inner whorls, up to the last septal edge, unfortunately, are crushed.

Horizon:— Upper Kimmeridgian. The specimens were labelled β (No. 173) and "probably β" (No. 127), but the bluish sandstone matrix is that of Rosenkrantz's 35 m horizon at section II, 27 m below the *subaperta* nodules.

Localities:— Hartz Mountain (South side, section A, No. 127), and Crab Valley (No. 173, the holotype).

Pavlovia (*Pallasiceras*) *inflata*, sp. nov.

(Plate 14, figs. 1a—c).

Diagnosis:— Whorls rather low (substenogyral), rather inflated (subpachygyral), umbilicus rather open (sublatumbilicate). Whorl-section depressed, with broadly arched venter and evenly convex sides. Umbilical wall vertical and rather high but without edge. Ribs biplicate or single at first, with occasional deep constrictions; later more irregular and unsymmetrical on the two sides. Suture-line simple (fig. 1c).

Measurements:—

Diameter	105 mm
Height of last whorl	31 %
Thickness of last whorl	42 %
Umbilicus	47 %

Remarks:— The preservation of the holotype suggests that it may have been broken off at the last septum, but a fragment of a large *Pallasiceras* from the same bed is still septate at a diameter of about 200 mm (see Plate 34, fig. 4). The impression of the ribbing of the previous whorl in the dorsal area, however, shows this fragment to have belonged

to a more closely costate species, probably a form intermediate between *P.* (*P.*) *inflata* and *P.* (*P.*) *kochi*, but with blunter costation.

The present species shows some resemblance to certain coarse but crushed English forms of *Pallasiceras*, occurring in the shales between the *Paravirgatites* nodules (in Blake's bed 7) and the *rotunda* nodules about 135 feet higher. They have been compared[1]) to *P. lomonossowi* (Michalski), but only resemble the biplicate variety figured by that author[2]), although even this may be generically different. *P.* (*P.*) *rugosa*, sp. nov. (Plate 11, fig. 2) is close to the form here described, but less distantly ribbed and shows occasional triplication of the costae; the depressed variety of *P.* (*P.*) *rotunda* (J. Sowerby) figured by Buckman as a 'plesiotype' of *Lydistratites lyditicus*, however, is somewhat intermediate between the two Greenland species, judging by an example of 112 mm diameter in Mr. C. H. Waddington's collection (No. B. 367).

In those inner whorls of large Portlandian ammonites that show resemblance to the present form (e. g. '*Crendonina*' *subrotundata*, Buckman)[3]) the costation is far less sharp and the inner whorls have fine, virgatoid, ribbing.

The small example figured in Plate 8, figs. 5a,b, is too immature to be definitely identified, but probably represents the inner whorls of the present species or of a close ally. It seems to develop too distantly spaced ribs to be referred to *P.* (*P.*) *kochi* and it is more inflated and more coarsely ornamented than the young *P. allovirgatoides*, nov., but it well shows the comparatively rapid change in the costation, so typical of *Pallasiceras*.

If a corroded and crushed specimen (Rosenkrantz Coll., 4107) belongs to the present species, as seems probable, then at larger diameters there is a change to more typical *Pallasiceras* ribbing, with constrictions, bordered by triplicate and single costae.

Horizon:— Glauconitic Series, apparently lowest part; Upper Kimmeridgian.

Localities:— Hartz Mtn., N. W. Ridge, Loc. N, No. 213. Doubtfully from Rosenkrantz's section I (at 100 m) and section II (70 m, loose).

Pavlovia (*Pallasiceras*) *kochi*, sp. nov.

(Plate 15, figs. 1a, b).

Diagnosis:— Rather narrow whorls (substenogyral), considerably wider than high (subpachygyral), with fairly wide umbilicus (sublatumbilicate). Whorl-section transversely oval, with broad and evenly rounded

[1]) In Lamplugh, Kitchin and Pringle: The Concealed Mesozoic Rocks in Kent. Mem. Geol. Survey, 1923, table to p. 224.

[2]) *Loc. cit.* (Mém. Com. géol. St. Pétersb., vol. VIII, no. 2), 1890, pl. XI, fig. 1.

[3]) Type Ammonites, vol. VI, 1925, pl. 607.

venter, gently flattened sides and high umbilical slope, with rounded border but overhanging the umbilical suture. Ribbing uniformly close and straight, mostly bifurcating beyond the middle of the side, but inside the umbilical suture, with occasional constrictions, bordered by accentuated, single or trifurcating ribs. Suture-line with external saddle rather broadly-stemmed and first lateral lobe as deep as external lobe; similar to that of *P.* (*P.*) *rotunda* (J. Sowerby).

Measurements:—

Diameter	220 mm
Whorl-height	31 %
Whorl-thickness	40 %
Umbilicus	48 %

Remarks:— The holotype is still septate at the end and it can be seen that there was at least another whorl, so that the complete ammonite must have been of gigantic dimensions. The great whorl-thickness which is the most characteristic feature distinguishing the present species from the closely allied *P.* (*P.*) *rotunda* (J. Sowerby) and its varieties, is based on the proportions at the middle of fig. 1b; nearer the end the side not figured is broken away and coated with *Ostrea* of the *bononiae* type. *P.* (*P.*) *gibbosa* (Buckman)[1]) has a different whorl-section, the sides being more projecting and, conversely, the venter less broad and flat. Both these species also have blunter ribbing, especially on internal casts; so has the large fragment, already referred to under *P.* (*P.*) *inflata*, from the same bed, the suture-line of which is figured in Plate 34, fig. 4.

P. (*P.*) *rugosa*, nov. has a less depressed whorl-section and is more distantly costate at the same diameter, while *P.* (*P.*) *similis*, nov. has still slenderer whorls. In *P.* (*Paravirgatites*?) sp. ind. (Plate 4, fig. 5) the ribbing is sharper and more projected ventrally.

Horizon:— Glauconitic Series, apparently lowest part; Upper Kimmeridgian.

Locality:— Hartz Mtn., N. W. Ridge, Loc. N, No. 213.

Pavlovia (*Pallasiceras*?) *alterneplicata*, sp. nov.

(Plate 11, fig. 1; Plate 12, fig. 3; Plate 17, fig. 2).

Diagnosis:— Rather narrow whorls (substenogyral), only slightly wider than high (subleptogyral), widely umbilicate (latumbilicate). Ribs rather blunt, especially on cast, alternately single and biplicate, but irregularly, on account of interference by constrictions, sometimes

[1]) Type Ammonites, vol. VI, 1926, pl. 639a—c; 1927, pl. 639d (as "*Lydistratites*" *gibbosus*).

preceded by triplicate ribs. Suture-line with slender saddles and first lateral lobe slightly deeper than the external lobe, resembling suture-lines of other *Pallasiceras* (Plate 17, fig. 2).

Measurements:—

Diameter	135 mm
Height of last whorl	30 %
Thickness of last whorl	32 %
Umbilicus	50 %

Remarks:— The unusual bluntness of the ribbing seems to be against reference to *Pallasiceras*, but on the last half-whorl of the holotype, just after the break visible in fig. 1 (Plate 11, on the left) there is a characteristic constriction, preceded by a triplicate rib and followed by two single costae. The inner whorls, judging by the impress left in the dorsal area of the youngest whorl shown, were very finely ribbed as in the immature *Pallasiceras* figured in Plate 5, fig. 5, but the change to more distant ribbing is gradual, not sudden, as in *P.* (*P.*) *rotunda* and its allies.

P. allovirgatoides, nov. is slenderer and less bluntly ribbed, while *P. kochi*, nov. is still more depressed. In spite of a slightly different, i. e. sharper type of ribbing, however, this latter species is probably the closest ally of the present form, so that its reference to *Pallasiceras* may be justified. The resemblance to Burckhardt's[1]) more involute *Perisphinctes theodosii*, a form compared to *Amm. panderi*, d'Orbigny, is probably only superficial, and, in any case, the inner whorls are different. The many other alterneplicate Perisphinctids described from more southern areas are still less closely related, and in *Crendonites*, which often has single costae alternating with bifurcating ribs, especially on the body-chamber, the whorl-shape and coiling are different.

Horizon:— Glauconitic Series, apparently lowest part; Upper Kimmeridgian.

Locality:— Hartz Mtn. N. W. Ridge, Loc. N; No. 213.

Pavlovia (*Pallasiceras*) *rugosa*, sp. nov.

(Plate 11, fig. 2; Plate 12, figs. 1a, b; Plate 17, figs. 3a, b).

Diagnosis:— Rather narrow-whorled (substenogyral), with thickness greater than whorl-height (subpachygyral) and fairly open umbilicus (sublatumbilicate). Whorl-section rounded, with convex sides, greatest thickness at middle, and broadly-arched venter, more depressed (like Plate 4, fig. 2b) in younger stages. Umbilical wall high but edge rounded.

[1]) Faunas jurasicas de Symon &c. Bol. no. 33, Inst. Geol. Mexico, 1919, p. 18; 1921, pl. VIII, fig. 1.

Ribbing at first rather closely spaced, biplicate, but with occasional triplicate ribs, followed by a constriction and then a single rib, as in typical *Pallasiceras*. Costation tending to become more irregular on body-chambers. Suture-line with broad external saddle, first lateral lobe less deep than external lobe, and short second lateral lobe (Plate 11, fig. 2).

Measurements:—	Holotype (Plate 11, fig. 2)	Pl. 12, fig. 1	No. R. 147
Diameter	97	130	165 mm
Height of last whorl	31	32	29 %
Thickness of last whorl	38	32	35 %
Umbilicus	44	45	48 %

Remarks:— The holotype and the small example figured in Plate 17, fig. 3 may not belong to the same species, but the larger and more fragmentary specimen represented in Plate 12, fig. 1 shows merely a less depressed whorl-section than the type. The measurements and the restored sectional outline, however, are not reliable, owing to deformation in the rock. The differences in ribbing also are probably due merely to the difference in size, the larger body-chamber portion (Plate 12, fig. 1) showing, as usual, irregularities, notably two single ribs, preceded by constrictions. There are also intercalated secondaries instead of distinct trifurcation, as in the holotype (third or fourth rib from end), so that the latter may be considered to be closer to *Pallasiceras*, while the larger example (Plate 12, fig. 1) approaches "*Holcosphinctes*" (= *Lydistratites*). Yet the differences are probably not even specific, for the much earlier forms of *Paravirgatites* (Plate 4, fig. 5) were also already essentially similar. On the other hand, the example figured in Plate 12, fig. 1 is perhaps a transition to the slightly more closely ribbed *P.* (*P.*?) *rotundiformis*, described below, which has a wider umbilicus.

The whorl-section of the small example figured in Plate 17, fig. 3 is more bulging at the lower half of the sides than the inner whorls of the holotype and the ribbing is less close. What is of greater importance, however, is the low position of the point of bifurcation of the ribs; as this is visible in the umbilicus, it suggests comparison of this small example with *Pavlovia pavlowi* (Michalski)[1]). According to Ilovaïsky[2]), Michalski figured only one rare and extreme variety of this variable species and since he considered a far commoner form to be rather close to a young *Dorsoplanites dorsoplanus* figured by Michalski, it is probable that he had in mind forms which in 1924[3]) (in ignorance of Ilovaïsky's

[1]) *Loc. cit.* (Mém. Com. géol. St. Pétersb., vol. VIII, no. 2), 1890, pl. XI, figs. 6a, b.

[2]) *Loc. cit.* (Bull. Soc. Nat. Moscou, N. S., vol. XXXVII), 1924, p. 339.

[3]) *Loc. cit.* (Pal. Indica, N. S., vol. IX, no. 1), 1924, p. 17.

work) I included in *Pallasiceras* (e. g., B. M., no. 33497). If these are the true *Pavlovia*, then the small example here figured is a far more typical representative of the genus than the holotype of *P.* (*P.*) *rugosa* or especially the other species referred to *Pallasiceras*, with their finely-ribbed centres.

The largest example listed above has over three-quarters of the outer whorl belonging to the body-chamber and the whorl-section is then greatly inflated, with the umbilical wall overhanging the previous whorl. There are two oblique constrictions on the body-chamber and the ribbing, less sharp than on the previous whorl or in the holotype, is merely biplicate or occasionally single, and inclined forward, as in many Portlandian ammonites (compare "*Leucopetrites*" *caementarius*, Buckman[1])) as well as in typical *Pallasiceras*. Fragments of other large examples, listed below, are only doubtfully included in the present species.

Horizon:— Glauconitic Series, about 14 m above base; Upper Kimmeridgian.

Localities:— Pinna Valley, Hartz Mtn., Loc. A, No. 223; Rosenkrantz's section I, between 115 and 130 m.

Pavlovia (*Pallasiceras*) *similis*, sp. nov.

(Plate 12, figs. 4a, b).

Diagnosis:— Like last (*P. rugosa*) but more evolute and at first slightly, and later distinctly, less distantly costate, the number of ribs (at about 90—100 mm diameter) being in the proportion of 44 : 33 per half whorl. Less depressed whorl-section, more nearly circular, with steep umbilical wall but rounded edge. Suture-line of same general plan, but first lateral lobe as deep as the external lobe, not shorter, as in *P.* (*P.*) *rugosa*.

Measurements:—

Diameter	112 mm
Height of last whorl	30 %
Thickness of last whorl	32 %
Umbilicus	47 %

Remarks:— The holotype is entirely septate and while it is sufficiently distinct from the other forms here described for specific separation, it is possible that on the body-chamber the differences from *P. rugosa* would have been still further accentuated, the resemblance being in reality confined to the earlier whorls, so far as can be seen.

[1]) Type Ammonites, vol. VI, 1926, pl. DCLXXVII.

While the inner whorls only are similar to those of *P.* (*P.*) *inflata*, the approximation of the ribbing on the outer whorl (not even body-chamber) is quite unknown in the English forms of the *rotunda* group. It is thus possible that *P.* (*P.*) *similis* is transitional to the genus *Epipallasiceras*. The doubtful immature example figured in Plate 21, figs. 1a, b and provisionally attached to *P.* (*P.*) *variabilis*, sp. nov. would not be readily separable from similar inner whorls of the present form, but it comes from a lower horizon. The other forms here described all differ in their ribbing and most of them also in proportions and whorl-shape.

Horizon:— Glauconitic Series, upper part? Upper Kimmeridgian (or Portlandian?).

Locality:— Hartz Mtn., N.W.Ridge, Loc. M (No. 209).

Pavlovia (*Pallasiceras*) *rotundiformis*, sp. nov.

(Plate 19, figs. 3a, b).

Diagnosis:— Like *P.* (*P.*) *rotunda* (J. Sowerby)[1]) but with a more rounded, less depressed, whorl-section, with the primary ribs less projecting sideways, and with longer secondaries. Ribbing sharp and rather irregular. Suture-line simple, similar to that of *P.* (*P.*) *rotunda* (Plate 18, fig. 4).

Measurements:—

Diameter	120 mm
Height of last whorl	32 %
Thickness of last whorl	(?) 32 %
Umbilicus	48 %

Remarks:— The constriction shown at the bottom of fig. 3a is preceded by a single rib and succeeded by a triplicate one, while the constriction at the last third of the outer whorl is followed by a single rib, so that no importance is attached to these irregularities, especially as the hundreds of examples of *P.* (*P.*) *rotunda* before me also show considerable variation. It is probable, however, that the present form is somewhat transitional to *Lydistratites* which generally has longer secondaries and which is less regularly costate than the typical *Pallasiceras*. Over three-quarters of the outer whorl of the (crushed) holotype belong to the body-chamber and in a comparable specimen of *P.* (*P.*) *rotunda* (Waddington Coll. no. 248, of dimensions:— 107—.29—.34—.49) with half a whorl of body-chamber, the ribbing of the adult is almost

[1]) For definition see Neaverson, *op. cit.* (Ammonites of the Upper Kimmeridge Clay), 1925, p. 18, pl. I, fig. 6. Both Neaverson and Buckman have had the loan of the specimen [no. 345] on which the genus *Pallasiceras* was based (Spath: Blake Collection of Ammonites from Kachh, *loc. cit.*, 1924, p. 16) and which is identical with Neaverson's example, now also in the British Museum.

identical, though perhaps not the whorl-shape. The ribs of the earlier volutions, however, are more distantly spaced; even on the innermost whorls sufficient of the ribbing is preserved to show that there was nothing like the densicostate stage of the typical *Pallasiceras* (see Plate 5, fig. 5).

The other forms of *Pallasiceras* here described, with the exception of one transitional example (Plate 12, fig. 1), are sufficiently distinct, even in proportions, to be easily separated from *P. rotundiformis*, but some of the species of *Crendonites* discussed below and especially the somewhat transitional forms described as *C. subregularis*, nov. and *C. anguinus*, nov. are perhaps more closely comparable. They differ in the ribbing, with comparatively short secondaries, and the regularly biplicate septate stage preceding the very long body-chamber, but in the case of fragments differentiation may not be easy.

There are two large fragments of Perisphinctids (loc. 179a,b) which may be outer whorls of the present species, but which are difficult to compare on account of their size. The larger example represents the body-chamber of an individual of about 270 mm diameter; and the more or less regular biplication (with comparatively long secondaries, but only one single rib, preceded by a constriction, also one or two intercalated ribs) is not noticeably different from that of many large English examples of *Pallasiceras* and *Lydistratites* before me.

Horizon:— Glauconitic Series, upper part; Portlandian?

Localities:— Cape Leslie, Rosenkrantz's section I, at 115—130 m. Doubtfully also from below Mt. Hennig (loc. E, no. 179).

Sub-genus *EPIPALLASICERAS*, nov.

Pavlovia (*Epipallasiceras*) *pseudaperta*, sp. nov.

Plate 8, fig. 1; Plate 9, figs. 3, 4; Plate 11, fig. 5; Plate 16, figs. 1, 4; Plate 20, fig. 1; Plate 39, fig. 2).

Diagnosis:— Rather narrow whorls in adult (substenogyral), with thickness about the same as or slightly more than the whorl-height (subleptogyral), but subplatygyral and subpachygyral in earlier stages. Whorl-section with flattened sides and evenly arched venter, high umbilical slope but rounded edge. Ribbing at first fine and close, projected peripherally and somewhat irregular; later more evenly biplicate with the two secondaries close together and the intervening spaces between the pairs of secondaries distinctly wider (except when the ribs alternate across the ventral area). Deeply triplicate or bidichotomous ribs again on larger whorls. Suture-line simple, with external lobe as deep as the first lateral and rather broad saddles (Plate 8, fig. 1a; Plate 9, fig. 3a).

Measurements:—	Holotype, Pl. 16, fig. 1	Pl. 8, fig. 1	Pl. 9, fig. 3	Pl. 9, fig. 4	Pl. 11, fig. 5
Diameter	118	93	67	50	40 mm
Height of last whorl	30	30	34	34	38 %
Thickness of last whorl	30(?)	32	39	40	40 %
Umbilicus	47	46	40	38	40 %

Remarks:— The holotype retains a part of the body-chamber (over a third of the outer whorl) and most of the numerous other specimens of this commonest of all the ammonites of the Glauconitic Beds are even smaller. The malformation represented in Plate 16, figs. 4a—c, also septate to quite near the end, is interesting because the animal had its shell injured at a very early stage, and kept on growing asymmetrically. The siphonal lobe is displaced slightly to the left, while the secondary ribbing is moved down from the periphery to the (morphologically) right-hand side (as seen in fig. 4b); since the suture-line also is scarcely affected, the injury to the shell-secreting anterior portion of the mantle cannot have been very serious and the difference in the ornamentation of the two sides (to us of generic importance) may have been negligible, the septal surfaces and position of the siphuncle automatically restoring equilibrium.

The example figured in Plate 8, fig. 1 with a more rounded and more inflated whorl-section, loses the characteristic ribbing towards the end and then shows considerable resemblance to *P. allovirgatoides* (Plate 14, fig. 3). Conversely the inner whorls attached to the latter species (Plate 16, fig. 3) are not distinguishable from those of undoubted examples of the present form, e. g. the original of Plate 9, fig. 4; but the inner whorls of another specimen figured in Plate 11, fig. 5, with short and paired secondaries already at a small diameter, suggest affinity with some of the other species here described. It shows more distinctly than the other examples what has been called the "*Lydistratites* stage", but at that size it is scarcely distinguishable from the form figured in Plate 39, figs. 2a,b which is merely an involute variety of the present species, with slightly more virgatoid ribbing. The proportions of this variety (var. *superba*, nov.) are:— 68—.40—.35—.34, and they might have been considered sufficiently distinct for specific separation of this form. But the later whorls of the smaller example represented in Plate 11, fig. 5 are again so much like the typical *P.* (*E.*) *pseudaperta* that the var. *superba* is now also left in this species.

The crushed example figured in Plate 20, fig. 1 seems to have longer secondaries and a smaller umbilicus, but these differences may be due merely to the crushing. It appears to stand in the same relationship to *P.* (*E.*) *pseudaperta*, as the crushed specimen figured in Plate 18, fig. 3

does to *P.* (*E.*) *costata*, but the preservation of the two fragments (in micaceous, glauconitic sandstone) is different from that of the typical examples.

P. (*E.*) *costata*, described below, has more distant costation and *P.* (*E.*) *tumida* differs considerably in proportions, but *P.* (*E.*) *praecox* is connected with the present species by transitions. One such passage-form, intermediate between the holotype of the species here described and the smaller example of *P.* (*E.*) *praecox* listed below (p. 60) shows a return to more irregular and partly triplicate costation on the outer whorl, but its ribs remain sharp and the point of branching is low. Another transitional form (166 m), with nearly half a whorl of body-chamber at 77 mm diameter, shows irregular ribbing at a much earlier stage than the inflated variety of *P. pseudaperta* figured in Plate 8, fig. 1a and may lead to species like *P.* (*Pallasiceras*) *rotundiformis*.

Horizon:— Glauconitic Series, chiefly upper part; Portlandian.

Localities:— Many localities between C. Leslie and Hartz Mtn., e. g. nos. 142, 162—164, 167, 175—178, 185. Also from Rosenkrantz's Section I, at 100—115 m.

Pavlovia (*Epipallasiceras*) *costata*, sp. nov.

(Plate 7, fig. 1; Plate 10, fig. 7; Plate 18, figs. 1a, b; 3).

Diagnosis:— Like *P. pseudaperta*, but with ribbing coarser and more distantly spaced. Suture-line simple, as in the last species.

Measurements:—	Holotype (Plate 7, fig. 1)	Plate 18, fig. 1
Diameter	75	73 mm
Height	31	31 %
Thickness	39	37 %
Umbilicus	47	45 %

Remarks:— The peripheral view of the body-chamber figured in Plate 18, fig. 1 seems very typical, yet it can only doubtfully be attached to this species. It is probably transitional to some of the other forms of *Pavlovia* here described, for example *P.* (*Pallasiceras*) *rugosa* or *P.* (*P.*) *rotundiformis*, but, before irregularities in the costation appear toward the end of this fragment, the paired secondaries have the characteristic appearance of those of the holotype. The latter might perhaps be considered too close to *P. pseudaperta* to be separated as more than a variety thereof; but I am now describing it as a distinct species on account of its resemblance to *Acuticostites pallasianus* (d'Orbigny). This resemblance is particularly striking in peripheral views (compare Plate 18, fig. 1 and Plate 25, fig. 3), but there is no tendency to produce single ribs in

the forms of the present group which rather revert to the *Pallasiceras* type of ribbing on the outer whorl.

It ought to be added that the holotype shows just the beginning of the body-chamber. A portion of this (omitted in the figure on account of imperfect preservation) retains the typical distant costation and depressed whorl-section, but the umbilical wall is there overhanging.

The crushed fragment figured in Plate 10, fig. 7 is only provisionally referred to the species here described, but it is of interest on account of its resemblance to *Crendonites pregorei*, sp. nov. (Plate 22, fig. 2). The pairs of secondaries, however, in the latter species, are not nearly so closely spaced (viewed peripherally) as in *P.* (*E.*) *costata*.

Horizon:— Upper part of Glauconitic Series; Portlandian.

Localities:— East side of Hartz Mtn., between Crab Valley and Gray Ravine (Locs. D, A, P, nos. 162, 134, 245); also Cape Leslie (Rosenkrantz's section I, at 165 m).

Pavlovia (*Epipallasiceras*) *tumida*, sp. nov.

(Plate 17, figs. 1a, b).

Diagnosis:— Rather narrow whorls (substenogyral); much wider than high (subpachygyral), rather widely umbilicate (sublatumbilicate). Whorl-section with convex sides and broadly arched venter, high and vertical umbilical wall, but rounded edge. Primary ribs in umbilicus rather regular, 32 to the whorl, with occasional constrictions, as in *Pallasiceras*, but inner whorls not so closely ribbed and secondaries arranged in pairs, with wide interspaces. Suture-line not clearly visible.

Measurements:—	
Diameter	108 mm
Height of last whorl	30 %
Thickness of last whorl	41 %
Umbilicus	44 %

Remarks:— The type of this species could have been taken to represent the inner whorls of a form like *P.* (*Pallasiceras*) *kochi* which has similar dimensions, but it is now separated on account of its paired secondary ribs which bring it closer to the forms here described as *P.* (*Epipallasiceras*) *praecox* and *P.* (*E.*) *costata*, nov. These are, however, more slender and they differ in ribbing, while *P.* (*P.*) *inflata* has peculiar and irregular costation. But it is possible that a poorly preserved example of about 180 mm diameter (R. 147) is a passage-form between the two species; its coarse, earlier ribbing becomes more closely spaced on the outer whorl and it is probable that the less extreme, i. e. coarsely ornamented holotype of the species here described similarly had less sharp

and less specialised costation on the body-chamber. *P.(E.) praecox* shows a comparable decline in the ribbing of the outer whorl.

A portion of the outer whorl of the holotype of *P. (E.) tumida* was omitted in the illustration, but at 110 mm diameter it was still septate. The whorl-thickness, then, was at least 44%, as in *P. (Pallasiceras) perinflata*, which, however, has entirely different ribbing.

Horizon:— Glauconitic Series, upper part; Portlandian.

Locality:— Cape Leslie (Rosenkrantz's section I, at 100—115 and 115—130 m).

Pavlovia (Epipallasiceras) praecox, sp. nov.

(Plate 25, figs. 1a, b).

Diagnosis:— Rather narrow whorls (substenogyral), wider than high (subpachygyral), with open umbilicus (latumbilicate). Whorl section evenly rounded, slightly depressed, with high and perpendicular umbilical wall and gently rounded edge. Ribbing at first flexuous, with secondaries clearly paired and wider interspaces; later, return to *Pallasiceras* costation, with constrictions, followed by single ribs, and with occasional tripartite ribs. Suture-line similar to that of *P. (E.) pseudaperta*, with first lateral lobe much shorter than external lobe.

Measurements:—	Holotype (Plate 25, fig. 1)	No. 176 m
Diameter	127 mm	100 mm
Height	28 %	30 %
Thickness	36 %	39 %
Umbilicus	52 %	45 %

Remarks:— The smaller example, also entirely septate, connects the holotype of this species with *P. (E.) pseudaperta*, but apart from the considerable differences in general shape, and in the whorl-thickness, there is a difference in the position of the point of bifurcation of the ribs, the forking in the present species not being visible inside the umbilical suture. The transitional young example figured in Plate 9, fig. 3, however, differs from the present form merely in its lateral flattening.

A fragmentary example (No. 176p), of about 125 mm diameter (still septate), has more finely-ribbed inner whorls, indistinguishable from those here associated with *P. (E.) pseudaperta* (e. g. Plate 11, fig. 5), but its outer whorl has the peripheral aspect of the holotype of *P. (E.) praecox* (Plate 25, fig. 1b). This example, however, is not only more involute at the same (large) diameter, but it has several single ribs among the bifid costae, so that it also bears some resemblance to (the less sharply ribbed) *P. (P.?) alterneplicata*. This second specimen

is probably merely a variety of the present species, especially since it comes from the same bed.

Horizon:— Glauconitic Series, upper part (top 5 feet); Portlandian.

Locality:— Ridge south of Crab Valley, loc. E, no. 176.

Pavlovia (Epipallasiceras?) sp. ind.

(Plate 20, figs. 6a, b).

The fragment here figured is too incomplete even for definite generic identification, but it is of interest on account of its resemblance to southern types, like *Perisphinctes biplicatus*, Uhlig[1]). This resemblance, in all probability, is entirely superficial; for the mode of biplication is different, the Himalayan species dividing its ribs into branches that diverge rapidly and sharply, whereas the Greenland fragment shows not only far more projected costation, but thickened primaries, with the thinner secondaries separating very gradually.

This may seem a small point; and Ilovaïsky's provisional reference of *P. biplicatus* to his genus *Pavlovia* shows that there is general agreement in ribbing and suture-line. But since I described *Subdichotomoceras biplicatoides*[2]) of Middle Kimmeridgian age, from Somaliland, and collected many biplicate ammonites, from *Perisphinctes biplex* (Sowerby) of the Ampthill Clay (Neoxfordian) to *Titanites* of the highest Portlandian, I have seen too many cases of convergence in these Perisphinctids to suggest definite reference to *Pavlovia*.

Imbedded in the same rock was a young example of *P. (Epipallasiceras) pseudaperta*, and although the larger ammonite of the same group figured in Plate 25, fig. 1 seems to have entirely different costation, towards the end, yet it is chiefly the length of the primaries (and the whorl-section) that causes the difference in aspect. Unfortunately the impress of the previous whorl in the dorsal area could not be exposed. The narrowness of the dorsum, shown in the outline whorl-section (fig. 6b) indicates that the fragment may be somewhat crushed even at the larger end (beginning of the body-chamber), as the ventral area of the camerate portion has been accidentally depressed. If the original whorl-shape, thus, was more rounded, much of the resemblance to southern types of Perisphinctids has lost its significance. Although it is possible that the fragment belonged to a form of the group of *P. (Epipallasiceras) pseudaperta*, there is a considerable difference in the ribbing, compared, for example, with the passage-form between this species and *P. (E.) praecox*, referred to on p. 60).

[1]) Fauna of the Spiti Shales. Pal. Indica, Ser. XV, Himalayan Fossils, vol. IV, fasc. 3, 1910, p. 379, pl. XLIX, fig. 1.

[2]) Monogr. Geol. Dept. Hunterian Museum, Glasgow University, I, pt. VII. Ammonites and Aptychi, p. 126, pl. XVI, fig. 6.

Horizon:— Glauconitic Series, upper part; Portlandian.

Locality:— 125 (East side of Hartz Mountain, Pinna Valley); Loc. A, south.

Genus *CRENDONITES*, Buckman, 1923.

Crendonites lesliei, sp. nov.

(Plate 13, fig. 1; Plate 19, fig. 1; Plate 22, fig. 5).

Diagnosis:— Rather narrow and thin whorls (substenogyral, subleptogyral), with rather open umbilicus (sublatumbilicate). Whorl-section evenly rounded, sides scarcely flattened. Ribbing fairly regularly biplicate, alternating across venter, with comparatively short secondaries; occasional constrictions, rarely single ribs or trifurcation; fine and close ribbing with long secondaries on earliest whorls. Suture-line simple, as in other *Crendonites*.

Measurements:—	Holotype Plate 13, fig. 1	Plate 22, fig. 5	Plate 19, fig. 1
Diameter	107	100	90 mm
Height	26	30	28 %
Thickness	24?	?	?
Umbilicus	49	47	48 %

Remarks:— The preservation of the various examples here figured is such that their reference to a single species is open to criticism. The impression, for example, from which was taken the plaster-cast figured in Plate 22, fig. 5 seems to show more reclined ribbing than the holotype and the similar but smaller paratype (Plate 19, fig. 1), but this may be due to deformation in the rock. More doubtful is the fragment with a portion of the solid (uncrushed) body-chamber, figured in Plate 22, figs. 1a,b, since it has three single ribs. It may belong to a distinct species; and such smaller, crushed, fragments as those represented in Plate 10, figs. 4—5 might, of course, equally provisionally be attached to some of the other forms of *Crendonites* here described, except for the irregularities in the ribbing. The same applies to the finely ribbed inner whorls figured in Plate 16, fig. 5.

While *C. euglyptus*, sp. nov. has more distant costation, *C. gorei* (Salfeld)[1]) and especially the more accelerated *C. subgorei*, nov. (Plate 9, fig. 5) have coarser ribbing already at a comparatively early stage. The inner whorls of another typical *Crendonites*, however (Plate 14, fig. 2), compare well with some of the examples included in the present species, e. g. the original of Plate 10, fig. 4. *C. leptolobatus*, Buckman[2]); being based on a poorly preserved specimen, is difficult to compare, but in costation seems to agree more with *C. subregularis*, described below, than with the present species. The fragment figured in Plate 22, fig. 1, however, shows how the ribbing of the body-chamber may closely resemble that of the typical *Crendonites* of the *gorei* group. One fragment before me (No. 176) from the Okus Quarry at Swindon, in fact, is almost indistinguishable from the outer whorl of the Greenland holotype.

[1]) Die Gliederung des oberen Jura in Nordwesteuropa. N. Jahrb. f. Min. &c., Beil. Bd., XXXVII, 1913, p. 130, based on *Amm. biplex*, de Loriol and Pellat, *loc. cit.* (1874), pl. II, fig. 1 = *Perisphinctes pellati*, Lewinski, 1923.

[2]) Type Ammonites, vol. IV, 1923, pl. CDI.

Horizon:— Sandy Shales above Glauconitic Series (horizon α); Portlandian.

Localities:— Cape Leslie (Rosenkrantz's section I at 165 m and II at 200 m); also south-east of Signal 6 M (No. 202); and 100 m north of Signal 1 M (No. 153).

Crendonites euglyptus sp. nov.

(Plate 9, fig. 1; Plate 13, figs. 3a, b).

Diagnosis:— Like last, but with slightly wider umbilicus (latumbilicate) and more distant costation (36 peripheral ribs, as against 44 to the half whorl in *C. lesliei*, at the same diameter). Ribs regularly bifurcating and perfectly alternating across the periphery from beginning to end (of body-chamber). Suture-line simple. Body-chamber a whole whorl in length.

Measurements:—	Holotype (Plate 9, fig. 1)	Plate 13, fig. 3
Diameter	110	73 mm
Height of last whorl	25	29 %
Thickness of last whorl	?	(?) 29 %
Umbilicus	51	49 %

Remarks:— Owing to the crushing of the holotype, the thickness cannot be determined, but in the smaller paratype which is only slightly deformed by pressure the whorl-thickness is about equal to the height. This paratype example, with a complete whorl of body-chamber, has fewer ribs than the holotype, but this is probably due merely to its smaller size. One of two other fragments, doubtfully referred to this species, shows the inner whorls more clearly than the paratype and they can be seen to be finely-ribbed, like the immature and crushed *Crendonites* figured in Plate 7, fig. 3. The still smaller inner whorls of probably *Crendonites*, figured in Plate 2, fig. 2 and Plate 22, fig. 6, are crushed obliquely and are not specifically determinable.

The typical *C. gorei* (Salfeld), as represented, for example, by a specimen in the Mantell Collection (B. M., no. 10133), less "accelerated" than the form figured in Plate 9, fig. 5, i. e. acquiring distant costation less rapidly, is very similar to the present species, towards the end of the

septate stage; but the ribbing of the body-chamber is less sharp and more irregular. *C. leptolobatus*, Buckman, which is connected with *C. gorei* by numerous passage-forms of intermediate size (e. g. B. M., no. C 35972, Buckman Coll.) is slightly less closely comparable, but *C. subregularis* differs from the present species chiefly in its more inflated whorl-section. It is, however, also less distantly costate, as is *C. anguinus*, with far less regular ribbing.

Horizon:— Sandy Shales above Glauconitic Series (horizon α); Portlandian.

Localities:— Cape Leslie (Rosenkrantz's section I at 165 m and II at 200 m).

Crendonites subregularis, sp. nov.

(Plate 13, figs. 4, 5; Plate 18, fig. 5; Plate 20, fig. 3).

Diagnosis:— Like *C. euglyptus*, but with whorl-thickness considerably greater than height, smaller umbilicus, and slightly less distantly-spaced costation. Suture-line apparently simple. Body-chamber a whole whorl in length.

Measurements:—	Plate 13, fig. 5	Holotype (Plate 13, fig. 4)
Diameter	53	90 mm
Height of last whorl	32	30 %
Thickness of last whorl	40	36 %
Umbilicus	42	46 %

Remarks:— Since the inner whorls of the holotype are not exposed, it is not certain that the smaller example here listed belongs to the same species, especially since it has a more depressed whorl-section. But it is clearly a very closely allied form and it is of interest on account of its subvirgatoid early volutions. Up to a diameter of about 15 mm, the inner sides are almost smooth, the fine secondary ribs are strongly projected at the venter and the whorl-section is greatly compressed, with a sub-tabulate periphery. In English *Crendonites* from the Portland Stone, such as the new species of which the suture-line is figured in Plate 7, fig. 7, the subvirgatoid aspect of the inner whorls may persist to a much later stage (compare Plate 28, fig. 4).

The specimens figured in Plate 18, figs. 5a, b, and Plate 20, fig. 3, are badly crushed and can only provisionally be attached to the present species, while the original of Plate 21, fig. 3, probably owes its long secondaries also merely to crushing. A still more doubtful fragment with the last two septal edges has one single rib, like the holotype.

The increased whorl-thickness of the present form as compared with *C. lesliei* and *C. euglyptus* causes a certain resemblance to *Pavlovia* (*Pallasiceras*) and, perhaps, less so to *P.* (*Lydistratites*) which latter,

however, has still longer secondaries, even in the adult. The resemblance to *Epipallasiceras* is perhaps slightly more pronounced, but this also, on its short body-chambers, reverts to *Pallasiceras* ribbing.

Horizon:— Sandy Shales above Glauconitic Series (horizon α); Portlandian.

Localities:— Cape Leslie (Rosenkrantz's section I at 165 m and II at 200); Lingula Ridge (No. 202); also 100 m north of Signal 1 M (Nos. 153, 155) and Crab Valley (loc. D, No. 165).

Crendonites anguinus, sp. nov.

(Plate 21, figs. 2a—c).

Diagnosis:— Rather narrow whorls (substenogyral), with thickness greater than height (subpachygyral) and open umbilicus (latumbilicate). Whorl-section at first almost subquadrate, later more circular, with bulging instead of flattened sides. Ribbing at first irregular, with smooth inner sides showing in umbilicus. Later more regular, biplicate, with the secondaries inclined forward but the primary stem straight and radial. Decline of costation on outer whorl, with single ribs appearing and secondaries becoming merely intercalated. Suture-line (fig. 2c and Plate 6, fig. 5) simple.

Measurements:—	Holotype	
Diameter	at 84	at 52 mm
Height of last whorl	29	32 %
Thickness of last whorl	?	36 %
Umbilicus	50	40 %

Remarks:— The holotype retains half a whorl of body-chamber and the general resemblance to the more megalomorph *C. gorei* (Salfeld) would no doubt be enhanced by the presence of the missing half, complete to the aperture, which may be presumed to have been a smooth collar, as in all *Crendonites*. In *C. gorei*, however, the inner whorls (compare Plate 14, fig. 2) are more compressed or at least not wider than high and although it is not certain that the immature *Crendonites* figured in Plate 17, fig. 6 (which, however, is compressed, like the young *C. gorei*) belongs to the present species, it indicates that in the Greenland forms of *Crendonites* the virgatitoid ribbing of the early volutions is less pronounced than in the examples from the Portland Stone.

The fragment figured in Plate 22, fig. 1, and already referred to under *C. lesliei* may be transitional between that species and *C. anguinus*, but differs from both, not only in its circular whorl-section, but in having single ribs, when the bifurcation is still sharp and perfect. *C. euglyptus* and *C. subregularis* have more distant costation.

Horizon:— Sandy Shales above Glauconitic Series (horizon *a*); Portlandian.

Locality:— Cape Leslie (Rosenkrantz's section I, at 165 m).

Genus *BEHEMOTH*, Buckman, 1922.

Behemoth groenlandicus, sp. nov.

(Plate 23, fig. 1; Plate 24, fig. 1).

1929. *Perisphinctes* cfr. *giganteus*, Rosenkrantz (*non* Sowerby) in Lauge Koch: Geology of East Greenland, *loc. cit.*, p. 147.

Diagnosis:— Rather narrow whorls (substenogyral), less wide than high (subleptogyral), widely umbilicate (latumbilicate). Whorl-section rounded, slightly compressed, with evenly arched venter and high and vertical umbilical wall but rounded edge. Ribbing biplicate at first, with blunt primary stems, almost radial and projected at umbilical end, and prorsiradiate secondaries, also some faint constrictions; later degeneration affects both primaries and secondaries and curvature increases. Suture-line not exposed. Length of body-chamber unknown.

Measurements:—

Diameter	(at) 378 mm
Height of last whorl	28 %
Thickness of last whorl	24 %
Umbilicus	52 %

Remarks:— The actual diameter of the holotype must have been over 600 mm and on account of the difficulty of recognising species from reduced figures, I am representing part of the inner whorls in natural size (Plate 24, fig. 1). The absence of the earlier volutions, unfortunately, prevents exact comparison with allied species, but the form is certainly different from any English Portlandian species before me except on the outer whorl. The degeneration of the ribbing on this outer whorl, of course, suggests affinity of the Greenland form with *Titanites titan*, Buckman[1]) and its allies "*Gigantites*" and "*Briareites*", Buckman, but the earlier whorls are unlike those of Portland Stone species and can be matched more satisfactorily with those of forms from the Portland Sands and especially their equivalents in the Glauconitic Beds of Long Crendon and neighbourhood. There is an example in the Buckman Collection (No. 3822) identified as a "*Glaucolithites*" which appears to be of the same group but has perhaps slightly longer secondaries, while another example (No. 3875) referred by Buckman to the same genus, has closer and more flexuous costation at an earlier stage than the Greenland species. There is a suggestion of increasingly coarser, blunter

[1]) Type Ammonites, vol. III, 1921, pl. CCXXXI A, B.

and more distant costation in the present form, the younger the whorl, and it is possible that the inner volutions were comparable to those bluntly ribbed ammonites that Buckman distributed among his genera *Behemoth*, *Glaucolithites*, *Leucopetrites* and *Hydrostratites*. There is nothing like these, however, among the many small Greenland ammonites from the Glauconitic Series, so that it would be unsafe to deduce the horizon from this general resemblance.

A large fragment of an ammonite in the Waddington Collection, similar to the outer whorl of the present species, but of a smaller individual, is from the Messive Bed, but what is preserved of the previous whorl shows much closer ribbing than that of the form here described. Conversely the ammonites from still lower levels are yet more different, so that *Behemoth*, as defined above (p. 32) seems to be the only genus available for the present species.

The *Behemoth* recorded by Cox[1]) from the basal Shell Bed of the Portland Stone again resembles the ammonite here described at a comparable size. It has the characteristic blunt costation of *Behemoth* on its inner whorls, but is, then, quite different from the young *Amm. bononiensis*, P. de Loriol.

Horizon:— Glauconitic Series; upper part. Portlandian.

Localities:— Rosenkrantz's section I, at 130 m. A doubtful small fragment is from loc. 181 (Ridge south of Crab Valley), E.

Genus *TITANITES*, Buckman, 1921.

Titanites? sp. ind.

There is a portion of presumably the body-chamber of a very large ammonite (associated with the Craspeditid referred to on p. 87), which shows at a whorl-height of at least 120 mm five primary ribs in a horizontal distance of 70 mm (measured on the vertical umbilical wall). One of the three median ribs bifurcates, but indistinctly; the secondary rib (the forward branch) comes off the continuous primary at a rather low level. The other two primary ribs are single and the secondaries are merely intercalated, one of them being shorter than the other which itself is not so long as the sub-bifurcating rib, already mentioned. The remaining two (end) ribs cannot be followed and the periphery is absent.

This type of ribbing is found in large *Titanites* from Portland and in various *Gigantites* and *Galbanites* from Long Crendon and Haddenham in the Buckman Collection (British Museum), but specific identification is, of course, out of question. I may add that the fragment and its counterpart form the two halves of a split nodule of a sandy ironstone and that it is not a portion of a large ammonite, out of a normal sediment.

[1]) *Loc. cit.* (Proc. Dorset Field Club, vol. XLVI), 1925, p. 163.

Horizon:— Hartzfjaeld Sandstone, 53 m above base (but loose?) Portlandian (or post-Portlandian?).

Locality:— Ridge between Crab and Astarte Valleys, Loc. O No. 241.

Genus *DORSOPLANITES*, Semenow, 1898.

Dorsoplanites antiquus, sp. nov.

(Plate 24, figs. 4a, b; Plate 27, figs. 6a, b, 7a, b; Plate 29, figs. 1a, b; Plate 3 figs. 2a, b; 4a—c; Plate 32, figs. 4a, b; Plate 33, figs. 7a, b; 8a, b; Plate 34, figs. 3a, b Plate 36, figs. 8a, b).

Diagnosis:— Slightly compressed whorls with rather wide um bilicus (sublatumbilicate). Whorl-section almost circular, slightly flat tened at the sides. Ribs slightly flexuous, generally bifurcating, rarel single, but tending to become more irregular near plain mouth-borde Suture-line simple, with short lateral lobes, especially the second. Body chamber over three-quarters of outer whorl.

Measurements:—	Holotype (Plate 31, fig. 4)	Plate 36, fig. 8	var. *robusta* (Plate 32, fig. 4
Diameter	47	48	54 mm
Height of last whorl	34	32	35 %
Thickness of last whorl	32	31	33 %
Umbilicus	45	45	41 %

Remarks:— Most of the specimens figured retain the complet body-chamber and the four largest also show the plain mouth-borde Even the small original of Plate 27, fig. 7, is complete, but the othe three immature examples have only part of the body-chamber. Th malformation figured in Plate 29, fig. 1, together with the originals o Plate 33, figs. 7, 8, and the third specimen listed in the table of measure ments, belong to a sligthly more inflated and slightly more coarsel ribbed variety which may be named var. *robusta*, nov.; it forms transition to the loosely coiled, rounded-whorled *D. transitorius*, sp. nov as well as to the form figured in Plate 26, fig. 3, which is already ver close to *Pavlovia*, e. g. *P.* (*Pallasiceras*) *regularis*, sp. nov. (p. 42) an indicates a common origin of the two stocks.

While the inner whorls do not differ greatly from those of *D. gracili* and its varieties, or those of the more inflated *D. aldingeri*, they ar more finely ribbed than the corresponding stage in *D. subpanderi*. O comparison of Plate 6, fig. 4, and Plate 27, fig. 7, however, it will be see that *Keratinites*, although with single ribs, was also already very simila in the young, whereas the immature *Pavlovia* (*Pallasiceras*) figured i Plate 5, fig. 5, is rather distinct.

At least one example, with a smaller umbilicus and slightly mor

pronounced ribbing on the flattened outer whorl could be taken to be a transition to such forms of *Pavlovia* as *P.* (*Pallasiceras*) *subaperta* (Plate 11, fig. 4). The resemblance, however, may be accidental and due to the fragmentary condition of many of the ammonites from the same bed. In any case the secondary ribs are much longer and less sharp in the forms referred to *D. antiquus* and there is never any approximation of the pairs of secondaries.

Horizon:— Glauconitic Series (base, 5—10 m up and again 46 m up, at another locality) and below (*subaperta* nodule bed).

Localities:— Pinna Valley (loc. A, no. 223); N. E. ridge of Hartz Mtn. (loc. P, no. 245); north-west ridge (loc. N, no. 213); also Cape Leslie (Rosenkrantz's section II, at 62 m).

Dorsoplanites transitorius, sp. nov.

(Plate 14, figs. 4a, b; Plate 33, figs. 9a, b).

Diagnosis:— Like *D. antiquus*, but with circular whorl-section and much coarser ribbing on the outer whorl. Suture-line very simple; body-chamber over three-quarters of last whorl.

Measurements:—	Holotype (Plate 33, fig. 9)	Plate 14, fig. 4
Diameter	58	31 mm
Height of last whorl	34	35 %
Thickness of last whorl	34	35 %
Umbilicus	45	43 %

Remarks:— This form might have been considered to represent merely a variety of *D. antiquus*, but it is separated because it is an important link between the present genus and the ancestral Pavlovids, e. g. *Pallasiceras*. The outer whorl of the holotype is essentially like that of *Dorsoplanites* sp. nov.? ind. figured in Plate 26, fig. 3, but the inner whorls show both finer ribbing and looser coiling. The ribs, moreover, are deeply and fairly regularly biplicate and although there may be an occasional single or triplicate rib, the lack of the accompanying deep constrictions, so conspicuous in *Pavlovia* (*Pallasiceras*), e. g. *P.* (*P.*) *kimmeridiensis*, Seebach sp. (B. M., no. C 4868), with somewhat similar external aspect, allows of ready distinction of the present form.

D. subpanderi which is similar in aspect but more megalomorph, has flattened sides and more projected ribbing. Its inner whorls are also less finely ribbed and less evolute than those of the present species, so that at an equal size the two forms are quite distinct. In *D. dorsoplanoides*, the ribbing is blunt and not sharp like that of the outer whorl of *D. transitorius*.

Horizon:— Glauconitic Series, lowest part (?) and 5—10 m above base; Upper Kimmeridgian (and Portlandian?).

Localities:— Pinna Valley, loc. A (No. 223); N. W. Ridge of Hartz Mtn., loc. N (No. 213).

Dorsoplanites aldingeri, sp. nov.

(Plate 5, figs. 1a, b; Plate 34, figs. 2a, b).

1929. *Pavlovia* aff. *dorsoplana* (Vischniakoff) Michalski; Rosenkrantz, in Laug Koch: Geology of East Greenland, *loc. cit.*, p. 147

Diagnosis:— Whorls depressed, rather inflated (subpachygyral) with fairly open umbilicus (sublatumbilicate). Whorl-section subreniform with bulging sides, broadly arched venter and high and steep umbilica slope. Ribbing first more or less regularly biplicate, later intercalate secondaries or triplicate ribs appear; branching occurs at middle of sid or below. Suture-line simple, with trifid first lateral lobe, shorter tha external lobe and very small bifid second lateral lobe, higher than i fig. 3 (Plate 4). Body-chamber apparently almost a whole whorl in lengt

Measurements:—	Holotype (Plate 5, fig. 1)	Plate 34, fig. 2
Diameter	67	59 mm
Height of last whorl	34	32 %
Thickness of last whorl	45	40 %
Umbilicus	40	42 %

Remarks:— The smaller and slenderer example figured in Plate 3 fig. 2, is close to the ammonite represented in Plate 37, fig. 6, and discusse under *D. maximus* (p. 71). It differs from the holotype of the prese species in its more finely ribbed inner whorls and a far less depresse whorl-section so that it might equally well have been referred to *D. maximus*. It agrees with the present form, however, in having a sligh sinus forward in the peripheral ribbing. This sinus is distinct alread on the inner whorls shown in fig. 1a (Plate 5) where a piece was intention ally omitted in the photograph. It is probable that the immatur example figured in Plate 28, figs. 2a, b represents the young stage o such a transitional form.

The holotype was labelled by Rosenkrantz "*Pavlovia* aff. *dorsoplan* (Vischniakoff) Michalski": and there is, indeed, considerable resemblanc to two Russian *Dorsoplanites* before me (B. M., no. C 2776 and 74213) The first agrees with Michalski's[1]) figure, but is still septate at a diamete of about 90 mm and therefore does not show the raised ribs at the end the second has much more closely ribbed inner whorls than the first, o

[1]) *Loc. cit.* (Mém. Com. géol. St. Pétersb., vol. VIII, No. 2), 1890, pl. XI, fig. 2

Michalski's figure, and remains more finely ribbed than Vischniakoff's[1]) second example. But there is no identity with the Greenland form which does not acquire raised ribs and remains comparatively small.

D. aldingeri may also be compared to *D. maximus* and to *D. triplex*. The former is bluntly ribbed on internal casts, but specimens that retain the test (e. g. 246*s*) show somewhat similar ribbing, although with a more flexuous and far less thickened primary stem at the same size. *D. triplex* at earlier stages and before the primaries become distantly spaced (Plate 25, fig. 4) likewise differs from *D. aldingeri* chiefly in the absence of the bulge in the lower whorl-side, with its primary ribs. But, as mentioned in the description of *D. triplex*, there are (incompletely known) passage-forms between the two species which connect the transitional example figured in Plate 34, fig. 2, with the variety of *D. triplex* represented in Plate 25, fig. 4.

Horizon:— Below Glauconitic Series, *subaperta* nodule bed, Upper Kimmeridgian.

Locality:— Cape Leslie, Rosenkrantz's section II, at 62 m.

Dorsoplanites maximus, sp. nov.

(Plate 26, fig. 1; Plate 28, fig. 1; Plate 32, fig. 3; Plate 37, figs. 6a, b).

Diagnosis:— Rather narrow whorls (substenogyral), rather inflated (subpachygyral), with fairly open umbilicus (sublatumbilicate). Whorl-section evenly rounded, slightly depressed, with gentle umbilical slope and no edge. Ribs more or less regularly biplicate at first, later triplicate or dischizotomous; the ribbing becomes more irregular and at the same time indistinct, especially on the internal cast. Primary ribs gently curving forward, on umbilical slope as well as towards periphery. Constrictions present on inner whorls. Suture-line (Plate 32, fig. 3) with deep external lobe, but variable.

Measurements:—	Holotype (Plate 28, fig. 1)	No. 176m
Diameter	(at) 155	96 mm
Height of last whorl	33	31 %
Thickness of last whorl	36	35 %
Umbilicus	46	43 %

Remarks:— The holotype is entirely septate but lacks only another air-chamber and the body-chamber, part of which is preserved but was omitted in the figure. The crescentic primary ribs or bulges continue apparently with little change. The specimen figured in Plate 33, fig. 1,

[1]) *Op. cit.* (Description des Planulati &c.), 1882, pl. II, fig. 3 (the lectotype being pl. I *bis*, fig. 5).

is directly transitional to *D. gracilis*, described below, and a number of still smaller examples, resembling that figured in Plate 33, fig. 2, are probably similar passage-forms between the two species; some are included here only on account of the absence of compression. But they are also comparable to the inner whorls of the example figured in Plate 37, fig. 6, which differs from the two typical examples above listed in retaining more pronounced ribbing, especially secondary, and in having almost no peripheral projection, so that it probably represents a distinct variety.

D. crassus (Plate 29, fig. 5) differs from the example figured in Plate 37, fig. 6 chiefly in its much coarser ribbing; and in *D. jamesoni* there are numerous single ribs, but no thickened primary stems. *D. flavus* (Plate 34, fig. 1) is perhaps the closest ally of the present species, but its primary ribs are much sharper and are becoming effaced earlier, while the secondary costae are indistinct at a considerably smaller diameter. The suture-lines, however, are very similar in all the forms of *Dorsoplanites* (compare Plate 34, fig. 1c and Plate 37, fig 6a), although the width of the lateral saddles varies considerably in the same species.

One example (No. 246s) retains portions of the test and it can be seen that the ribbing is considerably sharper there than on the internal cast, although the primary stems are blunter than in *D. flavus*. But some of the ribs are very nearly dischizotomous while others are biplicate or triplicate. This style of ribbing is somewhat reminiscent of that of the Andine *Virgatites* figured by Burckhardt[1]), but the resemblance is probably entirely superficial.

Horizon:— Glauconitic Series, 12—14 m up (where thickness is only about 17 m); Portlandian.

Locality:— Ridge south of Crab Valley; loc. E (Nos. 176, 221).

Dorsoplanites gracilis, sp. nov.

(Plate 27, figs. 1a, b; Plate 28, figs. 3a, b; Plate 29, figs. 2a, b; Plate 30, figs. 2a, b; Plate 32, figs. 2a, b, 5a, b; Plate 33, figs. 3—6; Plate 35, fig. 3).

Diagnosis:— Like *D. maximus*, but compressed instead of depressed, and with more elegant ribbing. Constrictions distinct and more projected than the costation. Suture-line generally with broader lateral saddles and less oblique auxiliaries than shown in Plate 32, fig. 3.

Measurements:—	Holotype (Pl. 29, fig. 2)	Transition to *D. maximus* (Pl. 33, fig. 1)	var. *tenuicostata* (Pl. 27, fig. 1)	var. *evoluta* (Plate 30, fig. 2)
Diameter	71	(at) 71	(at) 70	82 mm
Height of last whorl	35	33	34	30 %
Thickness of last whorl	31	35	31	28 %
Umbilicus	40	40	40	45 %

[1]) Beiträge zur Kenntniss der Jura- und Kreideformation der Cordillere. Palaeontogr., vol. L, 1903, e. g., pl. VII, fig. 1.

Remarks:— The holotype is entirely septate, but a portion of the outer whorl is omitted in the figure. There was nearly another half-whorl of camerae before the beginning of the body-chamber, where the ribbing is very feeble. With the body-chamber complete, the diameter must originally have been over 120 mm and the flattening of the outer whorl is not so conspicuous as in some of the numerous other specimens of this common species. In one example of the var. *evoluta* (No. 124) at a diameter of about 95 mm, the body-chamber occupies three-quarters of the outer whorl, but is broken at the apertural end. In this var. *evoluta*, the costation tends to become slightly coarser towards the end, even in the septate stage (Plate 30, fig. 2), which causes a distant resemblance to *D. subpanderi*. In the var. *tenuicostata*, the very fine and close secondary ribs, strongly projected in side-view, persist to the end, but the accidental crushing of the final portion (in the original of Plate 27, fig. 1) wrongly suggests loss of ornamentation.

The young examples now referred to the present species and its varieties may include immature individuals of allied species, like *D. maximus* and *D. crassus*, whereas some of the larger specimens are transitional to yet other species. Thus the original of Plate 32, figs. 5a, b has a slightly smaller umbilicus than the type and a broader periphery; but in the example figured in Plate 28, figs. 3a, b the roundness of the aperture is partly due to the cracking of the rock. The thickness is not greater than the whorl-height, even in this individual, but its costation is slightly less closely spaced than that of the type. A larger but compressed specimen of the same variety (No. 176p) suggests a transition to *D. jamesoni* (Plate 29, fig. 3) or, at least, the biplicate stage of that species, with more rigid secondaries.

The specimen figured in Plate 26, fig. 5, although from a high horizon, does not seem distinguishable from the inner whorls of the var. *evoluta*. What remains of its (crushed) outer whorl is all body-chamber; and the aperture is apparently complete.

Another variety (var. *flexuosa*, nov.) is represented in Plate 35, fig. 3. It is characterised by more flexuous ribbing than in the typical forms, and I thought at one time that this was a later mutation; for in the Rosenkrantz collection, this flexuous variety was represented only from the upper part of the Glauconitic Series. Since the type of *D. gracilis*, itself, however, was labelled as from higher still (not in error, judging by the matrix), I am doubtful whether any time significance attaches to the flexuosity of the ribbing.

The Russian form represented in Plate 21, figs. 5a, b, at first sight, appears to be identical (except, perhaps, in proportions) with some examples included in the present species, e. g. the original of Plate 32, figs. 5a, b. They seem to have the same type of ribbing, the same constrictions and a very similar suture-line, and the differences appear to be

trifling. They consist of a more pronounced peripheral sinus and greater irregularity of the ribbing at the constrictions in the Russian form which may be closer to the compressed variety of *Perisphinctes panderi*, figured by Michalski[1]), although this has longer and sometimes triplicate secondaries. Another Russian example before me (3093) differs from the transitional specimen figured in Plate 33, fig. 2 (with three triplicate ribs) merely in its rounder whorl-section, smoother umbilical wall and less thickened primary ribs.

Horizon:— Glauconitic Series, apparently base (or even below base) to top and Sandy Shales above; Upper Kimmeridgian and Portlandian.

Localities:— Hartz Mtn., loc. A (nos. 124, 138—139, 148—149, 152; Crab Valley, loc. D (nos. 162—163), E (no. 176); also Cape Leslie Rosenkrantz's section I (at 100—115 m); section I (at 165 m); section II (at 62 m).

Dorsoplanites crassus, sp. nov.

(Plate 29, figs. 5a, b; Plate 31, fig. 3).

1929. *Pavlovia panderi* (Michalski) Rosenkrantz; in Lauge Koch: Geology of East Greenland, *loc. cit.*, p. 147.

Diagnosis:— Like *D. maximus*, but with coarser ribbing, which remains biplicate. Suture-line with sub-bifid or trifid second lateral lobe and broad second lateral saddle, but essentially like that of *D. maximus*. Body-chamber three-quarters to whole of last whorl.

Measurements:—	Holotype Plate 31, fig. 3	(Plate 29, fig. 5)
Diameter	87	105 mm
Height of last whorl	31	31 %
Thickness of last whorl	33	?
Umbilicus	44	43 %

Remarks:— The crushed example figured in Plate 31, fig. 3 shows only the ornamentation of the last half-whorl, with the mouth border preceded by a smooth collar, but, on the side not figured, the earlier portion shows exactly the same ribbing as the paratype. On the same side the last few suture-lines are also displayed at the beginning of the last whorl which therefore was all body-chamber, whereas in the paratype the length of the body-chamber is only three-quarters of the last volution.

There are transitions between this species and *D. subpanderi* which is flattened laterally and modifies its costation more conspicuously

[1]) *Loc. cit.* (Mém. Com. géol. St. Pétersb., vol. VIII, no. 2), 1890, pl. XII, figs. 3a, b.

also passage-forms to the less coarsely ribbed *D. maximus* (Plate 37, fig. 6), as already mentioned. In *D. dorsoplanoides*, on the other hand, the ribbing is much coarser and more distantly spaced and soon becomes modified.

One example, more sharply and irregularly ribbed than the holotype, at the same diameter (up to about 60 mm) shows a remarkable resemblance to earlier Jurassic Perisphinctids of more southern areas, such as many *P. colubrinus* and *P. subcolubrinus* that have been figured. But the innermost whorls of this specimen (Plate 36, fig. 7) show a scar and it is possible that the ribbing of the later volutions is slightly malformed as a result of injury in the young. That is to say, the resemblance is accidental and on account of the similarity of the outermost volution of the specimen to an example (No. 245x) here referred to *D. subpanderi*, it is even possible that the malformation should be included with that species.

D. panderi, as figured by Michalski[1]) (*non* Eichwald *nec* d'Orbigny) has different inner whorls and longer secondaries on the outer volution, but the apparently greater resemblance between the present species and one of Vischniakoff's[2]) figures may be due partly to the poorness of the latter.

Horizon:— Glauconitic Series, top to base and below; Upper Kimmeridgian and Portlandian.

Localities:— Hartz Mtn. (N. W. Ridge, loc. M., no. 209; N. E. Ridge, loc. P, no. 245); Pinna Valley (loc. A, nos. 224 and 230); Crab Valley (loc. D, no. 166); Cape Leslie (Rosenkrantz's section II at 62 m).

Dorsoplanites flavus, sp. nov.

(Plate 34, figs. 1a—c).

Diagnosis:— Rather narrow whorls (substenogyral), with fairly open umbilicus (sublatumbilicate). Whorl-section almost circular, slightly depressed, with high and steep umbilical wall, but rounded edge. Ribbing at first very fine and close, later with some oblique constrictions and a few irregularities, visible in the umbilicus; then the secondaries become very feeble (especially on internal cast) and irregular and finally only indistinct primary bulges are left. Venter smooth in adult. Body-chamber nearly a whole whorl in length. Suture-line (fig. 1c) as in other *Dorsoplanites*, but with rather slender saddles.

Measurements:—	
Diameter	205 mm
Height of last whorl	32 %
Thickness of last whorl	33(?)%
Umbilicus	45 %

[1]) *Loc. cit.* (Mém. Com. géol. St. Pétersb., vol. VIII, no. 2), 1890, pl. XII, fig. 1.
[2]) *Loc. cit.* (Planulati de Moscou), 1882, pl. II, fig. 2.

Remarks:— The inner whorls of the large specimen here describe show great resemblance to the holotype of *D. maximus*; and since th latter is entirely septate it could be held that it is merely the absenc of the body-chamber that causes a difference in appearance. There ar slight differences in the rib curve and in the spacing of the primarie at corresponding stages, also in the suture-line which has broade saddles in *D. maximus;* but these differences are scarcely specific. On th other hand, there is an example (No. 174) which, although it may belon to a distinct species, rather than to *D. flavus*, shows the inner whor to be sharply ribbed, as in *D. antiquus* (Plate 33, figs. 7—8). At diameter of about 130 mm the two forms are very similar, and althoug *D. flavus* is more closely ribbed they are near allies. On the other han the large body-chamber of this presumably new form still show irregular and pronounced costation, strongly oblique forwards. Unfor tunately it is too fragmentary to be figured, but it shows that *D flavus* is not identical with *D. maximus* and represents an earlier type

Pallasiceras ultimum, Neaverson[1]), only known in fragments an possibly (with another allied form, described by the same author) th only English representative of the genus *Dorsoplanites*, is apparentl much like the species here described but the latter is not a *Pallasiceras* The dimensions are very similar, which may not be of any significance but the primary ribs of the English form are more distantly spaced an apparently stronger, like those of *D. triplex*, described below (p. 79)

Horizon:— Below Glauconitic Series (horizon β?); Upper Kimmer idgian.

Localities:— N. W. Ridge of Hartz Mtn., loc. M (No. 212). Th doubtful example above referred to is from the first ravine south o Astarte Valley (loc. C) at about 140 m (No. 174).

Dorsoplanites subpanderi, sp. nov.

(Plate 27, figs. 5a, b; Plate 31, figs. 1a, b).

Diagnosis:— Rather narrow and thin whorls (substeno-sublepto gyral), with fairly open umbilicus (sublatumbilicate). Whorl-section slightly compressed, gently flattened laterally and with distinct but rounded umbilical border. Ribbing of inner whorls as in *D. antiquus*; later fairly regularly but bluntly biplicate, and on body-chamber irregular, with single ribs and constrictions. Near plain mouth-border, last few ribs may be replaced by striae. Body-chamber nearly a whole whorl. Suture-line simple, as in *D. crassus* or *D. maximus*.

[1]) *Op. cit.* (Ammonites of the Upper Kimmeridge Clay), 1915, p. 20, pl. 1, fig. 11.

