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UPPER CRETACEOUS DECAPODA AND SERPULIDAE FROM JAMES ROSS ISLAND, GRAHAM LAND

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ABSTRACT

RECENT collections of decapod crustaceans and serpulid worms from the Upper Cretaceous of James Ross Island have facilitated the re-description of three species previously recorded from the area and have contributed four new species. The decapods include *Hoploparia stokesi* (Weller), *Meyeria crofti* sp. nov. and *Callianassa meridionalis* sp. nov., and the serpulids *Rotularia callosa* (Stoliczka), *Rotularia shackletoni* (Wilckens), *Rotularia dorsolaevis* sp. nov. and *Ditrupa varicosa* sp. nov. The diagnosis of the subfamily Homarinae Mertin, 1941 is amended and observations are made on the taxonomic position and stratigraphical range of the genus *Meyeria*. In addition, the structure of the tube-wall of the genera *Rotularia* Defrance, 1827 and *Ditrupa* Berkeley, 1832–34, and their stratigraphical range are discussed. The age of the fauna is shown by associated ammonites to be of Lower to Middle Campanian age.

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INTRODUCTION

THE fauna described in this report consists largely of part of the collections made by the late W. N. Croft, members of "Operation Tabarin", and more recently R. Stoneley, from the Upper Cretaceous of James Ross Island. An account of "Operation Tabarin", which preceded the Falkland Islands Dependencies Survey, has been given by Wordie (1947), and some of the serpulids were collected on the second of two sledge journeys undertaken in 1945 which circumnavigated James Ross Island (*op. cit.*, pp. 378–80). During the period of his secondment to the Falkland Islands Dependencies Survey in 1946, Croft made further extensive collections from James Ross Island and adjacent areas. Parts of the Upper Cretaceous faunas collected have been described, the ammonites by Spath (1953) and Howarth (1958) in other reports of this series, and a remarkable cirripede by Withers (1951). The present report is concerned with the decapod crustaceans and serpulids, respectively the least common and one of the most common fossil groups obtained from the Upper Cretaceous strata. With the exception of material from the collections of the Walker Museum, Chicago, and the Swedish Museum of Natural History, all the specimens described in this report have been deposited in the Department of Palaeontology, British Museum (Natural History). The numbers given in brackets throughout the text are the registered catalogue numbers of the British Museum (Natural History), except where otherwise indicated.

The earliest and most complete record of the Upper Cretaceous fauna from the area of James Ross Island is provided by the Swedish South Polar Expedition of 1901–3, although the first description of part of the fauna was given by Weller (1903*a*, *b*). A footnote by Andersson (1906, p. 34) in his account of the geology of the area throws an interesting sidelight upon the background to Weller's paper:

> 'A note on Cretaceous fossils from Snow Hill Island was published during our stay in the South:
>
> STUART WELLER. The Stokes collection of Antarctic fossils. Journal of Geology. Vol. XI. No: 4. 1903. P. 413–419.
>
> Stokes is an American artist who joined the "Antarctic" on its first voyage to the Graham region, but left the expedition in Port Stanley in March 1902.
>
> He collected some fossil specimens on Snow Hill Island during two days in Febr. 1902 when the wintering party was landed. Though he had agreed not to communicate anything of the scientific results of the expedition, we found on our return that a description of his small fossil collection had been published.
>
> Evidently he did not give the eminent palaeontologist who wrote the description much information about the conditions under which the fossils were collected, as our expedition is called in Mr. Weller's paper " Belgian Antarctic Expedition".'

In addition to the misinformation regarding the title of the expedition, Stokes added further confusion by providing Weller with inadequate and inaccurate details of the locality from which the fossils were collected. This is given by Weller as "Admiralty Inlet, Louis Philippe Land", and Andersson has shown the correct locality is in fact Admiralty Sound, Snow Hill Island.

The results of the Swedish expedition are published in the scientific reports of the expedition, which include a full account of the annelids by Wilckens (1910). The only account of a decapod from the region is that of Weller (1903*a*, *b*). The author is indebted to the Walker Museum, Chicago, for the loan of the serpulids and decapod collected by Stokes and described and figured by Weller, and to the Swedish Museum of Natural History for the loan of the collection of hitherto undescribed decapods made by members of the Swedish Expedition. The fauna collected by the members of the Falkland Islands Dependencies Survey, though in part augmenting these earlier collections, has facilitated the re-description and re-appraisal of the systematic and stratigraphical position of some of the groups, as well as providing a number of new forms.

