FALKLAND ISLANDS DEPENDENCIES SURVEY

SCIENTIFIC REPORTS
No. 3

THE UPPER CRETACEOUS CEPHALOPOD FAUNA OF GRAHAM LAND

By

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

RESEARCH AND DISCOVERY

LONDON: PUBLISHED FOR THE COLONIAL OFFICE
BY HER MAJESTY'S STATIONERY OFFICE: 1953

THIRTY SHILLINGS NET

THE UPPER CRETACEOUS CEPHALOPOD FAUNA OF GRAHAM LAND

By L. F. SPATH, D.Sc., F.R.S.

(Manuscript received 3rd May, 1951)

CONTENTS

A. INTRODUCTION

THE REPORT on the Cretaceous cephalopod faunas of Graham Land published by Kilian and Reboul in 1909 was based on collections made by the Swedish South Polar Expedition of 1901–3, and these came chiefly from Snow Hill and Seymour Islands. No further material was obtained from Graham Land for many years, but in 1945–6 the collection to be described in the following pages was made by members of the Falkland Islands Dependencies Survey on sledging trips from a base at Hope Bay.

The first collections were made by Capt. (now Major) A. Taylor, R.C.E., in 1945, with the assistance especially of Dr. I. M. Lamb, and they came chiefly from new localities on James Ross Island and neighbouring islands. A number of specimens, however, were also obtained from Snow Hill and Seymour Islands. The following year, Mr. W. N. Croft made further extensive collections from Taylor's main localities on the east side of James Ross Island. The accompanying sketch map, prepared by Mr. Croft, shows the fourteen locality-areas in which the ammonites were collected, and further details of the localities are given as an Appendix The new collections, which have been entrusted to me for description by the Falkland Islands Dependencies Survey, were thus obtained from a considerably wider area than the original Swedish collections.

I am greatly indebted to Mr. Croft for all the stratigraphical information referred to in the text, and especially to Mr. W. N. Edwards, the Keeper of the Geology Department of the British Museum (Natural History), for his constant readiness to do everything to facilitate my work. The specimens here described are now all part of the National Collection.

It may here be recalled that Kilian and Reboul's work of 1909 caused considerable excitement in geological circles. Haug (1909) in fact hailed it as without doubt the finest stratigraphical discovery that had been made in the Antarctic; unfortunately Haug, in his interpretation of the fauna, went far beyond what had actually been demonstrated. He not only saw in the undoubtedly late Cretaceous constituents of the Graham Land fauna confirmation of his great Maestrichtian transgression, as well as of his theory of a more or less continuous geosyncline surrounding an imaginary Pacific continent (map on p. 1359). Far more serious was Haug's perfectly unjustifiable splitting up of Kilian and Reboul's ammonite faunas into Eocretaceous, Mesocretaceous and Neocretaceous components.

It is true that these authors had misidentified two of their ammonites, and that the presence of the Senonian genus *Hauericeras* in their lowest bed (table on p. 58) with "*Grahamites*" and "*Seymourites*" scarcely bore out the comparison with the earlier Utatur Group of Southern India. But these were trifling errors compared to Haug's identification of these same two forms, "*Grahamites*" and "*Seymourites*", with the boreal Barremian genus *Simbirskites*, Pavlow, and his consequent assumption of equally world-wide and imaginary Lower Cretaceous geosynclines.

Kilian and Reboul, it may be explained, had mistakenly believed their two Antarctic ammonites already cited to be the same as two forms described by Whiteaves (1876) from the Queen Charlotte Islands. It was unfortunate that they turned out to be Jurassic species; but Kilian and Reboul at least included their "*Grahamites*" and "*Seymourites*" as sub-genera in *Kossmaticeras*, Grossouvre, which was the dominant ammonite genus in their Senonian fauna. They thus implied no great difference in the date of existence of these two from the other sub-genera of *Kossmaticeras*, although in their table on p. 58 they correlated the bed with "*Grahamites*" and "*Seymourites*" with the Utatur Group of India, as already mentioned, a deposit in which *Kossmaticeras*-like ammonites had long been known to exist.

Haug, on the other hand, in order to justify his interpretation of these Antarctic forms and his reconstruction of the Eocretaceous palaeogeography of the world (map on p. 1358) relied on a series of misidentifications of ammonites by other authors which is probably without parallel in geological history. The "*Simbirskites*" faunas invoked by Haug, in fact, range from the Argentine "*Simbirskites*" of R. Douvillé (Upper Jurassic *Pseudinvoluticeras*, Spath, 1925) and the East Greenland "*Simbirskites*" *payeri*, Toula sp. (an Infra-Valanginian *Tollia*) to the "*Simbirskites*" described from Mexico by Burckhardt and from the Himalayas by Uhlig, both of which are species of the Tithonian genus *Grayiceras*. The resemblance of any of these to the genera "*Grahamites*" and "*Seymourites*" is as distant as that between the earlier Jurassic prototypes of "*Grahamites*" and "*Seymourites*" from Canada and the Antarctic Kossmaticerates described by Kilian and Reboul.

It is easy, of course, in the light of our present knowledge, to criticise these early misidentifications, and it is also possible now to assess the age of the Antarctic *Kossmaticeras* fauna more accurately than when Kilian and Reboul wrote and the writer himself first discussed the ammonites in 1921 and 1922. But, by a curious coincidence, the ammonite material now before me also includes two impressions from the NW. of James Ross Island (SW. of Cape Lachman) that I cannot identify. The preservation of these is such that they might have been discarded at once as useless and indeterminable; yet because they are impressions in a bright green, glauconitic sandstone matrix, quite different from that of any other ammonite, they are specially mentioned as possibly of different date from the main *Kossmaticeras* fauna. On the other hand, there is no evidence at all that these execrably preserved impressions could not have been made by contemporaries of the ammonites here described from the localities to the east.

My misgivings concerning these two fragmentary impressions were revived when a crushed fragment of another ammonite in a clay-ironstone matrix was submitted a long time afterwards; for it looked undoubtedly Jurassic. The resemblance of the two impressions from SW. of Cape Lachman to Jurassic Perisphinctids had thus to be reconsidered. The new fragment, here figured (Plate XII, fig. 5), was found loose at the western side of Hidden Lake, also in the northern part of James Ross Island, but still farther west. It shows great resemblance to *Perisphinctes transatlanticus*, Steinmann (1881, p. 279, pl. xiii, fig.1) which was compared to *Planites polygyratus* (*Reinecke*) Loriol sp., to *Idoceras balderum* (Oppel) Loriol sp., and to *Planites praenuntians* (Fontannes), all of the Lower Kimmeridgian *tenuilobatus* zone. None of these forms, however, shows the bifurcating ribs of the inner whorl, characteristic of the specimen here figured. In *P. transatlanticus*, the umbilicus is covered by matrix, so the resemblance is confined to the outer whorl. Siemiradzki (1899, p. 147) included Steinmann's species in the synonymy of *Biplices tiziani* (Oppel) but this is of Upper Oxfordian (*bimammatum*) age and is here taken to be generically different from the Lower Kimmeridgian *Planites*. In the genus *Idoceras* the primary ribs are less sharp. It may be mentioned in this connection that fragments of similar Upper Jurassic ammonites have since been collected by Mr. L. Fleming of the British Graham Land Expedition of 1935–7 in Alexander Land, together with Lower Cretaceous forms of which the Aptian *Sanmartinoceras patagonicum*, Bonarelli and Nagera, and *Ancyloceras patagonicum*, Stolley, are the most typical species. These will be described in a subsequent paper.

The two impressions from SW. of Cape Lachman, if Jurassic (and possibly derived), have no resemblance to the fragments just discussed and unfortunately must remain unidentified.

In any case it should be emphasised that the blackish limestone which Kilian and Reboul listed as their lowest bed and from which I am also recording "*Grahamites*", may well be higher instead of lower than the main *Kossmaticeras* (or *Gunnarites antarcticus*) fauna.

The latter consists of some 200 specimens, all ammonoids except a dozen examples of a single species of nautiloid. There are a few forms not before recorded from Graham Land, and, thanks to the excellent preservation of most of the material, it has been possible to give what is hoped will be an improved account of several of Kilian and Reboul's species. Since the Antarctic fauna was first made known a good deal of additional work has also been done on Neocretaceous ammonites from, for example, New Zealand, Japan, California and South Africa, not to mention the classical deposits of Europe and India. The rich collections from the Pondicherry and Trichinopoli districts of India, including Forbes's original material, preserved in the British Museum (Natural History) were particularly useful in this investigation and it will be found that the number of Indian species in the Antarctic ammonite fauna has been very greatly reduced.

B. SPECIFIC DESCRIPTIONS

I. ORDER AMMONOIDEA

FAMILY PHYLLOCERATIDAE, ZITTEL, 1884

THE two examples of Phylloceratids described by Kilian and Reboul (1909) were first recorded by Kilian (1906) as *Phylloceras* cf. *velledae* and *P. ramosum*, Meek. It is difficult to decide which of these identifications applied to the unfigured *P. surya* (Forbes) of the later account, but in any case, the Indian species just mentioned has been made the genotype of the genus *Paraphylloceras*, Shimizu, 1935, and this was described as "having ornamentation of a special kind". The irregular bundling of the ribs in *P. surya*, in fact, is rather different from the orthodox *Phylloceras* ornamentation found in Kilian's earlier species (of 1906) so that it is not certain that the revised identification of 1909 really referred to a *Paraphylloceras*. This genus, it should be added, is not invalidated by "*Paraphylloceras*", Salfeld, 1919, which was created for the group of *Psiloceras calliphyllum*, Neumayr sp. For the latter species, with its mut. *polycyclum* Waehner, had already been designated by Hyatt (1900) as the type of his genus *Parapsiloceras* and this was ignored by Salfeld as well as more recent writers, e.g. Lange (1941, p. 39), who attempted to revive the stillborn "*Paraphylloceras*" of Salfeld.

The second specimen was described and figured by Kilian and Reboul as *Phylloceras* ("*Schlueteria*"?) *ramosum*, Meek and it could have been either of the ammonites provisionally named by Kilian in 1906. It has no affinity with "*Schlueteria*" (*recte Desmophyllites*) as now restricted, but it may have been correctly identified with the Quiriquina form of *P. ramosum*, Meek, figured by Steinmann (1895), which was also associated with *Paraphylloceras surya*. On account of its resemblance to *P. subramosum*, Shimizu, the genotype of *Neophylloceras* (see Spath, 1939, p. 453) and because of its very finely divided suture-line, with an almost Lytoceratid first lateral lobe, *P. ramosum*, Meek, is now also referred to *Neophylloceras*.

It is interesting to note that in the new material here described there are also only three species of Phylloceratids, two of them based on unique examples, the third represented by six small specimens. Compared with the numerous large forms of *Kossmaticeras*, especially *Gunnarites*, collected at the same localities, and the relative abundance of the Lytoceratidae in all Upper Cretaceous faunas, this scarcity of Phylloceratids may seem significant to some. It is probably only apparent, however, partly due to collection failure, and the family certainly shows no sign of decline in any form whatever.

In this connection it is interesting to note that what is probably the latest known Phylloceratid still has the most typically phylloid terminations to its saddles. This form, *Neophylloceras* **ultimum,** sp. nov. (Plate VII, fig. 7) from the *Sphenodiscus* beds of Dande, Angola (see p. 49) differs from the ammonite described below as *N. hetonaiense* (Matumoto) in having flattened, parallel whorl-sides, like *N. compressum*, Matumoto (1943, p. 675, text-fig. 1 a_2), without any bulge near the umbilicus, and especially in having very fine costation, extremely closely spaced and showing no sign of becoming coarser with increase in size. The suture-line is even more complex than that of the original *N. ramosum*, Meek sp. (1876, p. 371, pl. v, fig. 1) from Vancouver or of the Quiriquina form figured by Steinmann (1895, p. 82, pl. text-fig. 6); and the prominent central leaflet in the almost Lytoceratid first lateral lobe asserts itself so conspicuously between the external and first lateral saddles that the original tripartite character of the principal lobe is completely lost. In addition to the ribbing *N. ultimum* has very indistinct folds on the whorl-side, parallel to the lines of growth and with the outer half prorsiradiate rather than rursiradiate, as in *N. subramosum*, Shimizu (Spath, 1939, p. 453) or *N. hetonaiense*. These folds are not at all comparable to the peculiar ribbing of *Paraphylloceras*.

Genus *Neophylloceras* (Shimizu) Spath, 1939

Neophylloceras meridianum, sp. nov.

Plate I, figs. 1 a, b

Diagnosis: Whorl-section oval, as in *Phylloceras velledae* (Michelin) d'Orbigny sp. (1840, pl. 82, figs. 1–2), with closed umbilicus, but a slightly broader periphery. Cast smooth; test with fine striation, less flexuous at the middle of the whorl-side than in *P. velledae*. Median saddle of the external lobe lanceolate, as in that species, but with two notches on each side. Phylloid terminations of the saddles very finely subdivided. Suture-line as a whole not quite so complex as in *N. ramosum* (Meek) Steinmann (in Steinmann, Deecke and Möricke, 1895, text-fig. 6, p. 82).

Remarks: The magnificent example here figured is broken off at the last septum; a small portion of the beginning of the body-chamber was removed to expose the earlier part of the outer whorl. The present diameter is 115 mm.; allowing for half a whorl of body-chamber the complete specimen would have been about 180 mm. in diameter. The ribbing is almost straight, except on the inner third of the whorl-side, where the striae are concave forwards. The flexuosity is not nearly so pronounced as in *N. subramosum*, Shimizu, which is before me in several Japanese examples, three named by the author himself. That species, moreover, is laterally flattened, not evenly rounded like the present form, and the median saddle of its external lobe is oblong and highly divided.

I am not unduly stressing the importance of the configuration of the median saddle in the ventral lobe although this is probably an ancient feature in the *velledae* group, though it is not seen in the Aptian *P. buchianum* (Forbes), the holotype of which is in the British Museum, Natural History (No. C.22680). In a very fine example of *P. velledae* from Escragnolles (Astier Coll., No. 73695), almost exactly the same size as the form here described and also entirely septate, this lanceolate siphonal saddle is very conspicuous. It should be noted, however, that that feature may easily be masked or lost (compare Stoliczka, 1865, pl. lix, fig. 3), and in the Cenomanian form figured by Crick (1907, pl. x, fig. 10) as *P. velledae*, Stoliczka (?Michelin sp.) the siphonal saddle is already as subdivided as that of Paulcke's Patagonian *P. nera*, Forbes sp. (1906, pl. xiv, fig. 5 c). The same applies to the much more compressed true *P. ramosum*, Meek (1876, pl. v, fig. 1 b) and to *Neophylloceras velledaeforme*, Schlüter sp. (1872, pl. xviii, fig. 7) which also has more flexuous ribbing than the Graham Land form here discussed.

Phylloceras angolaense, Haughton (1925, p. 267, pl. xii, figs. 1–2) somewhat resembles the present species in whorl-shape and the broadly rounded periphery, but its umbilicus is slightly open. This applies also to *Neophylloceras pergensi*, Grossouvre sp. (=*Amm. velledae*, Sharpe; 1857, p. 39, pl. xvii, figs. 7 a, b; pl. xix, fig. 6, *non* Michelin) and to the more flattened *N. rousseli*, Grossouvre sp. (1894, p. 217, pl. xxiv, figs. 2 a, b) which also has peculiarly reclined ribbing. *N. woodsi*, van Hoepen sp. (1921, p. 3, pl. ii, figs. 1–6), which has also been recorded from Madagascar, is another laterally compressed form, apart from accidental crushing.

Locality and Horizon: Dagger Peak, James Ross Island (C.41320). According to Shimizu (1935, p. 201) *Neophylloceras subramosum* ranges from the Lower Senonian (*Yezoites* Beds) into the Maestrichtian, with its maximum in the upper half of the Campanian. It is unlikely that the range of the present species is strictly limited.

Neophylloceras hetonaiense, Matumoto

Plate I, fig. 2

1943. *Neophylloceras hetonaiense*, Matumoto, p. 674, text-fig. 1 a/3, 1 b/3, p. 675

The septate nucleus here figured is characterised by its high whorl-section, of about 62% of the diameter (33 mm.), by its compression, without lateral flattening (thickness = 35%) and by its small umbilicus (6% of the diameter). The very fine and sharp ribs are distinctly sigmoidal, with a pronounced concavity forwards on the high umbilical slope and a strong convexity forwards at the middle of the side. The ribs are arranged in irregular folds, with depressions in between, but they are rather faint. They are not nearly so pronounced as in *N. marshalli*, Shimizu sp. (1935, p. 180 = *Phylloceras nera*, Marshall, *non* Forbes) and there is no resemblance whatever to the ribbing in *Paraphylloceras* (*surya* group) to which genus both *N. nera* and *N. marshalli* had wrongly been referred.

The suture-line is of the type of that of *N. ramosum* (Meek), already recorded from Graham Land by Kilian and Reboul, though their example is much more flattened laterally than the present form. In case it might be thought that the latter is related to the new form above described as *N. meridianum*, I may mention that the median saddle in the external lobe alone is sufficient for distinction. In the form under discussion it is rectangular, not lanceolate, and the terminal lappets in front are similar to those of *N. radiatum*, Marshall (1926, p. 135, pl. 19, fig. 7; pl. 26, figs. 3–4).

After the present account was already completed, I saw Matumoto's (1943) paper on the Japanese Cretaceous Phylloceratidae, and it appears that Shimizu established or is said to have established the genus *Neophylloceras* in some Japanese publication a year before he wrote the 1935 paper which formed the basis of my criticism of his two genera *Paraphylloceras* and *Neophylloceras*. Whatever the genotype may have been in that paper, printed in Japanese, the genus *Neophylloceras* was a *nomen nudum* until I stabilised it in 1939; and as I pointed out then, Matumoto, in 1938, had not adopted Shimizu's names created three years earlier.

N. radiatum, like many of Marshall's forms, unfortunately, is difficult to recognise from the bad illustration, but the radial folds seem much longer and straighter than those of *N. hetonaiense*, here described, in which, in fact, the faint folds are probably not even a specific character. Moreover, the outline whorl-sections of *N. radiatum* as well as of *N. marshalli* are so obviously different from that of the Antarctic form that comparison with the Japanese species seems indicated. The closely allied and common *N. subramosum* (Shimizu), the genotype of *Neophylloceras*, is distinguished by its spiral depression and by a more biconvex radial line.

Locality and Horizon: Humps Islet (C.41350), out of the body-chamber of an example of *Gunnarites pachys*. According to Matumoto the species passes from the Campanian up into the Maestrichtian.

Genus *Phyllopachyceras*, Spath, 1927

Phyllopachyceras forbesianum (d'Orbigny)

Plate I, figs. 3–5

1925. *Phylloceras forbesianum* (d'Orbigny), Diener, Catalogus, p. 42
1926. *Phylloceras forbesianum* (d'Orbigny), Marshall, p. 136, pl. 27, figs. 3–4, pl. 19, fig. 6
1935. *Phyllopachyceras forbesianum* (d'Orbigny) Shimizu, p. 201
1940. *Phyllopachyceras forbesianum* (d'Orbigny) Spath, p. 43

This species is represented by six small examples, only one of which slightly exceeds in size the largest of the three individuals here figured (fig. 3 a). The latter has half a whorl of body-chamber and the whorl-thickness is about 54% of the diameter (12.5 mm.). In others it is only 52%. The second specimen (fig. 4) shows the inner whorls in natural section and therefore the rate of increase in thickness. The umbilicus is almost closed and the broad venter is evenly rounded. The third example (figs. 5 a–d) shows a "normal" line on the periphery of the body-chamber, continuing the position of the siphuncle. This is seen also in two of the ten New Zealand specimens of *P. forbesianum* before me (Wright and Mason Colls.), but the largest of these (at 26 mm. diameter), has distinct longitudinal striation on the venter.

The whorl-shape of all the examples is identical with that of an example of *P. forbesianum* from Sakhalin, presented to the British Museum (Natural History) by S. Shimizu in 1935 (No. C.36685), also of a fine Hokkaido specimen (No. C.12232) which had been labelled *P. ezoense*, but the name of which (on the tablet) had been altered to "*forbesianum*" by Shimizu when on a visit to the Museum.

Now the only difference between *P. forbesianum* and *P. ezoense*, Yokoyama sp. (1890, p. 178, pl. xix, figs. 2 a–c), upheld even by Kossmat, is the reputed slenderer whorl-section of the latter. Yet in two more Hokkaido specimens labelled *P. ezoense* before me (Nos. C.22419–20) the whorl-thickness is 58% and 57% respectively, whereas in the eleven Indian specimens of *P. forbesianum* in the B.M. and Geol. Soc. Colls. it averages about 54%. Forbes's type specimen itself, at a diameter of 31 mm., has a whorl-thickness of 16 mm.; Kossmat's example showed 60%, but in the largest specimen in the B.M. (Kaye and Cunliffe Collection) at a diameter of 48 mm., the whorl-thickness again is 54%. This example also shows the beginning of the concentration of the radial striation into rib-bundles, somewhat as in *Paraphylloceras*, which seems to lead to the *infundibulum*-like ornamentation of the fully grown shells. The costation, however, is not nearly so coarse as in the large example of *P. ezoense* figured by Yabe and Shimizu (1921, p. 54, pl. viii, fig. 2), so that it may yet be possible to keep the Japanese form distinct from *P. forbesianum*.

With regard to the opinion expressed by Yabe and Shimizu that some specimens of *P. ezoense* were exact matches of the figure of *P. rouyanum* given by d'Orbigny (1840, p. 362, pl. cx, figs. 3–5), it may be pointed out that that figure represents an exceptionally depressed form (see Sayn, 1921, p. 201). The average specimens of the Gargasian *P. rouyanum*, for example, some Blieux individuals before me (Nos. 72773 a–e, Astier Coll.) are indeed indistinguishable from the young *P. forbesianum* or *P. ezoense*, except in suture-line and, at larger diameters, by the change in ornamentation. This change, from striate to costate, sets in at an early age in *P. rouyanum*, i.e. at a diameter of about 25 mm., but it is much more gradual than in *P. infundibulum* (d'Orbigny) of the Neocomian. The Aptian *P. rouyanum* thus is not here considered to be identical with the earlier *P. infundibulum* or even a variety of it, as suggested by Sayn, but it is taken to be an independent species of *Phyllopachyceras*, like the Barremian *P. baborense*, Coquand sp.

Whether the connection of all these Lower Cretaceous forms with the Upper Senonian *P. forbesianum* is as direct as Gignoux (1921, p. 99) suggested and the writer (Spath, 1940, p. 43) endorsed, is difficult to prove in the absence of intermediaries other than the Albian and Cenomanian *P. whiteavesi*, Kossmat sp. (1898, p. 124, Collignon, 1928 and 1932). The Albian *Phyllodesmoceras valdedorsatum*, Reynès sp. (see Spath, 1927, p. 99, pl. iv, figs. 3 a, b) belongs to a distinct branch of the Phylloceratinae; it is comparable to the much later "*Schlüteria*" (now *Desmophyllites*); but the *Phylloceras* sp. figured by Woods (1908, p. 332, p. xli, figs. 5 a, b) with its flattened whorl-sides and a whorl-thickness of only 48% may be an unnamed intermediate species.

Phylloceras bistriatum, Marshall (1926, p. 138, pl. 27, figs. 1–2; pl. 19, fig. 5) is probably an allied form of *Phyllopachyceras*, but not well enough known for detailed comparison. The same author's *P. minimum* (1926, p. 137, pl. 26, figs. 5–6; pl. 19, fig. 8) differs only slightly in proportions and may be the young of a slender-whorled variety of *P. forbesianum*.

In some individuals of these species, as in the Antarctic examples here described, the intersection of the radial striation by incipient longitudinal lineation may cause a striking reticulate ornamentation on the broad venter of the test or at least on one of the various layers. The convexity forwards of the fine striation of the funnel-like umbilical depression is also often very marked but, like the ventral ornamentation, depends on the preservation.

Locality and Range: Humps Islet (six examples). According to Shimizu, *P. ezoense* is the Campanian successor of the Upper Santonian *P. forbesianum*. In view of what has been said above, the species may not be separable, at least in small specimens (see also Spath, 1940, p. 43). The present examples were associated with various forms of *Gunnarites*, but not *G. antarcticus*.

FAMILY TETRAGONITIDAE, HYATT EMEND. SPATH, 1927

Genus *Pseudophyllites*, Kossmat, 1895

Pseudophyllites peregrinus, sp. nov.

Plate I, figs. 6–9

1908.? *Pseudophyllites indra* (Forbes), Kilian and Reboul, p. 14
1926.? *Pseudophyllites indra* (Forbes), Marshall, p. 152 (*pars?*)

Diagnosis: *Pseudophyllites* like *P. indra*, Forbes sp. (1845, p. 105, pl. xi, fig. 7) but with a more evenly rounded whorl-section and broader venter. Whorl-thickness (56%) slightly greater than whorl-height (53%); umbilical slope vertical, not inclined, as in *P. indra*. Suture-line perhaps slightly less complex than in that species; with only first auxiliary saddle (at umbilical border) deeply bifid (in adult), but the succeeding four auxiliary saddles (on the umbilical slope) sub-monophylloid. Median saddle of external lobe with a broad front, not long and lanceolate (as in Boule and Thévenin, 1906, pl. i, fig. 1 a).

Remarks: The difference in whorl-shape between the present form and *P. indra* is best seen on comparing fig. 6 of Plate I with the section of Forbes's species given by Collignon (1938, p. 23, text-fig. E). The difference is conspicuous already at a small diameter, for example, in the small original of Plate I, fig. 9, as compared with Kossmat's smaller specimen (1895, pl. xvi, fig. 8=B.M. No. 10469, Geol. Soc. Coll.). This difference, notably the greater thickness and the deep umbilicus, is the reverse of that distinguishing *P. indra* from *P. garuda*, Forbes sp. (1845, p. 102, pl. vii, figs. 1 a–c=Kossmat, 1895, pl. xvi, figs. 6 a, b). The latter has a still smaller whorl-thickness (44%) and a still shallower umbilicus; and although the diameter of the unique type is only 21 mm., the species is here kept distinct.

P. colloti, Grossouvre sp. (1894, p. 229, pl. xxxvii, figs. 8 a, b) appears to represent a similar slender form and may perhaps be considered a European equivalent of the Indian *P. garuda*. On the other hand, in the Maestrichtian *P. amphitrite* and *P. nereididetitus*, Maury (1930, pp. 168–9, pls. xxvii–xxix) which are also more compressed than *P. indra*, crushing in the rock, however slight, may have changed the whorl-shape.

In the young *P. indra* as well as in *P. garuda* the elongated median saddle in the external lobe is a characteristic feature already at under 10 mm. diameter, compared with the broad-fronted, massive siphonal saddle in *P. peregrinus*. The latter, however, has the eight saddles of its external suture-line fully developed at the same small size. The immature suture-line figured in Plate I, fig. 9 c from the early part (diameter = 6 mm.) of a young example (C.41492) represents a still more primitive stage, when there is scarcely any other difference between the present species, *P. indra* and *P. garuda.*

Kilian and Reboul's unique and unfigured specimen of *Pseudophyllites* may have belonged to the present species rather than to *P. indra*; for the latter was interpreted too comprehensively by all authors, including Marshall (1926, p. 153), whose New Zealand specimens were accepted as belonging to that species by Kilian as well as the writer, but might include *P. peregrinus*, as fig. 2 of Marshall's pl. 29 suggests. Both figs. 2 and 3 of that plate, however, have a wider umbilicus than the species here described.

The three Pondoland specimens of *P. indra* I recorded in 1922 (p. 119) and the Vancouver example (B.M. No. C.22341) referred to by Kossmat (1894, p. 472) and Whiteaves (1903, p. 331) have the narrow, elongated siphonal saddle and the characteristic whorl-shape of *P. indra*. This is evident even from the original figure in Whiteaves (1879, p. 105, pl. xiii, fig. 2). The Vancouver form is listed in Diener (1925, p. 53) as *P. indra* "var.", but the specimen before me does not seem separable from the typical *P. indra.* The measurements of the latter, of the Canadian form and of *P. peregrinus* compare as follows:

	Forbes's type	Vancouver *P. indra*	*P. peregrinus*
Diameter	(at) 64 mm.	53 mm.	64 mm.
Whorl-height	55%	50%	53%
Thickness	50%	50%	56%
Umbilicus	20%	22%	20%

"*Tetragonites*" *teres*, van Hoepen (1920, p. 144, pl. 25, figs. 1–2) I previously included in *P. indra*, also the same author's "*T.*" *virgulatus* (1921, p. 11, pl. iii, figs. 1–2) which is almost identical in whorl-section with the young *P. peregrinus* figured in Plate I, fig. 7. The suture-line of the Pondoland form, however, has the lanceolate siphonal saddle of *P. indra* and the auxiliary elements may appear to be less inclined towards the umbilicus only because the suture-line was taken at a very small size, compared with the gigantic Pondoland *Pseudophyllites* before me. Collignon's small Madagascan *Tetragonites* cf. *virgulatus* (1938, p. 9, pl. i, figs. 1 a, b) is a much less inflated form.

The collection includes three casts (C.41950–2) of isolated air-chambers of large Lytoceratids of which the largest has a whorl-thickness of about 160 mm. and a height of 140 mm. On the basis of the septal surface shown in Boule and Thévenin's fig. 1 b of pl. i (1904) and the illustrations in Nagao and Saito (1934, p. 359, figs. 1–10) I am inclined to attribute this cast to *Pseudophyllites peregrinus*. In the large Pondoland *P. indra* previously referred to (B.M. No. C.19417), the last septal surface occurs where the whorl-height is 100 mm. and the thickness a little over 90 mm., so that with the complete body-chamber (three-quarters of a whorl in a specimen of *P. indra*, No. C.19419, with traces of the aperture) the Antarctic *Pseudophyllites* must have reached enormous dimensions. The two smaller casts are badly worn and more doubtful, but they have a similar, large internal cavity, perhaps comparable to that observed by E. Basse (1928) in a form of *Epigoniceras*.

Localities and Horizon: Dagger Peak, James Ross Island (five specimens). Humps Islet (C.41325), Lachman Crags, South (C.41492, C.41938). The age of *P. indra* has generally been taken to be Campanian or even Maestrichtian (Spath, 1921, p. 265), but the somewhat similar *Epigoniceras sphaeronotum* (Jimbo) which Collignon (1940) included in *Pseudophyllites*, appears already in the Coniacian (of Japan) to be followed, in the higher Santonian and Campanian by *E. glabrum* (Jimbo) which also greatly resembles *Pseudophyllites indra*, but has slenderer whorls (B.M. Nos. C.12231, C.36692–3). The two Brazilian forms above cited come from undoubted Upper Maestrichtian *Sphenodiscus* beds, so that the present species also may have an extended range.

The *Lytoceras* "grande taille", recorded by Kilian in 1906 (C.R. Ac. Sci.) may be the same as the fragments above referred to.

Genus *Saghalinites*, Shimizu, 1935

Of the three genera separated from *Epigoniceras* by Shimizu, *Saghalinites* (p. 181) covering the true *Amm. cala*, Forbes, may be held to be sufficiently characterised for general adoption, even though its genotype is still unfigured and it was not properly introduced in accordance with the Rules. The other two genera may or may not be found acceptable by a future reviser of the family, but they are not represented in the Antarctic material and need not be discussed here.

Saghalinites cala (Forbes)

1925. *Tetragonites cala*, Forbes sp.; Diener, Catalogus, p. 54
1935. *Tetragonites cala*, Forbes sp.; Shimizu, p. 181

A young, fragmentary example which at a diameter of only 12 mm. has already half a whorl of body-chamber, compares well with the inner whorls of Forbes's type of *S. cala*, refigured in Kossmat (1895, pl. xvii, fig. 12), and various other specimens in the B.M. and Geol. Soc. Collections. It is much more evolute than the corresponding stage in *Epigoniceras epigonum* (Kossmat), the only "*Tetragonites*" recorded by Kilian and Reboul.

Locality and Horizon: Humps Islet (C.41485). The Indian type came from the Valudayur Beds. Pervinquière (1907, p. 79, pl. ii, figs. 30 a, b) described a "var. *zeugitana*" (indistinguishable at the size of the present example) wrongly from the Upper Santonian; but Shimizu (1935) recognised *Saghalinites* in a zone of "*Epigoniceras schmidti*" in the Maestrichtian. Matumoto (1943, p. 127) listed *Epigoniceras cala* doubtfully as of Santonian age (perhaps after Pervinquière) but this is certainly wrong.

FAMILY GAUDRYCERATIDAE, SPATH, 1927

This family was taken to include the genera *Eogaudryceras*, Spath, 1927 (genotype: *E. numidum*, Coquand sp.) and *Mesogaudryceras*, Spath, 1927 (genotype: *M. leptonema*, Sharpe sp.), in addition to the large genus *Gaudryceras*, de Grossouvre emend. Kossmat, 1895, which has for genotype *G. mite*, Hauer sp., not *Amm. duvalianus*, d'Orbigny, as Anderson (1938, p. 151) states. Even after the separation from *Gaudryceras* of the genus *Vertebrites*, Marshall, 1926 (genotype: *V. murdochi*, Marshall), which includes the well-known *V. kayei* (Forbes), the former still covered a variety of types and further subdivision seemed possible.

The new genera put forward by Shimizu in 1935 have neither diagnoses nor adequate descriptions and under the new Rules (Art. 25, i) have no legal standing. The scanty Antarctic material does not add greatly to our knowledge of these forms. I have before me only the three examples described below and a cast of Kilian and Reboul's *Gaudryceras varagurense* (Kossmat) which scarcely warrants a revision of the present family. But I saw Shimizu's manuscript and may be held by some to have sanctioned his new divisions. Moreover, I have before me Japanese specimens of *Neogaudryceras*, *Paragaudryceras*, and *Pseudogaudryceras*, named by Shimizu himself, so that I may at least express an opinion on the usefulness or otherwise of that author's genera without committing a future reviser of the family to adopt them.

The genus *Hypogaudryceras*, Shimizu, 1935, has for genotype *H. compressum*, Shimizu which was described (1929) as belonging to the group of *G. aeolus* (d'Orbigny) Jacob, though in 1935, in a paper on that species and *G. aeoliforme*, Fallot, Shimizu left the former in *Eogaudryceras* and referred the latter to *Hemitetragonites*. The small *G. dozei*, Fallot, which was cited by Shimizu as another species of *Hypogaudryceras* is also of Albian age so that this genus need not here be further discussed.

The genus *Anagaudryceras*, Shimizu, 1935, is based on a large Utatur form, figured by Stoliczka (1866, pl. lxxvi, fig. 3) as *Amm. sacya*, Forbes. This specimen was distinctly stated to "contain only the air-chambers", so that it must have been at least 200 mm. in diameter, a very large size for a *Gaudryceras*. Shimizu may have been right in renaming the Utatur form (*Anagaudryceras utaturense*) and so far it appears to be the only species in the sub-genus; but renaming all the many forms that have been described in geological literature as *G. sacya* without first establishing the identity of that species is worse than useless.

Forbe's type of *A. sacya* was associated with *Amm. buddha*, *Amm. gaudama* and *Amm. sugata*; and that author specially kept these "four Verdachellum ammonites" distinct from the Pondicherry species, apparently, not because he doubted the locality, as Blandford did at a later date, but because they are preserved in a different matrix (a gritty, yellowish limestone, as I previously pointed out). At first sight it appears that Stoliczka and Kossmat went out of their way to identify *Amm. sacya* and *Amm. buddha* with Utatur forms and to consider the other two species to be of later (Upper Trichinopoly) age.

Now, curiously enough, Shimizu proposed the sub-genus *Paragaudryceras* for the group of *Amm. sacya*, Forbes, but chose as genotype a Senonian (Coniacian) species, namely *G. limatum*, Yabe, from the *Scaphites* Beds of Hokkaido. If the inner whorls of that species resemble *G. yokoyamai*, Yabe, of the Santonian (and this was put into the *limatum* group by Yabe himself) then *G. sacya* does not belong to *Paragaudryceras*. According to an example of *Paragaudryceras yokoyamai* before me (B.M. No. C.36684) the lineation is much more sigmoidal in that species than in *G. sacya*. In fact it is not very different, laterally, from the striation in examples of *Neogaudryceras tenuiliratum*, Yabe sp. (Nos. C.36889–90) and *Pseudogaudryceras intermedium*, Yabe sp. (Nos. C.36886–7), but it is less projected ventrally. The holotype of *G. sacya*, on the other hand, has almost straight lineation, except on the umbilical slope. The direction of the ribbing is similar to that of *G. vertebratum*, Kossmat (1895, pl. xv, fig. 4 a) but much finer, without actual branching, and, of course, the whorl-section is circular, not depressed as in Kossmat's form. There are two slightly prorsiradiate bulges or ridges as in *G. tenuiliratum*, var. *ornata*, Yabe (1903, pl. iii, fig. 2 a), but the second ridge in *G. sacya* occurs already at 29 mm. diameter.

Stoliczka, of course, interpreted *Amm. sacya* too widely, as was the custom in his time, yet even Kossmat left in it the form now separated by Shimizu as *Anagaudryceras utaturense*, apart from "*Paragaudryceras*" *buddha* (Forbes), which differs from the restricted *G. sacya* only in having slenderer inner whorls (see Spath, 1921, p. 41). The acquisition of *hircinus*-like ornamentation on the body-chambers of Lytoceratids of course was no new departure; it had been tried out in the Upper Lias and it was almost certainly not confined to one particular lineage within the family Gaudryceratidae. It also probably had no stratigraphical significance.

Kossmat, who somewhat inaccurately described the radial line of *G. sacya* as sigmoidal, thought Whiteaves's Vancouver examples more like what he conceived to be Forbes's species than any other non-Indian form. The sketchy figures of Whiteaves's *Amm. filicinctus* (1876, p. 43, pl. ii, figs. 2–3) may well represent a Maestrichtian *Neogaudryceras*; the *Lytoceras sacya* of 1884 (pl. xxv) resembles the Middle Albian Madagascar form referred to below almost as much as it does the true *G. buddha*. It is possible that the single specimen of Kossmat's *G. sacya* in his own material (Warth Coll.) was unsatisfactory, and it certainly does not seem to have been good enough to be figured; but it would be necessary to re-examine all the specimens in Calcutta to discover whether the suspected Verdachellum ammonites agree with the Utatur forms figured by Stoliczka. The true *G. sacya* may turn out to be more closely related to Trichinopoly species like *G. politissimum*, Kossmat (1895, p. 128, pl. xv, figs. 7 a–c) which was described by Yabe (1903) as most nearly resembling *G. limatum*; and the Coniacian *G. limatum* var. *iwakiense*, Tokunega and Shimizu (1926, pl. xxv, figs. 1–2) is a good match of the true *G. buddha*.

It may be noticed that in the Upper Trichinopoly (Lower Senonian) *G. varagurense* there is strongly sigmoidal lineation, whereas in the presumably Maestrichtian *G. jukesi*, Sharpe sp. (1856, p. 53, pl. xxiii, figs. 11 a–e), the ribbing is radial at first and merely convex forwards in the adult. The course of the radial line, by itself, does not seem to be of decisive importance in classifying the many species of *Gaudryceras*; nor is the suture-line very helpful, being of the same general plan and in any case not invoked by Shimizu as the guiding principle of his classification. The same may be said of the *hircinus*-ornamentation of the body-chambers.

Since I discussed *G. buddha* in 1921, the rough natural section that disclosed the crystalline inner whorls has been polished, and although the section is not central, it facilitates the reconstruction of the complete shell. The body-chamber of which Forbes figured only a small portion projects from the matrix for about 110 mm., but it proved impossible to expose the inner whorls except in section. The measurements at 115 mm., diameter, taken from the section, are very close to those obtained by reconstructing the shell from what is visible externally and compare as follows with the proportions of Stoliczka's example:

	Type of *G. buddha*			Stoliczka, pl. 75, fig. 7
Diameter in mm.	49	115	133	95
Whorl-height in %	36	37	38	43–46
Thickness in %	33	33	31	35–36
Umbilicus in %	37	37	37	30–32

Stoliczka's figure shows the typical ornamentation on the last quarter of the outer whorl. In Forbes's type the corresponding portion is longer, having fourteen ribs up to the mouth-border, but the earlier transitional stage in costation is not seen. Altogether, it is a more evolute form than Stoliczka's.

The homoeomorph of *G. buddha* that occurs in the Middle Albian of Madagascar was recorded by Breistroffer (in Besairie, 1936, p. 167) as "*Paragaudryceras*", but his figure also shows only part of a body-chamber. There is in the British Museum an excellent specimen from the same locality (Berambo) presented by Dr. Besairie in 1931 which is complete to the mouth-border at 145 mm. diameter. The last septal surface is almost a whole whorl earlier. The inner whorls are well preserved and show the ornamentation of the test but not the suture-line. These inner whorls are quite different from those of the typical *G. sacya*.

In the Madagascan form the lineation is strongly inclined forwards, after first turning backwards on the umbilical wall; and it becomes reclined a second time at the middle of the whorl-side. The ribs then pass across the periphery with a sinus directed forwards. The periodic constrictions of the earlier whorls become more closely spaced towards the end of the septate stage, then change to ridges and finally to the coarse pleats of the body-chamber. These are more reclined on the whole than those of the Utatur form figured by Stoliczka and the still more comparable example from the Queen Charlotte Islands figured by Whiteaves (1884, pl. xxv). In the latter, however, as in the typical *G. buddha*, even the umbilical portion of the ribs is strongly projected.

There are thus at least three *buddha*-like developments of *Gaudryceras* in the Cretaceous, the first in the Middle Albian, the second in the uppermost Albian or Cenomanian, the third in the Coniacian. It is almost certain that the first, which may be a development of *Eogaudryceras*, has no direct connection with *G. limatum*, the genotype of "*Paragaudryceras*". I may add that Collignon's Madagascan *G. sacya*, so common in the Cenomanian, was associated with a form described as a variety of *Eogaudryceras numidum* (Coquand); and since they are well preserved they may yet prove useful in the study of these early Gaudryceratids. Meanwhile a purely morphological genus "*Paragaudryceras*" will not find general acceptance.