Measurements:—	Holotype (Plate 31, fig. 1)	Plate 27, fig. 5
Diameter	115	82 mm
Height of last whorl	32	34 %
Thickness of last whorl	30	30(?) %
Umbilicus	45	40 %

Remarks:— The holotype is corroded and the paratype has suffered by crushing, but there are at least a dozen specimens of this species, in addition to passage-forms to *D. triplex* and *D. jamesoni*. The latter species remains more closely ribbed, but in the transitions to *D. triplex* (e. g. No. 245d) the primary ribs move farther apart on the body-chamber. *D. crassus* has a rounded whorl-section and different ribbing, but in the passage-forms to the present species, including perhaps the malformation of which the innermost whorls are here figured (Plate 36, fig. 7), a change in ornamentation takes place near the aperture and the whorls are slightly flattened (e. g., no. 245g).

The coarsely ribbed form figured in Plate 39, fig. 10 which, much more than the original of Plate 36, fig. 7, suggests connexion also with *Pavlovia*, may be merely an extreme variety of the present species, transitional to *D. transitorius*. The form described below as *D. dorsoplanoides* has much blunter and more distant ribbing.

The paratype shows great resemblance to one of Michalski's[1]) figures of *Perisphinctes panderi*, more, to my mind, than the original of Plate 29, fig. 5, which had been compared by Rosenkrantz with the same figure. But there is not specific identity, in spite of the similarity of the suture-line. The Russian forms have different inner whorls and judging by the (scanty) material before me, they have a somewhat different aspect from those here described, although this may be a matter of habitat more than difference in age.

Horizon:— Glauconitic Series, especially *Pinna* Bed, on coast, but also from 10 m and 20 m below (inland). Portlandian (and Upper Kimmeridgian ?).

Localities:— Most localities between Hartz Mtn. and Cape Leslie, e. g. loc. A (nos. 129, 130, 135, 136, 223), E (no. 180), M (no. 209), O (no. 239), P (no. 245), also Rosenkrantz's section I at 100 m and II at 115 mm and nos. 196—199. Sandstensfjaeld (inland) at 3 M (nos. 234 and 235).

Dorsoplanites dorsoplanoides, sp. nov.

(Plate 26, fig. 2; Plate 27, fig. 2; Plate 39, fig. 7).

Diagnosis:— Like *D. subpanderi*, but with depressed whorl-section and costation becoming blunt, coarse, and distantly spaced at a much

[1]) *Loc. cit.* (Mém. Com. géol. St. Pétersb., vol. VIII, No. 2) 1890, pl. XII, fig. 2 only.

earlier stage. Suture-line (Plate 39, fig. 7) simple, with broad externa saddle, small, sub-bifid second lateral lobe and two small auxiliaries

Measurements (approximate):—

Diameter	80 mm
Height of last whorl	31 %
Thickness of last whorl	35 %
Umbilicus	44 %

Remarks:— The unique holotype includes a large part of the body-chamber (from the break at the last suture-line, indicated in the figure, Plate 26, fig. 2), but the second half of this, shown in the peripheral view, is crushed, so that the venter appears too flat. With its distant and blunt biplicate ribs, this species is quite different from the other forms of *Dorsoplanites* here described, but it shows some resemblance to certain Russian species like *D. dorsoplanus* (Vischniakoff)[1]) itself and the closely allied *D. panderi*, as understood by Michalski[2]). I am figuring in Plate 37, fig. 4, the suture-line of a Russian ammonite (B. M., no. C 2776) intermediate between the two species just mentioned, i. e. more depressed than *D. panderi*, but not developing the raised primaries of *D. dorsoplanus*, at least at a diameter of about 85 mm (still septate). The differences between this suture-line and that of another Russian form of the *panderi* group (B. M., no. 74213) on the one hand, and that of *D. dorsoplanoides* on the other, are negligible; conversely the peculiar costation of the present form and its comparatively sudden change from fine to coarse preclude identification with either *D. dorsoplanus* or the doubtful *D. panderi*.

A second fragment (no. 245 r) is slightly less extreme than the holotype and therefore somewhat transitional to *D. crassus* and *D. subpanderi*. Unfortunately it consists of less than half of an ammonite of about 90 mm diameter and half of the outer whorl is body-chamber. But the suture-line (Plate 39, fig. 7) is well displayed and shows great resemblance to that of the holotype, but the umbilical portion is still more inverse.

Horizon:— Glauconitic Series, near top; Portlandian.

Localities:— Hartz Mtn. (loc. A, no. 137, and P, no. 245r).

Dorsoplanites jamesoni, sp. nov.

(Plate 29, fig. 3; Plate 30, fig. 1).

Diagnosis:— Like *D. subpanderi*, but with costation remaining comparatively close to the end and with a fairly large number of single

[1]) *Loc. cit.* (Planulati de Moscou), 1882, pl. I *bis*, fig. 5, pl. II, fig. 3.

[2]) *Loc. cit.* (Mém. Com. géol. St. Pétersb., vol. VIII, no. 2), 1890, pl. XII, figs. 1—2.

ribs on latter part of body-chamber which is nearly a whole whorl in length.

Measurements (approximate):—

	Holotype (Plate 29, fig. 3)	Plate 30, fig. 1	No. 128
Diameter	96	145	120 mm
Height of last whorl	33	33	30 %
Thickness of last whorl	?	?	?
Umbilicus	43	42	43 %

Remarks:— The holotype and the Jameson Land example figured in Plate 30, fig. 1 are crushed and completely flattened, while slighter compression has also affected the third example here listed, so that the whorl-section cannot be determined. It is almost certain, however, that it resembled that of *D. subpanderi*, i. e. the whorl-thickness was probably just a trifle less than the whorl-height. A number of examples included with *D. subpanderi* are transitional to the present species, but they all have blunter and more thickened primary ribs, after the early, finely-ribbed stage, which is similar in many of the species of *Dorsoplanites*.

The other forms here described are less closely comparable, but in the biplicate stage there is resemblance to certain varieties of *D. gracilis*, as mentioned on p. 73.

Horizon:— Glauconitic Series, upper part?; Portlandian.

Localities:— Cape Leslie (loc. 200) and Hartz Mtn. (loc. A, no. 128). The Jameson Land example figured in Plate 30, fig. 1, was found loose on the shore at Camp II, west of Cape Stewart.

Dorsoplanites triplex, sp. nov.

(Plate 25, fig. 4; Plate 32, fig. 1; Plate 35, figs. 1, 2).

Diagnosis:— Rather narrow whorls (substenogyral), less wide than high (subleptogyral), with fairly open umbilicus (sublatumbilicate). Whorl-section slightly compressed, evenly rounded, with high and steep umbilical wall and rounded edge. Ribs at first biplicate, as in *D. subpanderi* and allies; later the primary stems move farther apart and triplication, with occasional intercalated secondaries, appears. Towards the end of the body-chamber there may be coarsening of the ornamentation, as in *D. subpanderi*. Body-chamber nearly a whole whorl. Suture-line fairly simple, similar to that of *D.* aff. *crassus* (Plate 37, fig. 6a).

Measurements:—

	Holotype (Plate 35, fig. 2)	var. *mutabilis* Plate 35, fig. 1	var. *mutabilis* Plate 32, fig. 1
Diameter	110	110	192 mm
Height of last whorl	30	33	31 %
Thickness of last whorl	(?)	28	(?)
Umbilicus	48	45	45 %

Remarks:— Although the holotype consists of only half a whor of body-chamber, corroded on the side not figured and with the remain of the next inner whorl badly crushed, yet it can be seen at once to belon to a form different from those so far described. There is, in fact, almo more resemblance to Perisphinctids from much earlier Jurassic formatior such as the Bathonian-Callovian genus *Choffatia*, Siemiradzki em. than to the other *Dorsoplanites* here described, but the similarity is onl superficial. The largest example figured in Plate 32, fig. 1, agrees fair well with the specimen represented in Plate 35, fig. 1 and it can be see that the inner whorls are not distinguishable from those of e. g. *D. jamesoni* or the var. *evoluta* of *D. gracilis*. In the two examples ju mentioned, however, the secondaries are less closely spaced than i the holotype, i. e. there are no more than three secondaries to each primar stem; and since the primaries are slightly more distant than in th holotype, the secondaries also are farther apart. It seems advisable t separate this coarsely ornamented variety with a distinct name, va *mutabilis*, nov. One body-chamber fragment (No. 199 m) of a form th may be provisionally included in *D. subpanderi* shows some resemblanc to this var. *mutabilis* in having the primary stems moved some distan apart and in having intercalated secondaries. Another transition (N 245d) between *D. subpanderi* and the present species shows occasion triplicate ribs and comparatively close costation even on the bod chamber, but loses all costation near the mouth-border.

The squeeze of a natural mould, covered with serpulae, and figure in Plate 25, fig. 4, represents perhaps another variety, with a small umbilicus (41 % of the diameter) and a more rounded whorl-sectio bulging at the rounded umbilical border, instead of being flattened. It possible that this variety connects directly with *D. aldingeri*, from th same bed, for it is accompanied by a still different form which compare well with the example figured in Plate 34, figs. 2a, b.

An example of about 112 mm diameter (No. 16627), unfortunatel crushed and also transitional to *D. gracilis*, has more numerous secondar ribs. It differs from the holotype of the present species in having th

[1]) See Spath, *loc. cit.* (Pal. Indica, N. S., vol. IX, no. 2, pt. 4), 1931, p. 32

primary stems less conspicuous and less distantly spaced. Since the holotype of *D. gracilis* tends to reduce its costation towards the end, it appears that this transitional example is, indeed, closer to the present species, but it also may represent a new variety.

Horizon:— Glauconitic Series, and below; Upper Kimmeridgian and Portlandian.

Localities:— Hartz Mtn. (loc. M, no. 209 and loc. P, no. 245). Ridge south of Crab Valley (loc. E, no. 180), and Cape Leslie (Rosenkrantz's section I, at 130 m?, and II, at 62 m).

Genus *KOCHINA*, gen. nov.

Genotype:— *K. groenlandica*, sp. nov. (p. 82).

Diagnosis:— Finely-ribbed developments of *Dorsoplanites*, with tendency to reduce costation and become entirely smooth. Some lose primary ribs before the secondaries (which are generally projected ventrally), others lose secondaries and retain bulging primaries which may become more and more distantly spaced. Suture-line as in *Dorsoplanites*, with rather individualised second lateral lobe.

Remarks:— This genus is of interest because it fore-shadows *Kachpurites* and *Subcraspedites*, two genera discussed below under Craspeditidae. The graceful, sigmoidal costation of the inner whorls of *Kochina stschurowskii* and *K. groenlandica* is reproduced again on the inner whorls of *Kachpurites fulgens* (Trautschold), according to some Bolobanowow specimens (bed No. 6) in the Blake Collection. This species, however, modifies its outer whorl, much like certain *Subcraspedites*. The suture-line of *S. preplicomphalus* (Swinnerton), again, shows such perfect agreement with that of *Kochina stschurowskii* (Plate 37, fig. 2) that derivation of the Craspeditids from *Dorsoplanites* and *Kochina* is almost certain.

Whether any of the Riasan species belong to *Kochina* is doubtful. Even *Perisphinctes solowaticus*, Bogoslowsky[1]) which had been compared to *Dorsoplanites dorsoplanus* on the one hand and to *Perisphinctes kokeni*, Behrendson (of the *privasensis* zone of the Tithonian[2])) on the other, is probably closer to the biplicate "variety" of *Craspedites subditus* (non Trautschold), figured by Pavlow[3]) (= *Subcraspedites lamplughi*, nom. nov.) from the Spilsby Sandstone. This form is connected by transitions with the other species of *Subcraspedites* in the same formation (of approximately Riasan age) and has the typical body-chamber of

[1]) *Loc. cit.* (Der Rjasan Horizont), 1897, p. 78, pl. IV, fig. 9, pl. V, fig. 1.
[2]) See Spath, *loc. cit.* (Quart. Journ. Geol. Soc., vol. LXXIX), 1923, p. 304.
[3]) *Loc. cit.* (Argiles de Speeton), 1892, p. 116, pl. VI, fig. 5a—c (B. M., no. C 34981).

the forms of the *subpressulus* group. It is not probable that *Perisphinct solowaticus* acquired the smooth body-chamber of the typical *Kochin*

Kochina groenlandica, sp. nov.

(Plate 36, figs. 1a, b; Plate 38, figs. 1a—c).

Diagnosis:— Rather narrow whorls (substenogyral), compresse laterally (subleptogyral), with fairly open umbilicus. Whorl-sectio rounded, with ventral and lateral flattening slight but distinct, al evenly rounded umbilical slope. Involution two-fifths. Ribbing first fine, flexuous and bipartite, more closely spaced than in Plate 1 fig. 5; later as in *K. stschurowskii* (Nikitin)[1]), with additional secondarie but with strongly flexuous primaries which are getting less and le closely spaced until at beginning of body-chamber there are only (now crescentic) to the last half-whorl. Secondaries disappearing at abo 130 mm diameter. One or two constrictions visible in umbilicus. Sutur line of *Dorsoplanites* pattern, but more complex at larger diameters (s fig. 1c).

Measurements:—	Holotype		Plate 36, fig.
Diameter	(at) 175(150)	(at) 70	102 mm
Height of last whorl	33	36	34 %
Thickness of last whorl	29	20(?)	?
Umbilicus	42	37	38 %

Remarks:— The holotype includes a portion of the body-chamb (from the last break) and a larger fragment of this, also with impressio of *Lingula*, was omitted in the photograph. The original of Plate 36, fig. is crushed and the sectional outline is restored, but it almost certain belongs to the same species. This has been aptly compared by Rosenkran to *K. stschurowskii* (Nikitin) which differs merely in dimensions a in losing its primary ribs after a diameter of 100 mm. In the present for on the contrary, the primaries remain, while the secondaries disappe In the Russian example (B. M., no. C 2473) from which was taken t suture-line figured in Plate 37, fig. 2, the whorl-section[2]) is far le compressed than on the inner whorls of the present species which ther fore shows more resemblance to the ammonite figured by Michalsk as *Perisphinctes stschurowskii*. The latter differs chiefly in having le high whorls than *K. groenlandica* at the same diameter, but since Ni

[1]) *Loc. cit.* (Mém. Acad. Imp. Sci. St. Pétersb., ser. VII, vol. XXVIII, no. 1881, pl. VII, fig. 53.

[2]) The proportions (56 — .38 — .38 — .37) are comparable to those of t second example listed by Siemiradzki, *op. cit.* (Palaeontographica, vol. XLV), 18 p. 180.

[3]) *Loc. cit.* (Mém. Com. géol. St. Pétersb., vol. VIII, no. 2), 1890, pl. x figs. 4a, b.

tin's smallest specimen was badly drawn and since all the forms of this group become inflated with age, this may not be of specific importance.

The example figured in Plate 37, fig. 1 (of dimensions 132—.30—.26(?)—.44) shows less projected secondary ribs than the holotype, and its primaries have not begun to move apart. There is a suture-line near the end, showing the example to be still septate, so that modification of the ribbing could have set in at a later stage; but the example is also more loosely coiled, especially on the inner whorls. Though certainly not identical with the present species, this Jameson Land form may be thought to be a close ally. It was labelled "*Pectinatites*" and there is, indeed, more resemblance to forms of the *eastlecottensis* group, discussed on p. 19, than to *Kochina*, but I do not know of any species with such serpenticone inner whorls. The fact that it came from a micaceous sandstone full of valves of *Lingula* may also suggest a spurious affinity with the present form; unfortunately it was accompanied only by the doubtful fragments figured in Plate 36, fig. 2, Plate 37, fig. 3, Plate 38, fig. 2, that also cannot be definitely identified either with any Cape Leslie species or with European forms. The ribbing of the smallest example (Plate 38, fig. 2), resembling that of Craspeditids, also suggests a high horizon rather than the early *pectinatus* zone, but I am now leaving them all provisionally in *Pectinatites* on account of the presence in the original of Plate 37, fig. 3, of one thickened rib and the general resemblance to *Amm. seorsus*, Oppel[1]).

Horizon:— *Lingula* bed, about 70 m above base of Hartzfjaeld Sandstone; Portlandian.

Localities:— North of Cape Leslie, Rosenkrantz's section II at 240 m and at Signal 7M (no. 196).

Family *CRASPEDITIDAE*.

When establishing this family, in 1924[2]), I included in it the genera:
Craspedites, Pavlow, 1892[3]) (type: *C. subditus*, Trautschold sp.).
Kachpurites, Spath, 1924[4]) (type: *K. fulgens*, Trautschold sp. in Nikitin).
Garniericeras, Spath, 1924[4]) (lectotype: *G. catenulatum*, Trautschold sp.).
Subcraspedites, Spath, 1924[4]) (type: *S. plicomphalus*, Sowerby sp.)[5]).

To these may now be added:—
Paracraspedites, Swinnerton, 1935[6]) (type: *P. stenomphaloides*, Swinnerton)

[1]) In Zittel: Cephalopoden der Stramberger Schichten. Pal. Mitteil., II, I, 1870, p. 114, pl. XXIV, figs. 1a—c (2?).

[2]) Spath, *loc. cit.* (Pal. Indica, N. S., vol. IX, no. 1), 1924, p. 17.

[3]) Established (*loc. cit.*, 1892, p. 116) for the "*Olcostephani* of the *subditus* group".

[4]) First quoted in 1923 (Quart. Journ. Geol. Soc., vol. LXXIX), pp. 306—307.

[5]) See also Geol. Mag., vol. LXI, 1924, p. 78.

[6]) The Rocks below the Red Chalk of Lincolnshire, and their Cephalopod Faunas. Quart. Journ. Geol. Soc., vol. XCI, 1935, p. 38.

which is closely allied to *Subcraspedites* and, like it, includes some specie that could be considered to be transitional to the family Polyptychitida While *Craspedites subditus* and *Subcraspedites preplicomphalus*, Swinnerto however, recall the ribbing of *Dorsoplanites*, *Paracraspedites* shows mo resemblance to other Pavlovids and to Virgatitids (*Epivirgatites*). I have suggested before that the resemblance of the Craspeditids of th Upper Volgian to such Olcostephanids as *Umiaites* and *Proniceras* w apparently due largely to the common origin of all these so-calle *Olcostephani* in Perisphinctid root-stocks. But there are still considerab gaps in our knowledge of the Upper Jurassic stocks and correlation the Mediterranean and boreal faunas is as yet very uncertain.

In spite of its keel, *Garniericeras* is close to *Kachpurites* and th again is intimately related to *Craspedites*. *Subcraspedites* of higher be is so similar to *Craspedites* in inner whorls, type of suture-line, chang with age, of whorl-shape and ornamentation[2]), that its reference to an family but the Craspeditidae is out of the question. But the ammoni fauna of the uppermost Volgian is different from that of the transgressi Riasan Beds; and although they have many pelecypods in common an although Bogoslowsky was certain that the Riasan Beds must ha been deposited immediately after the Upper Volgian, I am not no convinced that the whole story has yet been told.

The three Greenland forms of *Craspedites* described below are n identical with any species of the Upper Volgian and at least one of the is associated with *Titanites* sp., presumably of the Upper Portlandi which might show them to be probably early forms. But only 8 m abo the *Titanites* horizon were found several examples of the form figur in Plates 36 and 38 as *Subcraspedites groenlandicus*, sp. nov.[3]), and th can only be compared to forms that have been described as Cretaceo Such are *Olcostephanus* ("*Nikitinoceras*") *sosnovskii*, Sokolov[4]), *Subcr pedites primitivus*, Swinnerton[5]) and *S.* sp. ind. aff. *subditus*, Pavl *non* Trautschold, recorded by myself[6]) from the Claxby Ironstone a

[1]) *Loc. cit.* (Pal. Indica, N. S., vol. IX, no. 2, pt. 6), 1933, p. 694.

[2]) See Bogoslowsky: Der Rjasan Horizont. Mater. Geol. Russl., vol. XVI 1895 (1897?), p. 145.

[3]) Diagnosis:— Subplatygyral (whorl-height = 43—46 %), subleptogy (thickness = 28 %), subangustumbilicate (umbilicus = 21—25 %). Whorl-secti like that of *S. sosnovskii* (Sokolov) but more compressed, and with a lower and m gradual umbilical slope. Blunt, sigmoidal primary ribs with first three or four, la five or more, projected secondaries to each, crossing periphery with a pronoun chevron pointing forwards. Suture-line (Plate 34, fig. 5) with four auxiliary lobes

[4]) Sur les fossiles des blocs erratiques de Novaya Zemlia. Trav. Mus. Gé Pierre-le-Grand. Acad. Imp. Sci. St. Pétersb., vol. VII, 1913, No. 2, p. 70, pl. figs. 2a—c.

[5]) *Loc. cit.* (Quart. Journ. Geol. Soc., vol. XCI), 1935, p. 32, pl. II, figs. 1a—

[6]) On the Ammonites of the Speeton Clay and the Subdivisions of the Neo

now figured (Plate 36, figs. 6a,b) as *S. claxbiensis*, sp. nov.[1]) The inner whorls of the first (Sokolov's fig. 2b) are so much like the fragment figured in Plate 38, fig. 3, that specific identity might be claimed if the suture-lines agreed; but the Novaya Zemlya form has a more individualised first auxiliary lobe and a broader external saddle, apart from the differences in cross-section. This suture-line, in fact, suggests reference to *Tollia*[2]) rather than *Subcraspedites*, so that the difference is more than specific.

S. bidevexus, Bogoslowsky[3]), which is more evolute than *S. claxbiensis*, nov. is also close to *S. groenlandicus*, as is an Oka (Spassk) specimen of an apparently undescribed species in the Blake Collection (B. M.), with more distantly spaced ribs in the umbilicus. But the exact age of most of the forms cited is as yet unknown and since I[4]) have been following Bogoslowsky[5]) in including the *stenomphalus* beds (with the Spilsby Sandstone) in the Cretaceous, it appears that we have to consider *Subcraspedites groenlandicus* to be already of post-Jurassic age.

Genus *CRASPEDITES*, Pavlow, 1892.

Craspedites leptus, sp. nov.

(Plate 37, figs. 5a, b).

Diagnosis:— Rather high-whorled (subplatygyral), rather thin (subleptogyral), with fairly small umbilicus (subangustumbilicate). Whorl-section greatly compressed, with narrowly arched venter, rounded umbilical edge and only slightly convex sides. Ribs bifurcating or single, low and blunt, and directed forwards with a pronounced sinus on the periphery. Suture-line unknown.

Measurements:—

Diameter	32 mm
Height of last whorl	44 %
Thickness of last whorl	25(?) %
Umbilicus	25 %

[1]) Diagnosis:— Like *S. groenlandicus*, but with fewer and less projected secondary ribs, less difference between the primaries and secondaries and less rib-flexure. Suture-line with a much shorter auxiliary series, ascending towards umbilicus, deep external lobe, broad external saddle, and narrower first lateral lobe.

[2]) Pavlow: Les Céphalopodes du Jura et du Crétacé inférieur de la Sibérie septentrionale. Mém. Acad. Imp. Sci. St. Pétersb., sér. VIII, vol. XXI, No. 4 (1913) 1914, pls. XII and XIII.

[3]) *Loc. cit.* (Der Rjasan Horizont), 1897, p. 141, pl. III, figs. 1—3.

[4]) Ammonites from New Zealand. Quart. Journ. Geol. Soc., vol. LXXIX, 1923, p. 306.

[5]) Materalien zur Kenntnis der unterkretacischen Ammonitenfauna von Central- und Nord-Russland. Mém. Com. géol. St. Pétersb., N. S., vol. LIV, livr. 2, 1902, table [illegible], p. 160.

Remarks:— The unique holotype, slightly crushed on the side not figured is preserved in a coarse grit and appears to be largely body-chamber (three-quarters of the outer whorl); and in the absence of the suture-line, it may seem risky to give it a name. Yet, like the form described below as *C. ferrugineus*, the present form is believed to represent a new and presumably early type of *Craspedites* which does not seem to have been found elsewhere. There is superficial resemblance to *Craspedites* of the *subditus* group but this is due largely to the fact that the numerous figures of these forms, especially those of the older authors, are defective. There are large numbers of the Russian *Craspedites* in the British Museum (Natural History) and as soon as actual specimens are compared it is seen that the species here described is different. Corresponding stages in the Russian forms show either a smooth or else a nodate umbilical margin; those in which the primary ribs are continuous to the umbilical suture show either marked flexuosity or too many branching and no single ribs. The umbilicus also is generally larger and its border thickened, causing a different whorl-section. It would be misleading, therefore, to attach the present form, however, provisionally, to an existing species of *Craspedites*; on the other hand, it differs little in ribbing from the closest allies of the *subditus* group, except in the greater number of single ribs and the absence of any tendency to weaken the ribs at the middle of the whorl-side.

Horizon:— Hartzfjaeld Sandstone, 116 m above base; Portlandian (or post-Portlandian).

Locality:— Hartz Mtn. (Pinna Valley), loc. A, no. 158.

Craspedites ferrugineus, sp. nov.

(Plate 22, figs. 3a, b).

Diagnosis:— Rather high whorls (subplatygyral), as thick as high (subpachygyral) and with rather small umbilicus (subangustumbilicate). Whorl-section nearly circular, slightly flattened laterally and with rounded umbilical edge but almost vertical wall. Ribbing fairly regularly biplicate, low and blunt, with point of bifurcation at or below the middle of the whorl-side. Ribs inclined forward, but straight across the periphery. Suture-line unknown.

Measurements:—

Diameter	(at)	32 mm
Height of last whorl		39 %
Thickness of last whorl		39 %
Umbilicus		31 %

Remarks:— The difference in the ribbing, in whorl-section, and the larger umbilicus indicate that the present form is specifically distinct

from *C. leptus*, but what has been said in the description of that species holds with regard to the superficial resemblance of *C. ferrugineus* to certain Russian Craspeditids. Thus the inner whorls of *C. subditoides* (Nikitin), as figured by Prigorovsky[1]), show similar ribbing, though more projected secondaries, but the costation soon changes and in the larger example[2]), on which *C. subditoides* must be taken to be based (Nikitin's[3]) figure being almost useless), whorl-shape and umbilication also are seen to be different.

Horizon:— Hartzfjaeld Sandstone, 79 m above base (loose); Portlandian (or post-Portlandian?).

Locality:— Hartz Mtn. (Pinna Valley), loc. A, no. 228.

Craspedites sp. ind.

(Plate 39, fig. 6).

The form to be described is so incomplete that I fear the photograph will be of little help; I was even in doubt at first whether the fossil was an ammonite, until an accidental fracture in attempting to develop it revealed a septal surface. The part of the last whorl shown is merely the outer whorl-side, convex and almost smooth, rounding off towards a broadly arched periphery and provided with indistinct, low, projecting outer ribs, as in d'Orbigny's[4]) original figure of *C. okensis*. The ribs of the Greenland form, however, are longer and comparatively closer and as it represents a portion of an ammonite much larger than d'Orbigny's figure, the resemblance is still less close at that stage. What is preserved of the inner whorls, showing considerable overlap by the outer, has even finer costation, so that identification with *C. okensis* of which there are large examples in the Blake Collection, is out of the question.

In side-view Nikitin's[5]) second figure of his *Perisphinctes stschurowskii* somewhat suggests the appearance of the form here described, but the peripheral view may be assumed to have been more like that of *C. okensis* of the same plate (fig. 58). For the same reason *C.* cf. *fragilis* (Trautschold) from Novaya Zemlya, figured by Frebold[6]), suggests

[1]) Nouvelles données sur les Ammonites du groupe *Craspedites okensis* du Gouvernement de Yeroslavl. Bull. Soc. Imp. Mineral. St. Pétersb. (Ser. 2), vol. XLIV, 1907, p. 488, pl. x, figs. 3—4.

[2]) In Vischniakoff: Observations sur la dernière loge de quelques Ammonitides de Russie. Bull. Soc. Nat. Moscou, 1878, p. 43, pl. I, figs. 1a, b.

[3]) *Loc. cit.* (Mém. Acad. Imp. Sci. St. Pétersb., ser. VII, vol. XXVIII, no. 5), 1881, p. 86, pl. VII, fig. 60.

[4]) In Murchison, Verneuil and Keyserling, *loc. cit.* (Géologie de la Russie), 1845, pl. XXXIV, fig. 15 (reproduced in Pal. Universalis, 1911, pl. 213).

[5]) *Loc. cit.* (Mém. Acad. Imp. Sci. St. Pétersb., ser. VII, vol. XXVIII, no. 5), 1881, pl. VII, fig. 54 only.

[6]) Verbreitung und Ausbildung des Mesozoikums in Spitzbergen. Skrifter om Svalbard og Ishavet, no. 31, 1930, p. 77, pl. XXVIII, fig. 1.

comparison with the present form, at least so far as the largest example is concerned, but the whorl-section cannot be checked and the ribbing seems to have been almost completely lost.

I do not know of any other forms with which the present ammonite could be compared, but since it was associated with a fragment here provisionally referred to *Titanites*? (see p. 67) I may mention that there is nothing among the English Portlandian ammonites that has anything like the indistinct ribbing and apparently smooth inner whorl-sides of the form in question.

Horizon:— Hartzfjaeld Sandstone, 53 m above base (but loose?); Portlandian (or post-Portlandian?).

Locality:— Ridge between Crab and Astarte Valleys, loc. O no. 241.

b. Order *BELEMNOIDEA.*

Family *BELEMNITIDAE.*

Sub-family *Cylindroteuthinae.*

Genus *CYLINDROTEUTHIS*, Bayle, 1878.

Cylindroteuthis? aff. *explanata* (Phillips).

(Plate 39, figs. 3a, b).

1920. *Acroteuthis explanata* (Bull) Phillips; Bülow-Trummer, Fossilium Catalogus (Diener), I, pars 11, p. 207.

In addition to the many fragments described below as *Pachyteuthis* aff. *panderiana* (d'Orbigny) there is at least one fragmentary example of a belemnite with an alveolar cavity of apparently less than one-third the length of the guard. This is distinctly depressed at the lower end, where the ventral side is flattened, but the section is nearly circular at the upper end. There is no appreciable flattening of the sides, yet there are two distinct lateral lines or grooves, disappearing about 30 mm from the apex, where, conversely, the ventral groove begins to be conspicuous. The alveolus is excentric, the point being closer to the ventral side, and the apical line shows about the same curvature as that of one of Phillips's[1]) examples of *Belemnites abbreviatus*. At 22 mm from the apex where the lateral diameter is 13 mm and the ventro-dorsal 12 mm, the apical line is only 4.5 mm away from the ventral side.

The species is probably identical with at least some of the examples included in *Belemnites explanatus*, Phillips[2]), if the ventral flattening of the cross-sections is considered to have been exaggerated by the artist. The medium sized example from Wheatley (Shotover Hill) figured by Phillips in Plate XXXVI, fig. 95 V seems to be the most closely comparable, but if this is not identical with the typical Waterstock specimens, 95, IV and 96, VI, then the present form cannot be identified with

[1]) Monograph of the British Belemnitidae, part V. Pal. Soc. 1870, pl. XXXV, fig. 88.

[2]) *Ibid.*, p. 128, pl. XXXVI, figs. 94—96.

B. explanatus. Pavlow[1]) thought Phillips's large example (96, VI) to be perhaps referable to *B. khirgisensis*, d'Orbigny; if this be so, *B. explanatus* would have to be interpreted by the original of Phillips's Plate XXXVI, fig. 95 V, which is still close enough to the form here described to justify the provisional determination.

This form, however, is neither the Speeton nor the Moscow species figured by Pavlow[2]) nor has it anything to do with the examples represented by Damon[3]) and Danford[4]). *B. magnificus*, d'Orbigny, recorded from Milne Land[5]) has a shorter alveolus than any of the forms just cited, and seems to be again closer to the form here described, especially if Pavlow[6]) is right in considering it intermediate between *Cylindroteuthis oweni* (Pratt) and *Bel. absolutus*, Fischer. The form described in part I of the present memoir (p. 50) as *Cylindroteuthis* sp. nov.? ind. differs in its more conical shape and flattened (but not grooved) sides; but it also has an alveolus of only about a third of the length of the guard.

The Valanginian *Acroteuthis explanatoides* (Pavlow), recorded from Milne Land[7]) is distinguished by its ventro-dorsal flattening.

Horizon:— Glauconitic Series, probably upper part; Portlandian(?).

Locality:— Cape Leslie, 300 metres north of Section II (Rosenkrantz) at 70 m (loose), probably from the 100 m horizon of section I.

Genus *PACHYTEUTHIS*, Bayle, 1878.

Pachyteuthis aff. *panderiana* (d'Orbigny).

(Plate 12, fig. 2; Plate 24, figs. 3a, b; Plate 39, figs. 9a, b).

See Part I, p. 51.

I mentioned before that stout belemnites from a much higher level than those described in Part I did not seem to differ specifically. Unfortunately there is only one from Milne Land (figured in Plate 24, figs. 3a, b) that is complete enough to show that the alveolus was about half the length of the guard. The sides are distinctly flattened, and there are broad lateral grooves; the ventral flattening is confined to the apical region and the section about 30—40 mm from the apex is almost circular, with the ventro-dorsal diameter equal to the lateral. At the alveolar end the latter diameter is less than the former (26.5 : 25) but owing to the flattened sides converging towards the dorsum the section is subtrapezoidal, as in some Russian belemnites from the Volgian before me, in which the sides are also deeply grooved. This feature suggests comparison

[1]) Argiles de Speeton, 1892, p. 57.

[2]) *Ibid.*, pl. III, fig. 2; pl. V, figs. 8—9.

[3]) Supplement to the Geology of Weymouth, 1888, pl. XIII, fig. 6.

[4]) Notes on the Belemnites of the Speeton Clays. Trans. Hull Geol. Soc., vol. V, pt. 1, 1906, pl. II, figs. 6—7.

[5]) Parat and Drach, *loc. cit.* (Ann. hydrograph.), 1934, p. 11.

[6]) *Loc. cit.* (1892), p. 47.

[7]) Parat and Drach, *loc. cit.* (Ann. hydrograph.), 1934, p. 11.

with that large example of *B. explanatus*, Phillips, above referred to which was considered by Pavlow to be perhaps identical with *B. khi gisensis*, d'Orbigny; but this author's[1]) original figures of that speci are far less like the form here discussed than d'Orbigny's *B. panderianu*

Of the two smaller examples here figured, one (Plate 12, fig. is somewhat corroded, but the other (Plate 39, fig. 9) shows a co spicuous ventral groove; both are flattened laterally but without distin longitudinal furrows. The second somewhat resembles *Belemnites abs lutus*, Fischer[2]), recorded by Parat and Drach[3]), but is less deep grooved; both are less depressed than *B. russiensis* (d'Orbigny)[4]), t other common species of the *virgatus* beds or Lower Volgian, and al recorded from Cape Leslie[5]).

Belemnites panderianus, d'Orbigny, figured by Toula[6]) from Ku Island has a far more excentric apex.

Horizon:— Glauconitic Series and above and below (horizon β Upper Kimmeridgian and Portlandian.

Localities:— Cape Leslie, Rosenkrantz's section I (at 100—115 at 130 m and at 165 m); Section II at 62 m and at 200 m; Section I (at 190 m [loose]); Crab Valley (localities D and E, nos. 168 and 183 also at Aucella River, Jameson Land (Block I, Plate 39, figs. 9a, b).

2. Class *Gastropoda*.

A. Sub-class *Streptoneura*.

a. Order *Aspidobranchiata*.

Family *PLEUROTOMARIIDAE*.

Genus *PLEUROTOMARIA*, Defrance, 1826.

Pleurotomaria cf. *rozeti*, P. de Loriol.

(Plate 39, fig. 5).

1867. *Pleurotomaria rozeti*, P. de Loriol, in de Loriol & Pellat, *loc. cit.* (Mém. So phys. Genève, vol. XIX), p. 38, pl. IV, fig. 3.

The single cast before me has been deformed (obliquely) in the rock so that the illustration does not show as much resemblance to P. d Loriol's figure as does the specimen. The whorl-shape, however,

[1]) In Murchison, Verneuil and Keyserling, *loc. cit.*, 1845, p. 423, pl. XXIX figs. 17—21.

[2]) Oryctographie du Gouvernement de Moscou. 2nd. ed., 1837, pl. XLIX, fig. 2

[3]) *Loc. cit.* (Ann. hydrograph.), 1934, p. 11.

[4]) In Murchison, Verneuil and Keyserling, *op. cit.*, 1845, p. 422, pl. XXIX figs. 1—6.

[5]) Parat and Drach, *loc. cit.* (Ann. hydrograph.), 1934, p. 11.

[6]) Beschreibung mesozoischer Versteinerungen von der Kuhn Insel. Wiss. Erg Zweite Deutsche Nordpolfahrt, vol. II, Geol. 2, 1874, p. 500, pl. I, figs. 2*a*, *b*.

perhaps not so sub-quadrate as in the French form and the umbilicus is deeper, owing to the distortion; but it is possible that the Greenland form originally had a more elevated spire than *P. rozeti*. The cast is compared to this species only because the Kimmeridgian forms described by d'Orbigny and de Loriol are far less closely comparable. *P. rugata* (Benett)[1]) which, with *P. rozeti*, was listed by Blake[2]) and Damon[3]) as the only English Portlandian *Pleurotomaria*, has a sharply angular, internal cast.

Horizon:— Glauconitic Series, 33 m below base of Hartzfjaeld Sandstone; Portlandian.

Locality:— Sandstensfjaeld, W. slope (loc. no. 256), at 612 m.

Family *TURBINIDAE*.

Genus *TURBO*, Linnaeus, 1758.

Turbo sp. ind.

(Plate 39, fig. 13).

The cast here figured is smooth but shows faint spiral ridges (on the last whorl) of which the uppermost probably represented a row of tubercles. These appear to have been continued to the suture by strongly projected striae of growth. Between the next two, prominent at the widest part of the middle of the whorl, there is a very faint spiral depression, as in many forms of *Turbo*, and the fourth or lowest ridge is almost imperceptible. The upper edge of the whorl is not sharply angular, but clearly separates the convex outer from the concave inner slope. The missing test was thus probably fairly thick; part of a thick callus closes the umbilicus at the base.

Not having been able to find a form with which the present could be identified, I may add (merely for the sake of illustration) that the upper row of tubercles, placed slightly higher than in d'Orbigny's[4]) (inverted) figure of *T. midas*, consisted of fewer but far stronger nodes. Conversely the striae, connecting them with the suture above, were fine and numerous and still more inclined forward. The most prominent (second) ridge thus was placed at the widest part of the whorl and only the third is in the position of the second ridge in d'Orbigny's figure. Since this also represents an internal cast, the species are possibly not at all related.

[1]) Catalogue of the Organic Remains of the County of Wilts, Warminster. 1831, pl. 16, top right-hand figure (*Trochus rugatus*).

[2]) Portland Rocks of England. Quart. Journ. Geol. Soc. vol., XXXVI, 1880, p. 225.

[3]) Geology of Weymouth. New ed., 1884, p. 99.

[4]) Pal. Française, Terr. Jurass., vol. II, 1850—60, p. 334, pl. 327, figs. 14—16.

Turbo capitaneus, Münster[1]), though from the *opalinus* zone, may be closer, probably also the Novaya Zemlya form figured by Tullberg[2]) under that name. This seems to be less coarsely ornamented than Münster's original and Quenstedt's figure[3]), but T. *murchisoni*, Münster[4]), has a coarse upper row of tubercles and may be presumed to yield smooth internal casts comparable to the Greenland form. That second species, however, is also of earlier Jurassic age.

Horizon:— Glauconitic Series (Pinna Band), upper part; Portlandian.

Locality:— Hartz Mtn., Pinna Valley, loc. A (no. 161), at 321 m.

Family *DELPHINULIDAE.*

Genus *DELPHINULA*, Lamarck, 1803.

Delphinula(?) sp. ind.

(Plate 40, figs. 3a—h).

Three examples are in such defective preservation that specific or even generic determination is not easy. They show remains of the test and the ornamentation, but only on parts of the shell and not in corresponding positions, so that it is doubtful how many different forms they may include. The impression of a fourth example in a piece of matrix is possibly different again, yet they all show a certain resemblance to *D.* (*Nododelphinula*) *vivauxea* (Buvignier) as figured by de Loriol[5]), a species that has now been recorded from the English Portlandian[6]). The spiral rows of the base may be coarser in the example figured in Plate 40, figs. 3a, b, suggesting a form more like *D.* (*Calliomphalus*) *muricata*, Buvignier[7]), but the remainder is largely a smooth internal cast. One of two more such casts (figs. 3e—h) may have belonged to a species with a shorter spire. They are less slowly increasing in thickness than *Turbo apertus*, Blake[8]), also a *Delphinula* s. l., but with ornamentation (in a specimen in my collection) entirely different from that of the forms here discussed and somewhat resembling that of *Turbo calisto* (d'Orbigny)[9]).

[1]) In Goldfuss: Petrefacta Germaniae, 2nd ed. 1862, p. 91, pl. 194, fig. 1.

[2]) Über Versteinerungen aus den Aucellen-Schichten Novaya-Semljas. Bih. K. Svenska Vet. Akad. Handl., vol. VI, no. 3, 1881, p. 9, pl. II, figs. 1—3.

[3]) Der Jura, 1858, p. 314, pl. XLIII, fig. 21.

[4]) In Goldfuss, *loc. cit.* (2nd ed., 1862), p. 93, pl. 194, figs. 10a, b.

[5]) *Loc. cit.* (in de Loriol and Pellat), 1867, p. 38, pl. IV, figs. 2, 2a, b.

[6]) Cox, *loc. cit.* (Proc. Dorset Field Club, vol. XLVI), 1925, p. 42.

[7]) Statistique géologique . . . du Departement de la Meuse. 1852, p. 35, pl. XXXII, figs. 19—21.

[8]) *Loc. cit.* (Quart. Journ. Geol. Soc., vol. XXXVI), 1880, p. 230, pl. IX, fig. 7.

[9]) *Loc. cit.* (Pal. Française, Terr. Jurass., vol. II), 1850—60, pl. 332, figs. 9—10.

Horizon:— Glauconitic Series.

Localities:— Hartz Mtn., Pinna Valley, loc. A (nos. 140 and 147); also Cape Leslie, Rosenkrantz's section III, at 190 m (loose?).

Family *VANIKORIDAE.*

Genus *VANIKORO*, Quoy and Gaimard, 1832.

Vanikoro sp. nov. (?).

(Plate 40, figs. 1a, b).

The earlier portion of the Greenland form here figured might well have been referred to *V. delphinula* (d'Orbigny)[1]) if found separate from the enormously expanding final whorl. But the resemblance is perhaps greater to diagrammatic figures like Etallon's[2]) than to d'Orbigny's original. In any case the spire is still lower and the traces of spiral ornamentation left on the internal cast are more distantly spaced, at least on the middle of the whorl, where alone they are preserved. The whorl then expands as much in the apical as in the opposite direction so that the aperture is considerably higher than the top of the spire. There are traces of the test left near the aperture; it is very thick on top and below and shows very coarse striae of growth on the convex upper surface, sloping down to the spire, and on the umbilical side, but there is no trace of spiral ornament. Conversely, the smooth cast, near the aperture, shows a few obscure spiral ridges, or, at least, it is not evenly rounded. Since there are also two transverse constrictions on the cast, corresponding to irregularities in the striae of growth, the uneven aperture may not have any specific significance.

The top-view of the Greenland example is almost exactly that of *V. fittoni*, Cox[3]), allowing for difference in size, but the similar loss of spiral ornament in the two forms is accidental. The Portland species, on the other hand, though showing greater expansion of its last whorl than *V. delphinula* (d'Orbigny) is still closer to that species than to the Greenland form here described.

Horizon:— Glauconitic Series, upper part; Portlandian.

Locality:— Pinna Valley, Hartz Mtn., loc. A (no. 147).

[1]) *Loc. cit.* (Pal. Française, Terr. Jurass., vol. II), 1850—60, p. 228, pl. 301, figs. 14—15.

[2]) In Thurmann & Etallon: Lethaea bruntrutana, 1862, p. 119, pl. X, fig. 77.

[3]) *Loc. cit.* (Proc. Dorset Field Club, vol. XLVI), 1925, p. 49, pl. V, figs. 17a—c.

b. Order *CTENOBRANCHIATA.*

Family *PYRAMIDELLIDAE.*

Genus *PSEUDOMELANIA*, Pictet, 1862.

Pseudomelania cf. *delia* (d'Orbigny).

(Plate 40, figs. 5a, b).

1850—60. *Chemnitzia delia*, d'Orbigny, Pal. Française, Terr. Jurass., vol. II, p. 69, pl. 250, figs. 3—4.

The fragmentary spire represented in Plate 40, fig. 5, showing the thick test as well as the smooth and rounded internal cast, was labelled by A. Rosenkrantz: *Pseudomelania* (*sensu stricto*) sp. nov. It almost fits on to another specimen, consisting of two whorls, nearer the apex, also labelled *Pseudomelania* which, however, is from a different locality, unless the labels have been confused. A third example corresponds to the two lower whorls of the figured specimen. There is not enough, in any case, to create a new species and the only difference I can see between the Greenland form and specimens referred to d'Orbigny's *Chemnitzia caecilia*[1]) (especially the Sequanian example figured by P. de Loriol[2])) is that the whorls of the former are slightly more convex at the top and bottom. As figured by d'Orbigny himself, however, *C. caecilia* is less like the present form than his *Chemnitzia delia*. Since the smooth and rounded internal cast also shows good agreement, the Greenland specimens are provisionally attached to d'Orbigny's species. In the rather marked lines of growth, perhaps, they show more resemblance to *P. clytia* (d'Orbigny)[3]).

P. dezignoi, Gemmellaro[4]), which was described as intermediate in its general form between *P. athleta* (d'Orbigny) and *P. clytia* (d'Orbigny), has slightly more convexity, at least in the larger (lectotype) specimen; conversely the sutures are less marked. *P. fischeriana* (d'Orbigny)[5]) of doubtful age, also has the whorls more convex at the middle, but it is based on an internal cast and this is much more rounded in the Greenland form and on account of the very thick test, the whorls are much more loosely coiled.

The only gastropod recorded by Parat and Drach[6]) from three

[1]) Pal. Française, Terr. Jurass., vol. II, 1850—60, p. 64, pl. 248, fig. 2.

[2]) In de Loriol and Pellat, *op. cit.* (I. Moll. Céph. et Gastr.), 1874, p. 79, pl. VIII, fig. 1.

[3]) Pal. Française, Terr. Jurass., vol. II, 1850—60, pl. 246, fig. 1 (*Chemnitzia*).

[4]) Studii paleontologici sulla Fauna del Calcare a *Terebratula janitor*. Pt. II, 1869, p. 8, pl. I, figs. 17—20.

[5]) In Murchison, Verneuil and Keyserling, *op. cit.*, 1845, p. 448, pl. XXXVII, fig. 6 (*Chemnitzia fischeriana*).

[6]) *Loc. cit.* (C. R. Acad. Sci., vol. 196), 1933, p. 1929.

exposures of their bed C is *Cerithium autissiodorensis*, Cotteau[1]) which has somewhat similar whorls, but the aperture of the forms here described is holostomatous.

Horizon:— Glauconitic Series, upper part; Portlandian.

Localities:— Cape Leslie, Rosenkrantz's section II, at 95 m (loose) and section III, at 190 m (loose?).

Pseudomelania sp. ind.

(Plate 40, fig. 4).

A fragmentary specimen, consisting of about three whorls, shows much more delicate lines of growth than the form described above, and a greater apical angle, resembling in this respect *P. cepha* (d'Orbigny)[2]). The two earlier whorls seem to be slightly more convex than the volutions preceeding the last whorl of d'Orbigny's form, but the final whorl and the aperture are very similar.

Horizon:— Glauconitic Series, upper part; Portlandian.

Locality:— Cape Leslie, Rosenkrantz's section III, at 190 m (loose?).

Family *NATICIDAE.*

Genus *NATICA*, Adamson in Scopoli, 1777.

Sub-genus *Ampullina*, Lamarck, 1821

Natica (*Ampullina*) sp. juv. cf. *hemisphaerica* (d'Orbigny).

(Plate 39, fig. 4).

Cf. 1853. *Natica hemisphaerica*, d'Orbigny: Pal. Française, Terr. Jurass., vol. II, p. 204, pl. 294, figs. 1—2.

A single small internal cast of a *Natica* was labelled (by A. Rosenkrantz) cf. *N. rupellensis*, var. *minor*, but it seems to me to show better agreement with the more oblique *N.* (*Ampullina*) *hemisphaerica*, d'Orbigny, or to belong to a form intermediate between that species and the same author's *N.* (*A.*) *armata*[3]). In view of the many other similar species of *Natica* described in geological literature it does not seem advisable to attempt specific identification of this immature and imperfect example.

Horizon:— Glauconitic Series, upper part; Portlandian.

Locality:— Cape Leslie, Rosenkrantz's section I, at 100 m.

Family *TURRITELLIDAE.*

Genus *TURRITELLA*, Lamarck, 1799.

Turritella sp. ind.

(Plate 39, figs. 8a, b).

The single, fragmentary specimen here figured consists of a little over three whorls of a gently tapering spire, resembling the *Turritella*

[1]) In de Loriol and Cotteau: Monographie pal. et géol. de l'étage Portlandien du Dept. de l'Yonne. Bull. Soc. Sci. Yonne, 2nd. ser., vol. I, 1868, p. 465, pl. III, fig. 3.

[2]) *Loc. cit.* (Pal. Française, Terr. Jurass. vol. II), 1850—60, p. 66, pl. 249, fig. 1.

[3]) *Loc. cit.* (1850—60), pl. 294, figs. 3—4.

sp. figured by Ravn[1]) from a much earlier bed on Kuhn Island. The is identical ornamentation of the similarly flattened whorls, but the spir lines are not so conspicuously irregular in the present form. Ravn thoug his species to be probably undescribed, but there is sufficient resemblanc in ornamentation, to a form like *Cerithium molarium*, P. de Loriol which may conceivably have been referred to that genus only becau its canal was unknown and because it resembled the same author *C. caraboeufi* and Buvignier's *C. striatellum*. In any case, the sing example available, from a comparatively high horizon, is insufficie either to decide whether it really belongs to a new species or to show th it is the same form as that described by Ravn from the Upper Oxfordia

Horizon:— Nodule bed β in Sandy Clays below Glauconitic Seri (with *Pavlovia* [*Pallasiceras*] *communis*); Upper Kimmeridgian.

Locality:— Between Crab and Astarte Valleys (loc. O., no. 23 at 425 m.

B. Sub-class *Euthyneura.*

Order *TECTIBRANCHIATA.*

Family *ACTAEONIDAE.*

Genus *ACTAEONINA*, d'Orbigny, 1850.

Sub-genus *Ovactaeonina*, Cossmann, 1895.

Actaeonina (*Ovactaeonina*) *groenlandica*, sp. nov.

(Plate 40, figs. 2a—e).

Diagnosis:— Shell oval, rather inflated, with general shape *A. peroskiana*, d'Orbigny[3]), but last whorl slightly less bulbous and ba of aperture slightly more drawn out, as e.g. in *A. cylindrica*, d'Orbigny Just over three whorls, with the first whorl, including the protocon an almost flat, open spiral. Last whorl very large, occupying more th five-sixths of the total height (12 mm), diameter 8.5 mm; narro rounded shoulders, deeply grooved suture. Shell thin, with fine spir lines as in *C. insularis*, Cox[5]); cast smooth, with traces of irregul growth-lines, crossing whorls obliquely. Aperture elongated, ovate, in *A. peroskiana*.

Remarks:— Like *A. insularis*, this species has the appearance an *Actaeon*, but its columella is not plicated. I thought of identifying t Greenland form with d'Orbigny's species, but if I now adopt the

[1]) *Loc. cit.* (Medd. om Grønl., vol. XLV, no. 10), 1911, p. 483, pl. xxxv, fig.

[2]) *Loc. cit.* (in de Loriol and Pellat, I, Moll. Céph. et Gastr.), 1874, p. 72, pl. fig. 19.

[3]) In Murchison, Verneuil and Keyserling, *op. cit.*, 1845, p. 449, pl. xxx figs. 12—14.

[4]) *Loc. cit.* (Pal. Française, Terr. Jurass.), 1850—60, p. 179, pl. 288, fig. 9

[5]) *Loc. cit.* (Proc. Dorset Field Club, vol. XLVI), 1925, p. 50, pl. v, fig. 18

name "*groenlandica*" I found on some of the labels (A. Rosenkrantz's) of additional specimens, sent later, it is less on account of the slight morphological differences noticed above and the absence of the faint folds caused by the irregular striae of growth on d'Orbigny's (very small) cast, than because of the absence of comparable material and the obvious inapplicability of d'Orbigny's phrase: "la bouche paraît avoir été ornée d'une dent". Since the Russian form came from a locality that also yielded *Amm. panderi*, the age seems to be about the same.

I ought to add that while the smaller specimens before me are also quite smooth, one, about 9 mm high, shows the striae of growth also on the test, crossing the spiral lines, as in *A. sarthacensis*, d'Orbigny[1]), but the spiral lines are as distinct in *A. groenlandica* as in *A. insularis*.

Horizon:— Glauconitic Series and above? (but loose); Portlandian.

Localities:— Pinna Valley (loc. A., no. 140) at 286 m); also Cape Leslie (Rosenkrantz's section II, at 95 m (loose) and at 240 m; section III at 190 m (loose).

3. Class *Pelecypoda.*

A. Sub-class *Anisomyaria.*

Family *PTERIDAE (= AVICULIDAE).*

Genus *OXYTOMA*, Meek, 1864.

Oxytoma expansa (Phillips).

(Plate 42, figs. 4—7).

1933. *Oxytoma expansa* (Phillips) Arkell: Monograph British Corallian Lamellibranchia, pt. 5 (Pal. Soc.), p. 190, pl. xxiv, figs. 1—5, 8.

A few impressions of left valves like that which yielded the squeeze figured in Plate 42, fig. 5, show the details of the ribbing, but little of the true shape of the shell. The wide interspaces between the larger ribs are bisected by smaller secondary ribs and each half again has a still finer tertiary rib in the middle. These, however, are not distinct in all the interspaces, and in some they cannot be distinguished from the very fine lines that occur in the remainder of the interspaces. The convexity of the valve and the general shape, however, can be gauged from the (broken) internal cast represented in Plate 42, fig. 6. One impression well shows the delicate reticulate ornamentation of the large posterior wing.

A few of the specimens had been labelled by Rosenkrantz *O.* aff. *octavia* (d'Orbigny), but that species, characterised by having one

[1]) *Loc. cit.* (Pal. Française, Terr. Jurass., vol. II), 1850—60, pl. 286, fig. 2.

secondary riblet alternating with each primary rib[1]), looks rather differen at least in de Loriol's[2]) figure, though not perhaps in the descriptio *O. expansa* is said to range from the Cornbrash to the Corallian, b the agreement of the Greenland specimens with Arkell's figures is close that the range of this species appears to have extended upwar to the Portlandian, as recognised already by Lewinski[3]).

Horizon:— Glauconitic Series and above (*Lingula* Bed); Por landian.

Localities:— Cape Leslie, Rosenkrantz's section I, at 100—115 m section II, at 240 m; section III at 190 m (loose?).

Oxytoma sp. ind.

(Plate 42, fig. 8).

The existence of a second species of *Oxytoma* had been notic already by Rosenkrantz who labelled one specimen "*Oxytoma*, n *O. octavia*", this being the species to which he had compared the exampl described above as *O. expansa*. The most conspicuous difference is in t umbonal region (smooth on test and cast) which is broader and mo inflated in the present example and the posterior wing seems to be short and less projecting. The cast is smoother than that figured in Plate 4 fig. 6 (which is incomplete), but there were traces of radial ribbing the damaged ventral margin. The example may represent another form the *münsteri* group, in spite of the apparent smoothness, but speci identification cannot be attempted.

Horizon:— Glauconitic Series, upper part; Portlandian.

Locality:— Cape Leslie, Rosenkrantz's section I, at 100 m.

Family *MYALINIDAE*.

Genus *BUCHIA*, Rouillier, 1845.

Buchia mosquensis (v. Buch).

(Plate 42, figs. 1a—g).

1888. *Aucella pallasi*, Keyserling; Lahusen: Über die Russischen Aucellen. Mé Com. géol. St. Pétersb., vol. VIII, no. 1, p. 9, pl. I, fi 12—20.

1904. — — Keyserling; Madsen: On Jurassic Fossils from East Gre land. Medd. om Grønl., vol. XXIX, no. 6, p. 1 pl. VI, figs. 7a—c.

1907. — *mosquensis* (v. Buch), Pavlow: Enchaînement des Aucelles. No Mém. Soc. Imp. Nat. Moscou, vol. XVII, no. 1, p. pl. II, figs. 5—8.

[1]) See Cox, *loc. cit.* (Proc. Dorset Nat. Hist. & Arch. Soc., vol. L), 1929, p. 1

[2]) *Loc. cit.* (Mém. Soc. phys. Genève, vol. XIX), 1867, pl. VIII, figs. 7—9.

[3]) *Loc. cit.* (Mém. Soc. géol. France, Pal. vol. XXIV, fasc. 3—4), 1923, p.

1929. *Buchia mosquensis*, Keyserling [sic]; Sokolov and Bodylevsky, *loc. cit.* (Skrifter om Svalbard, no. 35), p. 36.

?1933. *Aucella* — Keyserling [sic]; Parat and Drach, *loc. cit.* (C. R. Acad. Sci., vol. 196), p. 1909.

?1934. — — Keyserling [sic]; Parat and Drach, *loc. cit.* (Ann. hydrograph.), p. 11.

?1934. — *pallasi*, Keyserling; Parat and Drach, *ibid.*, p. 12(?).

This species is represented by examples from various levels but there appears to be no difference between the small form from the lower beds (figs. 1f, g) and the larger examples from the higher beds (figs. 1a—c). As mentioned below, there are transitions to *B. rugosa* (Fischer), with coarser and more distant folds; and one of the two flat smaller valves (fig. 1e) may belong to that species rather than to *B. mosquensis*.

A single specimen of a *Buchia* in Block II from the *Aucella* River, unfortunately, is poorly preserved; and it can, perhaps, only be provisionally referred to the present species. It seems to agree in ornamentation with the elongated example figured in figs. 1a—c, but it is preserved in a light grey, micaceous sandstone, full of *Lingula*, which cannot be the same rock as that which yielded *B. pallasi* to Madsen. From Block I of the same locality there are other and perhaps more typical examples.

The fragmentary example of a *Buchia*, represented in Plate 42, fig. 3, shows fine concentric ornamentation in a few places and the shape is doubtful, so that definite identification is impossible. There is agreement, however, in the striation, with typical Russian examples of *B. fischeriana* (d'Orbigny[1])) before me, from the *Craspedites* zones, and this species, which is also known from Spitsbergen[2]), has already been recorded by Parat and Drach[3]) from Cape Leslie. Associated with the specimen here figured, however, was a piece of rock with another, more inflated, valve of a *Buchia* which may well be a Cretaceous form. In view of what is said on p. 163 about the horizon of these isolated specimens (from the Hartzfjaeld Sandstone, 183 m above the Glauconitic Series) I am not describing them separately as elements of the Jurassic fauna and it is clearly necessary to await the discovery of more material in a better state of preservation.

Horizon:—Glauconitic Series, also above and below; Upper Kimmeridgian and Portlandian.

Localities:— Hartz Mtn., N. E. ridge (loc. P, no. 245); N. W. spur (loc. M, no. 210); Cape Leslie, Rosenkrantz's section I, 100—115 and

[1]) In Murchison, Verneuil and Keyserling, *op. cit.*, 1845, p. 472, pl. XLI, figs. 8—10 (*Avicula fischeriana*); see also Pavlow, *loc. cit.* (Enchaînement des Aucelles), 1907, p. 58, pl. IV, figs. 15—19.

[2]) See Sokolov and Bodylevsky, *loc. cit.* (Skrifter om Svalbard, no. 35), 1931, p. 38.

[3]) *Loc. cit.* (Ann. hydrograph.), 1934, pp. 11, 14.

165 m; section II, at 35 m, 62 m, 115 m?, 200 m; section III at 130 190 (loose) and 415 m. Also from Aucella River, Jameson Land, bl and (more doubtfully?) from II.

Buchia rugosa (Fischer).

(Plate 42, figs. 2a, b).

1888. *Aucella pallasi*, Keyserling, var. *plicata*, Lahusen; Über die Russische cellen, *loc. cit.*, p. 9, pl. I, figs. 21—23.

1907. — *rugosa* (Fischer) Pavlow: Enchaînement des Aucelles, *loc. cit.*, pl. I, figs. 6—7.

1931. — — Pavlow; Sokolov and Bodylevsky, *loc. cit.* (Skrifte Svalbard, no. 35) p. 36.

1934. — — Fischer; Parat and Drach, *loc. cit.* (Ann. hydrograph.),

The two examples here figured seem to be connected witl typical *B. mosquensis* by transitions, so that it is doubtful wh *B. rugosa* is really a distinct species. The difference in ribbing o extremes, however, is conspicuous. The larger example shows trac radial lineation crossing the strong concentric ribs. It is possible the flat smaller valve represented in fig. 1e belongs to the present rather than to *B. mosquensis*, since it resembles Lahusen's fig. 2

Horizon:— Glauconitic Series, and above?; Portlandian.

Localities:— Cape Leslie, Rosenkrantz's section II, at 115 also R III, 190 m (loose?).

Family *PINNIDAE*.

Genus *PINNA*, Linnaeus, 1758.

Pinna *constantini*, P. de Loriol.

(Plate 44, fig. 4; Plate 45, figs. 5—6).

1929. *Pinna constantini*, de Loriol; Cox, *loc. cit.* (Dorset Nat. Hist. & Arch vol. L), p. 143.

1933. — — — Parat and Drach, *loc. cit.* (C. R. Acad p. 1929.

1934. — — — Parat and Drach, *loc. cit.* (Ann. hydrog pp. 10, 11.

I mentioned in the first part (p. 54) that the new material inc at least two species, as I considered the slenderer and more coa ribbed form from the higher beds (Plate 45, fig. 5) to be distinct the shorter and more inflated forms of the *Pinna* Bed in the Glauc Series. According to Dr. Aldinger, there are countless individuals in the vertical position, in this bank. It is probable, however, tha differences are largely due to the imperfect preservation, many speci being crushed, so that the quadrate cross-section is rarely symmet The original of Plate 45, fig. 5, in fact, owes its slenderness mere deformation in the rock, and all the examples are thus now inc

in de Loriol's species. The large example figured in Plate 44, fig. 4, has a square cross-section where both the ventro-dorsal and the lateral diameters are about 40 mm. After that there is lateral crushing so that at the widest end (80 mm) the thickness is still only 40 mm. The quickly tapering apex, about 25 mm long, and showing fine lineation, with bluntly rounded umbones (on the internal cast), was not discovered until after the photograph was taken, but it proves that the shape is less elongated than that of *P. lanceolata*, Sowerby[1]). On the other hand, a number of smaller examples cannot satisfactorily be distinguished from the much earlier *P. sublanceolata* (Eichwald), I[2]) figured from Jameson Land, the ornamentation being identical, so far as can be seen. Parat and Drach record as many as three species of *Pinna* from their bed C, including *P. lanceolata* Goldfuss [*sic*], but the original figure[3]) of that species shows more complete loss of lineation even than the large example figured in Plate 44, fig. 4. *P. suprajurensis* (d'Orbigny), of which Lewinski[4]) considered *P. constantini* to be merely an extreme variety, is rather different from any example before me.

Horizon:— Glauconitic Series and above (*Lingula* Bed); Portlandian.

Localities:— Pinna Valley (loc. A, nos. 126 and 137; also Cape Leslie, Rosenkrantz's section I, at 100 and 165 m; II at 95 and 130 m (loose), at 200 and 240 m; III at 130 m and at 190 m (loose?). Also at Aucella River, Jameson Land (Block I).

Family *ISOGNOMONIDAE*.

Genus *ISOGNOMON*, Solander, 1786.

Isognomon aff. *bouchardi* (Oppel).[5])

(Plate 42, fig. 12; Plate 43, figs. 1a, b).

1929. *Isognomon bouchardi* (Oppel) Cox, *loc. cit.* (Dorset Nat. Hist. & Arch. Soc., vol. L), p. 144.

1933. *Perna* aff. *bouchardi* (Oppel) Parat and Drach, *loc. cit.*, (C. R. Acad. Sci.), p. 1929.

1934. — — — Parat and Drach, *loc. cit.*, (Ann. hydrograph.), pp. 10, 11, 14.

There are numerous examples of this form labelled by Rosenkrantz "*Isognomon milnelandensis*, sp. nov." but in the absence of a description it is impossible to say which of the features he considered to be character-

[1]) Mineral Conchology, vol. III, 1819, p. 145, pl. 281.

[2]) Spath, The Invertebrate Faunas of the Bathonian-Callovian Deposits of Jameson Land. Medd. om Grønl., vol. 87, no. 7, 1932, p. 108, pl. XVII, fig. 4.

[3]) In Goldfuss: Petrefacta Germaniae, 1836, pl. CXXVII, fig. 7.

[4]) *Loc. cit.* (Mém. Soc. géol. France, Pal., vol. XXIV, fasc. 3—4), 1923, p. 55.

[5]) Or *I.* aff. *listeri* (Brown). See Arkell, *op. cit.*, 1935, p. 306.

istic of this new species. The shape varies greatly, and while some indistinguishable from examples of the common *I. bouchardi* in *Pectinatites* beds of Wheatley and Shotover, others are either broa like *I. flamberti* (Dollfus)[1]) or else have a conspicuous, wing-like, poste extension, while the general shape of some is altogether more oblique t in *I. bouchardi*, as figured by de Loriol[2]); but since it is most unli that this assemblage includes more than one species, I take it that varying aspect is due merely to accidents of preservation; just a other beds in which *Isognomon* is plentiful, no two individuals exactly alike. The excellent figure in Lewinski[3]) represents the ave shape of the most complete examples and those that show unu obliquity, like the original of Plate 43, fig. 1a, are defective and, m over, connected with the first by transitional forms. It does not s possible to recognise even a distinct variety "*milnelandensis*" on basis of shape; and the ligament pits (Plate 42, fig. 12) and pointed u also are not distinctive.