Much of the material described in this report occurs in a matrix of fine-grained, silty, glauconitic, calcareous sandstone. Most of the decapods and several of the serpulids occur in nodules, the formation of which was post-depositional since most of the decapods have been crushed, but there is no evidence of distortion within the nodules. In contrast, the much more solid serpulid tubes remain uncrushed. The weathered surfaces of the nodules are extensively marked with trace-fossils (Plate III, fig. 12), some similar to *Chondrites* (Simpson, 1957), which suggests that the sediment was originally highly charged with organic debris, supporting a large population of tubicolous and sipunculoid worms and riddled with their tunnels. The worm tubes occupy random positions within the sediment and probably represent a life association

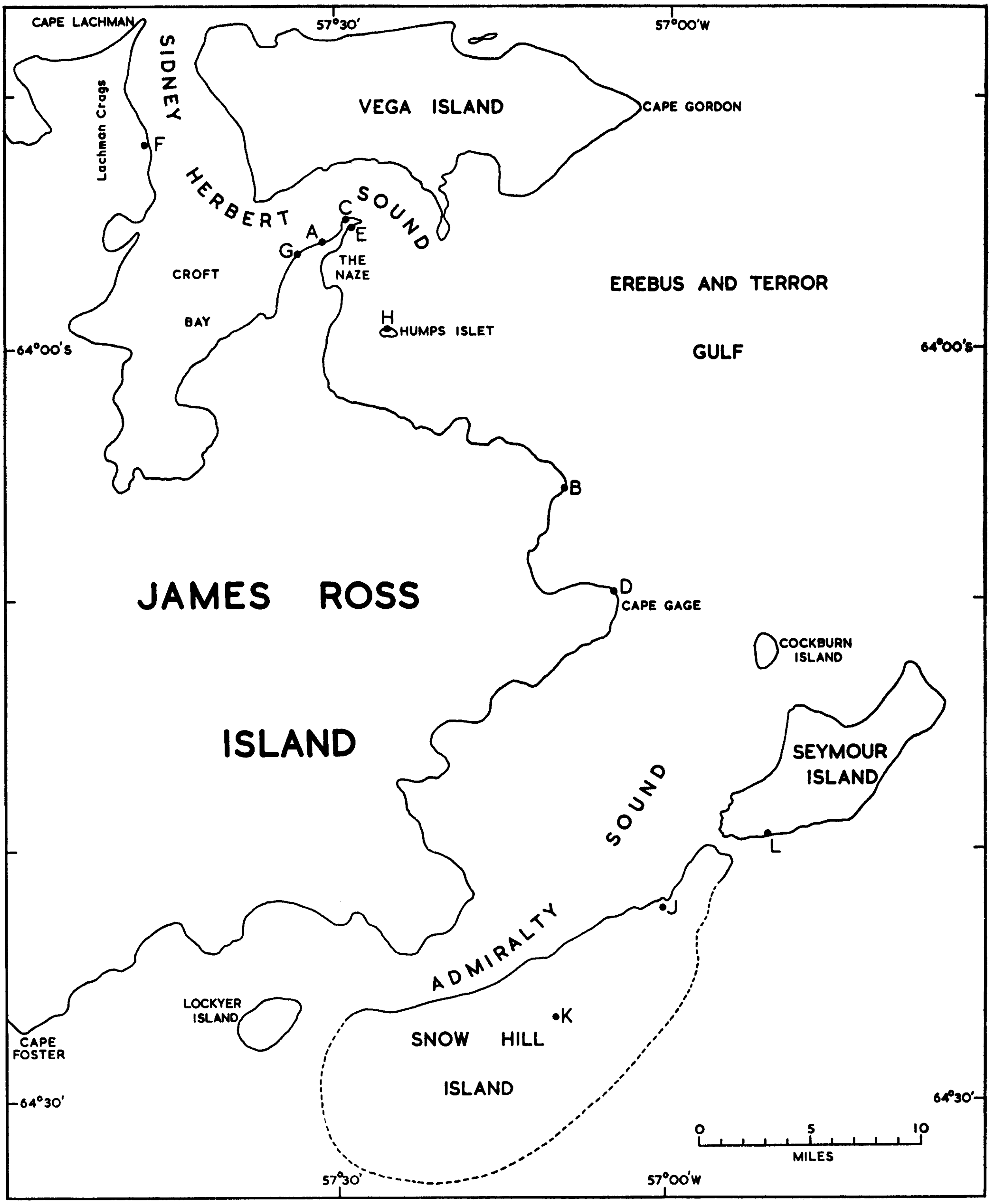

FIGURE 1

Sketch map of the James Ross Island area showing the position of stations from which Upper Cretaceous decapods and serpulids have been collected.

A. 4846–54, 5314–31.
B. 5011–17.
C. 5266, 5279–80, 5291, 5313, D.84.1, D.84.4, D.86.3, D.86.6, D.87.7, D.87.10, D.88.3, D.90.2, D.97.2, D.97.3.
D. 5412, 5420.
E. D.99.1.
F. D.417.4, D.422.1, D.422.5.
G. D.541.2.
H. 4679–4700, 4704, 4709–16, D.529.2, D.533.3, D.535.2.
J. D.2026.1–2.
K. D.2040.4, D.2042.2a.
L. D.2036.1.

since extremely fragile peripheral carinae, which could not have survived transporting, are preserved in some specimens of *Rotularia dorsolaevis* sp. nov. However, some degree of bottom drift is evidenced by the dissociated segments of the more buoyant decapod appendages.