The genus *Neogaudryceras* was proposed (again as a sub-genus) for *G. tenuiliratum*, Yabe (1903, p. 19 = *Lytoceras sacya*, Yokoyama *non* Forbes, 1890, p. 178, pl. xviii, figs. 12–13), which seems distinct enough. For in the restricted *Gaudryceras*, i.e. in the Santonian group of *G. mite*, the same style of ribbing persists to the adult (up to 190 mm. in diameter) though there may be some variation in the rib-curve (compare e.g. *G. cinctum*, Crick MS. Spath, *G. rouvillei*, de Grossouvre, or the original *G. varagurense*, Kossmat, 1895). *Neogaudryceras* was also made to include *G. sachalinense* (Schmidt), no doubt correctly, but this species was described as having far fewer whorls than *G. kayei* (Forbes). The latter belongs to the genus *Vertebrites*, Marshall, based primarily on the internal suture-line, but easily recognised by its polygyral coiling and the retention of the very fine, branching lineation to the end. In *Neogaudryceras* this lineation becomes differentiated already at a small size, i.e. 50 mm. or even less. But I can see no generic difference between the ornamentation in *N. tenuiliratum* (Yokoyama's type) and the var. *intermedia* of Yabe (1903, p. 27, pl. iii, figs. 1 a, b).

Yet Shimizu established the sub-genus *Pseudogaudryceras* for this form which was said to range from the Santonian to the Maestrichtian. The two Sakhalin examples of *G. (P.) intermedium*, above referred to, indeed have a peculiar rib-curve, resembling that of *G. cinctum* rather than that of *Neogaudryceras*. From Yabe's figures, however, it is not evident that the course of the radial line is of greater significance than the amount of involution. And since Jimbo's *G. denseplicatum* (1894, p. 182, pl. vii, fig. 1) of Cenomanian age and with *buddha*-like ribbing, is referred to *Pseudogaudryceras* on pp. 194 and 195, but to *Paragaudryceras* on p. 218, it is difficult to find any justification for separating *Pseudogaudryceras*.

The Antarctic form described below as *G. (N.) pictum*, Yabe, is referred to *Neogaudryceras* because *G. striatum*, Jimbo, of which Yabe considered *G. pictum* to be a variety, has been identified with the Maestrichtian *G. (N.) sachalinense* (Schmidt). If Yabe's fig. 5 (1903) represent the same form as Jimbo's original and if *G. crassicostatum*, Jimbo, is correctly referred to the same group, the sub-generic name *Neogaudryceras* may well be adopted for it. But in view of the impossibility of identifying, sub-generically, an average, small example of *Gaudryceras*, it seems premature to accept even *Vertebrites* and *Neogaudryceras* as distinct genera. In all the groups left in *Gaudryceras s.l.* the suture-line is characterised by its dependent auxiliaries; in *Eogaudryceras* it is straight and serial; in *Mesogaudryceras* it is distinguished by its shallow external lobe.

It ought to be added that since *Paragaudryceras*, Shimizu, was proposed for the group of *Amm. sacya*, Forbes, and since the genotype of *Anagaudryceras* is definitely stated to be *A. utaturense*, Shimizu, Matumoto's (1943) interpretation of *Anagaudryceras*, with *Amm. sacya*, Forbes, as genotype, is unacceptable. Apart from any objections from the purely nomenclatorial point of view, any "emendation" of *Amm. sacya*, not based on the study of Indian type material, can have no lasting value.

Genus *Gaudryceras*, Grossouvre, 1894

Gaudryceras sp. juv.

? 1909. *Gaudryceras mite* (Hauer) Kilian and Reboul, p. 13

A small example of just over 25 mm. diameter, completely septate, is slightly deformed so as to show an elliptical outline instead of a regular spiral. It differs from the larger form described below as *G.* (*Neogaudryceras*) *pictum*, Yabe in having a smaller umbilicus, a less depressed whorl-section, and straighter lateral ribbing, which, however, is strongly projected on the periphery. There is, thus, a decided resemblance to *G. cinctum* (Crick MS.) Spath (1922, p. 118, pl. ix, fig. 3), but this species is perhaps still more compressed.

The form may be the same as that recorded (but not figured) by Kilian and Reboul as *G. mite* (Hauer), since the peripheral ribbing has a similar sinus and there is general resemblance to the smaller of the two examples figured by Grossouvre (1894, p. 227, pl. xxvi, fig. 4), except in the ribbing, which, like that of *G. cinctum* is much less reclined, i.e. straighter laterally. The striation is similar again in that species of *Gaudryceras* (perhaps *G. varagurense*, auct. *non* Kossmat) which is common in the Egito (Angola) fauna mentioned on p. 49; but this differs from *G. cinctum* in having a larger umbilicus (42% of the diameter, instead of 34%). *G. denmanense*, Whiteaves sp. (as represented by *Lytoceras jukesi*, *non* Sharpe sp. in Whiteaves, 1896, p. 129, pl. ii, fig. 1 only) also has an umbilicus of about 35% of the diameter, when fully grown; but the inner whorls are much more evolute than the form here discussed.

Among the many Japanese species of *Gaudryceras*, the form figured by Yokoyama (1890, p. 180, pl. xix, fig. 3) as *Lytoceras* sp. and later doubtfully included in *G. intermedium* (Yabe) has a general resemblance to the Antarctic example here described. The ribbing of the Japanese form, however, lacks the strong peripheral projection of the present example which is thus provisionally referred to the restricted *Gaudryceras* (group of *G. mite*, Hauer sp.).

Locality and Horizon: Lachman Crags, South. C.41490. The typical *Gaudryceras mite* (Hauer) is Santonian, but the Pondoland *G. cinctum* was associated with a typically Campanian fauna.

Sub-genus *Neogaudryceras*, Shimizu, 1935

Gaudryceras (*Neogaudryceras*) *pictum*, Yabe

Plate I, fig. 10

1903. *Gaudryceras striatum* (Jimbo) var. *picta*, Yabe, p. 33, pl. iv, figs. 6 a–c
1906. ? *Gaudryceras* cf. *striatum* (Jimbo) Kilian (C.R. Acad. Sci.), p. 1

The example here figured shows half a whorl of body-chamber, but just over another quarter of a whorl has been removed since it is rather badly deformed. Even the remaining half is crushed obliquely, so that the three varices (ridges) visible seem unnaturally twisted. These varices are unevenly spaced; there are two more on the omitted part of the body-chamber (apparently complete to the aperture) but they are still closer together though slightly less prominent, and each ridge is succeeded by a constriction. The total diameter is about 75 mm.; at 45 mm., which marks the end of the septate stage, the dimensions are as follows:

Height of outer whorl	35% of the diameter
Thickness of outer whorl	37% of the diameter
Width of umbilicus	44% of the diameter

These dimensions do not seem to show very good agreement with the percentages given by Yabe; the umbilicus especially, is still fairly open, as in the young of the Japanese original. But the whorls are broader than high, becoming subquadrate towards the end of the shell, and on the whole the Antarctic form is more closely comparable to Yabe's illustrations than to other species of *Gaudryceras* with more exact agreement in the (unessential) dimensions.

Among the New Zealand forms *G. subsacya*, Marshall (1926, p. 144, pl. 29, figs. 1–2), is close to the present species though more involute. The figured example of that New Zealand species shows a whorl-thickness of 25 mm. where the height is only 19 mm. (in fig. 2), but the width of the umbilicus is scarcely 40%. The same author's *G. particostatum* (p. 143, pl. 30, figs. 3–4) may thus be thought to be more closely comparable to the form here described, but it has the whorl-height equal to the thickness already at a small diameter (24 and 27 mm.). Like *G. varagurense*, Kossmat (1895, 122, pl. xviii, figs. 2 a–c) it becomes compressed at later stages, yet I had at first grouped the present form with Kilian and Reboul's large *G. varagurense*, in spite of its open umbilicus, because the very finely divided suture-line seemed to be identical. The form here described, however, has little in common with Kossmat's Lower Senonian species which differs in many features, even the comparatively simple suture-line with only slightly dependent, feebly subdivided auxiliary elements.

None of the other Antarctic forms of *Gaudryceras* described by Kilian and Reboul shows close resemblance to the example here figured. The Japanese *G. crassicostatum*, Jimbo sp. (1894, p. 182, pl. vi, fig. 7), however, may belong to the same group of forms; and though the whorl-section is different, this could be the result of lateral compression in the rock. Yabe's (1903, p. 29, pl. iv, fig. 4) illustration of the same species looks rather different, but it appears that the shell is actually compressed, so that the reference of the present form to *G. pictum* seems more appropriate.

Localities and Horizon: Lachman Crags, South (C.41327; Humps Islet, C.41328 ?) (C.41486, impression on *Gunnarites antarcticus*). The Japanese type of the species came from the *Pachydiscus* Beds of Teshio Province, Hokkaido. But *Neogaudryceras*, there, has a long range (Santonian to Maestrichtian). Matumoto (1943) listed *G. striatum* as of Campanian and Maestrichtian age.

FAMILY SCAPHITIDAE, MEEK, 1876

This family was discussed in 1934 (p. 496) and I then did not feel able to accept Reeside's (1927) division of the group into derivatives of four distinct families. It cannot be affirmed that the Scaphitidae are not as polyphyletic as that author and others before him held; yet the fact remains that we are not at present in a position to attach any given group of *Scaphites* to a more likely source than the previously existing Scaphitids and so to the fundamental Lytoceratids. Thus the typical *Scaphites*, persisting from the Albian into the Senonian, are a very compact group, including various shapes and styles of ornamentation, yet all connected by transitions. Breistroffer (1947, p. 77) has recently separated the early *circularis* group as a subgenus *Eoscaphites*, and others may consider some of the slightly aberrant Cenomanian and Turonian types worthy of sub-generic separation. As I stated before, this closely inter-related group probably originated in the Lytoceratidae of the Mediterranean-Equatorial Province and it apparently produced degenerate offshoots (?*Worthoceras*, Adkins, 1928) already before the *Scaphites* type had become fixed and universally distributed.

Whereas the increase in size up to the Turonian *Scaphites geinitzi* (d'Orbigny) was only slight, their presumed Senonian descendants produced such comparatively enormous types as the Campanian *Rhaeboceras halli*, Meek sp., and *Acanthoscaphites tridens* (Kner) and *Discoscaphites conradi*, Morton sp. (in Meek, 1876, pl. 36, fig. 2) of the Maestrichtian. It is not easy, in view of the large size of many of the late Cretaceous Scaphitids to identify small inner whorls like the Antarctic example described below. Fortunately this shows good agreement with a Chilean form considered by Wilckens (1904) to be a variety of the well-known *S. constrictus*, J. Sowerby. The generic nomenclature of these Scaphitids, however, requires clarification.

There is certainly resemblance between the Chilean form, now taken to be an independent species (*S. quiriquinensis*), and the Polish examples figured by Nowak (1911) as *S. constrictus*, var. *vulgaris*, Nowak, and var. *tenuistriata*, Kner; but Sowerby's original is rather different. The holotype of *S. constrictus* from St. Colomb, Normandy, is before me (B.M. No. C.43988) and it is generically distinct from the restricted *Discoscaphites*, Meek (genotype: *S. conradi*, Morton) to which genus Sowerby's species has been referred by Reeside. A number of typical *Discoscaphites* from the Maestrichtian of Alabama and Missouri are in the B.M. Collections and they include both *D. conradi* and *D. cheyennensis* (Owen), differing only in umbilication. It is difficult to see why these highly specialised, multi-tuberculate developments were grouped with *S. constrictus*, especially since Nowak based his genus *Hoploscaphites* on that very species. Contrary to Reeside, therefore, I adopt *Hoploscaphites* for the almost entirely Maestrichtian *S. constrictus* as well as its Campanian forerunners of the prolific *nodosus* group.

The latter had been grouped by Reeside with *Acanthoscaphites*, Nowak, 1911, but that genus was established for the very distinctive group of *S. tridens*, Kner, and should be restricted to it. In the case of inner whorls of the average *Hoploscaphites*, of course, it may be difficult to distinguish them from similar nuclei of *Acanthoscaphites* or *Rhaeboceras* of the Campanian, or even earlier true *Scaphites*. But there is one group of compressed Scaphitids that requires separation and that is the very special development represented by "*Ammonites*" *cunliffei*, Forbes (1845, p. 109, pl. viii, figs. 2–3). For this I would suggest the new genus **Indoscaphites**, gen. nov.,* and it is only necessary to compare Stoliczka's *Amm. cunliffei* (1864 pl. 1, fig. 3) with the smaller example of *Pseudaspidoceras footeanum*, Stoliczka sp. (pl. lii, fig. 2) to realise how much *Indoscaphites* differs from the other Campanian-Maestrichtian Scaphitids. There seem to be morphological transitions between *Indoscaphites* and *Hoploscaphites*, e.g. *H. quadrangularis* and especially *H. exilis* (Meek and Hayden). But if Kossmat's interpretation of *S.*(?) *andurensis*, Stoliczka, and the malformed *S.*(?) *idoneus*, Stoliczka be correct, then it may be necessary to go back to an earlier group of Scaphitids for the ancestry of *Indoscaphites*. *Amm. pavana*, Forbes, is intermediate in ornamentation between *I. cunliffei* and the doubtful *S. andurensis*, but unlike the Tunisian form figured by Pervinquière (1907, pl. iv, figs. 41–2) *I. pavana* has a wider whorl-section and an angular venter. *S. kambysis*, Zittel (in Quaas, 1902) with which Pervinquière compared *I. pavana* is a *Discoscaphites*. The small Scaphitids figured by v. Hoepen (1921, pl. v, figs. 5–7) as *S. cunliffei* do not belong to *Indoscaphites*, as I thought possible in 1922 (p. 136).

For the sake of completeness, brief reference may be made to the remaining Scaphitids. These include *Anascaphites*, Hyatt, 1900 (genotype: *Scaphites ventricosus*, Meek and Hayden) with very stout shells, typically untuberculate and well deserving generic rank. Reeside thought it closely allied to *Scaphites s.s.*, but his own illustrations of forms of the *ventricosus* group from the Cody Shale (1927, pls. iii–vi) show that *Anascaphites* differs considerably from the small earlier true *Scaphites*. Similarly distinct is the genus *Desmoscaphites*, Reeside, 1927 (genotype: *D. bassleri*, Reeside) with its constricted, thick-ribbed young and trifid first lateral lobe. In view of its close connection with the other Scaphitids, e.g. *Anascaphites*, the derivation of this group from a Desmoceratid stock seems to me far from "undoubted".

The genus *Yezoites*, Yabe, 1910 (genotype: *Y. planus*, Yabe, selected by Reeside) seems to me to represent a very distinctive local group. I have only fragmentary material for comparison, but it comes out of a block with a peculiar fauna of *Hyphantoceras*, associated with *Neophylloceras subramosum* (Shimizu), *Epigoniceras sphaeronotum* (Jimbo) and young *Gaudryceras*, and therefore of Coniacian or Santonian, not Cenomanian age. The ornamentation of *Y. planus* is as characteristic as the non-bifid internal lobe or the open umbilicus.

Finally, there is the *hippocrepis* group which was left in *Scaphites s.s.* by Reeside ("*Holcoscaphites*" in Nowak). It seems to me to be at least equally close to the *nodosus* group and is therefore now included in *Hoploscaphites*, although some forms (e.g. *S. levis*, Reeside) do not compare well with the typical *H. constrictus*. Such unrepresentative forms, however, occur in all the main stocks, from the early *S. subevolutus*, Böse (1927, p. 225, pl. vii, figs. 7–36) to the untuberculate endforms of *Discoscaphites* (*S. nicoletti* and *S. mandanensis*, Morton).

The genus *Ponteixites*, Warren, 1934 (genotype: *P. robustus*, Warren) according to its author "seems to fall within the limits of *Scaphites*", yet it was referred to a sub-family Hoplitinae, Hyatt, i.e. to a different sub-order from *Scaphites* (in Hyatt). In the absence of original material it is not easy to place this genus. The British Museum (Natural History) obtained from the Geological Survey of Canada (through the kind intervention of Dr. Jeletzky) plaster-casts of Warren's types (*Ponteixites robustus* and *P. gracilis*) from the Bearpaw Formation, associated with forms of the Campanian *nodosus* group, and I agree that they are inner whorls of Scaphitids. But the genus *Ponteixites* is clearly as yet too incompletely known to discuss its affinity with the other Upper Senonian Scaphitids.

Genus *Hoploscaphites*, Nowak, 1911

Hoploscaphites quiriquinensis (Wilckens)

Plate X, fig. 8

1904. *Scaphites constrictus*, J. Sowerby, var. *quiriquinensis*, Wilckens, p. 189, pl. xvii, figs. 3–8
1927. *Discoscaphites constrictus* (Sowerby) var. *quiriquinensis* (Wilkens) Reeside, p. 29

The small specimen here figured is only 13 mm. in diameter and, judging by the preservation, nearly half of the last whorl is body-chamber. Though the umbilicus seems to be opening out, it is not certain that the

**Diagnosis:* Scaphitids with striate or costate stage reduced to a minimum and stage with strong single uni- or bituberculate ribs following more or less directly on early smooth stage. At 10 mm. diameter shell is a miniature replica of *Pseudaspidoceras*. Later, the whorls become more compressed, with parallel sides and tabulate venter. Two rows of clavate tubercles; inner row overhanging the vertical umbilical wall, projecting slightly downwards as well as sideways. Outer row at ventral edge, connected across flat periphery first by fine and later by coarse ribs, always irregular but declining towards the aperture. Excentrumbilication very slight for a Scaphitid. Suture-line comparatively simple, of *Scaphites* pattern.

shell was beginning to uncoil already at this small diameter. The ribs are strongly biconcave forwards, and two or three of the shorter ribs combine irregularly with the long ribs to form slight bulges at the middle of the side. The lateral bend in the ribs points strongly forwards. The ribs are blunt and fairly regularly spaced on the periphery, continuous across but not strongly projected. The venter is broadly rounded, yet the whorl-section is higher than wide. The umbilical slope is high but merely rounded. The suture-line is not visible.

There seems to be good agreement with the inner whorls of Wilckens's examples, except the malformed original of fig. 3; but since only the small specimen here figured has been collected, the identification is tentative. This also applies to the small *Hoploscaphites* I recorded (1921, p. 49) from Pondoland and considered similar to Wilckens's form, except in suture-line. It has nothing to do with *Indoscaphites*, as I thought possible the year after (1922, p. 136).

Locality and Horizon: Lachman Crags, South (C.41340). The species was originally described from the Upper Senonian Quiriquina Beds.

FAMILY DIPLOMOCERATIDAE, SPATH, 1926

The Hamitidae, so characteristic of the Albian, became scarce in the Upper Cretaceous, *H. simplex*, d'Orbigny, being almost the last typical *Hamites*, though Turonian and Lower Senonian forms of the type of "*Toxoceras*" *turoniense* and "*T.*"(?) *aquisgranense*, Schlüter, may also prove to be ordinary Hamitids. *Allocrioceras*, Spath, 1926, however, and the Phlycticrioceratidae, Spath, 1926 (including the doubtful genus *Böhmoceras*, Riedel, 1931, *non Böhmiceras*, *nom. illegit.*), seem to be the commoner Hamitids in the Turonian. When dealing with the Hamitidae of the Gault epoch, the writer (1939) did not discuss the post-Albian developments of the family, but he mentioned the occurrence, in the *dispar* zone of a form (*H. multicostatus*, Brown) which was almost indistinguishable from the uppermost Cretaceous *Diplomoceras cylindraceum* (d'Orbigny). So far as is known, there are no intermediaries, yet the forms of the Campanian and Maestrichtian grew to comparatively enormous dimensions and, by analogy with the families Scaphitidae and Baculitidae, assumed to persist throughout the Upper Cretaceous and, similarly increasing in size in the higher beds, it might be held that the Hamitidae also are a long-lived family.

The so-called *Hamites* of the uppermost Cretaceous, however, are rather different from the typical forms of the Albian. Some of the groups, in fact, have already received independent generic names, and it seems advisable to keep them all apart from the true Hamitidae in a separate family. This family was named Diplomoceratidae in 1926, after the genus *Diplomoceras*, Hyatt, 1900 (genotype: *Hamites cylindraceus*, d'Orbigny), the first genus to be separated. The typical forms of *Diplomoceras* are characterised by their high and small, trifid internal lobe, inconspicuous between the two internal saddles which often coalesce at the base into one slender element. This character alone is sufficient to distinguish *Diplomoceras* from its Albian homoeomorph as well as from forms like "*Diplomoceras*" *wakanene*, Marshall (1926). The latter, in fact, belongs to that group of Indian "*Anisoceras*" which I included in *Diplomoceras* in 1921 (p. 256) because large examples of the group of "*A.*" *rugatum* (Forbes) Kossmat (1895, pl. xix, fig. 8) in the Kaye and Cunliffe Collections showed an internal lobe and differentiation of the ribbing on the inner layers of test almost as in the typical *Diplomoceras*. Later, however, I separated the Indian forms as *Glyptoxoceras*, Spath, 1926 (genotype: "*Anisoceras*" *rugatum*, Forbes sp. in Kossmat = *G. indicum*, Forbes sp.), a group more recently discussed by Shimizu (1935). His account is somewhat sketchy and his diagnosis of *Glyptoxoceras* is inaccurate in describing the antisiphonal lobe as asymmetrically bifid. It happens to be that in one specimen, figured by Shimizu, but it is trifid in others, just as there is variation in this respect in true *Hamites* (compare *H. attenuatus* and *H. rotundus*, J. Sowerby in Spath, 1941, text-figs. 218 and 219, pp. 609–13). The latter tend to have small and trifid or at least irregular second lateral lobes, though these become more Lytoceratid, like the principal lobe, in the Upper Albian *Stomohamites*; but the chief difference between *Hamites* and *Glyptoxoceras* is in the coiling. Kossmat, indeed, included the latter in *Anisoceras*, on account of the prolonged helicoid stage, but the early spiral is not often retained.

Glyptoxoceras is not represented among the Antarctic material, but there are numerous large and small examples of *Diplomoceras*, already recorded by Kilian and Reboul (as *Anisoceras*). The Campanian-Maestrichtian genus *Neancyloceras*, Spath, 1925 (genotype: *Ancyloceras bipunctatum*, Schlüter) appears to have been found also in Angola (p. 49). I had previously (1921, p. 254) referred that species to

Oxybeloceras, Hyatt, 1900 (genotype: *Ptychoceras crassum*, Whitfield) but the coiling is too widely different in the two genera to make probable any close relationship.

Oxybeloceras is represented from Graham Land by the four examples described below. This genus has been identified by some with *Solenoceras*, Conrad, 1860 (genotype: *Hamites annulifer*, Morton, 1842) and there are some intermediate species, e.g. *Solenoceras multicostatum*, Stephenson (1941, p. 399, pl. 76, figs. 12–14). Both genera may have reduced and approximately similar suture-lines, but the typical *Oxybeloceras* like *O. crassum* and *O. meekanum* (Whitfield) are here taken to be generically distinct; and I would also include in *Oxybeloceras* hamitid forms like *Hamites interruptus*, Schlüter (1872, p. 105, pl. xxxii, figs. 8–9). Such large species, however, as *Ancyloceras*? *lineatum*, Gabb (1869, p. 139, pl. 23, figs. 18, 18 a–c) are probably closer to *Pseudoxybeloceras*, Matumoto, 1938, a *nomen nudum*, but clearly meant for the well established *Hamites quadrinodosus*, Jimbo (1894, p. 39, pl. vii, figs. 3–4).

On the other hand, the genus *Solenoceras* has hitherto seemed to me to cover a group of hamitids with ptychoceratid coiling that "stood in the same relationship to the Diplomoceratidae as *Metaptychoceras*, Spath, 1926 (genotype: *Ptychoceras smithi*, Woods, 1896) did to the last (Turonian) survivors of the true Hamitidae" (Spath, 1926, p. 81). The genus *Solenoceras* was then adopted for annulate hamitids, with the shape of Woods's form, and the presumably similar original of Morton, but not for the forms [of *Oxybeloceras*] that Whitfield (1892, p. 273) evidently had in mind when discussing *Solenoceras*. The latter, as I interpret it, has a range of some 200 feet in the Upper Campanian (zone of *Hauericeras gardeni*) of Kurdistan, Iraq, but *Oxybeloceras* is known from only one level near the top of that range.

Whereas *Oxybeloceras* and *Neancyloceras* are distinguished by their regular and very sharp costation, the two genera *Polyptychoceras*, Yabe, 1927 (genotype: *Anisoceras pseudogaultinum*, Yokoyama, 1890), and *Subptychoceras*, Shimizu, 1935 (genotype: *Polyptychoceras yubarense*, Yabe, 1927) have blunt and irregular ribbing. They are known chiefly from the Upper Senonian of the North Pacific Province, but the same style of ornamentation occurred already in the Albian *Hamites ptychoceratoides*, Spath. This is one of the obliquely ribbed Hamitids that were considered to be intimately connected with the early Baculitid *Lechites*; and a similar loss of ornamentation or at least modification of the ribbing is found in *Ptychoceras sipho*, Forbes, and the allied *P. zelandicum*, Marshall, which I thought, at first, might be the same as "*Baculites*" *teres*, Forbes (1845, p. 115, pl. x, fig. 5), based on a body-chamber fragment (B.M. No. 10490, Geol. Soc. Coll.). The latter, however, has very oblique, sigmoidal folds instead of constrictions, as in the New Zealand form; and these folds are much more closely spaced than in *P. sipho*. Moreover, there is longitudinal striation in "*Baculites*" *teres* which, as Kossmat observed, is not known in any other form of *Baculites*.

This small group of forms (excluding *B. teres*) may be separated as a new genus **Phylloptychoceras,** gen. nov.* (genotype: *Ptychoceras sipho*, Forbes, 1845, p. 118, pl. xi, figs. 5 a–g) and the two species of which the suture-line is known (*P. sipho* and *P. zelanidcum*) have the phylloid terminations of the saddles of *Polyptychoceras pseudogaultinum*, Yokoyama sp. (1890, pl. xx, fig. 2 a) but considerably more reduced. These two genera *Polyptychoceras* and *Phylloptychoceras*, together with *Subptychoceras*, above mentioned, could be grouped in a special family or sub-family and the name Polyptychoceratidae suggests itself. Only this name has already been used by Matumoto (1938, p. 193) for apparently a different assemblage, including, besides *Polyptychoceras* itself, a new genus (again a *nomen nudum*) based on *Helicoceras scalare*, Yabe. That new genus in any case is close to or identical with *Euhyphantoceras*, Shimizu, 1935 (genotype: *E. maestrichtiense*, Shimizu = *Helicoceras* (?) *venustum*, Yabe, *pars*), a stock which is related to *Hyphantoceras* and *Bostrychoceras* of the family Nostoceratidae. These have nothing to do with *Polyptychoceras*, and since the family name Polyptychoceratidae can obviously only be used for an assemblage that includes the genus that gave it its name, it will either have to be adopted for the group above discussed or else discarded.

The large family Nostoceratidae, Hyatt, 1900, already mentioned, is not represented in the material before me. It includes many genera, not all turrilitid, and they seem divisible into a number of sub-families, i.e. the Nostoceratinae s.s., with body-chambers becoming modified, the Hyphantoceratinae, an early group with tuberculate, flared ribs; the Bostrychoceratinae, with simply costate corkscrews or tangles;

**Diagnosis:* Heteromorph ammonoids with *Diptychoceras*-coiling from a very early stage onwards, but final hook not in contact. Whorl-section circular in young, later oval, but greatly depressed just before and after final bend. Smooth in young, later with irregular ribs which are, first, distantly spaced and later more closely spaced, blunt folds on final shaft, but break up into closer ribs and then indistinct striae at and beyond last bend, near flared aperture. Dorsum smooth or faintly striate, where it is flat, near end of shell. Suture-line greatly simplified, distinguished from that of *Oxybeloceras mortoni*, Meek and Hayden sp. (in Meek, 1876, pl. 20, fig. 4 e) by neatly diphyllic or tetraphyllic saddles and wider internal saddles.

the Proavitoceratinae, with discoidal early volutions; the Emperoceratinae, with hamitid early whorls; and the Neocrioceratinae with quadrituberculate, depressed whorls. Unfortunately in many of the genera fragmentary specimens will be difficult to classify.

Genus *Diplomoceras*, Hyatt, 1900

Diplomoceras lambi, sp. nov.

Plate II, figs. 1–3; Plate III, fig. 1

1909. *Anisoceras notabile*, Whiteaves; Kilian and Reboul, p. 15 (*pars* ?), pls. ii–iii, v–vi (?)

Kilian and Reboul probably interpreted their "*Anisoceras notabile*" rather widely, but since they definitely stated that their Graham Land specimens were identical with Whiteaves's type of *Diplomoceras notabile* (1879, pl. xiv, fig. 2; 1903, pl. 44, fig. 4) I am figuring (Plate II, fig. 4) part of a Vancouver Island specimen (B.M. C.3486) to show that the Canadian species differs from the form here described both in details of the suture-line and in cross-section. All the fifteen specimens in the collection are circular in section, except two or three which are crushed or weathered; they are also all straight, except the slightly curved fragment figured in Plate II, fig. 1 and the magnificent original of Plate III, fig. 1.

This specimen shows the last septal surface at the smaller end and thus represents only the body-chamber. The longer arm of this is 342 mm. ($13\frac{1}{2}$ inches) in length, the anterior part being omitted in the figure; and it may not even include the full length of the body-chamber because the apertural end is incomplete and damaged. There are, however, still twelve ribs to the (longer) diameter, the whorl-section being slightly compressed laterally and flattened internally (dorsally) at the end. The (unfigured) septate shaft is represented by only two small fragments, but since they were *in situ* the animal cannot have shed its earlier chambered portion (as did some Palaeozoic Nautiloids) and lived only in its massive body-chamber.

The ribs are of the typical *Diplomoceras* pattern and fairly closely spaced (thirteen–fifteen in a distance equal to the diameter, against sixteen in Kilian and Reboul's original of pl. iii, fig. 1 a); but in two examples of a more densely ribbed variety there are nineteen ribs to the diameter. The suture-line differs but little from that of *D. cylindraceum* (Defrance in d'Orbigny) as represented by Normandy examples in the British Museum, including the specimen figured by Woodward (1851–6, p. 69, fig. 58; 1890, p. 201, fig. 65). As indicated in d'Orbigny's figs. 1–3 (pl. 136), however, the whorl-section of *D. cylindraceum* is compressed, and the ribbing is more distant than in *D. lambi*, there being eleven ribs in a length equal to the diameter but eighteen in Binkhorst's large example (1861, pl. v b, fig. 6). In the largest of the specimens of *D. cylindraceum*, before me (B.M. 6410 a, 37027) the ribbing is only preserved on the hooked portions and there it is very coarse.

Hamites latior, G. B. Sowerby MS., briefly described by Forbes in his Appendix to Darwin (1846) may be thought to be perhaps identical with the species here discussed. The two original specimens are lost; and it is only the dimensions given, indicating a nearly circular cross-section, that suggest specific identity. The name *latior*, however, has already been used by White (1890, p. 13, pl. ii, figs. 1–2) for a possible topotype from the Magellan Straits, and by Stuart Weller (1903, p. 418, pl. ii, fig. 3) for a similar, compressed, Antarctic species with much closer ribbing, more like that of Kilian and Reboul's "*Anisoceras*" *obstrictum*, Jimbo, than the present form. The other Antarctic *Hamites* sp. figured by Stuart Weller (pl. ii, fig. 4) could belong to the form here described; for in one example (No. C.41471) the ribbing is similarly distant at 80 mm. diameter. Since, however, the costae are closer on the opposite side, this merely indicates the proximity of the final bend. The annular ridges are unsymmetrical with a steep posterior edge in the few examples that retain the test and sometimes even on the cast. In at least one example of *D. notabile*, on the other hand, the ribs have flat tops.

The Brazilian *Glyptoxoceras parahybense*, Maury (1930, p. 185, pl. xi, fig. 2) appears to be closer to *D. notabile*, Whiteaves sp. than to the present form, but it was associated with true *Glyptoxoceras* as well as the Upper Maestrichtian genus *Sphenodiscus*.

Localities and Horizon: James Ross Island (The Naze and Dagger Peak, sixteen specimens). With the *G. antarcticus* fauna. The age of *Diplomoceras* is Campanian–Maestrichtian. It may be added that *Anisoceras*, to which genus Kilian and Reboul attached the present form, persists from the Upper Albian into the Cenomanian and Turonian and seems to die out in the Lower Senonian (*Anisoceras armatum*, J. Sowerby sp. *in* Riedel, 1931). *Ancyloceras* (?) *pseudoarmatum*, Schlüter (1872, p. 99, pl. xxxi, figs. 1, 3), is probably a somewhat homoeomorphous development of *Neancyloceras*.

Genus *Oxybeloceras*, Hyatt, 1900

Oxybeloceras aff. *mortoni* (Meek and Hayden)

Plate II, figs. 10 a–e

1876. *Ptychoceras mortoni*, Meek and Hayden, in Meek, p. 412, pl. 20, figs. 4 a–e
1925. *Ptychoceras mortoni*, Meek and Hayden; Diener, p. 78
1941. *Solenoceras mortoni*, Meek and Hayden; Stephenson, p. 400

Apart from the specimen figured in Plate II, figs. 10 a, b, there is a second example (figs. 10 c, d), representing a short portion of a septate shaft and somewhat crushed, but showing four suture-lines. There is tolerable agreement with Meek's species in ribbing, oblique and regular on the septate portion, more irregular on the hook and body-chamber. Cross-section and ventral tubercles also seem to be identical, but the suture-line (fig. 10 d) is much more finely subdivided, although similar in plan or arrangement of the elements. The suture-line here figured and enlarged $\times 5$ was taken where the transverse diameter is 5 mm. and it is possible that its greater complexity is partly due to the larger size.

A third fragment, consisting of the hook only, has a slightly simpler suture-line (fig. 2 e), but the drawing is diagrammatic. It suggests, however, that Meek's figure was too simplified. There is also the impression of the bituberculate venter of a fourth example.

Locality and Horizon: Lachman Crags, South (C.41393, C.41389, C.41493, C.41835). *O. mortoni*, Meek sp. is a fossil of the Campanian Ft. Pierre Group.

Genus *Polyptychoceras*, Yabe, 1927

Polyptychoceras sp. juv. ind.

Plate VII, fig. 5

The figured example consists of the straight, early part of a body-chamber, broken off at the last septum, and with the anterior end damaged. The oblique ribbing is blunt and closely spaced, though perhaps not so close as in "*Hamites*" *berkelis*, Schlüter (="*H.*" *obliquecostatus*, Schlüter, 1872, p. 107, pl. xxix, fig. 6). The ribbing also is not unlike that of some Indian fragments of *Glyptoxoceras* before me, e.g. of *G. tenuisulcatum*, Forbes sp. (1846, p. 116, pl. x, fig. 8, pl. xi, fig. 3), but only after the outer layers of test had been rubbed off. In the typical *Glyptoxoceras*, however, the ribbing is sharp and straight. The difference in coiling did not at first seem of special significance, but two more straight examples reached me after the present account was already completed, and it could be seen at once that the suture-line was also much simpler than in *Glyptoxoceras*.

There is undoubted external resemblance between the three fragments here discussed and *Polyptychoceras pseudogaultinum*, Yokoyama sp., especially the original of that author's fig. 3 (1890, pl. xx). Ribbing and circular whorl-section are similar, but the Japanese form has narrower dorsal saddles than are shown in the suture-line here figured (Plate VII, fig. 5 c, enlarged $\times 2\frac{1}{2}$). It should be mentioned, however, that the perfect pentagonal symmetry of the last septal surface of the example figured in figs. 5 a, b, indicates a suture-line more like that represented in Yokoyama's pl. xx, fig. 2 a. That is to say, the internal lobe is so small and the two dorsal saddles are so slender that they seem to form a single element in the circular septal surface. It is, of course, possible that the three fragments are not specifically identical and even the reference to *Polyptychoceras* is tentative.

Internal casts of *Diplomoceras* with similar whorl-section would be smooth, and the suture-line is highly complex. In the associated examples of *Oxybeloceras* the ventral tubercles are always distinct.

Locality and Horizon: Lachman Crags, South (C.41390, 41486). Lachman Crags, North (C.41487). *P. pseudogaultinum* (Yokoyama) according to Shimizu (1935, p. 191) is Campanian, but in Matumoto (1943, p. 133) the range is given as from the Santonian to the Maestrichtian.

Genus *Phylloptychoceras*, nov.

Phylloptychoceras zelandicum (Marshall)

Plate XI, fig. 8

1926. *Ptychoceras zelandicum*, Marshall, p. 157, pl. xix, fig. 2; pl. xxxii, figs. 11–12

One short and straight fragment (C.41491), 10 mm. long and comprising the last three camerae and a portion of the body-chamber, is entirely smooth and was at first taken to be a *Baculites*. But its very simple suture-line is against reference of the fragment to that genus, and the circular whorl-section (with the perfect pentagonal symmetry of the septal surface) shows that it has nothing to do with *B. rectus*. The specimen was then doubtfully attached to the form above described as *Polyptychoceras* sp. ind. (and compared to *P. pseudogaultinum*, Yokoyama sp.), but the suture-line, with the phylloid terminations of its saddles could only be matched by that of the New Zealand species above cited and its close ally, *Phylloptychoceras sipho*, Forbes sp., the typical species of the genus. The latter species, at the size of the fragment figured by Marshall, has a distinctly undulating surface, and though at earlier stages (as in the original of Forbes's fig. 5 c) the Indian form could not be distinguished from the straight Antarctic fragment, the suture-line of the latter (Plate XI, fig. 8) is perhaps rather simpler. But it should be mentioned that Marshall's drawing of the suture-line of *P. zelandicum* cannot be correct. The internal lobe, unlike the lateral and umbilical lobes, is not bifid, but distinctly trifid and somewhat narrower than the others.

The differences between the two species seem to appear only at larger diameters. *P. zelandicum*, according to Marshall, has deep and oblique constrictions at intervals, whereas *P. sipho* has straight annular ribs or folds, at least after 6–7 mm. diameter, which are distant at first but gradually become more closely spaced. The constrictions in *P. sipho* are much less oblique than those of *P. zelandicum*; and they generally follow the hook, whether this occurs on the early septate portion or on the body-chamber. One of the specimens in the Kaye and Cunliffe Collection (B.M. No. C.41501) mounted on a tablet with other duplicates of *P. sipho*, is indeed a smooth body-chamber fragment of *Gaudryceras* (*Vertebrites*) *kayei* (Forbes), misidentified on account of a similar if more sigmoidal constriction.

The ribbing of *P. sipho* changes on the body-chamber, as shown in Forbes's largest specimen, but it is very irregular, especially after the deep constriction following the bend. The dorsal side of this final portion (not present in the holotype) is flattened and the striae of growth across it have a distinct median sinus, directed forwards. The aperture itself is flared, trumpet-wise, on the lateral and ventral parts; it is preceded by an oblique ridge, following a final shallow depression.

Baculites teres, Forbes, above referred to, has faint and very oblique ventral ribbing and the more complex suture-line of *Polyptychoceras pseudogaultinum* and allies (see Plate VII, fig. 5 c) according to duplicates (C.41504–5) in the Kaye and Cunliffe Collection (B.M.), one of which shows the longitudinal striation of the holotype body-chamber. Stoliczka's (1866, pl. xc, fig. 13 b) drawing of the suture-line of *P. teres* is rather inaccurate; for example, the median saddlets subdividing the lateral and umbilical lobes are almost entire, i.e. monophyllic. It is possible that the equally diagrammatic suture-line of "*Ptychoceras*" *sipho* (*ibid.*, fig. 9) was also taken from a *Polyptychoceras* fragment, for it is too widely different from that of the former species, as Kossmat (1895, p. 150) already recognised. At small diameters, however, *Polyptychoceras teres* is also smooth, at least on internal casts, since the test may show the linguiform processes of the striae of growth, before the ventral ribs appear. Small portions without a suture-line, of course, could not be distinguished from other straight heteromorphs with circular section.

Locality and Horizon: Lachman Crags, South (C.41491). The species is common in the Upper Cretaceous of New Zealand where it is associated with *Pseudophyllites*, *Gaudryceras* (*Vertebrites*), and other close allies of Valudayur forms.

FAMILY BACULITIDAE, MEEK, 1876

Genus *Baculites*, Lamarck, 1799

Baculites aff. *rectus*, Marshall

Plate VII, figs. 2 a–e

1926. *Baculites rectus*, Marshall, p. 154, pl. 19, fig. i; pl. 32, figs. 9–10

A crushed body-chamber fragment and two small septate portions of a smooth *Baculites* with an oval cross-section might be compared to *B. ovatus*, Say (see Meek, 1876, pl. xx, figs. 1–2), only the suture-line is different. In its comparatively slender saddles it is remarkably like the suture-line of the New Zealand species described by Marshall. There is, however, no close affinity, so far as I can see, with *B. chicoensis*, Trask, or at least the Chico Creek and Vancouver Island specimens in the British Museum, the latter of which I referred to on a previous occasion (Spath, 1921, p. 261). Contrary to Marshall I do not consider the large *B. chicoensis*, with sharpened venter, to approach so very closely to *B. rectus*.

There is also resemblance to the somewhat less compressed *B.* cfr. *anceps*, Lamarck, figured by Paulcke (1906, p. 176, pl. xvi, fig. 6), though the suture-line is rather different, as it also is in the Normandy specimens of Lamarck's species in the British Museum. On the other hand, *B. cazadorianus* (attached by Paulcke as a variety to *B. vagina*, Forbes), with sharpened venter and a flatter dorsum than the form here described, has similar indefinite lines of growth. Marshall described this faint ornamentation as "much stronger sculpture" than was shown in his *B. rectus*; and therefore the identification of the Antarctic examples with the New Zealand species might be questioned. In all smooth *Baculites*, however, there are similar striae of growth and though in the few New Zealand specimens of *B. rectus* before me (Wright Coll.) only fragments of test remain and the internal cast is entirely smooth, there are traces of the usual "ornamentation". The suture-line of the largest example, at a diameter of 26 × 20 mm., is here figured (Plate VII, fig. 3) for comparison with that of the much smaller Antarctic form; and it will be seen that they are indeed closely similar.