Horizon:— Glauconitic Series, upper part; Portlandian.

Localities:— Cape Leslie, Rosenkrantz's section I, at 100— and at 130 m; section II, at 115 m.

Family *OSTREIDAE.*

Genus *OSTREA*, Linnaeus, 1758.

Ostrea bononiae, Sauvage.

(Plate 39, figs. 10—12; Plate 49, figs. 6a, b).

1929. *Ostrea bononiae* Sauvage; Cox, *loc. cit.* (Proc. Dorset Nat. Hist. & Arch. vol. L), p. 148.
?1933. — sp., Parat and Drach, *loc. cit.* (C. R. Acad. Sci.), p. 1929.
1934. — *bononiae* Sauvage; Parat and Drach, *loc. cit.* (Ann. hydrogra p. 11.
1935. — — — Spath, *supra* (part I), p. 54.

The two examples figured in Plate 39, figs. 10 and 11 were attac to opposite sides of the same ammonite (*Dorsoplanites*? cf. *subpand* suggesting deposition in disturbed water, probably on a slope, as indica by the glauconite. Fig. 10 of the same plate shows how the oyster co the umbilicus in many of the ammonites, as noticed already by P and Drach; but the Lower Kimmeridgian oysters I recorded in the part (and which were attached to examples of *Rasenia*) are essenti

[1]) La Faune Kimméridienne du Cap de la Hève. Paris, 1863, p. 84, pl. figs. 3—5.

[2]) *Loc. cit.* (Mém. Soc. phys. Genève, vol. XIX), 1867, pl. x, fig. 1; also *loc* II (Mém. Soc. phys. Genève, vol. XXIV), 1875, p. 167, pl. XXI, figs. 1, 2.

[3]) *Loc. cit.* (Mém. Soc. géol. France, Pal., vol. XXIV, fasc. 3—4), 1923, pl fig. 9.

similar, when uncrushed. The original of Plate 49, figs. 6a, b bearing the impress of an *Epipallasiceras*, clearly on one valve and less distinctly on the larger, convex, valve, is perhaps the best so far as ornamentation is concerned; but there are others which, although attached to ammonites, show a smooth convex valve. The largest example, comparable to one figured by de Loriol[1]), but still bigger, measures about 100 × 100 mm. It was attached to the ammonite figured in Plate 10, fig. 1.

All the oysters before me, whether ribbed or smooth, seem to be referable to this one species, and there is nothing comparable to *O. expansa*, Sowerby, recorded by Parat and Drach, or to any other species. Whether *O. bononiae* is identical with *O. undulata*, Eichwald[2]), created many years before for the similar oysters of the *Virgatites* beds of Russia, I am unable to say, lacking material for comparison; but the older name would have to be used if they should turn out to be identical. *O. ventilabrum*, Fischer[3]), non Goldfuss, also is remarkably like examples of the present form.

Horizon:— Glauconitic Series and below, down to nodule horizon β(?); Upper Kimmeridgian and Portlandian.

Localities:— Hartz Mtn. (loc. D, nos. 164, 173; loc. E, nos. 176, 177, 220, and first Kloeft south of C, no. 172); Cape Leslie, Rosenkrantz's section I, at 100—115 m; section II, at 62 m and at 115 m; section III, at 190 m.

Family *PECTINIDAE.*

Genus *ENTOLIUM*, Meek, 1864.

Entolium nummularis (Fischer).

(Plate 41, figs. 9, 10a—c; Plate 42, figs. 11a, b).

1845. *Pecten nummularis* Phillips [*sic*] d'Orbigny, in Murchison, Verneuil and Keyserling, *loc. cit.*, p. 475, pl. XLI, figs. 20—23.
1931. — (*Entolium*) *nummularis*, d'Orbigny; Sokolov and Bodylevsky, *loc. cit.* (Skrifter om Svalbard, no. 35), p. 51, pl. VIII, fig. 1.

There are numerous examples of this species and many had been labelled by Rosenkrantz: "*Pecten* (*Entolium*) *nummularis*, var.". The only difference I can see is in the broader shape of Fischer's form, noticeable especially in the Spitsbergen specimen figured by Sokolov and Bodylevsky, which, however, is badly preserved. The shape is orbicular and since d'Orbigny, in the text, stated that the shell is as broad as it is high, there is probably little in this difference of the figures. The more acute umbo of the present form, especially the original of Plate 42, fig. 11a,

[1]) *Loc. cit.* (Mém. Soc. phys. Genève, vol. XXIV), 1875, p. 212, pl. XXIII, fig. 9.

[2]) Lethaea rossica, 1868, p. 378, pl. XIX, figs. 2 and 3.

[3]) *Loc. cit.* (Oryctographie Moscou), 1837, p. 133, pl. XLVI, fig. 5.

as compared with d'Orbigny's drawing, also is not taken to be of sign cance, but it is more acute than that of the Cretaceous *Pecten orbicula* J. Sowerby[1]), which, as Sokolov and Bodylevsky already showed, h great resemblance to the Jurassic *E. nummularis*.

It will be seen that in the young (Plate 41, fig. 10c) the wings a comparatively large, but in the adult (Plate 42, fig. 11a) they are sma One internal cast (Plate 41, fig. 9, enlarged by $^3/_2$) shows the concent ribbing of the test, in the central portion, and there is at least one oth a larger and fairly well preserved example, with test and cast, like t original of Plate 41, fig. 10a, in which the cast also is ribbed. Mo however, are smooth (Plate 42, fig. 11 b) and the thickness occasiona is slightly more than in d'Orbigny's drawing.

Horizon:— Glauconitic Series; upper part; Portlandian, a perhaps below, since Plate 41, fig. 9, was marked (on photograp R II, 62 m (error?).

Localities:— Cape Leslie, Rosenkrantz's section I, at 100—115 and at 130 m; section II, at 130 m; section III, at 190 m. Also at Auce River, Jameson Land (block I).

Entolium sp. ind.

(Plate 45, fig. 1).

Compare 1865. *Pecten demissus*, Bean; Lindstroem: Om Trias- och Juraforstenin från Spitsbergen. Kgl. Svenska Vetensk. Ak Handl., vol. VI, no. 6, p. 14, pl. III, figs. 9—10.

The only example available was labelled by Rosenkrantz — "*Pec* cf. *demissus*, Lindström" and it is apparently comparable to the seco of this author's figures, but it is not the *E. demissus* (Phillips) I[2]) figu from the Bathonian of Jameson Land or the similar form recorc in the first part of this memoir (1935, p. 56). The smooth cast (w traces of test) of the left valve is only moderately convex and the anter ear is highly projecting, but the ventral margin is incomplete, so t the broad shape may be unduly accentuated.

Horizon:— Hartzfjaeld Sandstone (*Lingula* Bed); Portlandian

Locality:— Cape Leslie, Rosenkrantz's section II, at 240 m.

Genus *CAMPTONECTES*, Meek, 1864.

Camptonectes praecinctus, sp. nov.

(Plate 40, fig. 6; Plate 41, fig. 1).

"*Pecten* (*Camptonectes*) *praecinctus*" sp. nov. Rosenkrantz (in coll.).

Diagnosis:— Shape like *C. cinctus* (J. Sowerby)[3]), orbicu but with right valve distinctly flatter than left and with anterior do

[1]) Mineral Conchology, vol. II, 1818, p. 193, pl. 186.
[2]) Spath, *loc. cit.* (Medd. om Grønl., vol. 87, no. 7), 1932, p. 112, pl. XXVI, fi
[3]) Mineral Conchology, vol. IV, 1822, p. 96, pl. 371.

margin more curved, also smaller apical angle, and small, triangular ligament. Ornamentation as in *C. lamellosus* (J. Sowerby)[1]), consisting of concentric growth-lines and lamellae at irregular intervals and crossed by extremely fine, fibrous, radial lines. Test fairly thick, especially in the umbonal region.

Measurements:—

Plate 40, fig. 6.....	Height 168 mm,	Length 165 (?) mm
Plate 41, fig. 1.....	— 100 mm,	— 100 mm

Remarks:— The comparison to *C. cinctus* (Sowerby), implied in Rosenkrantz's MS name, was very apt; but *C. lamellosus*, so common in the English Portland Stone, is also very similar and differs chiefly in having the right valve less flattened in the umbonal region, so that the greatest thickness is in the dorsal part of the shell, and not in the middle, as in *C. praecinctus*. The concentric ornamentation is also much more pronounced, as it is in well preserved examples of *C. cinctus* from the Neocomian Claxby Ironstone of Lincolnshire.

Pecten validus, Lindstroem[2]), from Spitsbergen is difficult to compare, but an impression of the interior of a convex left valve of the present form, with its triangular ligament pit, resembles Lindstroem's drawing. Sokolow and Bodylevsky[3]), who put *P. validus*, with doubt, into the sub-genus *Aequipecten*, figured two more examples and gave the age as approximately Lower Kimmeridgian — Lower Volgian, so that specific identity of the two forms is not impossible and, of course, the older name would have to be adopted.

Remains of a large form of *Pecten* from the *Parallelodon keyserlingi* Sandstone at Rosenkrantz's locality IV were also labelled *P. cf. praecinctus*, and thus missed when I compiled the list on p. 64 of part I. It is possible that they belonged to *P.* (*Camptonectes*) *broenlundi*, Ravn[4]) from a corresponding horizon on Koldewey Island; but the preservation of the remains, in the yellow micaceous sandstone, is altogether unfavourable to specific identification.

Horizon:— Glauconitic Series, upper part; Portlandian.

Locality:— Cape Leslie, Rosenkrantz's section I, at 100 m.

Camptonectes morini (P. de Loriol).

(Plate 41, figs. 5—6).

1929. *Camptonectes morini* (de Loriol) Cox, *loc. cit.* (Proc. Dorset Nat. Hist. & Arch. Soc., vol. L), p. 162 (with synonymy).

There are numerous examples of *Camptonectes* of which some had been labelled by Rosenkrantz and referred partly to *C. morini* and

[1]) Ibid., vol. III, 1819, p. 67, pl. 239.
[2]) *Loc. cit.* (K. Svenska Vet. Akad. Handl., vol. VI), 1865, p. 15, pl. III, figs. 5—6.
[3]) *Loc. cit.* (Skrifter om Svalbard, no. 35), 1931, pl. III, figs. 1—2.
[4]) *Loc. cit.* (Medd. om Grønl., vol. XLV, no. 10), 1911, p. 465, pl. XXXIV, figs. 5—6.

partly to *C.* sp. nov. These, however, are now discussed below u *C. suprajurensis*, while I am including in the present form only t specimens that are not only equilateral but rather convex. Most smooth (Plate 41, fig. 5) and the slightly convex right valve fig in the same plate (fig. 6) showing traces of the ornamentation is, perh more doubtful.

Horizon:— Glauconitic Series and above (*Lingula* bed?); P landian.

Localities:— Cape Leslie, Rosenkrantz's section I, at 100—1 and at 165 m; section II, at 240 m (?); section III, at 190 m; also Au River, Jameson Land (block I).

Camptonectes suprajurensis (Buvignier).

(Plate 41, figs. 2—4; Plate 42, fig. 9; Plate 43, fig. 4).

1925. *Camptonectes suprajurensis* (Buvignier); Cox, *loc. cit.* (Proc. Dorset Club, vol. XLVI), p. 138.

1929. — — (Buvignier), Cox, *loc. cit.* (Proc. Dorset Nat. & Arch. Soc., vol. L), p. 162.

The more inequilateral examples of *Camptonectes*, with slight vexity, especially of the right valves, are here referred to Buvigr species, but most of them are smooth casts and the ornament (which is not noticeably finer than that of *C. morini*) is preserve only a few small examples (Plate 41, fig. 3). Since the matrix o specimens is generally a micaceous sandstone, often rather coarse, not surprising that differentiation of the smaller forms of *Camptor* has to be based merely on shape and proportions. It is possible tha other species are represented; for example *C. nudus* (Buvignier)[1]) v has the shape of the cast of a left valve figured in Plate 43, fig. 4, b equilateral.

Horizon:— Glauconitic Series and above (*Lingula* bed); landian.

Localities:— Cape Leslie, Rosenkrantz's section I, at 100—1 and at 165 m; section II, at 240 m; section III, at 190 m; also Au River, Jameson Land (block I).

Family *LIMIDAE*.

Genus *LIMA*, Bruguière, 1792.

Subgenus *Plagiostoma*, J. Sowerby, 1814.

Lima (*Plagiostoma*) sp. nov.? ind.

(Plate 46, fig. 5; Plate 47, fig. 10).

This is a typical, obliquely oval *Lima* (*Plagiostoma*) of the ge aspect of *L.* (*P.*) *spitiensis*, Holdhaus[2]), but the surface is without

[1]) *Loc. cit.* (Statistique Meuse), 1852, Atlas, p. 25, pl. xx, fig. 1.

[2]) Fauna of the Spiti Shales (Lamellibranchia and Gastropoda). Mem.

of radial ornamentation. Where the test is preserved, in the umbonal region and the more central parts, it is entirely smooth, with very fine lines of growth; these are more conspicuous nearer the ventral margin and towards the auricles, but so far as can be seen there were no radial ribs or grooves, even at the anterior and posterior margins. The antero-dorsal ridge is almost straight; the anterior auricle is invisible from the front, but in fig. 5b of Plate 46 (*representing part of the opposite side of* the specimen figured in Plate 47, fig. 10) the area between the antero-dorsal ridge and the anterior auricle is crushed, and thus deeply concave. The ligament pit in the sub-triangular hinge area has slightly rounded sides. The test is rather thin, but tends to thicken posteriorly (not on the *auricle*) and on the dorsal side of the antero-dorsal ridge.

L. radula, Contejean[1]), which was described as having a short lunule and which in any case has a different shape, seems comparable, but only in the illustration, for in reality it has very fine radial striation, even if this is effaced in the middle of the valves. Another apparently smooth *Plagiostoma* is *Lima baylei*, Gemmellaro[2]), but this also has the concentric striae of growth crossed by radial lines and their disappearance over the greater part of the shell is due to defective preservation. In the various examples of the present form, however, the portions of test remaining are entirely unworn.

It is possible that the present form is identical with *Lima incrassata*, Eichwald[3]), for the antero-dorsal ridge is equally straight and the apparently different size of the posterior auricle alone would scarcely be sufficient for separation. But Eichwald's species was compared to a Turonian form; and as its exact age is unknown, I hesitate to identify it with the present species.

Horizon:— Glauconitic Series, upper part; Portlandian.

Locality:— Cape Leslie, Rosenkrantz's section I, at 100—115 m; also at 130 m.

Subgenus *Pseudolimea*, Arkell, 1932.

Lima (*Pseudolimea*) aff. *blakei*, Cox.

(Plate 45, figs. 7a, b).

1929. *Lima* (*Plagiostoma*) *blakei*, Cox, *loc. cit.* (Proc. Dorset Nat. Hist. and Arch. Soc., vol. L), p. 165, pl. IV, fig. 2.

The largest example available (Plate 45, fig. 7a) represents the interior of a left valve, firmly embedded in a micaceous sandstone; the ribbing thus appears far less prominent than it would on the exterior of the shell although this is comparatively thin. The obliquely oval, strongly inequilateral shape, with excavated area inside the antero-dorsal ridge, also the auricles, are those of a typical *Plagiostoma*, not a

[1]) *Loc. cit.* (Mém. Soc. Emul. Doubs), 1859, p. 306, pl. XXII, fig. 11.

[2]) *Op. cit.* (Calcare a *Terebratula janitor*), pt. III, 1871, p. 55, pl. VIII, fig. 7.

Limatula, which some of the smaller casts resemble. The number of r is about twenty which suggests comparison to *L. blakei* rather th to any other species, from the more distantly ribbed *L. rhomboidal* Contejean[1]) to the closely costate *L. boloniensis*, de Loriol[2]). On t internal casts, the interspaces are wider than the ribs; on the test appears to be the reverse, but only the ventral edge is exposed. Th however, is far less highly corrugated than Contejean's fig. 10.

L. bonanomii, Etallon[3]), with 26—28 ribs, is also very similar, b most of the sandstone casts are too immature for definite identificati either with described species or the larger example figured in Pl 45, fig. 7a. The *Limea* sp. from Spitsbergen, recorded by Sokolov a Bodylevsky[4]), is probably as little related to the present form as Lundgren's[5]) Cape Stewart *Limaea duplicata* (*non* Sowerby) which of Lower Liassic age and has now been identified by Rosenkrant with *Limea acuticosta*, Goldfuss.

Horizon:— Glauconitic Series and Hartzfjaeld Sandstone (*Ling* bed); Portlandian.

Localities:— Cape Leslie, Rosenkrantz's section I, at 100 m a section II, at 240 m.

Family *ANOMIIDAE*.

Genus *ANOMIA*, Linnaeus, 1767.

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

(Plate 10, fig. 3a).

The small valve of an *Anomia*? (or *Placunopsis*?), referred to p. 43 as being attached to the inner whorls of a form of *Pavlov* may not be specifically determinable, but in convexity, smoothness, a shape resembles *A. suprajurensis*, Buvignier[7]). This form occurs in the Po land Sands[8]) and also in the Kimmeridgian. Among the examples figu by de Loriol[9]) the original of his fig. 7, though larger, is perhaps the m comparable, but the illustration shows that not enough of the valve exposed for definite identification. In a small oyster (*O. bononiae*, Sauvag

[1]) *Loc. cit.* (Mém. Soc. Emul. Doubs.), 1859, p. 310, pl. XXII, figs. 7—10.
[2]) *Loc. cit.* (Mém. Soc. phys. Genève, vol. XIX), 1867, p. 102, pl. IX, fig
[3]) In Thurmann and Etallon, *loc. cit.*, 1862, p. 241, pl. XXXII, fig. 11.
[4]) *Loc. cit.* (Skrifter om Svalbard, no. 35), 1931, p. 49.
[5]) Anmärkningar om några Jura-fossil från Kap Stewart i Öst-Grönland. Me om Grønl., vol. XIX, 1895, p. 198, pl. III, fig. 6.
[6]) *Loc. cit.* (Medd. om Grønl., vol. CX, no. 1), 1934, p. 14.
[7]) *Loc. cit.* (Statistique Meuse), 1852, p. 26, pl. XX, figs. 25—27.
[8]) See Cox, *loc. cit.* (Proc. Dorset Nat. Hist. & Arch. Soc. vol. 1) 1929, p. 1
[9]) *Loc. cit.* (Mém. Soc. phys. Genève, vol. XIX), 1867, p. 117, pl. XI.

similarly attached to the young *Keratinites* figured in Plate 6, fig. 4, the ribbing of the ammonite is reproduced on the convex valve.

Horizon:— Nodule bed β, 36 m below the Glauconitic Series, Upper Kimmeridgian.

Locality:— Ridge south of Crab Valley (loc. E, No. 183).

Genus *PLACUNOPSIS*, Morris & Lycett, 1853.

Placunopsis aff. *lycetti*, P. de Loriol.

(Plate 42, fig. 13).

1867. *Placunopsis lycetti*, P. de Loriol, *loc. cit.* (Mém. Soc. phys. Genève, vol. XIX), p. 116, pl. XI, fig. 5.
1875. — — — *loc. cit.* (Mém. Soc. phys. Genève, vol. XXIV), p. 385, pl. XXV, fig. 9.

The slightly distorted example here figured was labelled by Rosenkrantz "*P. lycetti*" and I am provisionally adopting the identification, but the Corallian *P. radiata* (Phillips), as figured by Arkell[1]), seems to be at least equally close. While the shape is more circular than that of de Loriol's first figure, both this and his later illustration show regular and straight radial ornamentation, whereas in the present form it is more wavy and far more irregular. Phillips's original figure being rather sketchy, it is perhaps not surprising that de Loriol did not compare his species with *P. radiata*; but Arkell's recent figures, especially his fig. 4, show exactly the same ornamentation as the Greenland form now discussed. *P. lycetti* thus is probably merely the Kimmeridgian-Portlandian mutation of the Corallian *P. radiata*, and may have to be united with it when more satisfactory and more abundant material becomes available.

Anomia columbiana, Crickmay[2]), from beds containing Macrocephalitidae, does not seem to differ from the form here described, except, perhaps, the paratype (Crickmay's fig. 6).

Horizon:— Glauconitic Series, upper part; Portlandian.

Locality:— Cape Leslie, Rosenkrantz's section I, at 100 m (with *Pinna*).

Family *MYTILIDAE*.

Genus *MODIOLUS*, Lamarck, 1799.

Modiolus aff. *boloniensis* (P. de Loriol).

(Plate 46, fig. 7).

1867. *Mytilus boloniensis*, de Loriol, *loc. cit.* (Mém. Soc. phys. Genève, vol. XIX), p. 92, pl. IX, fig. 3.

[1]) *Loc. cit.* (Monogr. British Corallian Lamellibranchia, pt. I), 1929, p. 49, pl. III, figs. 4—5.
[2]) Fossils from Harrison Lake Area, B. C. Nat. Mus. Canada, Bull. 63, Geol. Ser. no. 51, 1930, p. 53, pl. XIV, figs. 4—5.

1928. *Modiolus boloniensis* (de Loriol) Cox, *loc. cit.* (Proc. Dorset Field Club, v XLVI), p. 141.

1929. — — — Cox, *loc. cit.* (Proc. Dorset Nat. Hist. & Ar Soc., vol. L), p. 170.

The shape of the only complete example available is that of t common *M. bipartitus* (J. Sowerby)[1]; and since the range of this spec is very long[2]), and since I have myself collected smooth casts in t Hartwell Clay that do not seem to differ from the Upper Oxfordi examples on the one hand and the Greenland specimen on the oth it could be held that *M. bipartitus* ranges up into at least the Kimm idgian. The dorsal region of the Greenland form, however, has fi radiating ridges, as distinct on the umbo as at the posterior end and well marked as in the species described below (*M. strajeskianus*, d'Orbig sp.). This suggests comparison of the Greenland example with P. Loriol's species, although the original figure shows much greater i flation at the anterior end. Cox suggested that this may be due to i correct drawing, and, in any case, the anterior end of both valves in t present example has been crushed. But de Loriol's species is probab at least very close to the form here described, even if not identic

A crushed second example shows no trace of radial ornamentatio although the test is preserved; and it is possible that this is closer *M. bipartitus* than to *M. boloniensis*.

Horizon:— Glauconitic Series, and below?; Portlandian (and Upp Kimmeridgian?).

Localities:— Cape Leslie, Rosenkrantz's section I, at 100 The doubtful example mentioned above is from section II, at 35

Modiolus strajeskianus (d'Orbigny).

(Plate 46, figs. 4a—c).

1845. *Mytilus strajeskianus*, d'Orbigny, in Murchison, Verneuil and Keyserling, *cit.*, p. 463, pl. XXXIX, figs. 22, 23.

There are sixteen examples now referred to this distinctive specie but the preservation varies and a number are crushed in different dire tions. Thus while the transverse ridge is unduly marked in some (Plate 4 fig. 4b) owing to deformation in a ventro-dorsal direction, others a perfectly smooth owing to lateral flattening (fig. 4a). Some, agai rather larger than the examples figured, are apparently without t characteristic radial ornamentation of the dorsal area; but this also probably due merely to the preservation. For while the species describ below as *M.* sp. ind. shows no sign of striae where the test is perfect preserved, even sandstone casts of the present form may have the radi

[1]) Mineral Conchology, vol. III, 1818, p. 17, pl. CCX, fig. 4.

[2]) See Arkell, *loc. cit.* (Monogr. Brit. Corallian Lamellibr.), pt. I, 1929, p. 5

ornamentation as distinctly developed (fig. 4c) as examples with the test.

The resemblance between the flattened original of Plate 46, fig. 4a, and the shell figured by Ilovaïsky[1]) as *Modiola* cfr. *strajeskyi*, d'Orb. [*sic*] is probably accidental. The ornamentation at the anterior end of this Oxfordian form seems to be quite different from that of d'Orbigny's species.

Horizon:— Glauconitic Series, upper part; Portlandian.

Localities:— Cape Leslie, Rosenkrantz's section I, at 100 m and at 130 m; section II at 115 m; also 300 m, north of II, at 70 m (loose).

Modiolus sp. ind.

(Plate 48, fig. 2).

A larger form than the last, which, even where the test is well preserved, shows no trace of radial ornamentation on the dorsal area, is comparable in shape to a *Modiolus* figured by de Loriol[2]) as *M. subaequiplicatus* (*non* Roemer) Goldfuss, but not to the latter author's shorter and fatter original. Boden's[3]) small Oxfordian examples of *M. aequiplicata* (*non* Strombeck) are also less elongate than the large Greenland specimens, the best of which, however, here figured, is not only incomplete posteriorly, but crushed at the umbonal end. I am recording this species chiefly because it seems to be different from that last described, and in the circumstances comparison to the diagrammatic figures of the older authors are of little use, especially since the forms of the *aequiplicata* type have been so differently interpreted by authors, from Brauns[4]) to Lewinski[5]) and Borissjak[6]). It is probable that this large and smooth form will require a new name.

Horizon:— Sandy Shales, above Glauconitic Series, and Hartzfjaeld Sandstone (*Lingula* Bed); Portlandian.

Localities:— Cape Leslie, Rosenkrantz's section II, at 200 m and 240 m.

[1]) L'Oxfordien et le Sequanien des gouvernements de Moscou et de Riasan. Bull. Soc. Imp. Nat. Moscou, Année 1903, no. 1, p. 253, pl. VIII, fig. 24.

[2]) *Loc. cit.* (Mém. Soc. Linn. Normandie, vol. XVI), 1872, p. 344, pl. XIX, fig. 7 only.

[3]) Die Fauna des unteren Oxford von Popilany in Litauen. Geol. Pal. Abh., vol. XIV, 1911, p. 190, pl. XXVI, figs. 13—14.

[4]) Der Obere Jura, 1874, p. 301.

[5]) *Loc. cit.* (Mém. Soc. géol. France, Pal., vol. XXV), 1923, p. 69.

[6]) Die Pelecypoden der Jura-Ablagerungen im Europäischen Russland. III. Mytilidae. Mém. Com. géol. St. Pétersb., N. S., No. 29, 1906, p. 27.

B. Sub-class *Isomyaria.*

a. Order *TAXODONTA.*

Family *ARCIDAE.*

Genus *PARALLELODON*, Meek & Worthen, 1866.

Parallelodon sp. nov.? aff. *keyserlingi* (d'Orbigny)

(Plate 43, fig. 3: Plate 44, fig. 6; Plate 45, fig. 2; Plate 49, fig. 3).

See part I, p. 58, for synonymy.

?1934. *Arca menandellensis*, de Loriol; Parat and Drach, *loc. cit.* (Ann. hy graph.), p. 12.

I mentioned in the first part (p. 58) that Rosenkrantz had determi as *P.* cf. *keyserlingi* (d'Orbigny) some examples from much higher b than those that yielded what I then described as typical forms. Th later examples differ chiefly in being slightly broader posteriorly, height being little less than half the length, even in the large exam figured in Plate 44, fig. 6. The wider and unpleated shell, however, the more rounded posterior end give the present from an aspect differ from that of the typical *P. keyserlingi.*

The more parallel appearance of the ventral and dorsal marg in the cast figured in Plate 49, fig. 3 is due to defective preservati The dorsal aspect is still that of *P. keyserlingi*, as figured by Borissja The radial striation may, perhaps, be just a little less fine and cl

Macrodon lutugini, Borissjak[2]) differs from the small example figu in Plate 43, fig. 3 (enlarged) chiefly in having finer striation; and the sa author's figures of *Macrodon productum* (Rouillier)[3]) show this specie have more parallel margins than the form here described and a differ anterior termination. These are also smaller species than *P. keyserli* or the present form, but I am not definitely separating the last beca the innumerable examples from Oxfordian sandy concretions I previou recorded are all badly preserved and there is nothing from intermedi beds for a satisfactory comparison or the establisment of the real ra of *P. keyserlingi.*

Arca menandellensis, P. de Loriol[4]) which had been cited from t bed A by Parat and Drach, is also similar; but in the reprint of t paper, kindly sent to me by the authors, *Macrodon keyserlingi*? is ad in ink (and in brackets) after that first identification. Apart from obvious but slight differences in the outline, *P. menandellensis* apparen has slightly coarser radial ornamentation.

Horizon:— Glauconitic Series, upper part; Portlandian.

[1]) *Loc. cit.* (II, Arcidae), 1905, p. 42, pl. I, fig. 6c.

[2]) *Ibid.*, p. 44, pl. I, fig. 10.

[3]) *Ibid.*, p. 45, pl. I, figs. 14—15.

[4]) *Loc. cit.* (Mém. Soc. phys. Genève, vol. XIX), 1867, p. 88, pl. VIII, fig.

Localities:— Cape Leslie, Rosenkrantz's section I, at 100—130 m; Hartzfjaeld, N. E. ridge, loc. P, at 415 m (33 m below base of Glauconitic Series), No. 246.

Parallelodon schourovskii (Rouillier).

(Plate 43, figs. 2a—e; Plate 49, figs. 4a—b, 5).

1847—48. *Cucullaea schourovskii*, Rouillier, Études progr. Géol. Moscou, II. Bull. Soc. Imp. Nat. Moscou, p. 428, pl. H, fig. 39.

1905. *Macrodon schourovskii* (Rouillier) Borissjak, *loc. cit.* (II, Arcidae), p. 48, pl. II, figs. 10—12.

1911. — — (Rouillier) Ravn; *loc. cit.* (Medd. om Grønl., vol. XLV, no. 10), p. 469.

The typical examples of this species (Plate 43, figs. 2a-d), already identified by Rosenkrantz, show good agreement with Borissjak's figures. The surface of most of the examples shows only lines of growth but when the test is well preserved and with a lens, very delicate crenulation may be perceived, as represented in the enlarged fig. 2b of Plate 43. These first four figures were taken from squeezes of the impressions in the nodules of horizon β; the original of fig. e is from a higher bed, but is a poorly preserved sandstone cast and probably specifically identical. Some more doubtful, crushed, casts from still higher glauconitic beds and an isolated example from the Aucella River in Jameson Land are also included here.

The dorsal aspect represented in Plate 49, fig. 5 is that of the right valve figured in Plate 43, fig. 2d. The squeeze of the interior of a right valve represented in Plate 49, fig. 4a is comparable to that of another, given in Plate 43, fig. 2c, but the original of Plate 49, fig. 4b, is an actual double-valved example. It agrees with Borissjak's fig. 10b.

Horizon:— Sandy Clays (nodule bed above β?), up to Glauconitic beds; Upper Kimmeridgian and Portlandian.

Localities:— Hartz Mtn., N. W. spur, loc. M, nos. 210 and 211; Cape Leslie, Rosenkrantz's section I, at 100 and 130 m; section II, at 62 m. Also at Aucella River, Jameson Land (Block I).

b. Order *SCHIZODONTA.*

Family *TRIGONIIDAE.*

Genus *TRIGONIA*, Bruguière, 1789.

Trigonia aff. *thurmanni*, Contejean.

(Plate 41, fig. 8; Plate 42, fig. 10).

1859. *Trigonia thurmanni*, Contejean: Étude de l'étage Kimméridien dans les environs de Montbéliard et dans le Jura, la France et l'Angleterre, p. 280, pl. XVI, figs. 1—3.

A number of remains of forms of *Trigonia* (section *Clavotrigonia*, Lebküchner, 1932), have been collected in the Glauconitic Series and in the

Hartzfjaeld Sandstone above, but only one is complete enough t figured (Plate 41, fig. 8). It shows part of the test which is up to 3.5 in thickness or about 6.5 mm with the tubercles. The cast is smo At a length of about 100 mm, the height is 75 mm and the thickne the double cast is 45 mm; with the test and tubercles (thinner on widest part of the valves than at the ventral and posterior ends) thickness is about 53 mm. There are about twelve rows of tuber meeting the row of distant, small tubercles which forms the carina dering the area, at right angles. At the posterior end, which is dama the shell is almost evenly rounded, except for the slight mesial gro The three rows of tubercles of the area are lost before they reach that The escutcheon is concave and finely striated.

The example is close to *T. thurmanni* but differs in being rounded anteriorly, in having a shorter escutcheon and in bea comparatively large tubercles at the margin of the area, in wh moreover, the mesial row is as distinctly nodate as the line bordering escutcheon. Considering that there are also probably at least two transverse rows of large tubercles than in Contejean's species, it is p able that the Greenland form is distinct, but in the absence of suffici material it is impossible to name it. It may be merely another l variation of the common *T. voltzi*, Agassiz, as understood by m authors, e. g. Lycett[1]), but the original cast[2]) is quite different f that of the Greenland form. *T. aylesburiensis*, Cox[3]), another close a is again more rounded anteriorly.

The example figured in Plate 41, fig. 7, from the Aucella Rive Jameson Land, labelled *T.* aff. *pellati*, Munier-Chalmas by Ro krantz, is probably not identical with the Milne Land form, figured the same plate. But it compares equally well with *T. thurmanni*, exc perhaps in the still greater rounding of the anterior border and in direction of the transverse rows of tubercles. *T. pellati*, itself, as figu by Munier-Chalmas[4]), has a much more elongated shape and lacks marginal row of tubercles (absent on the inner layers of the tes but the Haute-Marne example figured by de Loriol[5]) closely resem the form here figured, although it also is more acute posteriorly. *T. al*

[1]) Monograph of the British Fossil Trigoniae. Pal. Soc., 1872, p. 20, pl. x, fi

[2]) Agassiz, Études Critiques sur les Mollusques Fossiles. Livr. 1, 1841, p pl. 9, figs. 10—12.

[3]) Synopsis of the Lamellibranchia of the Portland Beds of England. I. P Dorset Nat. Hist. & Arch. Soc., vol. L, 1929, p. 153, pl. III, fig. 4.

[4]) Quelques espèces nouvelles du genre *Trigonia*. Bull. Soc. Linn. Norman vol. IX, 1865, p. 418, pl. IV, fig. 4.

[5]) In de Loriol, Royer and Tombeck: Monographie paléont. & géol. des ét supérieurs de la formation Jurassique du department de la Haute Marne. Mém. Linn. Normandie, vol. XVI, 1872, p. 299, pl. XVII, fig. 2.

Contejean[1]), another comparable form of the same group, has more numerous transverse rows of tubercles.

It is possible that some of the poorly preserved fragments and casts of *Trigonia* included here belong to yet different species, especially one (No. 159) from about 100 m above the Glauconitic Series. But even this is not comparable to *T. gibbosa* (Sowerby) which has been recorded by Parat and Drach[2]), apparently from the same horizon.

Horizon:— Glauconitic Series, upper part (and higher?); Portlandian.

Localities:— Hartz Mtn., Pinna Valley (above locality A, no. 159) and N.W. ridge (loc. M, no. 209). Cape Leslie, Rosenkrantz's section III, at 190 m (loose?). Also at Aucella River, Jameson Land (Block I).

c. Order *HETERODONTA*.

Family *ASTARTIDAE*.

Genus *ASTARTE*, J. Sowerby, 1816.

Astarte aff. *saemanni*, P. de Loriol.

(Plate 46, fig. 6; Plate 47, figs. 1—5).

1909. *Astarte* sp. cf. *saemanni*, de Loriol; Madsen, Jurassic Fossils from East Greenland, *loc. cit.*, p. 183, pl. VI, fig. 16.

1933. *Astarte saemanni*, de Loriol; Parat and Drach, *loc. cit.* (C. R. Acad. Sci.), p. 1909.

1934. — — — Parat and Drach, *loc. cit.* (Ann. hydrograph.), p. 11.

There are many examples of this form, but not one shows an umbo as prominent as it is in de Loriol's[3]) original figure. If I provisionally identify the Greenland specimens with this species, to which both Rosenkrantz (on some of the labels) and Parat and Drach had already referred them, it is done because *A. saemanni* seems to be the closest ally, and because the Greenland form is probably the same as Skeat and Madsen's[4]) *A. saemanni*. In top view, the umbones are slightly more central in the Greenland examples, but this feature seems equally insufficient for separation. The ribbing is preserved on some of the internal casts (Plate 47, fig. 3) but not on others (fig. 4). The test is very thick and the sharp concentric ridges, at least near the umbones, form distinct steps. The hinge-area of a right valve is figured in Plate 46, fig. 6. Where the length is about 34 mm the thickness of the two valves is 62 %; at about 60 mm, the ratio is 66 %. The height is slightly less than the length.

[1]) Étude de l'étage Kimméridien dans les environs de Montbéliard et dans le Jura, la France et l'Angleterre, 1859, p. 282, pl. XIV, figs. 3—5.

[2]) *Loc. cit.* (C. R. Acad. Sci., 1933), p. 1909, and 1934 (Ann. hydrograph.), pp. 10—11.

[3]) *Loc. cit.* (Mém. Soc. phys. Genève, vol. XIX), 1867, p. 68, pl. VI, figs. 9, 9a.

[4]) On Jurassic, Neocomian and Gault Boulders found in Denmark. Danm. geol. Unders., II, no. 8, 1898, p. 123, pl. III, figs. 2a, b.

At Aucella River where this form is extremely common, it is a iated with a smooth species (Plate 47, fig. 7), perhaps *A. panderi*, Rouill which in its obliqueness somewhat resembles *A. veneris*, d'Orbig and an elongate form (Plate 47, fig. 6) which combines costation a umbo with striation over the remainder of the test, as in *A. michaud* d'Orbigny[3]), or in *A. striatocostata* (Münster) Goldfuss[4]) (of quite diffe shape). The former was labelled by Rosenkrantz *A.* cf. *duboisiana*, b is not the form which I am now referring to that species (see bel *A.* cf. *panderi* has not been found in Milne Land, unless represente smooth internal casts. One such internal cast of an *Astarte* is fig in Plate 45, figs. 9a, b, and it will be seen that specific identificati impossible.

Horizon:— Glauconitic Series and Hartzfjaeld Sandstone (*Lin* Bed); Portlandian.

Localities:— Hartz Mtn. (loc. A, no. 133); Cape Leslie (loc. nos. 196, 197); Rosenkrantz's section I, at 130 m and 165 m; sectio at 115, 200 and 240 m; section III, at 190 m (loose?) and 415 m. Al Aucella River, Jameson Land (Block I).

Astarte cf. *duboisiana*, d'Orbigny.

(Plate 46, fig. 8).

1845. *Astarte duboisiana*, d'Orbigny, in Murchison, Verneuil and Keyserling *cit.*, p. 455, pl. XXXVIII, figs. 14—17.

1923. — — — Lewinski, *loc. cit.* (Mém. Soc. géol. Fr Pal., vols. XXIV—XXV), p. 76, pl. v, 5—6.

There is only one example, with the thick test partly preserved its slight inflation as well as more ovate, less circular shape distingu it at once from the common *A.* aff. *saemanni* of the same horizon the beds below. The corrugation is also more regular and more pr nent, but the preservation is scarcely good enough for definite ide cation with the Russian species. Lewinski mentioned that *A. dubois* (which he considered took the place of the West European *A. saem* in Russia and Poland) had a greater thickness than de Loriol's sp while Skeat and Madsen[5]) stated that the two species agreed in

[1]) Études progressives sur la géologie de Moscou. Bull. Soc. Imp. Nat. Mo vol. XXI, 1848, p. 283, pl. G, fig. 28.

[2]) In Murchison, Verneuil and Keyserling, *op. cit.*, 1845, p. 456, pl. xx figs. 21—22.

[3]) See in Dollfus: La Faune Kimméridienne du Cap de la Hève, 1863, p figs. 20—22.

[4]) Petrefacta Germaniae, 1837, p. 192, pl. 134, fig. 18.

[5]) *Loc. cit.* (Danm. geol. Unders. II, 8), 1898, p. 125 (*A. ovoides*, v. Buch, nymous with *A. duboisiana*, according to these authors, was not figured till

respect; in reality, on comparing the original figures, it can be seen at once that *A. duboisiana* is much less inflated than *A. saemanni*.

Horizon:— Hartzfjaeld Sandstone (*Lingula* Bed); Portlandian.

Locality:— Cape Leslie, Rosenkrantz's section II, at 240 m.

Astarte sp. nov.? aff. *michaudiana*, d'Orbigny.

(Plate 47, fig. 6).

Cf. 1863. *Astarte michaudiana*, d'Orbigny; Dollfus: La Faune Kimméridienne du Cap de la Hève, p. 61, pl. XI, figs. 20—22.

The example here figured is from Aucella River in Jameson Land, and has already been referred to under *A.* aff. *saemanni* (p. 116), but there is a single impression from Cape Leslie that appears to represent the same form. The costation is confined to within 5 or 6 mm from the umbo and consists of about 12—15 sharp ribs, closely packed at first, but later more distantly spaced. The remainder of the test shows merely very fine lines of growth. The shape is elongated, with the length and height in the proportion of 4 to 3. *A. michaudiana*, d'Orbigny, already referred to, as figured by Dollfus, has a more prominent umbo and is higher than the Greenland form, but its ornamentation is similar. The thickness seems to be about the same in the two species.

Horizon:— Glauconitic Series, upper part; Portlandian.

Localities:— Cape Leslie, Rosenkrantz's section I, at 100—110 m. Also at Aucella River, Jameson Land (Block I).

Astarte sp. nov.? ind.

(Plate 47, figs. 9a, b).

The single left valve figured is almost equilateral, with the broad umbo, however, distinctly turned forward. The height exceeds the length; the thickness is 66% of the length. The concentric ribbing is similar to that of *A. saemanni*, already discussed, and irregular. There is no crenulation of the ventral margin, but the shell is somewhat corroded. *A. mediolaevis*, Buvignier[1]) which is less high and has a less blunt umbo, looks somewhat similar, but on account of its small size is difficult to compare.

Horizon:— Hartzfjaeld Sandstone, *Lingula* bed; Portlandian.

Locality:— Cape Leslie, Rosenkrantz's section II, at 240 m.

Astarte sp. ind.

(Plate 47, figs. 8a, b).

The figured example is slightly corroded and the sharpness of the concentric ribbing has somewhat suffered; but another example of probably the same form, with the two valves widely gaping, shows fine and

[1]) *Loc. cit.* (Statistique Meuse), 1852, p. 18, pl. xv, figs. 7—8.

regular ornamentation, resembling that of *A. socialis*, d'Orbigny, figured by de Loriol[1]). This minute species, however, is more elongat In another, isolated, right valve, the ribbing is finer than that of t young *A. saemanni* only in the umbonal region, but later becomes m like that of this species. This example may be intermediate betw *A. saemanni* and the present, more finely ribbed form. The length greater than the height; the thickness is 56 % of the length. The umb central and the shell almost equilateral. *A. submultistriata*, d'Orbig as figured by de Loriol[2]), has a somewhat similar appearance, judging the enlarged illustration, but it also is a much smaller species.

Horizon:— Hartzfjaeld Sandstone (*Lingula* bed); Portlandian.

Locality:— Cape Leslie, Rosenkrantz's section II, at 240 m.

Family *ARCTICIDAE.*

Genus *ISOCYPRINA*, Roeder, 1882.

Isocyprina sp. nov.? aff. *elongata*, Cox.

(Plate 48, figs. 6a, b).

Cf. 1925. *Isocyprina elongata*, Cox, *loc. cit.* (Proc. Dorset Field Club, vol. XL p. 35, pl. IV, fig. 4.

The internal cast of a left valve, here figured, retains enough of t very thick test to show the fine concentric lines of growth. The hinge also partly exposed. The general shape is that of Cox's species whi however, is much smaller and slightly more inflated. The dimensio are:— length 71 mm, height 61 mm; thickness (single valve) 22 m In addition to the figured example, there are three doubtful sandsto casts, but although the form is probably distinct, the material scarcely sufficient for the creation of a new species.

Horizon:— Hartzfjaeld Sandstone (*Lingula* bed); Portlandian.

Localities:— Cape Leslie, Rosenkrantz's section II, at 240 Also at Aucella River, Jameson Land (Block I), and doubtfully fr loc. O (between Astarte and Crab Valleys, no. 240), together with *S craspedites groenlandicus*, which may be lowest Cretaceous.

Isocyprina sp. nov.? ind.

A fragmentary example of a second species of "*Cyprina*" sho a much less convex shape and a less prominent umbo than t form last described. The thick test has very fine lines of growth, b most of the specimen is merely a smooth cast and the hinge-area only incompletely exposed. The general outline seems to have be

[1]) *Loc. cit.* (Mém. Soc. phys. Genève, vol. XIX), 1867, p. 69, pl. VI, fig. 7a o

[2]) In de Loriol, Royer and Tombeck, *loc. cit.* (Mém. Soc. Linn. Normand vol. XVI, 1872, p. 281, pl. XVI, fig. 14.

much like that of the last species. The form described below as *Isocyprina* (?) sp. ind is not only much smaller, but has far more inflation.

Horizon:— Glauconitic Series, upper part; Portlandian.

Locality:— Cape Leslie, Rosenkrantz's section III, at 190 m (loose?).

Isocyprina (?) sp. ind.

Two poorly preserved sandstone casts show prominent umbones and a subtrigonal shape which, together with the considerable inflation, is reminiscent of forms like *Cyrena ambigua*, Eichwald[1]), or *Isocyprina glabra* (Blake and Hudleston)[2]). The former has the umbones slightly blunter; the latter is smaller and less elongated. The dimensions of the better of the two casts are:— length 31 mm, height 27 mm, thickness (of one valve) 11 mm. In the absence of the hinge or other characteristic feature, the real affinities of the present form must remain uncertain. Apart from the great difference in inflation, *Arctica etalloni*, Contejean[3]), and the right valve doubtfully identified with it by Skeat and Madsen[4]), have the shape of the form here discussed, except that, the anterior end being shorter in the Greenland examples, they are more triangular in side-view, although inequilateral.

Horizon:— Glauconitic Series, upper part; Portlandian.

Localities:— Cape Leslie, Rosenkrantz's section I, at 100 m; section II, at 115 m.

Family *TANCREDIDAE.*

Genus *CORBICELLA*, Morris and Lycett, 1854.

Corbicella aff. *portlandica*, Morris and Lycett.

(Plate 42, figs. 14a, b).

1929. *Corbicellopsis portlandica* (Morris and Lycett) Cox: Notes on the Mesozoic Family Tancredidae. Ann. Mag. Nat. Hist. (ser. 10), vol. III, p. 583.

1929. — — (Morris and Lycett) Cox: *loc. cit.* (Proc. Dorset Nat. Hist. & Arch. Soc., vol. L), p. 178.

The small example here figured shows good agreement in general form with the original figure in Damon[5]). The length is 25 mm and the height 16 mm, while the thickness of the two valves is 10 mm. These dimensions do not quite agree with the measurements given by Cox,

[1]) *Loc. cit.* (Lethaea rossica), 1868, p. 658, pl. XXIV, figs. 10a, b.

[2]) See in Arkell, *loc. cit.* (Monogr. Brit. Corallian Lamellibr.), pt. VI, 1934, p. 267, pl. XXXV, figs. 9—11.

[3]) *Loc. cit.* (Mém. Soc. Emul. Doubs), 1859, p. 256, pl. X, figs. 34—36 (as *Mactra sapientium*).

[4]) *Loc. cit.* (Danmarks geol. Unders., II, no. 8), 1898, p. 134, pl. IV, fig. 22 only.

[5]) Geology of Weymouth &c. New ed., 1884, p. 88, text-fig. 37; p. 192.

but so far as can be judged from the immature specimens availa they are at least as close to the Portlandian species as to the simi French forms of Kimmeridgian age described chiefly by de Lor The posterior ridge is more marked on the smooth internal cast than the thin test, with its concentric striae of growth; and the poster adductor impression is as drawn in Damon. The entire pallial line, rat distant from the ventral margin, ascends vertically to the poster adductor, so that it is well away from the posterior end, obliqu truncated, as in Damon's drawing.

While *C.* (*Eodonax*?) *pellati*, de Loriol[1]) is shorter and more inflat *C. lorioli*, Cox[2]) is more rounded at both ends and has no distinct poster ridge. One doubtful cast (Plate 50, fig. 10) with the posterior slope clearly ridged may, however, belong to *C. lorioli* or some other spec rather than the present form; but its umbones are almost centr *C. unioides*, de Loriol, discussed below, is closer in general shape more elongated.

Horizon:— Glauconitic Series and Hartzfjaeld Sandstone (*Ling* Bed); Portlandian.

Localities:— Cape Leslie, Rosenkrantz's section I, at 100 section II at 200 m and 240 m.

Corbicella cf. *unioides*, P. de Loriol.

(Plate 46, fig. 9).

1929. *Corbicellopsis unioides* (de Loriol) Cox, *loc. cit.* (Ann. Mag. Nat. Hist., ser. vol. III), p. 582, pl. XIII, figs. 3—5.

1929. — — (de Loriol) Cox, *loc. cit.* (Proc. Dorset Nat. Hist. Arch. Soc., vol. L), p. 178.

The only specimen available was labelled (like the last speci "*Corbicellopsis*? cf. *unioides*, de Loriol," and although it is somew defective, it may be compared to that form, being closest to Cox's fig Its length, however, is 26 mm, the height 15 mm, and the thickness 19 m These dimensions are not very different from those of *C.* aff. *portlandi* discussed above, but the shell seems decidedly more elongated and ovate, with the umbones more prominent. But it is not impossi that both are merely variants of a distinct Greenland species that can yet be separated on account of lack of material. The original of de Lori fig. 11[3]) which has been chosen by Cox as the lectotype of *C. unioi* in any case, does not appear to have the posterior slope ridged, and were not for the position of the umbo being more forward in the Gre

[1]) *Loc. cit.* (Mém. Soc. phys. Genève, vol. XXIV), 1875, p. 67, pl. XIV, fig.
[2]) See *ibid.*, figs. 9 and 10 only.
[3]) *Loc. cit.* (Mém. Soc. phys. Genève, vol. XXIV), 1875, p. 64, pl. XIV.

land form, it might be compared to *C. tenera*, de Loriol[1]), which, however, is more compressed, or to *C. bayani*, de Loriol[2]) which is less pointed anteriorly.

Horizon:— Hartzfjaeld Sandstone, *Lingula* Bed; Portlandian.

Locality:— Cape Leslie, Rosenkrantz's section II, at 240 m.

Corbicella (?) sp. ind.

An example of a doubtful *Corbicella*, larger than those discussed above, is too fragmentary to be figured, but seems to differ from *C. portlandica* (Morris and Lycett) in having a narrower and more prominent umbo and in being more acute anteriorly. At a length of about 45 mm, the height is nearly 30 mm and the inflation (of the single valve) about 7 mm. The thick shell has lamellar or wrinkly striae of growth and there is a blunt posterior ridge where the growth-lines are sharply bent. The internal cast is entirely smooth. The umbo is slightly prosogyrous and placed distinctly anterior to the centre. The hinge is not exposed. Compared with the much smaller example figured in Plate 42, figs. 14a, b, the present form is distinguished by a greater concavity of the antero-dorsal margin, which makes the umbo more prominent. This is also less broad, but otherwise the shape is very similar, as is the posterior ridge.

Horizon:— Glauconitic Series, upper part; Portlandian.

Locality:— Cape Leslie, Rosenkrantz's section I, at 100 m.

Genus *TANCREDIA*, Lycett, 1850.

Tancredia hartzi, sp. nov.

(Plate 48, figs. 4, 5a, b; Plate 50, fig. 2).

Tancredia hartzi, Rosenkrantz MS (on label).

1909. *Tancredia* sp., Madsen: Jurassic Fossils from East Greenland, *loc. cit.*, p. 185, pl. VI, fig. 19.

Diagnosis:— Shell comparatively large, inequilateral, high and obliquely truncate posteriorly, narrow and rostrate anteriorly. Posterior slope ridged, with transverse sulcus below, reaching to posterior margin which is widely gaping. Lines of growth near ventral and posterior margins thickening into ribs, forming an acute angle in the posterior corner, where crossed by the sulcus. Umbo low and flat, hinge apparently as in other species of *Tancredia*. Pallial line entire. Test extremely thick.

Dimensions:— Length 50 mm, height 30 mm; thickness (both valves) 27 mm.

Remarks:— This species shows some resemblance to *T. curtansata*

[1]) *Ibid.*, p. 66, pl. XIV, figs. 13a—c.
[2]) *Ibid.*, p. 67, pl. XIV, fig. 14.

(Phillips) recently re-figured by Arkell[1]), but it is more elongated and t ventro-posterior edge is sharply angular, while the sulcus below t posterior ridge is inconspicuous or absent in Phillips's species. T umbones in the Greenland form, also, are low and flat, so that the who shape is more tetragonal or, rather, spindle-shaped. The dorsal vie of the larger left valve here figured (fig. 5) illustrates the curious sha of the posterior margin, which is less extreme in the smaller examp (fig. 4). The smooth, internal cast of a left valve figured in Plate 50, fig. unfortunately is broken at the anterior end.

Horizon:— Hartzfjaeld Sandstone (*Lingula* Bed); Portlandia

Localities:— Cape Leslie, Rosenkrantz's section II at 240 m also at Aucella River, Jameson Land. (Block I).

Family *MACTROMYIDAE.*

Genus *MACTROMYA*, Agassiz, 1842.

Mactromya verioti (Buvignier).

(Plate 46, figs. 2—3).

1925. *Unicardium verioti*, Buvignier; Cox, *loc. cit.* (Proc. Dorset Field Club, vo XLVI), p. 150, pl. III, fig. 1.

1929. *Mactromya verioti* (Buvignier): Cox, *loc. cit.* (Proc. Dorset Nat. Hist. Arch. Soc., vol. L), p. 179.

1935. *Matromya* cf. *verioti* (Buvignier), Cox, in Geology and Palaeontology British Somaliland, pt. II: Mesozoic Palaeont., pt. VII Jurass. Gastr. & Lamellibr., p. 184, pl. XX, fig. 12.

This long-ranged and common species is represented by wha appear to be typical examples, but they are preserved in sandston and show little except outline, general shape, and the concentric ribbing There is good agreement with the English Portland Stone examp figured by Cox, as well as with the Polish form, doubtfully attached b Lewinski[2]) to the present species, but Buvignier's[3]) original figure show less coarse ribbing and are, perhaps, comparable only to the smoothe casts listed below from the *Lingula* Bed. But it will be seen that even th two examples from the same bed, here figured, are slightly different in ribbing as well as the bluntness of the umbo.

Horizon:— Above Glauconitic Series; Portlandian.

Locality:— Cape Leslie, Rosenkrantz's section II, at 240 m section III, at 415 m.

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[1]) *Loc. cit.* (Monogr. Brit. Corallian Lamellibr.), pt. VII, 1934, p. 293, p XXXVIII, figs. 9, 9a.

[2]) *Loc. cit.* (Mém. Soc. géol. France, Pal., vols. XXIV—XXV), 1923, p. 7 pl. VII, fig. 5.

[3]) *Loc. cit.* (Statistique Meuse), 1852, p. 16, pl. XVII, figs. 1—5.

Family *LUCINIDAE.*

Genus *LUCINA*, Bruguière, 1797.

Lucina sp. nov. aff. *inaequalis*, d'Orbigny.

(Plate 46, figs. 1a, b; Plate 50, figs. 8a, b).

Cf. 1845. *Lucina inaequalis*, d'Orbigny; in Murchison, Verneuil and Keyserling, *loc. cit.* (Geologie de la Russie), p. 459, pl. XXXIX, figs. 6—8.

The most favourably preserved example (Plate 46, fig. 1) is small and compressed (in the rock), but a larger specimen (Plate 50, fig. 8) has the following measurements: length 72 mm, height 54 mm, thickness (two valves) 39 mm. The resemblance to d'Orbigny's species is thus confined to the general appearance, the short and truncated posterior and produced anterior end and the concentric ornamentation, whereas the thickness (or convexity) of the valves is considerably greater in the Greenland form. Both lunule and escutcheon are deeply excavated and bordered by overhanging ridges. None of the three specimens collected shows the characters of the hinge and the preservation does not encourage further preparation.

The present form shows some resemblance to species of *Lucina* from the Lower Volgian of Russia, like *L. lineata*, *L. lyrata* and *L. lyrata*, var. *pinguis*, in Rouillier[1]), but they are all less angular in outline or less inflated. The true *L. lirata*, Phillips[2]), however, is also very close and differs merely in length and ornamentation.

L. arenaria, Cox[3]) is perhaps another sub-quadrate species to which the present, much larger, form might be compared, but it is far less sharply truncate, posteriorly. *L. plebeia*, Contejean[4]), which *L. arenaria* was said to resemble in shape, though less rectangular, is already rather remote from the present form. One example of the latter, in Mr. Rosenkrantz's collection, together with the short and rounded form described below, bore a label: "*Cyprina*? sp. *Lucina*?", but although the interior is unknown, the generic position seems certain.

Horizon:— Glauconitic Series and below (down to horizon β?); Upper Kimmeridgian and Portlandian.

Localities:— Hartz Mtn., loc. A (no. 226), and Cape Leslie, Rosenkrantz's section I, at 100 m.

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[1]) *Loc. cit.* (Bull. Soc. Imp. Nat. Moscou), vol. XIX, 1846, pl. E, figs. 3a, b; 6a—d; vol. XXI, 1848, pl. H, figs. 31a, b; pp. 275, 276, 285.

[2]) Refigured in Arkell, *loc. cit.* (Monogr. British Corallian Lamellibr.), pt. VII, 1934, p. 278, pl. XLI, figs. 1—3, 7.

[3]) *Loc. cit.* (Proc. Dorset Nat. Hist. & Arch. Soc., vol. L), 1929, p. 180, pl. V, fig. 9.

[4]) *Loc. cit.* (Kimméridien de Montbéliard), 1859, p. 271, pl. XII, figs. 6—9.

Lucina sp. nov.? ind.

(Plate 50, figs. 9a, b).

This form, represented by only two imperfect examples, differs from the species last described merely in its round shape, with a much shorter anterior end and consequently greater height. The measurements are: length 60 mm, height 60 mm, thickness (two valves) 40 mm. The test is fairly thick, especially near the margins, and it is provided with irregular concentric lines of growth, while the smooth cast also shows traces of radial ornamentation. This radial ornamentation is more pronounced in the Jameson Land specimen figured in Plate 48, figs. 7a, b as *Lucina* (?) sp. ind., the very thick test of which also has merely fine concentric lines of growth. But apart from the general rounded shape there is little of diagnostic value preserved in this example which moreover, is probably crushed. Its resemblance to a form like Buvignier's[1] much less rounded *L. ingens* is confined to a similar state of preservation o the casts, and the rounded outline suggests that the apparent difference of this Aucella River example from the more inflated Milne Land form here discussed may be due only to the crushing.

L. lirata (Phillips), referred to under the last species, on account of its more rounded shape, is closer to the present form than to *L.* sp. nov. aff. *inaequalis*, but the largest example listed by Arkell has a length of only 53 mm and its inflation is much less than that of the Greenland form here discussed.

Horizon:— Glauconitic Series, upper part; Portlandian.

Locality:— Cape Leslie, Rosenkrantz's section I, at 100 m.

Family *CARDIIDAE.*

Genus *PROTOCARDIA*, Beyrich, 1845.

Protocardia sp. juv. ind.

(Plate 43, figs. 5a—c; Plate 50, fig. 5).

One of the immature examples here figured (fig. 5a) and a few others like it were labelled by Rosenkrantz *Protocardia* cf. *morinica* (de Loriol) and they agree well enough with the specimen illustrated by Skeat and Madsen[2]); but they are rather too small to be identified specifically. *P. concinna* (v. Buch) as figured by d'Orbigny[3]) is similar, as already stated by Lewinski[4]), and it is doubtful whether the slight differences in thickness etc. could be appreciated at so small a size and

[1]) *Loc. cit.* (Statistique Meuse), 1852, p. 11, pl. x, figs. 3—5.

[2]) *Loc. cit.* (Danmarks geol. Unders., II, no. 8), 1898, p. 132, pl. III, fig. 5.

[3]) In Murchison, Verneuil and Keyserling, *loc. cit.* (Geologie de la Russie), p. 454, pl. XXVIII, figs. 11—13.

[4]) *Loc. cit.* (Mém. Soc. géol. France, Pal., vols. XXIV—XXV), 1923, p. 79.

in so indifferent a preservation, i. e. in smooth, internal casts. The largest and best example (Plate 43, figs. 5b, c) shows better agreement with d'Orbigny's figure than with de Loriol's[1]) original drawing of *P. morinica*. The latter species which has been shown by Lamplugh, Kitchin and Pringle[2]) to have an extended range, in the case of crushed examples such as are commonly found in the English Kimmeridge Clay, would, of course, be difficult to distinguish from allied forms of *Protocardia*.

Horizon:— Hartzfjaeld Sandstone, *Lingula* Bed, and 94 m above base of Hartzfjaeld Sandstone (loose); Portlandian.

Localities:— Cape Leslie, Rosenkrantz's section II, at 240 m; Hartz Mtn., east slope, at 530 m (No. 229).

Family *ISOCARDIIDAE.*

Genus *PSEUDOTRAPEZIUM*, Fischer, 1887.

Pseudotrapezium groenlandicum, sp. nov.

(Plate 49, figs. 7a—c).

Pseudotrapezium groenlandicum, Rosenkrantz MS (on label).

Diagnosis:— Shell rather large, elongated, the length (58 mm) considerably exceeding the height (44 mm), and rather inflated (thickness of single valve 18 mm); subtrigonal in outline, very inequilateral, angulate posteriorly. Umbones broad and flat, very slightly prosogyrous, situated at about one-third the length from the anterior end. Test fairly robust, especially in umbonal region; ornamented with irregular concentric lines of growth, but more distinct costation at the umbones. Internal cast smooth. Anterior margin sharply rounded; posterior margin truncate and almost straight between the terminations of the two strongly curved posterior ridges. Ventral edge sharp and entire. Hinge with two large cardinal teeth and one elongated posterior lateral tooth; margin entire and straight. Adductors and pallial line as in *Pronoella trigonellaris* (Schlotheim)[3]) allowing for difference in shape.

Remarks:— This species, in dorsal view, is much like *P. bathonicum* (Morris and Lycett)[4]), except for the broader umbones. The two posterior ridges, especially, are identical, also the proportion of length to inflation; but the lateral view is considerably different, for not only is

[1]) *Loc. cit.* (Mém. Soc. phys. Genève, vol. XIX), 1867, p. 59, pl. VI, figs. 5, 5a.

[2]) Concealed Mesozoic Rocks in Kent. Mem. Geol. Surv., 1923, pl. II to face p. 224.

[3]) See Benecke: Versteinerungen der Eisenerz-Formation von Deutsch-Lothringen &c. Abh. geol. Spez. Karte Els.-Lothr. N. F., Heft VI, 1905, p. 242, pl. XVIII, fig. 3.

[4]) *Loc. cit.* (Monograph Mollusca Great Oolite), 1853, p. 75, pl. VII, figs. 8, 8a—c.

the height greater in *P. bathonicum*, but the umbo is also much more projecting and the posterior end is far more oblique. The lateral aspect of *Cyprina kharoschovensis*, Rouillier[1]), is more like that of the Greenland form, this shell being only slightly more elongated, and more rounded anteriorly, but in the dorsal view its sharp umbones give it a quite different aspect.

There are many examples of this species, in all states of preservation, but most are fragmentary or else crushed or deformed in the rock. The internal casts appearing more elongated on account of the thickness of the test in the umbonal region, show the adductor impressions, of which the anterior has a conspicuous ridge on the inner edge; the pallial line rises vertically to the posterior adductor.

Horizon:— Glauconitic Series and Hartzfjaeld Sandstone (*Lingula* Bed); Portlandian.

Localities:— Cape Leslie, Rosenkrantz's section I, at 100 to 165 m; section II at 200 to 240 m; section III, at 190 m (loose).

Pseudotrapezium (?) sp. nov. ind.

It is probable that there is another species of *Pseudotrapezium* (or of *Pronoella*?) in the same beds with *P. groenlandicum*, but the material available is very unsatisfactory. One example, labelled with the MS name "*Pseudotrapezium*? *leslieanum*" in Mr. Rosenkrantz's collection, seems to me the same as his *Pronoella nuculaeformis* (Roemer), described below, but two fragmentary specimens, also labelled *P.* ? *leslieanum*, although having *Pronoella* hinges so far as can be seen, differ in their truncate posterior margin. There is no distinct posterior ridge, at least on the thick test, and the umbones are small and sharp, so that there is little real resemblance to *P. groenlandicum*; but as the shape of the whole shell cannot be reconstructed from the two fragmentary (left and right) valves, further discussion will have to be deferred until more material is available.

Horizon:— Glauconitic Series, upper part; Portlandian.

Locality:— Cape Leslie, Rosenkrantz's section II, at 115 m.

Genus *PRONOELLA*, Fischer, 1887.

Pronoella (?) sp. ind. aff. *nuculaeformis* (Roemer).

(Plate 48, figs. 1a, b; Plate 50, fig. 6).

Compare 1929. *Pronoella nuculaeformis* (Roemer) Cox, *loc. cit.* (Proc. Dorset Nat. Hist. & Arch. Soc., vol. L), p. 184, pl. VI, fig. 9.

The specimens available are all crushed or fragmentary and none shows the hinge, so that examples of *Pleuromya tellina* and even

[1]) *Loc. cit.* (Bull. Soc. Imp. Nat. Moscou, vol. XXI), 1848, pl. H, figs. 35a—c, p. 285.

Thracia were included in small lots, labelled "*Pronoella nuculaeformis*". The Greenland form, however, is not identical with either Roemer's[1]) original figure or the Portlandian example figured by Cox, having a less convex ventral margin and a shorter anterior end. The shape, thus, is decidedly more trigonal, and the outline drawing given by Brauns[2]) for *P. brongniarti* (Roemer) is probably closer to the original shape of the present form than is the same author's figure of *P. nuculaeformis*. The concentric markings of the very thin test are irregular; on internal casts the coarse folds are rather conspicuous. The finer striation of the elongated umbones, however, is reminiscent of the forms referred to above as *Pseudotrapezium*, and the resemblance is accentuated by a suspicion of a posterior keel, visible in the example figured in Plate 50, fig. 6, and apparently not due to the crushing.