Difficulty was experienced in the preparation of some of the decapods owing to the fragile and fractured condition of the test. Fortunately, the hard, fine-grained matrix forms excellent natural moulds and after removing adherent portions of the test with a needle-vice, casts in polyvinyl chloride preserving a very high degree of detail have been obtained by using the methods described by Rixon and Meade (1956). Further advantages of this method are that impressions of skeletal structures revealed at successive stages of development can be preserved, and the casts yield excellent photographs when coated with ammonium chloride.

A. LIST OF LOCALITIES AND SPECIES

A MAP of the collecting stations listed below is given in Fig. 1.

James Ross Island

4846–54 The Naze. Lat. 63°56′ S., long. 57°30.9′ W.
Rotularia callosa (Stoliczka) (A.7991–9).

5011–17 Beach on south side of snow point, five miles north of Cape Gage. Lat. 64°05.8′ S., long. 57°09.4′W.
Rotularia callosa (Stoliczka) (A.8000–6).

5266, 5279–80, 5291, 5313 The Naze. Lat. 63°55.1′ S., long. 57°29.1′ W.
Rotularia dorsolaevis sp. nov. (A.8007).
Rotularia shackletoni (Wilckens) (A.8008–9, A.8010).
Ditrupa varicosa sp. nov. (A.8011).

5314–31 The Naze. Lat. 63°56′ S., long. 57°30.9′ W.
Rotularia callosa (Stoliczka) (A.8012–29).

5412, 5420 Low cliffs behind fifteen-foot raised beach on north side of Cape Gage. Lat. 64°09.7′ S., long. 57°04.6′ W.
Rotularia callosa (Stoliczka) (A.8030–31).

D.84.1 Dagger Peak col, The Naze. Lat. 63°55.2′ S., long. 57°29′ W.
Hoploparia stokesi (Weller) (In. 51770).

D.84.4 Dagger Peak col, The Naze. Lat. 63°55.2′ S., long. 57°29′ W.
Meyeria crofti sp. nov. (In. 51769).
Hoploparia stokesi (Weller) (In. 51771).

D.86.3 Dagger Peak col, The Naze. Lat. 63°55.2′ S., long 57°28.9′ W.
Hoploparia stokesi (Weller) (In. 51772–5).

D.86.6 Dagger Peak col, The Naze. Lat. 63°55.2′ S., long. 57°28.9′ W.
Ditrupa varicosa sp. nov. (A.8032).

D.87.7 Dagger Peak col, The Naze. Lat. 63°55.2′ S., long. 57°28.9′ W.
Hoploparia stokesi (Weller) (In. 51776).