The true *Eubaculites vagina* (Forbes) which I discussed recently (1940, p. 48) has a perfectly tabulate, not a sharpened, venter already at 10 mm. (long diameter) and the ribs appear at about 16 mm., so that *Baculites cazadorianus* is neither a *Eubaculites* nor a variety of *E. vagina*. None of the Quiriquina *Baculites* collected by Darwin and wrongly labelled *B. vagina* by Forbes himself, is comparable to the present form; they are not so typical as Kossmat (1895, p. 156) stated, but include all the forms figured by d'Orbigny (1846) as *B. anceps*, Lamarck, *B. lyelli* and *B. ornatus*, d'Orbigny.

Locality and Horizon: Lachman Crags, South (C.41391–2). Marshall's *B. rectus* came from the Upper Senonian of New Zealand.

FAMILY PUZOSIIDAE, SPATH, 1922

The genus *Parapuzosia* is doubtfully represented by a single small example, but there is one new Puzosid genus, apparently much commoner, which has the outward shape of *Zelandites* (="*Varunaites*") combined with a Desmophyllitid, not a Lytoceratid, suture-line. This new genus, *Oiophyllites*, gen. nov., described below, is taken to be a close relation of *Desmophyllites* (olim "*Schlüteria*") which I included in the Puzosiinae already in 1922.

It is well known that *Puzosia*, Bayle, 1879, technically antedates *Desmoceras*, Zittel, 1884, and that Puzosiidae should have been used instead of Desmoceratidae, as a family name, from the beginning. But the rules were not enforced as strictly in 1884 as they are now; and, after all, *Puzosia* had been thrown out as a mere name without any explanation. In any case, since the genus *Desmoceras*, Zittel, was restricted by de Grossouvre (1894) to the group of *Amm. latidorsatus*, Michelin, also included in *Puzosia* by Bayle, there is no clear-cut necessity to change the existing nomenclature.

Genus *Parapuzosia*, Nowak, 1913

Parapuzosia (?) sp. juv. ind.

Plate III, fig. 2

Part of the septate whorl of an example only about 13 mm. in diameter shows a suture-line which, in complexity, can compete with any species of *Puzosia* or *Parapuzosia*. The only other features recognisable are the evenly rounded venter, a fairly open umbilicus and the presence of two constrictions, on the internal cast. These constrictions are curved forwards, and on the venter project in the usual V-fashion. There is a suspicion of striation on the periphery of the half-whorl preserved, in between the two constrictions, but this appearance is deceptive since there was no ornamentation before the fragment was treated with dilute acid to expose the suture-line.

Kilian and Reboul (1909, p. 19) already recorded a *Puzosia* from Snow Hill but considered it specifically indeterminable. Of all the species mentioned by them, only *P. darwini* (Philippi MS.) Steinmann (1895, p. 73, pl. v, fig. 3) is perhaps likely to be related to the nucleus here described. The suture-line certainly is similarly complex, but size alone prevents closer comparison.

Locality and Horizon: Lachman Crags, South (C.41341). The last survivors of *Puzosia* and the often gigantic *Parapuzosia* seem to be of Campanian age.

Genus *Oiophyllites*, gen. nov.

Genotype: *O. decipiens*, sp. nov. Plate IV, fig. 7.

Diagnosis: Puzosids with whorl-shape of *Zelandites* (="*Varunaites*"), i.e. with compressed, discoidal whorls and with comparatively narrow umbilicus, yet showing the numerous concentrically coiled inner whorls. Umbilical slope low, with gently rounded edge, almost flat sides and narrowly rounded venter. Test and cast smooth; the former with very fine sigmoidal striae of growth, as in *Zelandites*. Suture-line Puzosid, with subphylloid terminations of the saddles as in *Desmophyllites*, but differing from the suture-line of *D. diphylloides* (Forbes)* in having a shallow external lobe and fewer elements.

Remarks: This genus is based on the Antarctic form described below, but it includes a very similar African species (*O.* **angolaensis,** sp. nov., Plate VI, fig. 6) which differs chiefly in having a slightly broader venter (in the young), retained to a later stage, and in having a more finely frilled, i.e. a more typically Puzosid suture-line. This African species, however, also has the general discoidal whorl-shape of *Zelandites*, e.g. *Z. varuna* (Forbes) as figured in Steinmann (1895, pl. v, figs. 2 a, b).

The young of *Puzosia gaudama* (Forbes) figured by Pervinquière (1907, p. 161, pl. vi, figs. 33–34) differs from the inner whorls of *O. angolaensis* and still more so from those of *O. decipiens* in its broader whorl-section, but shows where the affinities of the new genus are. Likewise, *Tragodesmoceras clypeale*, Schlüter sp. (1872, p. 51, pl. xv, figs. 9–14) is a closely allied stock, but it has constrictions and a tendency to acquire robust ornamentation, especially on the sharpened periphery.

Hauericeras durga, Forbes sp. (1845, p. 104, pl. vii, fig. 11), which is probably the young of *H. rembda* (Forbes), as Stoliczka already suspected, is distinguished from *Oiophyllites* by its open umbilicus, the presence of faint constrictions and the typical *Hauericeras* umbilical wall, also the much less "phylloid" suture-line.

Amm. yama, Forbes (1845, p. 107, pl. vii, fig. 4) is similar in whorl-shape to the Antarctic form here described. It had indeed been considered to be "nearly allied to *Amm. varuna*" by its author, but it has the extremely finely divided suture-line of *Pachydiscus* and could represent merely the inner whorls of a form like *P. compressus*, Spath sp. (= *P. gollevillensis*, Kossmat *non* d'Orbigny). But there is one faint constriction with great peripheral projection which might indicate affinity with *Parapuzosia* of the type of *P. icenica* (Sharpe).

Amm. (*Mortoniceras*?) *machueli*, Pervinquière (1907, p. 247, pl. ix, figs. 19–20) resembles *Oiophyllites* in whorl-shape, though it has less flattened sides and a suggestion of a keel. But its suture-line is greatly simplified and if it be a Puzosid at all, it is not directly related to the group here discussed, with its complex suture-line.

Oiophyllites decipiens, sp. nov.

Plate IV, figs. 7–8

Diagnosis: Whorl-section oval, compressed, with narrowly arched venter and rounded umbilical edge. Whorls more rounded at earlier stages, comparable to the section of *Zelandites varuna* above cited. Shell smooth, unconstricted, with very fine sigmoidal (biconvex) striae of growth. Suture-line Desmophyllitid, with deep trifid principal lobe and bifid saddles with tetraphylloid terminal leaflets.

Remarks: There are five examples of this species and the original of Plate IV, fig. 7, is taken as holotype because it retains portions of the test and well shows the suture-line and cross-section. The second example (fig. 8) is slightly crushed and the suture-line is asymmetrical, the median saddle of the external lobe being on the side not figured. This asymmetry resulted in the suture-line being somewhat different from that of the holotype. The remaining three examples do not show the suture-line, but they confirm the *varuna*-like shape of the shell, the largest specimen indicating a maximum diameter of little over 20 mm.

The only form with which the present species can be compared is the undescribed African form already

*The holotype of this species (B.M. No. C.22682), of only 21 mm. diameter, has the last third of the outer whorl (body-chamber) deformed by crushing and thus appears too inflated. I did not notice this at first (1921, p. 46) when I thought the original of Kossmat's pl. xix, fig. 9 to be a typical *D. diphylloides*. In fact it is more inflated and has a different suture-line. I am now figuring (Plate II, fig. 5) one of the three paratypes in the B.M. which is slightly larger than the holotype and shows the typical whorl-thickness of 38% at 24 mm. diameter. The larger Angola specimen (fig. 6 of the same plate) has a whorl-thickness of 40% at 33 mm. diameter and is figured because it shows the numerous elements of the suture-line, for comparison with that of the presumably earlier Ariyalur specimen figured by Kossmat. The Albian form figured by Barrabé (1929, pl. ix, fig. 20), of course, has nothing to do with Forbes's species.

referred to, namely *O. angolaensis*, sp. nov. (Plate VI, fig. 6) which may be defined as being slightly less compressed than *O. decipiens*, with a more broadly arched venter, especially in the young, and a distinct but low, vertical, umbilical wall. Its Puzosid suture-line has the terminal leaflets of the saddles more finely frilled and less phylloid than those of *O. decipiens*.

Locality and Horizon: Lachman Crags, South (C.41348, C.41343, C.41403–4, C.41900). The Angola species was associated with a fine Campanian? fauna (from Egito) in which a form of *Desmophyllites*, close to *D. diphylloides* (Forbes) is common, together with a new species of *Pseudophyllites*, and which is dated by, among others, several species of *Hoplitoplacenticeras* (group of *H. vari*, Schlüter) and *Dechenoceras* (group of *D. coesfeldiense*, Schlüter sp.) as mentioned on p. 49.

FAMILY KOSSMATICERATIDAE, SPATH, 1922

When dealing with this family (at first a sub-family) on previous occasions I uncritically adopted *Madrasites*, Kilian and Reboul, 1909, both as a sub-genus of *Kossmaticeras* (May, 1921) and as an independent genus (August, 1921); but I included in it forms that belong to the typical *theobaldianum*-group, i.e. to *Kossmaticeras s.s.* Kilian and Reboul, in fact, in subdividing the Kossmaticeratidae, ignored the genus *Kossmaticeras* itself and introduced *Madrasites* for a first group that included the type of the genus, namely *Kossmaticeras theobaldianum* (Stoliczka). This was against the Rules and Sayn (1910) and Diener (1925, p. 96) were right in holding that *Madrasites* was merely a synonym of *Kossmaticeras s.s.* and without legal standing. Among the three syntype-species of *Madrasites*, however, Kilian and Reboul also cited *M. bhavani* (Stoliczka); and while this played a prominent part in their Antarctic collections, *Kossmaticeras theobaldianum* was represented only by a so-called variety and the third species (*K. karapadense*, Kossmat sp.) was not even figured. Since a new name was obviously indicated for this *bhavani* group, it had seemed to me that a restricted *Madrasites* might serve the purpose, even if not in accordance with the Rules. But now that Marshall's genus *Maorites*, 1926, actually covers the group, since it was made to include *M. bhavani* (Stoliczka) var. *densicostata*, Kilian and Reboul, *Madrasites* will have to be abandoned. The differences in suture-line on which Marshall insisted are not of fundamental importance; they are differences of degree in complexity, etc., but not of kind (compare Marshall's pl. 21, figs. 6–7 with pl. 23, fig. 1).

A number of examples here figured show that *Maorites* is connected by transitions with other forms of "*Madrasites*", including *M. gunnari*, Kilian and Reboul. This was not only figured, unlike the species of Stoliczka and Kossmat that were only cited, but it was described at length and stated to show occasionally a tendency to crenelation of the ribs. This, of course, was exactly the character on which the sub-genus *Gunnarites* was founded and since Kilian and Reboul placed Stoliczka's *Amm. aemilianus* in their *Gunnarites*, it is clear that the two genera are not widely different. All the species referred to *Madrasites* can thus easily be distributed among the genera *Kossmaticeras s.s.*, *Maorites*, and *Gunnarites*; and those New Zealand species of *Madrasites* in which the ribs are not crenelate are obviously closer to *Gunnarites* than to *Kossmaticeras s.s.* by their tuberculate umbilical edges. The South African *Madrasites acuticostatus* (Crick MS.) Spath and *M. faku* (v. Hoepen), however, belong to *Kossmaticeras s.s.*, while other forms, like *M. natalensis* (Crick MS.) Spath differ from the typical *Kossmaticeras theobaldianum* in their strong umbilical tuberculation.

The genus *Jacobites*, Kilian and Reboul, is apparently very rare and was overlooked entirely at first. It is represented, however, by a single example of a new species, greatly resembling *Maorites*, before the periphery becomes modified. There is no example of such extreme developments as *Neomadrasites* and *Tainuia*, Marshall, 1926, and *Aucklandites*, Marshall, 1927, nor anything resembling *Amm. rotalinus*, Stoliczka, which Kilian and Reboul recorded from Snow Hill, but did not figure. This last species was made the genotype of a new genus *Rotalinites*, Shimizu, 1935, but this is still a *nomen nudum* and its relations with *Pseudojacobites*, Spath, 1922, and *Jacobites* itself are as yet far from established. In any case, *Amm. rotalinus* has been taken to be probably a Pachydiscid, whereas the Antarctic form cited by Kilian and Reboul may belong to one of the Kossmaticeratid genera from New Zealand above referred to.

Another form wrongly included in the present family is *Kossmaticeras* (*Besairieites*) *pseudorotalinum*, Collignon (1931, p. 18, pl. i, fig. 7). This may be identical with *Menuites rotalinoides*, Yabe sp. (1915, p. 21, pl. i, fig. 9; pl. ii, figs. 5–6) which has a long range in the Senonian–Maestrichtian of Japan and which is another member of the family Pachydiscidae.

Matumoto's (1943) identification of certain Japanese MS. species of Cenomanian age with the genera

Jacobites, *Maorites*, and *Neomadrasites* must be based on a complete misunderstanding of these Kossmaticeratids.

Grossouvrites, Kilian and Reboul, 1909 (genotype: *G. gemmatus*, Huppé sp.), also originally a sub-genus of *Kossmaticeras*, but raised to generic rank already in 1922, is represented by only a single specimen, fit for figuring and large, though without the inner whorls. It is well separable from the other genera.

As regards the remaining two Antarctic Kossmaticeratids, Kilian and Reboul were unfortunate in pinning them down to Canadian types which have since been found to belong to Jurassic genera, "*Grahamites*" *skidegatensis* (Whiteaves) being a Bajocian Stephanoceratid, as Hyatt (1877) had already suspected, while *Seymourites logani* (Whiteaves) is a Callovian *Kepplerites* (see Spath, 1932, p. 80). This means a change in nomenclature, but does not alter the fact that the Antarctic form figured by Kilian and Reboul as "*Grahamites*" is a Kossmaticeratid, recognisable by its oblique constrictions. It can be matched almost perfectly by two specimens in the collection, while a third belongs to an obviously related species. They are now included in a new genus **Neograhamites,** gen. nov. (genotype *N. kiliani*, sp. nov.) since the former name "*Grahamites*" cannot be used. These three examples have body-chambers at comparatively small diameters and clearly do not fit into the other Kossmaticeratid genera described.

Neograhamites has been found only on Humps Islet and it is the only Antarctic group with resemblance to the European species of *Pseudokossmaticeras*, like *P. düreri*, Redtenbacher sp. (1873, p. 118, pl. xxvii, fig. 2) as well as to the genotype, *P. pacificum*, Stoliczka sp. (1865, p. 160, pl. lxxvii, fig. 9) and especially to *Brahmaites haugi*, Seunes sp. (1891, p. 20, pl. vi, figs. 1 a–c). *Neograhamites*, in fact, is closer to *Brahmaites* than any of the other genera of Kossmaticeratidae and shows that Kossmat was right in stating that the affinities of *Brahmaites* were with "*Holcodiscus*", that is *Kossmaticeras*.

The original of Kilian and Reboul's fig. 2 of their pl. 18, mistaken for *Amm. loganianus*, is rather small (the figure is enlarged and the diameter is only about 20 mm.); it has two oblique constrictions which makes it probable that it is an immature *Gunnarites*, such as are here recorded from Snow Hill. The inner whorls of *Neograhamites*, however, are also similar. What the *Kossmaticeras loganianum* (Whiteaves) from New Caledonia, cited in Piroutet (1917) and again in Glaessner (1943) may represent, it is impossible to guess since there is no form of *Kossmaticeras* with any resemblance to Whiteaves's Jurassic type or the "varieties" associated with it.

The genus *Holcodiscoides*, Spath, 1922 (genotype: *Amm. cliveanus*, Stoliczka) is not yet known from outside India and it is still doubtful whether it belongs to the family here discussed. I may have been wrong in associating with it such Santonian species as *Amm. moraviatoorensis* and *Amm. paravati*, Stoliczka; but Jimbo (1894, p. 33) had already compared his "*Holcodiscus*" *kotoi* to *Amm. cliveanus*, Stoliczka, of supposed earlier date. Shimizu (1935, p. 198) has since established the genus *Yokoyamaoceras* (a *nomen nudum*) for Jimbo's species and stated it to be of Campanian age; but it will be necessary to discover the exact relations between the externally similar species *cliveanus* and *kotoi* before including *Holcodiscoides* in the family Kossmaticeratidae.

Genus *Maorites*, Marshall, 1926

Maorites densicostatus (Kilian and Reboul)

Plate II, figs. 7–9; Plate VII, fig. 6

1909. *Madrasites bhavani* (Stoliczka) var. *densicostata*, Kilian and Reboul, p. 30, pl. 15, fig. 4?; pl. 18, fig. 1 (reduced)

The two larger examples here figured show good agreement with Kilian and Reboul's originals, a plaster-cast of the larger of which is in the British Museum (No. C.23248). Yet there might be some doubt about the identification because in the second example (Plate II, fig. 8) the change in ornamentation which might suggest reference to *M. seymourianus* rather than to the present form sets in at only 65 mm. diameter. Only the inner whorls, showing the densicostate stage, are here figured; the complete specimen is about 100 mm. in diameter, but the outer whorl, with less regular and increasingly coarser costation, is crushed and displaced by pressure. Both the large example of their var. *seymouriana* figured by Kilian and Reboul in pl. 14, fig. 3 (cast in B.M. C.23247) and the smaller original of their pl. 19, fig. 1 have densicostate inner whorls, but they can easily be distinguished from the two specimens now figured by their open umbilicus. As mentioned below, the name *seymourianus* is here retained for those Antarctic *Maorites* that Kilian and Reboul included in *Madrasites bhavani* as well as the "variety". They are not believed to be identical with

Stoliczka's species and they connect directly with *Gunnarites kalika* (Stoliczka), but lack the crenelation of the ribs.

It will be noticed that the flattened form here referred to *M. seymourianus* (Plate IV, fig. 1) also has the larger umbilicus of the compressed forms of *Gunnarites* whereas the two examples of *M. densicostatus* are much more narrowly umbilicate. At very small diameters it may not be possible to distinguish the two species.

The third example (Plate II, fig. 9) differs from the other two in having a slightly more open umbilicus and apparently in losing the densicostate style of ribbing at a still smaller diameter. It might thus seem transitional to *M. seymourianus*, but in spite of these small differences, there can be no doubt that its affinities, like those of the still smaller original of Plate VII, fig. 6, and a fifth example (C.41489), are with the present species.

M. cumshewaensis, Whiteaves sp. (1879, p. 208, pl. xxiv, fig. 1) has less oblique constrictions and a somewhat different style of ribbing, especially on the inner whorl, though this may have been badly drawn by the artist. In any case, in the specimen from St. Vincent, New Caledonia (B.M. C.1536) which I recorded in 1921 (p. 300) as *Madrasites bhavani* var. *densicostata* and which has a body-chamber agreeing with Whiteaves's figure, the inner whorls are extremely densely costate.

The closely allied *M. mckayi* (Hector) recently refigured by Marwick (1950) apparently has very similar inner whorls.

Ancyloceras simplex, d'Orbigny, figured in Darwin (1846, p. 152, pl. v, fig. 2), according to the Patagonian original before me (B.M. No. 2612), is a deformed example of a similar densicostate form of *Maorites*, but perhaps nearer to *M. suturalis*, Marshall (1926, p. 179, pl. 43, fig. 1) than to the present species.

Localities and Horizon: Dagger Peak, James Ross Island (C.41334, C.41374, C.41338, C.41489). Lachman Crags, South (C.41349). The supposedly allied *M. aemilianus* (Stoliczka) was cited by Shimizu (1935) from the zone of *Hauericeras gardeni*, i.e. the top of his Campanian. I may add that this author had the species in *Maorites*, Kilian and Reboul included it in *Gunnarites*, and Matumoto (1943) put it with a ? in *Grossouvrites*.

Maorites seymourianus (Kilian and Reboul)

Plate IV, figs. 1 a, b

1909. *Kossmaticeras (Madrasites) bhavani* (Stoliczka) var. *seymouriana*, Kilian and Reboul, p. 29, pl. xix, fig. 1

Kilian and Reboul were somewhat vague about the scope of their variety and the originals of their pl. xv, fig. 4 and pl. xviii, fig. 1 were listed under the var. *seymouriana* on p. 29 and under the var. *densicostata* on p. 30. There is nothing in the present collection that could be identified with Kossmat's figures (pl. viii, figs. 5–6) of *M. bhavani* (Stoliczka) though *M. pseudobhavani*, sp. nov. (p. 25) is clearly related. On the other hand, Kilian and Reboul's statement that the var. *seymouriana* was connected by transitions with *Gunnarites bhavaniformis* indicates that the umbilical tubercles were far more conspicuous in their Antarctic *M. bhavani* than in the Indian types. So it may be suggested that their *M. bhavani* was not so typical as they insisted and that most, if not all their examples belonged to the var. *seymouriana*.

Reviewing the figures in Kilian and Reboul, we notice that the original of pl. xiv, fig. 3 (cast in B.M.) is perhaps more densicostate that the original of my Plate IV, fig. 1. Later the ribbing changes slowly, to become fairly coarse at about 125 mm. diameter. In the original of Kilian and Reboul's pl. xix, fig. 1 the change occurs earlier, but the inner whorls again can be distinguished only by the open umbilicus from those of the var. *densicostata*. This leaves the doubtful young shell, figured in pl. xiv, fig. 4 and the original of pl. xix, fig. 2. The umbilical tubercles on the early whorls of both are too prominent for the true *M. bhavani*, so these examples may also be taken to represent the Seymour Island form of *M. bhavani* in Kilian and Reboul's interpretation.

The inner whorls of the example figured in Kilian and Reboul's pl. xix, fig. 2 are more involute than the specimen here included in the present form. It is slightly corroded but the general compression is decidedly less than that of *M. densicostatus*. The comparison to *M. bhavani* suggests that *M. seymourianus* has inner whorls hardly more compressed than the young *Gunnarites* figured in Plate X, fig. 6. The latter differs from the typical *G. kalika* (Stoliczka) merely in lacking the crenelations of the ribs and in having a more elegantly costate early stage. There is a perfect series of transitions from the flattened form here included in *M. seymourianus* to these compressed forms of *Gunnarites*; but they are mostly comparatively small specimens. Large individuals are apt to develop disconcertingly aberrant body-chambers.

Locality and Horizon: Lachman Crags, South (C.41394). With next species (*M. pseudobhavani*, sp. nov.).

Maorites pseudobhavani, sp. nov.

Plate VI, figs. 7–9; Plate XI, figs. 2–4

Diagnosis: *Maorites* with *Gunnarites* early whorls, but no crenelation of the ribbing. To a diameter of 15 mm. comparable to the inner whorls of *G. bhavaniformis* (Plate VIII, fig. 7) or even slightly more depressed and with the faint tuberculation of *G. rotundus*. Ribbing at first very fine, gradually becoming bhavaniform, but with umbilical tubercles always more or less prominent. Oblique constrictions, undercutting three or four ribs. Whorl-section more broadly arched, ventrally, than in *M. bhavani*, Stoliczka sp. (see Kossmat, 1897, pl. viii, fig. 5). Suture-line comparatively simple, as in young *Gunnarites*. Slenderer terminal leaflets to first lateral saddle than in Kossmat's fig. 5 c.

Measurements:	Diameter	Height	Thickness	Umbilicus
Holotype (Pl. VI, fig. 7)	45 mm.	36%	33%	33%
Plate VI, fig. 9	50 mm.	44%	44%	30%

Remarks: The holotype includes nearly half a whorl of body-chamber and shows decline of the tuberculation near the end, which accounts for the decreased whorl-thickness. In the more inflated original of fig. 9, also a body-chamber fragment (with a portion of the penultimate whorl), the much greater whorl-thickness is partly explained by its having been taken at the very prominent umbilical spines. What seem to be the inner whorls of a third example (Plate VI, fig. 8) also include nearly half a whorl of body-chamber, so that the species apparently remained fairly small.

It is a perfect transition between *Gunnarites* and the more compressed types of *Maorites*, yet although Kilian and Reboul may conceivably have had specimens of the present form, none of their figured examples of "*Madrasites*" *bhavani* belongs to it, certainly not the small original of their fig. 4 (pl. xiv) which is here included in *M. seymourianus*. The latter is altogether more compressed and more evolute than the species now discussed, but connects it with the more typical *Maorites* of the *densicostatus* type.

The ribbing of the two larger specimens is fairly blunt, at least on the internal casts, as it is in the Indian form depicted by Kossmat, though perhaps not in Stoliczka's originals (1865, pl. lxix, figs. 4–7). The sharp ribbing of the South African form I figured as *Madrasites bhavani* in 1921 (pl. xxiv, fig. 8) is rather different, and in the small *Holcodiscus* sp. figured by Woods (1906, pl. xlii, fig. 2) the ribs are not prominent enough.

The ammonite figured by Redtenbacher (1873, p. 124, pl. xxx, fig. 2) and correctly compared to *Amm. bhavani*, Stoliczka, is morphologically intermediate between the present species and *M. seymourianus*, but lacks the umbilical tubercles. The form described below as *M.* aff. *suturalis*, Marshall, is a far more advanced type, with the tuberculate *Gunnarites* stage reduced to a much smaller diameter and the flattening of the whole shell appearing soon after.

After the above was written, half a dozen additional examples of the present form were received, associated with an equal number of specimens of *Gunnarites rotundus* and various transitions between the two species, as well as between *Maorites pseudobhavani* and *M. seymourianus*. These passage-forms show not only that the sub-genera originally recognised within *Kossmaticeras* are extremely closely allied, but that a classification based on a single character such as ribbing, compressed whorl-shape (*Maorites*) or crenelation (*Gunnarites*) is apt to prove somewhat artificial.

Locality and Horizon: Lachman Crags, South (thirteen specimens).

Maorites sp. juv. aff. *suturalis*, Marshall

Plate V, figs. 6–7

1926. *Maorites suturalis*, Marshall; p. 179, pl. 43, fig. 1

The small example here figured (Plate V, fig. 6), includes already half a whorl of body-chamber, and the apertural end is intact, just beyond the last constriction. This is the sixth on the outer whorl, according to the impression left in the rock. Like the delicate *Maorites* ribbing, the constrictions are gently sigmoidal, but oblique to the costae, so that, as in Marshall's type, they undercut about five shorter ribs. The umbilical tubercles are sharp on the body-chamber where they are on top of the vertical umbilical wall; they are blunt but very prominent on the earlier whorl and scarcely developed on the innermost volutions. The whorl-section, there, is greatly depressed, as in young *Rasenia*; later it becomes circular and on the body-chamber it is compressed, elliptical, with evenly arched venter. The suture-line is visible through the translucent test, but it is too immature to show more than that *Maorites* is a Kossmaticeratid, contrary to Marshall's views.

The figured example agrees with two more, smaller nuclei in the collection (including Plate V, fig. 7), whereas a fourth young specimen has flatter whorls and only traces of umbilical tubercles, so that it could also be included in *M. densicostatus.*

Among several young and exquisitely preserved New Zealand specimens of *Maorites* before me (Wright and Mason Colls.) too immature to be definitely referred to either *M. densicostatus* (? *non* Kilian and Reboul) or *M. suturalis*, the ribbing is finer than in the present form, the constrictions are less deep and the umbilical tubercles are much fainter.

Locality and Horizon: Lachman Crags, South (C.41342, C.41383). The second was associated with *Hoploscaphites quiriquinensis.* A fragmentary impression (C.41901) of a form of *Maorites* comparable to *M. suturalis* (or possibly *M. densicostatus*) came from an isolated locality (Persson Island), west of James Ross Island.

Maorites (?) sp. juv. ind.

Plate VIII, figs. 9–10

The two young examples figured in Plate VIII, figs. 9–10 were found on Snow Hill Island, associated with half a dozen fragments and impressions of forms of *Gunnarites* of the general aspect of the specimen figured by Kilian and Reboul (1909, p. 28, pl. xv, fig. 1) as *Kossmaticeras (Madrasites) theobaldianum* (Stoliczka) var. *snowhillensis.* Some of the fragments, however, may belong to *Gunnarites antarcticus* and the original of the var. *monilis* of that species, described below, p. 31) was one of them. Since the two examples here figured show crenelation of the ribbing, they were also taken to be young *Gunnarites*, in spite of their lateral compression and the fine sigmoidal ribbing which seemed to agree with that found in *Kossmaticeras theobaldianum* rather than that of the forms of *Gunnarites* here described.

The larger and only slightly crushed example (fig. 9) has a few low, umbilical tubercles on the inner whorl, and they are not prominent even on the outer whorl, which includes already part of the body-chamber. The ribbing, moreover, is more irregular than in young *Gunnarites*, like the immature *G. bhavaniformis* figured in Plate VIII, fig. 6; and the constrictions are not very oblique, and almost parallel with the costation. In the second example (fig. 10) the whorl section is less compressed and the tuberculation is more distinct, so that at a larger size it may have been more like some of the slenderer forms of *Gunnarites* here described. There is decided resemblance to the young *Jacobites* figured by Kilian and Reboul (pl. viii, fig. 5) from the same locality; except that both the young examples now discussed are distinctly crenelate.

There is, of course, no evidence that the immature form here figured has anything to do with Kilian and Reboul's large fragment, simply because this also was stated to show resemblance to Stoliczka's *Amm. theobaldianus.* My intention to record the Snow Hill form as a species distinct from the other forms of *Gunnarites* here described was, however, shaken by the receipt, at a much later date, of a well-preserved though young example, which is a young *Maorites* (Plate XI, fig. 6). Unlike the two Snow Hill examples, it is not crenelate but it also has already part of the body-chamber; and the suture-line of the septate portion is similar in all, resembling that of *Kossmaticeras buddhaïcum*, Kossmat sp. (1897, pl. viii, fig. 3 c.). There are seven constrictions on the outer whorl, as in the original of Plate VIII, fig. 9, but the ribs in between are somewhat coarser than in the more involute young *Maorites* represented in Plate VII, fig. 6. In spite of its small size (18 mm.) and its resemblance to the young *Jacobites*, figured by Kilian and Reboul, this third example is now considered identical with the crenelate original of Plate VII, fig. 9, but the name "*Maorites* (?) sp. juv. ind." will have to remain tentative.

One of the indeterminable impressions from SW. of Cape Lachman, James Ross Island, already referred to (p. 3), preserved in an intensely green, glauconitic matrix, may possibly belong to a Kossmaticeratid like that figured by Kilian and Reboul as the var. *snowhillensis.* In its costation this impression is an even better match of the typical *K. theobaldianum* than Kilian and Reboul's fragment, but similarly bifurcating ribs are, of course, found in many other ammonites, including Jurassic Perisphinctids. The example was associated with another indeterminable impression which, in the differentiation of its ribbing into longer primaries and shorter secondaries is quite unlike any Kossmaticeratid. This, of course, may be due simply to its execrable state of preservation.

Locality and Horizon: Snow Hill Island (C.41351–2) with *Gunnarites antarcticus*. Lachman Crags, South (C.41494). The two indeterminable impressions are from SW. of Cape Lachman, James Ross Island (C.41478–9). The Snow Hill fauna also includes two specimens of *G. kalika*.

Genus *Jacobites*, Kilian and Reboul, 1909

Jacobites crofti, sp. nov.

Plate IV, figs. 2, 3

Diagnosis: Discoidal, finely ribbed Kossmaticeratid, like *Maorites* to a diameter of about 50 mm. Then periodic tubercles develop along the siphonal line, later also on the ventro-lateral shoulders, as in typical *Jacobites*. Five or six oblique constrictions to the whorl. Ribbing almost straight on the flat sides, except for a slight lateral convexity forwards, continuous across the narrowly arched periphery. With the appearance of ventral tuberculation the costae become somewhat coarser and rather irregular. Suture-line very complex, with asymmetrically trifid first lateral lobe, deeper than the external lobe, and with the external saddle more slender-stemmed than in the *Jacobites* suture-lines figured in Marshall (1926, pl. 21, figs. 1–3).

The dimensions of the holotype are as follows:

Diameter	65 mm.
Height of the last whorl	45% of diameter
Thickness of last whorl	26% of diameter
Width of the umbilicus	29% of diameter

Remarks: The holotype is entirely septate, so it is probable that the ornamentation of the body-chamber became increasingly coarser and more tuberculate, as in *J. anderssoni*, Kilian and Reboul, one variety of which (pl. vii, fig. 2) retained the *Maorites* inner whorls to a diameter of about 40 mm. The innermost whorls are figured separately (fig. 2 *d*, enlarged ×2) to show the initial smoothness and rounded whorl-shape. There is only one faint constriction and neither umbilical tubercles nor lateral ribs are as yet developed. But even at later stages the costation is always much finer than in *Kossmaticeras buddhaicum* (Kossmat), with which Kilian and Reboul compared the young *Jacobites anderssoni*. The whorl-sides are also much more flattened, the umbilical tubercles soon disappear and the umbilical slope becomes low and rounded.

Of the New Zealand species of *Jacobites* described by Marshall (1926), only *J. whangaroaensis* (p. 170, pl. 37, figs. 1–2) might perhaps be thought to be comparable to the present form, but it is not only more inflated, but develops umbilical tubercles on the outer whorl, instead of losing them.

There is a second example in the collection which shows perfect agreement with the holotype at earlier stages, that is to a diameter of about 35 mm. Later the whorls become increasingly broader (Plate IV, fig. 3) so that at 66 mm. the whorl-thickness was about 30%. Unfortunately the example is worn, the venter of the outer whorl (after 35 mm. diameter) being completely weathered away; and the only means of distinguishing this example from the young of *Maorites seymourianus* is destroyed. The suture-line with its strongly dependent auxiliaries is similar in the two genera and does not help in identifying this doubtful specimen.

Localities and Horizon: James Ross Island, Dagger Peak (C.41355) and "North of Cape Gage" (C.41356). Beds with *Gunnarites antarcticus*.

Genus *Neograhamites*, gen. nov.

Neograhamites kiliani, sp. nov.

Plate IV, figs. 4, 5

1909. *Grahamites skidegatensis* (*non* Whiteaves) Kilian and Reboul, p. 39, pl. xviii, fig. 3

The two examples here figured are believed to belong to the same form as that cited above, their somewhat different appearance being due to the imperfect preservation of Kilian and Reboul's original, which does not show the inner whorls. The larger example (fig. 4) is taken as the holotype of the new species and its dimensions compare as follows with those of the paratype and Kilian and Reboul's example:

	Diameter	Height	Thickness	Umbilicus
Plate IV, fig. 4 (holotype)	62 mm.	35%	32%	44%
Plate IV, fig. 5 (paratype)	50 mm.	37%	34%	43%
Kilian and Reboul, pl. xviii, fig. 3	54 mm.	34%	31%	45%

The differences are believed to be due mainly to the fact that the body-chambers of all the three examples are worn. In the holotype the body-chamber occupied over two-thirds of the outer whorl, but is still incomplete; in the paratype the whole of what is left of the outer whorl is body-chamber, showing the last septal surface.

The inner whorls are smooth, with four constrictions per whorl, to a diameter of 20 mm. when the first umbilical tubercle appears. After that, fine ribs are developed, at first irregular but fairly closely spaced; later they become more prominent and there are about four to each inner tubercle, of which there are twelve to the whorl. Deep constrictions, with a blunt ridge behind and a sharp costa in front, cut obliquely across the ornamentation, and are projected forwards on the periphery, whereas the ordinary ribs are obsolescent on the venter. The bifurcation mentioned by Kilian and Reboul only appears after 40 mm. diameter, but the ribs tend to become irregular and finally break up altogether, producing single ribs continuous across the venter. The ribbing appears to be very irregular chiefly on account of the oblique constrictions. The whorl-section is circular at first, but later becomes compressed, with the greatest thickness at the umbilical tubercle.

The suture-line is very complex, with a deep, trifid, first lateral lobe, slender lateral saddles and three more auxiliaries, dependent towards the umbilicus. The suture-line is not visible in the paratype which differs from the holotype chiefly in retaining the ribbing across the periphery of the inner whorls (fig. 5 *b*). They agree in having the constrictions preceded by bulges that are thickened on the periphery, as in *Brahmaites*, whereas the ribs succeeding the constrictions are most prominent on the inner whorl-side. Later, these ribs become less conspicuous and more uniform, whereas the bulges in front of the constrictions are thickened also on the sides and even develop an umbilical tubercle, as in Forbes's holotype of *Brahmaites brahma*. I may add that Kossmat's example (1897, pl. viii, fig. 7) has almost as little resemblance to the type as this has to *B. vishnu* (Forbes) so that Yabe and Shimizu's (1924) subdivision of *Brahmaites* into three sub-genera is based on altogether insufficient evidence.

Locality and Horizon: Humps Islet (C.41366 and 41365). *Pseudokossmaticeras pacificum* (Stoliczka) and *Brahmaites haugi* (Seunes), already referred to as comparable to *Neograhamites*, have been recorded from the Maestrichtian of Madagascar (Collignon, 1938).

Neograhamites taylori, sp. nov.

Plate IV, fig. 6; Plate XI, fig. 5

Diagnosis: *Neograhamites*, like *N. kiliani*, described above, but with smaller umbilicus, higher and flatter whorl-sides and umbilical tubercles (eight to the whorl) quickly becoming unusually prominent. Deep sigmoidal constrictions, bordered by two raised ribs. Suture-line complex, of general plan of that of other Kossmaticeratids.

Dimensions:	Diameter	Height	Thickness	Umbilicus
Holotype (Plate XI, fig. 5)	32 mm.	42%	40%	31%

Remarks: The holotype of this species is only a flattened and more involute edition of the species described above as *N. kiliani*, but the aspect is very different, the umbilical nodes of the body-chamber being very prominent. There are two features in which the present form shows some resemblance to *Kossmaticeras karapodense*, Kossmat sp. (1897, p. 41, pl. viii, figs. 2 and 4), namely, the beginning compression of the whorl sides, with a smooth zone between the umbilical tubercles and the ribs; also a slight weakening of the costation on the venter, which, however, tends to become more pronounced on the body-chamber, though the ventral interruption of the ribbing persists in the fragment figured in Plate IV, fig. 6.

The latter was broken out of the matrix of a specimen of *Gunnarites pachys* and includes part of the body-chamber as well as remains of two earlier whorls of a shell about 35 mm. in diameter. The whorl section is first rounded and then oval as in the holotype, with the greatest thickness at the umbilical nodes which, however, are less prominent. The inner whorls are also rather smoother, with constrictions, as in the form above described as *N. kiliani*. The body-chamber shows the adult characters of that species already at a much smaller diameter. The single constriction preserved forms an acute angle on the periphery and the ribs are slightly weakened in the median line. There is a "normal line" on the venter of the earlier half of the body-chamber (not seen in the photograph), simulating a siphuncle. This second fragment may well belong to yet a different species of *Neograhamites*, but it is obviously closely allied to both *N. taylori* and *Kossmaticeras karapodense*, Kossmat sp. with which it agrees in the course of the oblique constrictions and (in the case of Kossmat's large example) in the reclined ribs, though not the lateral flattening. Kilian and Reboul (1909, p. 30) recorded Kossmat's species from Snow Hill Island, but in the absence of a figure or description, it is impossible to say whether their form has anything to do with the examples here described.

Locality and Horizon: Lachman Crags, South (C.41495) together with *Gunnarites rotundus*, etc. Humps Islet (C.41367) together with the last species and *G. pachys*.

Genus *Grossouvrites*, Kilian and Reboul, 1909

Grossouvrites gemmatus (Huppé)

Plate V, fig. 1

1925. *Grossouvrites gemmatus* (Huppé) in Gay; Diener, Catalogus, p. 100

The example here figured consists largely of the body-chamber which occupied three-quarters of the outer whorl. It was complete to the aperture, marked by a smooth, constricted band that is bordered anteriorly by a very prominent ridge. There are twenty tubercles on the outer whorl and fifty ribs on the periphery of its latter half, so that there are about five ribs to each tubercle, two or three long and the others intercalated. The tubercles surround a high and vertical, umbilical wall.

On the septate part the ribs are fine and, where the test is preserved, of the characteristic, filiform type. The internal cast is almost smooth, except for the umbilical tubercles. The suture-line is extremely complex (fig. 1 *b*) and apparently differs little from that of Steinmann's Quiriquina example (1895, p. 72, text-fig. 3, pl. vi, fig. 1) except that the saddles are still more finely subdivided.

The present example is slightly crushed and seems to have a much more open umbilicus than the Chilian specimen just cited. This is due entirely to the opening out of the umbilicus on the last half whorl. The innermost whorls are missing, but from what is left of the septate part of the ammonite it can be seen that the umbilicus in the earlier stages was comparatively narrow. It may not have been quite as narrow as in Steinmann's original or in the small New Zealand example figured by Trechmann (1917, p. 338, pl. xxi, fig. 6) and referred to by the writer in 1921 (p. 300); but judging by the Seymour Island examples figured by Kilian and Reboul in their pl. xvii, this reputedly common species is quite typical in the young (their figs. 2–3), while the large example (fig. 1), excentrumbilicate, like the present specimen, may be very slightly more coarsely ribbed.

The New Zealand form described by Marshall (1926, p. 189, pl. 38, figs. 5–6) as *Nowakites denticulatus* but later (1927) transferred to *Grossouvrites*, is not so close to the present species as its author thought. The crenelation of its ribbing shows it to be a *Gunnarites* and the ammonite was indeed labelled *Gunnarites* on the plate (? by mistake), but it is not identical with any Antarctic ammonite before me.

Locality and Horizon: Cape Bodman, on Seymour Island (C.41357). Apart from the figured example there is the worn umbilical cast of another large specimen (C.41905) and three doubtful casts of air-chambers (C.41850, 41852).

Genus *Gunnarites*, Kilian and Reboul, 1909

Gunnarites antarcticus (Stuart Weller)

Plate III, fig. 5; Plate IV, fig. 9; Plate VI, figs. 1–5; Plate VII, fig. 1; Plate VIII, fig. 8; Plate XI, fig. 1

1925. *Gunnarites antarcticus* (Stuart Weller), Diener; Catalogus, p. 101

There is a wealth of material of this species, yet as in all highly ornamented ammonites, there are scarcely two individuals exactly alike, and it is almost impossible to find a perfect match of the holotype. Kilian and Reboul interpreted the species rather comprehensively or loosely, and it is necessary to go back to Stuart Weller's original description and figures for a more definite reconstruction of the typical form.