Whether the cast figured in Plate 45, figs. 8a, b is a *Pronoella* or not, is uncertain. In shape it resembles a *Nucula*, but the preservation is so poor that it is doubtful whether the cast is inequivalve only through having been crushed. As it is also corroded, it may be provisionally included with the present form, rather than listed separately as a doubtful *Nucula*, a genus that is not represented in the material before me, so far as I can see.

Horizon:— Glauconitic Series, upper part (and above?); Portlandian.

Localities:— Cape Leslie, Rosenkrantz's section I, at 100 m, 100—115 m, and at 165 m; section II, at 200 m; section III, at 190 m (loose). Also from Aucella River, Jameson Land (one doubtful example in block I).

Genus *PSEUDISOCARDIA*, Douvillé, 1912.

Pseudisocardia (?) sp. ind.

(Plate 48, figs. 9a, b).

The generic position of this form is doubtful, since the interior is unknown. All the examples came out of one small nodule and are mostly smooth casts that resemble similar casts of *Protocardia*, but are less inflated. Where the test is preserved, the fine concentric lines of growth are seen to be continuous and uniform from the gently sloping anterior to the scarcely steeper posterior border, and there is no sign of the posterior radial ornamentation, characteristic of the genus *Protocardia*. The length of one of the largest examples is 12 mm, the height 11 mm and the thickness about 8 mm. The outline is sub-orbicular; the small umbones rise only slightly above the dorsal margin and are prosogyrous. The general

[1]) Versteinerungen des Norddeutschen Oolithen-Gebirges. 1836, p. 108, pl. VII, fig. 11.

[2]) Der Obere Jura, 1874, p. 272, pl. II, fig. 20.

appearance resembles that of *P.* (?) *rotunda*, Cox[1]), but the umbo are more mesial.

Horizon:— Nodule Bed β in Sandy Clays, 30—40 m below ba of Glauconitic Series; Upper Kimmeridgian.

Locality:— Hartz Mtn., Crab Valley, loc. E (no. 184).

Family *CORBULIDAE.*

Genus *CORBULA*, Bruguière, 1797.

Corbula sp. ind.

(Plate 48, figs. 8a—c).

An internal cast of a left valve, retaining fragments of test, but on 5 mm long and 4 mm high, can be determined as having belonged to a inflated and distinctly rostrate species of *Corbula*, but it is too doubtf to be definitely attached to *C. deshayesia*, Buvignier[2]), as the lab suggests. The natural external mould of apparently the same specime shows regular concentric ribbing, and since Buvignier's species w originally described as smooth, similarity of shape only remains. It thus probable that the Greenland form is closer to a costate species li *C. bayani* de Loriol[3]), or its allies.

Horizon:— Glauconitic Series, upper part (or above?); Por landian.

Locality:— Cape Leslie, Rosenkrantz's section II, at 170 (loose).

d. Order *DESMODONTA.*

Family *PLEUROMYIDAE.*

Genus *PLEUROMYA*, Agassiz, 1842.

Pleuromya tellina, Agassiz.

(Plate 45, figs. 4a, b; Plate 50, figs. 1a, b).

1929. *Pleuromya tellina*, Agassiz; Cox, *loc. cit.* (Proc. Dorset Nat. Hist. & Arc Soc., vol. L), p. 171.

There are numerous examples of this species, but preservati varies and crushing in the rock or other damage often changed t appearance so that scarcely two examples are identical. The best (e. Plate 50, fig. 1) show good agreement especially with the large examp figured by Skeat and Madsen[4]). Others (e. g. Plate 45, fig. 4a) mig equally well be compared to the similarly variable *P. subcompres*

[1]) *Loc. cit.* (Proc. Dorset Nat. Hist. & Arch. Soc., vol. L), 1929, p. 183, pl. fig. 8.

[2]) *Loc. cit.* (Statistique Meuse), 1852, p. 9, pl. x, figs. 15—17.

[3]) *Loc. cit.* (Mém. Soc. phys. Genève, vol. XXIV), 1875, p. 9, pl. xi, figs. 8—

[4]) *Loc. cit.* (Danmarks geol. Unders., II, no. 8), 1898, p. 135, pl. iii, fig. 8

Meek), as figured by Stanton[1]). The smallest specimen figured (Plate 45, ig. 4b) shows the narrow anterior end which is damaged in the other wo. The proportions of the largest (height = 60 % of the length, thick- ness = 46 %) and the position of the umbo at one-third the length of he shell support its reference to what Lewinski[2]) called the var. *voltzi* of *P. tellina*.

The Oxfordian examples figured by Boden[3]) do not seem to differ from the later types here discussed, but the Oxfordian specimens I pro- visionally referred to *P. tellina* in the first part (p. 61) are not well enough preserved for exact comparison.

Horizon:— Glauconitic Series and Hartzfjaeld Sandstone (*Lingula* Bed); Portlandian.

Localities:— Cape Leslie, Rosenkrantz's section I, at 100, 115, 130 and 165 m; section II, at 70 m (loose), at 115, 200, and 240 m; section III, at 190 m (loose) and at 415 m; at Signal 7 M (no. 195); Hartz Mtn. Pinna Valley, loc. A, northern side, nos. 147 and 148. Also Aucella River, Jameson Land (Block I).

Family *PANOPEIDAE.*

Genus *GONIOMYA*, Agassiz, 1838.

Goniomya aff. *sulcata*, Agassiz.

(Plate 44, fig. 1).

1842. *Goniomya sulcata*, Agassiz: Monographie des Myes, I, p. 7, pl. 1b, figs. 9—12 (pl. i, figs. 8—9, pl. 1c, figs. 13—14).

The acute V-shape of the ribbing is not apparent in the photograph, on account of lighting from the top-left, but it agrees with that of Agassiz's species. There are no cross-bars at any stage, as in most of the Arctic and other comparable forms so far described. The dorsal and ventral aspects also closely resemble those given in Agassiz's pl. 1b, figs. 9—12. The only differences are the larger size of the Greenland form and the greater width of the shallow sulcus which extends from the ridge, running from the umbones to the ventral margin, for some distance across the middle of the shell and includes the apices of the Vs. The gape of the posterior end is extreme; the anterior end is only slightly gaping. A smaller frag- mentary example includes merely the central portion of one valve and the impression of a third example also is too doubtful to be definitely identi- fied with the figured specimen which is from a higher horizon.

[1]) "Mesozoic Fossils". In Geology of the Yellowstone National Park. U. S. Geol. Survey, Monogr. 32, pt. 2, 1899, p. 626, pl. lxxiv, fig. 9 only.

[2]) *Loc. cit.* (Mém. Soc. géol. France, Paléont., vols. XXIV—XXV), 1923, p. 81, pl. vii, figs. 2a, b.

[3]) *Loc. cit.* (Pal. Geol. Abhandl., vol. XIV), 1911, p. 181, pl. xxv, figs. 4—5.

Horizon:— Glauconitic Series and Hartzfjaeld Sandstone (*Lingula* Bed); Portlandian.

Localities:— Hartz Mtn., N. E. spur (loc. P, no. 245); Cape Leslie, Rosenkrantz's section I, at 100 m; also 1 km north of Cape Leslie, no. 201, labelled "probably *Lingula* Bed".

Genus *ARCOMYA*, Agassiz, 1843.

Arcomya(?) sp. ind.

(Plate 50, fig. 7).

The few single valves collected are embedded in rock so that the shape and outline only are available for identification. They may belong to more than one species, but none agrees with any of the forms figured by Agassiz. That author's[1]) *A. helvetica* (Thurmann) is probably the closest ally of the Greenland form, but it has far more prominent umbones than any of the Greenland examples. Some of the specimens were labelled *Arcomya* and I am adopting the generic name, but whether the Greenland form or forms, like the original *A. helvetica*, are referable to *Machomya*[2]) rather than *Arcomya*, I am unable to decide.

A. latissima, Agassiz, as figured by de Loriol[3]) has a less straight ventral margin, a less rounded posterior end, and umbones that are rather more prominent than those of the Greenland examples.

Horizon:— Glauconitic Series and Hartzfjaeld Sandstone (*Lingula* Bed); Portlandian.

Localities:— Cape Leslie, Rosenkrantz's section I, at 100 m; section II, at 240 m.

Genus *MACHOMYA*, P. de Loriol, 1868.

Machomya(?) sp. ind.

A double-valved internal cast, though damaged at both ends, can be seen to have belonged to a shell gaping slightly anteriorly and more so posteriorly. Remains of the thick test near the umbones show it to have had fine, concentric growth lines. The general shape is that of *Homomya tibetica*, Stoliczka[4]), but there is less inflation. The anterior end was probably similarly pointed in both. The adductor impressions and the deep pallial sinus are those of a *Panopea*[5]). The cast shows two

[1]) *Loc. cit.* (Monographie des Myes), III, 1843, p. 167, pl. x, figs. 7—10.

[2]) See Brauns, Der Obere Jura, 1874, p. 255.

[3]) Étude sur les mollusques et brachiopodes de l'Oxfordien supérieur et moyen du Jura ledonien. Mém. Soc. pal. Suisse, vol. XXX, 1903, p. 150, pl. xix, fig. 8.

[4]) See Holdhaus: Fauna of the Spiti Shales (Lamellibranchiata and Gastropoda). Mem. Geol. Surv. India, Pal. Indica, Ser. XV, vol. IV, pt. ii, fasc. 4, 1913, p. 449, pl. xciv, figs. 1a, b.

[5]) Compare *P. antiqua*, d'Orbigny, in Murchison, Verneuil and Keyserling, *loc. cit.* (1845), p. 466, pl. xl, figs. 4—5.

grooves (corresponding to internal ridges of the shell) running from the umbones to the anterior adductors. The umbones are at about one-third the total length (of about 60 mm); the height is 25 mm, the thickness (of both valves) 19 mm.

M. dunkeri (d'Orbigny) de Loriol[1]), first described as a *Panopea*, differs from the Greenland form in having a straight instead of a convex ventral margin. The example of *Arcomya*(?) sp. ind. figured in Plate 50, fig. 7, is not only much higher at about the same length, but has a more elevated umbo and a much less acute anterior margin.

Horizon:— Hartzfjaeld Sandstone, *Lingula* Bed; Portlandian.

Locality:— Cape Leslie at Signal 7 M (no. 195).

Family *PHOLADOMYIDAE*.

Genus *PHOLADOMYA*, G. B. Sowerby, 1823.

Pholadomya aff. *inaequiplicata*, Stanton.

(Plate 44, figs. 2a, b; Plate 45, figs. 3a, b).

Cf. 1899. *Pholadomya inaequiplicata*, Stanton: Mesozoic Fossils, in Geology of the Yellowstone National Park. U. S. Geol. Survey, Monogr. 32, pt. ii, p. 625, pl. lxxiv, fig. 4.

There are about a dozen examples, large and small, as figured, complete and fragmentary, and they seem to me to be all referable to the same species. A few were labelled *P. tumida*, Agassiz *non* de Loriol, or *P. rustica*, by Rosenkrantz, who, however, had not seen the best specimen (Plate 44, figs. 2a, b). In shape, this shows perfect agreement with Stanton's smaller species, which, however, may have one or two more radial ribs. Agassiz's[2]) original small *P. tumida* is scarcely comparable, but some of the examples of *P. canaliculata*, Roemer (of which *P. tumida* is a synonym) figured by Moesch closely resemble the smaller specimens of the present form, especially those that have suffered by compression in the rock. De Loriol's[3]) *P. tumida*, renamed by Moesch[4]), is more elongated and has a less rounded ventral margin. As in *P. rustica*, Phillips[5]), which according to Cox[6]) is the same as *P. lorioli*, the radial ribbing is also stronger and more regular.

P. protei, Defrance, which has been recorded by Parat and Drach[7])

[1]) In de Loriol and Cotteau, *loc. cit.* (Bull. Soc. Sci. Yonne), 1868, p. 81 (557), pl. vi, figs. 8—9; also *loc. cit.* (Mém. Soc. Linn. Normandie, vol. XVI), 1872, p. 165.

[2]) *Loc. cit.* (Monographie des Myes), II, 1845, p. 111, pl. iia, figs. 6—11, pl. vb, figs. 1—3.

[3]) *Loc. cit.* (Mém. Soc. phys. Genève, vol. XIX), 1867, p. 47, pl. iv, fig. 9; *ibid.*, vol. XXIV, 1875, p. 23, pl. xii, fig. 3.

[4]) Monographie der Pholadomyen. Mém. Soc. pal. Suisse, vol. I, 1874, p. 73, pl. xxvi, figs. 1—4.

[5]) Geology of Oxford, 1871, p. 333, pl. xv, fig. 12.

[6]) *Loc. cit.* (Proc. Dorset Nat. Hist. & Arch. Soc., vol. L), p. 172.

[7]) *Loc. cit.* (Ann. hydrograph.), 1934, p. 11.

from Cape Leslie, is rather different from the form here discussed; and they also found a species of *Pholadomya* in their Kimmeridgian bed C, which like their species of *Thracia* and *Inoceramus*, was not represented among the material dealt with in part I of this memoir.

Horizon:— Glauconitic Series and Hartzfjaeld Sandstone, *Lingula* Bed; Portlandian.

Localities:— Hartz Mtn., Crab Valley (loc. D, no. 168); Cape Leslie, Rosenkrantz's section I at 100 m; section II, at 70 m (loose) and at 240 m; section III, at 130 m. Also at Aucella River, Jameson Land (Block I).

Pholadomya sp. ind.

A crushed and fragmentary example, labelled *P.* cf. *tumida*, Agassiz, is recorded separately only because it seems to have more reticulate ornamentation than the specimen figured in Plate 44, fig. 2. This ornamentation is comparable to that of numerous earlier species of *Pholadomya* in which the concentric ribs are as prominent as the radial costae, but the poor state of preservation of the example here discussed makes it possible that it may represent only an individual variation of the form last described, especially since the young specimen figured in Plate 45, fig. 3 came from the same bed.

Horizon:— Hartzfjaeld Sandstone, *Lingula* Bed; Portlandian.

Locality:— Cape Leslie, Rosenkrantz's section II, at 240 m.

Genus *HOMOMYA*, Agassiz, 1842.

Homomya aff. *hortulana*, Agassiz.

(Plate 47, figs. 11a, b).

1923. *Pholadomya hortulana* (Agassiz) Lewinski: *loc. cit.*, (Mém. Soc. géol. France, Pal., vol. XXV), p. 83.

This form is represented by a fine series of more or less well preserved specimens, most of them, unfortunately, slightly distorted; some specimens, with angularity and ridges of the short anterior region, also show great resemblance to *H. uralensis* (d'Orbigny)[1]. In the figured example, which had been labelled by Rosenkrantz *H.* aff. *uralensis*, the two blunt ridges of the anterior region and the accompanying shallow sulci are scarcely visible; but in other examples, labelled *H. hortulana*, they are quite distinct. Some of Agassiz's[2]) original figures of *H. hortulana* show merely a faint ridge running from the umbo to the ventral border, but the anterior margin is evenly rounded and does not show the sinuosity caused by the ridges and sulci, that distinguishes d'Orbigny's form and

[1]) In Murchison, Verneuil and Keyserling, *loc. cit.*, 1845, p. 468, pl. XL, figs. 13—14 (as *Pholadomya*).

[2]) *Loc. cit.* (Monographie des Myes, III), 1843, p. 155, pl. XV.

some examples of the present species. But these extremes clearly cannot be separated from the numerous specimens which, like the figured example, show only slight bisulcation of the anterior region. It is thus probable that the Greenland form is intermediate between *H. hortulana* and *H. uralensis*; but if Eichwald's[1]) *Pholadomya uralensis* really represent d'Orbigny's species, the present form is clearly more appropriately attached to *H. hortulana*.

Horizon:— Glauconitic Series (and Sandy Clays below?); Upper Kimmeridgian? and Portlandian.

Localities:— Cape Leslie, Rosenkrantz's section I, between 100 and 165 m; also at 70 m (loose); section II, at 70 m (loose) and at 115 m. Hartz Mtn., Crab Valley, loc. E (no. 220, labelled "horizon β, repeated by faulting").

Family *LATERNULIDAE* (= *ANATINIDAE*).

Genus *THRACIA*, Blainville, 1824.

Thracia incerta (Deshayes) Thurmann sp.

(Plate 48, fig. 3; Plate 50, fig. 4).

1923. *Thracia incerta*, Thurmann (Deshayes): Lewinski, *loc. cit.* (Mém. Soc. géol. France, Pal., vol. XXIV—XXV), p. 84, pl. VII, fig. 6.

1929. — — (Thurmann) Cox, *loc. cit.* (Proc. Dorset. Nat. Hist. & Arch. Soc., vol. L), p. 173.

(?) 1935. — cf. *incerta* (Roemer) Cox, *loc. cit.* (Mesoz. Pal. of British Somaliland, pt. VIII), p. 190, pl. XX, fig. 4.

The specimen figured in Plate 48, fig. 3, bore a label *T. friarsiana*, but it does not particularly resemble the illustration in d'Orbigny[2]), although it is crushed and the umbones therefore are flattened and not prominent. D'Orbigny's species, however, has been considered to be identical with *T. incerta* by various authors, and if I now adopt the latter name, it is done because there is good agreement between the Greenland form and the figure of *T. incerta* in Thurmann and Étallon[3]). The low umbo is perhaps the most striking feature, compared with the figure of Lewinski, or the American *T. weedi*, Stanton[4]), with a similar shape, but a comparatively sharp, pointed umbo.

While the original of Plate 48, fig. 3 is crushed and entirely flattened, the small example figured in Plate 50, fig. 4, is one of a number that,

[1]) *Loc. cit.* (Lethaea rossica), 1868, p. 755, pl. XXVII, fig. 2.

[2]) In Murchison, Verneuil and Keyserling, *loc. cit.* (1845), p. 471, pl. XL, figs. 17—18.

[3]) *Loc. cit.* (Lethaea bruntrutana, tom XIX, 1862), p. 165, pl. XIX, fig. 6.

[4]) *Loc. cit.* (U. S. Geol. Surv., Monogr. 32, pt. II), 1899, p. 627, pl. LXXV, figs. 1—3.

although similarly crushed, are double-valved and retain at least some trace of the original shape. This also agrees with that of *T. incerta*, while *T. scythica*, Eichwald[1]) and *T. archiaci*, Eichwald *non* Pictet[2]), are less closely comparable. As had been noted already by Krenkel[3]), in these variable forms of *Thracia* the differences in length and height also influence the position of the posterior ridge and thus the width of the area bordered by it. When crushing complicates matters still further, definite identification of each individual is impossible.

Horizon:— Sandy Shales (with horizon *a*) above Glauconitic Series; Portlandian.

Localities:— Cape Leslie, Rosenkrantz's section I, at 165 m and section II, at 200 m.

Thracia cf. *depressa* (J. de C. Sowerby).
(Plate 50, fig. 3).

1923. *Thracia depressa* (Sowerby) Lewinski, *loc. cit.* (Mém. Soc. géol. France, Pal., vols. XXIV—XXV), p. 84, pl. VII, fig. 7.
1929. — — — Cox, *loc. cit.* (Proc. Dorset Nat. Hist. & Arch. Soc., vol. L), p. 172, pl. V, fig. 3.

The differences between the present species and *T. incerta* have been discussed by Lewinski and I agree with him that Skeat and Madsen's[4]) figure represents a form closer to *T. depressa* than to *T. incerta*. Compared with examples of the latter species from the Hartwell Clay and the Portland Sands of Hounstout Cliff, Dorset, the specimen here figured shows good agreement, but as it is rather defective and the only one found, definite identification is not possible.

Horizon:— Hartzfjaeld Sandstone, *Lingula* Bed; Portlandian.

Locality:— Cape Leslie, Rosenkrantz's section II, at 240 m.

Phylum *Vermes*.
Class *Annelida*.
Sub-order *Tubicola*.

Genus *DITRUPA*, Berkeley, 1835.

Ditrupa nodulosa (Lundgren).

1884. *Dentalium nodulosum*, Lundgren, *loc. cit.* (Bihang K. Vet. Akad. Handl., vol. VIII, no. 12), p. 10, pl. II, figs. 7—9.
1934. *Dentalium* sp. Parat and Drach, *loc. cit.* (Ann. hydrograph.), pp. 12, 13.

In a separate copy of their paper, kindly sent me by the authors, Messrs. Parat and Drach have added "*Ditrupa nodulosa*, Ldgn." (in

[1]) *Loc. cit.* (Lethaea rossica), 1868, p. 735, pl. XXVI, figs. 15a, b.
[2]) *Ibid.*, p. 738, pl. XXVI, fig. 17.
[3]) Monographie der Kelloway Fauna von Popilani in Westrussland. Palaeontogr., vol. LXI, 1915, p. 337.
[4]) *Loc. cit.* (Danmarks geol. Unders., II, no. 8), 1898, p. 138, pl. IV, fig. 16.

writing) to their first identification of "*Dentalium* sp." (on pp. 12 and 13); and although some of the fragments of worm tubes which I am now attaching to this species come from higher beds, they may well be identical with Parat and Drach's earlier examples. The tube is very thick, and the straightness of most of the fragments also makes it probable that they belong to Lundgren's species.

Horizon:— Sandy Clays below Glauconitic Series (horizon *β*) up to Hartzfjaeld Sandstone (*Lingula* Bed); Upper Kimmeridgian and Portlandian.

Localities:— Hartz Mtn., Crab Valley, loc. E (no. 184); Cape Leslie, Rosenkrantz's section II, at 240 m and section III, at 190 m (loose).

Genus *SERPULA*, Linnaeus, 1758.

Serpula sp. ind.

The photograph of the ammonite reproduced in Plate 25, fig. 4, was taken from a squeeze and the actual impression, on one half of a split nodule, shows traces of a number of individuals of *Serpula*, originally attached to the shell of the ammonite. In the impression the tubes are flattened and it is impossible to say whether they were originally rounded and smooth, or angular and ornamented. A similar tangle of worm tubes is represented by *S. flaccida*, Goldfuss[1]) which, however, consists of longer individual tubes and is of earlier Jurassic age. *S. carinella*, J. de C. Sowerby[2]) is an almost exact reproduction of the mass of tangled tubes but this is from the Blackdown Albian. It is possible that, like the *Serpula* sp. recorded in pt. I (p. 62), the present form may be referable to *S. intestinalis*, Phillips[3]), although this is rather large, but the smaller *S. runcinata*, J. de C. Sowerby[4]), of Corallian age, and quoted by Blake[5]) from the Lower Kimmeridge Clay, is also a possibly comparable species, the ornamentation being confined to the upper surface which is not seen in the present impression.

Horizon:— Sandy clays below the Glauconitic Series (*subaperta* nodules); Upper Kimmeridgian.

Locality:— Cape Leslie, Rosenkrantz's section II, at 62 m.

[1]) Petrefacta Germaniae, 2nd. ed., 1862, p. 218, pl. LXIX, fig. 7.
[2]) Min. Conchology, vol. VI, 1828, p. 201, pl. 598, fig. 2.
[3]) In Fitton: Strata below the Chalk. Trans. Geol. Soc., 2nd. ser., vol. IV, p. 347, pl. XXIII, fig. 7.
[4]) Min. Conchology, vol. VI, 1829, p. 227, pl. 608, fig. 6.
[5]) *Loc. cit.* (Quart. Journ. Geol. Soc., vol. XXXI), 1875, p. 221.

Phylum *Brachiopoda.*

Class *Inarticulata.*

Order *ATREMATA.*

Family *LINGULIDAE.*

Genus *LINGULA*, Bruguière, 1789.

Lingula zeta, Quenstedt

(Plate 44, figs. 5a—d).

1858. *Lingula zeta*, Quenstedt: Der Jura, p. 796, pl. 98, fig. 13.
1875. — — — de Loriol, *loc. cit.* (Mém. Soc. phys. Genève, vol. XXIV), p. 243.
1904. — — — de Loriol, *loc. cit.* (Mém. Soc. pal. Suisse, vol. XXXI), p. 287.

There are many hundreds of specimens in excellent preservation; for, apart from blocks of the *Lingula* bed which are crowded with valves of this species, the matrix of every fossil here described from the same horizon is characterised by containing some examples of *Lingula*. One bore the label "*Lingula zeta*, Quenstedt", and there is indeed very good agreement, in ornamentation, shape and dimensions, the length being twice the maximum width. The sides are almost parallel, but the varying angularity of the valves here figured at the beak is due to cutting-out of the photographs. Fig. 5a is the best for general shape and fig. 5b for the striae of growth. Figs. 5 c and d represent internal casts, showing the muscle scars.

L. ovalis, J. Sowerby[1]), not very successfully figured in Davidson[2]), has less parallel sides than the Greenland form, but also occurs associated with *Orbiculoidea latissima*. According to de Loriol, *L. ovalis* is less close to *L. zeta* than is *L. suprajurensis*, Contejean[3]), but this was based on a single specimen and the truncation of the anterior end is accidental. The *Lingula* sp. (*L. brodiei*) figured by Davidson[4]), and the Spitsbergen form cited by Sokolov and Bodylevsky[5]) as resembling it, may well both be the same as the species here discussed. *L. brodiei* was described as being still more elongate, the width being less than half the length. As it was based on a single, imperfect example, however, and could easily be

[1]) Mineral Conchology, vol. I, 1813, p. 56, pl. xix, fig. 4.

[2]) Monograph of British Fossil Brachiopoda. Pal. Soc. Suppl., pt. II, No. 1, 1876, p. 74, pl. ix, figs. 1—9, pl. x, fig. 16b, pl. xi, fig. 29.

[3]) *Loc. cit.* (Mém. Soc. Emul. Doubs), 1859, p. 326, pl. xxi, fig. 3.

[4]) *Loc. cit.* (1876), p. 76, pl. ix, fig. 31; renamed in 1878 (Suppl., pt. II, no. 2) on p. 225.

[5]) *Loc. cit.* (Skrifter om Svalbard, no. 35), 1931, p. 31.

matched by slender examples in the blocks before me, it may well turn out to be a synonym of *L. zeta*.

Horizon:— Glauconitic Series and Hartzfjaeld Sandstone (*Lingula* Bed); Portlandian.

Localities:— Cape Leslie, Rosenkrantz's section II, at 240 m; section III at 190 m (loose) and at 415 m; at Signal 7 M (no. 195). Hartz Mtn., Pinna Valley, loc. A, south side, no. 151; N. E. spur, loc. P, no. 245. Also at Aucella River, Jameson Land (Block II).

Order *NEOTREMATA.*

Family *DISCINIDAE.*

Genus *ORBICULOIDEA*, d'Orbigny, 1847.

Orbiculoidea aff. *latissima* (J. Sowerby).

(Plate 44, figs. 3a—f).

1816. *Patella latissima*, J. Sowerby; Mineral Conchology, vol. II, p. 85, pl. cxxxix, figs. 1 and 5.
1876. *Discina latissima*, J. Sowerby; Davidson, *loc. cit.* (Suppl., II, no. 1), p. 80, pl. x, figs. 16—19; pl. xi, fig. 30.

The English examples of this rather large species are nearly always crushed, as pointed out by Davidson, so that exact comparison is difficult. In the Greenland examples the well marked apex is just above the centre so that in side-view the upper valves are unsymmetrical cones: but the convexity is less marked than in the earlier *O. reflexa* (J. de C. Sowerby), recorded[1]) from Jameson Land. The latter also shows a characteristic curve in the concentric striae of growth at the posterior margin whereas in the present form the fine striation is uniform all round the valves. Remains of the test are seen in the originals of figs. 3 a, b and 3 c, d, while the example figured in figs. 3 e, f, is a smooth internal cast, showing a distinct depression posterior to the umbo, but no muscle scars. The dimensions of the two larger examples are:—

	I	II
Maximum length	9.5	9
— width	9	7.5
— elevation	4.5	4

The lateral compression and comparatively high conical shape suggest comparison with *Discina elevata*, Blake[2]), rather than the present species. But the latter, as can be seen from the three examples here

[1]) In Spath, *loc. cit.* (Medd. om Grønl., vol. LXXXVII, no. 7), 1933, p. 123, pl. xx, fig. 4.

[2]) *Loc. cit.* (Quart. Journ. Geol. Soc., vol. XXXI), 1875, p. 231; Davidson, *loc. cit.* (Suppl. II, no. 1), 1876, p. 81, pl. xi, fig. 31.

figured, is circular at the small size of *D. elevata* and the compression and highly elevated shape of the two larger examples above listed may be due to deformation in the rock. In some examples, in fact, the crushing is obvious, but deformation of these very thin shells often leaves little trace (e. g. obvious cracks) when they are embedded in a soft, micaceous sandstone.

Horizon:— Glauconitic Series and immediately below (*subaperta* nodules); Upper Kimmeridgian and Portlandian.

Localities:— Hartz Mtn., Crab Valley, loc. E, no. 184; Pinna Valley, loc. A, south side, nos. 134 and 151; N. E. spur, loc. P, no. 245. Cape Leslie, Rosenkrantz's section III, at 415 m. Also at Aucella River, Jameson Land (block I).

Class *Articulata*.

Order *TELOTREMATA*.

Family *RHYNCHONELLIDAE*.

Genus *RHYNCHONELLA*, Fischer, 1809.

Rhynchonella aff. *grossesulcata*, Eichwald.

(Plate 46, figs. 10a—c).

1868. *Rhynchonella grosse-sulcata*, Eichwald, *loc. cit.* (Lethaea rossica), p. 331, pl. XVII, figs. 6a—d.

There is only a single example of a *Rhynchonella* and its preservation is rather defective, so that the anterior margin is not exposed. But so far as can be seen the agreement with Eichwald's species is close. There are 8 and 9 pleats not 16 or more, as in *R. lacunosa*, Schlotheim[1]), which has been doubtfully recorded by Parat and Drach from their bed A. Rouillier's[2]) var. *biplicata junior* of *R. lacunosa*, on the other hand, is undoubtedly closer, except for the less continuous pleats and a less pronounced sinus in the pedicle valve; and the absence of such a sinus in the doubtful example attached by Davidson[3]) to *R. lacunosa* also prevents its comparison with the form here described. Lewinski[4]) included Rouillier's variety in the synonymy of his *R. bononiensis* and the original of his "forme peu bombée" (figs. 4a-c) is, indeed, also comparable to the Greenland form; it, however, again lacks the median fold and sinus.

R. lacunosa var. *sparsicosta*, Quenstedt, as figured by Jacob and

[1]) See e. g. in Quenstedt: Der Jura, 1858, p. 632, pl. LXXVIII, fig. 15.

[2]) Études progressives, IV, Bull. Soc. Imp. Nat. Moscou, vol. XXII, no. 2, 1849, p. 388, pl. M, fig. 100.

[3]) *Loc. cit.* (Suppl. II, no. 2), 1878, p. 196, pl. XXVI, fig. 14 only.

[4]) *Loc. cit.* (Mém. Soc. géol. France, Pal., vol. XXIV), 1923, p. 45, pl. VIII, figs. 4—7.

Fallot[1]), has fewer plications, but the same authors'[2]) *R. malbosi*, Pictet, is probably closer, although not identical. The original of *R. malbosi*, Pictet[3]) also differs merely in having one or two more pleats, which are more acute (not on the cast?) and in these pleats developing at an earlier stage.

The dorsal valve of the specimen (a sandstone cast) retains traces of the test near the umbo, where plication is indistinct, and it shows a fibrous structure but there are no recognisable radial striae. This would seem to exclude the present form from *Rhynchonella* s. s. in Buckman's[4]) interpretation, but in the absence of scars, or internal features, it is impossible to suggest an alternative genus.

Horizon:— Glauconitic Series, about 8—10 metres below top and 34—36 m below base of Hartzfjaeld Sandstone; Portlandian.

Locality:— Hartz Mtn., Crab Valley, loc. D (no. 168).

Family *TEREBRATULIDAE*.

Genus *TEREBRATULA*, Müller, 1776.

Sub-genus *Rugithyris*, Buckman, 1917.

Terebratula (*Rugithyris*) *rosenkrantzi*, sp. nov.

(Plate 49, figs. 1a—h).

Diagnosis:— *Rugithyris* with circular outline and pedicle valve considerably more convex than brachial valve; the curvature of both valves is even, but there is sometimes a suggestion of flattening of the brachial valve from the umbo to the anterior margin. The lateral commissure is almost straight; the anterior entirely so. The umbo of the pedicle valve is comparatively short, truncated by a circular foramen and in close proximity to the circular brachial valve. The beak-ridges are obscure. Test with comparatively coarse, lamellar striae of growth, intersected by finer radial lineation. Cast almost smooth, with muscle scars indistinctly shown.

Measurements:— Maximum length about 42 mm; maximum width 36 mm; maximum thickness 22 mm.

Remarks:— As holotype may be taken the example represented in fig. 1a, because it is tolerably complete, but the dorsal and ventral aspects are well illustrated by the two paratypes fig. 1b and 1c respect-

[1]) Étude sur les Rhynchonelles portlandiennes &c. Mém. Soc. pal. Suisse, vol. XXXIX (1913), p. 22, pl. I, figs. 16, 17, 19.

[2]) *Ibid.*, p. 25, pl. II, figs. 17—18.

[3]) Études paléontologiques, sur la faune a *Terebratula diphyia* de Berrias. Mélanges pal. II, 1867, p. 111, pl. XXVI, figs. 10a—d.

[4]) The Brachiopoda of the Namyau Beds, Northern Shan States, Burma. Mem. Geol. Surv. India, Pal. Indica, N. S., vol. III, no. 2, 1917, p. 57.

ively, the unfigured sides of which, however, are defective. The original of fig. 1d has suffered by corrosion and shows the appearance after the lamellar outer layers of the test have been removed. The small internal cast represented in figs. 1e and 1f is typical, but the adductor scars are not distinct; the larger cast, 1g, is in a still worse state of preservation, but it still retains distinct traces of radial ornamentation. The original of fig. 1h is crushed obliquely and it is difficult to say whether its peculiar shape is due to the deformation in the rock; but its brachial valve is strongly convex, whereas in the original of fig. 2c it is crushed in, so as to be almost flat. Whereas the latter example, however, is doubtful and probably belongs to the form described below, the original of fig. 1h shows merely how, with increase in size, the shape becomes more elongated. In a less distorted cast, unfortunately with the brachial valve crushed in, the proportions of length to width have changed from 7 : 6 to 7 : 5½ at a length of 56 mm.

This species is close to *Terebratula boloniensis*, Sauvage and Rigaux[1]); and Parat and Drach[2]), in fact, recorded a *Waldheimia* cf. *bononiensis* from Cape Leslie, which is probably the form here described. As defined by de Loriol[3]) and especially Davidson[4]), this species differs merely in having the beak-ridges sharply defined, leaving a flattened space between them and the hinge line. In the present form, the posterior margin of the ventral valve is perfectly rounded off and there is neither a beak-ridge nor a distinct hinge-area, while the low umbo of the pedicle valve almost (or entirely) covers the deltidium. *Terebratula pycnostictus*, Zeuschner[5]), which has a very similar ventral aspect, is distinguished by the sharp beak of its pedicle valve and the small foramen, away from the dorsal umbo; but like the same author's *T. cyclogonia*[6]), with still more folded lateral commissure, it may belong to the same group as the Greenland form here described.

The present species was given a MS name by Rosenkrantz (on some of the labels) and referred to the genus *Rugithyris*, but since I am now putting it back in the genus *Terebratula* s. l., I have changed the specific name and dedicated the species to its discoverer, in recognition of the excellent work he has done in connection with the invertebrates of East Greenland. The reason for accepting *Rugithyris* only as a sub-genus of *Terebratula* is that I do not believe there is any direct connection

[1]) Journ. de Conchol. (3rd. ser.) vol. XIX, 1871, pl. CCCLIV; vol. XX, 1872, p. 87, pl. IX, fig. 3.

[2]) *Loc. cit.* (Ann. hydrograph.), 1934, p. 11.

[3]) *Loc. cit.* (Mém. Soc. phys. Genève, vol. XXIV), 1875, p. 237, pl. XXV, fig. 19.

[4]) *Loc. cit.* (Suppl. II, 2), 1878, p. 154, pl. XIX, figs. 1—2.

[5]) Palaeont. Beiträge zur Kenntniss des weissen Jura-Kalkes von Inwald bei Wadowici. Prag, 1857, p. 13, pl. III, figs. 1e, 2e, 3e, 4e.

[6]) *Ibid.*, p. 11, pl. III, figs. 1d, 2d, 3d, 4d.

between the present species and the Bajocian *T. subomalogaster*, Buckman, the type of *Rugithyris*[1]). That is to say, the Terebratulid stock was more than once affected by an outbreak of such a special feature as rugosity, and it is highly artificial to unite a Bajocian and a Portlandian form, regardless of internal structure, because they are both rugose, and to separate them from their normal smooth contemporaries that carried on the main Terebratulid stock.

Horizon:— Glauconitic Series; Portlandian.

Localities:— Hartz Mtn., E. side, loc. B, no. 157; N.W. spur, loc. M, nos. 210 and 211; N. E. spur, loc. P, no. 246; Cape Leslie, Rosenkrantz's section I, at 100 to 115 m; section II, at 70 m (loose), and at 115 m.

Terebratula (*Rugithyris*) sp. ind.

(Plate 49, figs. 2a, b).

The Terebratulids from Cape Leslie apparently include an elongated species, in addition to the circular form last discussed; and it is possible that the larger type is represented by the Cape Leslie examples attributed by Parat and Drach[2]) to *Terebratula insignis*, Schübler. That species, of course has been widely quoted and no doubt, often misidentified, but if it can be called egg-shaped and twice as long as wide[3]), it cannot be close to the form under discussion. In one of the largest examples referred to the present form, the length is 64 mm and the width 42 mm, but the brachial valve is crushed in, as it also is in the cast figured in Plate 49, figs. 2a,b, and in the doubtful example, already referred to under the last species (Plate 49, fig. 2e).

The beak of the pedicle valve is much more elevated than in the last species and it is more separated from the dorsal umbo. There seem to be only fine concentric growth-lines and no radial ornament at all in the examples that retain the test. Conversely the cast figured in Plate 49, figs. 2a,b is more rugose than that of the last form (figs. 1e,f), and even shows traces of the longitudinal lineation, so that the absence of the rugose ornament in other specimens (as in many examples of *T.* (*R.*) *rosenkrantzi*), is merely due to the defective preservation. The form, then, is probably merely a more elongate type of the same group, or perhaps only a variety, but the material at present available is insufficient.

Horizon:— Glauconitic Series; Portlandian.

Localities:— Hartz Mtn., N. W. spur, loc. M, no. 211; Cape Leslie, Rosenkrantz's section I, at 100—115 m and at 130 m.

[1]) Buckman, *loc. cit.* (Pal. Indica, N. S., vol. III, no. 2), 1917, p. 127, pl. XXI, fig. 20.

[2]) *Loc. cit.* (Ann. hydrograph.), 1934, p. 11.

[3]) Zeuschner: Palaeontologische Beiträge zur Kenntniss des weissen Jura-kalkes von Inwald bei Wadowici. 1857, p. 11, pl. III, figs. 1c, 2c, 3c, 4c.

III. THE LOCALITIES AND THE EVIDENCE OF THE SECTIONS

Dr. Aldinger's stratigraphical account, now in press[1]), will deal with the localities at which his fossils were collected, and it will include a detailed map of the part of Milne Land (the eastern portion, chiefly between Cape Leslie and Hartz Mtn.) in which all the sections discussed below are situated. The present chapter, therefore, is devoted merely to a discussion of the difficulties offered by nearly all of the successions and of the varying interpretations given by the different observers, since Rosenkrantz's first investigation in 1927. The difficulties are only partly due to the slipping of certain beds and their fossils to a lower level, so that, on ascending the slopes from the sea to the ridge running from Hartz Mtn. to Cape Leslie, some of the beds have been encountered by the collectors more than once. Even Dr. Aldinger who recognised and mapped these slip-faults, parallel to the coast line, had to leave some of his fossil horizons in doubt; and since the ammonites are nearly all new, I had to find their probable positions merely by comparison with known European successions. Of course, when there are identical faunal assemblages from different levels and the lithology is similar, it is easy to discover the repetition; but when there are similar nodule beds at different horizons and yielding different but superficially similar fossil assemblages, then it is impossible to detect repetition in a slipped mass, unless the beds have been located elsewhere *in situ* and their proper order and faunal contents have been ascertained. This, unfortunately, has not yet been done. The matrix is occasionally helpful, although all Greenland sediments, at least of the Mesozoic, seem to be micaceous; but for example the distinctive *Lingula* Bed is not the only horizon with *Lingula* and its usefulness is limited, for it has not been recognised by Dr. Aldinger north of his Castle Hill ("Schloss"), just where the great thickness of Hartzfjaeld Sandstone makes it desirable to have such a datum line. Again

[1]) See footnote 2) on p. 10. The mountain referred to in the present paper as Sandstensfjaeld is named Kronenberg on Dr. Aldinger's map (pl. 3), For details of the sections mentioned below see pp. 81—91 in Dr. Aldinger's account.

the intensely glauconitic beds are easily recognised but do not seem to be confined to one horizon; and as the Glauconitic Series varies in thickness from 17 m (at E, see below) to 72 m (at M), or, generally, to the west, i. e. nearer the ancient coast line, the fossils available (perhaps only a single ammonite from a given locality) are not always easy to correlate.

The Upper Jurassic succession of Milne Land, up to the base of the *Pectinatites* Beds, was discussed in part I and it was shown that the extent of the gap between the Lower and the Upper Kimmeridgian was difficult to appraise. Since then Messrs. Parat and Drach[1]) have recorded *Aulacostephanus pseudomutabilis* and *Perisphinctes bleicheri*, which would make it appear that at least the Middle Kimmeridgian *Aulacostephanus*[2]) and *Gravesia* beds (see Table on p. 74 of part I) were represented in Milne Land. But I cannot reconcile this record either with the information given me by Dr. Aldinger or with Messrs. Parat and Drach's own successions. In their

Section L

taken on the eastern slopes of Hartz Mtn., the basal Kimmeridgian bed A, on account of the combination of *Cardioceras* with "*Aspidoceras*", belemnites, and reptilian bones may be assumed to correspond to my *Hoplocardioceras* slabs, or Oil Shales, at the top of the *Amoebites* Shales (see part I, p. 67). If their record of *Aulacostephanus pseudomutabilis*, however, from this lowest bed A is correct, it is improbable that the same species, still associated with *Cardioceras*, occurred again in bed E, 110 m or 366 and more feet higher. In any case this would bring it above the black indurated shales with *Pectinatites* which according to Dr. Aldinger are at 90—100 m below the base of the Glauconitic Series; and since these are apparently followed by micaceous sandy shales, often reddish, and then by grey, sandy shales with layers of nodules, containing crustaceans (perhaps Parat and Drach's Kimmeridgian bed B) the two accounts are irreconcilable. The range of *Cardioceras*, which does

[1]) *Loc. cit.* (Ann. hydrograph.), 1934, p. 12.

[2]) The customary use of "*Aulacostephanus*" is open to objection, since the genotype is *Amm. mutabilis*, Sowerby, a species referred by Salfeld to *Rasenia* and subsequently renamed *Pararasenia* by myself. I therefore endorse the proposal of Arkell (Geol. Mag., vol. LXXII, June 1935, p. 256) to stabilise the common usage of *Aulacostephanus* by ruling that the genotype be *Amm. mutabilis*, d'Orbigny *non* Sowerby (= *Amm. pseudomutabilis*, de Loriol). But I cannot support Arkell's contention with regard to *Rasenia* discussed in part I (pp. 38—40); to overrule the confusions of previous authors in this manner would result in nomenclatorial chaos. With regard to *Pictonia*, I have nothing to add to what was said in part I, seen by Dr. Arkell before the appearance of his paper. Earlier still I confessed in a letter to him, that my spelling of "*cymadoce*" (instead of *cymodoce*) was wrong and purely accidental; nevertheless he thought fit to publish the pronouncement: "Not *cymadoce*, as Dr. Spath writes . . . Such changes are not allowed by the Rules."

not extend higher than the *Aulacostephanus* beds, is of little help in this connection, because there is a gap between Messrs. Parat and Drach's Kimmeridgian bed E and their "Portlandian" bed A; but even if it be assumed that there is repetition of certain beds, it does not fit in with their correlation of D, C and B with similar beds in another section (C). Dr. Aldinger has mapped the outcrops in this section (Chatton Kløft, or Kløft 2W of Dr. Aldinger) and the only beds represented, resting on the Chatton Bay (or Charcot Bay) Sandstone, are of Upper Oxfordian age, belonging to the *Cardioceras* Shales and *Pecten* Sandstone of my previous account (part I, p. 67).

It thus seems possible that in section L, as in C, the Kimmeridgian beds D, C and B could be Upper Oxfordian and that bed A is really E repeated by faulting or slipping, but unfortunately this is not borne out by Dr. Aldinger's map and in any case, E does not connect up with the succeeding "Portlandian".

This latter must be compared with Dr. Aldinger's successions established at his localities E, O and A, that is to say on those slopes between the southern ridge of Hartz Mtn, and the sea, where the crest is at approximately 450 m height. At

Section E,

that is on the ridge south of Crab Valley, the top of the succession is formed by Hartzfjaeld Sandstone, the base of which is at 310 m. Between this height and 280 m the Sandy Shales above the Glauconitic Series (including the nodule bed α at 294 m) crop out, followed by about 17 m of the Glauconitic Series; but the base of this (at 263 m?) is obscured. Nodule bed β, with many *Eryma* etc., at 227 m, according to Dr. Aldinger's information, is repeated at 162 m, 65 m below; but the ammonites are not the same, and, judging by the succession in Dorset, might well be in place. On the other hand, this second, lower horizon, found again at

Section D

(Nos. 171, 173, Crab Valley) was here also about 135 m below the top of the Glauconitic Series, that is, much lower than where β would be expected to be found, and I am thus including this horizon in the *Pectinatites* beds.

At

Section O

(ridge between Crab and Astarte Valleys) the succession includes Hartzfjaeld Sandstone from 462 to about 341 m, but only the shales above the Glauconitic Series (with horizon α) are exposed between 341 and about 320 or 315 m, while a layer of clay ironstone at 310 m probably represents merely the top (but all that is visible) of the Glauconitic Series, largely covered by debris. But here again, the phosphatic concretions

with crustaceans, thought by Dr. Aldinger to be probably horizon β, but not containing the same ammonites, were found at only 236—228 m, that is 80—90 m below the presumed top of the Glauconitic Series. Unfortunately, what has been called concretionary horizon β in the neighbouring

Section A

(Pinna Valley) again contains a slightly different assemblage, although still with *Pavlovia* (*Pallasiceras*) *regularis*. The ammonites suggest correlation with horizon 62 m at Rosenkrantz's section II (see p. 148) but this is probably above β; unfortunately there is no section where the different nodule beds with crustaceans have all been found *in situ*, one above the other. At Section A, the Hartzfjaeld Sandstone occurs from the top

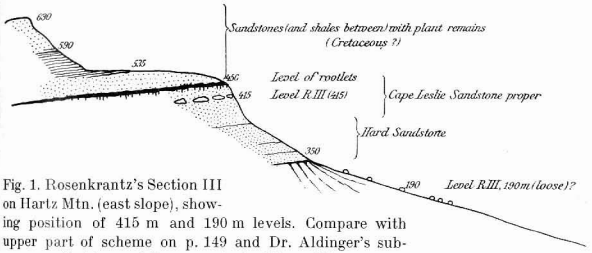


Fig. 1. Rosenkrantz's Section III on Hartz Mtn. (east slope), showing position of 415 m and 190 m levels. Compare with upper part of scheme on p. 149 and Dr. Aldinger's subdivisions of the same beds (his p. 53).

(444 m) down to 339 m, and is followed by Sandy Shales and the Glauconitic Series below, down to about 289 m. The concretionary horizon β already referred to, which also is unique in containing "masses of a large *Astarte*" (not brought back) is at 223 m, but at 189 m the Glauconitic Series (top part?) has reappeared, while the band of crushed Perisphinctids, which I took to mark the boundary between the Lower and the Upper Kimmeridgian portions of the succession, was 120—140 m lower. But this section is already due east of Hartz Mtn., and while the succession may go down to the *Hoplocardioceras* shales at sea-level, the *Pecten* Sandstone and the still earlier *Cardioceras* Shales, according to Dr. Aldinger's map, do not crop out till farther north. It is very doubtful, therefore, whether Parat and Drach's correlation of their beds D—B of sections L and C is reliable.

Mr. Rosenkrantz's

Section III

(June 15th, 1927) was taken somewhere near the Astarte Valley (Section O), and although many fossils here recorded from 190 m were found loose, or at least in the slipped portion of the cliff, the lower limit of his "hard

sandstones with loose sand between" (at 350 m) seems to agree with the base of the Hartzfjaeld Sandstone Series, always easy to recognise, according to Dr. Aldinger. But his "uppermost fossil horizon", from which many fossils are here recorded, at 415 m, i. e. 65 m above the base of the Hartzfjaeld Sandstone, has not been re-discovered by Dr. Aldinger, unless, in spite of lithological dissimilarity, it is the same as the bed with *Craspedites ferrugineus* (at 419 m or 79 m above the base of the Hartzfjaeld Sandstone) which is said to contain many pelecypods (*Pinna*, *Pleuromya*, *Parallelodon*, *Pecten*), *Orbiculoidea* and fragments of very large ammonites. This is probably the same bed as a layer of ferruginous concretions with *Titanites?* sp. and *Craspedites* sp. ind. (also said to include many *Pinna* and other pelecypods) encountered at 394 (or 398?) m in Section O, i. e. 53—57 m above the base of the Hartzfjaeld Sandstone. Unfortunately, the only ammonite fragment in Mr. Rosenkrantz's collection from the 415 m horizon is unrecognisable. It shows loss of ribbing, as in *Kochina groenlandica*, from the *Lingula* Bed of Cape Leslie, but is quite unlike any ammonite of the English Portlandian. In both sections O and A the horizon with large ammonite fragments is overlain almost immediately by the light coloured sandstones with *Subcraspedites groenlandicus*, sp. nov., showing pearly lustre. The associated *Entolium nummularis* and *Isocyprina?* sp. seem to connect these sandstones with the beds below and the *Protocardia* sp. juv. ind. figured in Plate 43, fig. 5b,c and enclosing in the same piece of glauconitic, gritty and phosphatic matrix the impressions of a *Trigonia* and of an *Astarte*, is from even higher, though found loose. In Mr. Rosenkrantz's section, the top of his "Cape Leslie Sandstone proper" is at 450 m (or 35 m higher than the fossiliferous horizon at 415 m) where there is a horizon of rootlets[1]), while the topmost 180 m of the series with plant remains were doubtfully classed as Cretaceous.

Combining the evidence from sections E to A, comprising the eastern slope of Hartz Mtn., it seems that the base of the Hartzfjaeld Sandstone moved up from 310 m in the south to 339 m in the north, the base of the Glauconitic Series from 263 to 289 m, and that the thickness thus remained fairly constant. But nodule bed β at E is not the same as β at O or A which accounts for the slight differences in the ammonites. Crustaceans are said to be common also in the presumably still lower nodules with *Pectinatites* and it is, of course, easy to confuse these similar nodule beds in the field. But there is as yet nothing to correlate section L, with the sequence here discussed, lithologically or palaeontologically, except the presence of nodules with *Eryma* sp. in Parat and Drach's bed B.

[1]) This level of rootlets, according to Dr. Aldinger, is a layer of worm tubes or something similar.

The upper beds of the littoral Hartzfjaeld Sandstone Series (between 327 and 656 m) are well exposed in

Section A_1 ("above A")

at the upper end of Kiderlen Ravine. Since Dr. Aldinger is publishing the details of this "rhythmic" deposit separately, it may suffice here to state that *Buchia* ("*Aucella*") cf. *fischeriana*, d'Orbigny sp. (Pl. 42, fig. 3) from about 160 m below the top of Hartz Mtn. (656 m), *Craspedites leptus*, sp. nov. from 213 m below, and a doubtful *Trigonia* from 229 m below the top are the only fossils before me. The base of the Hartzfjaeld Sandstone is said to be at 327 m (although at a spot slightly farther south) and the *Pinna* bed, near the top of the Glauconitic Series, at 298 m.

On the north-east spur of Hartz Mtn., at

Section P

the base of the Hartzfjaeld Sandstone has moved up to 405 m and the Glauconitic Series with the Sandy Shales above it has increased in thickness from 50 to 75 m. Nodule bed β was doubtfully placed at 95 m, i. e. 35 m below the base of the Glauconitic Series, but there are no fossils before me from this horizon.

Messrs. Parat and Drach have also published a

Section H

taken on this ridge, but again I am unable to reconcile the two accounts. Of all their ammonite identifications, the recurring "*Hoplites subrjasanensis*" is to me the least explicable.

Section M

at the north-west ridge of Hartz Mtn, shows the base of the Hartzfjaeld Sandstone at 431 m and the Glauconitic Series (with scarcely any "Sandy Shales" above) is again 72 m in thickness. But from horizon β at 328 m (31 m below the Glauconitic Series) there are no fossils.

The eastern end of Sandstensfjaeld and the adjoining *Perna* Ridge have yielded

Section 3 M

with the Hartzfjaeld Sandstone occupying only the top, down to 591 m. The Glauconitic Series (without Sandy Shales on top) goes down to 510 m, but the concretions just below and at 500 m have yielded only *Dorsoplanites jubilans*, not recognised anywhere else.

Messrs. Parat and Drach's

Section S

was taken on the northern side of the same Sandstensfjaeld but if their bed B is correctly correlated and is at 600—610 m then it is again impossible to reconcile this with Dr. Aldinger's account.

Nearer Cape Leslie

Section 7 M

taken on Castle Hill ("Schloss"), 500 m south of the top (340 m), showed Hartzfjaeld Sandstone down to 315 m, where the *Lingula* Bed cropped out. According to Dr. Aldinger's notes, this is 70 m above the base of the Hartzfjaeld Sandstone and as it is a conspicuous feature in the Cape Leslie area, it may be assumed to be fairly constant. On the *Lingula* Ridge, farther south, this bed is at only 240 m, according to Rosenkrantz's

Section II,

but unfortunately the lower beds, down to sea level, are largely slipped and therefore repeated. The following are the details of this section, as forwarded to me by Mr. Rosenkrantz.

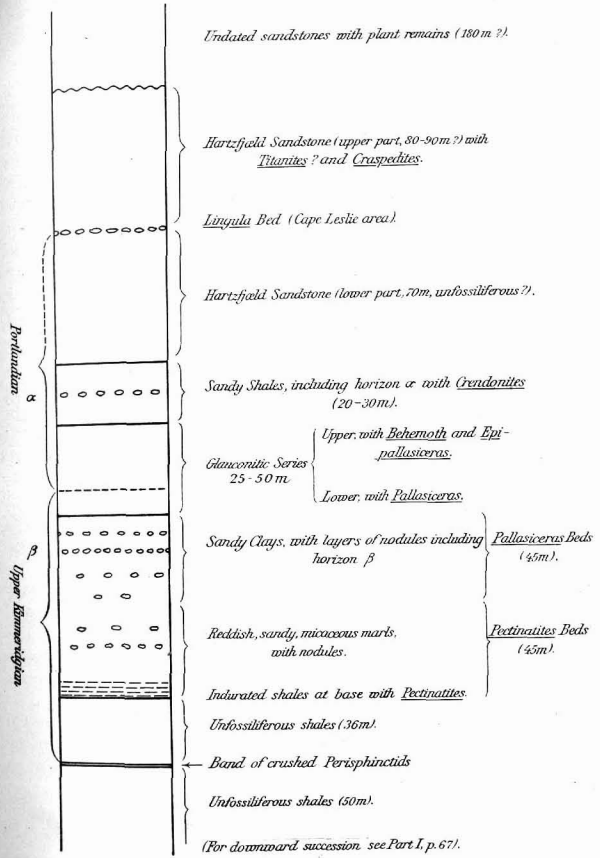
240 m	*Lingula* Bed (Calcareous sandstone with abundant *Lingula* &c., but only one ammonite).
200 m	Sandy limestone, with (mostly crushed) ammonites and pelecypods.
120—115 m	Glauconitic ironstone, upper part with numerous ammonites, lower part with pelecypods and brachiopods.
115 m	Calcareous, micaceous sandstone with numerous pelecypods but few and badly preserved ammonites.
62 m	Clay with small nodules containing numerous ammonites, crustaceans, fishes, etc.
35 m	Concretions of bluish sandy limestone, with fossils badly preserved. (The ammonite remains [*Dorsoplanites*? sp. ind.] are not definitely recognisable).

For comparison of this succession with that published by Parat and Drach, it may be useful to give first the evidence of Rosenkrantz's

Section I

although this is already on Glauconite Hill, just north of Cape Leslie, and does not go as high as the *Lingula* Bed. The sequence here is as follows:—

165 m	Sandy limestones, with crushed ammonites, as in 200 m level of Section II.
130 m	Glauconitic beds with large nodules and *Behemoth groenlandicus*, sp. nov.



Part of the Upper Jurassic succession on Milne Land, showing the Upper Kimmeridgian-Portlandian portion. (From information kindly supplied by Dr. Aldinger, and with modifications suggested by the ammonite evidence).

100—115 m Glauconitic ironstone, as in 115—120 m level of section II.
100 m Calcareous, micaceous sandstone with numerous pelecypods, as in 115 m level of section II.

The beds at still lower levels were covered by talus, but confirmation of part of the upper beds is supplied by a small succession, established by Dr. Aldinger on the eastern slopes of the same hill. Here the top beds (thickness ? m) included the concretionary horizon *a* and at 151 m were underlain by first a layer of clay ironstone, then dark green glauconitic marls (.8 m), then glauconitic sandstone with very many *Pleuromya*, ammonites (not brought back), wood (2 m), and finally sandy marls with ferruginous concretions below. Apart from the fact that the preservation of the ammonites is similar, it is probable that horizon 200 m in Section II and 165 m in Section I correspond to horizon *a* in the Sandy Shales above the Glauconitic Series, and that only the lower four beds of Section II may have slipped to lower levels than they should occupy according to section I and Dr. Aldinger's information.

An attempt to reconcile the successions just discussed with Parat and Drach's

Section L_2

must be made, irrespective of their ammonite identifications. *Perisphinctes bononiensis*, de Loriol, in their bed F shows that this comprises the *Lingula* Bed, the Sandy Shales above the Glauconitic Series, and part of the latter as well; but their remaining beds E to C are probably similarly in the Glauconitic Series. Only, judging by the presence of *Pinna* in C and of *Terebratula* in B, that is fossils characteristic of the 115—120 m horizon of Rosenkrantz's Section II and the upper part of the Glauconitic Series in other localities, it is doubtful whether the beds are in the right order. The nodules A with *Parallelodon*, however, may indicate the same horizon as the 62 m level in Rosenkrantz's section II, because *Parallelodon* is common in these nodules; only here again the abundance of *Rhynchonella* and *Terebratula* is rather baffling.

The generalised succession on p. 149, largely based on information kindly forwarded to me by Dr. Aldinger, must be considered to be provisional, in view of the many difficulties and ambiguities referred to in this account.

IV. THE AGE OF THE FAUNAL ASSEMBLAGES

The distribution of the 121 species of invertebrates in the various formations indicated in the foregoing generalised scheme (or, rather, the different assemblages) is given in the tables on pp. 154—9. Unfortunately neither the base nor the top of the series can yet be definitely fixed in the geological time scale. But I shall attempt to show in the present chapter that from the Indurated Shales, at the base of the *Pectinatites* Beds, to almost the last fossiliferous horizon in the Upper Hartzfjaeld Sandstone, there is close affinity of the faunas and that they are probably referable to the Upper Kimmeridgian and the Portlandian.

As mentioned on p. 13 the three ammonites from the band with crushed Perisphinctids are not definitely recognisable and may perhaps belong to the lower set of beds, dealt with in part I, or to some intermediate horizon. Until the shales above and below have yielded fossil evidence and until ammonites in a better state of preservation are available from this basal band, it will be impossible to appraise the size of the gap, if any, between the Upper and the Lower Kimmeridgian successions. But it appears to me to be a general rule that where beds are separated by a large break in the succession, involving an interval of unfossiliferous beds, these are more likely to form either the final phase of the earlier cycle of sedimentation or else the beginning of a fresh cycle, than to represent some intermediate formation, while a complete bridging of the gap is practically out of question. That is to say if I find a top Callovian bed 1 overlain by indeterminable sediments and then immediately the basal Kimmeridgian horizon 21, the intervening beds are more likely to be the post-Callovian 2, 3 and 4, or the immediately pre-Kimmeridgian 17, 18 and 19 than to represent either the full but condensed sequence from 2 to 19 or some beds like 11, 12 and 13, out of the middle. This universal incompleteness of the geological record is not yet fully recognised even by workers on the Jurassic and Cretaceous, i. e. systems in which non-sequences are more easily detected than in the less undisturbed Palaeozoic; and great confusion is still caused by erroneous correlations of slightly dissimilar faunas from different localities.

Nothing can be added then to what has been tentatively suggested on p. 13 with regard to the age of the ammonites from the band with crushed Perisphinctids. On the other hand, shales that are presumed to succeed the 36 m of unfossiliferous shales overlying this band, have yielded an ammonite (*Pectinatites* aff. *eastlecottensis*, Salfeld sp.) that can be dated with some confidence, although it also is crushed. It is a form of a group of Upper Kimmeridgian ammonites which occur in the lower *pectinatus* zone at Eastcot, Swindon, where the red and green, sandy Cemetery Beds (whence Salfeld obtained the holotype of his ill-named *P. eastlecottensis*) are immediately overlain by glauconitic marls with *Keratinites* and *Paravirgatites*. On the Dorset Coast, in the type succession of the Upper Kimmeridge Clay, few ammonites have so far been collected in the rather unfossiliferous shales between the Three White Stone Bands, but strongly horned *Keratinites* occur both between the two top bands (Blake's beds 12 and 10) and above the highest, up to within a few feet below the hard bed (no. 8) forming the cascade at Freshwater Steps. *Pectinatites scalariformis*, on the other hand, I have found at 10 feet above bed 10, but fragments of *Pectinatites* that compare well with *P. aulacophorus* and therefore the inner whorls of *P. eastlecottensis* occur as low as Blake's Cement Stone 14, below the Middle White Stone Band. Subdivision thus is not yet possible and the successions at Wheatley and Shotover[1]) also are not supporting the five or six hemerae recognised by Buckman[2]) in the *pectinatus* zone. Even at Swindon the upper and lower portions together have a thickness of only about 15 feet[3]).

The Greenland *P.* aff. *eastlecottensis* was found loose and there is some doubt about its horizon. According to Dr. Aldinger's list it was found at about 100 m below the Glauconitic Series; according to his sections, however, within this Series. At any rate it comes from a locality (M) where the next higher (or next lower) ammonite is a new species (*Dorsoplanites flavus*, sp. nov.), said to be from horizon β. The other forms of *Pectinatites* here described are from doubtful levels below the Glauconitic Series, varying between 15—20 m, 85 m and even 101 m. The placing of the *Pectinatites* shales below the marls with nodules in the scheme on p. 149 is thus provisional and cannot be taken to prove that the subdivision of the *Pectinatites* beds into a lower (*eastlecottensis*) and an upper (*devillei* or *boidini*) sub-zone, is correct.

Associated with the six forms of *Pectinatites* of these presumed upper *Pectinatites* Beds there was a doubtful *Paravirgatites* which is already much like *Pallasiceras*. Large forms of *Paravirgatites* are common in the

[1]) See Buckman, Type Ammonites, vol. IV, 1922, p. 28.

[2]) *Ibid.*, p. 47; also vol. VII, 1930 (ed. A. M. Davies), p. 23.

[3]) Chatwin and Pringle: The Zones of the Kimmeridge and Portland Rocks at Swindon. Summ. Progr., Geol. Surv., 1921, Appendix VI (1922), p. 163.

nodules of Blake's bed 7 and they occur in the Shotover Sands, together with *Pectinatites pectinatus* (Phillips) and its allies. It is probable that there is a perfect passage from *Paravirgatites* up into *Pallasiceras*, but on the Dorset Coast the beds between 7 and the lowest badly crushed *Pallasiceras* at the top of bed 4 have not yet yielded satisfactory evidence of the presence of *Keratinites boidini* and *K. devillei*. Yet in the Tour de Croie nodule bed of the Boulonnais, many examples of these two species, occur together with large numbers of *Pallasiceras* and overlie a clay with a species of *Pectinatites* (C. H. Waddington Coll.) that could well be identified with the Greenland form figured in Plate 3, fig. 1

The next assemblage, listed as from the *Pallasiceras* nodules, again includes some doubtful forms, but is most typically represented by the species from the nodule bed β. In view of what has already been said in the descriptions of these species, there can be no doubt about the correlation of this horizon with the *rotunda* zone of Dorset, but whether they correspond to the upper or lower part is as yet uncertain. In Dorset *Pavlovia* (*Pallasiceras*) *rotunda* occurs throughout 100 feet of clays but is well preserved only in one nodule bed, 6 feet below the top, or 15 feet above Blake's bed 2. But some small *Pallasiceras* from the *rotunda* nodule bed are very much like species here described from the 62 m level in Rosenkrantz's section II. There, however, they are associated already with forms like *Pavlovia* (*Pallasiceras*) *subaperta* that foreshadow the ammonites of the higher Glauconitic Series and with the first examples of several species of *Dorsoplanites*, common higher up. It is almost certain, therefore, that these *subaperta* nodules are at a higher level than the *communis* nodules (or horizon β of Dr. Aldinger), although they may have one species (*P. regularis*) in common.

The remaining ammonites are new forms but they are comparable to species described from the higher Glauconitic Series. They include *Pavlovia* (*Pallasiceras*) *variabilis* which was labelled "β" but has the bluish sandstone matrix of Rosenkrantz's 35 m horizon at section II, 27 m below the *subaperta* nodules. This, again, seems to confirm the view that there are several horizons of nodules, but the case of these isolated forms is rather different from that of the *communis* and *subaperta* nodules, which are represented by considerable numbers of specimens, many of them preserved on the halves of split nodules.