D.87.10 Dagger Peak col, The Naze. Lat. 63°55.2′ S., long. 57°28.9′ W.
Rotularia dorsolaevis sp. nov. (A.8033–9).
Rotularia callosa (Stoliczka) (A.8040–62).
Rotularia shackletoni (Wilckens) (A.8063).

D.88.3 North-west side of Dagger Peak, The Naze. Lat. 63°55.2′ S., long. 57°29.4′ W.
Hoploparia stokesi (Weller) (In. 51777–8).

D.90.2 North-west side of Dagger Peak, The Naze. Lat. 63°55.2′ S., long. 57°29.4′ W.
Hoploparia stokesi (Weller) (In. 51779).

D.97.2 About two hundred yards north-east of Dagger Peak, The Naze. Lat. 63°55.1′ S., long. 57°29′ W.
Hoploparia stokesi (Weller) (In. 51780).

D.97.3 About two hundred yards north-east of Dagger Peak, The Naze. Lat. 63°55.1′ S., long. 57°29′ W.
Rotularia callosa (Stoliczka) (A.8064).
Rotularia dorsolaevis sp. nov. (A.8065–70).

D.99.1 Coast south-east of Dagger Peak, The Naze. Lat. 63°55.4′ S., long. 57°28.9′ W.
Hoploparia stokesi (Weller) (In. 51781).

D.417.4 Coast east of Lachman Crags. Lat. 63°50.8′ S., long. 57°47.5′ W.
Rotularia shackletoni (Wilckens) (A.8071–4).

D.422.1 Coast east of Lachman Crags. Lat. 63°50.8′ S., long. 57°47.1′ W.
Rotularia shackletoni (Wilckens) (A.8075–80).
Rotularia callosa (Stoliczka) (A.8081–83).

D.422.5 Coast east of Lachman Crags. Lat. 63°50.8′ S., long. 57°47.1′ W.
Callianassa meridionalis sp. nov. (In. 53260–5).

D.541.2 Coast north-west of Terrapin Hill. Lat. 63°56.5′ S., long. 57°33.2′ W.
Rotularia callosa (Stoliczka) (A.8099).

Humps Islet

4679–4700 Humps Islet. Lat. 63°59.3′ S., long. 57°25.4′ W.
Rotularia callosa (Stoliczka) (A.7960–82).

4704, 4709–16 Half-way up north side. Lat. 63°59.4′ S., long. 57°25.3′ W.
Rotularia callosa (Stoliczka) (A.7982, A.7983–90).

D.529.2 North side. Lat. 63°59.4′ S., long. 57°25.2′ W.
Rotularia callosa (Stoliczka) (A.8084–7).

D.533.3 North side. Lat. 63°59.4′ S., long. 57°25.2′ W.
Rotularia dorsolaevis sp. nov. (A.8088–93).
Rotularia callosa (Stoliczka) (A.8094).

D.535.2 North side. Lat. 63°59.4′ S., long. 57°25.2′ W.
Rotularia callosa (Stoliczka) (A.8095–8).

Snow Hill Island

D.2026.1–2 Cliffs at foot of valley immediately south-west of Nordenskjöld's hut. Lat. 64°22′ S., long. 57°00′ W.
Rotularia callosa (Stoliczka) (A.8308–9).

D.2040.4 Foot of easternmost of larger buttresses, Sanctuary Cliffs. Lat. 64°27′ S., long. 57°10′ W.
Rotularia callosa (Stoliczka) (A.8311).

D.2042.2a Lowest point of western half of Sanctuary Cliffs. Lat. 64°27′ S., long. 57°10′ W.
Rotularia callosa (Stoliczka) (A.8310).

Seymour Island

D.2036.1 Small valley on the south coast, about one mile from D.2035. Lat. 64°19′ S., long. 56°54′ W.
Rotularia callosa (Stoliczka) (A.8305–7).

B. SYSTEMATIC DESCRIPTIONS

1. Phylum Arthropoda von Siebold, 1845

Class Crustacea Latreille, 1796

Order Decapoda Latreille, 1802

Suborder Reptantia Boas, 1880

Division Astacura Borradaile, 1907

Family Homaridae Bate, 1888

Subfamily Homarinae Mertin, 1941

Carapace and abdomen mostly without coarse spines or carinae, and only lightly granulated; chelae usually without carinae, more or less heterochelous.