It is seen that in the holotype, at a diameter of 68 mm, there are about sixty ribs on the outer whorl. Their arrangement is considered of only secondary importance, because they are always irregular. In the small example figured in Plate VI, fig. 2, there are five constrictions on the outer whorl and the number of ribs between them varies from fourteen, fourteen, and nine to ten, making a total of sixty-one ribs, including the six between the beginning of the outer whorl and the first constriction, and the eight succeeding the last constriction. In each case the rib immediately preceding a constriction bifurcates, as a rule on the periphery, but the last bifurcating rib, already on the body-chamber, splits up lower down on the whorl-side.

The tubercles between the constrictions number, first three and three, then two and two; again adding those before the first and after the last constriction there are, altogether, thirteen tubercles on the outer whorl but only ten on the next two inner whorls. In the holotype there seem to be more, but as will be seen from the larger example figured in Plate IV, fig. 9, the tubercles cannot always be counted with precision as they are apt to be very irregular in size and spacing. This second example, at 85 mm. diameter, has a whorl-height of 44 %, the same as the type, but it is slightly more inflated, the thickness being 36 %, instead of the usual 33–35 %, or 30 %, as in the [poorly preserved] holotype. The tubercles in this larger specimen are fourteen on the outer whorl; and though Kilian and Reboul gave the number of tubercles as ten to twelve, one example in the collections at Grenoble, of which the British Museum has a cast (No. C.23235) shows eighteen tubercles at a diameter of over 170 mm.

The largest example here figured (C.41497 = Plate XI, fig. 1) is an internal cast with the crenelation of the ribbing scarcely recognisable and it has the following dimensions:

Diameter:	Whorl-height	Whorl-thickness	Umbilicus
158 mm.	45 %	40 %	30 %

The increase in whorl-thickness, as compared with the immature type (30 % at 68 mm. diameter) is merely due to the larger size and is found in all the fully grown individuals. At the same time, the width of the umbilicus is reduced from the usual 33–35 % to only 30 %, but in some more involute individuals, the width of the umbilicus is not more than 30 % already in the young, e.g. in specimen No. C.41484, indistinguishable from the original of Plate IV, fig. 9, at 85 mm. diameter. The large example has just over half a whorl of body-chamber, but the aperture is not intact. The lateral curvature of the ribs in this specimen increases towards the end, but in other examples (e.g. C.41496) the edge of the peristome is almost straight, laterally, and there is only a small peripheral rostrum.

As already mentioned, there are many examples varying in details of dimensions, whorl-shape and especially ornamentation, not to mention the suture-line which cannot always be exposed. It is highly complex and therefore, as might be expected, very variable in detail, though the general plan is the same. The suture-line of the holotype was not figured and Kilian and Reboul did not make up the deficiency; in fact, there is not a single original suture-line, except those that appeared in their rather crude plates.

The varieties recognised by Kilian and Reboul were not well characterised and are not easy to separate from the type. In a large and variable species like *G. antarcticus*, of course, all kinds of transitions are to be expected between the typical form and the different varieties; and the more abundant the material the more it becomes necessary to designate one example as the type of a given variety. The var. *nordenskjöldi* of *G. antarcticus* was described by Kilian and Reboul as having "more circular whorls" than the type; but all the specimens figured by these authors are small (maximum diameter 50 mm.). Again, "tardy appearance of crenelation" does not appear to be a satisfactory character to distinguish this variety. In the example figured in Plate VI, fig. 5, the typical crenelation is developed already at about 20 mm. diameter, whereas the even larger example of *G. antarcticus* figured in Plate IV, fig. 9, is a smooth internal cast and might pass as uncrenelate, if found by itself. It is still more difficult to see how the var. *nordenskjöldi* can be "extremely close to *G. gunnari*", a species put by Kilian and Reboul into a different sub-genus ("*Madrasites*"), and compared to the very distinctive *Kossmaticeras karapadense* (Kossmat). These forms, in fact, are characterised by their lateral compression; conversely, the var. *nordenskjöldi* was said to have a less elevated whorl-section than the typical *G. antarcticus*.

The varietal name *nordenskjöldi* could thus be applied to examples like that figured in Plate III, fig. 5, which differ from other *G. antarcticus* merely in being more evolute, while also developing a more circular whorl section. But these may not be distinguishable from similar young of the var. *inflata*, Kilian and

Reboul. This variety, like the var. *nordenskjöldi*, was raised to specific rank by Marshall, but I can see no real resemblance between the New Zealand examples figured by that author (1926) and the Antarctic originals. In spite of Kilian's own identification, the small specimen of "*G. nordenskjöldi*" (Marshall's pl. 36, fig. 6) was recognised as different by Marshall himself; it is an indeterminable nucleus with a small umbilicus and few tubercles and may have nothing to do with *G. antarcticus*. For that species itself seems to have been misidentified. Marshall's small example (pl. 39, fig. 3), judging by the measurements (diameter =22 mm.), is considerably magnified ($\times 2\frac{1}{2}$) and at best a doubtful young *Gunnarites*; in any case the whorl-section (fig. 4) is much too quadrate for the typical *G. antarcticus*. The New Zealand "var. *inflata*" (Marshall's pl. 40, figs. 1–2), also identified by Kilian, has not only a whorl-section that is still higher than wide but is far more distantly ribbed than the Antarctic examples. It is probably a new local species though there is a certain resemblance to the var. *monilis*, described below.

I take this opportunity of figuring (Plate IX, fig. 6) a young example of what I believe to be Marshall's *G. inflatus*? (*non* Kilian and Reboul), which shows that ribbing and crenelation are much coarser than in the young of *G. antarcticus* or its var. *inflata*. In the absence of large examples of this form it would be rash to rename it; and the only other *Gunnarites* from New Zealand before me are new forms of the group of *G. zelandicus*, Marshall, from a new locality in the southern part of the South Island, sent by Prof. W. N. Benson. They are quite different from the Antarctic forms and show unusually strong peripheral projection of the ribbing.

Kilian and Reboul's original var. *inflata* was illustrated by an example (pl. ix, pl. x, fig. 1) which has a whorl-thickness of 45% as against 30% in the much smaller type of *G. antarcticus*. But another individual assigned to the same variety (pl. xi, fig. 1, pl. xvi, fig. 1) is a more densely ribbed form. Neither of these examples shows the slightly more flexuous ribbing which was stated to be characteristic of the var. *inflata* and it is probable that this variety was made to include still other forms, not figured, because they happened to have inflated outer whorls. I can see no objection to taking increased whorl-thickness as the distinguishing feature of the var. *inflata*, so long as the individuals do not differ too much from the typical form in ornamentation or other characters; but I consider it best to take Kilian and Reboul's second example (pl. xi, fig. 1, pl. xvi, fig. 1) as representing the var. *inflata*. The first specimen (Kilian and Reboul's pl. ix), it may be noted, was described by these authors (on. p. 33) as the typical *G. antarcticus*, but its outer whorl is less closely ribbed, as already mentioned. I would also include in the var. *inflata* the original of Plate VII, fig. 1, which is a typical *G. antarcticus*, except that its whorl-thickness is 42% of the diameter.

The examples figured by Kilian and Reboul in pl. viii, fig. 1; pl. x, fig. 2 (cast in B.M. No. C.23238), pl. xi, figs. 3 a, b, are more distantly ribbed than Stuart Weller's holotype, and generally have more conspicuous crenelation. In the unique Snow Hill Island specimen figured in Plate VI, fig. 3, this crenelation is very striking, even on the internal cast, and there are only twenty ribs to the half-whorl, instead of the typical thirty. It appeared probable that this form was a mutation of the crenelate variations of *G. antarcticus* tending to develop single ribs, but it was associated with fragments of that species, as was a second example (4865) from the Naze. There is thus no evidence in favour of a different date and I am also considering this form as a new var. **monilis** of *G. antarcticus*. The unusual prominence of the lateral tubercles is another characteristic feature of this variety.

The var. *bhavaniformis* of Kilian and Reboul is here taken to represent a separate species of *Gunnarites*, although it is connected by transitions with the typical *G. antarcticus* as well as with *G. gunnari*. One such transition is the original of Plate VIII, fig. 1, which does not differ much from the inner whorls of the typical example of *G. antarcticus* figured in Plate VI, fig. 2, yet has the more finely ribbed earlier volutions of *G. gunnari*. It begins to change its ribbing, from the comparatively coarse *antarcticus* to the more graceful *bhavaniformis* type at about 55 mm. diameter; in other examples the change occurs already at 45 mm. (e.g. No. 4845) but the outer whorl is not flattened enough for these transitions to be included in *G. bhavaniformis*. The type of this "variety" is the original of Kilian and Reboul's pl. xv, fig. 2 (cast in B.M. No. C.23239) and the still earlier change to the fine bhavaniform costation and the more flattened whorls indicate that *G. bhavaniformis* is also connected by intermediaries with *G. kalika* (Stoliczka).

Finally, there is an evolute variety (Plate III, fig. 5) which has an umbilicus of 40% of the diameter; it is not now given a varietal name because one example of Kilian and Reboul's var. *nordenskjöldi* (pl. xii, fig. 4) is equally evolute and differs merely in having a more rounded whorl-section. On account of its greater compression, this evolute variety may also be considered a passage-form to *G. gunnari*; but though the whorl-thickness is only 33% (at 46 mm. diameter), there is no lateral flattening and no resemblance to

Kossmaticeras karapadense (Kossmat), the chief characteristic of *G. gunnari.* The evolute variety has its counterpart in certain involute specimens (e.g. C.41484) in which the umbilicus is reduced to 30%, instead of the usual 33–35% of the diameter. There are still other varieties, in characters not so obvious and not yet discussed, but short of naming separately almost every individual, allowance will have to be made for very considerable variation within the large species, *G. antarcticus.*

Localities and Horizon: James Ross Island (The Naze, Dagger Peak, and "North of Cape Gage", about sixty-five specimens); Cockburn Island (1); Snow Hill Island (3?). Associated with *Diplomoceras lambi*, apart from a single specimen each of *Neophylloceras* and *Gaudryceras.*

Gunnarites bhavaniformis (Kilian and Reboul)

Plate VIII, figs. 1–7

1909. *Gunnarites antarcticus* (Stuart Weller) var. *bhavaniformis*, Kilian and Reboul, p. 33, pl. xv, fig. 2

This form, now raised to specific rank, connects directly with the typical *G. antarcticus*, and is separated only because the latter species is already rather comprehensive. The typical example of *G. bhavaniformis* is the original of Kilian and Reboul's pl. xv, fig. 2, which is embedded in a nodule, judging by a plaster cast in the B.M. (No. C.23239). It seems to have coarse ribbing, or at least rather distant ribs, at the beginning of the outer whorl and this is not merely a local irregularity. As can be seen in the typical examples represented in Plate VIII, figs. 1 and 5, this species develops a comparatively coarse stage for a time, following on the rather elegant, finely ribbed inner whorls (fig. 6). At a later stage or at least on the body-chamber there is a return to finer ribbing, producing a certain resemblance to *G. kalika.* But the general breaking down of the costation towards the aperture is common to all the forms of *Gunnarites* and is not considered of special significance. The flat whorl-sides, however, and the rather closely spaced ribbing are the characteristic features and suggested the varietal name to Kilian and Reboul. It will be noted that on the whole, the development of the ornamentation in *G. bhavaniformis* is from fine to coarse and back to fine again. In the small type of *G. gunnari*, on the other hand, the ribbing becomes increasingly more widely spaced.

The typical example represented in Plate VIII, fig. 5 shows inner whorls identical with the original of fig. 6 (enlarged $\times 2$ in figs. 6 c, d) which well displays the suture-line. The test was partly removed, but portions remain, showing the nacreous lustre and it can be seen that the ribbing was beautifully crenelate already at 15 mm. diameter. In *G. antarcticus*, at the same size, both tubercles and ribs are much coarser, as comparison with the inner whorls of Plate VI, fig. 5 a will show. The tubercles being less numerous and larger seem to be nearer the middle of the side, and there are only about three or four ribs to each tubercle, instead of five, as in *G. bhavaniformis.*

The slender inner whorls reproduced in fig. 7 (enlarged $\times 2$ in c, d) are perhaps too small to be referable to *G. bhavaniformis* with certainty. They have fewer tubercles in the early, smooth and constricted stage and thus resemble the inner whorls of *Neograhamites kiliani* (Plate IV, fig. 4), if only temporarily. Tuberculation, however, in the early stages of all these Kossmaticeratids is extremely variable, whether combined with slender or depressed whorls; and since it probably arose caenogenetically (in a Puzosid root-stock) it has no palingenetic significance.

The original of Plate VIII, fig. 2, is more compressed than the typical examples; it is also more finely ribbed and the whorls are laterally flattened already in the septate stage. Such more compressed types lead to the still more finely ribbed examples figured in Plate VIII, figs. 3a, b and 4 a, b which are already passage forms to *G. kalika.* It is only the rather blunt ribbing of the body-chamber that distinguishes these forms from the elegant Indian species. *G. bhavaniformis*, in fact, could be held to be intermediate between *G. antarcticus* and *G. kalika* rather than between *G. antarcticus* and *Amm. bhavani*, Stoliczka, as Kilian and Reboul thought, the latter having no umbilical tubercles.

Connected with the *kalika*-like forms just discussed by various intermediaries is another variety of the present species, represented by the examples figured in Plate V, figs. 2–3. They have the more sigmoidal ribbing of *G. kalika*, but their inner whorls are at least as tuberculate as those of the typical *G. bhavaniformis.* This variety differs from *G. antarcticus* or *G. rotundus* by its lateral compression and the flexiradiate costation is distinct already at an early stage. There is, as usual, great variation in the spacing of the ribbing. In one example of this variety (No. C.41475), otherwise indistinguishable from the original of Plate V, fig. 3, the ribbing between 35 and 45 mm. diameter is as coarse as in *G. antarcticus*, but only for half a whorl (which includes part of the body-chamber).

This variety may be named var. **vegaensis,** nov. (type to be the example figured in Plate V, fig. 3); but apart from the transitions to *G. kalika* (Plate VIII, figs. 3–4) there are passage forms even to the var. *kalikaformis* of *G. rotundus* (Plate XII, fig. 3). The identification of fragmentary specimens of these forms of *Gunnarites* may become rather difficult and unfortunately it is unknown at present if they have any stratigraphical significance; but it may be remembered that it is chiefly the presence of strong tuberculation on the earlier whorls that suggested to Kilian and Reboul inclusion of the present species in *G. antarcticus.*

Localities and Horizon: James Ross Island (The Naze and Dagger Peak, twenty-eight specimens); Vega Island (False Island Point, C.41362).

Gunnarites gunnari (Kilian and Reboul)

Plate V, figs. 4, 5

1925. *Kossmaticeras gunnari,* Kilian and Reboul sp.; Diener, Catalogus, p. 98

This species seems to be based on two young examples of 48 and 39 mm. diameter respectively, the former having a whorl-thickness of 35 % and the latter 31 %. The smaller example was figured (Kilian and Reboul's pl. xi, fig. 1) and there is a cast of it in the B.M. (No. C.23245). It differs from the young *G. antarcticus* in being slightly more evolute and decidedly more compressed laterally, notwithstanding the measurements. This presumably was the reason (in addition to the absence of crenelation of the ribs) for including *G. gunnari* in "*Madrasites*", i.e. *Kossmaticeras s.s.*, and for comparing it with *K. karapadense*, Kossmat sp. (1897, pl. viii, figs. 2 and 4), a species distinguished by a slightly different whorl-section and ribs effaced on the whorl-side. The species was also described as "*assez rare*", and the only other example figured but not referred to in the text is a very indifferently preserved Kossmaticeratid, possibly a *Gunnarites* of the *antarcticus* type, but with a larger umbilicus (about 38 % of the diameter, instead of 33–35 % as in the typical *G. antarcticus*). It has obviously no resemblance to *Kossmaticeras karapadense* and the "series of examples" is reduced to the two young specimens above referred to. The passage about the tendency "in certain examples" to develop crenelation of the ribs suggested a more representative collection.

There are two young specimens in the present collection (Plate V, figs. 4–5) that could be compared to *G. gunnari*, as just defined, but they are slightly less evolute. They represent the inner whorls (of diameters of 25 and 37 mm. respectively) of a form which has the more finely ribbed early stage of the forms of the group of *G. kalika* (Stoliczka), especially the transitions between that species and *G. bhavaniformis* here figured (Plate VIII, figs. 3–4), combined with an increasingly coarse costation on the outer whorl. That is to say it develops into a compressed young *G. antarcticus* after about 25 mm. diameter, and the absence of crenelation of the ribs (in one example ?) is purely accidental.

There is nothing to connect these young examples with any larger ammonite in the present collection and they might well have been considered to be variations of the common *G. antarcticus* which, after the very variable early stage, developed more flattened whorls than their congeners, just as others were more inflated. The name *gunnari*, however, is in existence and the large example figured by Kilian and Reboul may reveal more concerning the later stages of this species than the poor figure suggests. I am thus retaining Kilian and Reboul's name for the forms here figured, for they are at least as close to *G. bhavaniformis* (Plate VIII, fig. 2) as to *G. antarcticus*, and also differ from the transitions between *G. kalika* and *G. bhavaniformis* (Plate VIII, figs. 3–4) mainly in the coarseness of their ribbing.

Locality and Horizon: James Ross Island, Dagger Peak (C.41368, C.41372). Beds with *Gunnarites antarcticus.*

Gunnarites kalika (Stoliczka)

Plate X, figs. 1–6

1925. *Gunnarites kalika* (Stoliczka); Diener, Catalogus, p. 101

This species is easily recognised, and while there is no reason to doubt the identity of the numerous Ross Island examples in the present collection with the Indian holotype, Kilian and Reboul's unique and fragmentary specimen does not show much affinity with the Antarctic examples here figured or with the Indian holotype. As in the latter, the graceful, crenelate costation is interrupted by about five more or less distinct, oblique constrictions, more pronounced on the internal cast than on the test; and there is agreement in all the other characters.

The dimensions of the two largest examples, figured in Plate X, figs. 1–2, compare as follows with those of Stoliczka's unique holotype:

	Diameter	Height	Thickness	Umbilicus
Plate X, fig. 1	60 mm.	45%	35%	25%
Plate X, fig. 2	72 mm.	45%	35%	26%
Stoliczka, pl. lxx, f. 5	50 mm.	42%	32%	28%

The inner whorls of Stoliczka's original are poorly preserved or badly drawn, so I am figuring an immature example (fig. 6) natural size and enlarged ×2, to show the details of ornamentation of an average individual; but there is again considerable variation in the young. The suture-line, unknown to Stoliczka, is visible in the originals of figs. 2 and 3, and does not differ greatly in plan from that of *Maorites aemilianus*, Stoliczka sp. (1865, pl. lxx, fig. 8), but it is more complex, with more interpenetrating elements, a more symmetrical external lobe with a more parallel-sided median saddle and a less deep first lateral lobe, barely longer than the external lobe.

The small example figured in Plate X, fig. 5, is a micromorph offshoot of *G. kalika* that develops a strongly flexiradiate body-chamber already at a small diameter. It will be seen that the striation becomes irregular and degenerate towards the end of the body-chamber which is three-quarters of a whorl in length. This example may be separated as a var. **nana,** nov., but it is connected with the typical examples by intermediaries.

In the larger form figured in Plate X, fig. 4, the ribs are flexuous already in the young and finely striate, whereas on the outer whorl they return to the regular *kalika*-style of rather coarsely crenelate costation. This variety (var. **gracilis,** nov.) is transitional to the form described below as *G. flexuosus*, sp. nov. On comparing the figures of the var. *gracilis* and the typical form (Plate X, figs. 2 and 3) the former might be thought to deserve specific separation, but there are various transitions between them (e.g. No. 5249, etc.). Another example (fig. 6) seems to lack crenelations, but that is due to the body-chamber (three fifths of the outer whorl) being an internal cast. On the other hand this individual has a broader and flatter periphery than the more typical examples or Stoliczka's type. Yet it is not considered worthy even of a varietal name.

The largest of all the examples discussed, namely No. 2 in the above table of measurements (Plate X, fig. 2) includes a quarter of a whorl of body-chamber and is the only example that might be compared to the badly preserved fragment figured by Kilian and Reboul (pl. xiii, fig. 3). It does not seem that the reference of this execrable specimen to Stoliczka's species was at all apt. The ribbing is far too coarse and the astonishing reference to the Madagascan *Kossmaticeras theobaldianum* (Stoliczka) figured by Boule, Lemoine and Thévenin (1907, p. 26, pl. vii, figs. 2–3) indicates that Kilian and Reboul's interpretation of the elegant Indian species must have been wide of the mark.

Localities and Horizon: James Ross Island (The Naze and Dagger Peak, twenty specimens; Lachman Crags, South, C.41377); Humps Islet (C.41859, C.41375); Snow Hill Island (C.41854, C.41858). It will be seen that three of the twenty-five specimens are not associated with the *G. antarcticus* fauna.

Gunnarites pachys, sp. nov.

Plate IX, figs. 1–3

Diagnosis: *Gunnarites* with general resemblance to *G. antarcticus*, especially the var. *inflata*, but with more graceful, decidedly flexiradiate ribbing, projected forwards on the periphery from an early stage and not only near the aperture. Increase in whorl-thickness more rapid than in the other species of *Gunnarites*. Suture-line complex ; on same general plan as that of *G. antarcticus*, with second lateral saddle in the position of the umbilical tubercle and the oblique auxiliaries on the steep but not vertical umbilical slope.

	Diameter	Height	Thickness	Umbilicus
Plate IX, fig. 1 (Holotype)	63 mm.	39%	43%	35%
Plate IX, fig. 1 (Holotype)	121 mm.	40%	48%	32%

Remarks: I did not at first intend to separate this species from *G. antarcticus* with which it is probably connected by transitions, because fragmentary or otherwise defective examples may not be identifiable with accuracy. Kilian and Reboul also probably included specimens of the present form in their var. *inflata*, since they spoke of its costation being slightly more flexuous than that of the typical *G. antarcticus*. But taking all the differences into consideration, it seems that *G. pachys* requires specific separation from the varieties discussed under that large species.

The inner whorls are highly tuberculate and deeply constricted, like those of *G. antarcticus* (which later develops flattened whorls), but the whorl-height is less than the thickness already at 20 mm. diameter, i.e. earlier than in the var. *inflata* of that species. The peripheral sinus in the ribbing is also conspicuous already at a diameter at which, in the common *G. antarcticus* (see Plate VI, fig. 2) the costation passes across the venter without deviating from the straight. Even in the large example of the var. *inflata*, figured in Plate VII, fig. 1, in which the ribbing becomes slightly flexuous on the body-chamber, the ventral aspect shows no sign of a sinus in the costation.

The fragment figured in Plate IX, fig. 2, is still septate and the proportion of whorl-height to thickness is as 42–56. It is a more extreme variety, apparently of the present form, though in the absence of the earlier whorls this is perhaps not quite certain. Its inner whorls must have been increasing in whorl-thickness at a fairly rapid rate, more so than the young *G. rotundus* figured in Plate XII, fig. 2. On the other hand, the fragment under discussion is an internal cast and, even so, the ribbing is extremely robust. This suggests affinity with *G. pachys*, but not the other forms of *Gunnarites* here described.

The more slender original of Plate IX, fig. 3, could be held to be a transition from *G. antarcticus*, var. *inflata*, to the present species, at least in whorl-shape; but the ventral sinus in the ribbing shows that its affinities are with *G. pachys*. This example is less inflated than the holotype, the thickness being 44% at 88 mm. diameter; it is also slightly less closely ribbed. It is now considered to be a distinct variety, var. **media,** nov., because it includes already a portion of the body-chamber and is deemed unlikely to have increased in thickness sufficiently to equal the holotype. In a second example of this variety the innermost whorls are compressed and entirely different from those of any of the varieties of *G. antarcticus* or of any of the other forms here described. For while the inner whorls of *G. flexuosus*, for example, are also compressed and slender, those of the var. *media* are bluntly ribbed and untuberculate, almost as in *Kossmaticeras* s.s.

A third example of the var. *media*, fragmentary, but including part of the body-chamber of an individual about 140 or 150 mm. in diameter, has a whorl-thickness of 66 mm. and a height of 64 mm. at the end, so that in the adult there is little difference between the variety and the typical form. On the earlier whorls of the last example, the ribbing is slightly closer than that of the type of the variety; on the other hand, the umbilicus is smaller than in the holotype of *G. pachys*.

Locality and Horizon: Humps Islet (C.41380, C.41399, C.41398, C.41851, C.41470). Embedded in the body-chamber of the last specimen was found the example of *Neophylloceras hetonaiense*, described on p. 5.

Gunnarites flexuosus, sp. nov.

Plate III, figs. 3–4; Plate IX, figs. 4–5

Diagnosis: *Gunnarites* with comparatively fine, flexiradiate and highly crenelate ribbing from a very early stage. Bluntly tuberculate already at 3 mm. diameter; tubercles, becoming smaller and more closely spaced, move to edge of vertical umbilical wall (about sixteen to the whorl). They give rise to about five graceful, flexuous ribs, gradually reduced to four and then three to each tubercle. Occasional bifurcation of ribs, high up on the whorl-side, just before or just after a constriction. These constrictions are irregular and not so conspicuous as in *G. antarcticus*. Whorl-section compressed in young and adult, with flattened side but more rounded in the var. *transitoria*. Suture-line as in other *Gunnarites*.

	Diameter	Height	Thickness	Umbilicus
Plate III, fig. 3 (Holotype)	60 mm.	40%	35%	33%
Plate IX, fig. 5 (var. **transitoria**)	75 mm.	42%	40%	31%

Remarks: This species is closely related to *G. pachys*, sp. nov. and is connected with it by the var. *transitoria*, with a much less compressed whorl-section than the typical examples. The inner whorls, however, are always more finely ribbed in the present form than in *G. pachys*. Nevertheless, the very slender innermost whorls of the var. *media* of the latter species (Plate IX, fig. 3) may be said to foreshadow the compressed form now under discussion.

The example figured in Plate III, fig. 4, has the whorl-sides gently rounded, not flattened as in the holotype, and there is considerable resemblance to *G. kalika* (Stoliczka). The ornamentation on the whole, however, is finer and more uniform in the latter form, just as it is coarser and stiffer in *G. bhavaniformis* (Kilian and Reboul). That species, moreover, may develop flexuous ribbing near the aperture, as do even the still more strongly ornamented varieties of *G. antarcticus*. The peripheral projection of the ribbing, on the other hand, which is the characteristic feature of *G. flexuosus* and the more inflated *G. pachys* at quite small diameters, is not found in either *G. antarcticus* or *G. bhavaniformis*.

The inner whorls figured in Plate IX, figs. 4 a, b (enlarged ×4) belong to a specimen indistinguishable from the earlier part of the example just referred to (Plate III, figs. 4 a, b). They are entirely smooth, like the corresponding stage in some young *Maorites* and they show an unusually thick siphuncle, as does the young *Brahmaites brahma* (Forbes). The suture-line is rather simple, but has a deep external lobe already at 5 mm. diameter. This is reminiscent of the suture-line of *Maorites bhavani* (Stoliczka) of the Upper Trichinopoly Group, whereas in the adult *M. aemilianus*, Stoliczka sp. (1865, pl. lxx, fig. 8) the external lobe is much shorter than the first lateral lobe.

In the var. *transitoria* (Plate IX, fig. 5) the ribbing tends to become stronger and slightly more distantly spaced. Whereas the other examples above described are entirely septate, the typical example of the var. *transitoria* has already part of the body-chamber and it will be seen that the costation is much like that of the var. *media* of *G. pachys* which, however, is still considerably more inflated.

G. zelandicus, Marshall (1926, p. 161, pl. 39, figs. 1–2) could be held to be comparable to *G. flexuosus* and the whorl-section suggests a form somewhat intermediate between the type and the var. *transitoria*. But the flexiradiate ribbing seems to be confined to the anterior portion of the shell, as in *G. antarcticus* and the inner whorls may be rather different. In their absence, the New Zealand species cannot be accurately placed.

Locality and Horizon: Humps Islet (C.41395–97, C.41384, C.41817). Together with the *Neograhamites* fauna, but not *G. antarcticus*.

Gunnarites rotundus, sp. nov.

Plate XII, figs. 1–3

Diagnosis: *Gunnarites* (?) without the characteristic crenelation of the ribbing (the absence of which, however, may be due to the mode of preservation). Whorl-section depressed in the earlier stages, more rounded at about 50 mm. diameter, and compressed on the body-chamber. Oblique, comma-shaped primary ribs on the innermost whorls, gradually changing into tubercles (about ten to the whorl) and declining again on the outer whorl. Ribs at first very fine, five or more to each tubercle; later more distant (about three to each tubercle), with a few intercalated single ribs. Costae apparently septate, leaving internal cast almost smooth, where test has been removed. Oblique constrictions from a very early stage, cutting across costation. Ribs on outer whorl very irregular. Suture-line similar to that of *G. antarcticus* or *G. bhavaniformis* (Plate VIII, fig. 6).

	Diameter	Height	Thickness	Umbilicus
Plate XII, fig. 2	36 mm.	40%	45%	33%
Plate XII, fig. 1	at 42 mm.	40%	43%	34%
Plate XII, fig. 1	at 90 mm.	42%	33%	33%

Remarks: It was intended at first to include the present form as a variety in *G. antarcticus*, but considering the lack of crenelation of the ribbing, it could be held that the species may not even belong to the genus *Gunnarites*. In its rounded whorl-shape, the present form connects with the varieties *nordenskjöldi* and *inflata* of *G. antarcticus*; the resemblance, however, is only distant and both have a more open umbilicus. Both are also far less depressed in the young and the var. *inflata* especially has much more robust ornamentation on the inner whorls. What distinguishes the species now described from all the others, moreover, is the fact that the test, including the ribs, flakes off easily and exposes sometimes an almost smooth internal cast, especially on the venter, with only the blunt bosses of the tubercles at all prominent.

The large holotype example (figs. 1 a, b) has only a part of the body-chamber. It is broken off at the last septal surface, so that at least another third of a whorl is missing. The chambered portion is partly crushed and omitted in the figure, but the innermost whorls are represented separately in figs. 1 c, d, enlarged ×2, to show the suture-line. The second example (figs. 2 a–d) is entirely septate and is also figured again, enlarged ×2, to show not only the suture-line, but the peculiar test with its hollow ribs. A small third specimen (C.41402) has very inconspicuous tubercles, so that the whorl-thickness is almost as great at the middle of the side as at the umbilical tubercle. Its whorl-thickness at 13 mm. diameter is 53%. Like the inner whorls figured in fig. 1 c the periphery is still smooth and the fine ribs are confined to the test and the sides of the shell.

The example figured in Plate XII, fig. 3 has already been referred to (p. 33) on account of its resemblance to *G. bhavaniformis* or rather the transitions between that form and *G. antarcticus*. The inner whorls, however, are those of the typical *G. rotundus*, though, perhaps, less involute; and they are characterised by the prominence of the umbilical tubercles. The ribbing is comparable to that of the inner whorls of the holotype and not so closely spaced as that of the smaller example figured in Plate XII, fig. 2. On the other hand, the degeneration of the costation is far more evident than in the type of the present species so that a varietal name (var. **kalikaformis,** var. nov.) may be introduced for the original of Plate XII, fig. 3. In the true *G. kalika* the inner whorls are flattened and finely ribbed at an early stage, but certain transitions between that species and *G. bhavaniformis* (Plate V, fig. 2) are more comparable to the present variety.

A dozen additional examples received after completion of the plates prove that the present species is closely allied to *Maorites pseudobhavani* (p. 25) and there are, indeed, several transitions between the two forms. The absence of crenelation is not now considered sufficient to exclude the species under discussion from the genus *Gunnarites*, even if it were complete. But in at least one example there is a suggestion of crenelation of the ribbing, indistinct because the test is reduced to a chalky powder. There are also two fine additional examples of the var. *kalikaformis* and one example (C.41488) of a var. **compressa,** nov. in which the whorl-thickness is reduced to 38–40% at small diameters and to 32% in the adult (=94 mm.). The body-chamber shows the degenerate ornamentation of the holotype.

Locality and Horizon: Lachman Crags, South (thirteen specimens). Found together with *G. kalika*, but not *G. antarcticus*.

Gunnarites paucinodatus, sp. nov.

Plate VII, figs. 4 a–d

Diagnosis: *Gunnarites* with general resemblance to *G. rotundus* but unusually distantly costate inner whorls (eighteen ventral ribs to the half-whorl at 20 mm. diameter, twenty-one at 40 mm.). Whorl-section depressed, becoming compressed on body-chamber. Ribs simple or branching, with an occasional tubercle at edge of rounded umbilical slope. Ribs pass straight across the periphery, but are cut by oblique constrictions which have a pronounced ventral projection. Ribbing on body-chamber becoming very irregular. Suture-line very complex, but saddles of last few septal edges low and broad through simplification.

	Height	Thickness	Umbilicus
Holotype at 40 mm. diameter	35%	42%	32%
Holotype at 100 mm. diameter	41%	33%	33%

Remarks: This species, at first sight, seemed to be related to *Kossmaticeras sparsicostatum*, Kossmat sp. (1897, p. 38, pl. vi, fig. 5) and to *K. simile*, Spath sp. (1921, p. 48, pl. vi, fig. 1), but the development of the ribbing is from fine to coarse in these, i.e. the reverse of what it is in the present form. The same applies to the Patagonian species described by Paulcke (1905) which have the finely ribbed inner whorls of the *theobaldianum*-group and become comparable to *G. paucinodatus* only on the last whorl (pl. xvi, fig. 1). *Neograhamites* is perhaps closer in the coarseness of the ribbing, but only superficially; for here the inner whorls, with the typical *Gunnarites* aspect, have numerous tubercles and much finer ribbing persisting to an even later stage.

Kossmaticeras pachystoma, Kossmat sp. (1897, p. 39, pl. vii, fig. 1), also recorded by Kilian and Reboul from Snow Hill, shows more resemblance to the coarsely ribbed inner whorls of the present form than to the outer whorl. But it is difficult to appraise on account of the defective preservation of its earlier volutions. Stoliczka's original figure (pl. liv, fig. 1) is even less easy to interpret, and it seems unfortunate that Kilian and Reboul did not describe or figure their Antarctic form.

This species, like the last, is now included in *Gunnarites*, in spite of the apparent lack of crenelation of the ribbing. The resemblance to the restricted *Kossmaticeras*, with which I at first grouped the present form, is now believed to be superficial; and in view of the similarity of the body-chamber of *G. paucinodatus* to that of *G. rotundus*, it is felt that an entirely erroneous impression might be conveyed by the generic separation of these two species.

Locality and Horizon: Lachman Crags, South (C.41353). Associated with *Gunnarites rotundus*, but not *G. antarcticus*.

FAMILY PACHYDISCIDAE, SPATH, 1922, EMEND. 1923

This family is still used in the original sense, because its members, although perhaps independent "Desmoceratid" (or Puzosid) developments have an undoubted family resemblance, in spite of certain variations in shape, ornament, or suture-line. It was mentioned previously (1939, p. 294) that when Hyatt first separated "*Parapachydiscus*" from *Pachydiscus*, he did not restrict the latter to the Turonian *peramplus* group, for he figured as a true *Pachydiscus*, the late Senonian *P. wittekindi*, Schlüter sp., copied from Zittel's original Handbook (1884). Whether influenced by adverse criticism of Grossouvre's (1894) restriction of *Pachydiscus* to the group of *P. neubergicus* (Hauer), or whether unaware of the restriction and Grossouvre's protest (1899), Hyatt evidently meant to separate the typically Maestrichtian, more or less compressed forms with umbilical ribs or tubercles and finer secondary ribbing on the periphery from the inflated forms with loss of ornament that seemed to perpetuate the earlier *peramplus* group of almost equally gigantic dimensions. The suture-line, however, is similar in the two divisions, as a comparison of that of *Pachydiscus neubergicus* or *P. jaquoti*, Seunes (see Grossouvre, text-figs. 76 and 80, pp. 176 and 209) with the suture-line of *P. wittekindi* (in Zittel, 1884, fig. 650, p. 467) will show.

Hyatt's type of *Parapachydiscus*, namely *P. gollevillensis*, d'Orbigny sp., is undoubtedly a very close ally of *P. neubergicus* (Hauer) to which Grossouvre had restricted the genus *Pachydiscus*. This means that "*Parapachydiscus*" is a straight synonym of *Pachydiscus s.s.* and has to be suppressed. The suture-line of the Turonian *peramplus* group, moreover, differs in its high external lobe and comparative simplicity from that of the Upper Senonian types of superficially similar aspect, so that I separated the latter as *Eupachydiscus*, Spath, 1922, from their Turonian forerunners (now *Lewesiceras*, Spath, 1939). *Eupachydiscus*, of which "*Mesopachydiscus*", Yabe and Shimizu, 1926, is a synonym, remains strongly costate in advanced stages of growth; in the group of *P. naumanni*, Yokoyama, on the other hand, the constrictions may remain, but the ribbing is lost at an earlier stage than in the other groups. Shimizu, in 1935, still used the earlier name *Neopachydiscus*, Yabe and Shimizu, 1926, for *P. naumanni*, but Matumoto (1943) now puts this same species into *Anapachydiscus*, Yabe and Shimizu, 1926. Clearly the two developments are not widely different, and since *Anapachydiscus* has page preference, it is here adopted. It includes not only *A. fascicostatus* (Yabe) the genotype, in addition to *A. naumanni* and other Japanese species, but notably *A. patagonicus*, *A. hauthali*, and *A. steinmanni* (Paulcke) which in 1922 (p. 125) I had provisionally left in "*Parapachydiscus*".

Pachydiscus s.s. is represented in Kilian and Reboul's fauna by *P.* aff. *gollevillensis* from Seymour Island and perhaps by the more doubtful *P.* ("*Parapachydiscus*") sp. from Snow Hill. The single Pachydiscid in the present collection belongs to a different type. It is believed to be closely allied to *Amm. patagiosus*, Schlüter, which was listed by Diener (1925, p. 130) as a *Parapuzosia*, perhaps because Grossouvre (1891, table xxix, p. 700) had doubtfully grouped it with *Desmoceras* rather than *Pachydiscus*. In this connection it is interesting to note that *P. amarus*, Paulcke (1906, p. 227, pl. xvii, fig. 5), another nearly related or almost identical form, was considered by its author to show a "Desmoceratid" rather than a Pachydiscid suture-line. These two species, together with the Antarctic form described below as *Patagiosites* (gen. nov.) aff. *amarus* (Paulcke) thus show that there is a group of Pachydiscids, allied both to *Anapachydiscus naumanni* and to *Pachydiscus s.s.* which retains more primitive characters than either. This new stock, moreover, has a curious resemblance to inflated offshoots of the parallel development Kossmaticeratidae, such as *Gunnarites pachys*, mentioned above (p. 34).

The other Pachydiscid genera previously dealt with (e.g. *Menuites*, *Nowakites*, *Canadoceras*, Spath, 1922 [="*Pseudopachydiscus*", Yabe and Shimizu, 1926], *Lytodiscoides*, etc.) are not represented in the Antarctic fauna and need not be discussed here.

Genus *Patagiosites*, gen. nov.

Genotype: *P. patagiosus*, Schlüter sp. (1867, p. 22, pl. iv, figs. 4–5; 1872, p. 66, pl. xx, figs. 7–8)

Diagnosis: Pachydiscid, with Puzosid features still evident. Deep constrictions persisting to adult, but ornamentation (umbilical ribs or tubercles and then long or short, peripheral or lateral ribs) becoming feeble or disappearing altogether. About eight constrictions per whorl, distinctly projected forwards at middle of broadly arched periphery. Intermediate ribs very irregular or faint. Suture-line unknown, of Puzosid type and almost certainly less advanced than that of *Anapachydiscus* or *Pachydiscus s.s.*

Remarks: *P. patagiosus* is clearly allied to *Pachydiscus amarus*, Paulcke, cited above, and the Antarctic form here described; and on the discovery of more complete specimens they may be found to be connected by transitions, since the significance of the earlier or later disappearance of ribbing is difficult to appraise from single individuals. *Patagiosites* is also related to *Pachydiscus s.s.*, for example to *P. lettensis*, Schlüter sp. (1867, p. 24, pl. iv, fig. 3) which was not inaptly compared to *P. portlocki* (Sharpe) and to *P. ganesa* (Forbes), and thus connects also with *Menuites*, Spath, 1922 (genotype: *Amm. menu*, Forbes, 1845). The group of *Anapachydiscus naumanni* (Yokoyama), however, is probably still closer and differs mainly in its less primitive suture-line and in retaining distinct costation of the *Eupachydiscus* type to a later stage, beside the constrictions.

Pachydiscus boulei, Collignon (1931, p. 17, pl. iii, figs. 1–4) is probably another form of the Anapachydiscid stock that gave rise to *Patagiosites*, but it acquires strong costation after what has been described as the "*ganesa* stage". Kossmat (1897) and Grossouvre (1908) had considered *P. ganesa* (Forbes) to be the young of *P. egertoni* (Forbes), i.e. a true *Pachydiscus*; and the two are certainly closely allied, while I pointed out in 1922 that *P. ganesa* was more inflated than *Amm. soma*, Forbes, which had also wrongly been considered identical with *P. ganesa* and *P. egertoni* by most authors. As a matter of fact, *Amm. soma* is the only form of this group with constrictions, and these are faint and narrow, whereas the whorl-section is compressed, so that there is no resemblance to *Patagiosites*.