In the Glauconitic Series, of variable thickness, there are again several distinct faunas that are not yet clearly separable. The ammonites described as *Pavlovia allovirgatoides*, *P.* (*Pallasiceras*) *inflata*, *P.* (*P.*) *kochi* and *P.* (*P.?*) *alterneplicata*, and preserved in an intensely glauconitic marl, are said to be probably from the basal part of the Glauconitic Series; but they are from a locality (N) where only *Pectinatites* were found, 15—20 m lower. Judging by the neighbouring section M (see

	Basal Bed	*Pectinatites* Beds		Glauconitic Series		Sandy Shales with horizon *α*	Assemblage from R III (190) (See p. 164)	*Lingula* Bed	Hartzfjaeld Sandstone & fauna from R III (415) (see p. 164)
		Shale	Sandy Clays	Lower	Upper				
1. *Subdichotomoceras*? (*Sphinctoceras*?) sp. ind.	169	..	..	..	..	..	..	..	..
2. *Subplanites*? sp. ind.	169	..	..	..	..	..	..	..	..
3. *Subplanites*? (*Virgatosphinctoides*?) sp. ind.	169	..	..	..	..	..	..	..	..
4. *Pectinatites* aff. *eastlecottensis* (Salfeld)	..	242	..	..	..	..	..	..	..
5. — sp. ind.	..	..	248	..	..	..	..	..	..
6. — (?) sp. nov.	..	..	215	..	..	..	..	..	..
7. — aff. *tricostulatus* (Buckman)	..	..	248	..	..	..	..	..	..
8. — (*Keratinites*) aff. *devillei* (de Loriol)	..	..	171	..	..	..	..	..	..
9. — — cf. *boidini* (de Loriol)	..	..	220	..	..	..	..	..	..
10. — (— ?) *groenlandicus*, sp. nov.	..	..	217	..	..	..	..	..	..
11. *Pavlovia allovirgatoides*, sp. nov.	..	..	..	213	..	..	..	..	..
12. — *jubilans*, sp. nov.	..	..	..	234	..	..	..	..	..
13. — (*Paravirgatites*?) sp. ind.	..	..	220	..	..	..	..	..	..
14. — (*Pallasiceras*) *communis*, sp. nov.	..	..	..	182	..	..	..	..	..
15. — — *regularis*, sp. nov.	..	..	..	127, 1[illegible] 225, R [illegible]	..	..	..	..	..
16. — — *perinflata*, sp. nov.	..	..	..	182	..	..	..	..	..
17. — — *subaperta*, sp. nov.	..	..	..	R II	..	..	..	..	..
18. — (— ?) sp. nov.?	..	..	..	R II	..	..	..	..	..
19. — — *variabilis*, sp. nov.	..	..	..	127	..	..	..	..	..
20. — — *inflata*, sp. nov.	..	..	..	R II (70)?	R I (100)?	..	..	..	..
21. — — *kochi*, sp. nov.	..	..	..	213	..	..	..	..	..
22. — (— ?) *alterneplicata*, sp. nov.	..	..	..	213	..	..	..	..	..
23. — — *rugosa*, sp. nov.	..	..	..	223, R I (115—130)		..	..	..	..
24. — — *similis*, sp. nov.	..	..	..	..	209	..	..	..	..
25. — — *rotundiformis*, sp. nov.	..	..	..	..	R I (115—130), 179?	..	..	..	..
26. — (*Epipallasiceras*) *pseudaperta*, sp. nov.	..	..	..	162—164, 167, 175—178, 185, R I (100—115)		..	..	..	..
27. — — *costata*, sp. nov.	..	..	..	134, 162, 245		R I (165)	..	..	..
28. — — *tumida*, sp. nov.	..	..	..	..	R I (100—130)	..	..	..	..
29. — — *praecox*, sp. nov.	..	..	..	..	176	..	..	..	..
30. — (— ?) sp. ind.	..	..	..	..	125	..	..	..	..
31. *Crendonites lesliei*, sp. nov.	..	..	..	..	..	R I (165), R II (200), 202, 153	..	..	..
32. — *euglyptus*, sp. nov.	..	..	..	..	..	R I (165), R II (200)	..	..	..
33. — *subregularis*, sp. nov.	..	..	..	..	..	R I (165), R II (200), 153, 155, 165	..	..	..
34. — *anguinus*, sp. nov.	..	..	..	..	..	R I (165)	..	..	..
35. *Behemoth groenlandicus*, sp. nov.	..	..	..	..	R I (130), 181?	..	..	..	..
36. *Titanites*? sp. ind.	..	..	..	213	..	..	..	..	241
37. *Dorsoplanites antiquus*, sp. nov.	..	..	..	..	223, 245	..	..	..	..
38. — *transitorius*, sp. nov.	..	..	..	..	223	..	..	..	..
39. — *aldingeri*, sp. nov.	..	..	..	..	..	..	..	..	..
40. — *maximus*, sp. nov.	..	..	..	38—139, 148—149, 152, 162—163, 176, R I (100—115)	176, 221	..	..	..	..
41. — *gracilis*, sp. nov.	..	..	..			R I (165)	..	..	..

	Basal Bed	*Pectinatites* Beds		*Pallas.* Nod. (with	Glauconitic Series		Sandy Shales with horizon *a*	Assemblage from R III (190) (See p. 164)	*Lingula* Bed	Hartzfjaeld Sandstone & fauna from R III (415) (see p. 164)
		Shale	Sandy Clays		Lower	Upper				
42. *Dorsoplanites crassus*, sp. nov.	..	..	..	R II	166, 209, 224, 230, 245	..	..	..	..	..
43. — *flavus*, sp. nov.	..	..	..	212	..	..	..	..	..	..
44. — *subpanderi*, sp. nov.	..	..	..		130, 135—136, 180, 196—199, 209, 239, 245, R I (100), R II (115)		..	..	..	..
45. — *dorsoplanoides*, sp. nov.	..	..	..		..	137, 245	..	..	..	..
46. — *jamesoni*, sp. nov.	..	..	..		..	128, 200	..	..	..	..
47. — *triplex*, sp. nov.	..	..	..	R II	180, 209, 245, R I (130)?		..	..	..	..
48. *Kochina groenlandica*, sp. nov.	..	..	..		..	..	..	..	196, R II (240)	..
49. *Craspedites leptus*, sp. nov.	..	..	..		..	..	..	..	..	158
50. — *ferrugineus*, sp. nov.	..	..	..		..	..	..	..	..	228
51. — sp. ind.	..	..	..		..	..	..	..	..	241
52. *Cylindroteuthis?* aff. *explanata* (Phillips)	..	..	..		..	..	..	..	..	..
53. *Pachyteuthis* aff. *panderiana* (d'Orbigny)	..	..	..	R II	R II (70)?	..	R II (200)	R III (190)	..	..
54. *Pleurotomaria* cf. *rozeti*, de Loriol	..	..	..		168, 183, R I (100—130)		..	..	..	..
55. *Turbo* sp. ind.	..	..	..		..	256	..	..	..	..
56. *Delphinula*(?) sp. ind.	..	..	..		..	161	..	..	..	..
57. *Vanikoro* sp. nov.?	..	..	..		..	140, 147	..	R III (190)	..	..
58. *Pseudomelania* cf. *delia* (d'Orbigny)	..	..	..		..	147	..	..	..	..
59. — sp. ind.	..	..	..		..	R II (95)	..	R III (190)	..	..
60. *Natica* (*Ampullina*) sp. juv. cf. *hemisphaerica*, d'Orbigny	..	..	..		..	..	..	R III (190)	..	..
61. *Turritella* sp. ind.	..	..	..	23	..	R I (100)	..	..	..	..
62. *Actaeonina* (*Ovactaeonina*) *groenlandica*, sp. nov.	..	..	..		..	..	..	..	..	..
63. *Oxytoma expansa* (Phillips)	..	..	..		..	286, R II (95)	..	R III (190)	R II (240)	..
64. — sp. ind.	..	..	..		..	R I (100—115)	..	R III (190)	R II (240)	..
65. *Buchia mosquensis* (v. Buch)	..	..	..	R II	..	R I (100)	..	..	..	..
				R II	245, R I (100—115), R II (115)?, R III (130)?		R I (165), R II (200)	R III (190)	..	R III (415)
66. — *rugosa* (Fischer)	..	..	..		..	R II (115)?	..	..	..	..
67. *Pinna constantini*, de Loriol	..	..	..		127, R I (100), R II (95)?, R II (130)?		R I (165), R II (200)	R III (190)	R II (240)	..
68. *Isognomon* aff. *bouchardi* (Oppel)	..	..	..		..	R I (100—130), R II (115)	..	..	..	..
69. *Ostrea bononiae*, Sauvage	..	..	..	R II	164, 172—173, 176—177, 220, R I (100—115), R II (115)		..	R III (190)	..	..
70. *Entolium nummularis* (Fischer)	..	..	..		..	R I (100—130), R II (130)	..	R III (190)	..	..
71. — sp. ind.	..	..	..		..	..	..	..	R II (240)	..
72. *Camptonectes praecinctus*, sp. nov.	..	..	..		..	R I (100)	..	..	..	..
73. — *morini* (de Loriol)	..	..	..		..	R I (100—115)	R I (165)	R III (190)	R II (240)?	..
74. — *suprajurensis* (Buvignier)	..	..	..		..	R I (100—115)	R I (165)	R III (190)	R II (240)	..
75. *Lima* (*Plagiostoma*) sp. nov.? ind.	..	..	..		..	R I (100—115), R I (130)	..	..	..	..
76. — (*Pseudolimea*) aff. *blakei*, Cox	..	..	..		..	R I (100)	..	..	R II (240)	..
77. *Anomia?* (*Placunopsis?*) sp. ind.	..	..	..	16	..	..	..	..	..	..
78. *Placunopsis* aff. *lycetti*, de Loriol	..	..	..		..	R I (100)	..	..	..	..
79. *Modiolus* aff. *boloniensis*, de Loriol	..	..	..	R II	..	R I (100)	..	..	..	..
80. — *strajeskianus* (d'Orbigny)	..	..	..		..	R I (100—130), R II (115)	..	..	..	..
81. — sp. ind.	..	..	..		..	..	R II (200)	..	R II (240)	..

	Basal Bed	*Pectinatites* Beds		Glauconitic Series		Sandy Shales with horizon *a*	Assemblage from R III (190) (See p. 164)	*Lingula* Bed	Hartzfjaeld Sandstone & fauna from R III (415) (see p. 164)
		Shale	Sandy Clays	Lower	Upper				
82. *Parallelodon* sp. nov.? aff. *keyserlingi* (d'Orbigny)	..	..	..		R I (100—130)	..	..	..	..
83. — *schourovskii* (Rouillier)	..	..	..	..	R I (100—130), 210—211	..	..	..	..
84. *Trigonia* aff. *thurmanni*, Contejean	..	..	..	..	159, 209	..	R III (190)	..	..
85. *Astarte* aff. *saemanni*, de Loriol	..	..	..	..	133, 196—197, R I (130), R II (115)	R I (165), R II (200)	R III (190)	R II (240)	R III (415)
86. — cf. *duboisiana*, d'Orbigny	..	..	..	..	..	..	..	R II (240)	..
87. — sp. nov.? aff. *michaudiana*, d'Orbigny	..	..	..	..	R I (100—110)	..	..	..	..
88. — sp. nov.? ind.	..	..	..	..	..	..	..	R II (240)	..
89. — sp. ind.	..	..	..	..	..	..	..	R II (240)	..
90. *Isocyprina* sp. nov.? aff. *elongata*, Cox	..	..	..	..	..	..	..	R II (240)	240?
91. — sp. nov.? ind.	..	..	..	..	..	..	R III (190)	..	..
92. — (?) sp. ind.	..	..	..	..	R I (100), R II (115)	..	..	..	..
93. *Corbicella* aff. *portlandica*, Morris & Lycett	..	..	..	..	R I (100)	R II (200)	..	R II (240)	..
94. — cf. *unioides*, de Loriol	..	..	..	..	..	..	..	R II (240)	..
95. — (?) sp. ind.	..	..	..	..	R I (100)	..	..	..	..
96. *Tancredia hartzi* sp. nov.	..	..	..	..	..	..	..	R II (240)	..
97. *Mactromya verioti* (Buvignier)	..	..	..	..	..	..	..	R II (240)	R III (415)
98. *Lucina* sp. nov. aff. *inaequalis*, d'Orbigny	..	..	..	..	R I (100)	..	..	..	..
99. — sp. nov.? ind.	..	..	..	..	R I (100)	..	..	..	..
100. *Protocardia* sp. juv. ind.	..	..	..	..	..	..	..	R II (240)	229
101. *Pseudotrapezium groenlandicum*, sp. nov	..	..	..	..	R I (100)	R I (165), R II (200)	R III (190)	R II (240)	..
102. — (?) sp. nov. ind.	..	..	..	..	R II (115)	..	..	..	..
103. *Pronoella*(?) sp. ind. aff. *nuculaeformis* (Roemer)	..	..	..	..	R I (100), R I (115)	R I (165), R II (200)	R III (190)	..	..
104. *Pseudisocardia*(?) sp. ind.	..	..	..	..	..	..	..	..	..
105. *Corbula* sp. ind.	..	..	..	..	..	R II (170)?	..	..	..
106. *Pleuromya tellina*, Agassiz	..	..	..	..	147-148, R I (100-130), R II (70)?, R II (115)	R I (165), R II (200)	R III (190)	R II (240)	R III (415)
107. *Goniomya* aff. *sulcata*, Agassiz	..	..	..	..	245, R I (100)	..	..	201?	..
108. *Arcomya*(?) sp. ind.	..	..	..	..	R I (100)	..	..	R II (240)	..
109. *Machomya*(?) sp. ind.	..	..	..	..	..	..	..	195	..
110. *Pholadomya* aff. *inaequiplicata*, Stanton	..	..	..	R II (70)?	168, R I (100), R III (130)?	..	..	R II (240)	..
111. — sp. ind.	..	..	..	..	..	..	..	R II (240)	..
112. *Homomya* aff. *hortulana*, Agassiz	..	..	..	0?, R II (70)?	R I (100), R II (115)	R I (165)	..	..	..
113. *Thracia incerta* (Deshayes) Thurmann sp.	..	..	..	..	..	R I (165), R II (200)	..	..	..
114. — cf. *depressa* (J. de C. Sowerby)	..	..	..	..	..	..	..	R II (240)	..
115. *Ditrupa nodulosa* (Lundgren)	..	..	..	..	..	..	R III (190)	R II (240)	..
116. *Serpula* sp. ind.	..	..	..	..	..	..	..	..	..
117. *Lingula zeta* (Quenstedt)	..	..	..	..	151, 245	..	R III (190)	195, II (240)	R III (415)
118. *Orbiculoidea* aff. *latissima* (J. Sowerby)	..	..	..	..	134, 151, 245	..	..	..	R III (415)
119. *Rhynchonella* aff. *grossesulcata*, Eichwald	..	..	..	..	168	..	..	..	..
120. *Terebratula* (*Rugithyris*) *rosenkrantzi*, sp. nov.	..	..	..	R II (70)?	157, 210—211, 246, R I (100—115),	..	..	..	..

p. 147) the glauconitic sandy marls may be as much as 60 m or more below the *Pinna* Bed in the upper part of the Glauconitic Series, so that the lower portion of that Series, at this locality, may correspond to the Sandy Clays with nodules β elsewhere (e. g., E). Unfortunately the ammonites just named have not been recognised elsewhere, except in very doubtful fragments (of one of the species) and the assumption that the assemblage is later than that of horizon β may or may not prove to be correct.

An entirely different assemblage is that from the upper part of the Glauconitic Series at E (see p. 144), including the numbers 175—179, 181, and 221, and a particularly large number of individuals of *Pavlovia* (*Epipallasiceras*) *pseudaperta*. But this species is represented in Mr. Rosenkrantz's Collection only from the 100—115 m level of his Section I and in view of the *pseudaperta* horizon being, according to Dr. Aldinger's information, at only 17—19 m below horizon α and 33—35 m below the base of the Hartzfjaeld Sandstone, it cannot have been *in situ* at Section I. Moreover an intensely glauconitic rock (with *Behemoth groenlandicus*, belemnites, *Entolium nummularis*, *Lima* [*Plagiostoma*] sp. nov.? ind., *Astarte* aff. *saemanni*, *Pleuromya tellina*, *Modiolus strajeskianus*, &c.) at 130 m seems out of place, on comparison with section E; but since there is apparently no slipping on Glauconite Hill and since the 165 m level probably corresponds to horizon α, the glauconitic beds at 130 m appear to have no equivalent farther north. Many other fossils have also been listed merely as from the Glauconitic Series, without being assigned to either the lower or the upper half.

As regards the age of this Glauconitic Series, it seems to me that the four ammonites first named as from the lower part (locality 213) are Kimmeridgian and like the *communis* nodules (β) to fall somewhere within the *rotunda* zone. But whether the higher *pseudaperta* fauna should be regarded as already of Portlandian age is doubtful. On the Dorset Coast, crushed *Pallasiceras* still occur to about six feet above the *rotunda* nodule bed, but fossils then become very rare, except for a few levels of crushed ammonites or for an occasional *Thracia* sp. Buckman[1]) divided these beds into *Lingula* Shales below, *Rhynchonella* Marls in the middle, and Dark Clays (subsequently named Hounstout Clay by Arkell[2])) above, but he recorded no ammonites. Neaverson[3]) mentioned that the clays above the *rotunda* zone have yielded ammonites, similar to *P. pallasioides* (though in a poor state of preservation) but he tentatively included in the *pallasioides* zone even the lower portion of the overlying Portland

[1]) Type Ammonites, vol. VI, 1926, p. 33.

[2]) Jurassic System in Great Britain, 1933, p. 446.

[3]) The Zonal Nomenclature of the Upper Kimmeridge Clay. Geol. Mag., vol. LXI, 1924, p. 149.

Sands. I have myself found crushed ammonites at at least two horizons in these beds, one at about 50 feet below the line of seepage which must be taken to be the top of the Kimmeridge Clay[1]), the other at about 20 feet higher, i. e. at about *80 feet below the Massive Bed, both on Hounstout* and at Pier Bottom. These levels would be about the base and the top of the *Rhynchonella* Marls, but the ammonites, unfortunately are so poorly preserved that they cannot definitely be identified with the *pallasioides* fauna. Some triplicate forms, however, in the second assemblage, do not look like Hartwell Clay species and this fauna also includes portions of very large forms. The ammonites from the top of the Hounstout Marls, from the Massive Bed, 50 feet up in the Portland Sands, and from the 30 feet of overlying sandy shale (= Emmit Hill Marls) are also badly crushed and fragmentary, but they include already types like *Crendonites* and *Behemoth*, which are commoner higher up, in the Stinkstones, Upper Sandstone, and the Cementstone, where they are associated with forms unknown from Greenland. *Progalbanites*, which includes what we used to call "*Provirgatites* of the *scythicus* group" however, also occurs already in the Emmit Hill Marls and since Arkell[2]) recorded such forms tentatively, Mr. C. H. Waddington has found two species in place, associated with forms which he referred to *Epivirgatites*.

The occurrence of ammonites assigned to *Crendonites* in horizon α would seem to date this definitely as Portlandian, but such early forms occur already in the Lower Portland Sands. *Dorsoplanites*, being unknown in England, with the possible exception of "*Pallasiceras*" *ultimum*, Neaverson[3]), and, in any case, having a comparatively long range, is not suitable for exact dating; but *D. gracilis*, persisting into the beds with *Crendonites*, shows that there was continuous deposition and that horizon α is not separated from the earlier Glauconitic Series by a long time interval. In the circumstances, the occurrence of *Pallasiceras* still in the upper part of this Series might be considered decisive for not including the Glauconitic Series proper in the Portlandian. But the evidence of the large *Behemoth* here described, resembling forms of the Portland Sands, seems to me to carry more weight; and the line between the

[1]) Well visible in the spring and even in September, 1934, after a prolonged drought. Fitton (Strata below the Chalk, Trans. Geol. Soc. Ser. II, vol. IV, 1836, p. 212) clearly stated that "springs break out at the bottom of the group (Portland Sands) where the Kimmeridge Clay might be expected." His spelling of Kimmeridge which is that of the village of to-day and its post office, as well as the official spelling of the Geological Survey of Great Britain is here adopted. A recent attempt by Arkell (Jurassic System in Great Britain, 1933, p. 441) to revert to the old spelling "Kimeridge" seems to me all the more regrettable as the official spelling is now almost universally adopted.

[2]) Jurassic System in Gt. Britain, 1933, p. 49.

[3]) *Op cit.* (Ammonites of the Upper Kimmeridge Clay), 1925, p. 20, pl. I, fig. 11.

Correlation of the Uppermost Jurassic of Milne Land and the Standard Succession in England and the Boulonnais.

Stages	Ages	Zones	England (Dorset) Groups	England (Dorset) Divisions	Boulonnais, after Pruvost, 1925	Milne Land
Tithonian	Aulaco-sphinctean	*privasensis*	[Purbeck?]	..	(Purbeck ?)	?
	?	?		..	..	Hartzfjaeld Sandstone (upper part?) (80—90 m or 267—300 feet) (*Lingula* Bed?)
Portlandian	Gigantitan	*giganteus*	Portland	Stone: Building Stone	Sandstones (9—10) with *Trigonia gibbosa* (8 m)	Hartzfjaeld Sandstone (lower part) 70 m or 233 feet
		gorei		Stone: Cherty Series	Beds (7—8) with *Astarte saemanni* and *Protocardia pellati* (4 m)	Sandy Shales with horizon (*a* 20—30 m or 66—100 feet)
		vulgaris		Sands: Upper Sandstones (with White Cement Stone) ..... St. Albans Head Marls ..... Stinkstones ..... Emmit Hill Marls ..... Massive Bed ..... Hounstout Marls	Bed (6) with *Isognomon bouchardi* (10 m) (22 m or 73 feet)	Glauconitic Series (25—50 m or 83—167 feet)
Upper Kimmeridgian	Pavlovian	*pallasioides*	Upper Kimmeridge Clay	Hounstout Clay ..... *Rhynchonella* Marls ..... *Lingula* Shales	Condensed into Ph 3 (nodule bed of Tour Croi) (23 m or 76 feet)	Base of Glauconitic Series; *Pallasiceras* Beds (above and below *β*) (45 m or 150 feet)
		rotunda		*Rotunda* Clays ..... Crushed Ammonite Shales ..... *Paravirgatites* Clays		
		pectinatus		*Pectinatites* Shales ..... Three White Stone Bands	Clays (4—5) with *Exogyra dubiensis* (10 m)	*Pectinatites* Beds (45 m or 150 feet)
	Subplanitan	*wheatleyensis*		Dicy Clays	Ph1 (nodule bed of La Rochette)	Unfossiliferous Shales (36 m or 120 feet)
		grandis		Bituminous Shales	Clays (3) with *Anomia laevigata* (8 m)	Band of crushed Perisphinctids?
		vimineus?		Cattle Ledge Shales	Grès de la Crèche supérieur (5 m)	
	Gravesian	*gigas*		*Gravesia* Shales ..... (*Aulacostephanus* Shales)	Grès de la Crèche inférieur (10 m)	?

Kimmeridgian and the Portlandian will thus have to be drawn at the base of the *Epipallasiceras* beds. This may be unfortunate from the point of view of the field geologist, but the Glauconitic Series is obviously not a homogeneous formation or unit.

While the Sandy Shales with horizon *a* are also clearly referable to the Lower Portlandian, there is nothing whatever from East Greenland that resembles an English Upper Portlandian ammonite, except a single doubtful fragment of *Titanites*. Fortunately, this was found in the same bed as one form of *Craspedites* (Plate 39, fig. 6) while fragments of other large ammonites (not brought back) in a neighbouring section (A) were associated with *C. ferrugineus* (Plate 22, fig. 3). But whereas this horizon of ironstone concretions in the first locality (O) was at only 53—57 m above the base of the Hartzfjaeld Sandstone, at A, it was at 80 m[1]), to be followed only 8 m higher by more ferruginous concretions with *Subcraspedites* of Cretaceous aspect. Again, higher up, on the same eastern face of Hartz Mtn. (Section A), there were found two forms of *Buchia* (including Plate 42, fig. 3) at 183 m above the base of the Hartzfjaeld Sandstone and *Craspedites leptus* (Plate 37, fig. 5) at 116 m. While the

[1]) Heights, however, were not calculated precisely and thus varied from day to day.

former could be Cretaceous, as mentioned on p. 99, the latter is of Jurassic aspect, although a new species. It is more closely comparable to the species of the Upper Volgian than to the Craspeditids in the Riasan horizon or the equivalent Spilsby Sandstone, but the only ammonite known from the *Lingula* Bed, 70 m above the base of the Hartzfjaeld Sandstone, is a form very close to *Kochina stschurovskii* of the Lower Volgian.

The *Lingula* Bed of the Cape Leslie area has not been recognised on Hartz Mtn.; conversely there is nothing like the fauna of the 415 m level of Rosenkrantz's section III known from Cape Leslie. The few fossils here described from the Hartzfjaeld Sandstone of localities A, A_1, and O, with the exception, perhaps, of a doubtful *Trigonia* impression, have not been found where the *Lingula* bed is developed and correlation thus is impossible. But it seems to me that the Hartzfjaeld Sandstone, also, is not a homogeneous formation.

The last three columns in the lists on pp. 154—159 thus do not show successive faunas, but are merely intended to facilitate comparisons between the assemblages of the true *Lingula* Bed, of the horizons 190 and 415 m of Rosenkrantz's section III, and of the Hartzfjaeld Sandstone of the northern area. With only a few ammonites from different and uncertain marine levels within this variable littoral and occasionally cross-bedded series, satisfactory dating is impossible, but it seems to me that Rosenkrantz's first interpretation (see text-fig. 1 on p. 145) was perhaps justified. That is to say there is a Jurassic Cape Leslie Sandstone of perhaps 150 m thickness and including the *Lingula* Bed, overlying the Sandy Shales above the Glauconitic Series; and the upper 200 m or so of Hartzfjaeld Sandstone, doubtfully lowest Cretaceous, probably rest unconformably on the lower portion. But this suggestion is supported only by the fact that in the best section available (A) the ferruginous concretions with fragments of very large ammonites (*Titanites?*) are almost immediately overlain by sandstones with *Subcraspedites*.

V. COMPARISON WITH OTHER FAUNAS

When I first saw the ammonites of the collections here described I thought that their study would throw welcome light on a problem that has puzzled stratigraphers for many years and is still largely unsolved. I am referring to the exact (as distinct from an approximate) correlation of the Volgian deposits of Russia. In the first place, there was among the Greenland material a large number of forms of the *panderi* group (*Dorsoplanites*) that promised to be useful in this correlation; and other forms, like *Pavlovia* (*Pallasiceras*) *regularis* and *Kochina groenlandica*, though now described as new, are so much like species of the Russian Lower Volgian that interesting results seemed certain. I may also recall that Rosenkrantz[1]) already had correlated his Cape Leslie Formation with the Lower Volgian of Russia, although he pointed out that true *Virgatites* were not present in East Greenland. Unfortunately my expectations have not been realised and the "attempt to show that a fundamentally different succession of ammonites in the boreal province is yet compatible with almost perfect synchronisation"[2]) cannot be made on the strength of the Greenland material so far collected. The few fossils available from the upper beds are still too uncertain to date even the Hartzfjaeld Sandstone and the forms of *Craspedites*, being all new, are also of little use for exact correlation. In the circumstances it can only be hoped that at least the illustration of the new faunas as well as of some comparable Portlandian material will prove a stepping stone in the immense problem of Upper Jurassic correlation.

A few interesting facts, however, have emerged and may be discussed in some detail. Thus the occurrence of a form close to the Russian *Perisphinctes stschurovskii*, Nikitin, in the *Lingula* Bed, is significant. I may say at once that the presence of pelecypods like *Parallelodon schourovskii* or *Modiolus strajeskianus*, in addition to other Russian species, does not seem to carry much weight, for the majority of the mol-

[1]) In Lauge Koch, Geology of Greenland, *loc. cit.* (1929), p. 148.
[2]) Spath, *loc. cit.* (Pal. Indica, N. S., vol. IX, no. 2, fasc. 6), 1933, p. 878.

lusca here recorded have been attached to, or at least compared with, species of the English and French Portlandian and Upper Kimmeridgian; and most of the forms here described have rather too wide a horizontal as well as vertical distribution to make them suitable for exact correlation.

The case may be held to be different, however, with *Buchia* (*"Aucella"*) *mosquensis* which is a characteristic species of the Russian Volgian and has been found in so many of the beds at Cape Leslie though not in the *Lingula* Bed. Rosanow[1]) does not record *Buchia mosquensis* and *Kochina stschurovskii* together, but the latter was described as from the Lower Volgian, although a closely allied form (*Perisphinctes* cf. *stschurovskii* in Nikitin[2])) occurred in the Upper Volgian zone of *Craspedites nodiger*. *Kochina*, however, does not indicate the upper part of the Lower Volgian, as *Buchia mosquensis* (= *B. pallasi* of Lahusen) is characteristic of the lower part; for in the Orenburg District, Sokolov[3]) found it together with *Dorsoplanites dorsoplanus*, *Pavlovia pavlovi*, etc., below the *virgatus* zone; and in the Liapin country also, according to Ilovaïsky[4]), *K. stschurovskii* occurs together with the typical *Pavlovia* of the *iatriensis* group. In the former area, *Buchia mosquensis* (= *B. pallasi*) and *B. rugosa* are found together in a still earlier zone with *Perisphinctes scythicus*, *P. contiguus* and *Kossmatia richteri*, a peculiar mixture that defies exact dating in the present state of our knowledge but must be from some horizon in the Upper Kimmeridgian.

In England[5]) *B. mosquensis* has been found in the Lower Portland Sands but occurs already in the *pectinatus* beds of the Upper Kimmeridgian and in several intervening beds, including the *rotunda* zone. Moreover, one of the early Shotover forms has been described as a variety transitional to *B. mniovnikensis*, which is said to replace the earlier *B. mosquensis* in the *virgatus* beds or upper part of the Lower Volgian[6]).

In the Boulonnais, *B. mosquensis* occurs in the La Rochette nodule bed which is characterised by numerous examples of *Virgatosphinctoides* (and *"Allovirgatites"*), wrongly ascribed to *Wheatleyites* by Pruvost[7]) and

[1]) Sur la division zonale du Volgien inférieur du gouv. de Simbirsk. Bull. Com. géol, Sect. Moscou, vol. I (1919) 1923, p. 193.

[2]) Die Cephalopoden-Fauna der Jurabildungen des Gouvernements Kostroma. Verh. K. Mineral. Ges. St. Petersb., vol. XX, 1885, p. 41, pl. IV, fig. 17.

[3]) See *Bubnoff, Geologie von Europa*, vol. I, 1926, p. 124.

[4]) See in Obrutschew: Geologie von Sibirien. Fortschr. d. Geol. und Pal (Soergel), Heft 15, 1926, p. 294.

[5]) See Cox, *loc. cit.* (Proc. Dorset Nat. Hist. & Arch. Soc., vol. L), 1929, p. 147

[6]) See Dutertre: Les Aucelles des terrains jurassiques supérieurs du Boulonnais Bull. Soc. géol. France, ser. 4, vol. XXVI, 1927, p. 408.

[7]) Les subdivisions du Portlandien boulonnais d'après les Ammonites. Ann. Soc géol. Nord, vol. XLIV, 1925, pp. 187—215.

Dutertre[1]). This is a still earlier horizon in the Upper Kimmeridgian. Conversely in Poland[2]), *B. mosquensis* (= *B. pallasi*) has been found together with *"Provirgatites" scythicus*, a species which has more recently been taken to characterise the English Lower Portland Sands. The occurrence of corresponding *Buchia* in the Klentnitz beds of Austria[3]), placed at an intermediate horizon in my Correlation Table I (1933)[4]) is thus explained and it would seem that the range of *B. mosquensis* (between the *wheatleyensis* and *"scythicus"* horizon of the table) is established.

Burckhardt[5]) however, in his masterly survey of the Mesozoic deposits of Mexico, showed how what he called a "third invasion of Russo-boreal elements brought *Buchia* (*"Aucella"*) of the *mosquensis* group into that area. Only the date of the invasion in this case was "Middle Portlandian" or during the deposition of beds with *Kossmatia tenuistriata* (also containing *Blanfordiceras*) which are overlain immediately by Tithonian beds with *Steueroceras* and *Berriasella* cf. *calisto*. On the other hand, *Buchia* of the *pallasi* group occur already in the Middle (or even Lower) Kimmeridgian[6]), and although this suggests that the identifications of these difficult species of *Buchia* may occasionally be at fault, it appears that the range of *B. mosquensis* is rather extended. And while unreliable for exact dating, the presence of *Buchia* in East Greenland also cannot be held to show affinity of the fauna with that of the Volgian rather than the West European area. Even if we do not go so far as Holdhaus[7]) who doubted the value of *Buchia* for palaeogeographical purposes, and agree with Uhlig[8]), who stressed its abundance in the boreal province, we must admit that the more and more extended horizontal range of this genus makes it advisable to accept its evidence only when accompanied by other boreal elements.

Another ammonite that has been considered to be almost indistinguishable from a Lower Volgian species (*Pavlovia* [*Pallasiceras*] *regularis*, sp. nov., see p. 42) and this time associated with *Buchia mosquensis*, comes from nodule bed β, about 170 m or 567 feet below the *Lingula* bed

[1]) *Loc. cit.* (Bull. Soc. géol. France, ser. 4, vol. XXVI), 1927, p. 406.

[2]) See Lewinski, *loc. cit.* (Mém. Soc. géol. France, Pal., vols. XXIV—XXV), 1923, p. 11.

[3]) See Vetters, Die Fauna der Juraklippen zwischen Donau und Thaya. Beitr. Pal. Geol. Österr.-Ung., vol. XVII, 1905, p. 249.

[4]) Spath, *loc. cit.* (Pal. Indica, N. S., vol. IX, no. 2), 1933, fasc. 6, p. 864.

[5]) Etude synthétique sur le Mesozoique mexicain. Mém. Soc. pal. Suisse. vols. XLIX—L, 1930, p. 106 (Table 10).

[6]) Faunes jurassiques et crétaciques de San Pedro del Gallo (Durango). Boll. Inst. Geol. Mexico, No. 29, 1912, p. 204.

[7]) *Op. cit.* (Fauna of the Spiti Shales), 1913, p. 405.

[8]) Die Fauna der Spiti Schiefer des Himalaya, ihr geologisches Alter und ihre Weltstellung. Denkschr. K. Akad. Wiss. Wien, Math.-Nat. Kl., vol. LXXXV, 1910, p. 38.

with *Kochina stschurovskii*. The species of the long-lived *panderi* group are chiefly intermediate in age, but among the Greenland forms there are also some that closely resemble Russian species (see p. 77). Now this great thickness is out of all proportion to the vertical extent of the Lower Volgian which according to Rosanow is only about 15 m in the Simbirsk area, while elsewhere, as in the neighbourhood of Moscow it may be much less. This immediately suggests that the fauna of the lower part of the Lower Volgian may not be homogeneous and that the forms of *Pavlovia* (*Pallasiceras*), or of *Dorsoplanites*, may have been derived from several earlier beds, now destroyed, and condensed into a phosphatic basement bed, resting unconformably on presumably different horizons of the Kimmeridge Clay at different localities and itself not only including differing assemblages from place to place[1]) but being followed non-sequentially by different later deposits. Such a theory might explain the peculiarities in the horizontal distribution of his Volgian ammonites to which Michalski[2]) directed attention, and perhaps the local abundance of belemnites and forms of *Buchia*; but it is scarcely supported by the Simbirsk section given by Rosanow. Here again it may be hoped that the illustration of so many critical ammonites may be of use to those of our Russian colleagues who may tackle this problem anew.

The occurrence of *Crendonites* in a bed (*a*) 80 to 85 m below the *Lingula* Bed, again is suggestive. This is a genus occurring in the Upper Portland Sands and the Lower Portland Stone, and its intermediate position in East Greenland between *Pavlovia* (*Pallasiceras*) below and the Volgian *Kochina* above might be taken to indicate that the *Virgatites* beds cannot be either Lower or even Upper Portlandian as Nikitin thought, but are post-Portlandian. This was suggested by Buckman[4]) already in 1922 and might fit in with the high specialisation of the ammonites of the Volgian and their absence in the Portlandian deposits of England and it would confirm the independence of the ammonites of the so-called *scythicus* type which are here separated as *Progalbanites*. But it does not agree with the record (by Pavlow[5]) of *Perisphinctes bononiensis* and forms of the *triplicatus* group of Blake in beds higher than those with *Virgatites* though lower than the *Craspedites* zones.

There seems to be more doubt about this alleged Portlandian fauna (in a poor state of preservation) than Salfeld[6]) thought; for while

[1]) See in Bubnoff: Geologie von Europa, vol. I, 1926, pp. 168—9.

[2]) Die Ammoniten der unteren Wolga Stufe. Mém. Com. géol. St. Pétersb., vol. VIII, no. 2, 1894, p. 489.

[3]) Quelques excursions dans les musées et dans les terrains mesozoiques de l'Europe occidentale &c. Bull. Soc. Belge, Géol., Pal. Hydrol., vol. III, 1889, p. 53.

[4]) Type Ammonites, vol. IV, 1922, p. 17.

[5]) *Loc. cit.* (Bull. Soc. Imp. Nat. Moscou), 1889, no. 1, p. 62.

[6]) Gliederung des oberen Jura in Nordwesteuropa. N. Jb. f. Min. &c., Beil. Bd. XXXVII (1913), 1914, p. 238.

Pavlow[1]) himself, in his latest table, still listed a "zone of *Perisphinctes giganteus*", Lewinski[2]) only recognised a post-*virgatus* zone of *Olcostephanus lomonossovi* and *Perisphinctes nikitini*. Considering that the former of these two species is much like Pavlow's *O. blakei* from his *giganteus* zone and that *P. devillei* and *P. boidini*, de Loriol, also cited by Pavlow in 1889, certainly were misidentified, it is probable that this "*giganteus*" zone is in reality, as Sokolov and Bodylevsky[3]) think, the zone of *Epivirgatites nikitini* which species grows to a fairly large size (300 mm). And the doubtful *Titanites* here described from East Greenland and associated with a *Craspedites* (Plate 39, fig. 6) may also have nothing in common with *Perisphinctes giganteus*, except the large size. Such large ammonites, often indistinguishable in fragments, occur already in the *pectinatus* zone (*Paravirgatites*); a succession of megalomorph genera like *Pallasiceras*, *Lydistratites*, *Behemoth*, *Titanites*, characterises the higher Kimmeridgian as well as the whole of the Portlandian and gigantic ammonites may well have persisted into still higher beds, with *Craspedites*. This would make part of the Hartzfjaeld Sandstone of Tithonian (= "Aquilonian")[4]) age, but does not date the Volgian and East Greenland forms of *Kochina*; for the vertical distance above beds with *Crendonites* may be no guide to the age of these later elements. There is obviously far more evidence required before we can satisfactorily correlate these dissimilar faunas and the distinctness of the fauna of the Riasan Beds from that of the Portland Stone suggests that there is room between them for far more than even the *virgatus* beds and the Upper Volgian.

In view of the differences in the ammonite faunas, it may suffice to mention that the occurrence of only ten Russian species of invertebrates (or close allies) in East Greenland out of a total of 121 scarcely proves much affinity between the fauna here described and that of the Volgian. This is of interest, in view of the fact that of the species described in part I, those that were not new were compared or identified chiefly with Russian forms and only occasionally with species of northwestern Europe. In the present part, the forms comparable or identical with species described from the English and Boulonnais Kimmeridgian and Portlandian have increased to about thirty-two or over 26 % of the

[1]) Geological Sketch of the Environs of Moscow. Handbook for Excursions. 3rd. ed., 1923, p. 21. (In Russian.)

[2]) *Loc. cit.* (Mém. Soc. géol. France, Pal., vol. XXIV), 1923, pp. 34—35.

[3]) *Loc. cit.* (Skrifter om Svalbard, no. 35), 1931, p. 25.

[4]) I can see no reason why the term Tithonian should not be used for boreal deposits of uppermost Jurassic age. The name is derived from Tithon, the spouse of Eos (Aurora), the goddess of dawn, and is purely a time term. Nobody has yet suggested that the Eocene of the boreal regions should be referred to under a different name from the Eocene of Mediterranean areas. Purbeckian is obviously disqualified since it is not even certain that all the freshwater Purbeck Beds are Jurassic.

total, but again, little significance is attached to this, in view of the absence of modern descriptions of some of the Russian faunas and the bad preservation of much of the Spitsbergen material.

The comparison of such Volgian elements as have been described from Spitsbergen with the faunas here recorded from Milne Land also does not yield satisfactory results. It has been shown by Sokolov and Bodylevsky[1]) that there is no evidence for the presence of Upper Volgian deposits anywhere outside Central Russia (and I may add Novaya Zemlya) and the only Spitsbergen *Craspedites* they recorded belongs to the late *subpressulus* group (*Subcraspedites*). This also includes the Spitsbergen *Craspedites* recorded by myself[2]) and comparable forms have only been found in the Spilsby Sandstone and the Riasan beds. But Sokolov and Bodylevsky[3]) thought that the Lower Volgian was represented in Spitsbergen, at least by its lowest zone (with *Virgatites scythicus* and *Perisphinctes panderi*). Since I myself recorded *Virgatites* cf. *polygyratus* (Trautschold) Pavlow sp., *V.* cf. *scythicus*, Vischniakoff sp., and *V.* cf. *nikitini*, Michalski sp., from Spitsbergen and since both Frebold[4]) and Sokolov and Bodylevsky[5]) figured similar ammonites of the genus *Dorsoplanites*, partly under the same names, partly as *Perisphinctes panderi* or *P.* sp., it is probable that there is, indeed, some justification for assigning these forms to the Lower Volgian. But the new Greenland material of this *Dorsoplanites* assemblage, now available, demonstrates the long range of this genus and makes it doubtful whether the dating of such crushed ammonites as those from Spitsbergen can be any more exact than the dating of the King Charles Islands forms of *Buchia*[6])

In Spitsbergen, at Cape Fastness (Ice Fjord) beds 17—19 (or 20?) that yielded these Perisphinctids represent a thickness of merely 28.3 m or 94 feet; and although the underlying beds 14—16 (with pelecypods) are only doubtfully classed with the Lower Kimmeridgian, and although another 20 m separate this supposed Lower Volgian from horizon 21, with *Buchia* of Infra-Valanginian affinities, this thickness is clearly insufficient to comprise more than a portion of either the Upper Kimmeridgian, the Portlandian, or the Tithonian. In the absence of anything resembling the Kimmeridgian *Pavlovia* of wide horizontal distribution, or the true *Craspedites*, it may not be incorrect vaguely to describe the Spitsbergen *Dorsoplanites* as "Portlandian", but unfortunately this

[1]) *Loc. cit.* (Skrifter om Svalbard, no. 35), 1931, p. 94.

[2]) On Ammonites from Spitsbergen. Geol. Mag., vol. LVIII, 1921, p. 351.

[3]) *Loc. cit.* (Skrifter om Svalbard, no. 35), 1931, p. 138.

[4]) *Loc. cit.* (Skrifter om Svalbard, no. 19), 1928, p. 13, pl. I, fig. 3; *ibid.* (no. 31), 1930, pp. 35—41, pls. X—XIV.

[5]) *Loc. cit.* (Skrifter om Svalbard, no. 35), 1931, pp. 88—94, pls. VIII—IX.

[6]) Pompeckj: Marines Mesozoicum von König-Karls-Land. Vet. Ak. Öfvers., 1899.

helps little in the exact correlation of the Volgian. For even if the *Virgatites* cf. *scythicus* (Vischniakoff) figured by Sokolov and Bodylevsky[1]) should turn out to be the true *Zaraïskites* (= "*Provirgatites*") *scythicus*, a possibility that was considered doubtful by the second author himself[2]), the associated *Dorsoplanites* of the *panderi* group could not be safely associated either with the early *D. flavus* or the late *Kochina groenlandica* (both having smooth outer whorls) and may well be of an age different from that of either of these two Greenland forms. If I mention that bed 20, with numerous unidentifiable examples of *Buchia*, was stated by Frebold[3]) to contain many *Craspedites* that could be readily determined, generically at least, while Sokolov and Bodylevsky[4]) recorded from the same horizon *Perisphinctes* aff. *scythicus*, Vischniakoff, the unsatisfactory nature of the evidence will be realised.

Notwithstanding the many difficulties of exact correlation, there is the fact that most of the ammonites from the so-called Volgian of Spitsbergen belong to the genus *Dorsoplanites*, known also, with no fewer than eleven species, from East Greenland and probably equally well represented in the variable series of deposits that constitute the Lower Volgian of Russia, but generally referred to as *D. panderi*, a very comprehensive term. There may not be specific identity, although opinions will differ as to the interpretation of the various, local "*D. panderi*" and their close allies, common to all these regions. Waagen[5]) once said that "happy was he who was able to distinguish the very finest differences of form which organisms undergo in their development in time". The differences on which species are based at the present may seem crude to palaeontologists of the future, but now we are still largely hampered by the absence of exact, stratigraphical information and the limited amount of material at our disposal. Whether, however, we look upon *Perisphinctes* aff. *panderi* from Spitsbergen (Sokolov & Bodylevsky and Frebold) or from East Greenland (Rosenkrantz) as specifically distinct from the Russian type or not, they all belong to one group of ammonites that has not been found outside the boreal province, with the possible exception of some fragments recorded from the English Hartwell Clay (see p. 76). But with the exception of *Kochina* and *Craspedites* which are quite unknown from Western Europe, and of *Epipallasiceras*, which is apparently a local, Greenland, element, all the remaining ammonites belong to genera well known in England and the Boulonnais.

[1]) *Loc. cit.* (Skrifter om Svalbard, no. 35), 1931, pl. VIII, fig. 6.

[2]) *Ibid.*, p. 114.

[3]) Das Festungsprofil auf Spitzbergen. Jura und Kreide. II. Die Stratigraphie. Skrifter om Svalbard, no. 19, 1928, p. 14.

[4]) *Loc. cit.* (Skrifter om Svalbard, no. 35), 1931, p. 114.

[5]) Jurassic Fauna of Kutch. Vol. I, Mem. Geol. Survey India, Pal. Indica, Ser. IX, no. 4, Cephalopoda, 1875, p. 238.

Numerically the proportion (ten to three) may seem overwhelmi but in reality it includes groups like *Pavlovia* which are equally w represented in the boreal province. I am unable to say how many of t Greenland ammonites here described may prove to be identical wi any of the fifty "varieties" of *P. iatriensis*, described by Ilovaïsky, fro north-western Siberia, but Central Russian forms of *Pallasiceras*, as alread mentioned, are in any case sufficiently close to both Greenland an English types to prove that they all belonged to one province. On th other hand, genera like *Pectinatites*, *Keratinites*, *Crendonites*, *Behemo* and *Titanites* are typically West European, being known perhaps onl from England and the Boulonnais, although some of them have bee recorded from Russia. Holding, as I do, that the distribution of continent and oceans in Upper Jurassic times was much the same as at the presen day, I see no reason why the north-west European influence, previousl shown to have been dominant in the Callovian as in the Upper Oxfordia and Lower Kimmeridgian should not also have been felt in the highes Jurassic. No deposits of this age, later than Kimmeridgian, are know from Yorkshire or Eastern Scotland, yet the sea cannot have been fa off, as is proved by e. g. the Spilsby Sandstone. But although the Valan ginian deposits of North Germany, Speeton, the East Coast of Scotland (submarine), the Lofoden Islands, and Spitsbergen are certain proof o the existence of such marine connection in the lowest Cretaceous, the absence of deposits of the Upper Portlandian in every country outside England and the Boulonnais, except possibly Russia, has been taken to indicate the isolation of the Portland basin, just as the absence of true *Virgatites* outside Russia has been accepted as proof of the isolation of the Moscow basin (in Neumayr's sense).

The recognition of Portlandian ammonites like *Crendonites* and *Behemoth*, not to mention the doubtful *Titanites*, in East Greenland may not make it impossible any longer to hold this view of isolation, but it has certainly weakened it. It is useless to expect typical Portland Stone ammonites in Greenland if the beds overlying the *Crendonites* horizon are almost without cephalopods; and if, as I have suggested, the characteristic Volgian elements like *Virgatites* are post-Portlandian then their absence in England and the Boulonnais is at once explained. Salfeld[1]) who again considered isolation to be the determining factor in the formation of such dissimilar faunas, it may be remembered, misidentified the "*Virgatites*" he collected at Kimmeridge, as I have already mentioned (p. 30); and such a "*Virgatites*" as *V.* cf. *zarajskensis* (*non* Michalski) recorded by Lamplugh, Kitchin and Pringle is merely a *Subplanites*, scarcely more virgatoid on the outer whorl than many a Solnhofen

[1]) Das Problem des borealen Jura und der borealen Unterkreide. Centralbl. f. Min. &c., 1921, pp. 169—174.

example of the same group. The so-called *Provirgatites* of the Portland Sands, nearly 500 feet higher in the Kimmeridge Section, are more like true *Virgatites*, but even these (here separated as *Progalbanites*) have blunt, primary folds on the inner whorls (Plate 23, fig. 2 and Plate 24, fig. 2), quite unknown in the Russian types. Neither of these English "*Virgatites*" faunas can be correlated with the *Anavirgatites* assemblage of Neuburg on the Danube (found also in Somaliland) which, however, may be a mixture; and while I spoke of an Upper Kimmeridgian "*palmatus*

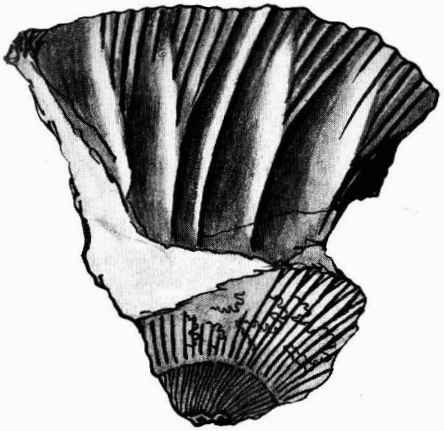


Fig. 2. *Subplanites pseudoscruposus*, sp. nov. Oil Shales, *grandis* zone, Corton and Kimmeridge. (Based on one of the crushed "*Virgatites*" of Salfeld and others, recorded as "*V.* cf. *zarajskensis*, Michalski", M. P. G. No. 51252, but bifurcation of median whorl restored from examples in my own collection).

zone" in 1925[1]) and later (1933)[2]) moved it partly up into the Portlandian, it is impossible to place it accurately in the present state of our knowledge. I may add in this connection that although I consider the *Riasanites* recorded by Parat and Drach[3]) from Milne Land to have been misidentified, I believe the absence of this supposed Mediterranean element[4])

[1]) Ammonites and Aptychi, in Monogr. Geol. Dept. Hunter. Mus. Glasgow, vol. I, part VII, 1925, p. 158.

[2]) *Loc. cit.* (Pal. Indica, N. S., vol. IX, no. 2, pt. VI) 1933, p. 864.

[3]) *Loc. cit.* (Ann. hydrograph.), 1934, pp. 10—13 (*Hoplites rjasanensis*).

[4]) Haug, Traité de Géologie, vol. II, fasc. 2, 1907, p. 1078.

from other boreal regions to be due entirely to the absence of stric equivalent deposits.

The great gap in the marine sequence at the top of the Jurass was probably not appreciated in full even by Buckman, although he created a "Proniceratan age" to occupy the time of the non-sequen between Portland and Purbeck Beds. He was unfortunate in suggesti that certain "*Perisphinctes*" figured by Neumayr and Uhlig might be approximately that date, since he could easily have discovered from t literature that these ammonites in reality are Neocomian Simbirskiti But it only proves that the palaeontologist is dependent on accura stratigraphical information; and where our knowledge is as deplorab scanty as it is regarding the uppermost Jurassic, definite dating is i possible, especially of a mixed assemblage like that of the Riasan bed Even the extended Tithonian successions known from Mexico and Sou America and differing from place to place, are not likely to bridge t gap completely; and the freshwater Purbeck Beds may be found represent but a small portion of this Tithonian time, if they are a hom geneous formation and entirely Jurassic at all. Although the bore faunas are always comparatively impoverished and are not likely yield more than some modified Perisphinctids, it is probable that Ea Greenland will yet largely contribute towards a solution of the proble which cannot be settled in Europe. The coarse sandstones of Hartz Mt may not be the most suitable deposit to contain unexpected po Portlandian ammonite faunas, yet they may be there; and the presen of *Subplanites* in the basal shales and the abundance of well-preserv ammonites in the Glauconitic Series prove that the seas just off t very ancient coast line swarmed with the assemblages found, unfortu ately disconnected at present, in northern and western Europe. T preservation of the successive ammonite faunas, however, during temp rary transgressions of the sea over such a coast, is subject to so ma accidental factors that the problem is not likely to be solved at any o spot. But much, no doubt, will yet be learnt from the detailed inves gation of the interior and north western part of Jameson Land, whi consists of a highly dissected elevated plateau that Rosenkrantz assum to be built up mainly of beds of the Cape Leslie Formation.

Comparison of the faunas here described with presumable Americ equivalents yields little concrete evidence. The single mollusc, a *Pho domya*, here attached to an American species is of no significance and any case the sea had probably retreated from the interior to the w coast before the beginning of Kimmeridgian time, as shown on Crickmay'

[1]) Type Ammonites, vol. IV, 1922, p. 16.

[2]) *Jurassic History of North America: Its Bearing on the Development Continental Structure.* Proc. Amer. Phil. Soc., vol. LXX, 1931, no. 1, pp. 90—

maps. There remain, then, only a few forms of *Buchia* of the *mosquensis* (= *pallasi*) group recorded from Alaska and British Columbia and the Tithonian faunas of California, as tantalisingly uncertain as the boreal formations with Craspeditids above discussed. With no Jurassic deposits preserved on the Atlantic sea board and over the immense area of North America, except the west coast, it is not surprising that the comparison attempted in this chapter has shown a decided preponderance of north-west European elements but as little support for the palaeogeographical conclusions of Lewinski[1]), as for his stratigraphy.

It remains to discuss the affinities of the faunas here described from Milne Land with those found by Rosenkrantz in Jameson Land, in two blocks, collected in 1926. It may be remembered that Madsen[2]) already recorded and figured a few fossils from the Aucella River, among them an ammonite which he compared to *Perisphinctes panderi* (d'Orbigny). I agree that this form resembles a *Dorsoplanites* of the *panderi* group, but it is not identical with any of the Cape Leslie ammonites here described, i. e. forms like *D. crassus* (Plate 29, fig. 5), and it seems equally distinct from the Russian *D. panderi*. I am thus disinclined now to attempt to place such an isolated find, in rather a defective state of preservation, instead of waiting for the discovery of better and more abundant material. What I insist on, however, is that while the Upper Jurassic is undoubtedly represented in both Milne Land and Jameson Land, it would be idle to assume that both areas would show similar successions or that the non-sequences present in each are on the same levels. The deposits are mostly shallow-water, micaceous sandstones, formed in the vicinity of the very ancient coast-line of East Greenland; and they vary greatly from place to place, even between Cape Leslie and Hartz Mtn. As already mentioned, it is probable that forms like *Buchia mosquensis* (= *Aucella pallasi*) and *Astarte* cf. *saemanni*, recorded by Madsen, have long ranges and the former, in any case, is represented in both blocks I and II.

The latter, a light grey, hard, micaceous sandstone, has yielded the following species:—

Pectinatites? sp. ind. (Plate 37, figs. 1, 3).
— ? (*Keratinites*?) sp. ind. (Plate 36, fig. 2; Plate 38, fig. 2).
Buchia mosquensis (v. Buch).
Modiolus sp. ind.
Lima (*Pseudolimea*) sp. ind.
Other indeterminable pelecypods
Lingula zeta, Quenstedt.
Orbiculoidea sp.

[1]) *Loc. cit.* (Mém. Soc. géol. France, Pal., vol. XXIV), 1923, p. 37.

[2]) *Loc. cit.* (Medd. om Grønland, vol. XXIX), 1904, pp. 202—203.

If the ammonite identifications are correct, then this fauna must be Upper Kimmeridgian age. But the only comparable ammonite fr Milne Land is *Pectinatites* aff. *eastlecottensis* (p. 19) and it is not o the only fossil from its bed, but it is preserved in a dark, sandy sh It therefore lacks the abundant *Lingula* that characterise this block and cause such great resemblance to the much higher *Lingula* Bed Cape Leslie; and exact correlation is obviously impossible in the pres state of our knowledge.

Since Madsen does not list *Lingula* from any of his light sandsto (11a, 11b, or 12) it is improbable that they included the same rock Rosenkrantz's block II; conversely, there are several species occurr both in Madsen's loose blocks 11b and in the assemblage listed bel from Rosenkrantz's block I. This, however, is a dark grey, fairly s sandstone, occasionally even black and it is teeming with pelecypo but has no ammonites. To the fossils already recorded by Mads namely:—

Astarte cf. *saemanni*, de Loriol (Plate 47, fig. 2).
Tancredia sp. (? *hartzi*, sp. nov., Plate 48, fig. 5).
Pleuromya sp. (? *tellina*, Agassiz).
Belemnite fragments (including *Pachyteuthis* aff. *panderi*, d'Orbig sp., Plate 39, fig. 9).

may now be added the following, referred to in the descriptions, above:

Pinna constantini, de Loriol.
Entolium nummularis (Fischer).
Camptonectes suprajurensis (Buvignier).
Parallelodon schourovskii (Rouillier).
Trigonia sp. aff. *thurmanni*, Contejean (Plate 41, fig. 7).
Astarte sp. nov.? aff. *michaudiana*, d'Orbigny (Plate 47, fig. 6).
Isocyprina sp. nov.? aff. *elongata*, Cox.
Pronoella? sp. ind. aff. *nuculaeformis* (Roemer).
Pholadomya aff. *inaequiplicata*, Stanton (Plate 45, fig. 3b).
Orbiculoidea aff. *latissima* (Sowerby).

It does not seem to make much difference whether this assembla came from the same bed as Madsen's or not, although in view of t difference in colour and the presence of ammonites in Madsen's bloc 11b, it is, perhaps, improbable. But in neither case is there concre evidence for correlating these assemblages with any of the faunas he described from Milne Land. For while it is true that the forms ju listed, or at least close allies, occur in the prolific Glauconitic Serie yet they are associated with distinctive species that have not bee found in Milne Land. These include:—

Dicranodonta groenlandica (Rosenkrantz MS) nov. (Plate 41, fig. 11).
Astarte cf. *panderi*, d'Orbigny (Plate 47, fig. 7).
Lucina (?) sp. ind. (Plate 48, fig. 7).
Mytilus jurensis (Merian) Roemer (not *M. suprajurensis*, Cox).
Quenstedtia sp.
Pentacrinus sp.

These are unknown from the Glauconitic Series, with a most prolific pelecypod fauna, but abundant ammonites; from the *Lingula* Bed of Cape Leslie, with an enormous number of individuals of *Lingula*, and a few ammonites but rather fewer pelecypods than the Glauconitic Series; absent also from the assemblage R. III, 415 m, with some special elements (e.g. *Mactromya verioti*, Buvignier sp.) and numerous large *Pleuromya tellina*, Agassiz, but no *Buchia*. Yet these three Portlandian faunas, not to mention the rather poorly represented, intermediate, fauna from horizon *a*, all probably very close in age, are the only Milne Land faunas comparable to the assemblage from block II of Aucella River, if the pelecypods can be relied on. And on inspection of the Correlation Table (p. 163) it will be seen that there is rather a considerable time interval between the *Pectinatites* Beds and the *Lingula* Bed. That is to say the occurrence of a form like *Buchia mosquensis* in both blocks I and II of Aucella River is without significance. It is to be hoped, however, that future finds, especially of ammonites, in Jameson Land will help to fill the many gaps in our knowledge of the Uppermost Jurassic revealed in the present investigation of the faunas from Milne Land.

VI. SUMMARY OF RESULTS

1. The great majority of the invertebrates from the upper part of the Upper Jurassic succession in Milne Land (Cape Leslie Formation) described in this memoir are shown to be of Neo-Kimmeridgian and Portlandian age, but the scarcity or absence of fossils in the higher beds prevents definite dating of the upper (Cretaceous?) part of this formation. There also is no real boundary line between the Cape Leslie Formation and the lower set of beds, dealt with in part 1.
2. The 121 invertebrates described include 53 cephalopods, 9 gastropods and 52 pelecypods, in addition to two worms, and 5 brachiopods (the many crustaceans are to be described by Prof. Van Straelen). Most of the ammonites are new species, but the pelecypods include many forms of long range.
3. The elements of the various fossil assemblages are comparable to those of north-western Europe and the affinities with Volgian (Russian) faunas, stressed by previous observers, are shown to be slight. There are no Virgatitids and the few *Craspedites* described are different from those of the Upper Volgian; but the *Pavlovia* fauna of western Siberia is comparable to certain Upper Kimmeridgian assemblages here described.
4. Comparison with other boreal or American faunas is difficult since few invertebrates of corresponding age have been described from anywhere except England and the Boulonnais.
5. The distribution of the continents and oceans cannot have changed much since earlier Jurassic times, as previously discussed.
6. The faunas of two blocks from Aucella River in Jameson Land are compared with the assemblages from Milne Land, and it is hoped that the outstanding problem as to the representation of the Tithonian (= "Aquilonian") in East Greenland will there find its solution.

VII. SUMMARY OF NEW NAMES

Page

AMMONITES

GASTROPODA

PELECYPODA

BRACHIOPODA

Færdig fra Trykkeriet den 25. Marts 1936.

EXPLANATION OF PLATES

Plate 1.

Fig. 1. *Subdichotomoceras?* (*Sphinctoceras?*) sp. ind. Part of a larger slab from band with crushed Perisphinctids (Base of Upper Kimmeridgian?). Astarte Valley, Hartz Mtn. (No. 169a) 14

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3. *Subplanites?* sp. ind. Same bed and locality (No. 169b) 15

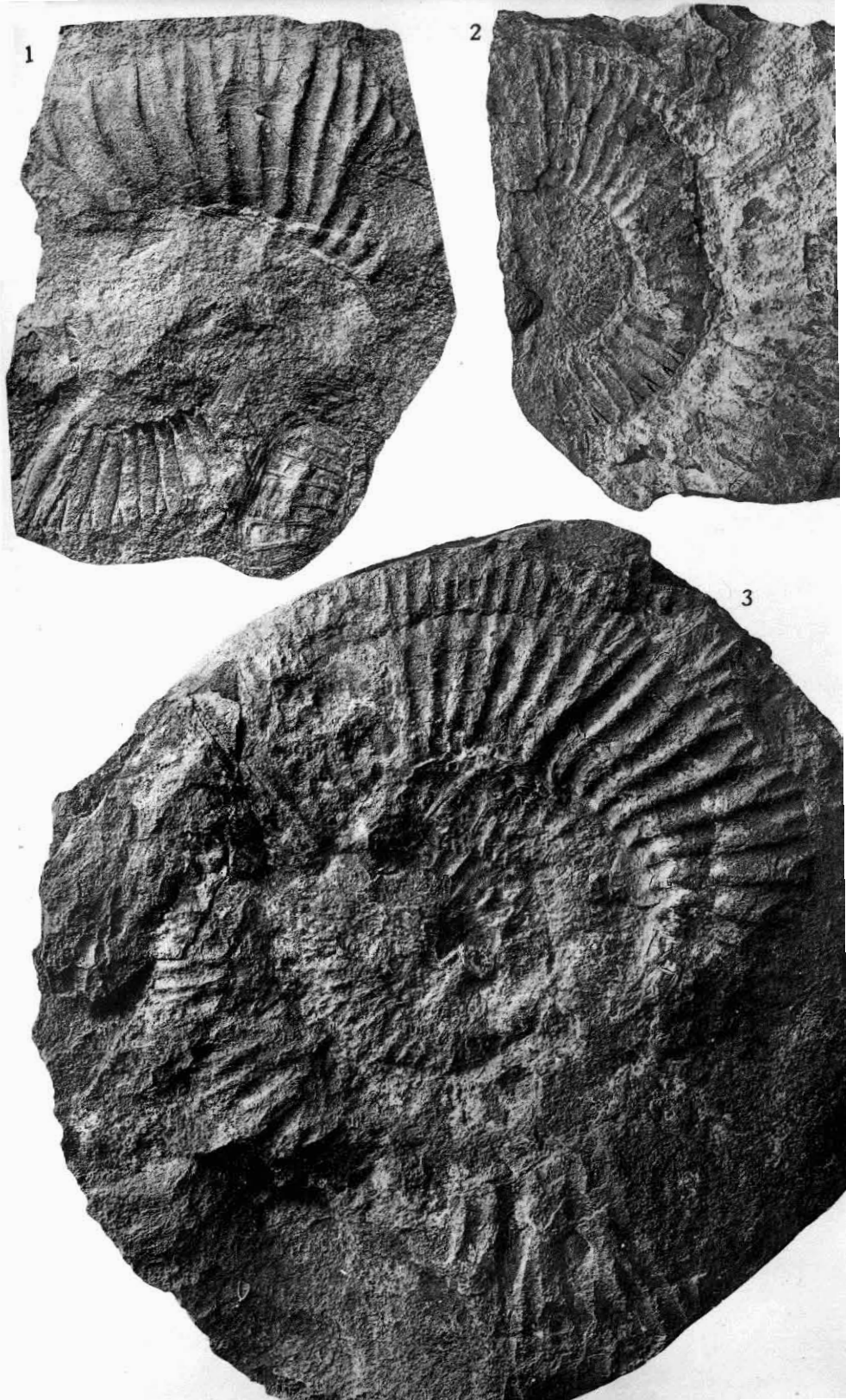

Plate 2.