Genus *Hoploparia* McCoy, 1849

Type species: *H. longimana* (Sowerby), 1826

Hoploparia stokesi (Weller)

Figs. 2, 3A; Plate I, figs. 1–5; Plate III, figs. 1–2.

Glyphea stokesi Weller, 1903*a*, pp. 418–419; pl. 1, fig. 1.

Diagnosis: Rostrum curved and strongly denticulate. Carapace grooves strongly marked, anterior of cephalothorax spinose. Abdomen strongly spinose. Heterochelous; carpus long, about equal in length to the merus.

Type Material: Holotype; right side of cephalothorax and incompletely preserved abdomen and appendages, forming part of the Stokes Collection of Antarctic Fossils in the Walker Museum, Chicago; Palaeontological Collection No. 9705.

Material: Holotype; fourteen specimens in the collection of the Department of Palaeontology, British Museum (Nat. Hist.), In. 51770–81, including seven specimens with the carapace in varying states of completeness; nine specimens in the collection of the Swedish Museum of Natural History, Ar. 46058–65, including eight specimens with the carapace in varying states of completeness.

Measurements: Average length of cephalothorax 33mm.; a detailed list of measurements is given in Table I.

Description: *Cephalothorax.* Subcylindrical, tapering to front and rear. The length from the posterior margin to the base of the rostrum (i.e. the posterior margin of orbit) along the mid-dorsal line is about one and two-thirds the greatest height, which is approximately equal to the maximum width. The length of the anterior region of the cephalothorax is about four-sevenths of its total length. The maximum height occurs mid-way along the length; the greatest width is at about a third of the length from the posterior margin, in the median lateral part of the branchiostegites at a point slightly posterior to the dorsal part of the post-cervical groove.

The length of the rostrum is about one-third the length of the carapace. The rostrum curves slightly downwards, with a gentle upward tilt at the tip, tapering in width moderately rapidly towards the front (Plate I, figs. 2a, c; Plate III, fig. 1). A median trough-like sulcus is bounded on each side by a well marked carina bearing up to three pairs of stout spines, not necessarily symmetrically arranged. The sulcus dies out in front of the third pair of spines and the front part of the rostrum is rounded in cross-section (Plate I, fig. 2c).

The rostral carinae continue posteriorly for a short distance onto the cephalothorax and bear a few short spines. Immediately external to each is a weakly developed carina bearing a stout spine in front, with a smaller spine and sometimes a few tubercles behind. The post-orbital spine is situated below and posterior

TABLE I

TABLE OF MAXIMUM DIMENSIONS OF SPECIMENS OF *Hoploparia stokesi* (WELLER)

	Holotype	In. 51780	In. 51772	In. 51777	In. 51779	In. 51781	In. 51778	In. 51770	Ar. 46063	Ar. 46062
Cephalothorax—length along mid-line	29	33	28	40	32	—	*32*	32	40	*19*
„ —length from posterior angle of orbit to post-cervical groove	17	19	16	22	18	18	*19*	18	24	*12*
„ —length from posterior margin to post-cervical groove	12	14	12	18	14	—	*13*	14[a]	16	*7*
„ —height at post-cervical groove	15	20[a]	17	24[a]	20[a]	18[a]	—	20[a]	*25*	*11*
„ —breadth	8[b]	20[a]	17	5[a b]	16[a]	11[a]	—	16[a]	5[a b]	*6*[b]
Rostrum —length	*4*	*12*	—	—	—	—	—	*6*	14	—
Abdomen —length	45[c]	47[d]	50[c]	—	44[c]	—	—	—	*65*[c]	*35*[c]
„ —width at second segment	14	*15*	12[a]	—	14[a]	—	15[a]	—	—	12