The young of *Pachydiscus ganesa*, *P. egertoni*, *P. crishna*, and *P. compressus* are totally unconstricted and therefore also rather different from the young *Patagiosites*. Moreover, the suture-line of *P. egertoni* differs from that of *Anapachydiscus boulei* in the arrangement of the auxiliary elements which are not oblique, as shown in Collignon's fig. 9 (pl. viii) but horizontal and numerous. That is to say, the auxiliary elements attached to the umbilical side of the fourth saddle of the external suture-line and those of the umbilical side of the third (and outermost) of the internal saddles form two vertical ladders on each side of the umbilical suture. This seems a more highly specialised arrangement than that attained by the more numerous elements of the suture-line of *P. stobaei* (Nilsson) at a much larger size (see Schlüter, 1872, pl. xvii, fig. 6), apparently also merely adumbrated in the Japanese Maestrichtian *Canadoceras kossmati* (Yabe), figured by Yabe and Shimizu (1926, fig. 1, p. 172).

Menuites menu (Forbes) is also unconstricted on the inner whorls and even on the tuberculate part, but it develops a great likeness to *Patagiosites* towards the end.

Patagiosites aff. *amarus* (Paulcke)

Plate X, fig. 7

Cf. 1906. *Pachydiscus amarus*, Paulcke, p. 227, pl. xvii, fig. 5

The Antarctic form here figured is almost certainly not quite the same as Paulcke's species or as Schlüter's *Amm. patagiosus*, above cited, but it is as yet incompletely known. There is general affinity and probably not specific identity. The original of Plate X, fig. 7, is a plaster-cast of an external mould in a piece of sandstone, and it apparently represents the body-chamber of an individual of about 140 mm. diameter. The whorl-section is well rounded, with a broadly arched periphery and a comparatively narrow umbilicus, with a vertical wall, but a rounded edge. There are seven ridges and accompanying constrictions, unequally high or deep and irregularly spaced. The intervening ribs are also very irregular; in two of the interspaces (between successive constrictions) there are scarcely any ribs and the remainder are most conspicuous on the lateral area. Some continue to the umbilical suture; others are continuous across the venter, but rather feeble. There is a distinct median sinus on the periphery, directed forwards and coinciding with the widest part of the ridges. These show a distinct thickening near the umbilical end, suggesting the presence of tubercles, as in Paulcke's figure, but the earlier stages may have been nodate, as in Schlüter's species. No measurements can be given and there is no indication of any septal edge.

Unfortunately, in the absence of the inner whorls, comparison of the Antarctic form with the two species cited cannot be carried any further. Schlüter's three original specimens differ slightly; of the two examples figured in 1867, the larger (fig. 4) is here chosen as lectotype, but the third specimen (1872, pl. xx, figs. 5 and 7) was evidently considered the most characteristic, showing ribbing between the constrictions. Schlüter's mention of the ridges accompanying the constrictions beginning at the umbilicus with a tubercle is reminiscent of a feature observed in *Menuites* as well as in *Pachydiscus*, e.g. *P. ganesa* and many others. Even the aperture of *Amm. yama*, Forbes, is formed by such a ridge and constriction, showing that this species (compared to *Parapuzosia icenica*, Sharpe sp. on p. 21) probably represents the young of a form of *Pachydiscus*, like *P. compressus* (Spath). The tuberculation of the inner whorls of *P. patagiosus* is a typical *Pachydiscus* feature.

The outer whorl of the large lectotype of *Anapachydiscus naumanni*, Yokoyama (pl. xxii, fig. 1) might have left an impression in the rock comparable to that here figured, but the smaller paratype (pl. xix, fig. 6) still retains strong costation of the *Eupachydiscus* type.

Locality and Horizon: James Ross Island, Lachman Crags, North (C.41329). Associated with the Lytoceratids (*Pseudophyllites*) referred to on p. 8. Schlüter's original *P. patagiosus* came from the *mucronata* zone of the neighbourhood of Coesfeld, Westphalia (Campanian), i.e. the *coesfeldiensis* horizon of the Upper Campanian. *P. amarus* itself was associated with three species of *Anapachydiscus*, in black limestones which are definitely below the corresponding *Hoplitoplacenticeras* Beds of Patagonia, though also of Campanian age.

II. Order Nautiloidea

Family Nautilidae, Owen

Genus *Eutrephoceras*, Hyatt, 1894

Eutrephoceras simile, sp. nov.

Plate XII, fig. 4; Plate XIII, figs. 1–5

1909. *Nautilus blanfordianus*, Kilian and Reboul, p. 8, pl. i, figs. 1–2

THIS SPECIES is available in twenty examples and fragments from James Ross Island, compared with two, from Seymour and Snow Hill Islands, studied by Kilian and Reboul. These, moreover, were not well preserved and the description is brief and vague, for example, in referring to "certain" of their specimens having even more depressed whorls than Blanford's *Nautilus bouchardianus* (*non* d'Orbigny). Kilian and Reboul's new name *N. blanfordianus* was definitely given to the Indian forms figured by Blanford in his pls. iv–v; but they failed to designate a type and they failed to point out that these plates represented a dozen examples from different localities. Meek (1877, p. 498) had already directed attention to the fact that Blanford's examples of *N. bouchardianus* differed in the position of the siphuncle as well as in other respects, though they were stated to be connected by imperceptible gradations in all of these characters.

Still more serious was the failure, by Kilian and Reboul, to notice that Stoliczka (1866) had already corrected Blanford's determinations and that he referred most of the specimens figured by that author to *N. sphaericus*, Forbes, the two exceptions being assigned as a variety to *N. sublaevigatus*, d'Orbigny. Foord, who also revised the Indian Cretaceous nautili in 1891, was similarly ignored by Kilian and Reboul. Their *Nautilus blanfordianus* thus is a synonym of *N. sphaericus*, Forbes, and it would only cause confusion to attempt to conserve the name by transferring it either to *N. sublaevigatus* var. *indica* (cited as *Eutrephoceras indicum*, Spengler, in Shimizu, 1935), or to *N. pseudobouchardianus*, Spengler, both created a year after Kilian and Reboul's name first appeared in print. To restrict *N. blanfordianus* to the Antarctic form, of course, would be entirely contrary to the Rules of Nomenclature.

Before deciding whether the Antarctic species agrees with Forbes's *Nautilus sphaericus* it seems advisable to give a detailed account of the former.

Diagnosis: Whorls considerably wider than high, except at very small diameters, the thickness (after about 40 mm.) being on the average 84%, to a whorl-height of 63% of the diameter. Shell thus not quite spherical, but umbilicus closed. Siphuncle ventro-centran in the adult, one-third of the whorl away from the venter and two-thirds from the dorsum. In the young (fig. 5) the siphuncle is more central and the whorl-section then is much less lunate. There is no sign of an annular lobe and the suture-line runs almost perfectly straight across the shell, especially in the younger stages, though later there may be occasionally a very faint peripheral sinus. At the border of the deep umbilical funnel, however, the suture-line is distinctly bent back, to straighten out once more as it disappears into the closed umbilicus. Body-chamber half a whorl; test thick and reticulate in the young (at 30 mm.). Aperture apparently plain.

Remarks: The example figured in Plate XIII, fig. 1, and now taken as the holotype of the present species, has a diameter of 150 mm. and is complete to the aperture. The internal cast of the body-chamber shows a few obscure folds across the periphery, but in three other large body-chambers these folds are scarcely perceptible and they are not considered of special significance. The reticulation of the test in the young is rougher than in most nautili, but apparently only on the outermost layer of the test, for the next inner layer is normal.

The suture-line is reminiscent of that of the genus *Cimomia* rather than *Eutrephoceras*, but the former has a distinct lateral lobe. In the present form the bend on the umbilical border is scarcely more pronounced than in *E. sloani*, Reeside (1924, text-fig. 1 c, p. 3) and there is no trace of a lateral lobe, so that the bend cannot be called a saddle.

E. simile differs from *E. sphaericum* (Forbes) in being less inflated and especially in having a ventro-centran siphuncle. Both have the umbilicus completely closed by a callosity and in both the suture-line is rather strongly bent down towards the umbilicus. The holotype of Forbes's species is in the British Museum (Geological Society Coll.) and was recorded by Blake in 1902 (p. 40, No. R.10453). The original figure (1846, p. 98) was reduced; the diameter is 127 mm. and the thickness 120 mm. or 95%. Even so, the body-chamber, or nearly half of the last whorl, is worn and corroded so that the whorl-thickness may well have been equal to the diameter. The last few septal edges are approximate and slightly more wavy than those of *E. simile* on the broad venter. A smaller and entirely septate Pondicherry example in the same collection, badly sectioned, is here figured (Plate XIII, fig. 6) for comparison. It shows the exterior aspect of one half, with the umbilical callus and part of the very thick test removed, to expose the wavy septal edges. The other half retains a few siphonal funnels and their position is at the inner third, at 35 mm. diameter, exactly as in the much larger holotype.

Of the examples of *E. sphaericum* from Dr. King's collection, mentioned by Foord (1891, p. 300) two (B.M. Nos. C.2501 b, C.2602), less complete than the holotype, are certainly very close to the present species, so that Kilian and Reboul undoubtedly had this Indian form in mind when renaming it. In a larger third specimen (C.2601 a) the innermost whorls are exposed (diameter = 12 mm.) and show the reticulate ornament of the young, as in the original of Plate XIII, fig. 5.

E. dekayi (Morton), the genotype of *Eutrephoceras*, is also very close to the present species, but typically has a dorso-centran siphuncle, though occasionally it may become central (Whitfield, 1891, pl. xxxviii, fig. 8; Stuart Weller, 1907, pl. c, fig. 4). I discussed this species in 1921 (Spath, 1921, p. 262) and it has since been referred to by various authors like Reeside (1927 a, p. 2; 1927 b, p. 6); Adkins (1928, p. 201); Miller and Thompson (1933, p. 301); Stephenson (1941, p. 397). But it seems that there is some individual variation. In numerous specimens before me, the siphuncle is dorso-centran or central, at least in the specimens from Alabama and Mississippi, South Dakota and Montana, whereas, according to Whitfield, in the Navesink (New Jersey) types, the siphuncle is even nearer the ventral than the dorsal margin. The suture-line is also generally less bent back at the umbilical end than in *E. simile*, but the shallow lateral lobe indicated in Reeside's drawing (1924, text-fig. 1 d, p. 3) is scarcely noticeable in the Antarctic form. On the other hand, in *E. planoventer*, Stephenson (1941, p. 397, pl. 75, figs. 1–6; pl. 76, figs. 9–11) the suture-line is more wavy on the venter.

E. subplicatum (Philippi) Steinmann sp. (1895, p. 65, pl. iv, figs. 2 a–c, lectotype) resembles the Antarctic form in the position of the siphuncle and in the suture-line, but has a far less lunate whorl-section. It is not identical with *Nautilus d'orbignyanus*, Forbes, as Steinmann thought; for the holotype of that species, figured by Darwin (1846, pl. v, figs. 1 a, b = B.M. No. C.2613) has a wavy suture-line, with a distinct lateral lobe, as in species of *Cimomia*. A similar suture-line, however, is found in the Madagascan *Nautilus sphaericus*, Forbes, figured by E. Basse (1931, pl. i, figs. 3–4) which clearly distinguishes it from the young *Eutrephoceras simile*.

The small *Nautilus* cf. *bouchardianus* figured by Boule, Lemoine and Thévenin (1907, pl. xv, fig. 7), also included by Kilian and Reboul in their *N. blanfordianus*, does not belong to the present species. Nor is it possible to discover why these authors, in their discussion of the Antarctic form, cited Crick's *Nautilus* sp. from the Albian of Zululand (1907, p. 248) since this has an annular lobe (B.M., No. C.18310).

Nautilus desertorus (Zittel MS.) Quaas (1902, p. 299, pl. xxix, fig. 1; pl. xxxiii, figs. 29–30) is also similar to the Antarctic species, but its siphuncle is first dorso-centran and then central until, near the end (at 110 mm. diameter), it is even more ventro-centran than in *Eutrephoceras simile*. Moreover, the Egyptian species has more closely spaced septa and a shallow lateral lobe, almost as in *Cimomia*. On the other hand, a form of *Eutrephoceras* common in the *Hoplitoplacenticeras* bed of Egito (Angola), of which a small example is here figured (Plate XIII, fig. 7), had undoubtedly more affinity with *E. simile* than with *E. sphaericum* (Forbes).

Locality and Horizon: James Ross Island, The Naze and Dagger Peak (twenty examples). The allied *Eutrephoceras dekayi* (Morton) is common in the upper part of the Fort Pierre Shale (Campanian) and deposits of corresponding age in other parts of North America.

C. PALAEONTOLOGICAL AND STRATIGRAPHICAL RESULTS

1. The So-Called Lower Horizon

THE CEPHALOPODS described in the foregoing pages can be naturally grouped into several more or less distinct assemblages. As has been pointed out before, *Gunnarites antarcticus* (Stuart Weller) is by far the commonest ammonite in the Antarctic Senonian deposits and Kilian and Reboul spoke of the beds which yielded that form as the "*niveau ordinaire*". The assemblage from this horizon is here distinguished as the fauna with *Gunnarites antarcticus.*

Opposed to this, Kilian and Reboul recognised an "*horizon inférieur*", with *Damesites loryi*, *Hauericeras* (and *Neograhamites*) which they correlated with the Cenomanian and Upper Albian. Before discussing the main fauna with *Gunnarites antarcticus* it seems advisable to review the evidence in favour of a "lower horizon", also styled "Vraconnian" (p. 59) or "Middle Cretaceous" (p. 64), but made up of two assemblages. The first (Snow Hill locality 2, *pars*) consisted of two ammonites (*Latidorsella* aff. *latidorsata*, Michelin sp. and *Desmoceras loryi*, Kilian and Reboul), in a red limestone with corals and therefore presumed to have come from a horizon different from that of the ordinary *Gunnarites antarcticus*, the fossils from the two levels being said to have become mixed up in the collections.

The second assemblage (Snow Hill locality 6) was characterised as including *Sequoia fastigiata* and "*Puzosia*" *loryi* (described on p. 18 as *Desmoceras* [*Latidorsella*] *loryi*) in addition to other ammonites, namely *Lytoceras* sp. (undescribed), *Hauericeras* sp. and various *Kossmaticeras*, especially the forms wrongly attributed to Canadian types and already referred to on p. 2, which are really of Jurassic age.

Of these ammonites, *Latidorsella* and *Hauericeras* are not of significance considering that the first, a genus of the European Gault and Cenomanian, was represented only by a doubtful, fragmentary and unfigured specimen, while the second, described as showing affinity to the well-known Campanian *Hauericeras gardeni* (Baily), was also said to be badly preserved and was not figured. There remains only *Desmoceras* (*Latidorsella*) *loryi*, Kilian and Reboul, figured and described as rather common, though it was listed also from beds with *Gunnarites antarcticus*. That species was identified by its authors with a Japanese form, now known as *Damesites umbilicatus*, Yabe sp., but originally figured as *Desmoceras* sp. in Yokoyama (1890, pl. xx, fig. 12). *Damesites umbilicatus* was recorded by Shimizu (1935, p. 192) from his Lower Campanian zone of *D. damesi*, but he quoted the latter also from the Santonian (p. 174) and according to Matumoto (1943, p. 129) *D. damesi* occurs already in the Lower Senonian. In any case, *D. damesi* (Jimbo) is the genotype of *Damesites*, Matumoto, 1943 (= *Kotoceras*, Shimizu, 1935 *non* Kobayashi, 1934), which also includes the well-known Indian *D. sugata* (Forbes) of the Santonian Verdachellum fauna (see p. 9). Kilian and Reboul's fig. 4 (pl. i) does not bear out the identification of the inflated Antarctic form with the Japanese *D. umbilicatus*; but the French authors also described their *D. loryi* as being very closely related to *Amm. sugata*, Forbes, and cited it on p. 47 as *Desmoceras sugatum* [*sic*], so that it is almost certainly a form of *Damesites*. The range of this genus may extend up into the Maestrichtian, but does not go below the Senonian. The forms of *Kossmaticeras* listed from the same bed only confirm what has been said above (p. 23) concerning the true nature of the ammonites that Kilian and Reboul included in the Jurassic genera *Grahamites* and *Seymourites*.

2. The Antarcticus Fauna

This disposes of the "lower horizon" and the hypothetical gap between it and the Snow Hill Beds of Kilian and Reboul's table on p. 58. The latter beds were correlated with the Upper Trichinopoly Beds of India (and the Santonian stage) and it will be of interest to list the fauna as now revised to see how far this correlation was justified:

Cephalopoda of the fauna with *Gunnarites antarcticus* (Snow Hill Beds)

Neophylloceras meridianum, sp. nov.
Pseudophyllites peregrinus, sp. nov.
Diplomoceras lambi, sp. nov.
Maorites densicostatus (Kilian and Reboul)
M.(?) sp. juv. ind.
Jacobites crofti, sp. nov.

Gunnarites antarcticus (Stuart Weller)
Gunnarites antarcticus (Stuart Weller) var. *nordenskjöldi* (Kilian and Reboul)
Gunnarites antarcticus (Stuart Weller) var. *inflata* (Kilian and Reboul)
Gunnarites antarcticus (Stuart Weller) var. *monilis*, nov.
Gunnarites bhavaniformis (Kilian and Reboul)
Gunnarites bhavaniformis (Kilian and Reboul) var. *vegaensis*, nov.
Gunnarites gunnari (Kilian and Reboul)
Gunnarites kalika (Stoliczka)
Gunnarites kalika (Stoliczka) var. *gracilis*, nov.
Gunnarites kalika (Stoliczka) var. *nana*, nov.
Eutrephoceras simile, sp. nov.

Among the differences between this fauna and the lists given by Kilian and Reboul we notice (1) the absence of *Gaudryceras* and (2) the absence of *Jacobites anderssoni* (Kilian and Reboul), one of the most characteristic elements of the Antarctic fauna and said to be very common, at least on Snow Hill. *Gaudryceras* is a long-lived genus of world-wide distribution and limited stratigraphical importance; and its absence in the present assemblage may be due simply to collection-failure. *Jacobites*, which is known also from New Zealand, has been recorded by Kilian and Reboul with the *Gunnarites antarcticus* fauna and with *Grossouvrites gemmatus* at locality 3 on Snow Hill and locality 8 on Seymour Island. It may thus not be strictly confined to the *antarcticus* horizon, as its absence from the *Grossouvrites gemmatus* fauna in the present collection suggested; or *Jacobites* may not be so common on James Ross Island as it is on Snow Hill. In any case it has to be borne in mind that whereas there are only ten specimens altogether before me from Snow Hill, and all the five ammonites from Seymour Island happen to be *Grossouvrites*, Kilian and Reboul had much larger collections from these two islands.

Apart from the two species *Jacobites anderssoni* and *Grossouvrites gemmatus*, then, it will be seen that the above list contains only one ammonite species, known also from the Indian Cretaceous (*Gunnarites kalika*), while the remaining fourteen are strictly local elements. There is none of the characteristic Santonian ammonites such as *Texanites* of the lower part of that stage (Texanitan, *olim* "Mortoniceratan" Age), known for example from Japan, or of *Placenticeras* (Stantonoceratan Age or Upper Santonian in Spath, 1926), which occurred in India, Madagascar and South Africa. On the other hand, they are all more nearly related to Campanian types, while some, in the descriptions above, have even been compared to Maestrichtian species. In addition to the abundance of *Gunnarites*, the frequency of large examples of *Diplomoceras*, comparable to *D. cylindraceum* (d'Orbigny) of the Baculite Limestone of the Cotentin (Normandy) and to *D. notabile* (Whiteaves) of the Nanaimo Beds of Vancouver is perhaps the most striking feature of the *Gunnarites antarcticus* fauna.

Most of the ammonites in the present collection came from The Naze and especially the neighbouring Dagger Peak on James Ross Island (Sidney Herbert Sound). A few isolated specimens came from "North of Cape Gage" on the coast of James Ross Island, also from Cockburn Island, and False Island Point, on Vega Island, just opposite The Naze. There are no fossils from Hamilton Point in the south of James Ross Island, whence Kilian and Reboul recorded a *Maorites* (? *Kossmaticeras cumshewaense*, Whiteaves sp.), but the few ammonites from Snow Hill Island, referred to above, again belong to the same *G. antarcticus* fauna.

3. The Other Assemblages

Two of the ammonites of the above list also occur in other assemblages mentioned below. These are *Pseudophyllites peregrinus* and *Gunnarites kalika*, known from Lachman Crags, South, as well as Humps Islet. This alone may be taken to indicate that the difference in age of the respective assemblages cannot be very great, but there are other species of *Gunnarites*, with close affinity to those of the first or *antarcticus* fauna, which confirm the smallness of the presumed time gap between them.

List of Ammonites from Humps Islet

Neophylloceras hetonaiense, Matumoto
Phyllopachyceras forbesianum (d'Orbigny)
Pseudophyllites peregrinus, sp. nov.
Gaudryceras, sp. juv.
Saghalinites cala (Forbes)
Neograhamites kiliani, sp. nov.
Neograhamites taylori, sp. nov.

Gunnarites pachys, sp. nov.
Gunnarites pachys, sp. nov. var. *media*, nov.
Gunnarites flexuosus, sp. nov.
Gunnarites flexuosus, sp. nov. var. *transitoria*, nov.

The first five of these ammonites are not of decisive value as time indicators. Shimizu (1935, pp. 200–1), in fact, gave a table showing the ranges of some equivalent species of the Campanian of South Sakhalin and Hokkaido and he considered them to have no value for zonal purposes. Matumoto's (1943) researches, while differing in detail and perhaps equally suspect, lead to the same conclusion. According to the latter author, *Neophylloceras hetonaiense* is Campanian and Lower Maestrichtian; *Phyllopachyceras ezoense*, the counterpart of *P. forbesianum* (see p. 6), is said to range from the Turonian through the whole of the Senonian up into the Maestrichtian, a range unequalled by any ammonite outside the two families Phylloceratidae and Lytoceratidae.

Neograhamites was considered (on p. 23) to be closer to the genus *Brahmaites*, Kossmat, than any other member of the family Kossmaticeratidae and to resemble certain species of *Pseudokossmaticeras*. Both occur in the "Campanian" of the sub-Pyrenean region of the South of France (Seunes, 1891), which has been considered to be the equivalent of the "Lower Danian" Baculite Limestone of Normandy. This has yielded such well-known Maestrichtian species as *Pachydiscus colligatus* (Binkhorst), *Desmophyllites larteti* (Seunes), and *Bostrychoceras polyplocum* (Schlüter) and, though a condensed deposit, may possibly be slightly later. The two new species of *Gunnarites* would be taken by most palaeontologists to be more specialised members of the *antarcticus* stock, rather than more primitive types, so that an immediately post-*antarcticus* age could be suggested for the Humps Islet assemblage.

Three somewhat different sets of ammonoids were collected at Lachman Crags, South, on the east coast of the northern extremity of James Ross Island, in Sidney Herbert Sound. There are several modes of preservation and a first assemblage, in a tough, bluish-grey sandstone, is entirely distinct from any other here discussed. The fossils are small, with the test irridescent or white and chalky, and with the exception of the species of *Maorites* they belong to genera not found elsewhere in Graham Land. The "*Baculites*", however, doubtfully recorded by Kilian and Reboul (p. 48) from Snow Hill could perhaps indicate the same horizon.

List A of Ammonoids from Lachman Crags, South (Loc. D430)

Hoploscaphites quiriquinensis (Wilckens)
Polyptychoceras sp. juv.
Oxybeloceras aff. *mortoni* (Meek and Hayden)
Baculites aff. *rectus*, Marshall
Parapuzosia (?) sp. juv. ind.
Oiophyllites decipiens, sp. nov.
Maorites aff. *suturalis* (Marshall)
Maorites seymourianus (Kilian and Reboul)

These fossils were marked by Mr. W. N. Croft, as having been collected *in situ*, except the last which was labelled "probably Drift". It is in a similar mode of preservation as the others, however, only larger (Plate IV, fig. 1). As has been shown under the specific descriptions, none of the ammonites in the list can be definitely dated as Maestrichtian rather than Campanian.

A second locality, south of the first, yielded only the Lytoceratid air-chamber casts, referred to on p. 8 as probably belonging to *Pseudophyllites*, but these may not have been *in situ*. While they may well be of the same age as the cast of *Plagiosites* aff. *amarus* (Plate X, fig. 7) from another locality, away to the north and inland, but also labelled "Lachman Crags", they cannot be dated with certainty. Large *Pseudophyllites* occur in the Upper Campanian of Pondoland. The single example of *Gaudryceras* (*Neogaudryceras*) *pictum* (Plate I, fig. 10), the only ammonite compared to a Japanese species, was found a short distance inland from this last locality, but was marked "probably Drift".

The third assemblage was collected *in situ* on the coast still farther south, and since the dip of the beds is generally to the south-east it was assumed to be the highest of the three faunas.

List B of Ammonites from Lachman Crags, South, about 1000 metres south of first locality (Loc. 8501–8642)

Gaudryceras sp. juv.
Maorites pseudobhavani, sp. nov.
Gunnarites rotundus, sp. nov.

Gunnarites rotundus, sp. nov. var. *kalikaformis*, nov.
Gunnarites rotundus, sp. nov. var. *compressa*, nov.
Gunnarites kalika (Stoliczka)

This fauna is probably not very different in age from the common *antarcticus* assemblage, and this also applies to two ammonites collected just inland from this last locality, but marked "probably Drift". These forms are here figured as:

Gunnarites rotundus, var. *kalikaformis*, nov.
Gunnarites paucinodatus, sp. nov.

The latter, with its coarse inner whorls, seems to be as different from *Gunnarites antarcticus* and its associates as from the superficially similar group of "*Madrasites*" *natalensis*, Spath, rediscovered in Madagascar (Besairie, 1932, p. 49, pl. vi, fig. 4), where it occurred together with *Pseudoschloenbachia umbulazi* (Baily) and *Hauericeras gardeni*, just as in the Pondoland Campanian. Yet there is scarcely more resemblance between *Gunnarites paucinodatus* and the Patagonian forms described by Paulcke from his beds with *Hoplitoplacenticeras plasticum*. These are probably equivalents of the beds with *Oiophyllites angolaensis* (p. 49) and *Hoplitoplacenticeras* of Egito, already referred to, and the Madagascan bed 6 of Besairie (1936, p. 93), both of which may be already of basal Maestrichtian age.

There remain only the few specimens from Seymour Island, the best of which is figured in Plate V, fig. 1 as:

Grossouvrites gemmatus (Huppé).

This is another species found at Quiriquina, Chile, like the form of *Hoploscaphites*, above described, and it may now be advisable to review the evidence for assigning a definite date to this fauna as well as that of South Patagonia. Both of these, it may be recalled, were declared by Haug (1909, pp. 1347–8) to be, without the slightest doubt, of Maestrichtian age.

4. Comparison with Faunas of Other Regions

a. NEW ZEALAND

It has been shown that there is no evidence for any deposits of pre-Campanian age in Graham Land, and in view of the complete absence of any ammonites of the Sphenodiscan Age or the Upper Maestrichtian, it remains to compare the assemblages described in the previous chapters with the faunas of about the same age known from other parts of the world. Kilian (1922) drew attention to the close relationship that existed between the "Campanian" ammonite faunas of Graham Land and New Zealand. This was emphasised by Marshall (1926) who stated that the affinity was most markedly shown in the Kossmaticeratids; for the genera of this family had a fuller representation in those countries than in any other. Moreover, the absence of *Baculites* and "*Ptychoceras*" which seemed surprising and significant to Marshall (pp. 199, 207), no longer holds since both are now recorded from Graham Land; the agreement seems even closer.

Yet among the Kossmaticeratidae themselves, there are, in the writer's opinion, no species in common between the two regions, contrary to the views of Kilian and his followers. It is true that *Gunnarites*, the most characteristic element of the Antarctic fauna, occurs in New Zealand; but so it does in southern India. The species of *Jacobites*, in fact, described by Marshall, and especially their allies *Neomadrasites*, *Aucklandites*, and *Tainuia*, are quite distinct from anything found in Graham Land and bear their own local stamp.

There are few typical Maestrichtian forms among the New Zealand ammonites. The genus "*Schlüteria*" (now *Desmophyllites*) seems to be one, but the form described by Marshall as "*S.*" *rarawa* is valueless; it was compared to *Desmophyllites diphylloides* (Forbes) but was probably entirely misidentified. *Brahmaites rotundus*, Marshall was first identified by Kilian (1922, p. 175) as *B. brahma* (Forbes), a Maestrichtian form of the Valudayur Group, but it is apparently a young *Jacobites*. Yet *Grossouvrites gemmatus*, *Pseudophyllites indra* and *Vertebrites murdochi*, first recorded by Kilian as *Gaudryceras kayei* (Forbes), suggest that the New Zealand fauna includes at least some forms of post-Campanian aspect.

The last two species, in fact, were cited by Marshall as indicating that his New Zealand fauna should be placed in the Maestrichtian, in Haug's sense, though he himself "preferred" to make it Upper Santonian or Lower Campanian. Marshall's conclusions, of course, are based on entirely antiquated comparisons and irrelevant statistics; for example, the percentage of genera supposed to be common to the New Zealand fauna and the entirely unrelated fauna of the much earlier Utatur Group of India is as meaningless as the fact, cited by Marshall, that the long-lived genera *Pachydiscus* and *Baculites* are represented by four and three species respectively in Patagonia, but only by one each in New Zealand.

The assemblage here referred to as the New Zealand fauna includes the ammonites of the Batley Series, described by Marshall, apart from smaller collections like those I recorded in 1921, the few Cretaceous ammonoids listed in Dr. Marwick's Palaeontological Report (1935, p. 11), the Kossmaticeratids from southern Otago, submitted by Prof. Benson and referred to on p. 3, and especially a collection from Kaipara Harbour, lent to me by Mr. E. V. Wright. A number of the latter have proved very useful, as mentioned under the descriptions above. All these ammonites do not necessarily belong to one subzone or even zone, yet I still take them to be of Campanian (and Lower Maestrichtian?) age, like the Zululand and Pondoland faunas I described in 1921. I then pointed out that the deposits in these areas, in South Africa, New Zealand, Graham Land, Patagonia and Chile consisted largely of glauconitic calcareous sandstones and contained essentially the same ammonite assemblages. The New Zealand fauna above discussed, however, does not include some isolated occurrences of earlier cephalopods, referred to in Marwick (1911) and Finlay and Marwick (1940), such as the presumably Albian Turrilitid (*Mariella* or *Pseudhelicoceras*?) recorded by Woods (1917) as *Turrilites circumtaeniatus* (Kossmat).

b. CONCEPTION BAY, CHILE

The family Kossmaticeratidae which is so abundantly developed in New Zealand has but a single representative in the fauna of the Quiriquina Beds of Conception Bay, Chile; but Kilian and Reboul already had considered their own Antarctic "fauna" to be of the same age as the Quiriquina "fauna". They cited in support of this opinion nine of the eleven species listed by Wilckens (1904, p. 272) and defined the age of both faunas as Upper Senonian, i.e. corresponding to the "Craie à *Baculites*".

The age of the latter, i.e. of the Baculite Limestone of Normandy, is Lower Maestrichtian in Haug's classification which I adopted in 1926 (table to p. 80). But few of the French ammonoids are also found in Chile. Apart from *Pachydiscus quiriquinae* (Philippi), Steinmann, which distantly resembles *P. fresvillensis*, Seunes, there are only *Diplomoceras* cf. *cylindraceum* and a *Scaphites* (*Hoploscaphites constrictus* var. *quiriquinensis*) that could be considered comparable species. And the last two, with *Grossouvrites gemmatus* (Huppé) are exactly the elements which we find again in the Antarctic fauna.

The most striking ammonoids in the Quiriquina "fauna", however, are the forms of *Eubaculites* (*E. lyelli* and *E. ornatus*, d'Orbigny) which are closely related to the Indian *E. vagina* (Forbes), *E. otacodensis* (Stoliczka) and *E.* (?) *simplex* (Kossmat). The last has been compared by Kossmat (1895, p. 157) to *Baculites chicoensis* var. of Gabb (1864, pl. xiv, fig. 29) and like it may be a passage-form between *Eubaculites* and the true *Baculites* (*anceps* group). Some specimens before me from near Coalinga, Fresno Co., California, labelled *B. vagina*, certainly are not typical *Eubaculites* and probably belong to the same form as Gabb's variety. They are associated with the true *B. chicoensis*, Trask, and a *Damesites* of the *sugata* group and thus presumably of Campanian age.

Typical examples of *Eubaculites*, however, have recently been rediscovered in West Australia (Spath, 1940, p. 48). The Madagascan *Baculites vagina* (*non* Forbes) on the other hand, recorded already by Boule, Lemoine and Thévenin (1907, p. 65, pl. xv, fig. 3) and completely misunderstood by E. Basse (1931, p. 20), does not even belong to *Eubaculites*, any more than the New Zealand forms described by Woods (1917, p. 36, pl. xx, fig. 5) and cited by Kilian (1922, p. 176) or the Hungarian *Baculites* aff. *vagina* figured by Pethö (1906, p. 87, pl. vi, fig. 1).

Less spectacular than the two large forms of *Eubaculites*, but of equal importance, are also the fragments of four or five species of *Glyptoxoceras* and the form of *Phylloptychoceras* (*P. constrictum*) figured by d'Orbigny (1846) from Quiriquina, because they are identical with or close to well-known species from the Valudayur Group of India and the Lower Maestrichtian of Japan. Finally *Diplomoceras cylindraceum*, cited in Wilckens's list of Quiriquina fossils, is undoubtedly a form of the Belgian and French Lower Maestrichtian; but the extra-European forms of *Diplomoceras* are as yet less definitely dated. Thus the Japanese "*Anisoceras*" *obstrictum* (Jimbo), recorded by Kilian and Reboul from Snow Hill, is not a

Diplomoceras, as this misidentification suggested; it is now included by Matumoto (1943, p. 133) in *Polyptychoceras* and its range ends with the Campanian. Likewise the Madagascan *Diplomoceras* cf. *cylindraceum* figured by Boule, Lemoine and Thévenin (1907, p. 54, pl. xiii, fig. 14) has a simpler suture-line than the typical Maestrichtian forms, so that the Antarctic species here described and the unnamed form from Snow Hill, confused by Kilian and Reboul with "*Anisoceras*" *obstrictum*, may well be of post-Campanian age. The Canadian *Diplomoceras notabile* (Whiteaves) is associated in the Nanaimo fauna not only with presumably Maestrichtian *Pachydiscus*, *Pseudophyllites* and other ammonites, but also with forms that could be Campanian. As in the case of the single Kossmaticeratid from the Queen Charlotte Islands, *Maorites cumshewaensis*, Whiteaves sp., there is lack of exact stratigraphical information.

The Upper Senonian and Maestrichtian ammonites so far described from Peru are not closely comparable to the forms from Graham Land here dealt with, but they may be briefly referred to because of their general interest. The few ammonites described from the Cretaceous of the Paita Region, NW. Peru, first by Gerth (1928) and then by Olsson (1944), include *Eubaculites lyelli* (d'Orbigny), a fragment of a Nostoceratic ("*Turrilites*" *peruvianus*, Olsson), a *Pachydiscus* ("*Parapachydiscus*" sp., Olsson), and two new ammonite genera of considerable importance. The first (*Austrosphenodiscus*) was introduced by Olsson for a species (*peruvianus*, Gerth) first made known by Gerth as a variety of *Sphenodiscus pleurisepta* (Conrad). The difference in the proportions of the external saddle to the rest of the suture-line made this assimilation improbable, but Olsson's relegation of *Austrosphenodiscus* as a mere sub-genus of *Coahuilites* is equally unacceptable; for in *C. sheltoni*, Böse, the type species of *Coahuilites*, the external saddle may be similarly subdivided, but the suture-line as a whole is far longer than in either *Austrosphenodiscus* or the nearly allied *Manambolites*, Hourcq, 1949.

The second genus *Paciceras* (type species: *P. pacificum*, Olsson, 1947) is an interesting form resembling earlier Tissotids, but probably only a simplified development of the stock that produced *Manambolites* which is also dated as Campanian. In view of the fact that *Paciceras* and *Austrosphenodiscus* come from a bed some 2000 feet below the beds with *Eubaculites lyelli* which was stated to be most certainly Maestrichtian, the incompleteness of the geological record of the Campanian and Lower Maestrichtian needs no stressing. The conclusion seems justified that the Chilean fossils associated with *Eubaculites lyelli* also came from widely separated horizons and do not constitute a single "Quiriquina fauna".

C. SOUTHERN PATAGONIA

Considering that Kossmaticeratids are the dominant ammonite family in the Antarctic faunas, it is unfortunate that they are so poorly represented in Chile and Patagonia. When describing a new West Australian form of *Kossmaticeras* (or *Maorites*) as *K.* sp. nov. ? aff. *aemilianum* (Stoliczka) I pointed out (p. 44) that it was very closely related to the Patagonian "*Holcodiscus*" *tenuistriatus*, Paulcke. This came from a bed higher in the sequence than the prolific *Hoplitoplacenticeras plasticum* bed which I called presumably Upper Campanian but which Haug had no hesitation in including in the Maestrichtian. In fact, my placing of a *theobaldianum* subzone above instead of below a *vari* subzone (Spath, 1926, table to p. 80) was influenced by this Patagonian succession. But I now believe that Paulcke's "*Holcodiscus*" *theobaldianus* was misidentified, for it lacks the umbilical edge and the very oblique constrictions of Stoliczka's species, its ribbing is different, without umbilical thickening, and its suture-line is unknown. "*Holcodiscus*" *hauthali*, Paulcke, is even less like the Indian "*H.*" *bhavani*, "*H.*" *aemilianus*, etc., with which it was compared, so that the small "*H.*" *tenuistriatus*, Paulcke, with its ally, *Grossouvrites gemmatus*, may possibly go up into the Maestrichtian, whereas "the common forms of *Kossmaticeras* are of Upper Campanian age". When I suggested this on a previous occasion (1940, p. 53), however, I was chiefly concerned with reconciling the presence of a *Kossmaticeras* in a fauna of which the principal element was *Eubaculites* of the group of *E. vagina*. After Haug I had always taken this to be a typical Maestrichtian element.

In India, the true *Kossmaticeras theobaldianum* occurs already in the Upper Trichinopoly Group which has yielded species of presumed Santonian age. *K. aemilianum* was associated with *K. kalika* in the Ariyalur Group and has thus generally been taken to be of later age. This suggests that Kossmaticeratidae had a comparatively long range, in spite of the fact that they are a highly specialised group. Moreover, since *Kossmaticeras buddhaicum* with umbilical tubercles, and the untuberculate *K. bhavani* occur together in the Upper Trichinopoly Group of Varagur, and since both tuberculate and untuberculate Kossmaticeratids are still associated in presumably much later deposits, it is difficult to tell which of their characters are of chronological significance. It may be noted, however, that no Kossmaticeratid, except *Brahmaites*, which occurs in the Maestrichtian of Europe, has yet been found in the Valudayur Group of India.

Since it has been impossible to assign definite dates to the Antarctic assemblages on the basis of their Kossmaticeratid ammonites, it could be suggested that the Pachydiscidae might offer a more satisfactory means of dating them. Unfortunately the Antarctic Pachydiscids are as yet very incompletely known, and the presence of such external casts as have been figured by Kilian and Reboul (pl. vi, fig. 2) and the writer in the present work (Plate X, fig. 7) indicates that a new fauna of possibly very large Pachydiscids may yet be brought back by future expeditions. Meanwhile, Kilian and Reboul's *Pachydiscus* aff. *gollevillensis* (d'Orbigny) may be accepted as a Maestrichtian fossil, though Besairie (1936, p. 92) found that species both above and below beds with *Hoplitoplacenticeras*, here believed to be of basal Maestrichtian age. The Pachydiscid now described as *Patagiosites* aff. *amarus* (Paulcke) is related to a group of forms from South Patagonia which includes *Anapachydiscus patagonicus*, *A. hauthali* and *A. steinmanni* (Paulcke). This group was stated to be very close to the Japanese *A. naumanni* (Yokoyama), at least in regard to ribbing; and it is interesting to note that Shimizu (1935) recognised a zone of *A.* ("*Neopachydiscus*") *naumanni* as the top-zone but one of his Maestrichtian.

On the other hand, in Madagascar, Besairie (1936, p. 93) found these species (*Anapachydiscus patagonicus*, *A. hauthali*) in his zone 5 which, as in Patagonia, was also below the *Hoplitoplacenticeras* beds. They could thus well be taken to be of Upper Campanian age; only since this zone 5 itself is underlain, first, by sandstones with echinoids, and then by a bed with *Hauericeras gardeni* and *Pseudoschloenbachia umbulazi* (Baily), characteristic of the top of the Campanian (Shimizu, 1935, p. 166), I am now accepting zone 5 as already of Maestrichtian age. It may be noted that both the Pachydiscids recorded by Kilian and Reboul came from beds higher than the "Snow Hill Beds" with *Gunnarites antarcticus*.

The typical Patagonian genus *Hoplitoplacenticeras* has not been found in Graham Land, but it may here be discussed because it is so widely distributed in beds at about the limit between the Campanian and Maestrichtian and because the contemporary Pachydiscids are not a satisfactory group of ammonites for dating the deposits, as Besairie has pointed out. *Hoplitoplacenticeras* has long been known from various parts of Europe, ranging from Galicia to Portugal; it was described from the Nanaimo Beds of Vancouver Island as long ago as 1876 (*H. vancouverense*, Meek sp.), but the prolific *H. plasticum* fauna of South Patagonia was not made known until 1906. Then Besairie (1929) recorded the genus from Madagascar; and I may add that a specimen of his *H. vari* (Schlüter) from Trangahy, Antsalova, which I owe to the kindness of the author, is identical with the Patagonian "*H. plasticum-semicostatum*", Paulcke sp. (1906, pl. xiv, fig. 2). Finally, *Hoplitoplacenticeras* was reported as occurring at Egito in Angola (Spath, 1940, p. 52) with species close to *H. dolbergense* (Schlüter), though there is quite a range of forms, some of them very near to species of the Patagonian *plasticum* group.

I referred to this undescribed fauna as of Upper Campanian age, since Haug included in that stage his zone of *H. vari* which corresponded approximately to the zone of *H. coesfeldiense* or the lower *mucronata* beds in the meaning of Imkeller (1901, p. 12) who, however, recorded typical Maestrichtian ammonites from the beds (Pattenauer Marls) that yielded his *H. vari*, var. *praematura*. This might be held to be an early type, but it shows no close affinity with *Metaplacenticeras*, Spath, 1926, or *Haresiceras*, Reeside, 1927, which could be taken to connect *Hoplitoplacenticeras** with the family Placenticeratidae. On the contrary, Imkeller's form compares more favourably with the Fresville (Valognes) *H. lafresnayanum* (d'Orbigny) of Maestrichtian age which has a simple suture-line.