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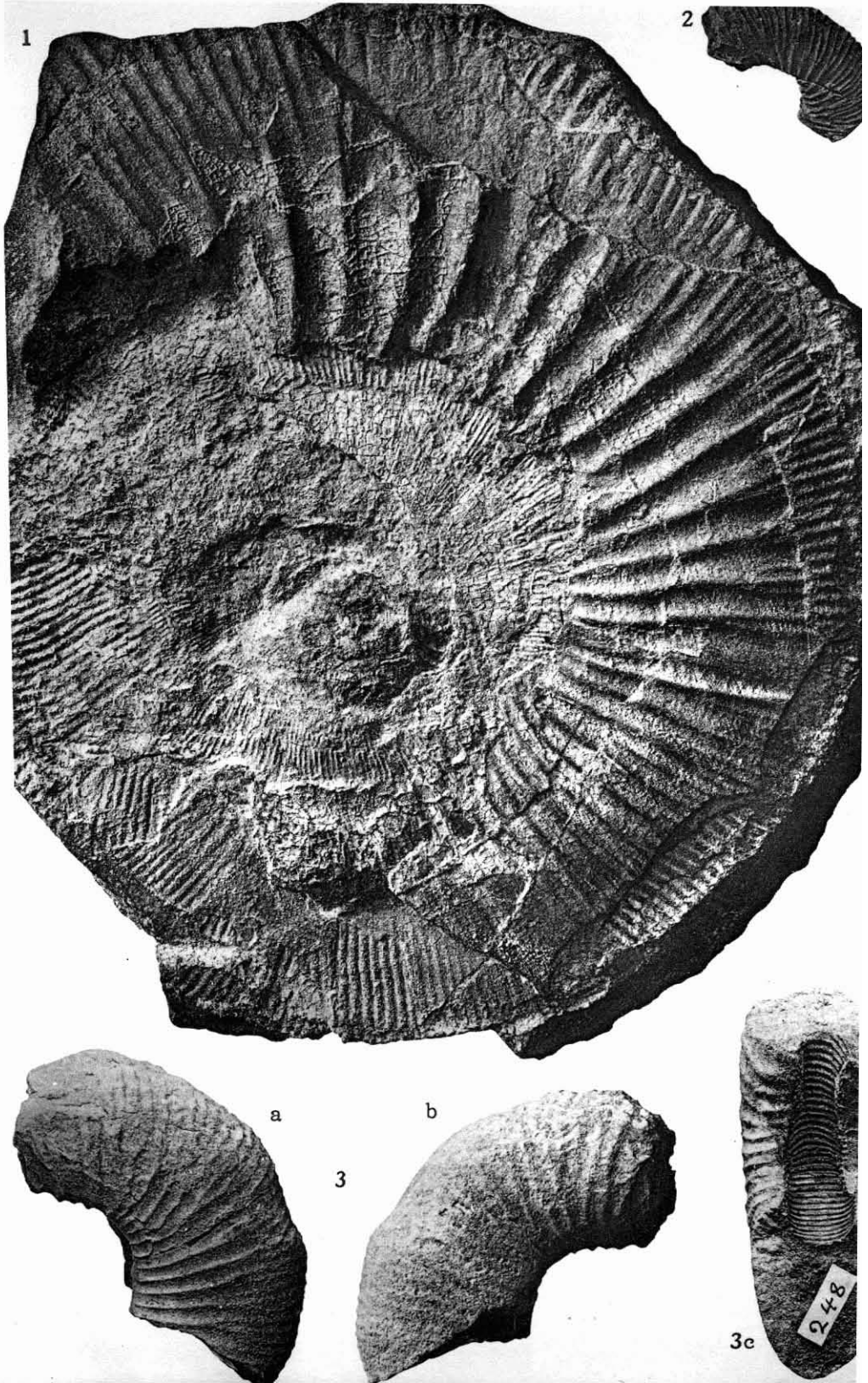
- 3a-c.	*Pectinatites* sp. ind. Two sides and dorsal area of a body-chamber fragment. Sandy Clays, below β? Upper Kimmeridgian. N.W. side of Hartz Mtn. (No. 248a)	20



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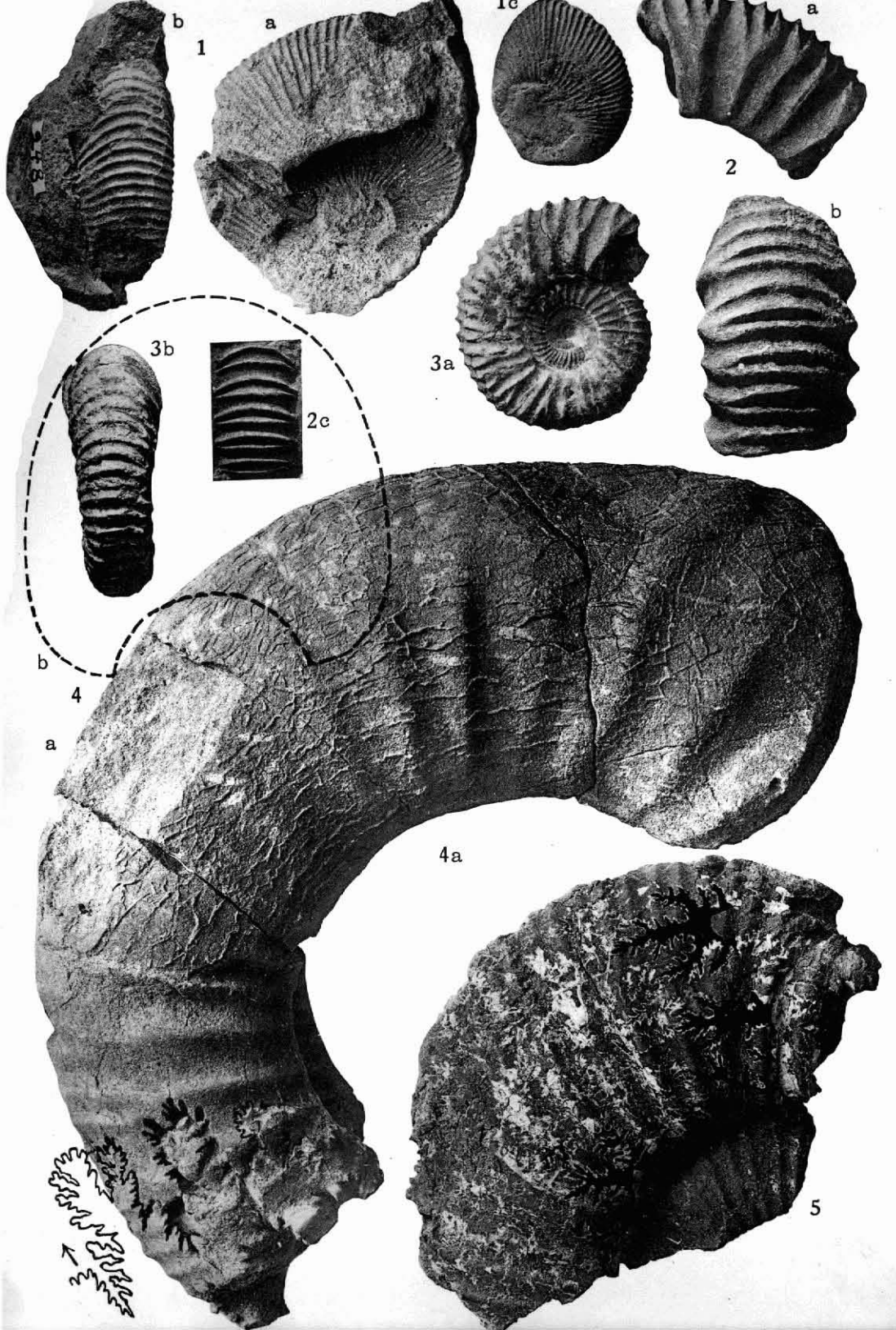

Plate 4.

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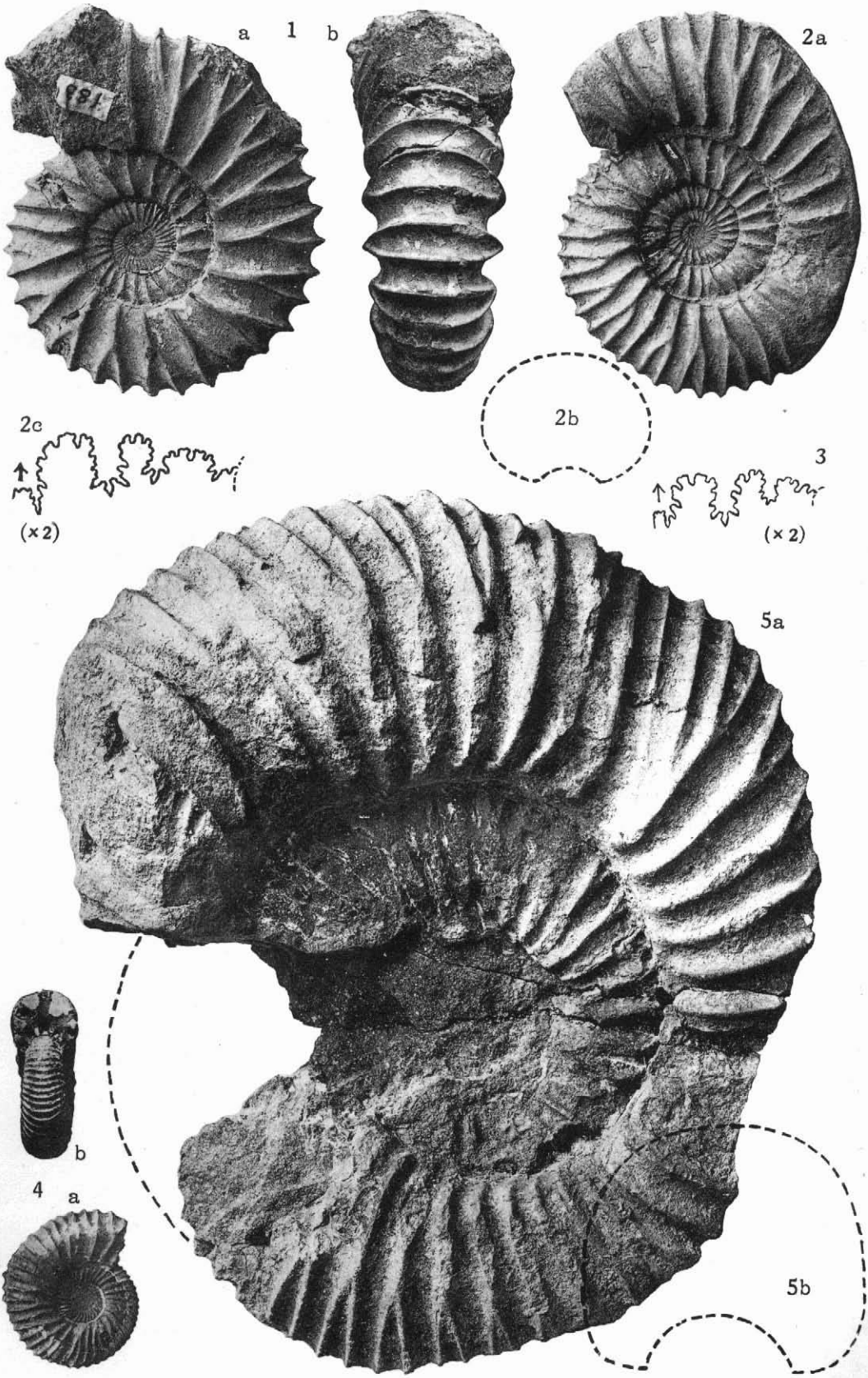
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1
b
2a
2b
2c
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3
(× 2)
5a
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4
a
5b

Plate 5.

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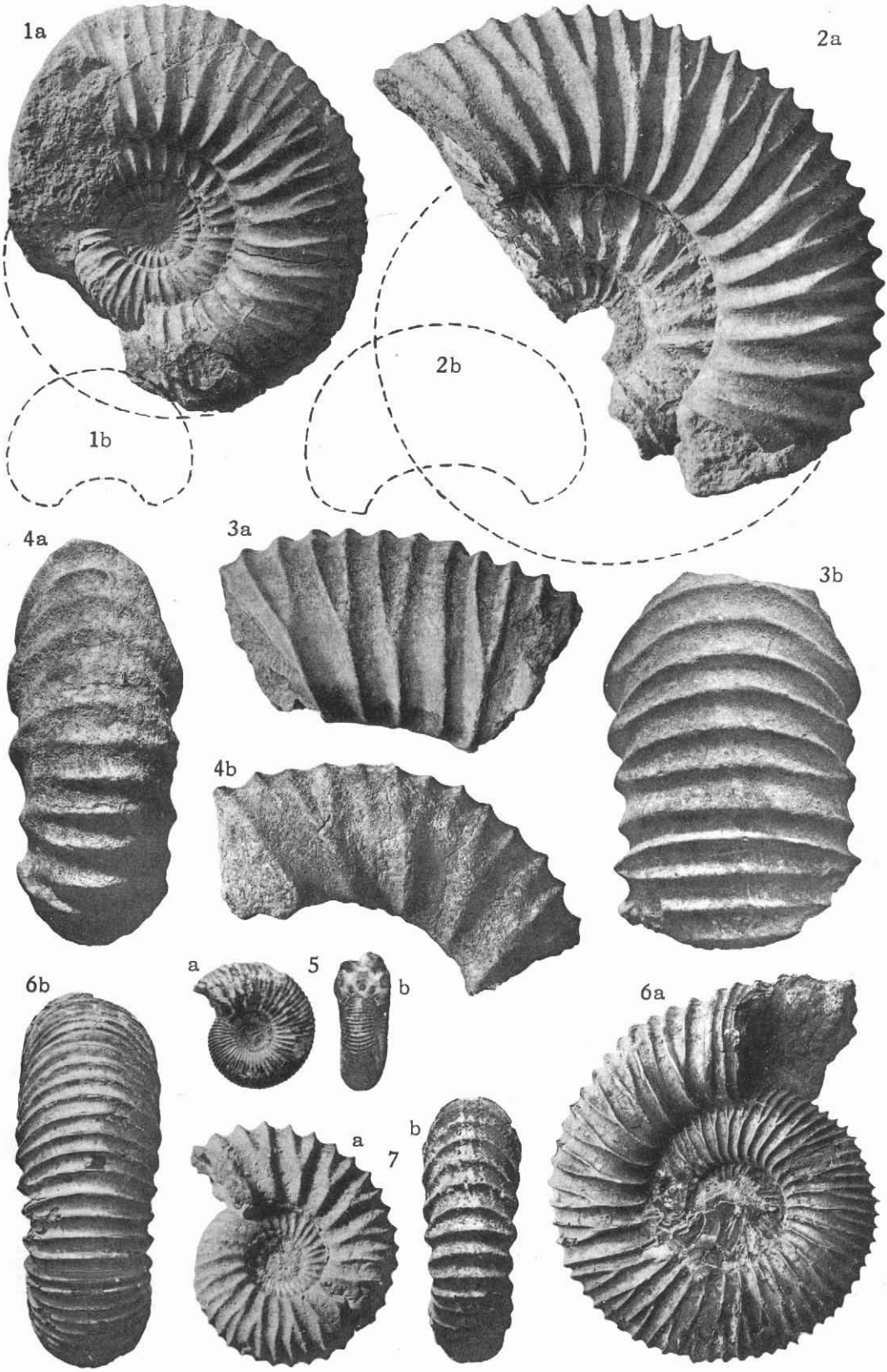
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6a
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7
b

Plate 6.

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Fig. 1. *Pectinatites* (*Keratinites*?) *groenlandicus*, sp. nov. Holotype. For inner whorls see Plate 7, fig. 5. Sandy Clays, below β? Upper Kimmeridgian. N.W. side of Hartz Mtn. (No. 217) 25

- 2a, b. *Pavlovia* (*Pallasiceras*) aff. *subaperta*, sp. nov. Fragmentary and transitional specimen. Sandy Clays (above β?). Upper Kimmeridgian. Cape Leslie (R. II, 62 m) 45

- 3. *Pavlovia* (*Pallasiceras*?) sp. nov.? Squeeze of dorsal area of doubtful body-chamber fragment figured in Plate 20, fig. 5. Same bed and locality 47

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1
(×1½)
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2a
3
2b
4a
4b

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Figs. 1a, b. *Pavlovia* (*Epipallasiceras*) *costata*, sp. nov. Holotype. Glauconitic Series, upper part, Portlandian. Crab Valley (No. 162) 58

- 2a, b. *Pectinatites* (*Keratinites*) aff. *devillei* (P. de Loriol). Septate inner whorls of an example from the Sandy Clays, below β?; Upper Kimmeridgian. Crab Valley (No. 171) 23

- 3. *Crendonites*? sp. juv. ind. Doubtful inner whorls (referred to under *C. euglyptus*). Sandy Shales (with horizon *a*), Portlandian. Cape Leslie (R. I, 165 m) 63

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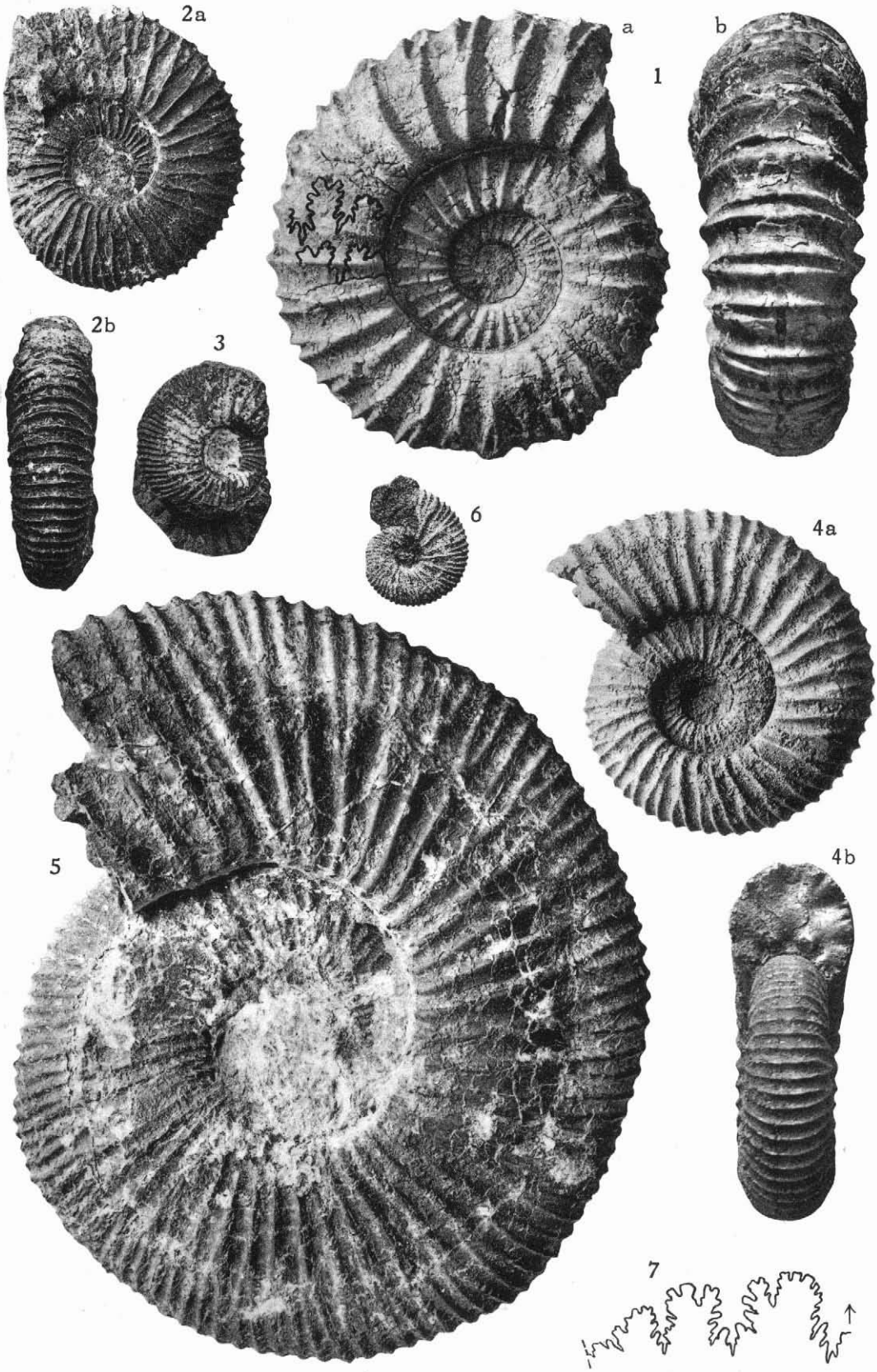
2a
a
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2b
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4a
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4b
7

Plate 8.

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Figs. 1a, b. *Pavlovia* (*Epipallasiceras*) aff. *pseudaperta*, sp. nov. Example with more inflated whorl-section. Glauconitic Series, upper part. Portlandian. Crab Valley (No. 163) 56

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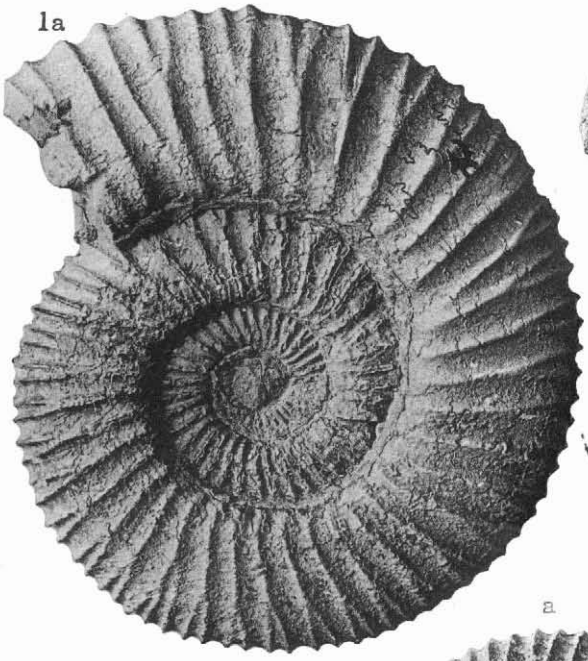
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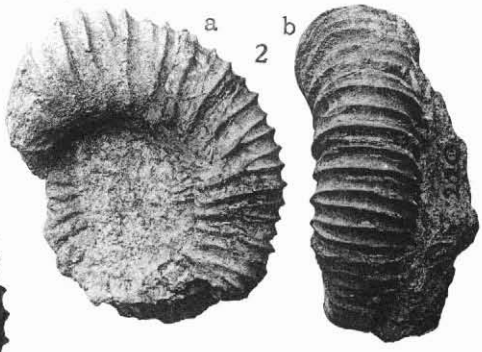
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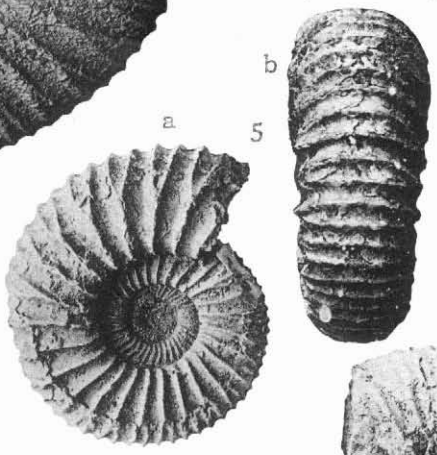
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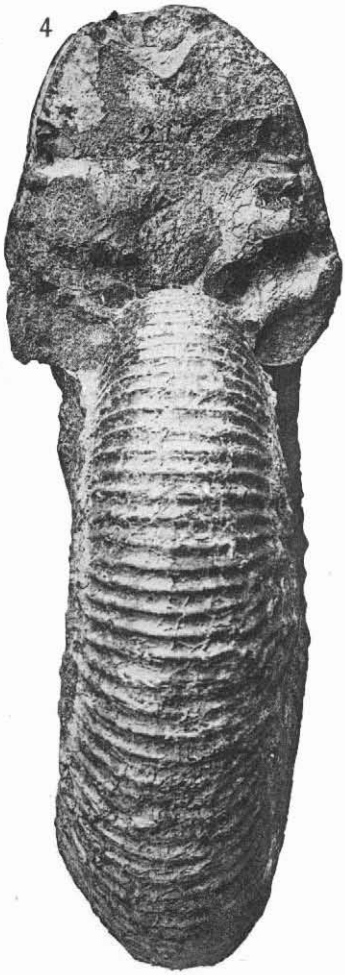
b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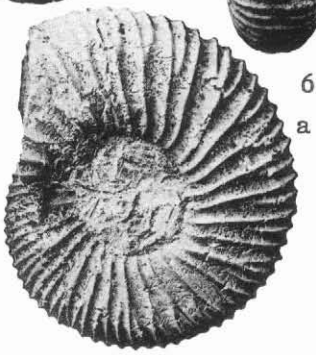
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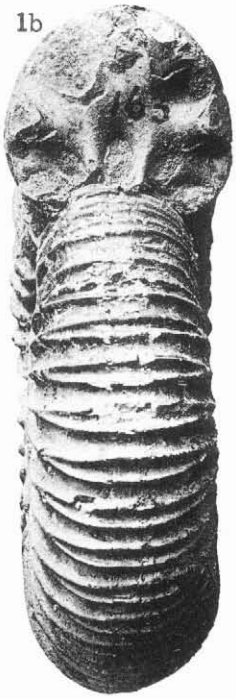
a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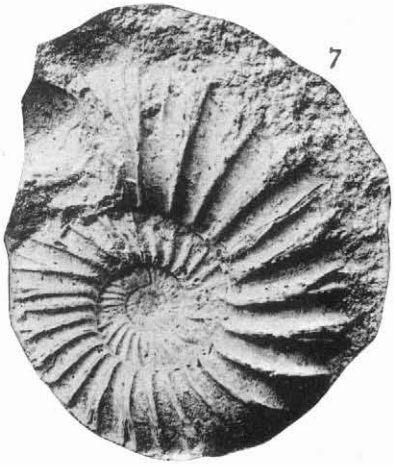
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Plate 9.

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Fig. 1. *Crendonites euglyptus*, sp. nov. Holotype. Sandy Shales (horizon *a*). Portlandian. Cape Leslie (R. I, 165 m) 63

2. *Pavlovia* (*Lydistratites*) *vulgaris*, sp. nov. Crushed fragment from the Portland Sands (Stinkstones) of Hounstout, Dorset. (L. F. S., Coll.) 31

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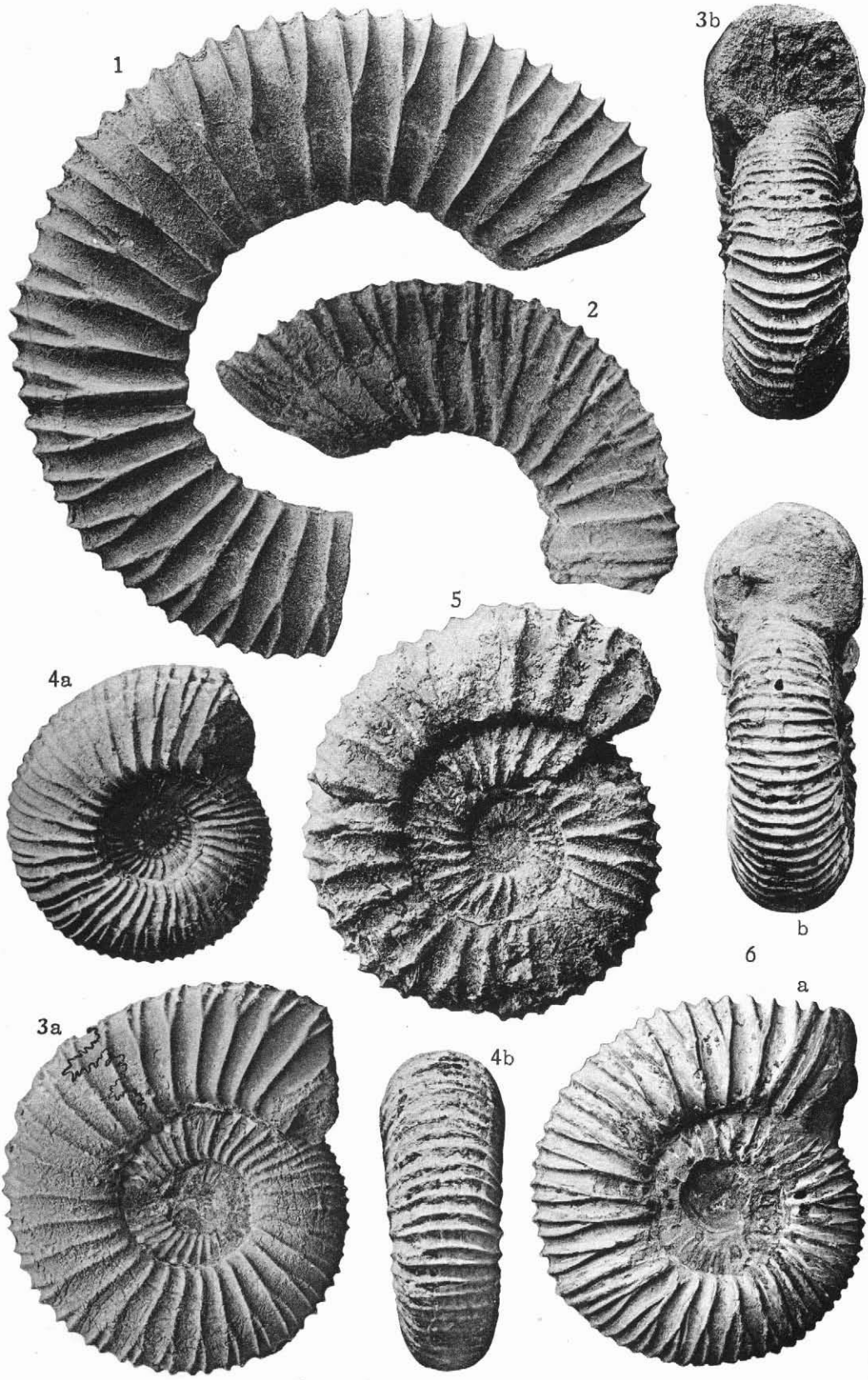
1
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3b
5
4a
b
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a
3a
4b

Plate 10.

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Figs. 1a, b. *Pavlovia* (*Pallasiceras*) *variabilis*, sp. nov. Holotype, slightly reduced. Sandy Clays below Glauconitic Series. Upper Kimmeridgian. Crab Valley (No. 173) 48

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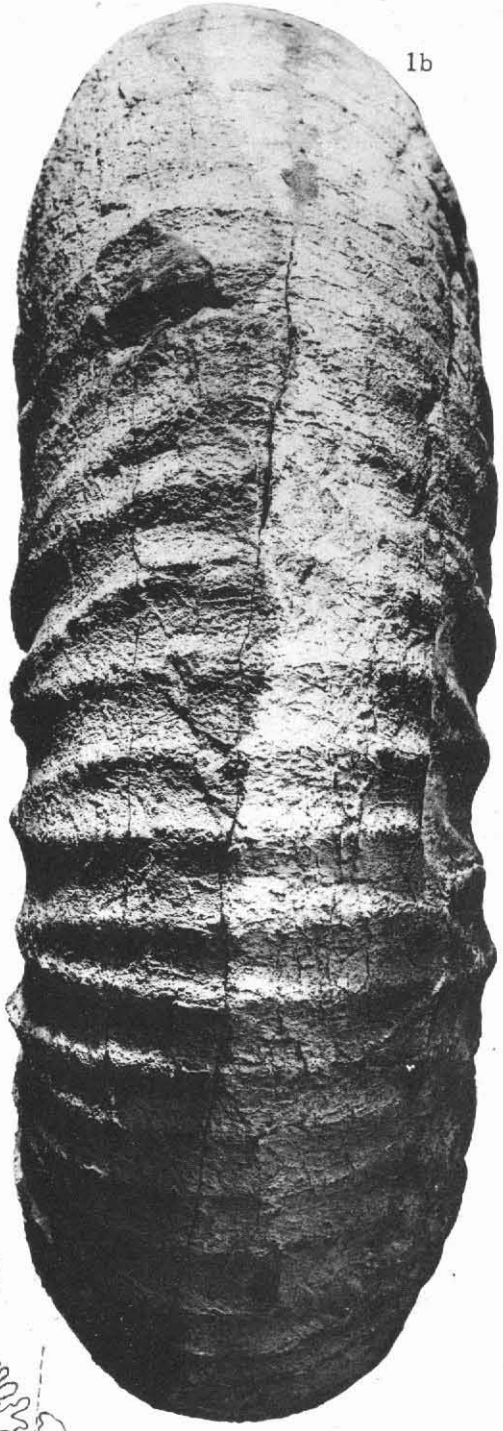
1a (×19/20)


a


2
b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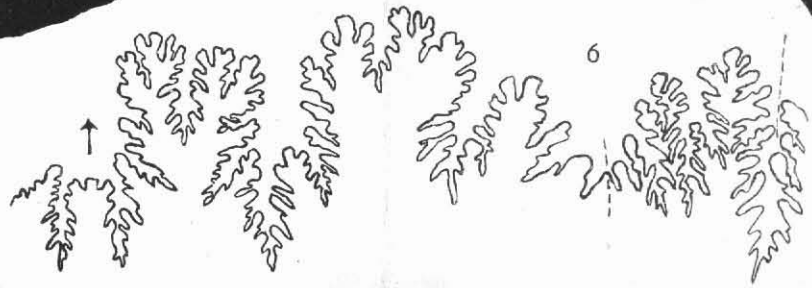
3a


3b


4


5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7

Plate 11.

Page

Fig. 1. *Pavlovia* (*Pallasiceras*?) *alterneplicata*, sp. nov. Holotype. (For peripheral view see Plate 12, fig. 3; for suture-line, Plate 17, fig. 2). Glauconitic Series (probably lowest part). Upper Kimmeridgian. N. W. Ridge of Hartz Mtn. (No. 213) 51

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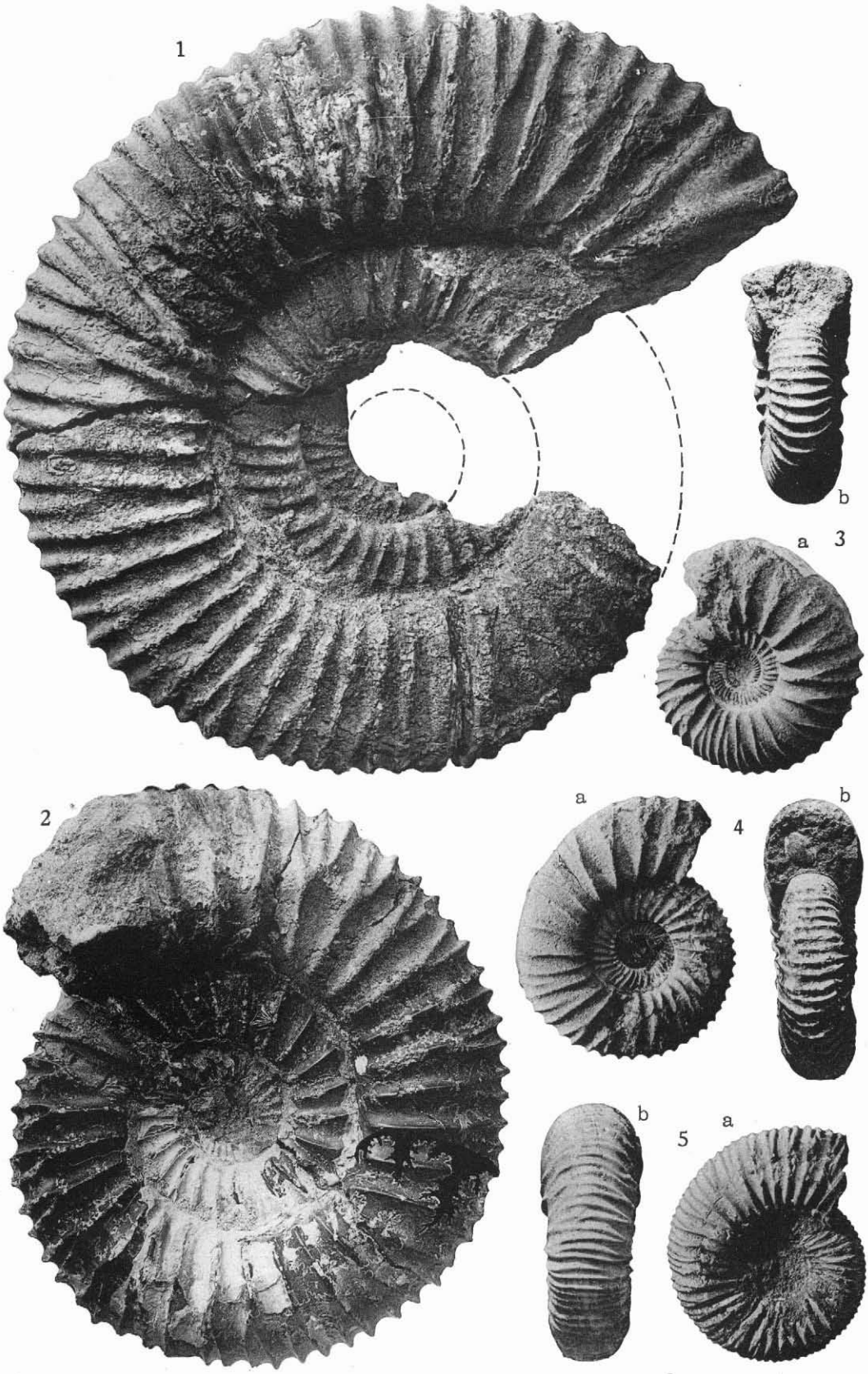
1
b
a
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a
4
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b
5
a

Plate 12.

Page

Figs. 1a, b. *Pavlovia* (*Pallasiceras*) aff. *rugosa*, sp. nov. Fragmentary, doubtful example, with restored whorl-section. Glauconitic Series, Upper Kimmeridgian? Pinna Valley (No. 223) 56

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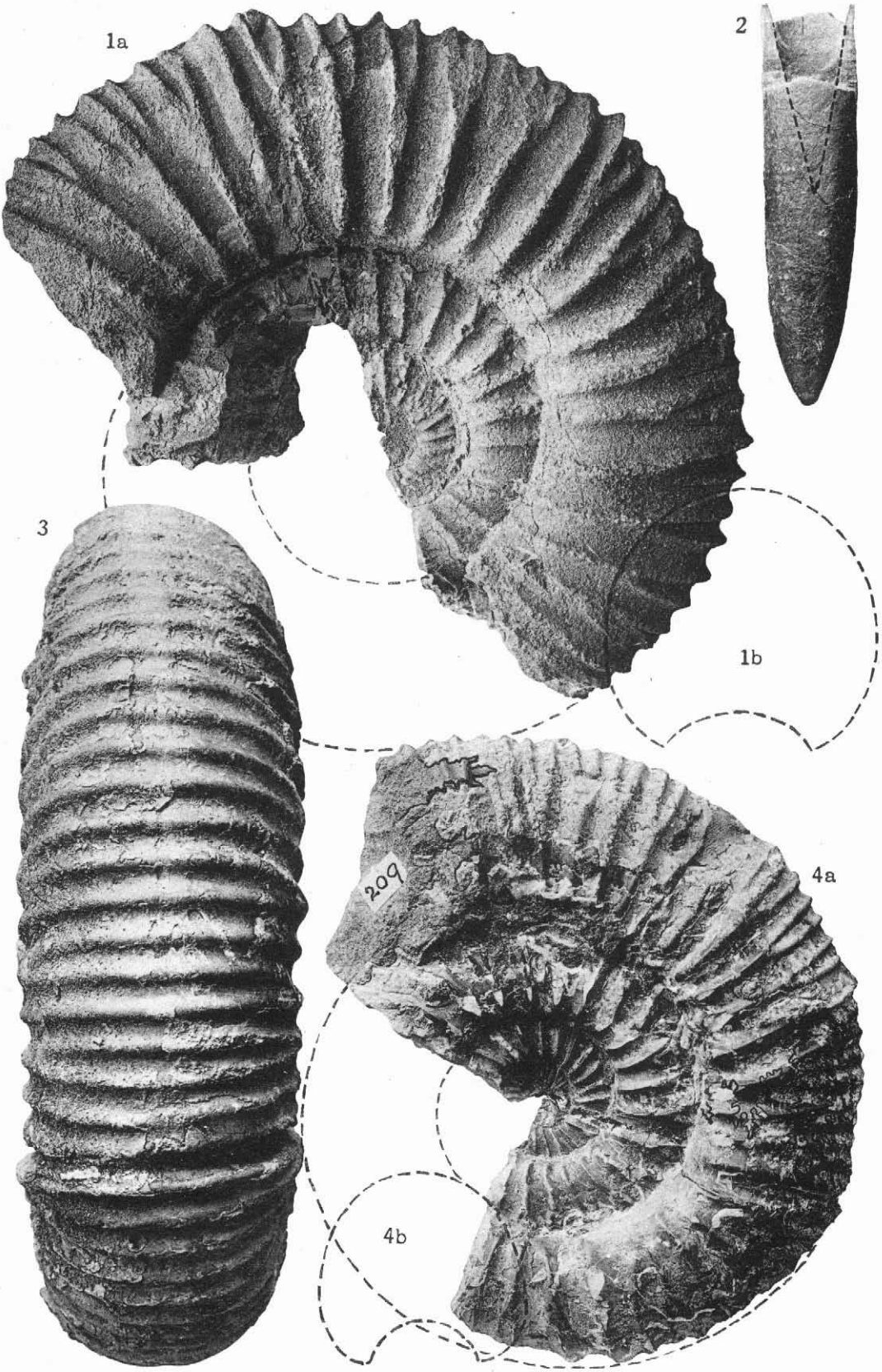

1a
2
3
1b
209
4a
4b

Plate 13.

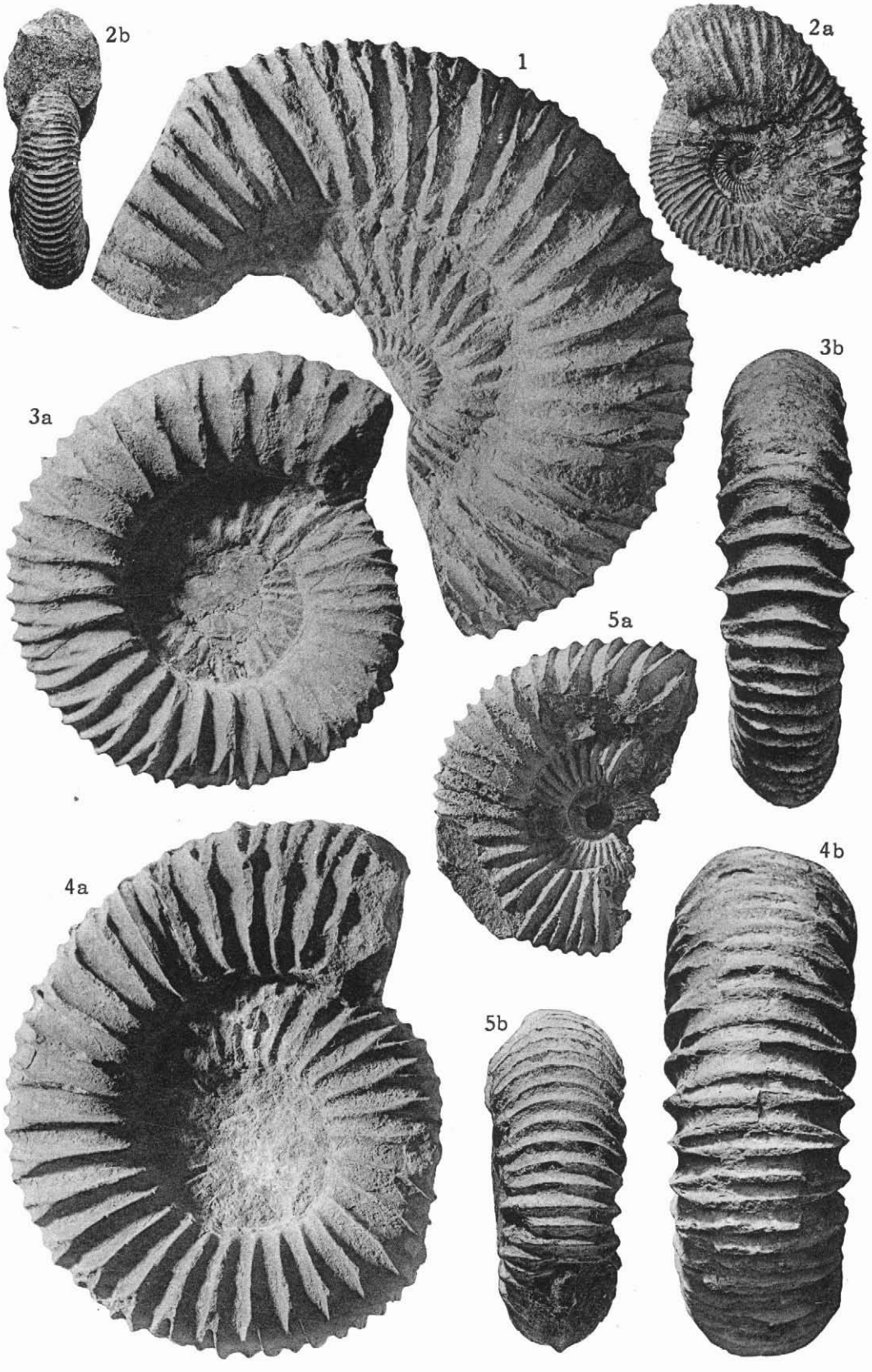
Page

Fig. 1. *Crendonites lesliei*, sp. nov. Holotype. Sandy Shales (horizon α). Portlandian. Cape Leslie (R. II, 200 m) 62

- 2. *Pectinatites* (*Keratinites*) cf. *boidini* (P. de Loriol). Crushed example with beginning of body-chamber. Sandy Clays, below β? Upper Kimmeridgian. Ridge south of Crab Valley (No. 220) 24

- 3a, b. *Crendonites euglyptus*, sp. nov. Paratype. Sandy Shales (horizon α). Portlandian. Cape Leslie (R. I, 165 m) 63

- 4a, b; 5a, b. *Crendonites subregularis*, sp. nov. Holotype and a smaller example. Same horizon. (Lingula Ridge, no. 202 and Crab Valley, no. 165) 64


2b
1
2a
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5b

Plate 14.

Page

Figs. 1a-c. *Pavlovia* (*Pallasiceras*) *inflata*, sp. nov. Holotype, with suture-line. Glauconitic Series (probably lowest part). Upper Kimmeridgian. N. W. Ridge of Hartz Mtn. (No. 213) 49

2. *Crendonites* sp. ind. cf. *gorei* (Salfeld). Inner whorls of an average young *Crendonites*, less finely ribbed than Plate 8, fig. 6 and less coarse than Plate 9, fig. 5. Portland Stone, Swindon, Wilts. (B. M., no. C 30740) 62

3a-c. *Pavlovia allovirgatoides*, sp. nov. Holotype, with suture-line at 70 mm diameter. Glauconitic Series (probably lowest part), Upper Kimmeridgian. N. W. ridge of Hartz Mtn. (No. 213) 37

4a, b. *Dorsoplanites transitorius*, sp. nov. Immature example from same bed and locality 69

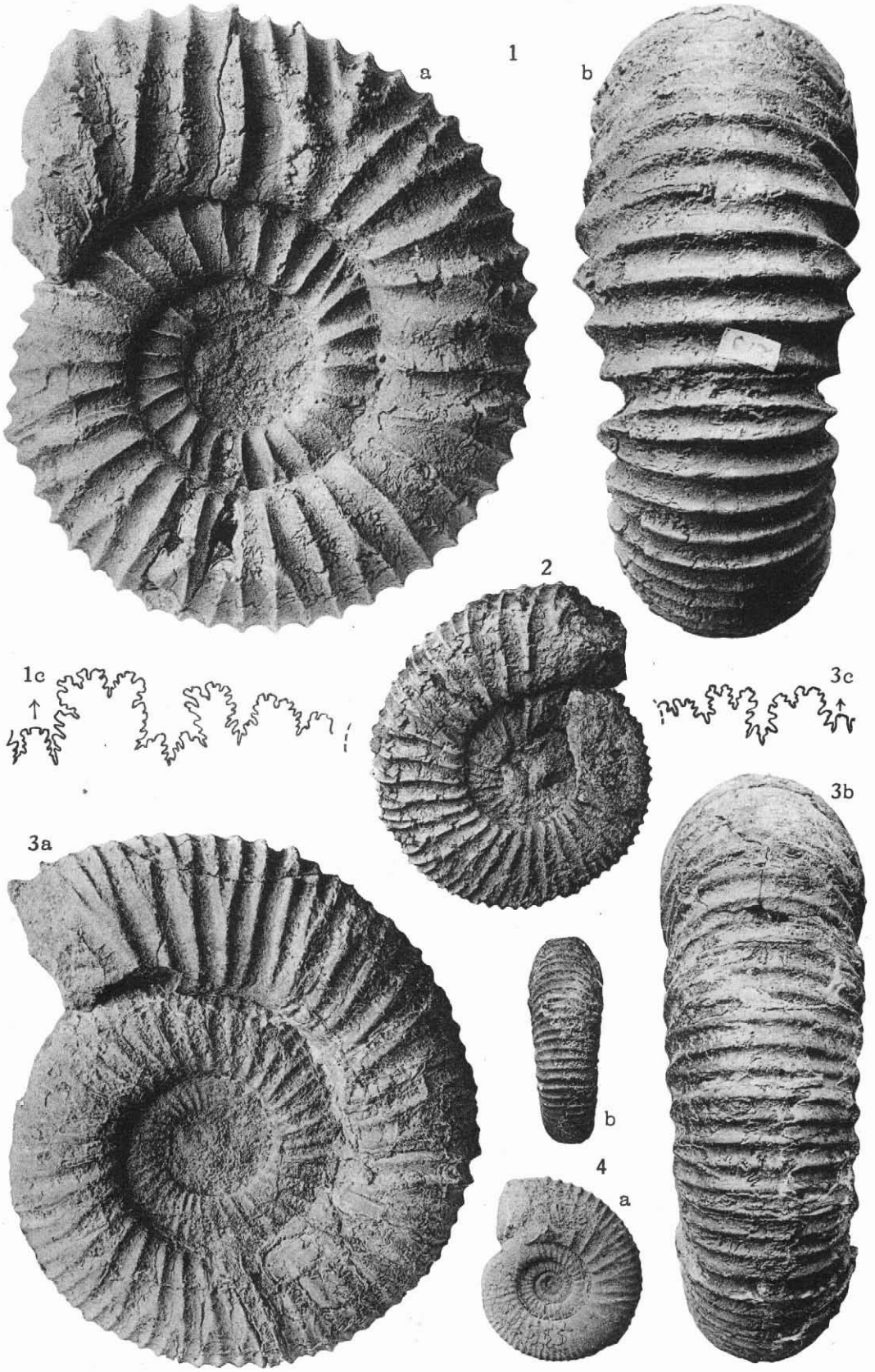
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Plate 15.

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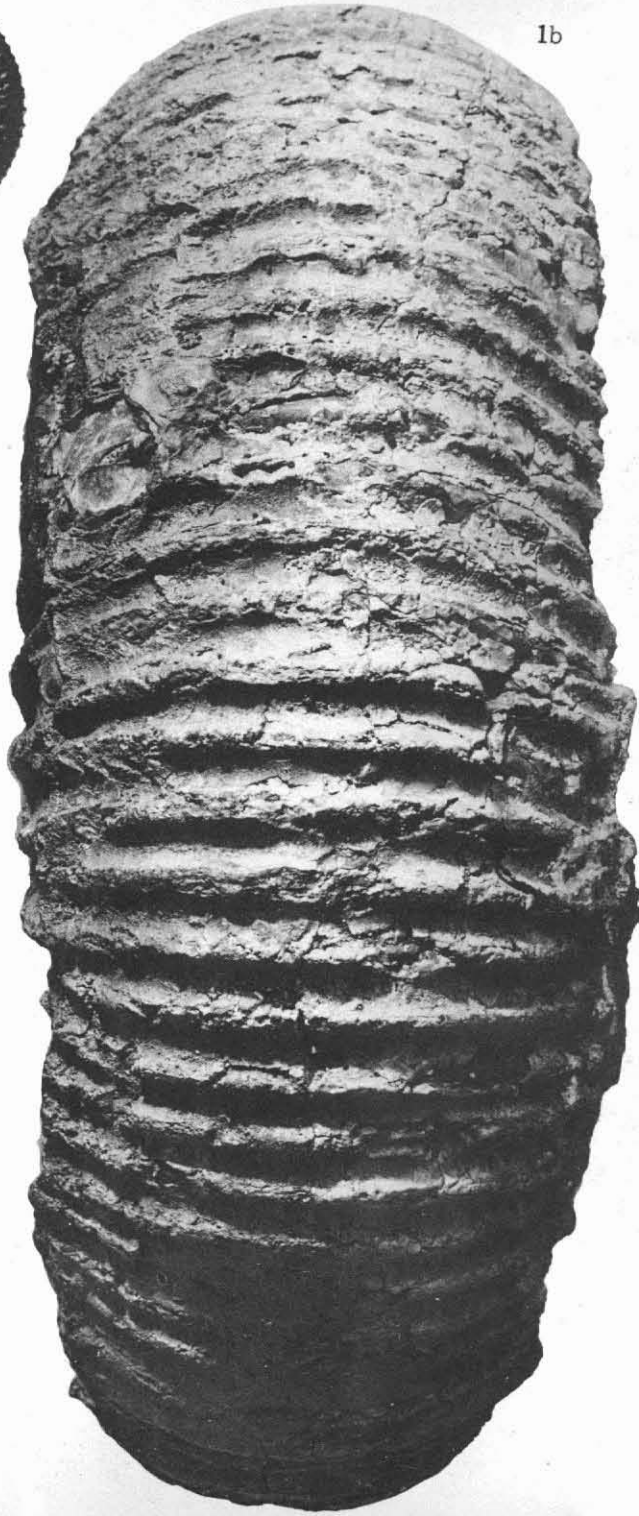
Figs. 1 a, b. *Pavlovia* (*Pallasiceras*) *kochi*, sp. nov. Holotype. Glauconitic Series (probably lowest part). Upper Kimmeridgian. N. W. ridge of Hartz Mtn. (No. 213) 50

2 a, b. *Pectinatites* (*Keratinites*) sp. juv. ind. Another example like Plate 6, fig. 4. *Pectinatus* zone, Upper Kimmeridgian (Shotover Grit Sands) near Oxford. (L. F. S. Coll.) 38

1a

2a

1b



2b

Plate 16.

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Figs. 1a, b. *Pavlovia* (*Epipallasiceras*) *pseudaperta*, sp. nov. Holotype. Glauconitic Series, upper part. Portlandian. Ridge south of Crab Valley (No. 176) 56

- 2a, b. *Kerberites* sp. juv. ("*portlandensis*" Cox). Original of Blake's *Amm. triplicatus* (1880, pl. x, fig. 7) said to be from Flinty Series, Portland. (Blake Coll.) 34

- 3a, b. *Pavlovia* cf. *allovirgatoides*, sp. nov. Inner whorls. Glauconitic Series (probably lowest part). Upper Kimmeridgian. N. W. Ridge of Hartz Mtn. (No. 213) 37

- 4a-c. *Pavlovia* (*Epipallasiceras*) *pseudaperta*, sp. nov. Malformation (two sides). Glauconitic Series, upper part. Portlandian. Ridge south of Crab Valley (No. 178) 56

- 5. *Crendonites* sp. juv. ind. Crushed inner whorls. Sandy Shales (horizon *a*). Portlandian. Lingula Ridge (No. 202) 62

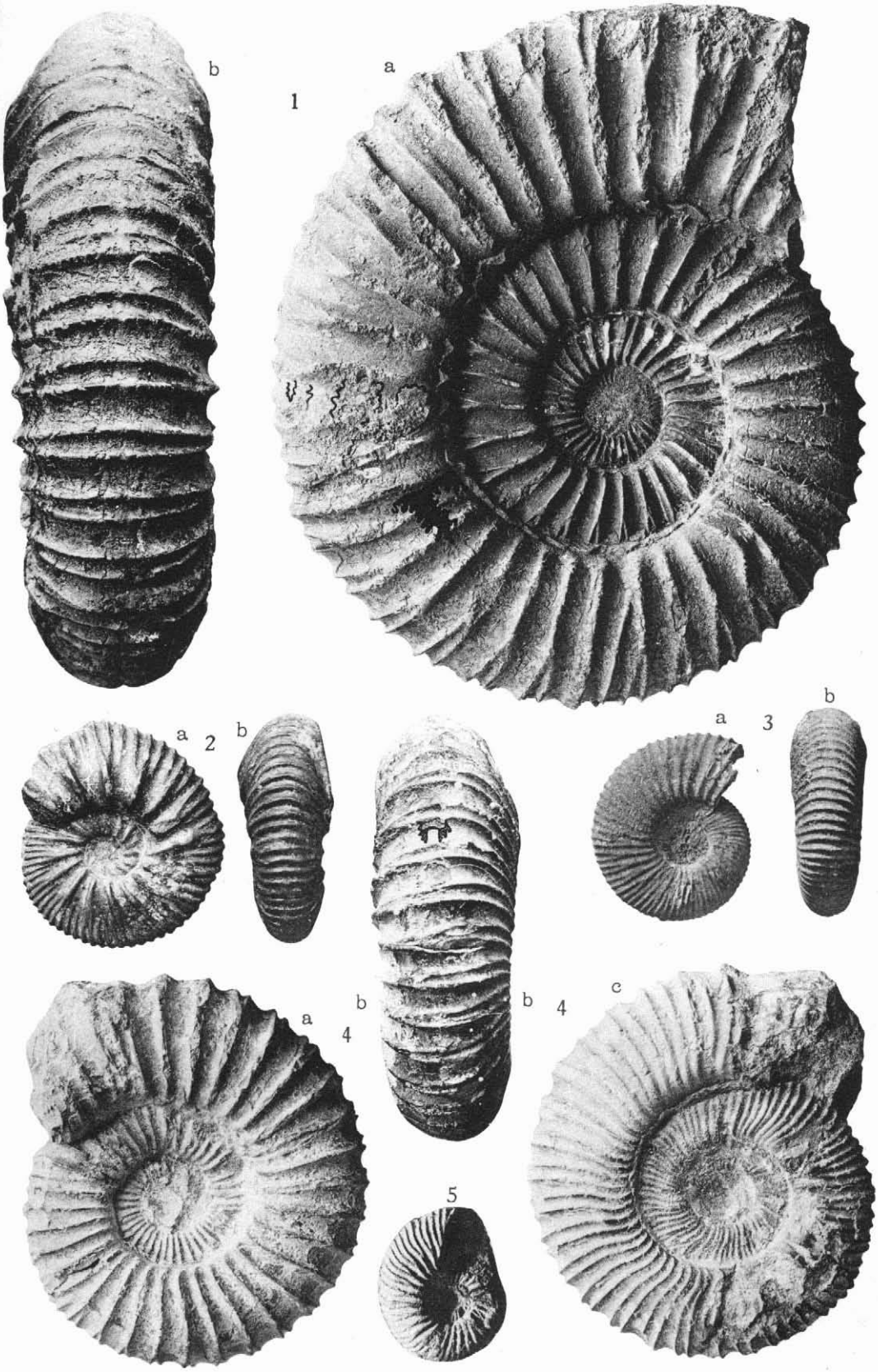
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Plate 17.

Page

Fig. 1. *Pavlovia* (*Epipallasiceras*) *tumida*, sp. nov. Holotype, with portion of outer whorl omitted. Glauconitic Series, upper part. Portlandian. Cape Leslie (R. I, 100—115 m) 59

2. *Pavlovia* (*Pallasiceras*) *alterneplicata*, sp. nov. Suture-line of holotype, Plate 11, fig. 1 51

3a, b. *Pavlovia* (*Pallasiceras*) aff. *rugosa*, sp. nov. Doubtful inner whorls. Glauconitic Series. Upper Kimmeridgian? Pinna Valley (No. 131) 53

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5. *Pavlovia* (*Lydistratites*) *vulgaris*, sp. nov. Crushed holotype, showing degeneration of ribbing on body-chamber. Portland Sands, Stinkstones, *vulgaris* zone. Hounstout, Dorset. (L. F. S. Coll.) 31

6. *Crendonites* sp. juv. Small example, with body-chamber. Sandy Shales (horizon *a*). Portlandian. Cape Leslie (R. I, 165 m) 65

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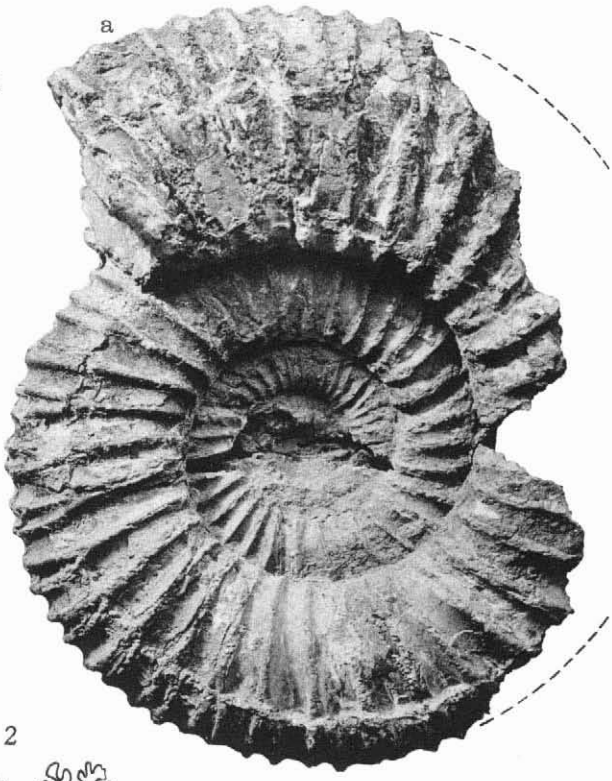

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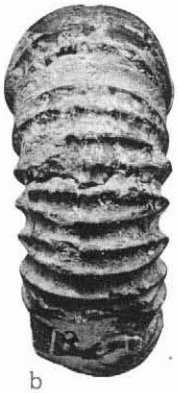

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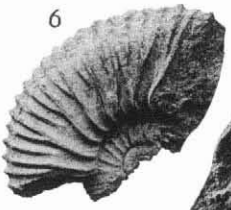

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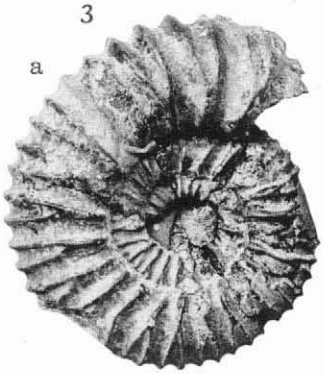

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Plate 18.

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Figs. 1a, b. *Pavlovia* (*Epipallasiceras*) *pseudaperta*, sp. nov. Body-chamber of a high zonal example. Sandy Shales (with horizon *a*), Portlandian. Cape Leslie (R. I, 165 m) 56

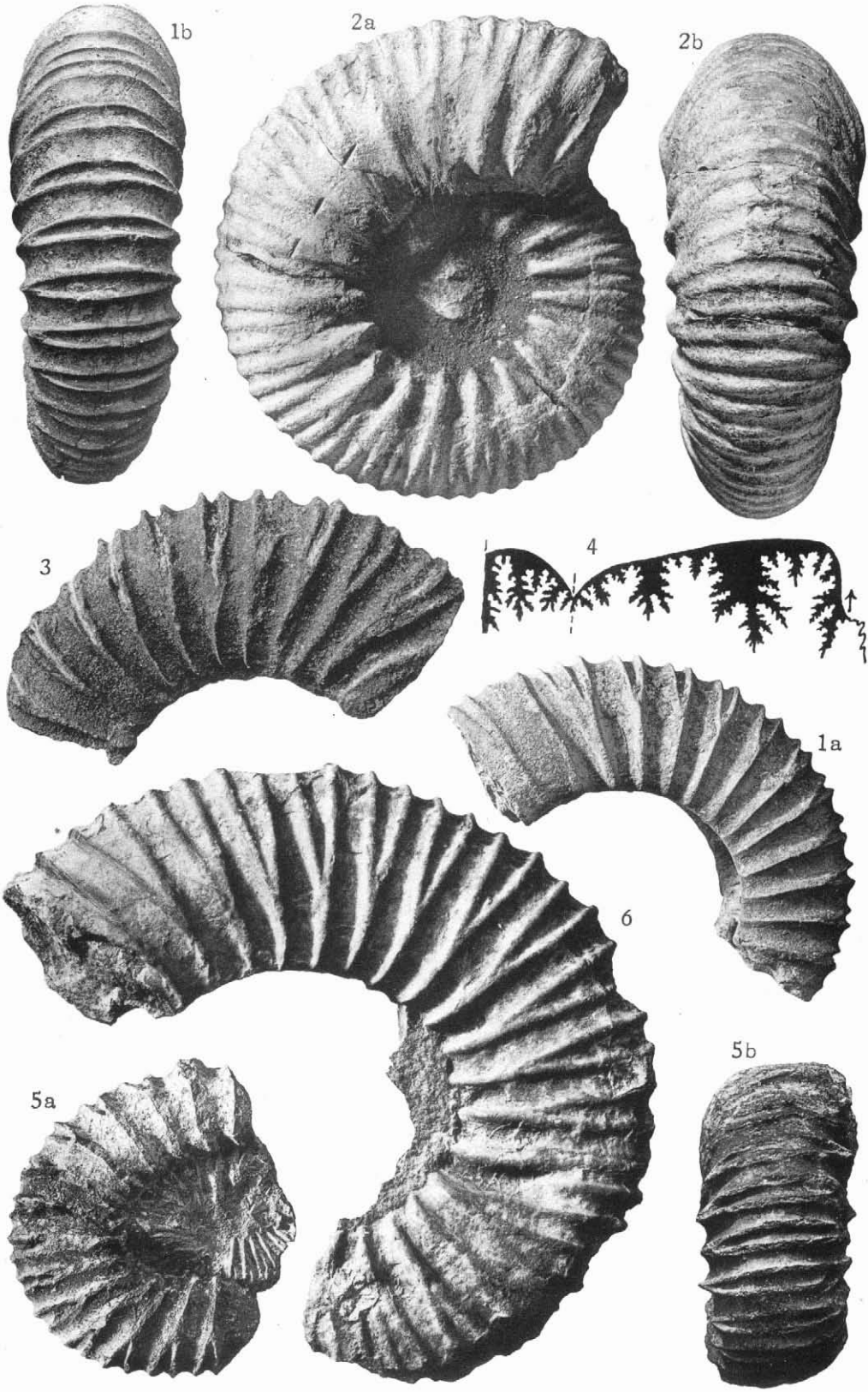
- 2a, b. *Kerberites kerberus*, Buckman. Slightly more inflated variety. Portland Stone. Buckinghamshire(?). L. F. S. Coll. (Showing greatly thickened primary ribs, unknown in any Greenland or Volgian species) 34

- 3. *Pavlovia* (*Epipallasiceras*) aff. *costata*, sp. nov. Doubtful, crushed fragment. Glauconitic Series, upper part. Portlandian. Pinna Valley (No. 134) 58

- 4. *Pavlovia* (*Pallasiceras*) *rotunda* (J. Sowerby). Complete suture-line. Upper Kimmeridge Clay, *rotunda* nodule bed. Chapman's Pool, Dorset. (C. H. Waddington Coll.) 55

- 5a, b. *Crendonites* cf. *subregularis*, sp. nov. Doubtful, crushed example. Sandy Shales (horizon *a*). Portlandian. Glauconite Hill (No. 153) 64

- 6. *Pavlovia* (*Lydistratites*) *worthensis*, sp. nov. Holotype (body-chamber). Portland Sands, Upper Sandstones. Hounstout, Dorset. (L. F. S. Coll.) 30


1b
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5a
5b

Plate 19.