1st Peraeopods	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R
Ischium —length	—	—	13	13	9	9	—	—	—	—	—	—	—	—	—	—	—	—	—	—
„ —breadth	—	—	*4*	*6*	5	*4*	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Merus —length	—	—	23	23	15	15	—	—	—	—	—	—	*15*	—	*24*	*27*	—	*21*	—	—
„ —height	—	—	7	7	6	5	—	—	—	—	—	8	6	—	9	9	—	10[a]	—	—
„ —breadth	—	—	8	8	—	5	—	—	—	—	—	6[a]	—	—	6	—	—	—	—	—
Carpus —length	—	—	21	*19*	*13*	14	25	—	15	—	22	22	*12*	*12*	*17*	*21*	—	18	—	—
„ —height	—	—	8	8	6	5	—	—	8[a]	—	—	7	7	8	*7*	*9*	—	11[a]	—	—
„ —breadth	—	—	9	9	6	6	10	—	6[a]	—	8	8	8	—	—	—	—	—	—	—
Propos —length of palm	—	—	—	—	17	15	36	29	22	23	22	23	18	20	—	—	—	19	—	—
„ —breadth of palm	—	—	—	—	8	7	20	16	9[a]	13	11	11	9	—	—	—	—	—	—	—
„ —thickness of palm	—	—	—	—	—	5	—	—	7[a]	6[a]	—	—	8	8	—	—	—	14[a]	—	—
Dactylus —length	—	—	—	—	*13*	*18*	*24*	*42*	*23*	*22*	*13*	*10*	—	*19*	—	—	—	—	—	—
„ —breadth	—	—	—	—	3	3	8	7	—	5	4	4	—	—	—	—	—	—	—	—

Figures in italics indicate incomplete measurements All measurements are given in millimetres
[a]specimen crushed or distorted [b]half total dimension [c]flexed [d]straight

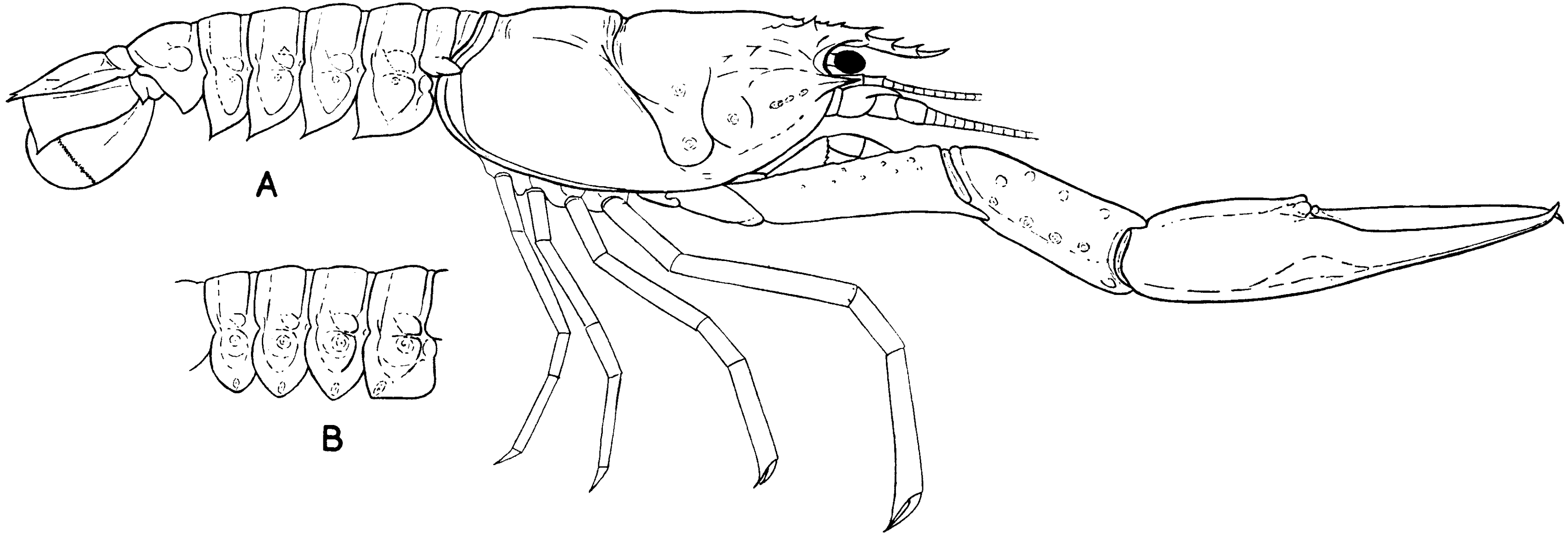

FIGURE 2

Outline reconstructions of *Hoploparia stokesi* (Weller).