* Paulcke did not select a type of the genus *Hoplitoplacenticeras*; in fact, he did not himself use the name, and as Cossmann (1907, p. 139) pointed out, the genus was proposed in complete disregard of the Rules of Nomenclature. I adopted the name as a generic name on previous occasions (e.g. 1922, p. 111) and Diener (1925, p. 177) listed it in his Catalogue. He gave *H. plasticum* as the type species, but included other species in the old genus *Hoplites*. Diener did not mention the genus *Dechenoceras* which was apparently first used in Kayser (1924, pp. 174–6) for *Amm. coesfeldiensis*, Schlüter (1867, p. 14, pl. i, figs. 1 a–c); and since Paulcke stated that the inflated *Amm. dolbergensis*, Schlüter stood in the same relationship to *Amm. coesfeldiensis* as did the group of *H. plasticus crassus* to the group of *H. plasticus laevis*, it might be thought that the two genera *Dechenoceras* and *Hoplitoplacenticeras* could be kept distinct for the European and American types respectively. It is true that there is no very close resemblance between *Hoplitoplacenticeras laevis*, Paulcke and *Amm. coesfeldiensis*, Schlüter; yet there is no exact information regarding the relative ages and the significance of the morphological differences of the forms of this variable group so that it seems premature to subdivide them on the basis of the coarseness or fineness of the ornamentation or of geographical distribution. Meanwhile, however, it is advisable to select a definite type-species of *Hoplitoplacenticeras* from among the various *plasticus* forms of Paulcke and I propose to take as the typical *H. plasticum* the species represented by Paulcke's pl. xiii, figs. 1, 1 a–d (1906, p. 204 = "*H. plasticus semicostatus*") which is intermediate between the extremes, *H. hauthali* and *H. laevis*.

d. ANGOLA

The fauna of Egito, Angola, above mentioned, consists of the following species:

Pseudophyllites sp. nov. (evolute)
Gaudryceras sp. (*varagurense*, auct. *non* Kossmat)
Epigoniceras (?) sp. ind.
Desmophyllites diphylloides (Forbes), Pl. II, fig. 6
Oiophyllites angolaensis, sp. nov. Pl. VI, fig. 6
Eupachydiscus sp. (cf. *haradai*, Jimbo sp.)
Gen. nov. (*Kitchinites* ?) sp. nov.
Hoplitoplacenticeras (various species)
Bostrychoceras polyplocum (Römer) Schlüter, *pars*
Bostrychoceras sp. nov. (cf. *punicum* ?, Pervinquière)
Polyptychoceras cf. *pseudogaultinum* (Yokoyama)
Eutrephoceras aff. *simile* sp. nov., Pl. XIII, fig. 7

The examples of *Hoplitoplacenticeras*, already referred to, are sufficient by themselves, to prevent the fauna from being placed lower than the very top of the Campanian, but it will be noticed that the list includes forms that have been recorded from earlier horizons. Thus *Desmophyllites diphylloides* has been referred to the Santonian by Pervinquière (1907, p. 140) but wrongly; for in the writer's opinion the whole fauna from Jebel Selbia was misjudged and placed too low. Again, Collignon's (1931, p. 15) *Desmoceras* (*Latidorsella*) *diphylloides*, var. *besairiei* from Madagascar, with only four bifid saddles in its suture-line, does not belong to Forbes's species. Although I first assigned this Egito fauna to the Upper Campanian, I do not now see why it could not equally well be considered to be basal Maestrichtian.

It should be added that there is another Senonian fauna before me from Angola ("well stratified clays in the valley of the Cavaco, Benguela") with the ammonites unfortunately all crushed and therefore difficult to recognise. But at least some of the impressions are recognisable by their dimensions alone as probably *Hauericeras gardeni* (Baily), so common in South Africa and characteristic especially of the Campanian. This form is associated with a species of *Damesites*; indeterminable, crushed Pachydiscids; and a particularly large proportion of uncoiled forms (*Neancyloceras*, etc.). This presumed Campanian here rests directly on Upper Albian, but there is no Cretaceous higher than the latter between Benguela and Lobito. Farther south, however, the upper beds of S. Nicolau, near Salinas, following on a basalt sill, contain Senonian fossils again, among them *Cardita beaumonti*. The only cephalopods from these beds are *Eutrephoceras indicum* (Spengler) and *Baculites asper* (Morton) Meek, but I am unable to place them definitely within the Senonian.

Haughton (1925) already recorded from farther north (Massangano) the Santonian *Placenticeras reineckei*, Haughton, which is not unlike the South-West African *P. merenskyi*, Haughton, 1930. Moreover, Turonian ammonites (see Haughton, 1925, p. 266) and a beautiful Cenomanian ammonite fauna (from the Salinas Limestone, see Spath, 1931, p. 316) are now known from Angola, so that the shore-line throughout the Upper Cretaceous was probably just on or just off the present coast. Believing, as I do, that the continents and oceans were already much like they are at the present day in Eotriassic times (Spath, 1930, p. 87), and the suggestion of a West African bay of the Tethys penetrating the Brazilo–African continent (Spath, 1922, p. 155) having been abandoned almost as soon as it was put forward, such temporary transgressions throughout the Upper Cretaceous are of no special significance. But they will be of use in our investigation as to whether the Indo-Pacific or the Atlantic type of fauna, in the meaning of Kilian and Reboul, is represented in the Antarctic deposits.

The presence of Maestrichtian ammonoids in Angola, first announced in papers by the writer (1921, 1922), was confirmed by Haughton (1925) who described some typical forms like *Libycoceras*; others were added by Haas (1943), but a magnificent new collection from the mouth of the River Dande, was sent to me by M. Henrique O'Donnell as long ago as 1930. The cephalopods in this collection were not specially referred to in Mouta and O'Donnell (1933, p. 64), but in view of their importance and of the fact that they are partly undescribed, a full list is now given:

Neophylloceras ultimum, sp. nov. (Plate VII, fig. 7)
Paraphylloceras surya (Forbes)
Menuites macgowani, Haughton
Sphenodiscus sp. nov. (*lenticularis* group)
Gen. nov. ("*Sphenodiscus*") sp. nov. (Plate III, fig. 6)
Libycoceras angolaense, Haughton
Libycoceras sp. nov.

Bostrychoceras polyplocum (Römer) Haughton
Nostoceras angolaense, Haughton
Nostoceras helicinum (Shumard) Haas
Nostoceras maria-there-sianum, Haas
Axonoceras angolanum, Haas
Didymoceras hornbyense (Whiteaves) Haughton
Solenoceras bembense, Haas
Oxybeloceras binodosa, Haughton
Glyptoxoceras cf. *indicum* (Forbes) Haughton
Phylloptychoceras sp. nov.
Baculites subanceps, Haughton
Baculites sp. ind.

There is not a single form in this latest Cretaceous fauna which also occurs in the earlier Maestrichtian assemblage from Egito. Deposits of Sphenodiscan age are known in many areas north of the equator, ranging from the Valudayur Beds of Pondicherry and the *Indoceras* beds of Baluchistan to the Maestrichtian limestones with *Sphenodiscus* or *Libycoceras* of Persia, Iraq, Transjordania, Palestine and Egypt to the classical deposits of Europe and North America, the latter including those formed in the extended Gulf of Mexico and on the Atlantic coast, but not in the Pacific area. The statement by Böse (1927, p. 188) that in northern Mexico *Sphenodiscus* occurs only in the Lower Maestrichtian requires correction. The various beds with *Sphenodiscus* and *Coahuilites* he discussed are of Upper Maestrichtian age, as here understood, and it is only the very poor representation of the earlier horizons (by beds with *Exogyra costata*) that misled him. That is to say, Böse did not allow for the various ammonite faunas known to have existed between the Santonian–Campanian *Placenticeras* fauna and the Upper Maestrichtian Sphenodiscan Age, especially the real Campanian ammonite assemblages, and envisaged a far too condensed succession.

In the southern hemisphere deposits with *Sphenodiscus* have so far been found only on the east coast of Brazil (Parahyba do Norte) apart from those in Angola, on the opposite side of the Atlantic, but farther south, and the south of Madagascar. I cannot believe that, if the Sphenodiscids could spread from as far north as New Jersey and the Maestricht area (Limburg) to Angola and Madagascar in the south, they could not have migrated beyond, say to Patagonia, as did the earlier *Hoplitoplacenticeras* and the Pachydiscids. It follows that in most of the circum-Antarctic areas here reviewed, i.e. Graham Land, New Zealand, Chili, Patagonia, South Africa and West Australia there is no higher Maestrichtian or at least there are no ammonitiferous deposits of that age, so far as we know at present.

e. SOUTH AFRICA

The Upper Cretaceous fauna of Natal was thought by Kilian (1906) to have an Indo-Pacific aspect and to be closely comparable to the fauna of Graham Land, though less so than the assemblages known from Peninsular India. At that time the description of the Pondoland fauna by H. Woods (1906) had just appeared and it was considered to be of Upper Campanian age. Woods, however, pointed out that *Pseudophyllites indra* (Forbes) which could not be of earlier age, occurred already in the basement bed of the Pondoland deposits. Contrary to Grossouvre (1901), who had put the fauna as low as the limit between the Coniacian and the Santonian, the writer (Spath, 1921, p. 54) then moved the whole of the Pondoland fauna up into the Upper Senonian (Campanian+Maestrichtian), but we may both have been wrong in accepting it as of one uniform age. Although more recently Stephenson (1941, p. 44) considered some of the Pondoland mollusca more or less analogous to species from the Atlantic and Gulf Coastal Plain of the Eastern States (of late Campanian and Maestrichtian age), it could still be held that three of the typical elements of the Pondoland fauna, namely *Pseudoschloenbachia umbulazi* (Baily), *Submortoniceras* and *Kossmaticeras* are probably Campanian, while a fourth (*Hauericeras gardeni*, Baily sp.) is even now recorded from the Maestrichtian of Poland (Pozaryski, 1938; Jeletzky, 1951). Another characteristic Pondoland genus, however, *Eulophoceras*, Hyatt, has more recently been claimed to be of earlier age (Hourcq, 1949).

With the exception of *Pseudophyllites indra* which attains an unusually large size in Pondoland, the genera of Maestrichtian affinities are represented only by small or fragmentary specimens which might be considered insufficient for definite dating. Thus the Japanese *Oxybeloceras quadrinodosum* (Jimbo), doubtfully recorded from Pondoland, is listed from the Lower Maestrichtian by Shimizu (1935, p. 190); but Matumoto (1943, p. 133) gives its range as from the Upper Santonian to the Maestrichtian. Another Japanese species, *Neocrioceras spinigerum* (Jimbo), also Maestrichtian in Shimizu (p. 171), is doubtfully listed by Matumoto (p. 132) as Santonian to Campanian. The species of *Glyptoxoceras* of the Valudayur Group are of Maestrichtian age, and so, perhaps, are the Pondoland fragments figured by Woods; but according to Matumoto, *Glyptoxoceras* occurred already in the Campanian. Conversely, there is no sign of elements like *Hoplitoplacenticeras*, found in Angola as well as Madagascar, not to mention the still higher Maestrichtian *Sphenodiscus* and associates. The Pondoland ammonites, coming from a condensed deposit, represent several zones; and even if there be forms of the Lower Maestrichtian, the majority are of Campanian or even earlier Senonian age. The Kossmaticeratidae show a general resemblance to those of Graham Land though the small form figured by Woods may be the only one that is really closely comparable to an Antarctic species.

The Senonian ammonite faunas of Zululand, discussed by the writer in 1921, and including Coniacian and Santonian as well as Campanian elements, are even less closely comparable to the Antarctic fauna here described than is the Pondoland fauna. There is nothing definitely known to be of Maestrichtian age, except possibly the single fragment of *Glyptoxoceras indicum* (Forbes); for the uncoiled forms described as *Nostoceras* ? and *Bostrychoceras* seem to resemble Campanian Fort Pierre forms of North America more than any other. Like the still more incompletely known fauna of Conducia in Portuguese East Africa, the assemblages recorded from Pondoland and Zululand include some ammonites of colossal dimensions; but in view of the far richer faunas known from the Upper Cretaceous of Madagascar it seems best to defer discussion of the mixed South African assemblages until there is more exact stratigraphical information.

In this connection I may mention that some years ago, by the kindness of Dr. S. H. Haughton, I saw certain (still undescribed) Middle and Lower Albian and Upper Aptian faunas from northern Zululand and I was astounded at the variety of new and unexpected types of ammonites that they contained. Yet the faunas also included more familiar forms and in time, no doubt, they will fit into and complement our accepted chronology. Unfortunately that time is not in sight. But I agree with Buckman (1922, p. 14) that the successive faunal developments that mark our chronology are probably world-wide, at least in the case of ammonites. And although I believe that we shall not for many years, if ever, arrive at perfect synchronisation of deposits in different provinces the reason is largely geological and not geographical. As Buckman said, the differences in the faunas are mainly due to differences of preservation of corresponding strata in the different provinces—in the south is preserved what the north has lost and *vice versa*. This was an exaggeration and invited contradiction; but broadly speaking it is proving true and vindicating Buckman's teaching of the significance of dissimilar faunas.

f. MADAGASCAR

Madagascar has a surprisingly varied succession of Upper Cretaceous ammonite faunas and may, in time, become a standard of comparison for other areas in the southern hemisphere. Unfortunately there are differing interpretations of the succession in different parts of the island, and the stratigraphy is perhaps not as simple as it appears. But the ammonite faunas are very interesting, well illustrated, at least in part, and may be discussed here, although there are few elements in common with the Graham Land fauna. Thus the Kossmaticeratidae, the dominant ammonite family in the Antarctic, has recently been stated to be well represented in Madagascar; yet, according to V. Hourcq (1950, p. 75), its species have not hitherto proved useful for sub-dividing the beds and in any case they have not yet been systematically described. Even less encouraging have been the results so far obtained by various authors from a study of the numerous Madagascan species of another ammonite family here dealt with, namely the Pachydiscidae.

In fact, the surprising richness and variety of the Madagascan ammonite assemblages seem to have perplexed those who described them. Thus, in an early report, Boule, Lemoine and Thévenin (1907) figured two forms of "*Sphenodiscus*" which might have been taken to indicate the presence of deposits of the latest of all ammonite ages (the Sphenodiscan Age of the Upper Maestrichtian). In reality, one of the Madagascan forms is a Turonian *Coilopoceras*, the other an Upper Albian *Manuaniceras*. Another Maestrichtian species, *Eubaculites vagina* (Forbes), has been consistently misinterpreted by all the authors writing on Madagascar. The premature records of other forms of "*Sphenodiscus*" from the Lower and Middle Campanian in one of the latest publications (Collignon, 1948, pp. 105–6) suggest still more misidentifications and do not inspire confidence in that author's chronology (table on p. 108). Similarly, Hourcq's suggestion that *Hauericeras gardeni*, above cited (p. 50), ranges throughout the Santonian and Campanian, "if it has been correctly interpreted", merely adds to the difficulties of Madagascan stratigraphy.

It may be recalled in this connection that Besairie in 1936 directed attention to certain anomalies. For example the well-known Maestrichtian *Pachydiscus neubergicus* (Hauer) occurred already below his horizon of *Hoplitoplacenticeras vari*; another Maestrichtian *Pachydiscus*, *P. gollevillensis* (d'Orbigny), was found both above and below *H. vari*. It has already been mentioned that Besairie's "*H. vari*" includes forms of the *plasticum* group; and in Normandy the closely allied *H. lafresnayanum* (d'Orbigny) occurs in the Maestrichtian Baculite Limestone.

This suggests that the Madagascan *Hoplitoplacenticeras* beds are later than Grossouvre's zone of *H. vari* and that they may be already of post-Campanian age, as in fact all of that author's Upper Campanian species are now considered to be Maestrichtian. In restricting the Campanian we thus come back to the two classical but comprehensive zones of *Submortoniceras delawarense* above and of *Diplacmoceras bidorsatum* below. The latter may be absent in Madagascar, like the whole of the Upper Santonian (zone of *Placenticeras syrtale*), especially in the southern half of the island.

Collignon has almost certainly misinterpreted the gigantic Pondoland species, *Amm. soutoni* and its ally, *Amm. stangeri*, Baily, which he wrongly referred to the genus *Texanites*. The former is a *Submortoniceras*, close to *S. woodsi*, but the holotype, with half a whorl of body-chamber, is no less than 470 mm. in diameter and the thickness of the test is 10 mm. near the end. The somewhat less large but far commoner "*Mortoniceras*" *stangeri* is a companion species of *Pseudoschloenbachia umbulazi*, Baily sp. (in the same hand-specimen), and since the latter is said to occur commonly in Madagascar, it is curious that *Amm. stangeri* has not been found. Nevertheless, Hourcq (1950, p. 84) listed both *Amm. soutoni* and *Amm. stangeri*, with *Pseudoschloenbachia umbulazi*, from the top of his "Santonian", together with the typical South African genera *Eulophoceras* and *Diaziceras*, apparently because they were found at what he calls a horizon "slightly higher" than that of the typical Lower Santonian *Texanites texanus*. In view of the proved incompleteness of all the known successions, I am not convinced that there is no stratigraphical gap between what Lower Santonian beds there may be in that part of Madagascar and the Campanian beds with *Submortoniceras* above; and this may well account for the different interpretations of the Campanian "transgression" given by Besairie and his successors.

The genera just mentioned do not occur in Graham Land and the local Madagascan "Texanitidae" are difficult to appraise until the remaining ammonites are described; but to show how incompletely informed we are I may mention that Knechtel (1947) recorded what appears to be a form of *Eulophoceras* from the Peruvian Andes, associated with *Tissotia* and, indirectly, *Lenticeras*. This would indeed take *Eulophoceras* a long way below the Upper Campanian zone of *Submortoniceras delawarense*, in the lower half of which it could be placed, even in the chronology of Hourcq (1950, p. 74). On the other hand, that author thought that the Coniacian forms of "*Eulophoceras*" (so-called *Hemitissotia* and *Plesiotissotia* of Karrenberg, 1935) belonged to a more primitive group, still close to the common ancestor of the family Tissotidae. But they certainly resemble the later and more typical species of this supposed long-ranged genus.

Eulophoceras, however, in my opinion, is more closely related to *Pseudoschloenbachia* and *Diaziceras*, which are not long-lived types, and it is directly connected by way of forms like *E. bererense*, Hourcq, with the new genus *Manambolites*, Hourcq, which is described as of Middle or Upper Campanian age. Since its author included in *Manambolites* also a Maestrichtian form from Palestine, originally described as ?*Sphenodiscus*, the new genus may be looked upon as one more of the various transitions between these long-lived Lenticeratidae (=Eulophoceratidae) and the true Maestrichtian Sphenodiscidae. But it would be rash to assume the latter family to be monophyletic and it must be admitted that owing to the incompleteness of the Geological Record and our ignorance of 75% or more of the organisms that once lived, we are not as yet in a position to offer more than a few conjectures as to the possible relationship of the ammonite families mentioned.

Although Hourcq (1950, p. 105) did not mention Maestrichtian ammonites from Madagascar, it should here be added that E. Basse (1928) recorded from the south that well-known fossil, *Sphenodiscus lenticularis* (Owen), a species which she described as *connu seulement dans le Maestrichtien de l'Amerique du Nord*. It was said to be associated with abundant specimens of a new form of *Calyptrea* which resembled *C. trochiformis* of the Paris Eocene, but the ammonites do not seem to have been figured so far. Since there are no marine Upper Maestrichtian deposits in Graham Land, the occurrence of *Sphenodiscus* in Madagascar may appear irrelevant; but it is mentioned here because, as I have stated before (1939, p. 151), I believe that ammonite assemblages are largely composed of the same elements all over the world if they are strictly contemporaneous, and that only assemblages of the very smallest subzones are really comparable. The re-discovery of the South African *Submortoniceras* and *Pseudoschloenbachia* in the Campanian of Japan (Shimizu, 1935, p. 190) is a case in point, and now we know that they are of different age, it is easy to see why Kilian and Reboul's "Indo-Pacific" type of Neocretaceous differed so much from their "Atlantic" type. It would be futile to deny the existence of local provinces in the Upper Cretaceous which must have influenced the composition of Mesozoic molluscan populations as much as they do at the present day.

It may also be admitted that the different groups of ammonites did not modify in exactly the same way and at precisely the same rate in the different provinces. But it is useless to ascertain the percentage of species common with the Upper Cretaceous of India while the identifications of the supposed Madagascan counterparts are so obviously open to correction. On the other hand, I am impressed by the agreement among the Lower Maestrichtian ammonite assemblages of Madagascar, Angola and Patagonia which all include the same *Hoplitoplacenticeras* group, whatever its local variants. If deposits of exactly the same age and a suitable facies were laid down elsewhere in the circum-Antarctic province, I feel confident that they will eventually yield the same ammonite assemblage, just as the peculiar Liassic genus *Bouleiceras*, at one time considered sufficiently aberrant to suggest for Madagascar the creation of a special zoological province, is now being found in most countries around the Arabian Sea. That is to say, parallelisation of ammonite faunas from one continent to another will probably become more and more exact as our knowledge of the less accessible parts of the world increases.

It will be seen that unfortunately the succession in the different parts of Madagascar is not nearly well enough correlated to be accepted as a standard for our more general chronology.

g. WEST AUSTRALIA

The ammonite fauna of the uppermost Cretaceous of West Australia has only recently been described and in the absence of further material or stratigraphical detail I have nothing to add. The fauna, however, because of its limitations, illustrates the difficulties of parallelisation of ammonite faunas from distant parts of the world. For there are two forms, a *Kossmaticeras* and a *Kitchinites*, that may not appear to be of later age than Campanian (but see p. 47); yet on account of their association with what everybody considered a typical Maestrichtian element, namely *Eubaculites* (group of *E. vagina*, Forbes sp.), the whole fauna was described as Maestrichtian. It is true that I suggested that the fauna might include heterogeneous elements; that is to say that the assemblages from the two localities concerned were not strictly isochronous. They may well include ammonites from just above as well as just below the border-line between the Campanian and the Maestrichtian.

As regards *Eubaculites*, it is known definitely only from India, West Australia, Chile and Peru; and while there is no reason why it should not also occur in Madagascar, the examples so far figured as *Baculites vagina* are not forms of *Eubaculites*. On the other hand, it is probable that the genus existed but has not been recognised elsewhere. For example, the Libyan *Baculites anceps* figured by E. Alberici (1940, pl. xix, fig. 1) shows close resemblance to *E. vagina* and the genus will probably also be found in countries like Iraq that have such an exemplary though undescribed Maestrichtian succession. Meanwhile, it may be remembered that the solitary ammonite from Selwyn Rapids, New Zealand, is a Quiriquina species, *Grossouvrites gemmatus* (Huppé), which found no obstacle to its migration, probably along the northern coast of the Antarctic continent.

Fortunately every fresh discovery helps to confirm rather than undermine the still delicate structure of the stratigraphical column and even if exact parallelisation of ammonite faunas is not possible the approximation so far achieved encourages hope that inter-continental correlation will become less and less tentative.

5. SUMMARY

The Cretaceous Cephalopods of Graham Land are largely of Upper Campanian age. That is to say, the typical ammonites are all more or less of the same date, though some isolated local assemblages may conceivably come from a slightly earlier horizon or be of somewhat later, even basal Maestrichtian, age.

There is no trace of any form of Upper Maestrichtian (Sphenodiscan) age; conversely, there is no evidence for any pre-Campanian horizon and no justification whatever for Haug's assumption of a still earlier Lower Cretaceous (Barremian) transgression.

The affinities of the Antarctic ammonoids with those of India are not specially pronounced; there are only two species in common and those are, significantly, Valudayur, i.e. very late Cretaceous species. The same small number of identical species occur in the Upper Cretaceous faunas of Japan, New Zealand and Quiriquina (Conception Bay, Chile). Only one species each has been found in the corresponding deposits of Patagonia and North America. That is to say, the fauna is typically Antarctic, has affinities with the South American, South African and Australian Provinces of the Cretaceous and was as susceptible to intermingling with so-called Atlantic as with Indo-Pacific elements.

Knowledge of the Cretaceous stratigraphy of the southern hemisphere is as yet appallingly scant. This is one reason why synchronisation has to be vague and approximate. Illustrations are adduced from undescribed African Cretaceous faunas that do not at first sight fit into our existing chronology. Yet it would have to be an extraordinary assemblage of heterodox ammonites whose average would not indicate its position in the stratigraphical time-scale as accurately as can be expected (Spath, 1933, p. 885).

D. SUMMARY OF NEW NAMES

Genus **Phylloptychoceras,** nov. (p. 18)
Type: *Ptychoceras sipho,* Forbes
Genus **Indoscaphites,** nov. (p. 14)
Type: *Scaphites cunliffei,* Forbes
Genus **Oiophyllites,** nov. (p. 21)
Type: *O.* **decipiens,** sp. nov. (p. 21)
includes also *O.* **angolaensis,** sp. nov. (p. 21)
Genus **Neograhamites,** nov. (p. 27)
Type: *N.* **kiliani,** sp. nov. (p. 27)
includes also *N.* **taylori,** sp. nov. (p. 28)
Genus **Patagiosites,** nov. (p. 38)
Type: *Amm. patagiosus,* Schlüter
Neophylloceras **meridianum,** sp. nov. (p. 4)
Neophylloceras **ultimum,** sp. nov. (p. 4)
Pseudophyllites **peregrinus,** sp. nov. (p. 7)
Diplomoceras **lambi,** sp. nov. (p. 17)
Maorites **pseudobhavani,** sp. nov. (p. 25)
Jacobites **crofti,** sp. nov. (p. 27)
Gunnarites antarcticus (Stuart Weller) var. **monilis,** nov. (p. 31)
Gunnarites bhavaniformis (Kilian and Reboul) var. **vegaensis,** nov. (p. 33)
Gunnarites kalika (Stoliczka) var. **gracilis,** nov. (p. 34)
Gunnarites kalika (Stoliczka) var. **nana,** nov. (p. 34)
Gunnarites **pachys,** sp. nov. (p. 34)
Gunnarites **pachys,** var. **media,** nov. (p. 35)
Gunnarites **flexuosus,** sp. nov. (p. 35)
Gunnarites **flexuosus,** var. **transitoria,** nov. (p. 35)
Gunnarites **rotundus,** sp. nov. (p. 36)
Gunnarites **rotundus,** var. **kalikaformis,** nov. (p. 37)
Gunnarites **rotundus,** var. **compressa,** nov. (p. 37)
Gunnarites **paucinodatus,** sp. nov. (p. 37)
Eutrephoceras **simile,** sp. nov. (p. 40)

E. LIST OF WORKS CITED

ADKINS, W. S. 1928. Handbook of Texas Cretaceous Fossils. *Bull. Univ. Texas* (*Bur. econ. Geol.*) 2838, 1–385, pls. i–xxxvii.

ALBERICI, E. 1940. Contributo alla conoscenza dei cefalopodi cretacici della Libia. *Pubbl. Ist. Geol. Univ. Milano.* **24**, 165–88, pl. xix (1941).

ANDERSON, F. M. 1938. Lower Cretaceous Deposits in California and Oregon. *Spec. Pap. Geol. Soc. Amer.* 16, x–339, pls. 83, map.

BASSE, E. 1928. Sur quelques Invertèbres fossiles crétacés du sudouest de Madagascar. *C.R. Acad. Sci. Paris.* **186**, 452–54.

————. 1928a. Sur un curieux échantillon d'Ammonite. *Bull. Soc. géol. France.* (4) xxvii, 461–5, pl. xxv.

————. 1931. Monographie paléontologique du Crétacé de la Province de Maintirano, Madagascar. Gour. Gén. Madagascar. *Serv. d. Mines,* 1–86, pls. i–xiii.

BAYLE, E. 1878. Fossiles principaux des Terrains. *Mém. Carte géol. dét. France.* **4**, Atlas, 158 pls. Paris.

BARRABÉ, L. 1929. Contribution à l'étude stratigraphique et pétrographique de la partie médiane du pays Sakalave (Madagascar). *Mém. Soc. géol. France* (n.s.). **5**, 3–4, Mém. 12, 1–270, pls. i–x, map.

BESAIRIE, H. 1930. Recherches géologiques à Madagascar. *Bull. Soc. Hist. Nat.*, Toulouse. **60**, 345–624, pls. i–xxvii, 4 maps.

———. 1932. Fossiles caractéristiques du Nord et du Nord-Ouest de Madagascar. *Ann. géol. Serv. d. Mines, Madagascar.* **2**, 37–53, pls. 5–6. Tananarive.

———. 1936. Recherches géologiques à Madagascar. I. La Géologie du Nord-Ouest. *Mém. Acad. Malgache.* **21**, 1–259, pls. i–xxiv, tables.

BINKHORST, J. T. 1861. Monographie des Gastéropodes et des Céphalopodes de la Craie supérieure de Limbourg. II, 1–44, pls. i–ix.

BLAKE, J. F. 1902. List of Types, etc. Geol. Soc. London, 1–100.

BLANFORD, H. F. 1861, in Blanford and Stoliczka. Fossil Cephalopoda, Cretaceous Rocks, S. India. Mem. Geol. Surv. India, *Palaeont. Indica*, I, 1–40, pls. i–xxv.

BÖSE, E. 1927. Cretaceous Ammonites from Texas and Northern Mexico. *Bull. Univ. Texas* (*Bur. econ. Geol.*) 2748, 143–357, pls. i–xviii.

BOULE, M., P. LEMOINE and A. THÉVENIN. 1906–7. Paléontologie de Madagascar. III. Céphalopodes crétacés des environs de Diégo-Suarez. *Ann. Paléont.* **1**, 173–92, pls. i–vii (xiv–xx), **2**, 1–56, pls. viii–xv (i–viii).

BREISTROFFER, M. In Besairie, 1936 (q.v.). Fossiles de l'Albien moyen (niveau supérieur). 167–76, fig. 10.

———. 1947. Notes de Nomenclature paléozoologique. *Procès verb. mens. Soc. Sci. Dauphiné*, Grenoble. **26**, 195, 5 pp.

BURCKHARDT, C. 1912. Faunes jurassiques et crétaciques de San Pedro del Gallo. *Bol. Inst. Geol. Mexico.* **29**, i–viii, 1–264, pls. i–xlvi.

COLLIGNON, M. 1929. Les Céphalopodes du Cénomanien pyriteux de Diégo-Suarez. *Ann. Paléont.* **17** (1928), 139–60, pls. xv–xix, **18** (1929), 1–56, pls. i–ii.

———. 1931. Faunes sénoniennes du Nord et de l'Ouest de Madagascar. *Ann. géol. Serv. d. Mines, Madagascar.* Fasc. i, 1–64, pls. i–ix.

———. 1938. Ammonites campaniennes et maestrichtiennes de l'Ouest et du Sud de Madagascar. *Ibid.* Fasc. ix, 55–118, pls. i–ix.

———. 1948. Ammonites néocrétacées du Menabe (Madagascar). I. Les Texanitidae. *Ann. géol. Serv. d. Mines, Madagascar.* Fasc. xiii, 1–62, pls. vii–xx (i–xiv); suite, fasc. xiv, 64–120, pls. xv–xxxii.

CONRAD, T. A. 1860. Description of New Species of Cretaceous and Eocene Fossils of Mississippi and Alabama. *J. Acad. Nat. Sci. Philadelphia.* 2nd ser. **4**, 275–97 (1858–60).

CRICK, C. G. 1907. The Cephalopoda from the Deposit at the North End of False Bay, Zululand. Cretaceous Fossils of Natal. III, i. *Third Rep. Geol. Surv. Natal and Zululand.* 163–234, pls. x–xv.

DARWIN, C. 1846. Geological Observations on South America. Geol. Voyage Beagle. III, i–vii, 1–279, pls. i–v, map.

DIENER, C. 1925. Ammonoidea Neocretacea. Fossilium Catalogus, I. *Animalia.* **29**, 1–244.

DOUVILLÉ, R. 1910. Céphalopodes argentins. *Mém. Soc. géol. France, Paléont.* **18**, Mém. 43, 1 24, pls. xvii–xix.

FINLAY, H. J. and J. MARWICK. 1940. The Divisions of the Upper Cretaceous and Tertiary in New Zealand. *Trans. Roy. Soc. N.Z.* **70**, 77–135.

FORBES, E. 1845. Report on Cretaceous Fossils from S. Fé de Bogotá, etc. *Quart. J. Geol. Soc. Lond.* **1**, 174–9, figs.

———. 1846. Report on the Fossil Invertebrata from Southern India, collected by Mr. Kaye and Mr. Cunliffe. *Trans. Geol. Soc.*, London. (2) **7**, 97–174, pls. vii–xix.

———. 1846a. Descriptions of Secondary Fossil Shells from South America. Appendix to Darwin, C., 1846, q.v., 265–8, pl. v.

FOORD, A. H. 1891. Catalogue of the Fossil Cephalopoda in the British Museum (Nat. Hist.). II. *Nautiloidea.* i–xxvii, 1–407, figs.

GABB, W. M. 1864–9. Geological Survey of California. Palaeonotology. i, 1864, xx–243; pls. i–xxxii; ii, 1869, xiv–299, pls. i–xxxvi.

GERTH, H. 1928. Neue Faunen der oberen Kreide mit Hippuriten aus Nordperu. *Leidsche Geol. Meded.* **2**, 231–41, 4 figs.

GIGNOUX, M. 1921. Les Phylloceratidés du Paléocrétacé. In Kilian, etc. Contrib. à l'étude des Céphalopodes paléocrétacés du SE. de la France. *Mém. Carte géol. dét. France* (1920), 85–101.

GLAESSNER, M. F. 1942. Problems of Stratigraphic Correlation in the Indo-Pacific Region. *Proc. Roy. Soc. Victoria.* **55** (n.s.), 1943, 41–80, table.

GROSSOUVRE, A. DE. 1894. Recherches sur la craie supérieure. II. Paléontologie. Les Ammonites de la craie supérieure. *Mém. Carte géol. dét. France*, 1–264, pls. i–xxxix.

———. 1899. Sur l'*Ammonites peramplus* et quelques autres fossiles turoniens. *Bull Soc. géol. France* (3), xxvii, 328–35.

———. 1901. Recherches sur la craie supérieure. I. Stratigraphie générale, ii. *Mém. Carte géol. dét. France*, 561–1013, figs., tables.

———. 1908. Description des Ammonitidés du Crétacé supérieur du Limbourg, etc. *Mém. Mus. Roy. Hist. Nat. Belgique.* **4** (1906), 1–39, pls. i–xi.

HAAS, O. 1942. Some Upper Cretaceous Ammonites from Angola. *Amer. Mus. Novit.* 1182, 1–24, figs.

———. 1943. Some abnormally coiled Ammonites from the Upper Cretaceous of Angola. *Ibid.*, 1222, 1–19, figs.

HAUG, E. 1909. Traité de Géologie. II, fasc. 2. Periode Crétacée, 1153–1396, pls. cxiii–cxix, figs. Paris.

HAUGHTON, S. H. 1925. Notes on Some Cretaceous Fossils from Angola (Cephalopoda and Echinoidea). *Ann. S. Afr. Mus.* **22**, 4. 263–88, pls. xii–xv.

———. 1930. On the Occurrence of Upper Cretaceous Marine Fossils near Bogenfels, SW. Africa. *Trans. Roy. Soc. S. Afr.* **18**, 4, 361–5, pl. xi.

HOEPEN, E. C. N. VAN. 1920. Description of Some Cretaceous Ammonites from Pondoland. *Ann. Transvaal Mus.* **7**, 2, 142–7, pls. xxiv–xxvi.

———. 1921. Cretaceous Cephalopoda from Pondoland. *Ibid.* **8**, 1, 1–48, pls. i–xi, figs.

HOURCQ, V. 1949. Sur quelques Ammonites du Sénonien. Pal. de Madagascar, xxviii, *Ann. Paléont.*, xxxv, 89–117, pls. xi–xiii.

———. 1950. Les Terrains sedimentaires de la Region de Morondava. *Ann. géol. Serv. d. Mines, Madagascar.* Fasc. xx, 1–109, pl. i.

HUPÉ, L. H. 1854. In Gay: Fauna Chilena. Hist. Fis. y Polit. de Chile. Zool. **8**, 7–41, pls. i–ii.
HYATT, A. 1877. In Whiteaves: Report of Progress. *Geol. Surv. Canada for* 1876–7, 150–9.
———. 1900. Cephalopoda. In Zittel's Text-Book of Palaeontology. 1st English ed. (Eastman). 502–604. London and New York.
IMKELLER, H. 1901. Die Kreidebildungen und ihre Fauna am Stallauer Eck und Enzenauer Kopf bei Tölz. *Palaeontographica.* **48**, 1–64, pls. i–iii, map.
JACOB, C. 1908. Études sur quelques Ammonites du Crétacé moyen. *Mém. Soc. géol. France, Paléont.* **15**, mém. 38 (1907), 1–64, pls. i–ix.
JELETZKY, J. A. 1951. Die Stratigraphie und Belemnitenfauna des Obercampan und Maastricht Westfalens, etc. *Beihefte z. Geolog. Jahrb.* eft **1**, 1–142, pls. i–vii (Hanover).
JIMBO, K. 1894. Beiträge zur Kenntniss der Fauna der Kreideformation von Hokkaido. *Paläont. Abhandl.* N.F., II, 3, 149–94, pls. xvii–xxv.
KARRENBERG, H. 1935. Ammonitenfaunen aus der Nordspanischen Oberkreide. *Palaeontographica.* **82**, Abt. A, 125–61, pls. xxx–xxxiii.
KAYSER, E. 1924. Lehrbuch der Geologie. II. Geologische Formationskunde. viii, 1–657, 54 pls., 147 figs., tables.
KILIAN, W. 1906. Sur une faune d'Ammonites néocrétacée recueillie par l'expédition antarctique suédoise. *C.R. Séances Acad. Sci. Paris*, 29 janvier, 1906.
———. 1922. Note sur une faune d'Ammonites de Nouvelle-Zélande, decouverte par M. Marshall. *C.R. Séances Soc. géol. France.* No. 14, 175–6.
——— and P. REBOUL. 1909. Sur une faune néocrétacée des Regions antarctiques. *C.R. Ass. Franç. Avancem. Sci.* Congrès de Clermont-Ferrand (1908), 440–53.
——— and P. REBOUL. 1909. Les Céphalopodes néocrétacés des Îles Seymour et Snow Hill. Wiss. Ergebn. Schwed. Süd-Pol. Exp. 1901–3. III, 6. 1–75, pls. i–xx.
KNECHTEL, M. M. 1947. In Knechtel, Richards and Rathbun: Mesozoic Fossils of the Peruvian Andes. *Johns Hopkins Univ. Stud. Geology*, No. 15, 1–150, pls. i–l.
KOSSMAT, F. 1895–8. Untersuchungen über die südindische Kreideformation. I. *Beitr. Paläont. Geol. Österr.-Ung.*, ix, 97–203, pls. xv–xxv. II. *Ibid.* xi, 1–46, pls. i–viii. III. *Ibid.*, 89–152, pls. xiv–xix.
MARSHALL, P. 1926. Upper Cretaceous Ammonites of New Zealand. *Trans. Proc. N.Z. Inst.* **56**, 129–210, pls. xix–xlvii.
———. 1927. A Kaipara Ammonite. *Ibid.* **58**, 357–8, pls. 36–7.
MARWICK, J. 1934. The Sequence of Molluscan Life in New Zealand. *Proc. Fifth Pacific Science Congress, Canada*, 1933. **3**, 947–60.
———. 1950. The Type of the Ammonite *Madrasites mckayi* (Hector). *Trans. Roy. Soc. New Zealand.* **78**, 482–4, pl. 59.
MATUMOTO, T. 1938, *Zelandites*, a Genus of Cretaceous Ammonites. Contribution to the Cretaceous Palaeontology of Japan. IV. *Jap. Journ. Geol. Geogr.* **15**, 137–48, pl. xiv.
———. 1942. A Note on the Japanese Cretaceous Ammonites belonging to the Sub-family Desmoceratinae. *Proc. Imp. Acad. Tokyo.* **18**, 1, 24–9, Figs.
———. 1943. A Note on the Japanese Ammonites belonging to the Gaudryceratidae. *Ibid.* 10, 666–70, figs.
———. 1943a. A Note on the Japanese Ammonoid Species belonging to the Tetragonitidae. *Ibid.* 671–3, fig. 1.
———. 1943b. A Short Note on the Japanese Cretaceous Phylloceratidae. *Ibid.* 674–6, figs.
———. 1943c. Fundamentals in the Cretaceous Stratigraphy of Japan. Parts ii and iii. *Mem. Fac. Sci. Kyusyu Univ.* Ser. D, ii, 1. 97–237.
MAURY, C. J. 1930. O Cretaceo da Parahyba do Norte. *Monogr. Serv. geol. min. Brasil.* **8**, 1–305, i–xxiii, pls. i–xxxv, map.
MEEK, F. B. 1876. A Report on the Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country. U.S. Geol, Surv. Territ. IX (Meek and Hayden), i–lxiv, 1–629, pls. i–xlv.
———. 1876a. Descriptions and Illustrations of Fossils from Vancouver's and Sucia Islands. Bull. U.S. Geol. and Geogr. Surv. Territ. II, 4. 351–74, pls. i–vi.
MORTON, S. G. 1834. Synopsis of Organic Remains of the Cretaceous Group of the United States, 1–88, pls. i–xix. Philadelphia.
———. 1841. Description of some new species of organic remains of the Cretaceous group of the U.S. *J. Acad. Nat. Sci. Philadelphia.* **8**, 2, 207–27.
———. 1842. Description of several species of fossil shells from the Cretaceous deposits of the U.S. *Proc. Acad. Nat. Sci. Philadelphia.* **1**, 1841–3. 106–10.
MOUTA, F. and H. O'DONNELL. 1933. Carte géologique de l'Angola. Rep. Portug. Minist. d. Colon., Colon. d. Angola. Lisboa. 1–87, map.
NAGAO, T. and R. SAITO. 1934. Peculiar Septal Features observed in Ammonites of certain Lytoceratid Genera. *Proc. Imp. Acad. Tokyo.* **10**, 6. 357–60, figs.
NOWAK, J. 1908–13. Untersuchungen über die Cephalopoden der oberen Kreide in Polen. *Bull. Acad. Sci. Cracovie.* Cl. math.-nat., Ser. B. Sci. Nat. I (1908) 327–53, pl. xiv; II (1911) 547–89, pls. xxxii–xxxiii; III (1913) 335–415, pls. xl–xlv.
OLSSON, A. A. 1944. The Cretaceous of the Paita Region. Contrib. Pal. N. Peru, No. 111. *Bull. Amer. Paleont.* xxviii, 1–146, pls. i–xvii.
ORBIGNY, A. DE. 1840–2. Paléontologie Française, Terrains Crétacés. 1–662, pls. i–cxlviii.
———. 1848. In Dumont-d'Urville: Voyage au Pol Sud et dans l'Océanie meridionale. (Voyage de l'Astrolabe). Géol., pls. i–vi (Paléont.).
PAULCKE, W. 1906. Die Cephalopoden der oberen Kreide Südpatagoniens. *Ber. Naturf. Ges. Freiburg i.B.* **15**, 167–244, pls. x–xix.
PERVINQUIÈRE, L. 1907. Études de Paléontologie Tunisienne. I. Céphalopodes des terrains secondaires. *Mém. Carte géol. Tunisie.* 1–428, pls. i–xxvii.
PETHÖ, J. 1906. Die Kreide- (Hypersenon-) Fauna des Peterwardeiner (Pétervárader) Gebirges (Fruska Gora). Palaeontographica, **52**. 57–160, pls. v–xi.
PIROUTET, M. 1917. Étude stratigraphique sur la Nouvelle Calédonie (Thèse). Protat Frères, Macon. 1–313, Sections, map.
POZARYSKI, W. 1938. Senonstratigraphie im Durchbruch der Weichsel zwischen Rachöw und Pulawy in Mittelpolen. *Serv. géol. de Pologne. Bull.* 6. Instit. géol. de Pologne, 1–94, pl. i (Warsaw).