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Figs. 1a, b. *Crendonites lesliei*, sp. nov. Paratype. Sandy Shales (horizon *a*). Portlandian. Cape Leslie (R. II, 200 m) 62

2. *Acuticostites pallasianus* (d'Orbigny). For comparison with periphery of *Pavlovia* (*Epipallasiceras*) *pseudaperta*. See also Plate 25, fig. 3. Lower Volgian, near Moscow (B. M., no. 74212) 29

3a, b. *Pavlovia* (*Pallasiceras*) *rotundiformis*, sp. nov. Holotype. Glauconitic Series, upper part. Portlandian? Cape Leslie (R. I, 115—130 m) 55


1a
2
1b
3b
3a

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Figs. 1. *Pavlovia* (*Epipallasiceras*) *pseudaperta*, sp. nov. Crushed example from Glauconitic Series, upper part. Portlandian. Pinna Valley (No. 133) 56

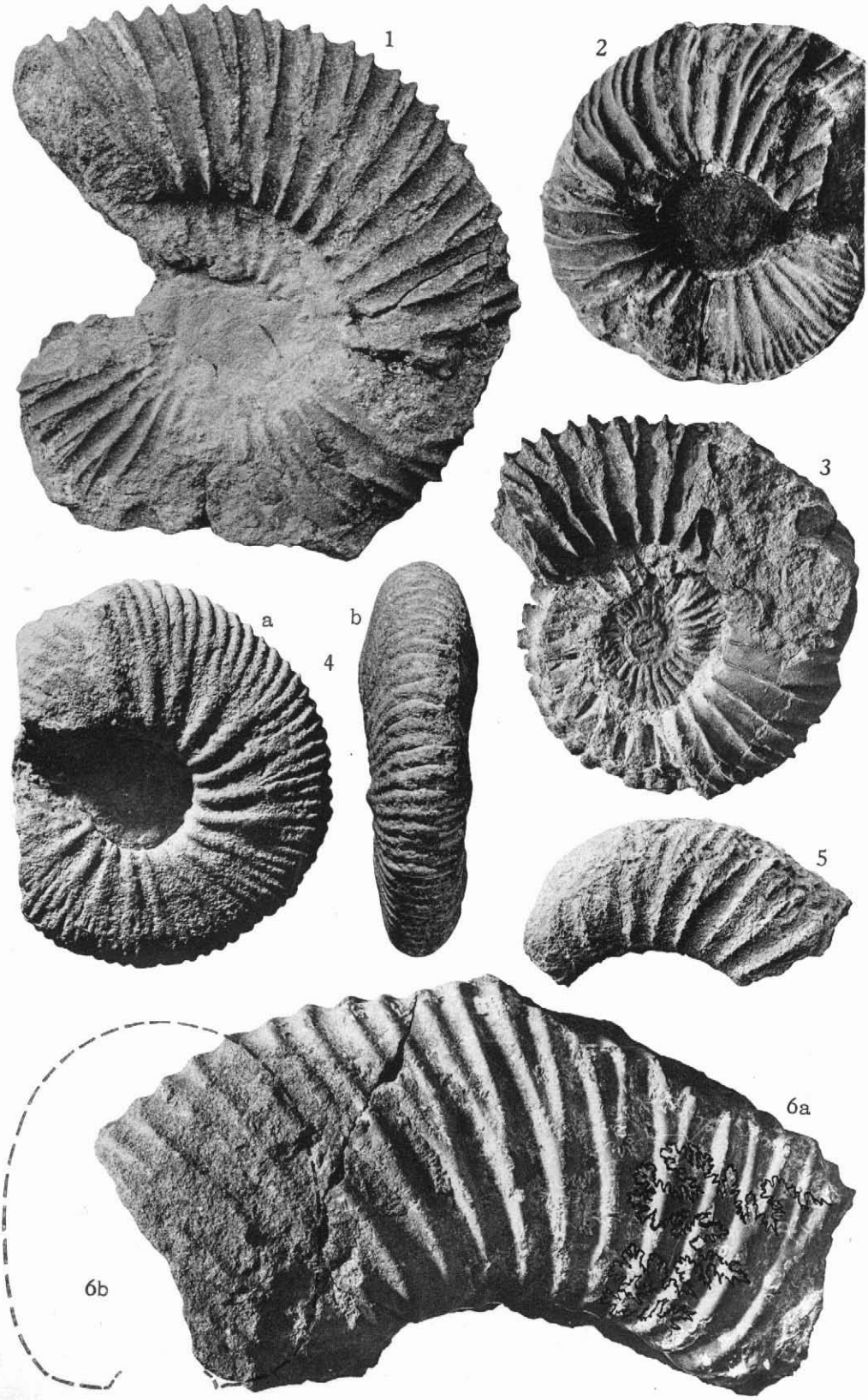
2. *Progalbanites albani*, Arkell sp. Portland Sands, Stinkstones, *vulgaris* zone. Hounstout, Dorset. (L. F. S. Coll.) 30

3. *Crendonites* cf. *subregularis*, sp. nov. Doubtful, crushed example from Sandy Shales (horizon α). Portlandian. Cape Leslie (R. II, 200 m) 64

4a, b. *Kerberites subswindonensis*, sp. nov. Holotype. Portland Stone, locality unrecorded. (Differs from *K. swindonensis*, Pavlow sp. [1889] in great compression). (B. M., no. C 26697) 34

5. *Pavlovia* (*Pallasiceras*?) sp. nov.? Doubtful body-chamber fragment. (See Plate 6, fig. 3 for dorsal area). Sandy Clays (above β?). Upper Kimmeridgian. Cape Leslie (R. II, 62 m) 47

6a, b. *Pavlovia* (*Epipallasiceras*?) sp. ind. Doubtful fragment, showing suture-line. Glauconitic Series, upper part. Portlandian. Pinna Valley (No. 125) 61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6a
6b

Plate 21.

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Figs. 1a, b. *Pavlovia* (*Pallasiceras*) cf. *variabilis*, sp. nov. Doubtful, young example. Sandy Clays or Glauconitic Series? Upper Kimmeridgian. Pinna Valley (No. 127) 48

2 a-c. *Crendonites anguinus*, sp. nov. Holotype, with outline whorl-section (at ×) and suture-lines. (For another suture-line see Plate 6, fig. 5). Sandy Shales (horizon *a*), Portlandian. Cape Leslie (R. I, 165 m) 65

3a, b. *Crendonites* cf. *subregularis*, sp. nov. Crushed example, with restored outline whorl-section. Sandy Shales (horizon *a*), Portlandian. Glauconite Hill (No. 155) 64

4a, b. *Kerberites trikraniformis*, sp. nov. Holotype. Portland Stone, Swindon, Wilts. (B. M., no. C. 5122). (Differs from *K. trikranus*, Buckman, in proportions [80 — .41 — .37 — .29] and in finely ribbed inner whorls) 34

5a, b. *Dorsoplanites* sp. ind. Septate example, comparable to the variety of *D. panderi* (*non* d'Orbigny) figured by Michalski (Pl. XII, fig. 3). Lower Volgian. Charasschova. (B. M., no. 22287). For comparison with *D. gracilis* (Plate 33, fig. 3) 73

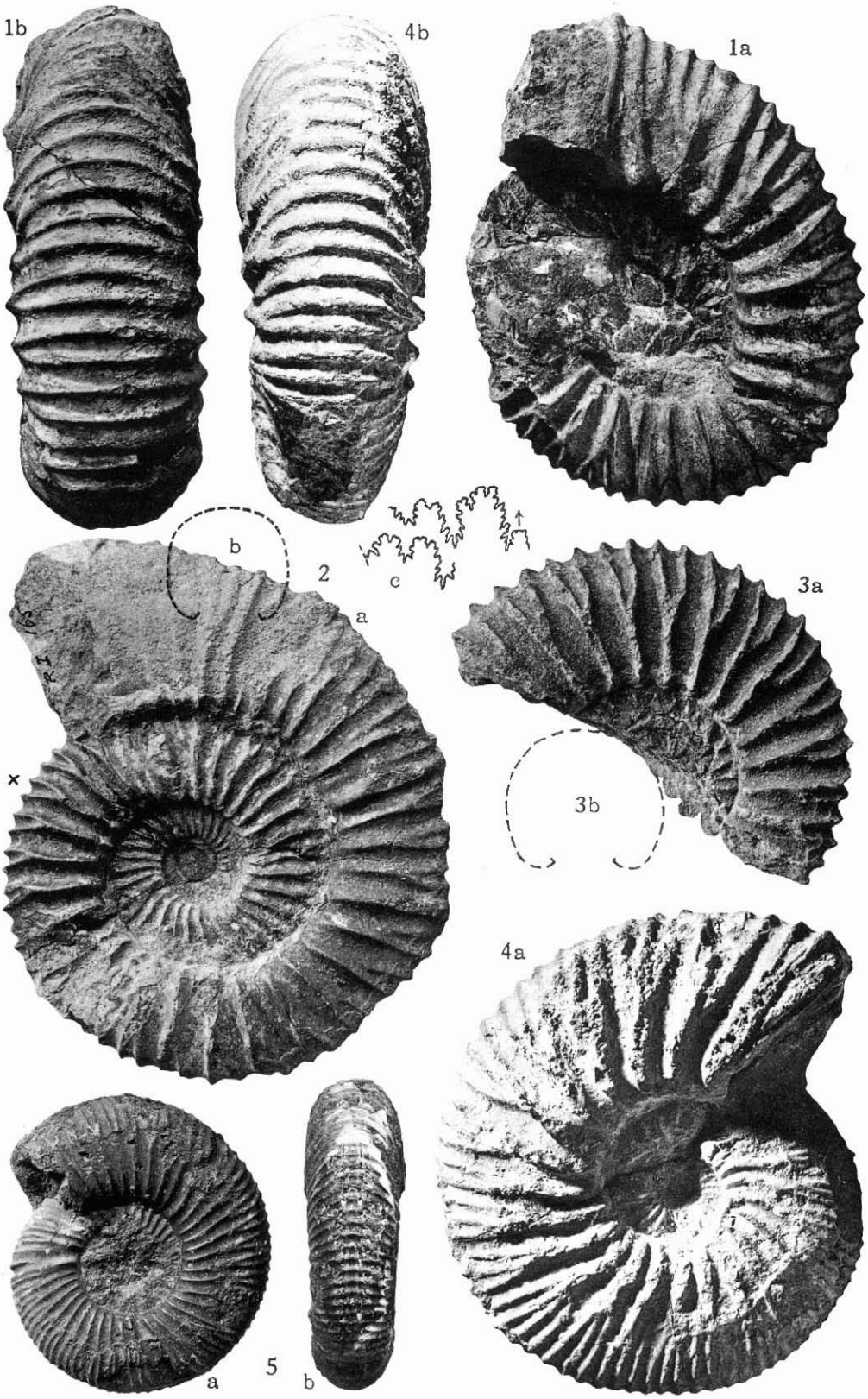
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Plate 22.

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Figs. 1a, b. *Crendonites* sp. nov.? aff. *lesliei*, sp. nov. Fragment with part of body-chamber. Sandy Shales (horizon *a*), Portlandian. Glauconite Hill (No. 154) 63

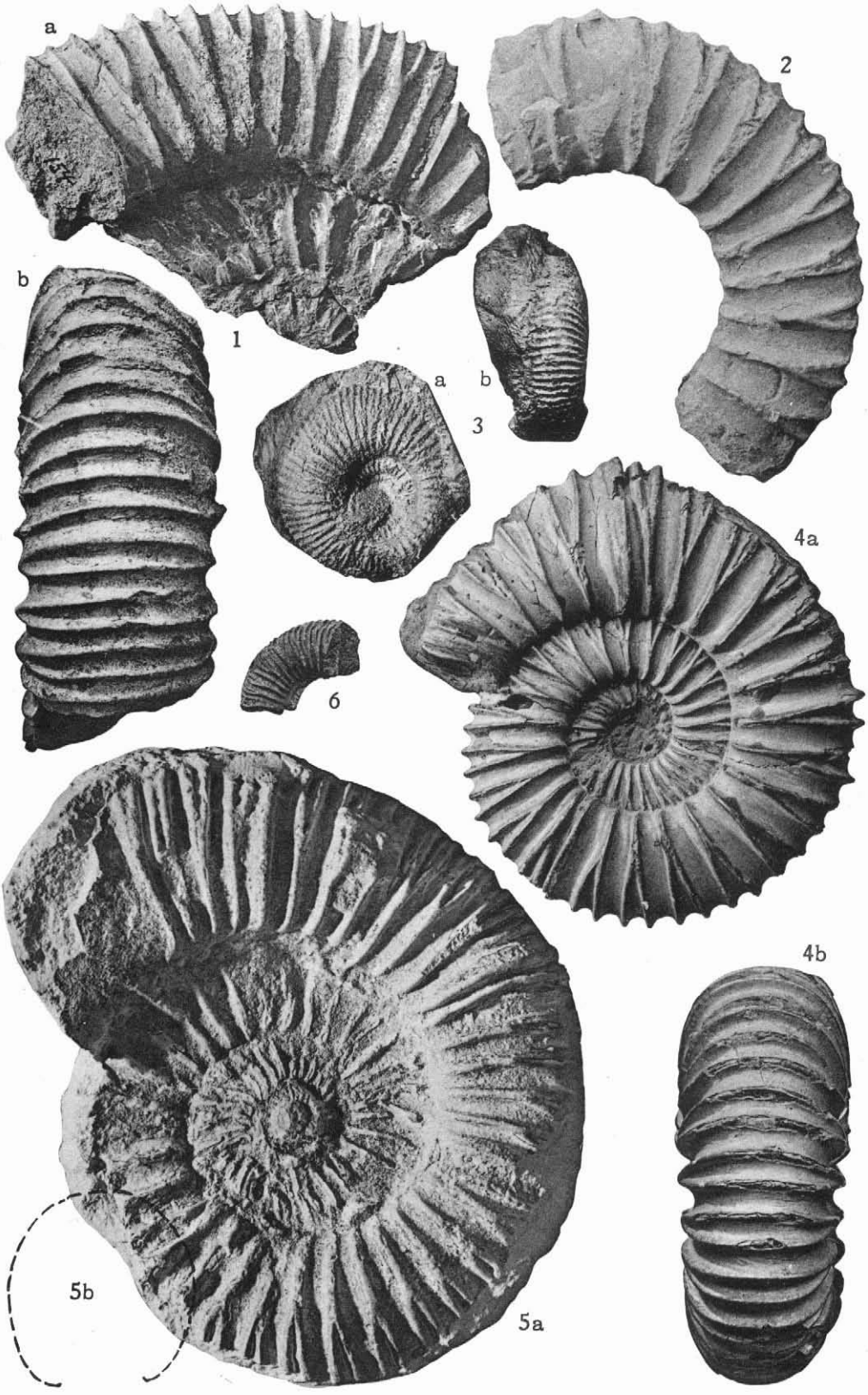
- 2. *Crendonites pregorei*, sp. nov. Holotype (crushed body-chamber). Portland Sands, Stinkstones, Hounstout, Dorset. (L. F. S. Coll.). (Differs from *C. subregularis* in more distant spacing of costation) 31

- 3a, b. *Craspedites ferrugineus*, sp. nov. Holotype (squeezes of a natural mould). Hartzfjaeld Sandstone (Tithonian?). Pinna Valley (No. 228) 86

- 4a, b. *Pavlovia* (*Lydistratites*) *iris*, sp. nov. Example referred to by Healey, 1904, p. 61. Hartwell Clay, Upper Kimmeridgian. Aylesbury, Bucks. (B. M., no. 88622), for comparison with *Acuticostites pallasianus* (d'Orbigny) 28

- 5a, b. *Crendonites* cf. *lesliei*, sp. nov. Plaster cast of a poor impression. Sandy Shales (horizon *a*). Portlandian. Cape Leslie (R. II, 170 m, loose) 62

- 6. *Crendonites* sp. juv. ind. Fragment of a crushed inner whorl from the same bed (R. I, 165 m) 63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5a

Plate 23.

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Fig. 1. *Behemoth groenlandicus*, sp. nov. Holotype, reduced to two-fifths. Glauconitic Series. Portlandian. Cape Leslie (R. I, 130 m) 66

2. *Progalbanites albani*, Arkell sp. Crushed inner whorls (compare Plate 24, fig. 2). Portland Sands, Stinkstones, Hounstout, Dorset. (L. F. S. Coll.) 30

3. *Titanites okusensis* (Salfeld) Buckman sp. Complete suture-line of a fragment (C. H. Waddington Coll.). Portland Stone, Cockly Bed, Swindon. (For comparison with Plate 18, fig. 4) 35

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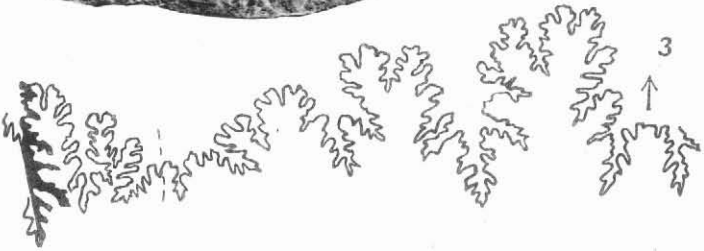

Plate 24.

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Fig. 1. *Behemoth groenlandicus*, sp. nov. Part of holotype (Plate 23, fig. 1), in natural size 66

2. *Progalbanites albani*, Arkell sp. Crushed inner whorls (compare Plate 23, fig. 2). Portland Sands, Stinkstones, Hounstout, Dorset. (L. F. S. Coll.) 30

3a, b. *Pachyteuthis* aff. *panderiana* (d'Orbigny). Ventral and lateral aspects. Sandy Shales (horizon *a*) Portlandian. Cape Leslie (R. I, 165 m) 89

4a, b. *Dorsoplanites antiquus*, sp. nov. Small example, with part of body-chamber. Glauconitic Series, Upper Kimmeridgian? Pinna Valley (No. 223) 68

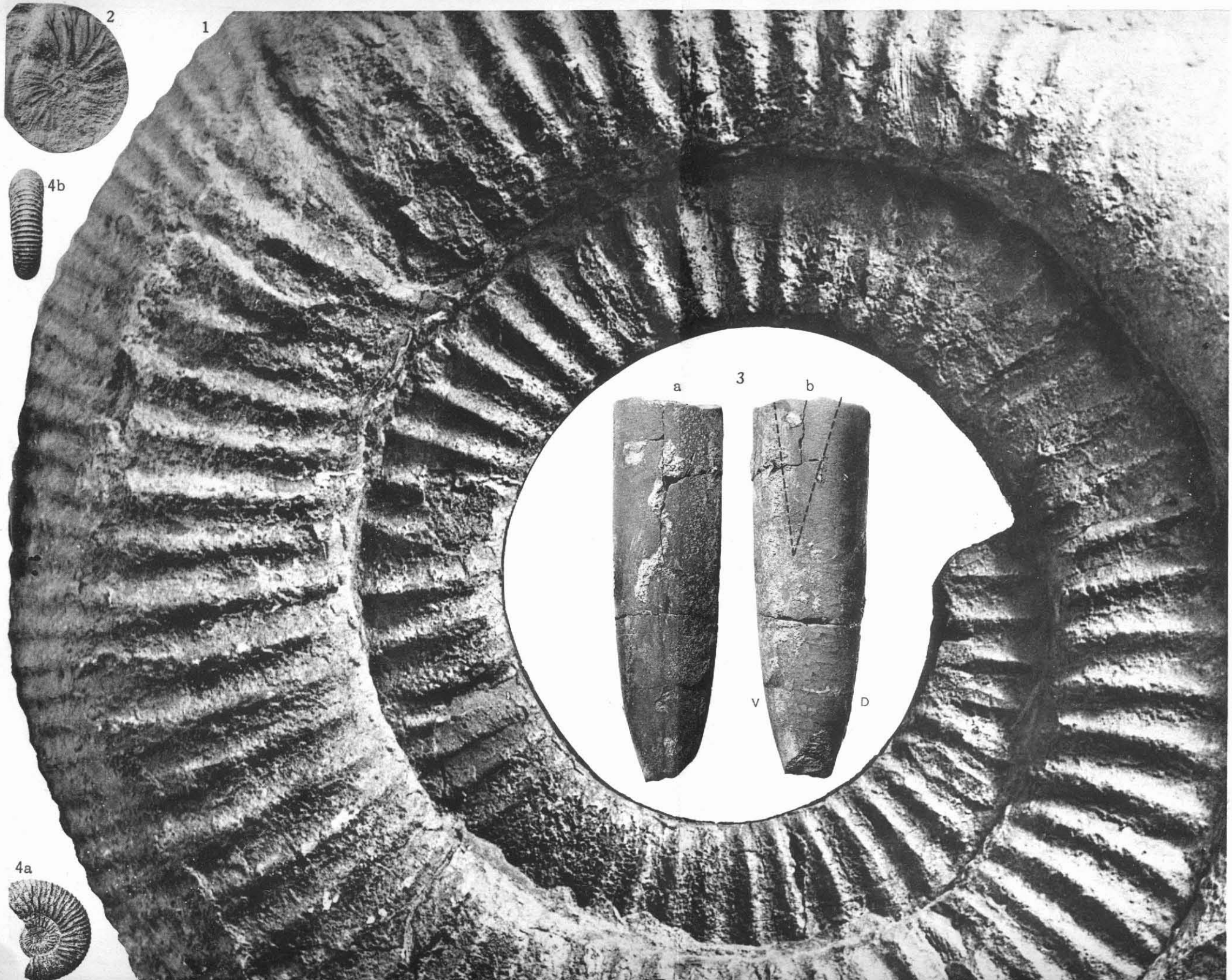
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Plate 25.

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Figs. 1a, b. *Pavlovia* (*Epipallasiceras*) *praecox*, sp. nov. Holotype. Glauconitic Series, upper part. Portlandian. Ridge south of Crab Valley (No. 176) 60

2. *Pavlovia* (*Pallasiceras*) *kimmeridiensis*, Seebach sp. Small example, more accelerated than typical specimen B. M., no. C 4868a. Upper Kimmeridge Clay, Wootton Bassett, Wilts. (B. M., no. C 4868b). For comparison with *P.* (*P.*) *regularis*, sp. nov. 43

3. *Acuticostites* aff. *pallasianus* (d'Orbigny). Compressed variety. (Compare Plate 19, fig. 2 for final stage). Lower Volgian. Russia. (B. M., no. 33499) 29

4. *Dorsoplanites* aff. *triplex*, sp. nov. Squeeze of a natural mould, with a tangle of flattened *Serpula* sp. ind. Sandy Clays (above β?). Upper Kimmeridgian. Cape Leslie (R. II, 62 m) 80, 135

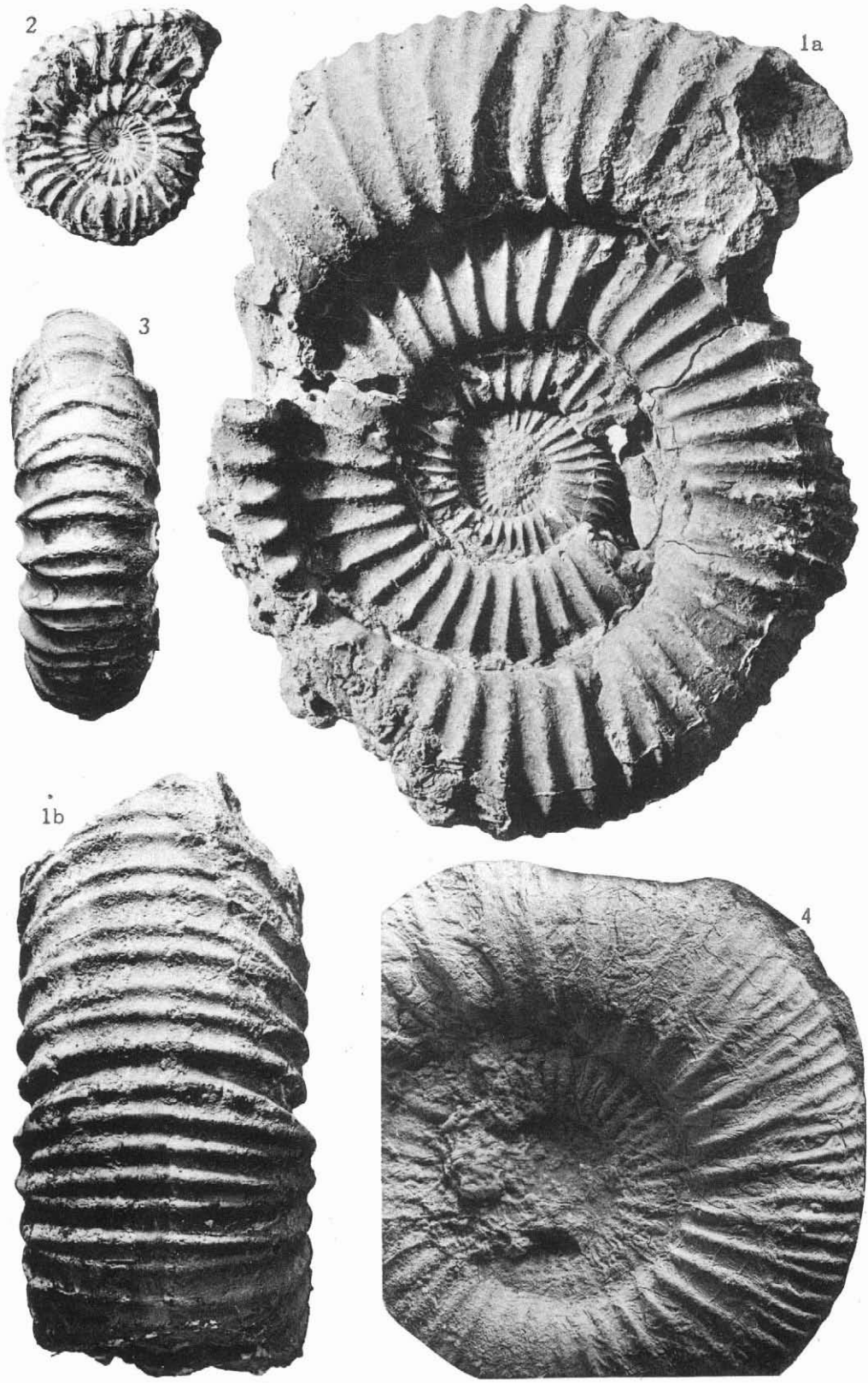
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Plate 26.

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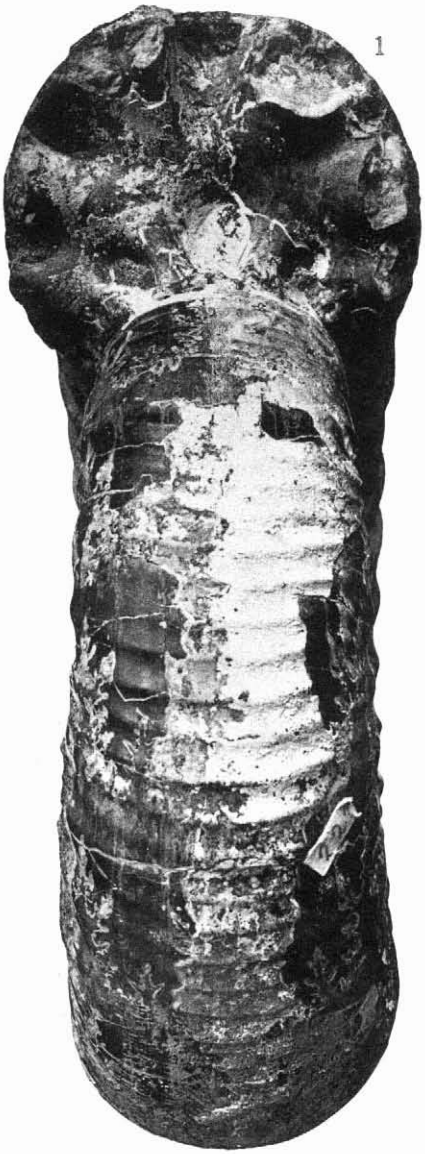
Fig. 1. *Dorsoplanites maximus*, sp. nov. Holotype (for side-view see Plate 28, fig. 1). Glauconitic Series, Portlandian. Ridge south of Crab Valley (No. 221) 71

2. *Dorsoplanites dorsoplanoides*, sp. nov. Holotype (for peripheral view see Plate 27, fig. 2). Glauconitic Series, near top; Portlandian. Pinna Valley (No. 137) 77

3a, b. *Dorsoplanites* sp. nov? ind. aff. *antiquus*, var. *robusta*, nov. Transition to *Pavlovia*, e. g. *P.* (*Pallasiceras*) *regularis*, sp. nov. Sandy Clays, 131 m below base of Hartzfjaeld Sandstone, Upper Kimmeridgian. Sandstensfjaeld (No. 260) 68

4a, b. *Pavlovia* (*Pallasiceras*) aff. *subaperta*, sp. nov. Transition to *P.* (*Epipallasiceras*) *costata*, sp. nov. Complete, with over half a whorl of body-chamber. Sandy Clays (above β?), Upper Kimmeridgian. Cape Leslie (R. II, 62 m) 47

5. *Dorsoplanites* aff. *gracilis*, sp. nov. High zonal form, perhaps var. *evoluta*. Sandy Shales (horizon α). Crab Valley (No. 165) 73



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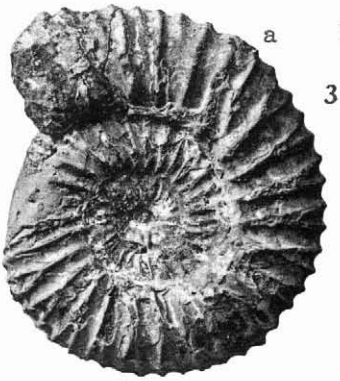

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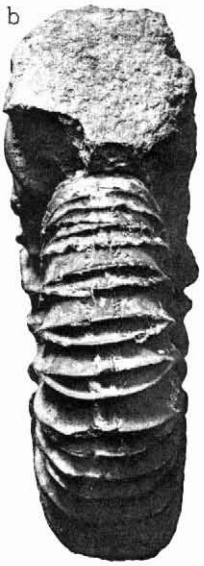

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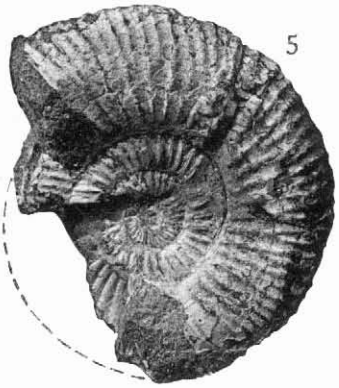

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Plate 27.

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Figs. 1a, b. *Dorsoplanites gracilis*, sp. nov. var. *tenuicostata*, nov. Glauconitic Series, upper part; Portlandian. Crab Valley (No. 162) 72

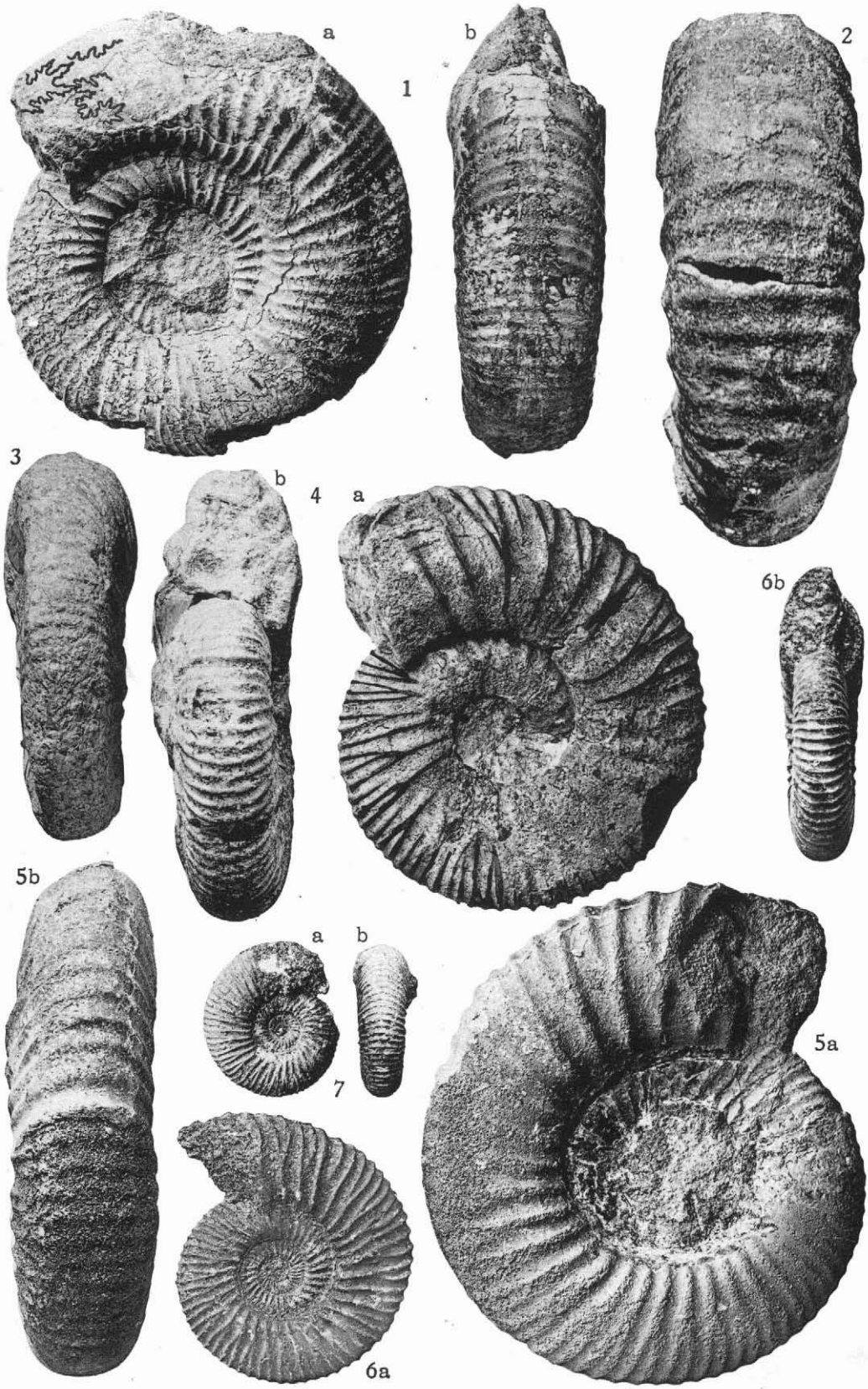
2. *Dorsoplanites dorsoplanoides*, sp. nov. Peripheral view of holotype, Plate 26, fig. 2 77

3. *Crendonites transitorius*, sp. nov. Peripheral view of holotype, Plate 28, fig. 4 64

4a, b. *Kerberites virguloides*, sp. nov. Holotype, with less finely ribbed inner whorls than *K. trikraniformis* (Plate 21, fig. 4) and larger umbilicus. (Proportions 72 — .35 — .35 — .38). Portland Stone, Cockly Bed, Swindon (L. F. S., Coll.) 34

5a, b. *Dorsoplanites subpanderi*, sp. nov. Paratype. Glauconitic Series, 51 m below base of Hartzfjaeld Sandstone (loose), Portlandian? Between Crab and Astarte Valleys (No. 239) 76

6a, b; 7a, b. *Dorsoplanites antiquus*, sp. nov. Two small but complete examples. Glauconitic Series, upper part, Portlandian. Pinna Valley (No. 223) 68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5b
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b
7
5a
6a

Plate 28.

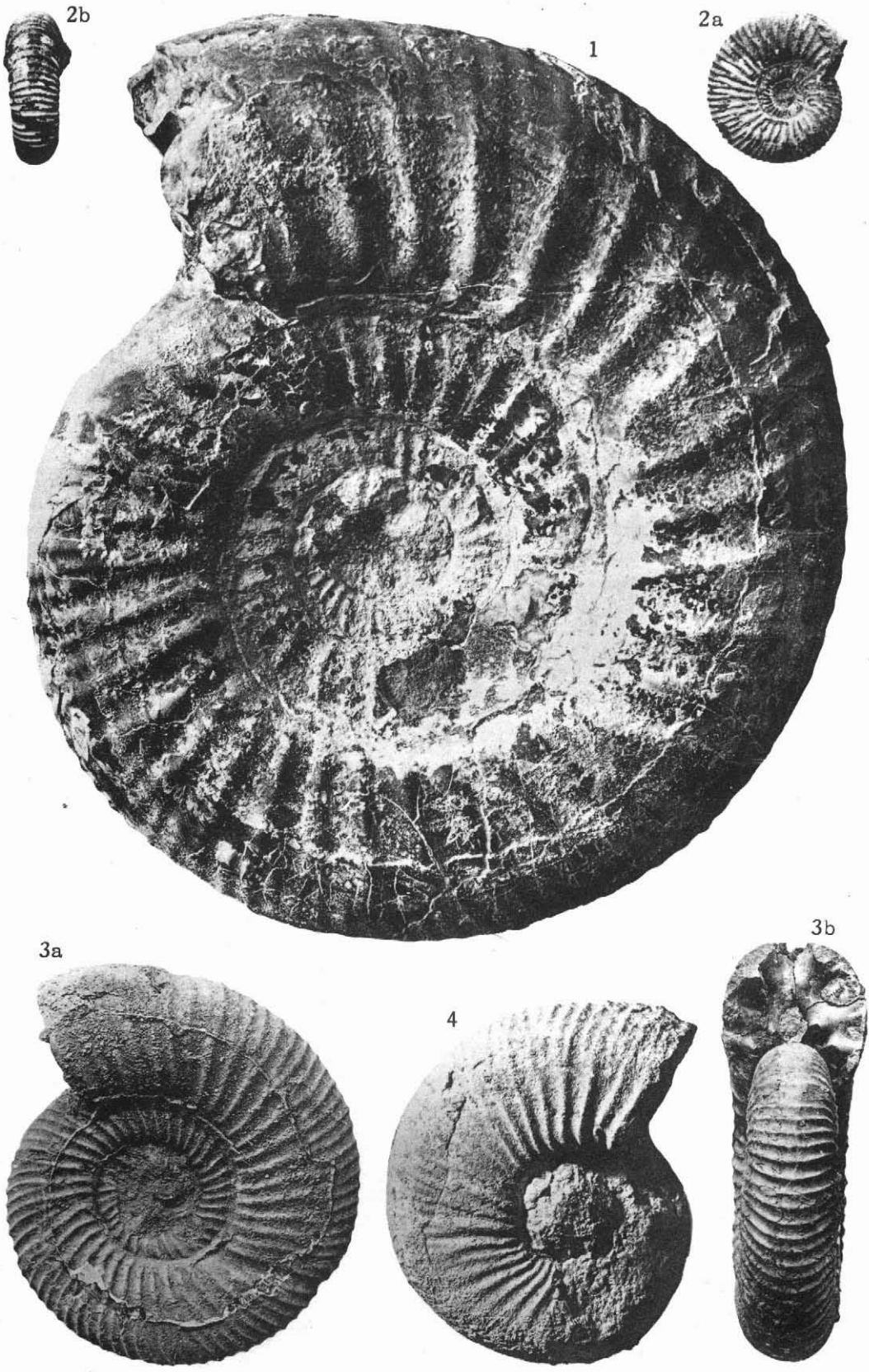
Page

Fig. 1. *Dorsoplanites maximus*, sp. nov. Holotype, with body-chamber omitted. (For peripheral view see Plate 26, fig. 1) 71

- 2a, b. *Dorsoplanites* cf. *aldingeri*, sp. nov. Immature transitional example, with beginning of body-chamber. Sandy Clays (above β?), Upper Kimmeridgian. Cape Leslie (R. II, 62 m) 70

- 3a, b. *Dorsoplanites* aff. *gracilis*, sp. nov. Transitional example, with slightly less closely spaced ribbing than type. Glauconitic Series, upper part, Portlandian. Crab Valley (No. 163) 72

- 4. *Crendonites transitorius*, sp. nov. Inner whorls of holotype. Portland Stone, Chalbury Hill, Dorset. (B. M., no. 50746). Proportions 60 — .40 — .37 — .32, but at 75 mm, where biplicate *gorei* stage is taken to begin, the whorl-height is reduced to .32 and the umbilicus widened out to .37. (Compare Plate 7, fig. 7) 64


2b
2a
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3a
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3b

Plate 29.

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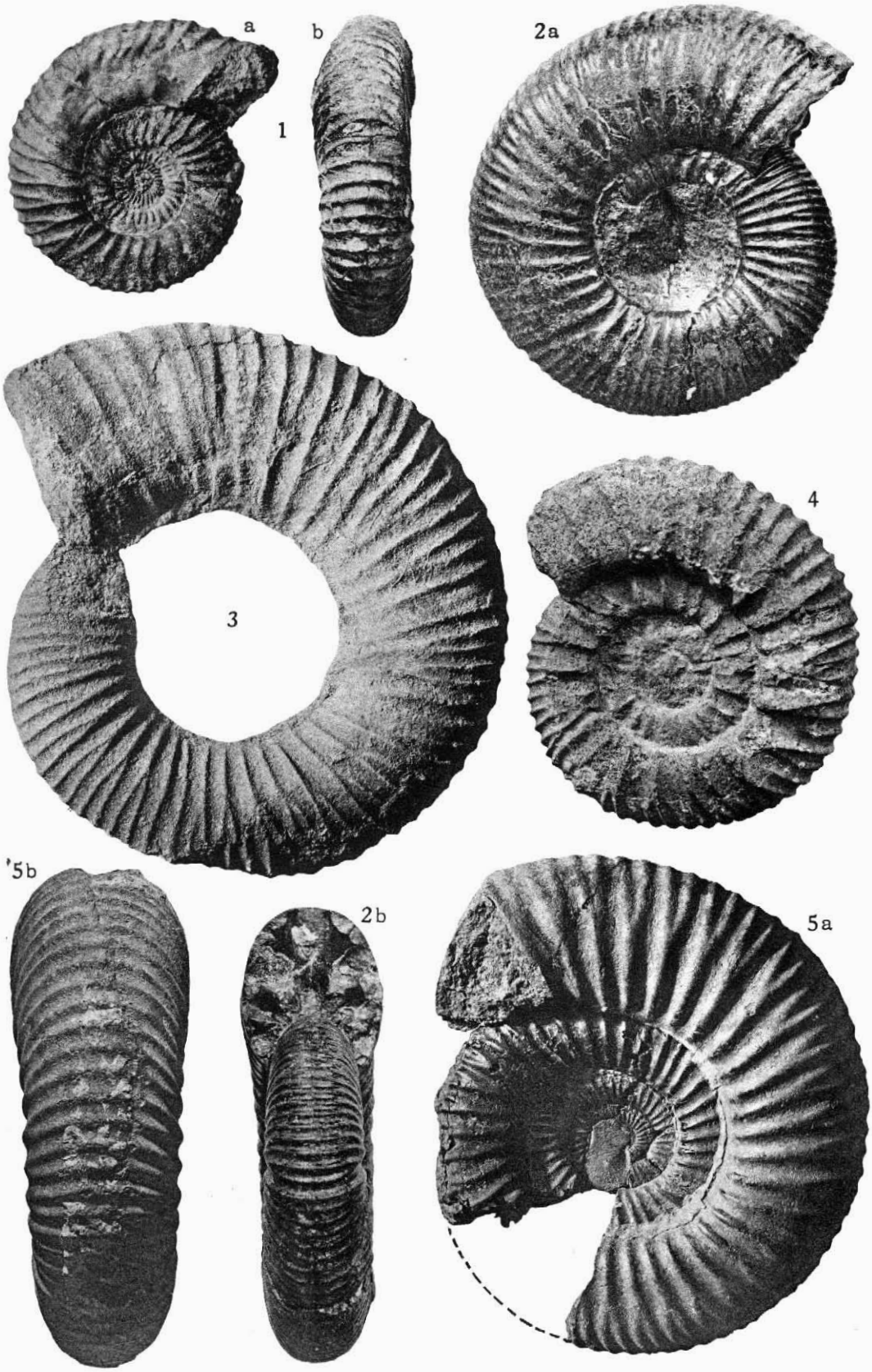
Figs. 1a, b. *Dorsoplanites antiquus*, sp. nov. var. *robusta*, nov. Malformation, with complete body-chamber (almost whole whorl) and opposite side normal. Sandy Clays (above β?), Upper Kimmeridgian. Cape Leslie (R. II, 62 m) 68

2a, b. *Dorsoplanites gracilis*, sp. nov. Holotype. Sandy Shales (horizon a), Portlandian. Cape Leslie (R. II, 200 m) 72

3. *Dorsoplanites jamesoni*, sp. nov. Holotype. Glauconitic Series, upper part? Portlandian? 500 m north of Cape Leslie, loose (No. 200) .. 78

4. *Titanites* sp. juv. Inner whorls of an example from the Portland Stone, probably the Cockly Bed of Swindon (B. M., no. 9840), to show Pavlovid beginning of *Titanites* of the *okusensis* type. (For peripheral view see Plate 30, fig. 3) 35

5a, b. *Dorsoplanites crassus*, sp. nov. Holotype. Sandy Clays (above β?) Upper Kimmeridgian. Cape Leslie (R. II, 62 m) 74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5a

Plate 30.

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Fig. 1. *Dorsoplanites jamesoni*, sp. nov. Crushed example from the Portlandian? of south-eastern Jameson Land, south of Hill 67 on Camp River, loose on shore (No. 10) 78

- 2a, b. *Dorsoplanites gracilis*, sp. nov. var. *evoluta*, nov. (Part of body-chamber omitted). Glauconitic Series, upper part, Portlandian. Crab Valley (No. 163) 72

- 3. *Titanites* sp. juv. Peripheral view of the original of Plate 29, fig. 4. 35

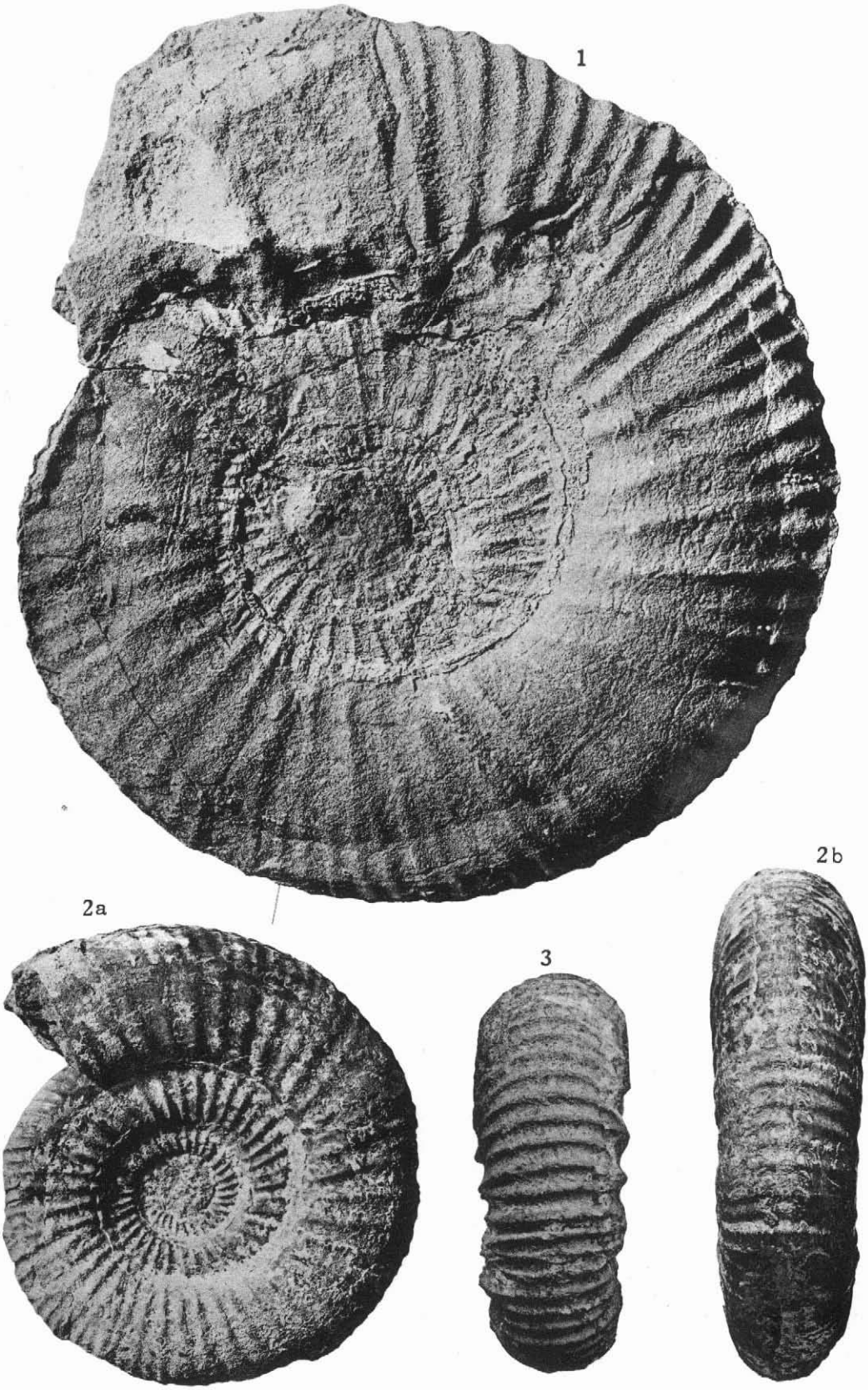
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Plate 31.

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Figs. 1a, b. *Dorsoplanites subpanderi*, sp. nov. Holotype. From 10 m below the Glauconitic Series on Sandstensfjaeld (No. 234). Upper Kimmeridgian? or Portlandian? 76

2a, b. *Dorsoplanites antiquus*, sp. nov. Immature example. Glauconitic Series, upper part. Portlandian. Pinna Valley (No. 223) 68

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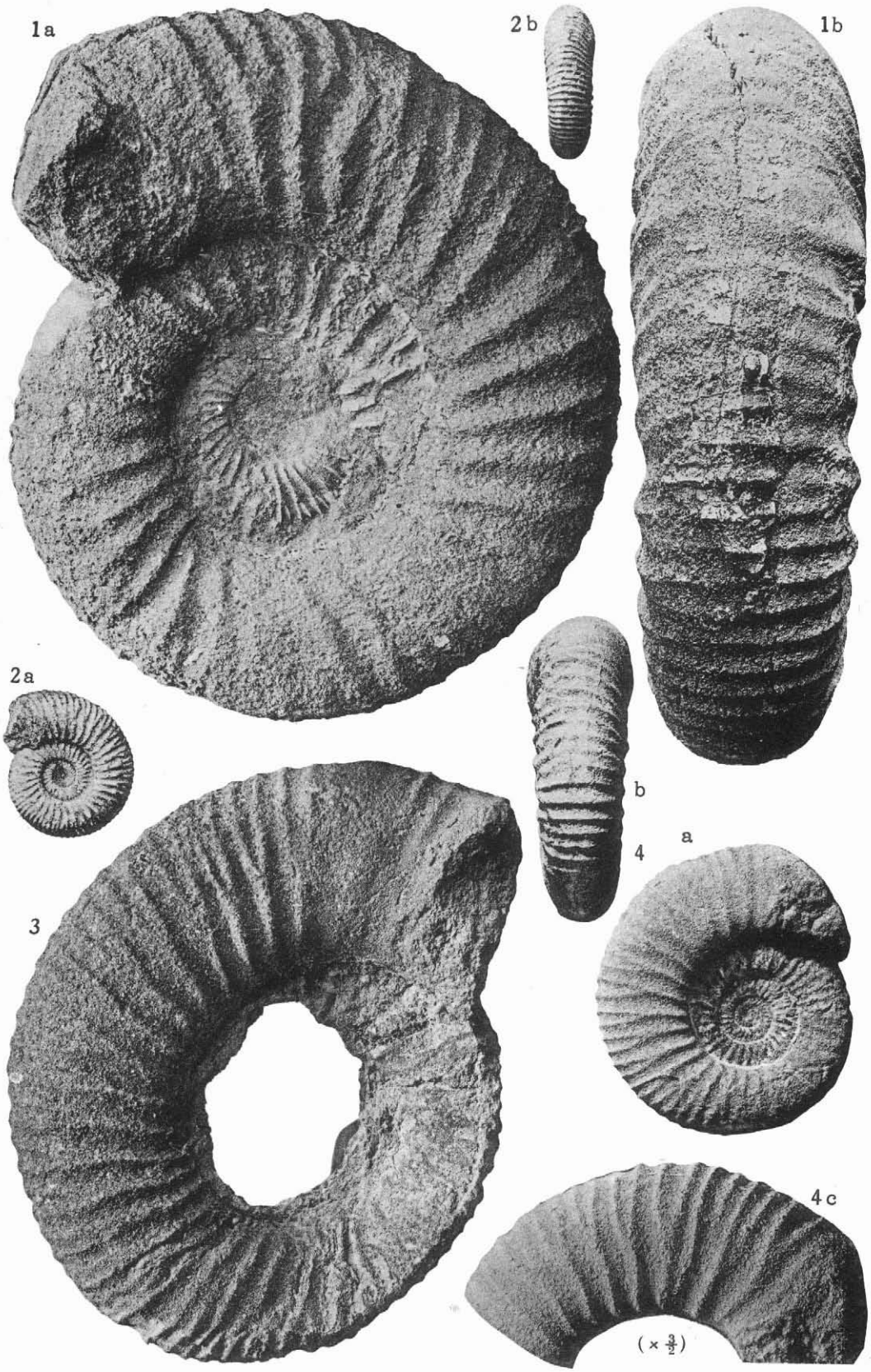
1a
2b
1b
2a
b
4
a
3
4c
(× 3/2)

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- 5a, b. *Dorsoplanites gracilis*, sp. nov. Example with slightly smaller umbilicus than type and with broader periphery. Same bed..... 72

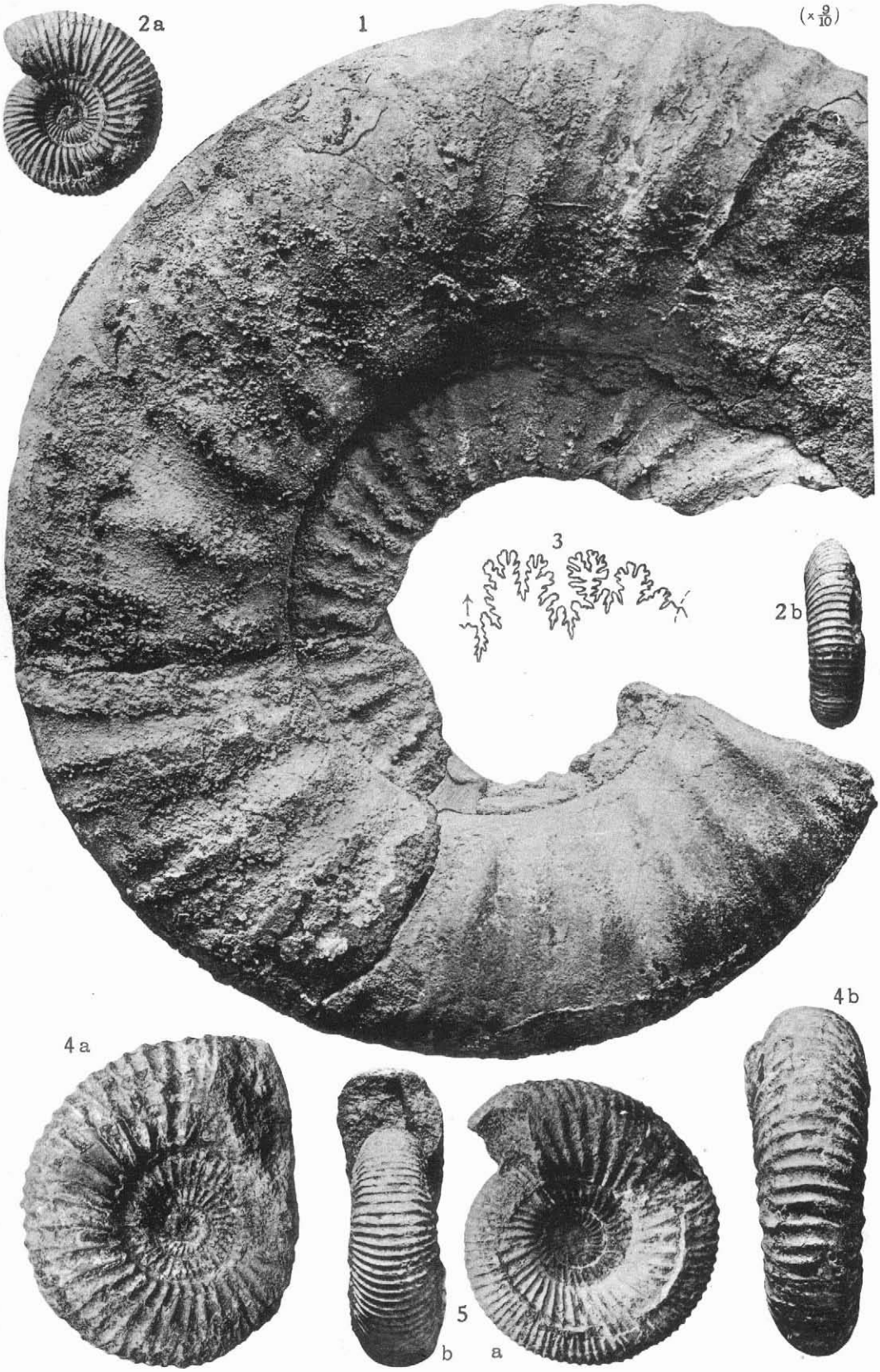
2a
1
(× 9/10)
3
2b
4b
4a
5
b
a

Plate 33.

Page

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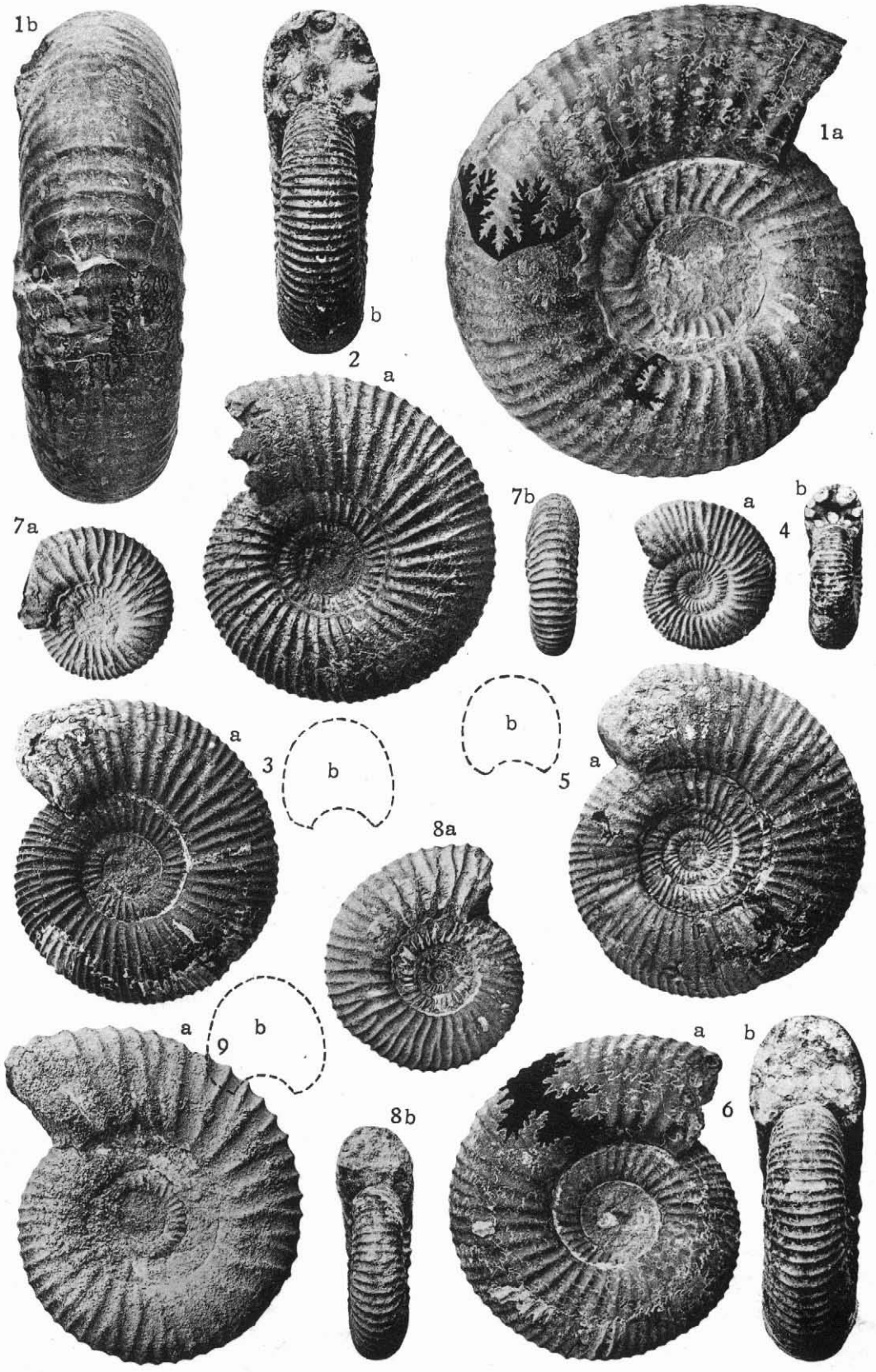
1b
1a
2
b
a
7a
7b
a
b
4
a
3
b
b
5
a
8a
a
b
9
a
b
6
8b

Plate 34.