QUAAS, A. 1902. Beitrag zur Kenntniss der Fauna der obersten Kreidebildungen in der libyschen Wüste. II. Oberwegi-schichten und Blätterthone. *Palaeontographica*. **30**, 2, 153–338, tables, pls. xx–xxxiii.

REDTENBACHER, A. 1873. Die Cephalopodenfauna der Gosauschichten in den nordöstlichen Alpen. Abhandl. k.k. *Geol. Reichsanst.* Wien v, 91–140, pls. xxii–xxx.

REESIDE, J. B. jr. 1924. A New Nautiloid Cephalopod, *Eutrephoceras sloani*, from the Eocene of South Carolina. *Proc. U. S. Nat. Mus.* **65**, art. 5, No. 2518.

————. 1927. Cephalopods from the Lower Part of the Cody Shale of Oregon Basin, Wyoming. *U.S. Geol. Surv., Prof. Pap.* 150–A. 1–10, pls. i–viii.

————. 1927a. The *Scaphites*, an Upper Cretaceous Ammonite Group. *Ibid.*, 150–B. 21–36, pls. ix–xi.

————. 1927b. The Cephalopods of the Eagle Sandstone and Related Formations in the Western Interior of the United States. *Ibid.*, 151. 1–40, pls. i–xlv.

RIEDEL, L. 1931. Zur Stratigraphie und Faciesbildung im Oberemscher und Untersenon am Südrande des Beckens von Münster. *Jb. Preuss. Geol. Landesanst.* (1930). **51**, 2. 605–713, pls. 72–79.

SAYN, G. 1910. Review of Kilian and Reboul, 1909 (q.v.) in *Revue Critique de Paléozool.* **14**, I. 40–1.

————. 1921. Les Phyllocératidés gargasiens du SE. de la France. Espèces nouvelles ou peu connues. In Kilian, etc. Contrib. à l'étude des Céphalopodes paléocrétacés du SE. de la France. *Mém. Carte géol. dét. France.* 191–203, pl. i.

SCHLÜTER, C. 1867. Beitrag zur Kenntnis der jüngsten Ammoneen Norddeutschlands. Bonn. 1–36, pls. i–vi.

————. 1871–2. Cephalopoden der oberen deutschen Kreide. I. *Palaeontographica.* **21**, 1–120, pls. 8–i-xxxv.

————. 1876. II. *Ibid.* **24**, 1–144, pls. xxxvi–lv.

SCHMIDT, F. 1873. Über die Petrefacten der Kreideformation von der Insel Sachalin. *Mém. Acad. Imp. Sci. St. Pétersbourg.* (Ser. vii) **19**, 3. 1–37, pls. i–viii.

SEUNES, J. 1890. Contribution à l'étude des Céphalopodes du Crétacé supérieur de la France. *Mém. Soc. géol. France, Paléont.* ii, 1–22, pls. i–vi.

SHARPE, D. 1853–7. Description of the Fossil Remains of Mollusca found in the Chalk of England. Cephalopoda. *Palaeontogr. Soc.* [*Monogr.*]. 1–68, pls. i–xxvii.

SHIMIZU, S. 1935. The Upper Cretaceous Cephalopoda of Japan. I. *J. Shanghai Sci. Inst.* Sect. II, i. 159–226, tables.

SIEMIRADZKI, J. v. 1898–9. Monographische Beschreibung der Ammonitengattung *Perisphinctes*. *Palaeontographica.* **45**, 69–296, pls. xx–xxv (1898); 297–352, pls. xxvi–xxvii (1899).

SPATH, L. F. 1921. On Cretaceous Cephalopoda from Zululand. *Ann. S. Afr. Mus.* **12**, vii. No. 16, 217–321, pls. xix–xxvi.

————. 1921a. On Upper Cretaceous Ammonoidea from Pondoland. *Ann. Durban Mus.* **3**, 2, v. 39–57, pls. vi–vii.

————. 1922. On Cretaceous Ammonoidea from Angola, collected by Professor J. W. Gregory, D.Sc., F.R.S. *Trans. Roy. Soc. Edinb.* **53**, (1) No. 6. 91–160, pls. i–iv.

————. 1922a. On the Senonian Ammonite Fauna of Pondoland. *Trans. Roy. Soc. S. Afr.* **10**, iii, 113–47, pls. v–ix.

————. 1923–30. A Monograph of the Ammonoidea of the Gault. I. Pal. Soc. 1–311, pls. i–xxx.

————. 1925. Ammonites and Aptychi. In Wyllie and Smellie: On the Collection of Fossils and Rocks from Somaliland. vii. *Monogr. Geol. Dept. Hunterian Mus.*, Glasgow Univ. 111–64, pls. xv–xvi.

————. 1926. On New Ammonites from the English Chalk. *Geol. Mag.* **63**, 77–83, table.

————. 1927. On the Classification of the Tertiary Nautili. *Ann. Mag. Nat. Hist.* (9), **20**, 424–8.

————. 1927a. Sur quelques Ammonites du Gault, nommées par P. Reynès. *Ann. Mus. Hist. Nat. Marseille.* **20**, 97–106, pl. iv.

————. 1930. The Eotriassic Invertebrate Fauna of East Greenland. *Meddel. o. Grønland.* **83**, 1–90, pls. i–xii.

————. 1932. The Invertebrate Faunas of the Bathonian-Callovian Deposits of Jameson Land (East Greenland). *Ibid.* **87**, 7. 1–158, pls. i–xxvi.

————. 1939. Problems of Ammonite Nomenclature. 6. The Genus *Pachydiscus*, Zittel. *Geol. Mag.* **76**, 293–6.

————. 1939a. *Ibid.* 7. The Genera *Paraphylloceras* and *Neophylloceras*, Shimizu. 451–4.

————. 1940. On Upper Cretaceous (Maestrichtian) Ammonoidea from Western Australia. *J. Roy. Soc. W. Australia.* **26**, 41–57, pls. i–ii.

————. 1947. Additional Observations on the Invertebrates (chiefly Ammonites) of the Jurassic and Cretaceous of East Greenland. I. The *Hectoroceras* Fauna of SW. Jameson Land. *Meddel. o. Grønland.* **132**, 3. 1–70, pls. i–v.

SPENGLER, E. 1910. Untersuchungen über die südindische Kreideformation. IV. Die Nautiliden und Belemniten des Trichinopolydistriktes. *Beitr. Paläont. Geol. Österr.-Ung.* **23**, 3. 125–57, pls. i–iv.

STEINMANN, G. 1881. Zur Kenntniss der Jura- und Kreideformation von Caracoles (Bolivia). *Neues Jb. Min. Geol. Paläont.*, Beil. i, 239–301, pls. ix–xiv.

————. 1895. In Steinmann, Deecke and Möricke: Das Alter und die Fauna der Quiriquinaschichten. Beitr. z. Geol. und Pal. v. Südamerika, etc. III. *Neues Jb. Min. Geol. Paläont.*, Beil. x. C. Die Cephalopoden der Quiriquinaschichten. 64–94, pls. iv–vi.

STEPHENSON, L. W. 1941. The Larger Invertebrate Fossils of the Navarro Group of Texas, etc. *Univ. Texas Publ.* 4101. 1–641, pls. i–xcv, tables.

STOLICZKA, F. 1863–6. In Blanford and Stoliczka (q.v.), 41–216, pls. xxvi–xciv.

TOKUNAGA, S. and S. SHIMIZU. 1926. The Cretaceous Formation of Futaba in Iwaki and its Fossils. *J. Fac. Sci. Imp. Univ. Tokyo.* (2) **1**, 6. 181–212, pls. xxi–xxvii.

TRECHMANN, C. T. 1917. Cretaceous Mollusca from New Zealand. *Geol. Mag.* (n.s.), Dec. VI, iv. 294–305; 337–42. pls. xix–xxi.

UHLIG, V. 1910. The Fauna of the Spiti Shales. Mem. Geol. Surv. India. *Palaeont. Indica.* Ser. xv. Himalayan Fossils. IV, 2. 133–306, pls. xix–xlviiiA and lxxvii–xci.

WARREN, P. S. 1934. Palaeontology of the Bearpaw Formation. *Trans. Roy. Soc. Canada.* (iii) Sect. iv, **28**, 81–99, pls. i–iii.

WELLER, S. 1902. The Stokes Collection of Antarctic Fossils. *J. Geol.* **11**, 4, 413–19, pls. i–iii.

————. 1907. A Report on the Cretaceous Paleontology of New Jersey. *Geol. Surv. N.J. Pal. Ser.* IV, i–ix, 1–87, 871, pls. i–cxi.

WHITE, C. A. 1890. On Certain Mesozoic Fossils from the Islands of St. Paul's and St. Peter's in the Straits of Magellan. Sci. Res. Explor. Albatross. X. *Proc. U.S. Nat. Mus.* **13**, 13–14, pls. ii, iii.

WHITEAVES, J. F. 1876. Mesozoic Fossils. I, 1. On Some Invertebrates from the Coal-Bearing Rocks of the Queen Charlotte Islands. 1–92, pls. i–x, map.

WHITEAVES, J. F. 1884. *Ibid.* I, 3. On the Fossils of the Coal-bearing Deposits of the Queen Charlotte Islands, collected by Dr. G. M. Dawson in 1878. 191–262, pls. xxii–xxxii.
———. 1903. *Ibid.* I, 5. On Some Additional Fossils from the Vancouver Cretaceous, etc. 309–415, pls. xliv–li.
WHITFIELD, R. P. 1892. Gasteropoda and Cephalopoda of the Raritan Clays and Greensand Marls of New Jersey. *Monogr. U.S. Geol. Surv.* **18**, Sect. v. Cephalopoda of the Cretaceous Marls of New Jersey. 243–83, pls.
WILCKENS, O. 1904. Revision der Fauna der Quiriquina-Schichten. In Steinmann: Beitr. z. Geol. und Pal. v. Süd-Amerika XI. *Neues Jb. Min. Geol. Paläont.*, Beil. xviii, 181–284, pls. xvii–xx.
WOODS, H. 1906. The Cretaceous Fauna of Pondoland. *Ann. S. Afr. Mus.* **4**, vii. No. 12. 275–350, pls. xxxiii–xliv.
———. 1917. The Cretaceous Faunas of the North-Eastern Part of the South Island of New Zealand. *N.Z. Geol. Surv., Palaeont. Bull.* 4. 1–41, i–xix.
WOODWARD, S. P. 1851–6. A Manual of the Mollusca. pp. xvi, 486, 24, pls. xxiv, map, text-illustrations. 1880. A Manual of the Mollusca. With appendix by R. Tate. 4th Edit. pp. xvi, 542, 86, pls. xxiii, map, text-illustrations. 1890. Fourth Edition. Reprint.
YABE, H. 1903. Cretaceous Cephalopoda from Hokkaido. I. *J. Fac. Sci. Imp. Univ. Tokyo.* **18**, 2. 1–55, pls. i–vii.
———. 1910. Die Scaphiten aus der Oberkreide von Hokkaido. *Beitr. Paläont. Geol. Österr.-Ung.*, etc., **23**, 159–74, pl. xv.
———. 1915. Notes on Some Cretaceous Fossils from Anaga on the Island of Awaji and Toyajo in the Province of Kii. *Sci. Rep. Tôhoku Imp. Univ.* (b) Geol., iv, i. 13–24, pls. i–iv.
———. 1927. Cretaceous Stratigraphy of the Japanese Islands. *Ibid.* xi, i. 27–100, pls. iii–ix, table.
YABE, H. and S. SHIMIZU. 1921. Notes on Some Cretaceous Ammonites from Japan and California. *Ibid.*, v, iii. 53–9, pls. viii–ix.
———. 1924. A New Species of *Brahmaites* from the Upper Cretaceous of South Saghalin with Some Remarks on the Genus *Brahmaites. Jap. J. Geol. Geogr.* **3**, 77–80, pl. xiii.
———. 1926. A Study on the Genus *Parapachydiscus*, Hyatt. *Proc. Imp. Acad. Tokyo.* II, 4. 171–3, figs.
YOKOYAMA, M. 1890. Versteinerungen aus der japanischen Kreide. *Palaeontographica.* **36**, 159–202, pls. xviii–xxv.
ZITTEL, K. A. 1884. Handbuch der Palaeontologie. I, 2, iii. Cephalopoda. 329–522, figs. 467–715.

APPENDIX

This appendix contains details of the fourteen locality areas on James Ross Island and adjoining islands from which the ammonoids forming the subject of this Report were obtained. (See sketch-map, p. 59.) Several of the locality areas include a number of distinct localities, and these are marked on large-scale manuscript maps held in the Falkland Islands Dependencies Scientific Bureau in London. Those localities which were visited more than once have received more than one locality number. Collecting numbers, such as D.127.4, D.130.8, are entered on the maps as locality numbers in the form D.127, D.130. Four-figure collecting numbers also serve as locality numbers, the first and last number being entered on the map, e.g. 1234–1257.

Under each locality are given the collecting numbers of those specimens which are figured, or mentioned in the text, and in parentheses the numbers under which the specimens have been registered in the Dept. of Geology, Brit. Mus. (Nat. Hist.).

The following three symbols are used to denote whether or not the specimens were collected *in situ*:

*Fossils obtained from rock *in situ*.

†Fossils obtained from solifluxion-slopes or bare outcrops which there is good reason to believe were weathered out from the underlying sediments. Doubtful cases are shown as ?†.

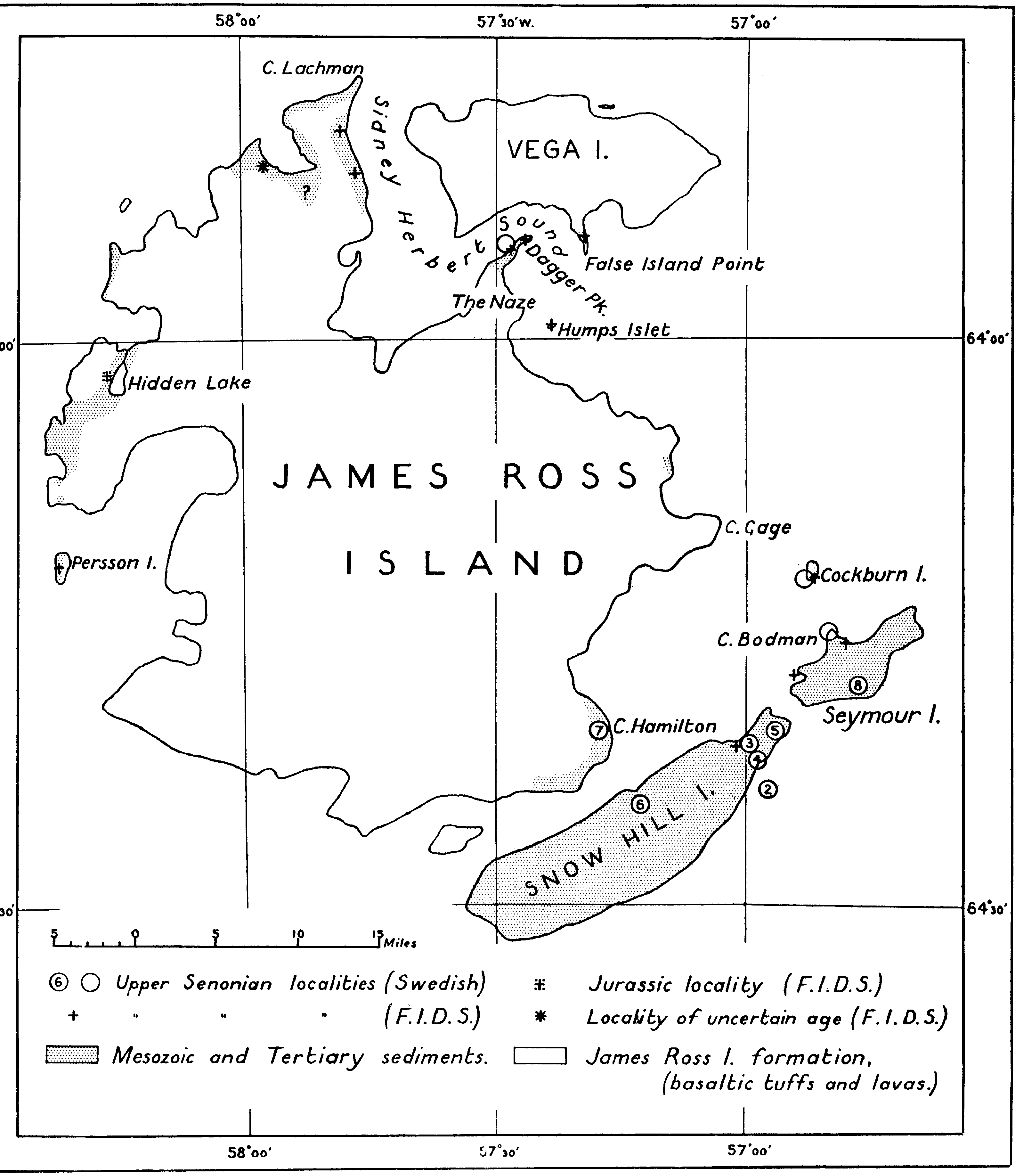
‡Fossils picked off the surface which have probably or certainly been transported by ice. Derived fossils from moraines, sand-bars, etc., are included in this category.

Lachman Crags, North. Localities on the northern part of the coastal strip lying east of Lachman Crags at the northern end of James Ross Island. Lat. 63°49′ S.; long. 57°48′ W. Map: F.I.D.S. Misc. E. 66/47, scale 1:10,000.
†*Loc. 5442–49:* 5442 (C.41329).
?‡*Loc. 8643–8730:* 8657 (C. 41487).

Lachman Crags, South. Localities on the southern part of the above-mentioned coastal strip. Lat. 63°51′ S.; long. 57°47′ W. Map: F.I.D.S. Misc. E. 66/47, scale 1:10,000.
?†*Loc. D. 418:* D.418 (C.41327).
**Loc. 8501–8642: D.413, D.416, D.422:* 8622 (C.41500), 8624 (C.41488), 8626 (C.41498), 8635 (C.41495), 8639 (C.41490), D.413.3 (C.41344, C.41345), D.416.3 (C.41371, C.41382), D.422.7 (C.41370, C.41377).
†*Loc. 8731–8760:* 8739 (C.41938), 8745 (C.41494), 8746 (C.41486), 8747 (41493), 8754 (C.41491, C.41492).
?†*Loc. D.427:* D.427.3 (C. 41394).
**Loc. D.430, D.432, D.433, D.543:* D.430.7 (C. 41342, C.41349, C.41383), D.432.2 (C.41340, C.41341, C.41348, C.41389, C.41393, C.41484, V.41835).
?†*Loc. D. 421, D.424:* D.421.1 (C.41353), D.424.3 (C.41369).

The Naze. Southern end of low-lying isthmus on James Ross I. Lat. 63°56′ S.; long. 57°30′ W. Map: F.I.D.S. Misc. E. 70/47, scale 1:10,000.
†*Loc. 5168–5174:* 5168, 5169, 5171, 5174 (all C.41400).

Dagger Peak. Slopes of this hill and Comb Ridge near the tip of the Naze. Lat. 63°55′ S., long. 57°28′ W. Map: F.I.D.S. Misc. E. 70/47, scale 1:10,000.
†*Loc. 4748–4766, 5044–5113, 5247–5313, D.84–D.90, D.97:* 4749 (C.41388), 4750 (C.41385), 5078 (C.41471), 5079 (C.41330), 5080 (C.41332), 5087 (C.41337), 5090 (C.41336), 5095 (C.41379), 5110 (C.41386), 5113 (C.41387), 5251 (C.41378), 5258 (C.41482), 5259 (C.41339), 5260 (C.41354), 5267 (C.41338), 5271 (C.41368), 5275 (C.41376), D.84.5



Sketch-map of ammonoid localities on James Ross Island and adjoining islands.

(C.41484), D.84.6 (C.41361), D.84.7 (C.41355, C.41372), D.85.2 (C.41381), D.85.3 (C.41323), D.85.4 (C.41326, C.41374), D.86.1 (C.41320), D.86.2 (C.41333, C.41373, C.41374), D.87.5 (C.41496), D.87.6 (C.41331, C.41364), D.88.1 (C.41489, C.41497), D.88.3 (C.41360), D.89.8 (C.41358), D.90.3 (C.41334), D.97.1 (C.41324, C.41346, C.41363).

False Island Point. About two miles north of the point. Lat. 63°54′ S.; long. 52°21′ W.
†*Loc. D.537:* D.537.1 (C.41362).

Humps Islet. On the saddle between the two peaks. Lat. 63°59′ S.; long. 57°25′ W. Map: F.I.D.S. Misc. E. 71/47, scale 1:10,000.
†*Loc. 4679–4717, 5425–5428, D.529, D.530, D.533, D.535:* 4705 (C.41395), 4707 (C.41851), 5425 (C.41859), 5426 (C.41375), 5427 (C.41396), 5428 (C.41350, C.41470), D.529.1 (C.41365), D.530.2 (C.41321, C41485), D.533.4 (C.41322, C.41328, C.41347, C.41366, C.41367, C.41384, C.41397, C.41398, C.41399, C.41817), D.535.1 (C.41325, C.41380, C.41398).

North of Cape Gage on James Ross I. Beach-like feature about five miles north-north-west of Cape Gage. Lat. 64°7′ S.; long. 57°10′ W.
?†*Loc. 4728, 5410–5423:* 4728 (C.41356), 5415 (C.41472).

Cockburn I. Steep southern slope of the island. Lat. 64°13′ S.; long. 56°50′ W. Map: F.I.D.S. Misc. E. 10/47, scale 1:25,000.
†*Loc. D. 489:* D.489.1 (C.41335).

Cape Bodman, on Seymour I. Area about one mile south-east of the cape. Lat. 64°16′ S.; long. 56°50′ W. Map: F.I.D.S. E. 10/47, scale 1:25,000.
†*Loc. 4406–4411:* 4406, 4407 (C.41852), 4408 (C.41850).
**Loc. 4412–4413:* 4413 (C.41357).

South-west of Seymour I. Sand-bar off south-west extremity of island. Lat. 64°20′ S.; long. 56°55′. Map: F.I.D.S. Misc. E. 10/47, scale 1:25,000.
‡*Loc. 4399–4400:* 4400 (C.41905).

Snow Hill I. In the neighbourhood of the Swedish Expedition hut. Lat. 64°22′ S.; long. 57°00′ W.
†*Loc. 4280–4340:* 4329 (C.41359), 4333 (C.41854), 4334 (C.41352), 4335 (C.41858), 4339 (C.41351).

Persson I. Near middle of western side. Lat. 64°13′ S.; long. 58°21′ W.
**Loc. 5135–5136:* 5135 (C.41901).

Hidden Lake, on James Ross I. Hill slopes on west side of lake. Lat. 64°3′ S.; long. 58°17′ W.
?†*Loc. 5175–5177:* 5177 (C.41401).

South-west of Cape Lachman. About eight miles south-west of the Cape, on west side of large bay. Lat. 63°52′ S.; long. 57°58′ W.
†*Loc. 5239–5241:* 5239 (C.41478), 5240 (C.41479).

Printed in Great Britain under the authority of Her Majesty's Stationery Office by Benham and Company Limited, Colchester

Wt. P1614 K.4 1066 6/53

PLATE I

Figs. 1 a, b *Neophylloceras meridianum*, sp. nov. Holotype. C.41320. Dagger Peak.

2 a, b *Neophylloceras hetonaiense*, Matumoto. Example (C.41350) out of body-chamber of *Gunnarites pachys*, extreme variety (C.41470). Humps Islet.

3 a–d; 4; 5 a–d *Phyllopachyceras forbesianum* (d'Orbigny). Three examples, two also enlarged ×2. (C.41322, C.41321; C.41347). Humps Islet.

6; 7–9 *Pseudophyllites peregrinus*, sp. nov. Holotype (6 = C.41323) and three other examples (C.41325, C.41324, C.41326). Dagger Peak. Also suture-line of a nucleus (at 6 mm. diameter) from Lachman Crags (C.41492).

10 a, b *Gaudryceras* (*Neogaudryceras*) *pictum*, Yabe. Example (C.41327) with part of body-chamber removed. Lachman Crags, South.

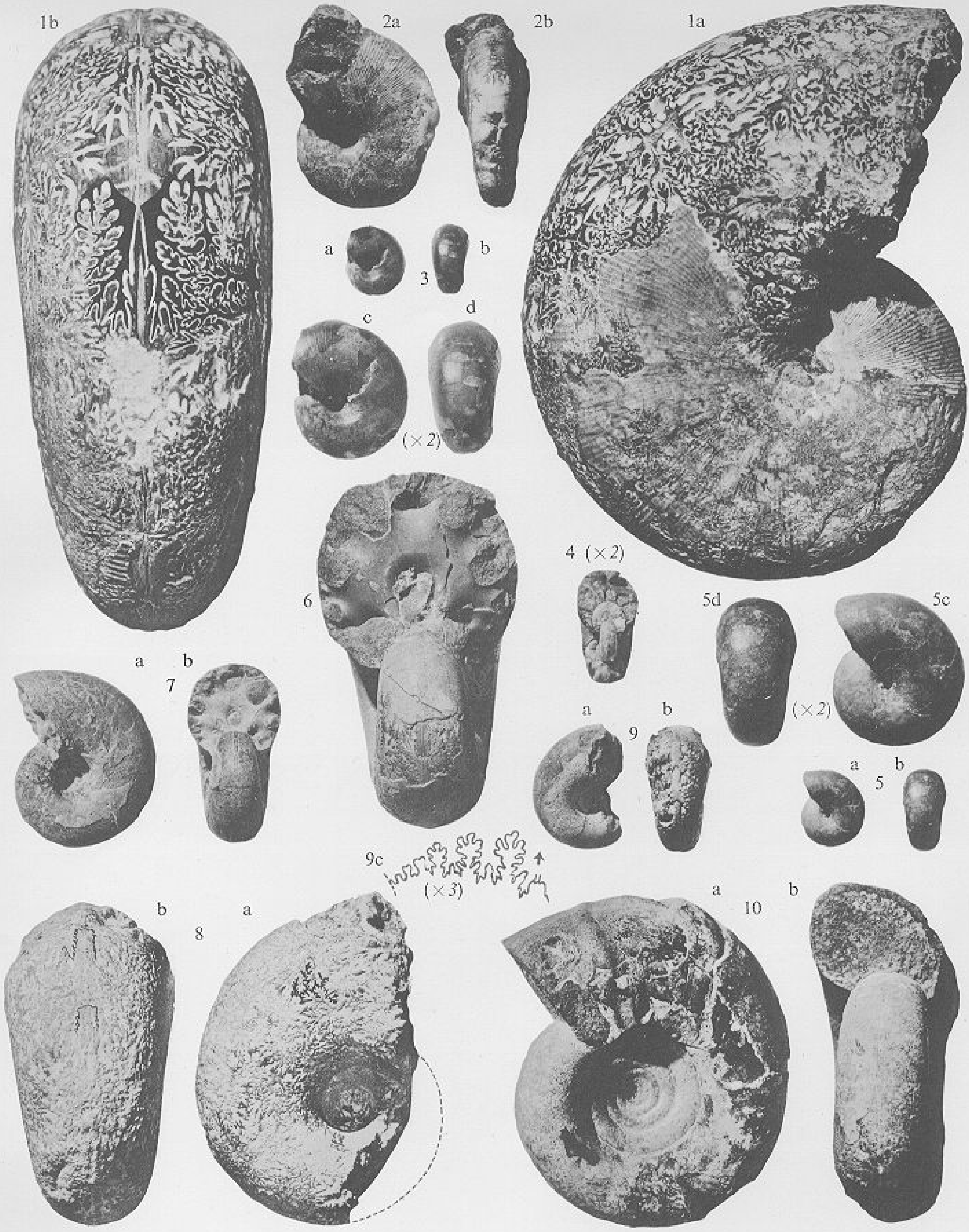

1b
2a
2b
1a
a
3
b
c
d
(×2)
6
4 (×2)
5d
5c
a
b
7
a
9
b
(×2)
a
5
b
9c
(×3)
b
8
a
a
10
b

PLATE II

1–3 *Diplomoceras lambi*, sp. nov. Three typical fragments. C.41330 in ventral and lateral views; C.41332 in dorsal and ventral views; C.41331 in lateral view, with sectional outline. Dagger Peak.

4 a, b, c *Diplomoceras notabile* (Whiteaves). Dorsal (antisiphonal) and lateral views, slightly reduced, of part of an example (C.3486) from Vancouver Island. (Sectional outline 4 c natural size).

5–6 *Desmophyllites diphylloides* (Forbes). One of Forbes's originals from the Valudayur Group of Pondicherry (C.22683) and an example from Egito, Angola (C.41473), with suture-line, enlarged $\times 2$.

7–9 *Maorites densicostatus* (Kilian and Reboul). Three slightly different examples. C. 41334; C.41374 (inner whorl only); C.41338. Dagger Peak

10 a–e *Oxybeloceras* aff. *mortoni* (Meek and Hayden). Body-chamber, enlarged $\times 2$, with outline whorl-section (C.41393); part of a septate shaft enlarged $\times 2$, with suture-line, enlarged $\times 5$ (C.41389) and suture-line, enlarged $\times 4$, of a third example (C.41493). Lachman Crags, South.

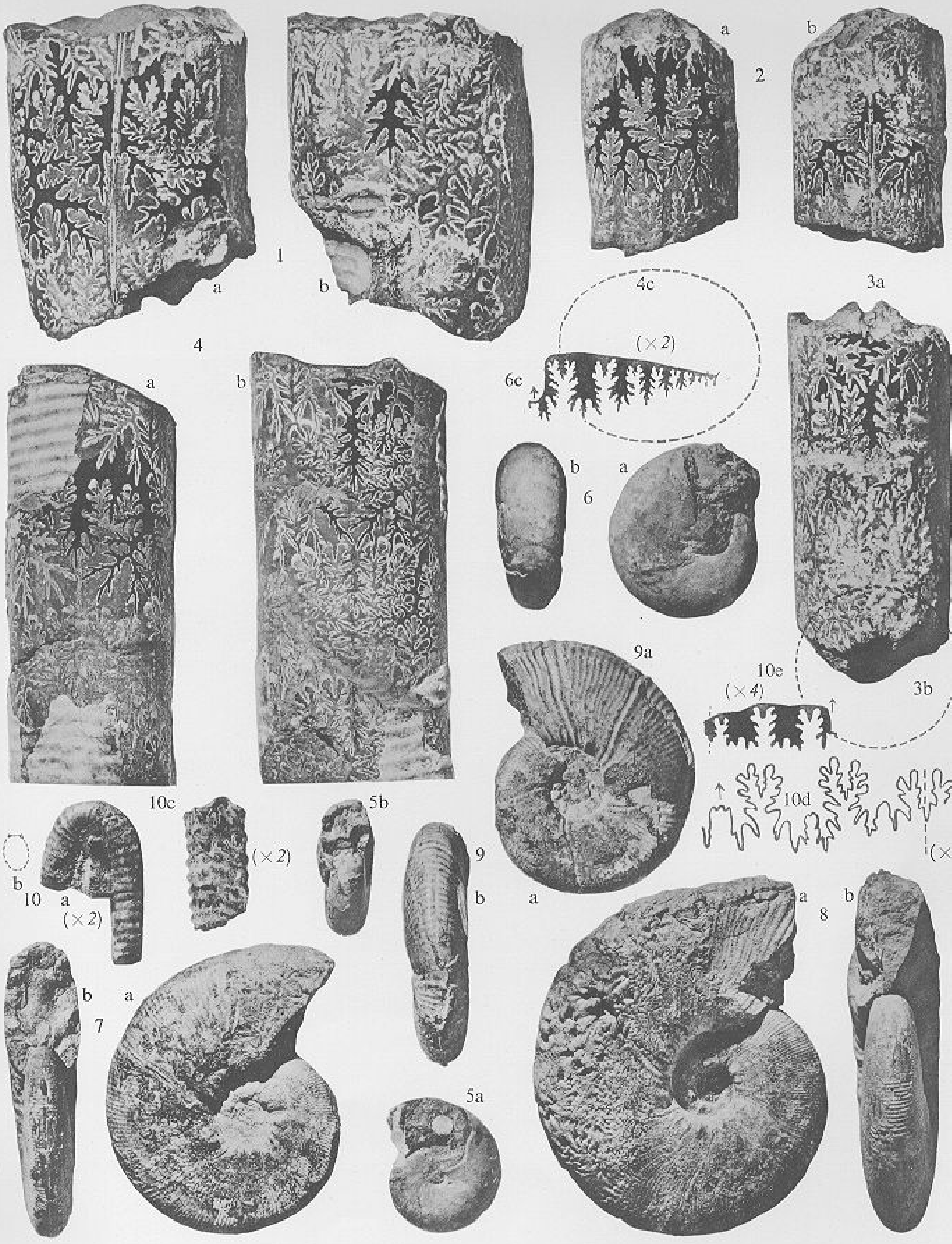

1
a
b
2
a
b
3a
3b
4
a
b
4c
(×2)
5a
5b
6
a
b
6c
7
a
b
8
a
b
9
9a
a
b
10
a
b
(×2)
10c
(×2)
10d
(×5)
10e
(×4)

PLATE III

Figs. 1	*Diplomoceras lambi*, sp. nov. Holotype. Part of body-chamber, from last septum onwards, but with right-hand shaft (total length = 342 mm.) incomplete. C.41400. The Naze.
2 a, b	*Parapuzosia* (?) sp. juv. ind. Septate fragment (C.41341) also enlarged $\times 3$. Lachman Crags, South.
3–4	*Gunnarites flexuosus*, sp. nov. Holotype (C.41395) and example (C.41396) with less flat whorl-side. Humps Islet.
5	*Gunnarites antarcticus* (Stuart Weller). Evolute variety. C. 41472. James Ross Island, north of Cape Gage.
6	Gen. nov. ("*Sphenodiscus*") sp. nov. aff. *Manambolites spathi*, Picard sp. Last suture-line of a complete example (C.41474) with half a whorl of body-chamber at 130 mm. diameter. Barra do Dande, Angola.

PLATE III

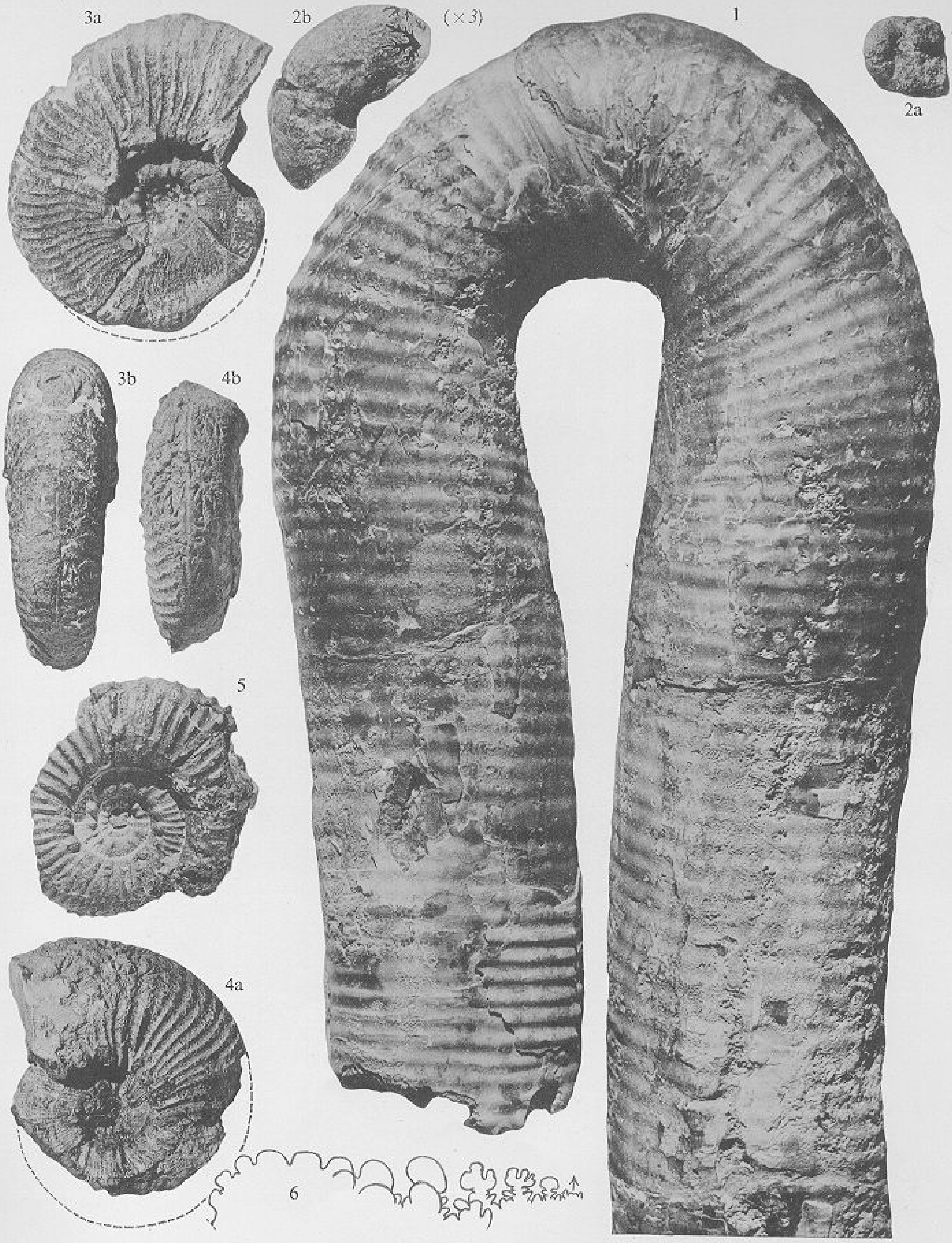


PLATE IV

Figs. 1 a, b *Maorites seymourianus* (Kilian and Reboul). Example C.41394, with part of the body-chamber omitted. Lachman Crags, South.

2 a–d, 3 *Jacobites crofti*, sp. nov. Holotype (C.41355) with innermost whorls enlarged $\times 2$. Dagger Peak. Also (3) doubtful example C.41356, from James Ross Island, north of Cape Gage.

4–5 *Neograhamites kiliani*, sp. nov. Holotype (C.41366). Peripheral view (4 b) with earlier half of body-chamber removed. Also paratype (C.41365) with peripheral view of inner whorls and part of body-chamber removed. Humps Islet.

6 *Neograhamites* sp. nov. juv. aff. *taylori*, nov. Fragmentary example (C.41367) with peripheral aspect of body-chamber (6 b). Humps Islet.

7–8 *Oiophyllites decipiens*, sp. nov. Holotype (C.41348), also enlarged $\times 3$, with suture lines wrongly connected; Paratype (C.41343), enlarged $\times 3$, showing asymmetrical suture-line (8 a–c). Lachman Crags, South.

9 a, b *Gunnarites antarcticus* (Stuart Weller). Example C.41360, with slight degeneration of ribbing and lateral flattening, transitional to *G. bhavaniformis*. Dagger Peak, on James Ross Island.

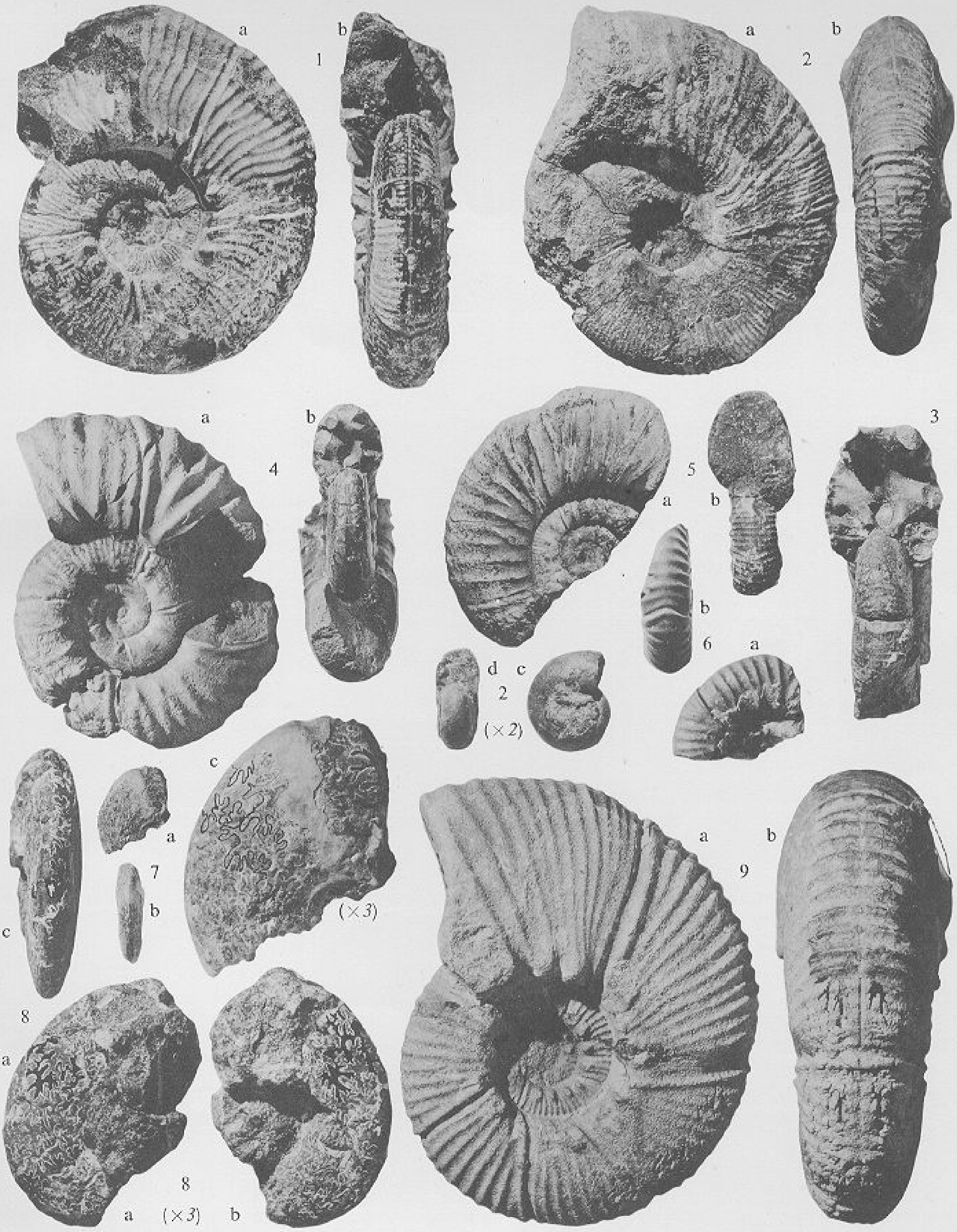

a
b
1
a
b
2
a
b
4
5
a
b
3
b
6
a
d
c
2
(×2)
c
a
7
b
c
(×3)
a
b
9
8
a
8
a
(×3)
b

PLATE V

Figs. 1 a, b *Grossouvrites gemmatus* (Huppé). Crushed example (C.41357) with complete body-chamber; also part of inner whorls (of opposite side), enlarged $\times 2$ to show suture-line. Cape Bodman on Seymour Island.

2–3 *Gunnarites bhavaniformis* (Kilian and Reboul), var. *vegaensis*, nov. Small example (2 = C.41364) from Dagger Peak; and type of variety (3 = C.41362) from False Island Point, Vega Island.

4–5 *Gunnarites gunnari* (Kilian and Reboul). Two doubtful examples (4 = C.41372 and 5 = C.41368) from Dagger Peak.

6–7 *Maorites* sp. juv. aff. *suturalis*, Marshall. Example (C.41342) complete to the aperture; also immature specimen (C.41383) natural size (7 a) and enlarged $\times 2$ (7 b, c) to show depressed earliest whorls. Lachman Crags, South.

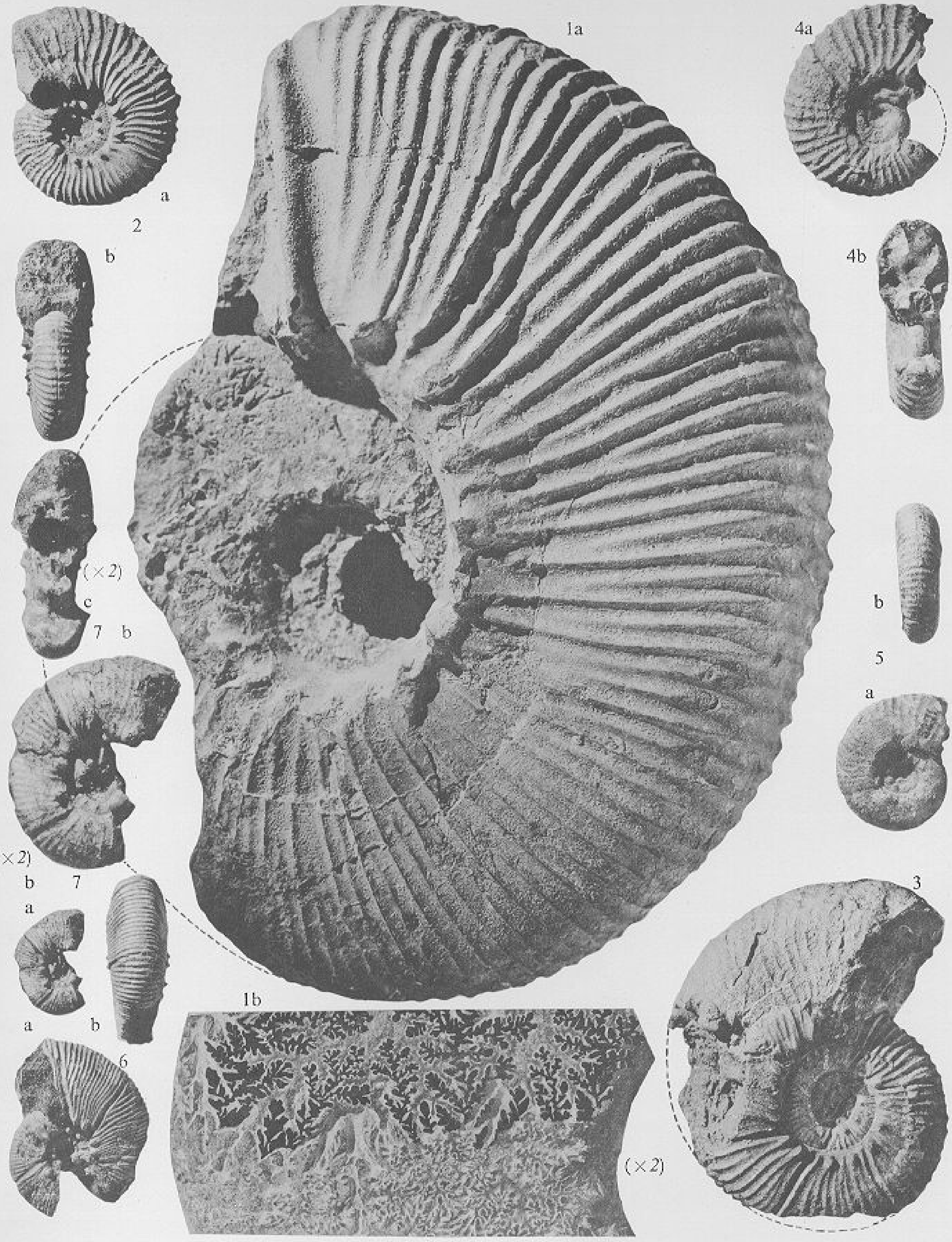

1a
1b
(×2)
2
a
b
3
4a
4b
5
a
b
6
a
b
7
b
c
(×2)
(×2)

PLATE VI

Figs. 1–5 *Gunnarites antarcticus* (Stuart Weller). Typical example (1 = C.41335) with half a whorl of (inflated) body-chamber. Cockburn Island. 2 a, b. Typical young example (C.41358) from Dagger Peak. 3 a, b. Var. *monilis*, nov. (C.41359). Crushed body-chamber fragment from Snow Hill. 4 a, b. Example (C.41361) with early inflation of whorls. Dagger Peak. 5 a, b. Fragmentary inner whorls (C.41482) to show rapid increase in thickness. Same locality.

6 a–c *Oiophyllites angolaensis*, sp. nov. Septate holotype (C.41476) with part of outer whorl enlarged × 2 to show suture-line, simplified by erosion. Egito, Angola.

7–9 *Maorites pseudobhavani*, sp. nov. Holotype (7 a, b = C.41344) with body-chamber complete to aperture; also two more inflated examples (8 = C.41345, 9 = C.41382). Lachman Crags, South.

PLATE VI

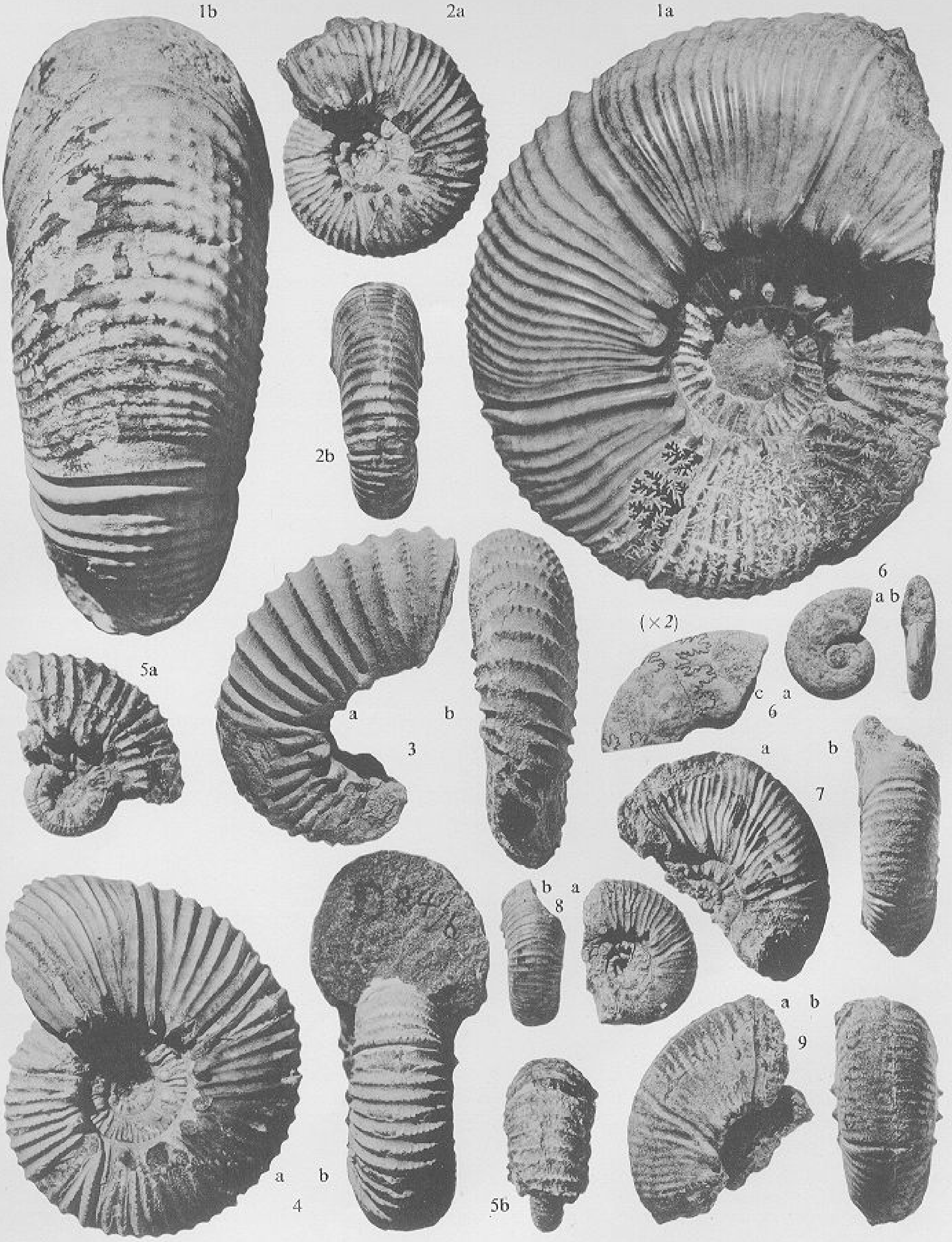


PLATE VII

1 a, b — *Gunnarites antarcticus* (Stuart Weller) var. *inflata*, Kilian and Reboul emend. Nearly complete example (C.41381) from Dagger Peak, James Ross Island. (For back-view see Plate VIII, fig. 8).

2 a–e — *Baculites* aff. *rectus*, Marshall. Body-chamber fragment (C.41392) and side- and dorsal-views, enlarged $\times 2$ of a septate fragment (C.41391); also sectional outline (natural size) and suture-line (enlarged $\times 2$). Lachman Crags, South.

3 — *Baculites rectus*, Marshall. Suture-line, enlarged $\times 1\frac{1}{4}$ of a New Zealand (Kaipara Harbour) specimen (E. V. Wright Coll.).

4 a–d — *Gunnarites paucinodatus*, sp. nov. Holotype (C.41353) with inner whorls figured separately to show slightly malformed periphery. Lachman Crags, South.

5 a, b — *Polyptychoceras* sp. juv. ind. Ventral and lateral views of a body-chamber fragment (C.41390). Also suture-line ($\times 2.5$) of a fragment (C.41486). Lachman Crags, South.

6 a–d — *Maorites* sp. juv. Immature example (C.41349), also enlarged $\times 2$, from Lachman Crags, South.

7 a, b — *Neophylloceras ultimum*, sp. nov. Holotype (C.41477) from the *Sphenodiscus* beds of Barra do Dande, Angola.

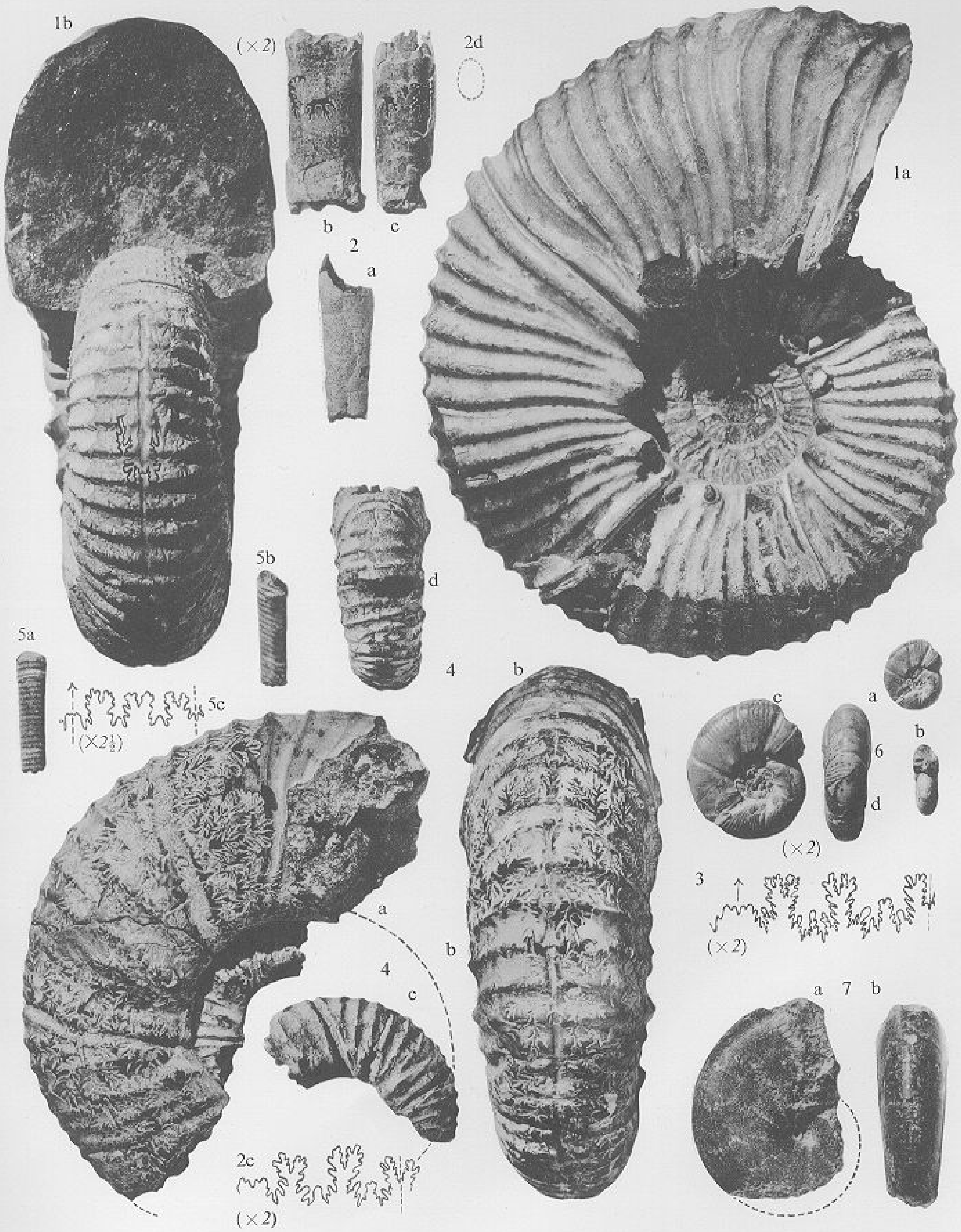

1b
(×2)
2d
1a
b
c
2
a
5b
d
5a
4
b
5c
(×2½)
c
a
6
b
d
(×2)
3
(×2)
a
4
b
c
a 7 b
2c
(×2)

PLATE VIII

Figs. 1–7 *Gunnarites bhavaniformis* (Kilian and Reboul). Dagger Peak. 1 a, b. Transition to *G. antarcticus* (C.41337). 2 a, b. More flattened example (C.41363). 3–4. Transitions to *G. kalika* (C.41336, C.41379). 5 a, b. Typical example (C.41373). 6 a–d. Probable young (C.41354) in natural size. (a, b) and enlarged $\times 2$ (c, d). 7 a–d. Still smaller nucleus (C.41346), also enlarged $\times 2$.

8 *Gunnarites antarcticus* (Stuart Weller) var. *inflata*, Kilian and Reboul, emend. Peripheral view of example (C.41381) figured in Plate VII, figs. 1 a, b.

9, 10 *Maorites* (?) sp. juv. ind. Two doubtful, young and crushed examples (C.41351–2) from Snow Hill Island.

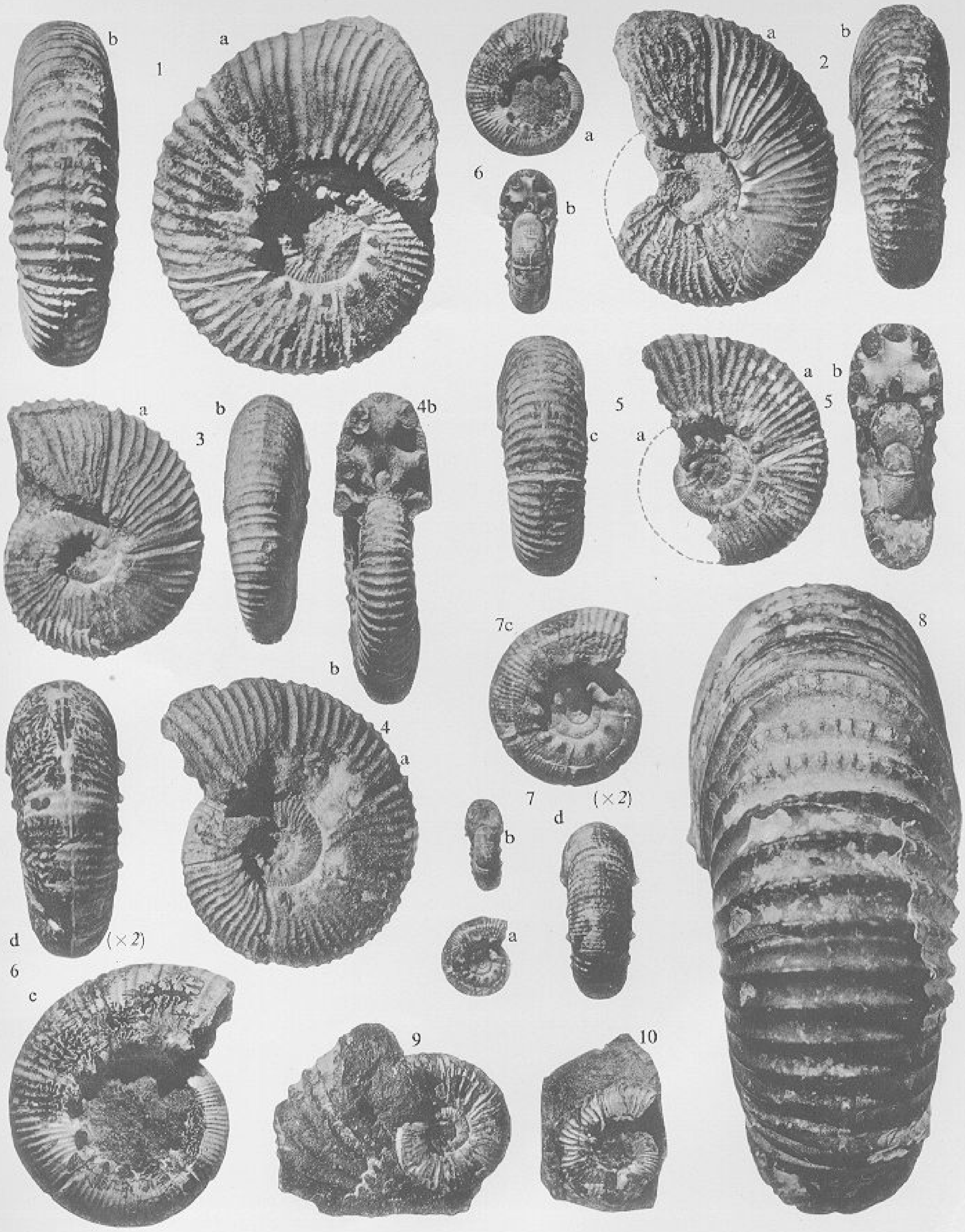

b
a
1
a
6
b
a
2
b
a
3
b
4b
5
c
a
a
b
5
7c
8
b
4
a
7
(×2)
d
b
a
d
(×2)
6
c
9
10

PLATE IX

Figs. 1–3 *Gunnarites pachys*, sp. nov. Holotype (C.41380) with outline whorl-section and peripheral aspect of inner whorls. Fragment (C.41399) of an extreme variety, and (3 a, b) var. *media*, nov. (C.41398). Humps Islet.

4–5 *Gunnarites flexuosus*, sp. nov. Innermost whorls, enlarged ×4, of a typical fragment (C.41384) and (5) var. *transitoria*, nov. (C.41397). Humps Islet.

6 *Gunnarites*, sp. juv. (cf. *inflatus*, Marshall, *non* Kilian and Reboul). Young example from Kaipara Harbour, New Zealand (E. V. Wright Coll.) for comparison with inner whorls of *G. antarcticus* (Plate VI, fig. 5).

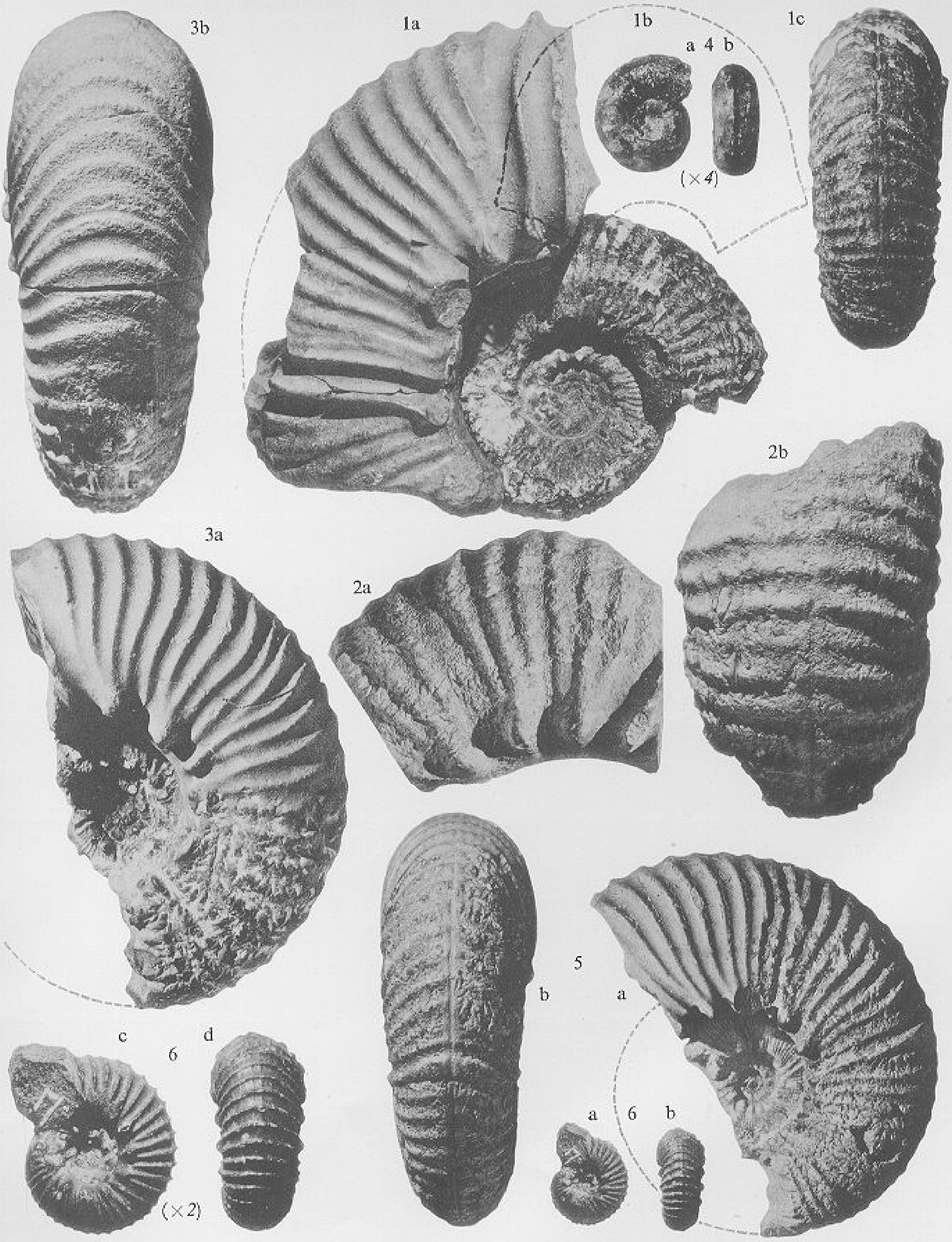

3b
1a
1b
a 4 b
(×4)
1c
2b
3a
2a
5
b
a
c
6
d
a
6
b
(×2)

PLATE X

Figs. 1–6 *Gunnarites kalika* (Stoliczka). 1. Example (C.41333) with slightly more coarsely ornamented septate whorls than type. Dagger Peak. 2. Similar large example (C.41375) from Humps Islet. 3. Example (C.41377) without crenelations. Lachman Crags, South. 4. Var. *gracilis*, nov. (C.41378), with finely ribbed early whorls. Dagger Peak. 5. Var. *nana*, nov. (C.41339), with complete body-chamber. Dagger Peak. 6. Young, with its inner whorls enlarged $\times 2$ (C.41376) from the same locality.

7 *Patagiosites* aff. *amarus* (Paulcke). Plaster-cast of an impression (C.41329) from Lachman Crags, North.

8 *Hoploscaphites quiriquinensis* (Wilckens). Small example (C.41340), also enlarged $\times 2$. Lachman Crags, South.

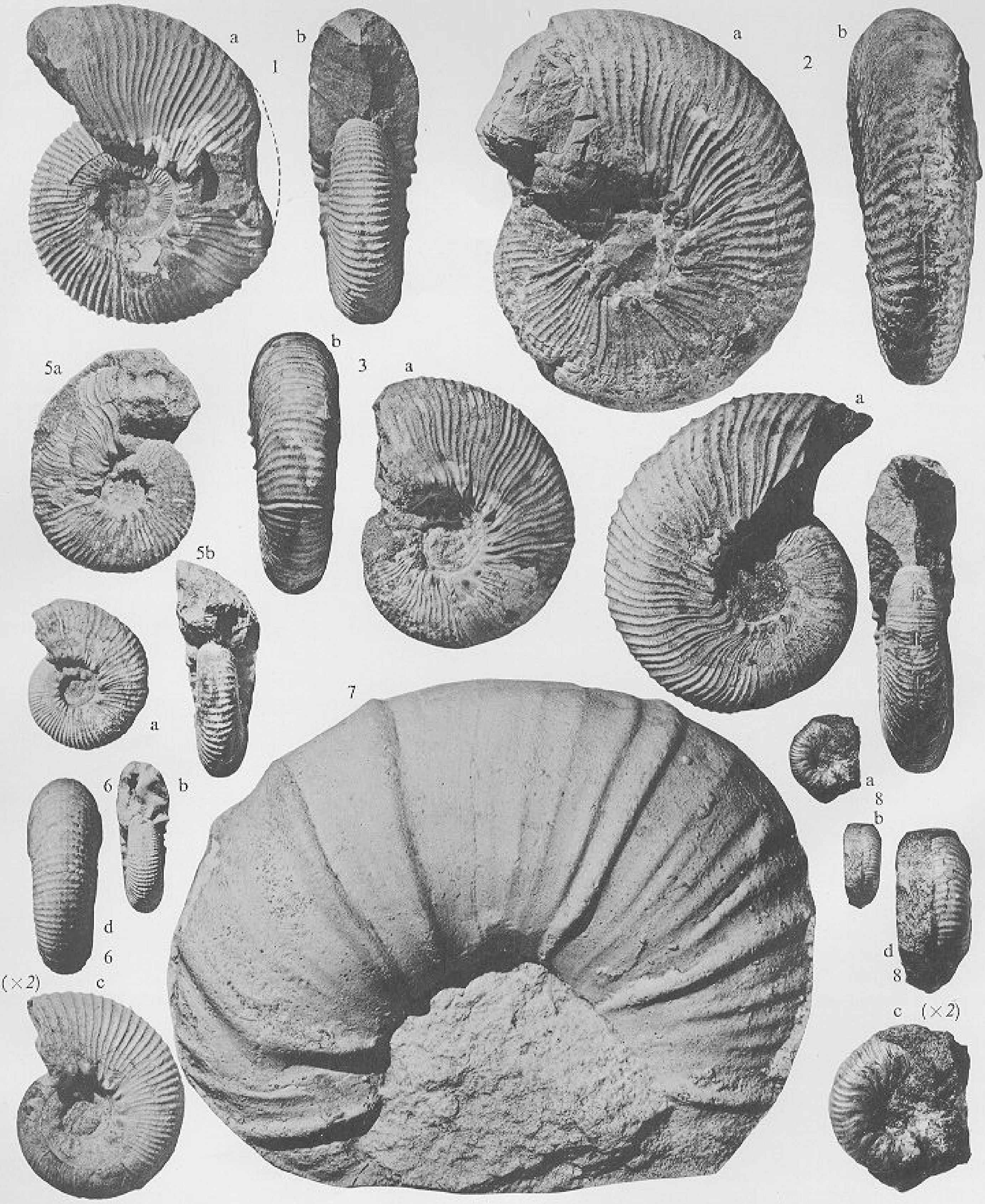

a
b
1
a
b
2
5a
b
3
a
a
5b
a
7
6
b
a
8
b
d
6
d
8
(×2)
c
c
(×2)

PLATE XI

Figs. 1 a, b *Gunnarites antarcticus* (Stuart Weller). Large example (C.41497) slightly reduced, with sectional outline. Dagger Peak.

2–4 *Maorites pseudobhavani*, sp. nov. (2 a, b). Side and peripheral views of a passage-form to *Gunnarites rotundus*, sp. nov. (C.41498). (3 a–c). Side and peripheral views and part of suture-line (with dorsal elements) of a similar form (C.41499) and side-view of an inflated example (C.41500). Lachman Crags, South and North (C.41499).

5 a–d *Neograhamites taylori*, sp. nov. Side and peripheral views of holotype (C.41495), also side-view enlarged ×2 to show suture-line. Lachman Crags, South.

6 a–c *Maorites* (?) sp. juv. ind. Side and peripheral views, natural size and enlarged ×2, of a doubtful, immature example (C.41494) believed to be the same form as Plate VIII, fig. 9. Lachman Crags, South.

7 *Phylloptychoceras sipho* (Forbes). Suture-line, enlarged ×2, of a Pondicherry example (C.41502) in the Kaye and Cunliffe Coll.

8 *Phylloptychoceras zelandicum* (Marshall). Suture-line, enlarged ×5, of a young specimen (C.41491) from Lachman Crags, South.

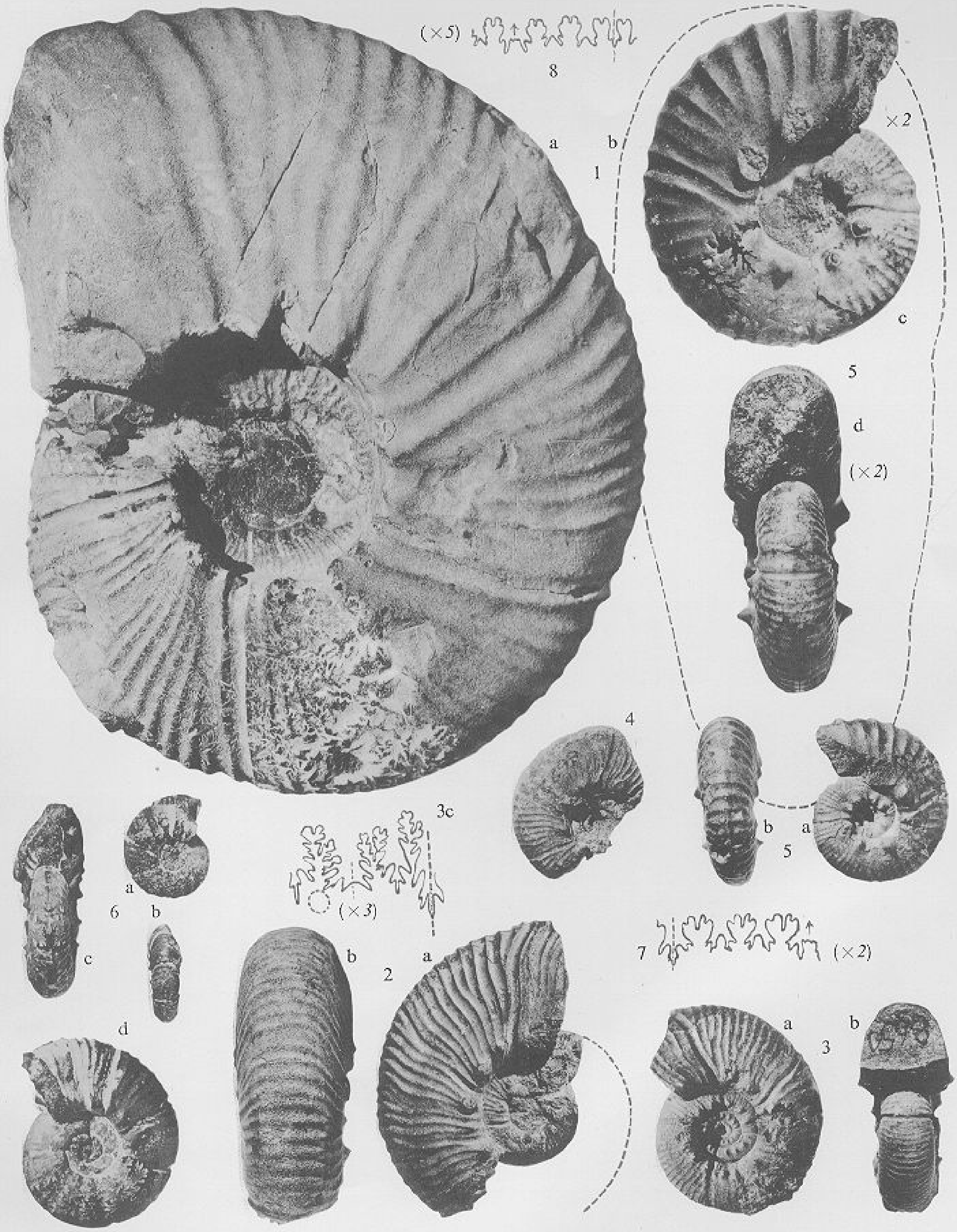

(×5)
8
a
b
1
×2
c
5
d
(×2)
4
b
a
5
3c
(×3)
a
6
b
c
d
b
2
a
7
(×2)
a
3
b

PLATE XII

1–3 *Gunnarites rotundus*, sp. nov. Lachman Crags, South. (1). Holotype (C.41371) with inner whorls enlarged ×2. (2). Young septate example (C.41370), parts also enlarged ×2; and (3). var. *kalikaformis*, nov. (C.41369), with body-chamber nearly complete.

4 *Eutrephoceras simile*, sp. nov. Septal surfaces of a medium-sized example (C.41388) from Dagger Peak.

5 *Planites* cf. *transatlanticus* (Steinmann). Plaster-cast of an impression (C.41401) from west side of Hidden Lake, James Ross Island. Upper Jurassic, Lower Kimmeridgian (derived ?).

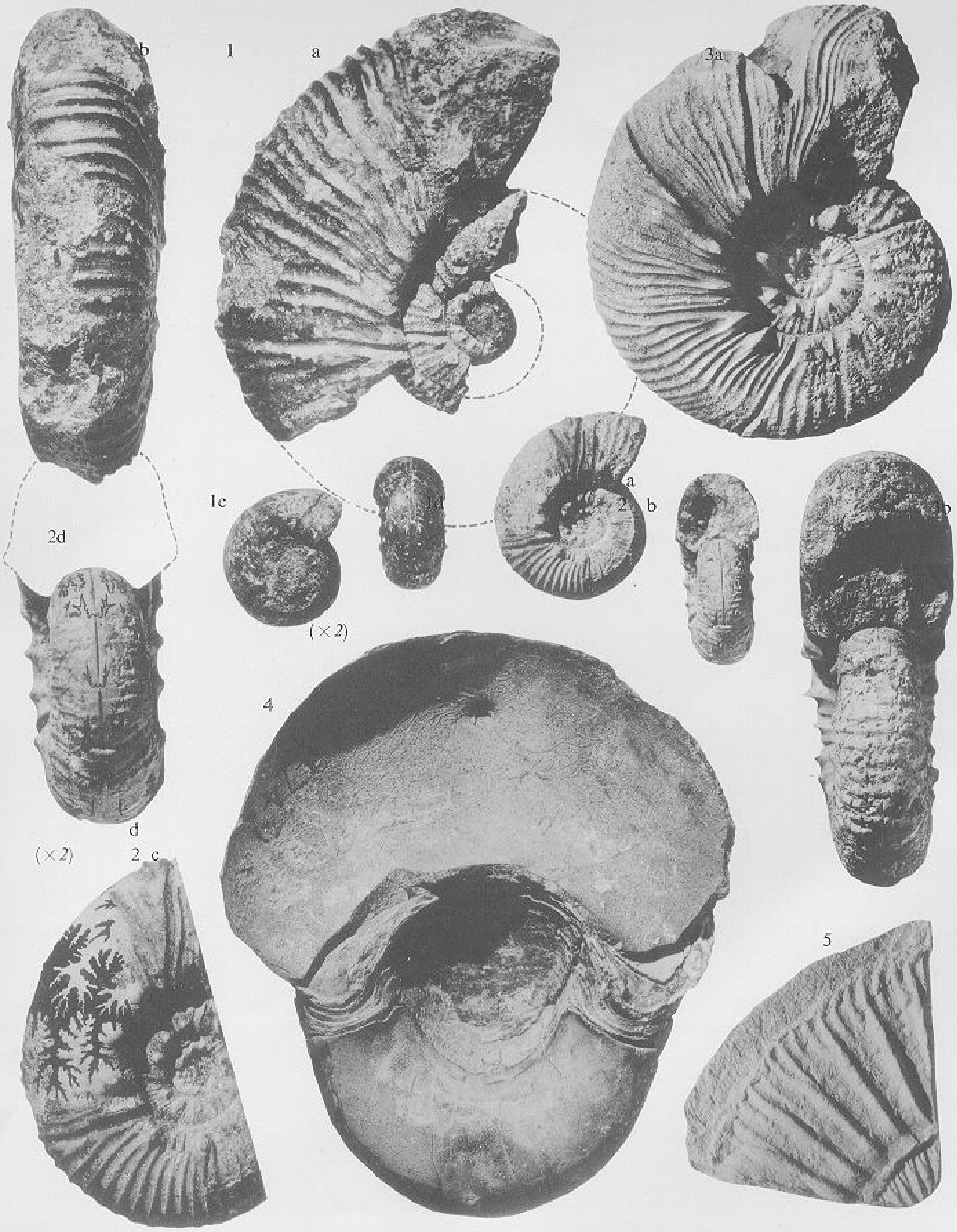

b
1
a
3a
a
1c
1d
2
b
3b
2d
(×2)
4
d
(×2)
2 c
5

PLATE XIII

Figs. 1–5 *Eutrephoceras simile*, sp. nov. The Naze. Holotype (1 = C.41385) with tracing of external suture-line. (2). Septal surface of two isolated air-chambers (C.41387). (3–5). Two septal surfaces and ventral aspect of inner whorls of same specimen (C.41386) to show the coarsely reticulate ornament of the thick test.

6 *Eutrephoceras sphaericum* (Forbes). Topotype (C.41409) from the Valudayur Group of Pondicherry (ex Geological Society Coll.).

7 *Eutrephoceras* aff. *simile*, sp. nov. One of nine examples from Egito, Angola (C.41480), with almost ventral siphuncle.

PLATE XIII