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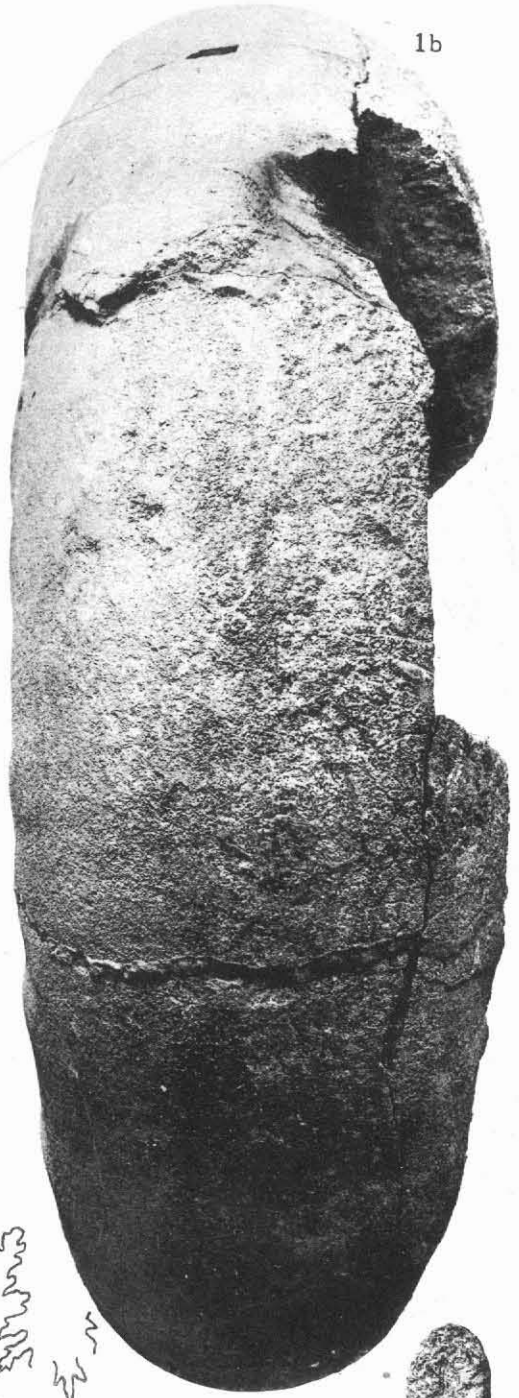
1a
212


a


1b


2
b

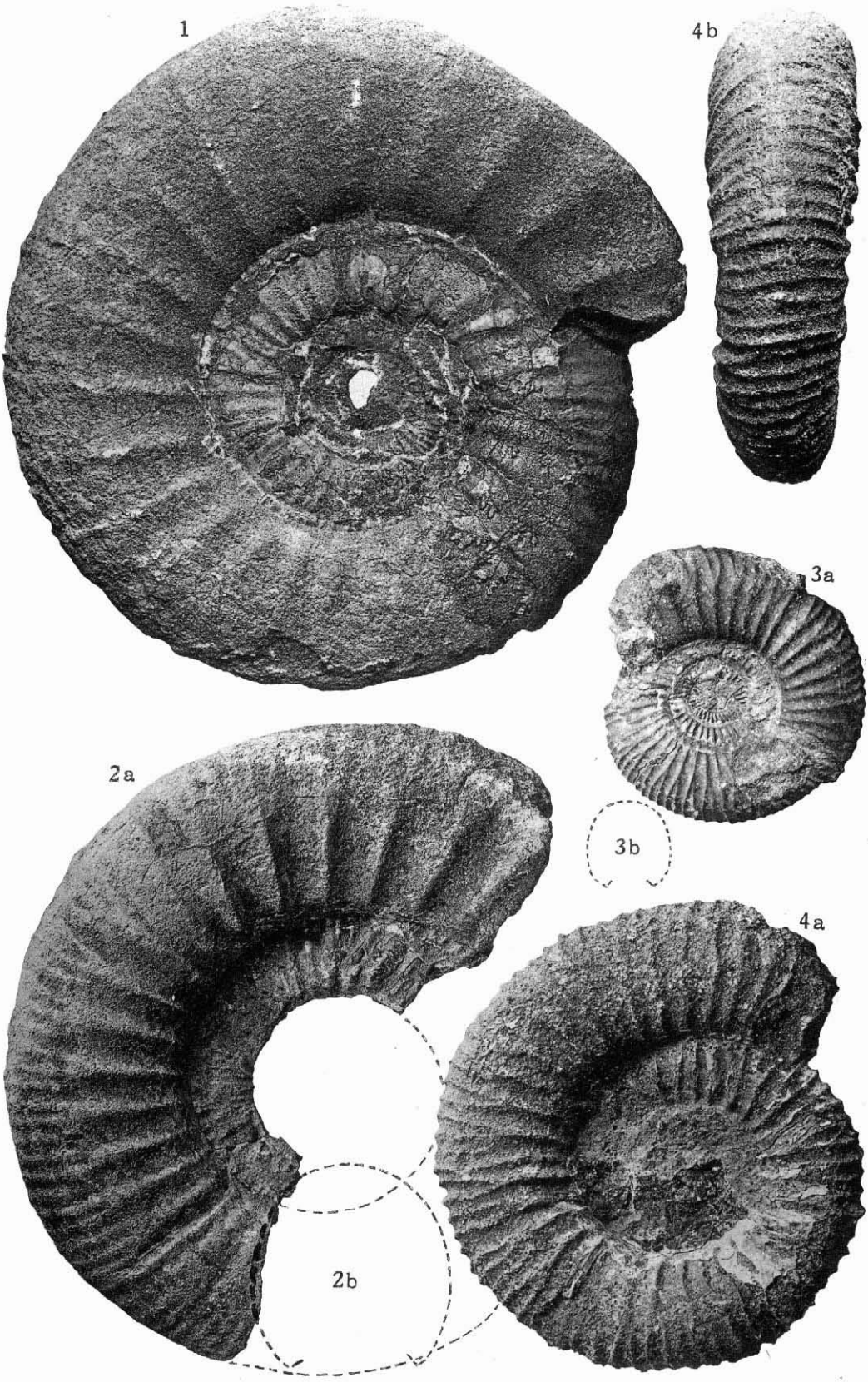

3a


4


1c
5


3b

Plate 35.


1
4b
3a
2a
3b
4a
2b

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Page

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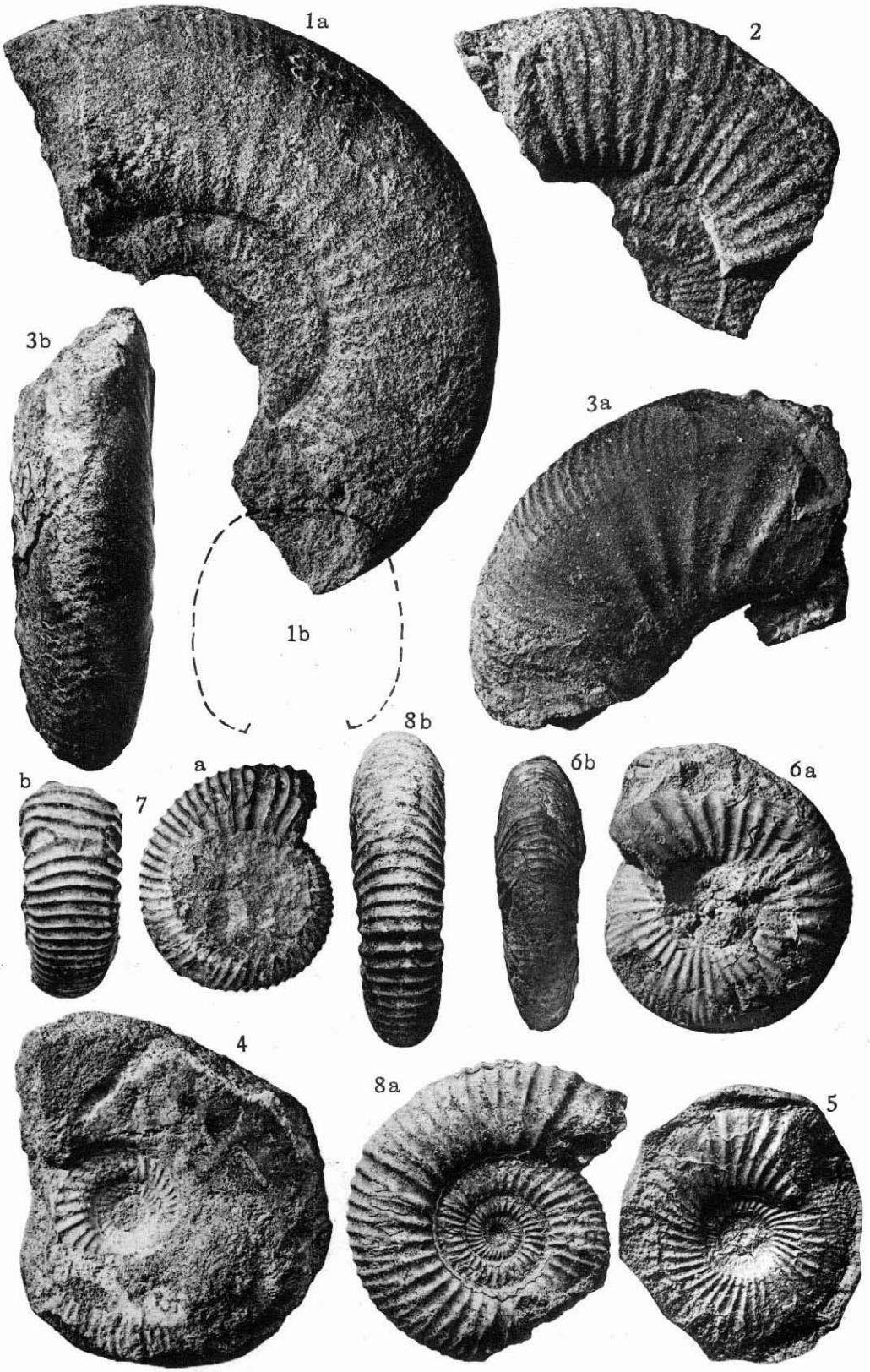
1a
2
3b
3a
1b
8b
b
a
7
6b
6a
4
8a
5

Plate 37.

Page

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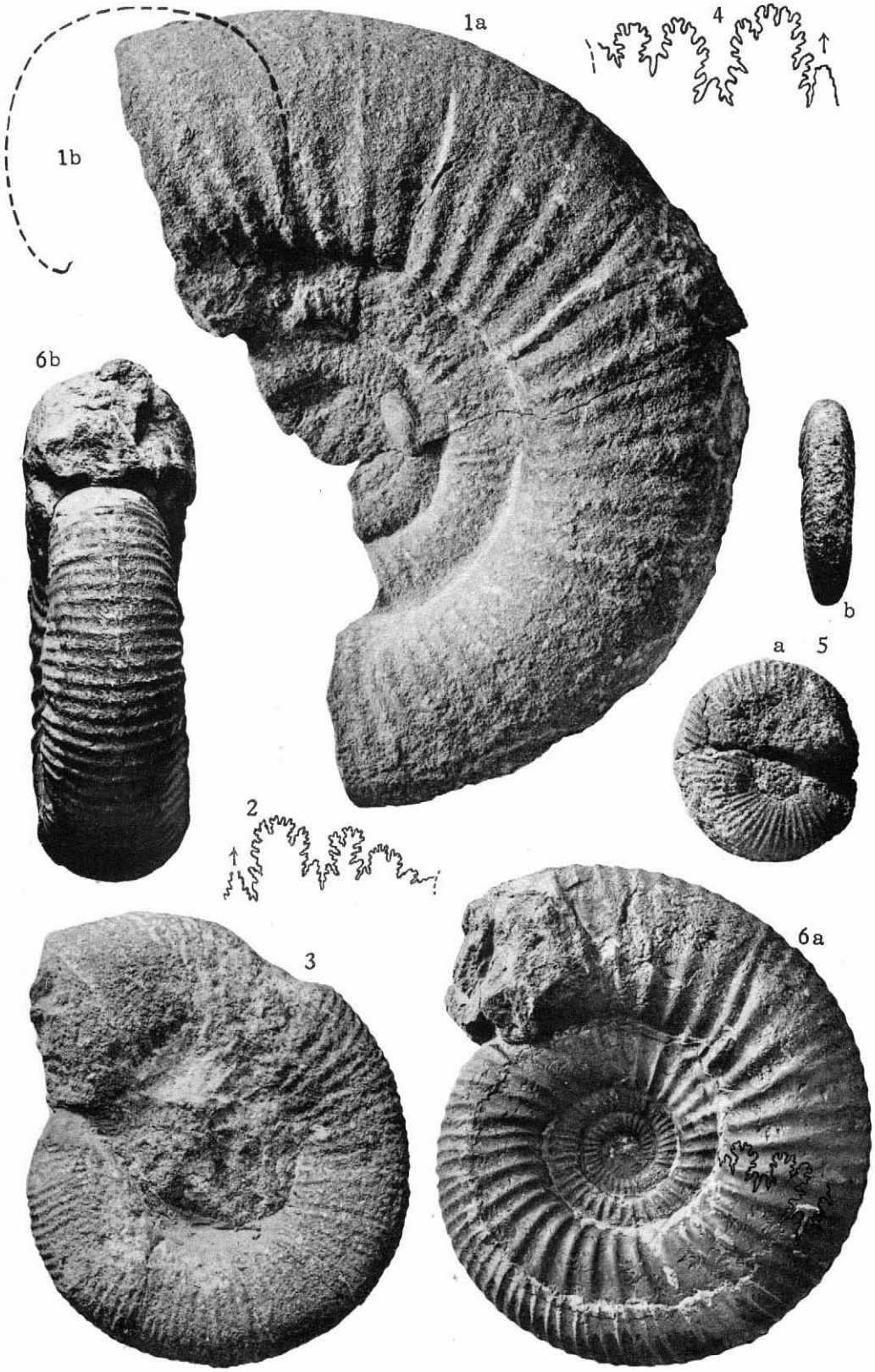
1a
1b
4
6b
b
a
5
2
3
6a

Plate 38.

Page

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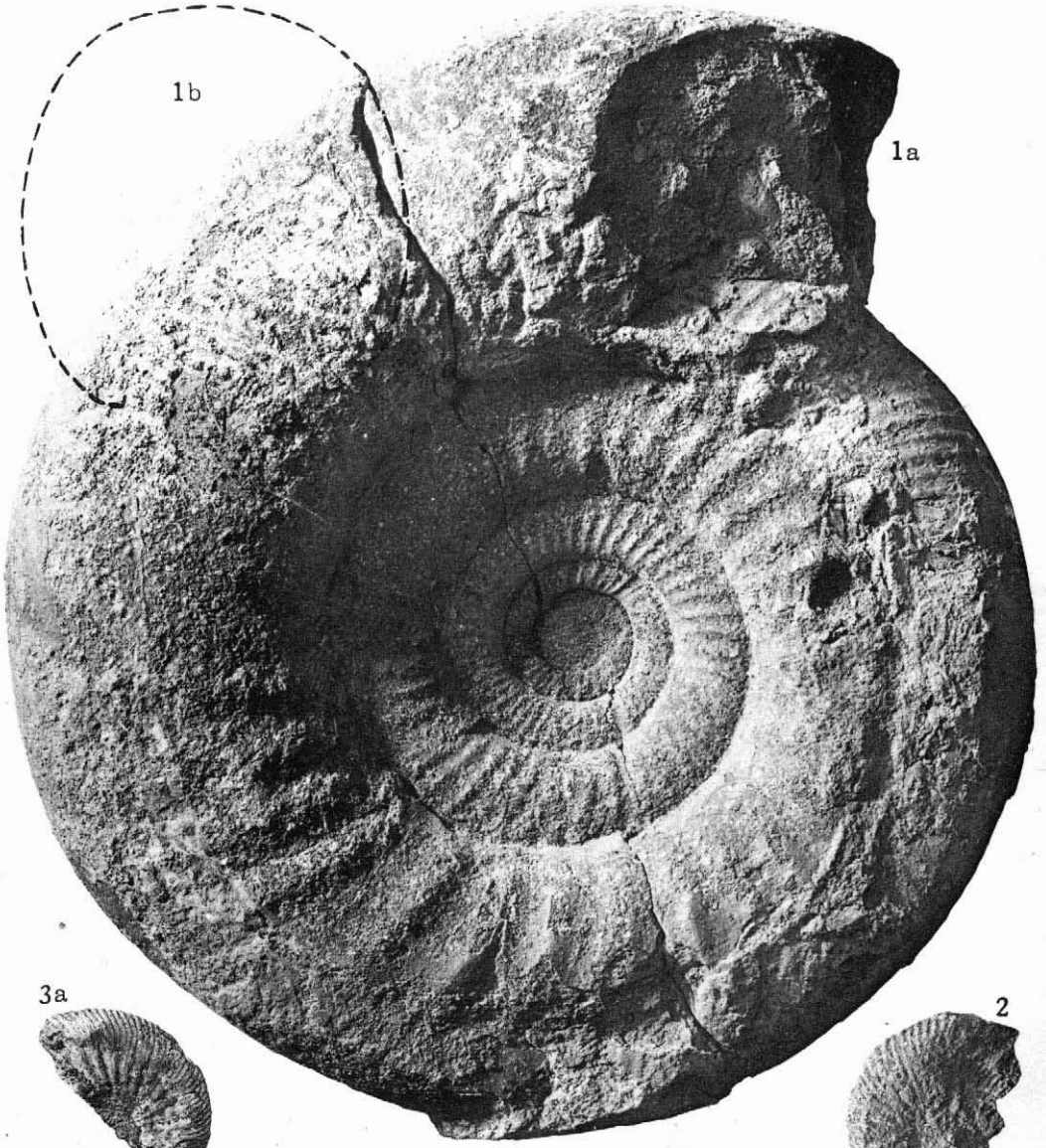
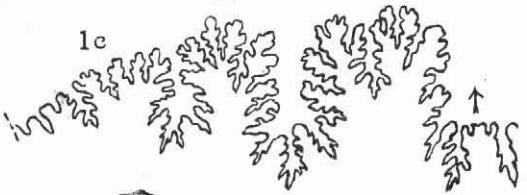

1b
1a


3a


2


1c


b
5


a


3b


4

Plate 39.

Page

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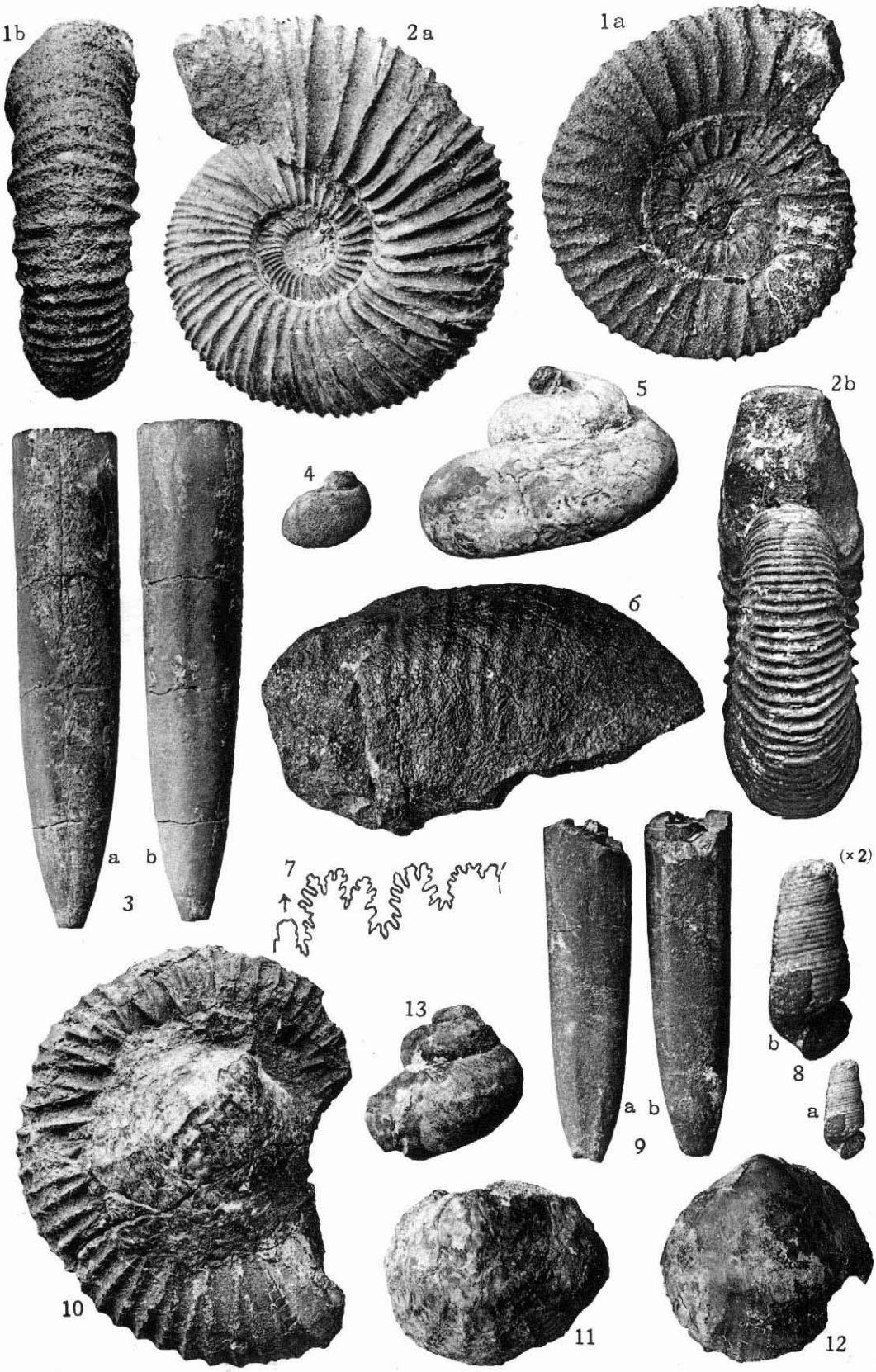
1b
2a
1a
5
2b
4
6
a
b
3
7
(×2)
13
b
8
a
a b
9
10
11
12

Plate 40.

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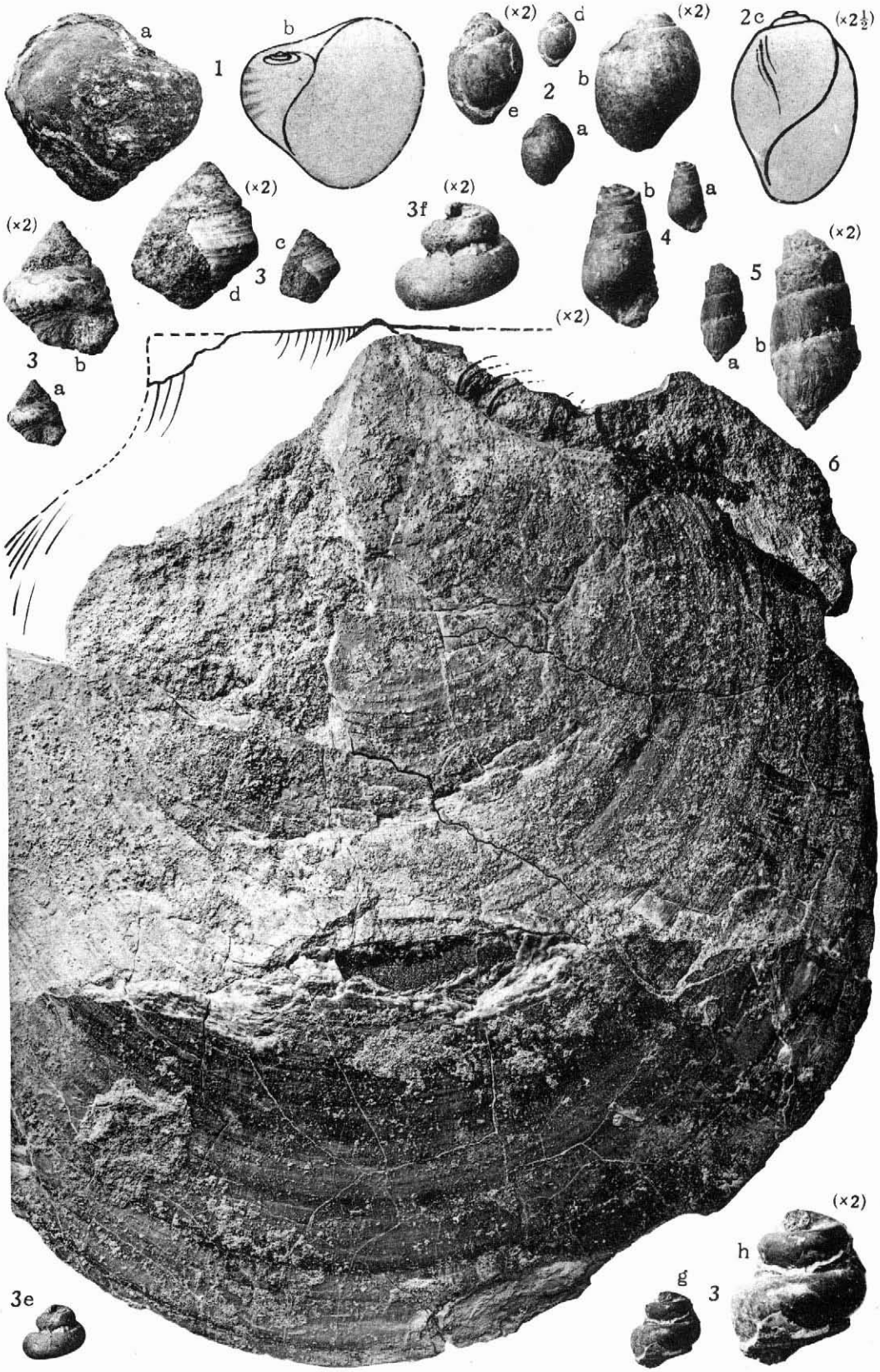
a
b
1
(×2)
d
e
2
a
(×2)
b
2c
(×2½)
(×2)
c
3
d
(×2)
3f
b
a
4
(×2)
3
b
a
5
a
b
(×2)
6
3e
g
3
(×2)
h

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Page

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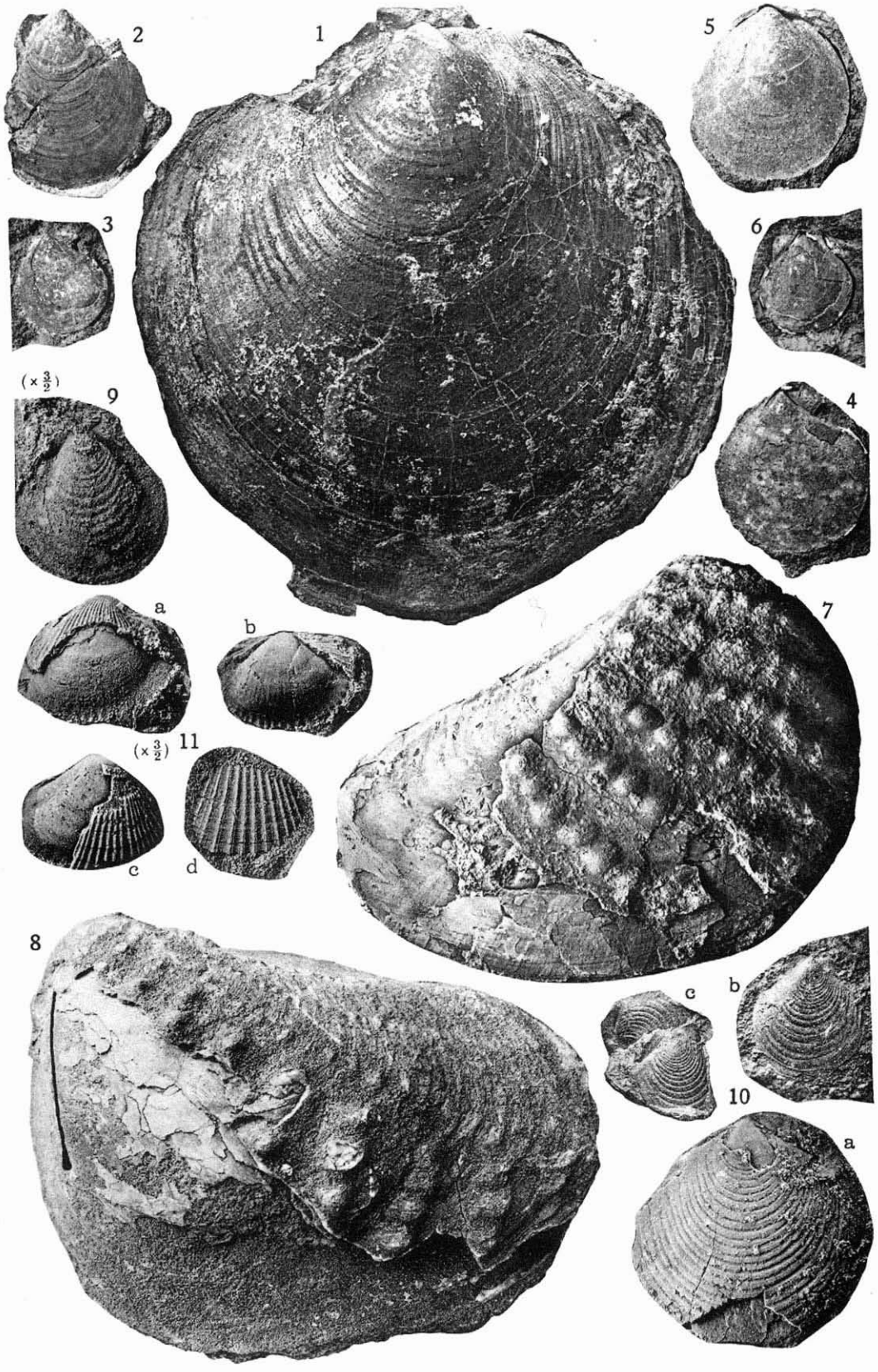
2
1
5
3
6
(× 3/2)
9
4
a
b
7
(× 3/2) 11
c
d
8
c
b
10
a

Plate 42.

Page

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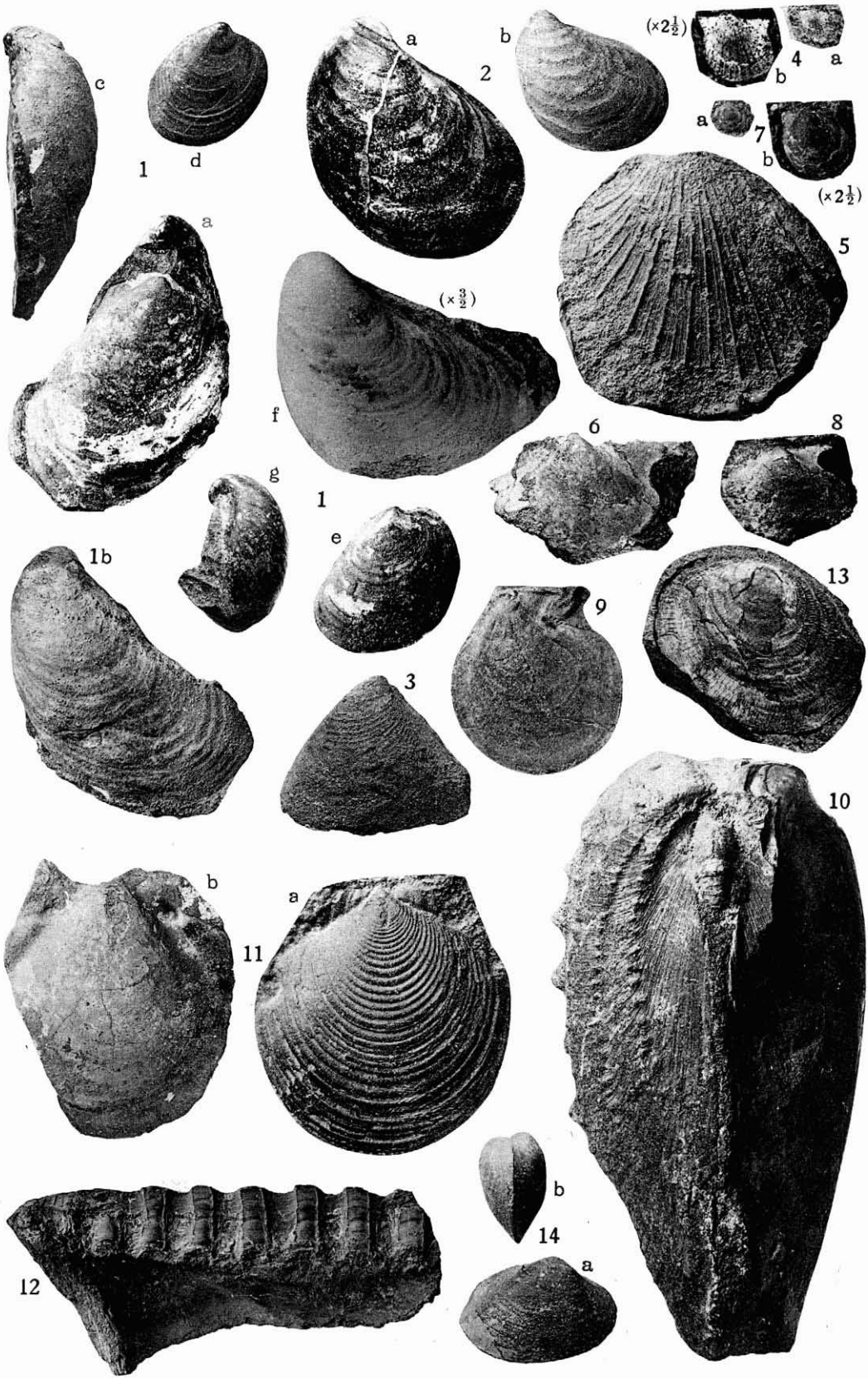
c
1
d
a
2
b
(×2½)
4
a
b
a
7
b
(×2½)
5
a
(×3/2)
f
6
8
g
1
e
1b
9
13
3
10
b
a
11
b
14
a
12

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a
2 (× 3/2)
b
5a
b
5
c
(× 2)
4
a
1
b
c
2 (× 3/2)
d
2e
(× 3/2)
3
(× 3/2)

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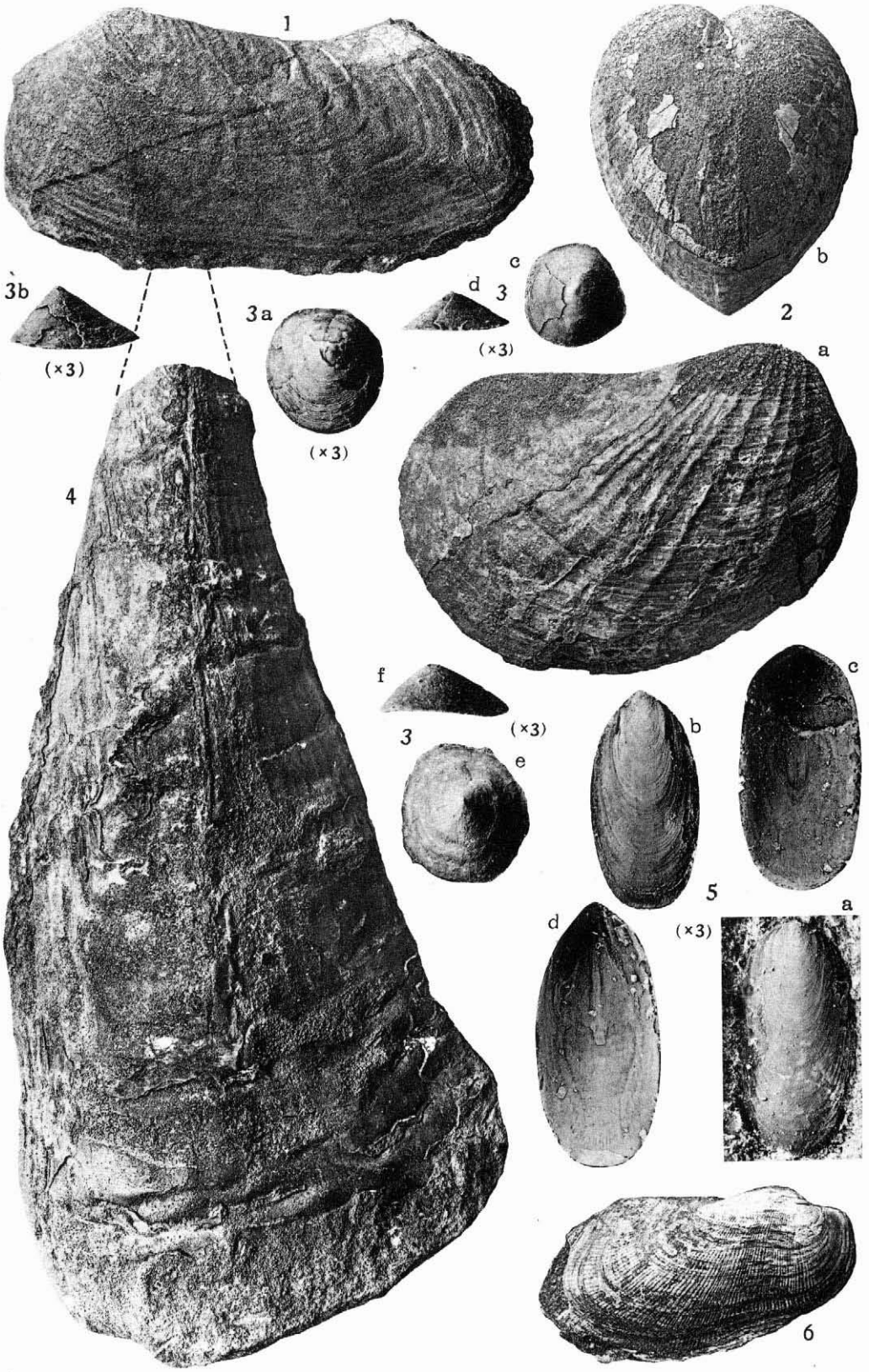
1
2
b
c
3
d
(×3)
3b
(×3)
3a
(×3)
a
4
f
(×3)
3
e
b
c
5
d
(×3)
a
6

Plate 45.

Page

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- 8a, b. *Pronoella*(?) sp. ind. *Nucula*-like internal cast from the *subaperta* nodule bed, below Glauconitic Series. Upper Kimmeridgian. Cape Leslie (R. II, 62 m) 127

- 9a, b. *Astarte* sp. ind. Internal cast, side and anterior end. Same horizon and locality 116

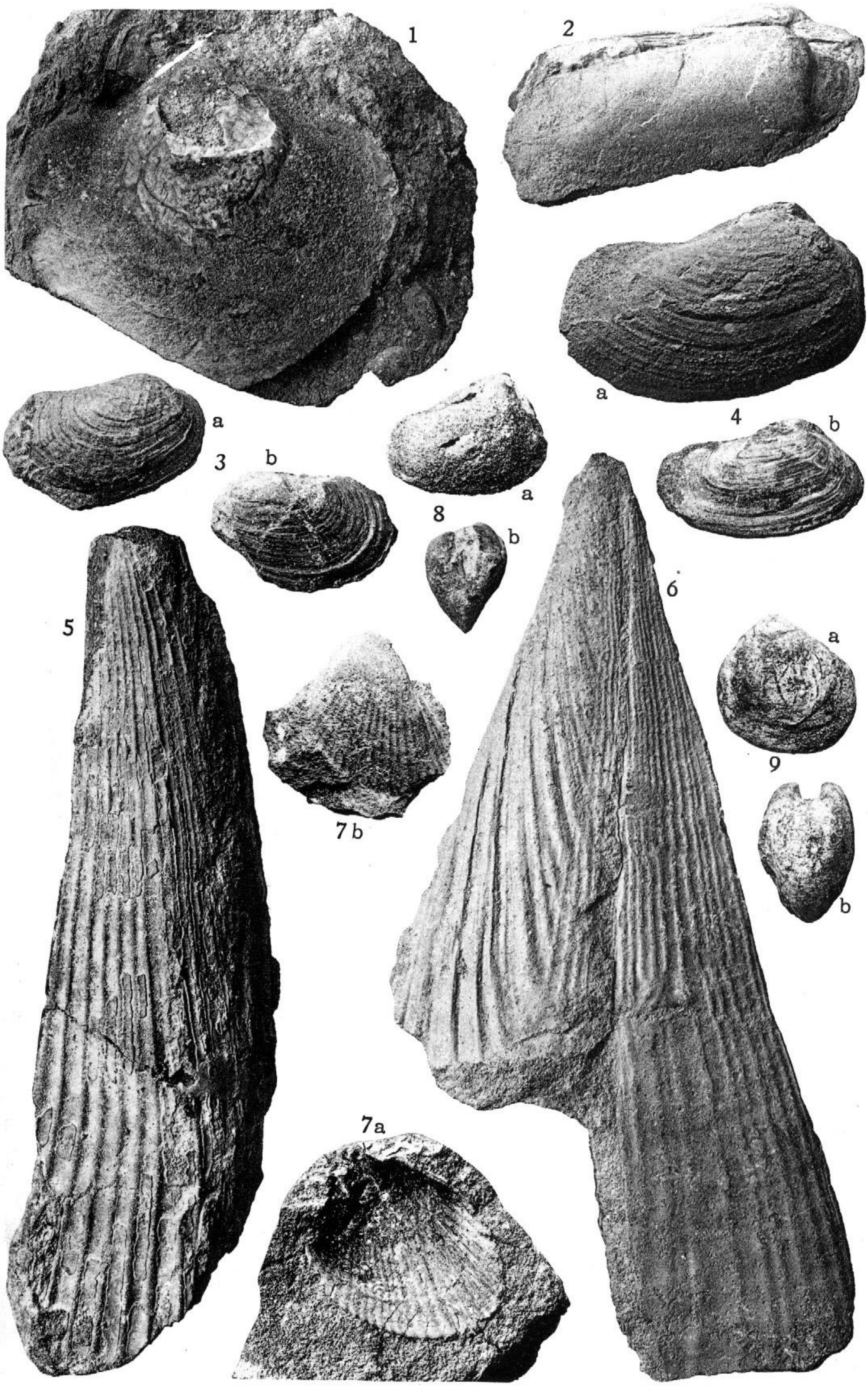
1
2
a
4
b
a
3
b
a
8
b
6
5
a
9
7b
b
7a

Plate 46.

Page

Figs. 1a, b. *Lucina* sp. nov. cf. *inaequalis*, d'Orbigny. Small, compressed example. From below Glauconitic Series (? Upper Kimmeridgian). Hartz Mtn. (No. 226) 123

- 2, 3. *Mactromya verioti* (Buvignier). Two slightly different examples from above Glauconitic Series, Portlandian. Hartz Mtn. (R. III, 415 m) 122

- 4a-c. *Modiolus strajeskianus* (d'Orbigny). Three examples, deformed in different directions. Glauconitic Series, Portlandian. Cape Leslie (R. I, 100 m) 110

- 5a, b. *Lima* (*Plagiostoma*) sp. nov.? ind. Crushed double-valved example and hinge area of original of Plate 47, fig. 10. Same horizon and locality 106

- 6. *Astarte* aff. *saemanni*, de Loriol. Hinge area of a right valve. Portlandian. Cape Leslie (R. III, 190 m, loose?) 115

- 7. *Modiolus* aff. *boloniensis* (de Loriol). Glauconitic Series, Portlandian. Cape Leslie (R. I, 100 m) 109

- 8. *Astarte* cf. *duboisiana*, d'Orbigny. *Lingula* Bed, Portlandian. Cape Leslie (R. II, 240 m) 116

- 9a, b. *Corbicella* cf. *unioides*, de Loriol. Same horizon and locality 120

- 10a-c. *Rhynchonella* aff. *grossesulcata*, Eichwald. Three views. Glauconitic Series, upper part, Portlandian. Hartz Mtn.; Crab Valley (No 168) 138

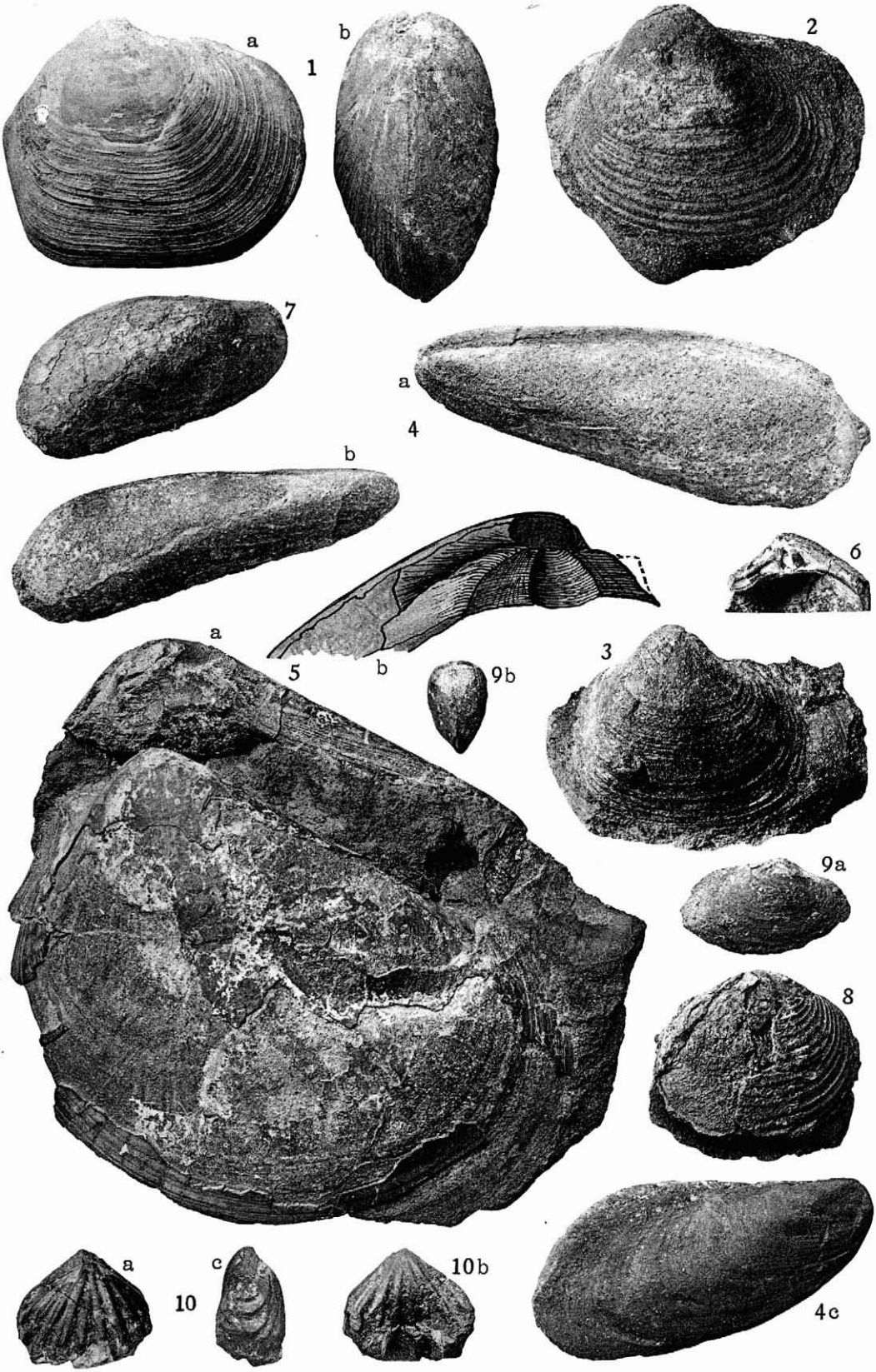
a
1
b
2
7
a
4
b
6
5
b
9b
a
3
9a
8
a
10
c
10b
4c

Plate 47.

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Figs. 1-5. *Astarte* aff. *saemanni* (de Loriol). Examples from the *Lingula* Bed of Cape Leslie (1 and 5), the Glauconitic Series of Hartz Mtn. (3, 4) and from Aucella River, Jameson Land, Block I (2). Portlandian. (1 = No. 197; 3 = No. 133; 4 = R. II, 115 m; 5 = R. II, 240 m) 115

- 6. *Astarte* sp. nov.? aff. *michaudiana*, d'Orbigny. Portlandian, Aucella River, Jameson Land, Block I 117
- 7. *Astarte* sp. cf. *panderi*, Rouillier. Same horizon and locality 116
- 8a, b. *Astarte* sp. ind. *Lingula* Bed, Portlandian. Cape Leslie (R. II, 240m) 117
- 9a, b. *Astarte* sp. nov.? ind. Two sides of same left valve. Same horizon and locality 117
- 10. *Lima* (*Plagiostoma*) sp. nov.? ind. For hinge area of opposite side see Plate 46, fig. 5b. Glauconitic Series, Portlandian. Cape Leslie (R. I, 100 m) 106
- 11a, b. *Homomya* aff. *hortulana*, Agassiz. Lateral and posterior aspects. Same bed 132

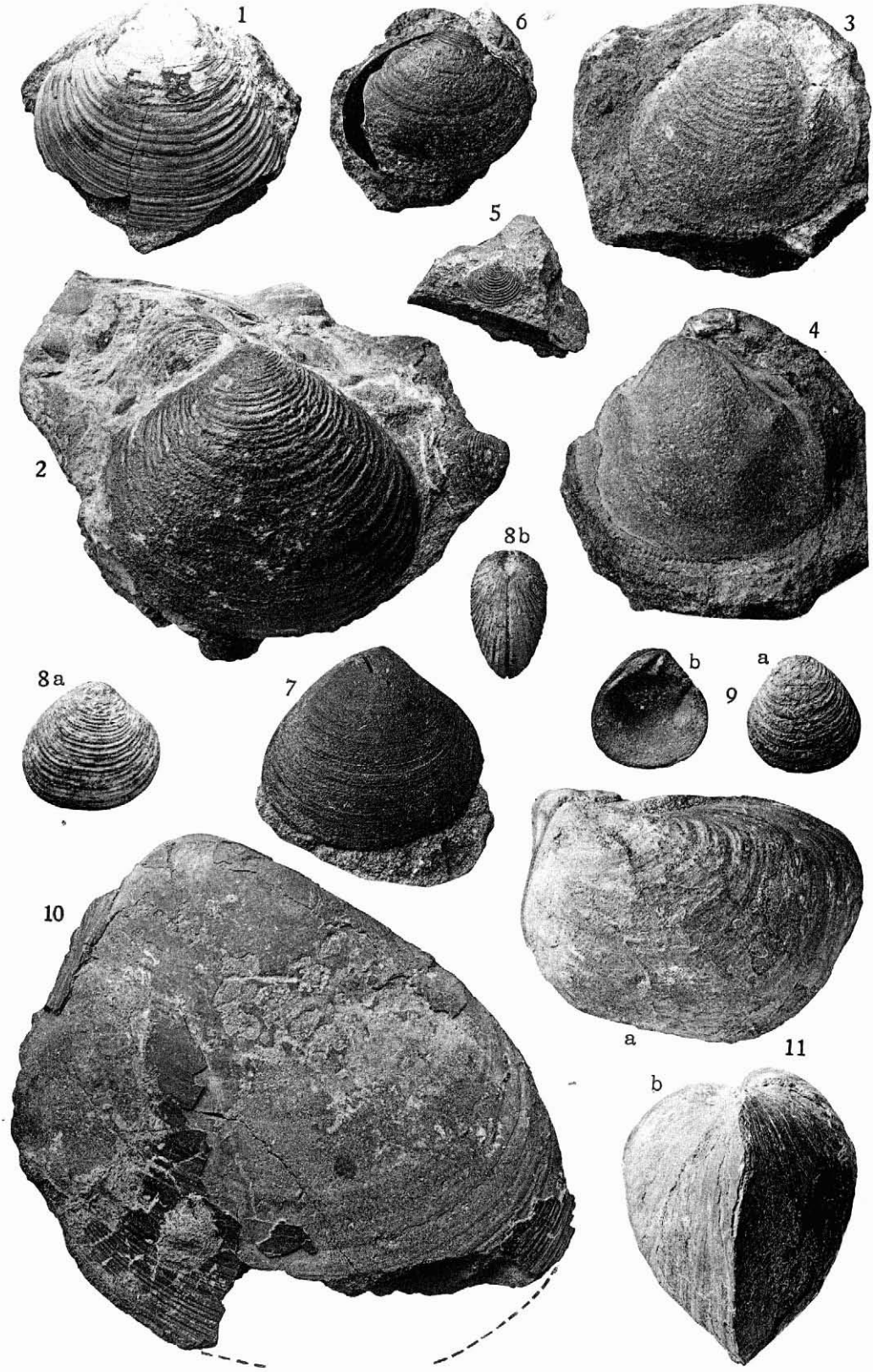
1
6
3
5
2
4
8b
8a
7
b
a
9
10
a
11
b

Plate 48.

Page

Figs. 1a, b. *Pronoella*(?) sp. ind aff. *nuculaeformis* (Roemer). Two examples from the Glauconitic Series (R. I, 100 m) and the Sandy Shales (horizon *a*) above (R. I, 165 m). Portlandian. Cape Leslie..... 126

- 2. *Modiolus* sp. ind. *Lingula* Bed. Portlandian. Cape Leslie (R. II, 240 m)..... 111

- 3. *Thracia incerta* (Deshayes) Thurmann sp. Sandy Shales (horizon *a*), Portlandian. Cape Leslie (R. II, 200 m)..... 133

- 4, 5a, b. *Tancredia hartzi*, sp. nov. Small example from *Lingula* Bed, Cape Leslie (R. II, 240 m), and holotype (5) from Aucella River, Jameson Land, Block I. Portlandian..... 121

- 6a, b. *Isocyprina* sp. nov.? aff. *elongata*, Cox. Left valve, lateral and anterior aspects. *Lingula* Bed, Portlandian. Cape Leslie (R. II, 240 m)... 118

- 7. *Lucina*(?) sp. ind. Crushed example from Aucella River, Jameson Land, Block I. Portlandian..... 124

- 8a-c. *Corbula* sp. ind. Internal cast of a left valve, natural size and enlarged × 2, and [c] squeeze of its external mould. Glauconitic Series, or above, Portlandian, Cape Leslie (R. II, 170 m, loose)..... 128

- 9a, b. *Pseudisocardia*(?) sp. ind. Right valve in natural size and enlarged × 2 out of a nodule from horizon *a*, Sandy Clays, Upper Kimmeridgian. Ridge South of Crab Valley (No. 184)..... 127

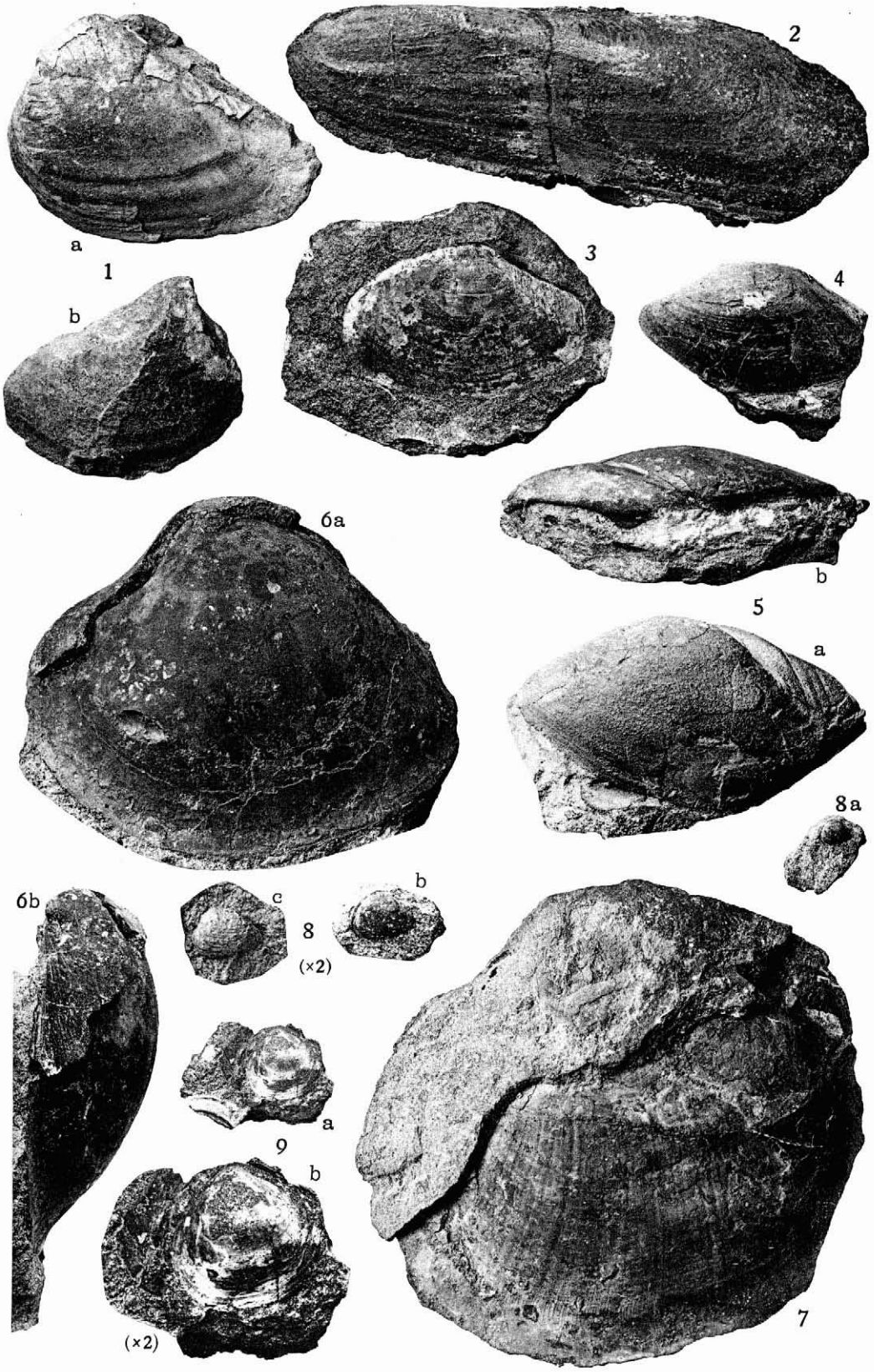
1
a
b
2
3
4
5
a
b
6a
6b
7
8
a
b
c
(×2)
8a
9
a
b
(×2)

Plate 49.

Page

Figs. 1a-h. *Terebratula* (*Rugithyris*) *rosenkrantzi*, sp. nov. Holotype (a), two paratypes (b, c), two internal casts (e-f, g) and two defective examples (d, h). Glauconitic Series, Portlandian. Cape Leslie (R. I, 100 m) 139

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- 4a, b, 5. *Parallelodon schourovskii* (Rouillier). Squeeze of interior of a right valve (4a), dorsal view of another example (4b) and dorsal aspect of a right valve (5), figured in Plate 43, fig. 2d. Sandy Clays, *subaperta* nodules, Upper Kimmeridgian. Cape Leslie (R. II, 62 m) . . 113

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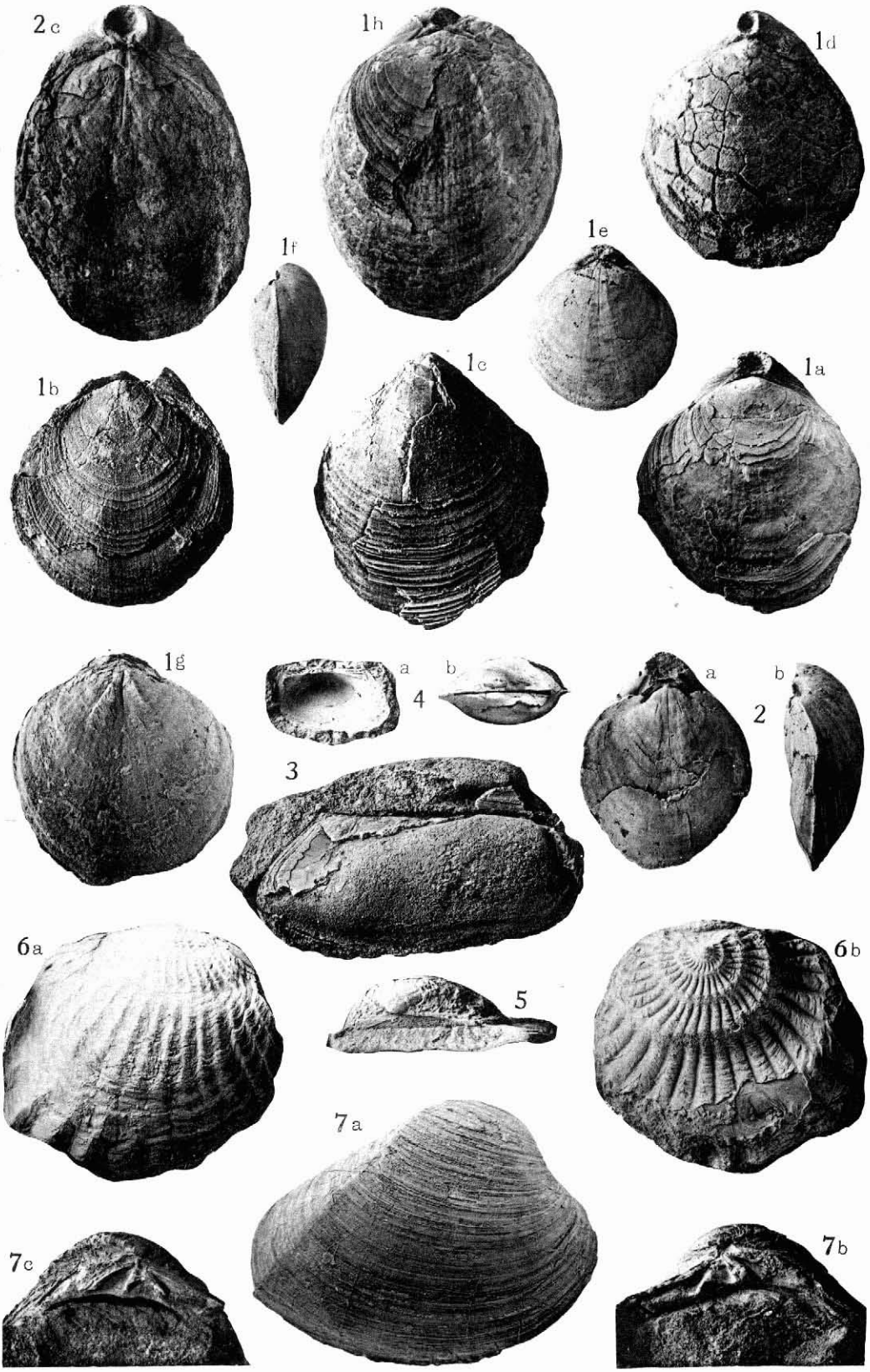
- 7a-c. *Pseudotrapezium groenlandicum*, sp. nov. Holotype right valve (a), with hinge (b) and hinge of a left valve (c). Sandy Shales, horizon α, Portlandian. Cape Leslie (R. II, 200 m) 125

All the photographs for this plate, taken by Chr. Halkier, were kindly sent to me by Mr. A. Rosenkrantz.


2c
1h
1d
1f
1e
1b
1c
1a
1g
a
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a
b
2
3
6a
6b
5
7a
7c
7b

Plate 50.

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Figs. 1a, b. *Pleuromya tellina*, Agassiz. Lateral and anterior views. Glauconitic Series, Portlandian. Cape Leslie (R. I, 100—115 m) 128

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- 3. *Thracia* cf. *depressa*, J. de C. Sowerby. Broken example from the same bed and locality 134

- 4. *Thracia incerta* (Deshayes) Thurmann sp. Small example from the Sandy Shales (horizon *a*), Portlandian. Cape Leslie (R. I, 165 m) 133

- 5. *Protocardia* sp. juv. ind. On a slab with *Lingula zeta*, Quenstedt. *Lingula* Bed, Portlandian. Cape Leslie (R. II, 240 m) 124

- 6a, b. *Pronoella*(?) sp. ind. aff. *nuculaeformis* (Roemer). Lateral and anterior aspects. Sandy Shales (horizon *a*). Portlandian. Cape Leslie (R. II, 200 m) 126

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- 8a, b. *Lucina* sp. nov. cf. *inaequalis*, d'Orbigny. Lateral and posterior aspects. Glauconitic Series, Portlandian. Cape Leslie (R. I, 100 m) 123

- 9a, b. *Lucina* sp. nov.? ind. Lateral and posterior aspects. Same bed and locality 124

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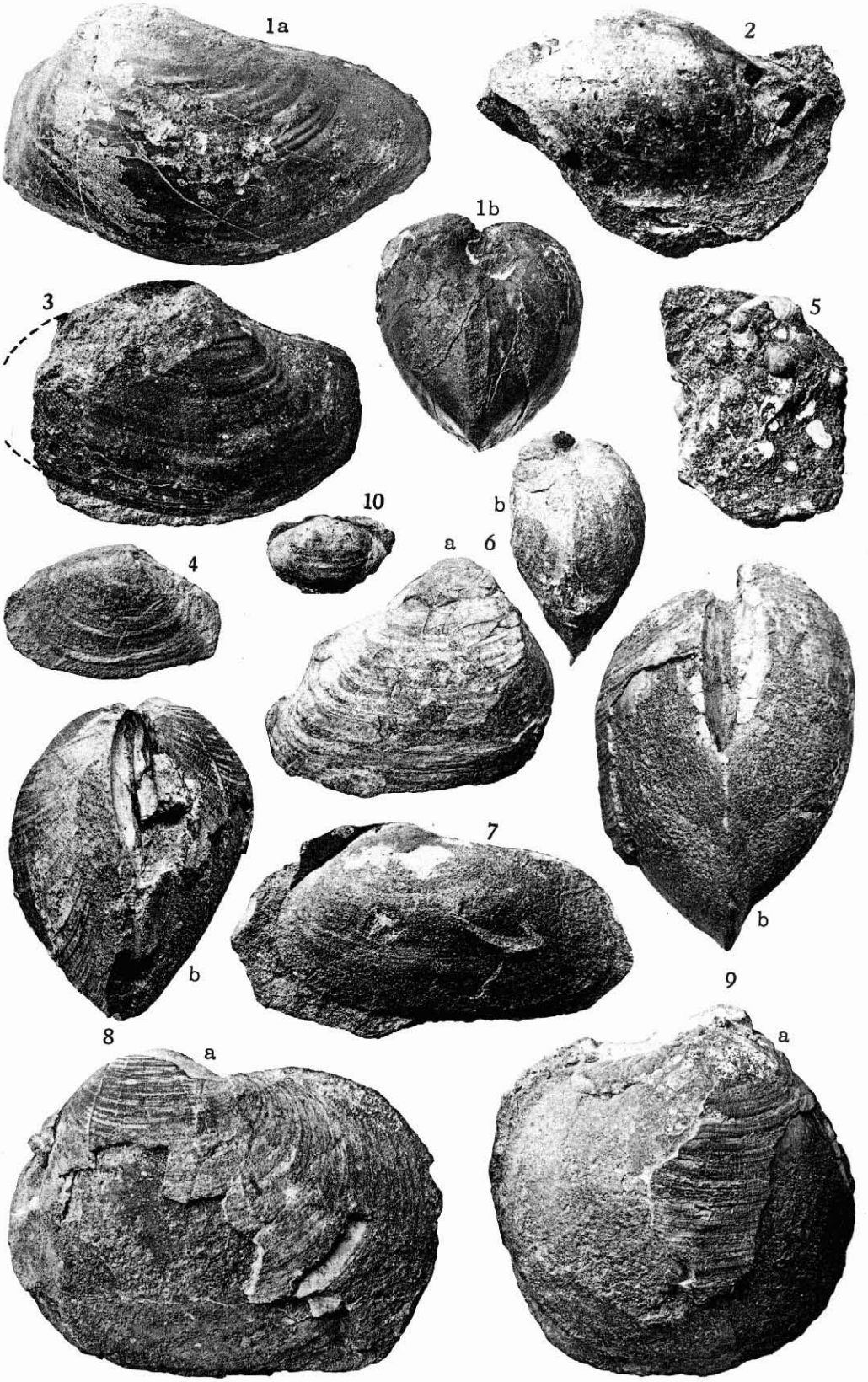
1a
2
1b
3
5
10
b
a 6
4
b
7
b
9
8
a
a