A. Reconstruction of complete animal (the form of the eye and of peraeopods 3–5 being conjectural) with a rounded anterolateral angle on the second abdominal pleuron (? ♀).

B. Reconstruction of abdominal segments 2–5 of a form with a sharply rounded anterolateral angle on the pleuron of the second segment (? ♂).

to the carina, well behind the margin of the orbit. From the stout antennar spine, a marked ridge extends backwards and slightly downwards to about half the distance from the base of the spine to the cervical groove. It is terminated by a shallow transverse groove between which and the cervical groove is a prominent isolated spine (Plate I, figs. 1, 4b, 5).

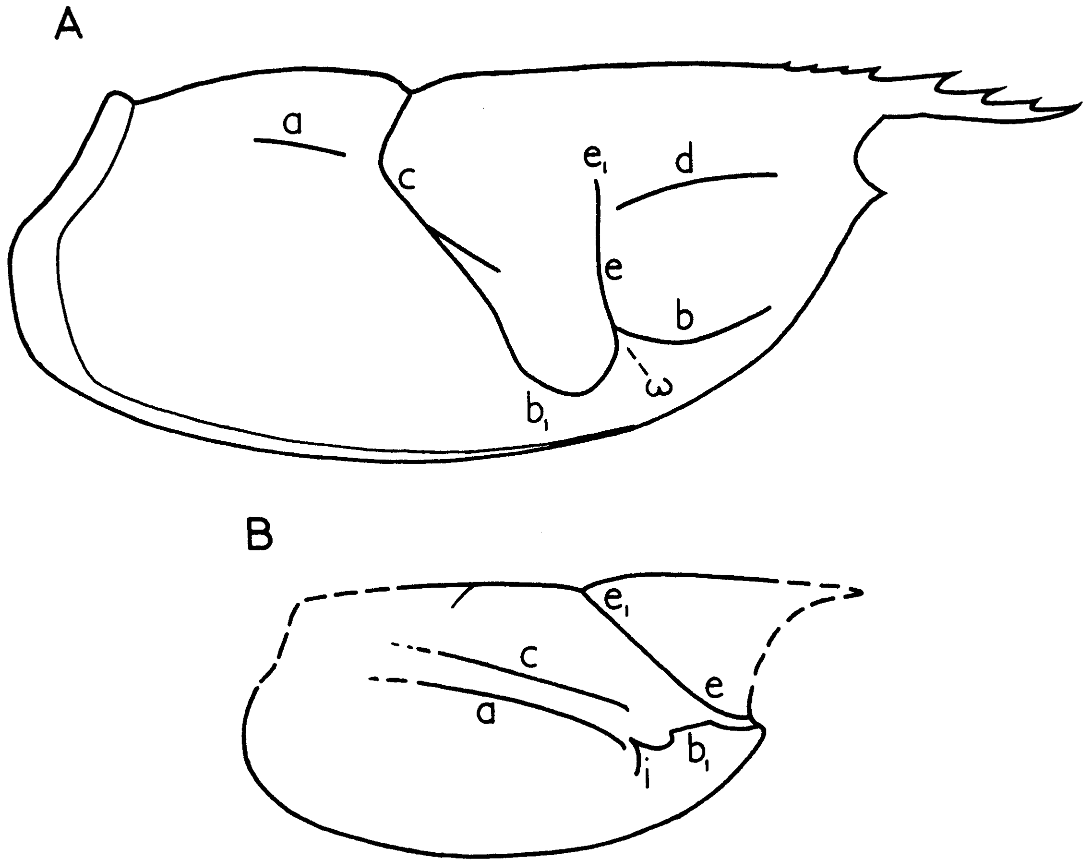

FIGURE 3

Outline reconstruction of carapace and notation of carapace grooves.
A. *Hoploparia stokesi* (Weller).
B. *Meyeria crofti* sp. nov.
a, branchio-cardiac; b, antennar; b_1, hepatic; c, post-cervical; d, gastro-orbital; e–e_1, cervical; i, inferior; ω, hepatic lobe.

The lower part only of the cervical groove (e–e_1) is present, being deeply incised and extending from the level of the base of the orbit, downwards and slightly forwards (Fig. 3A). It is joined by the antennar groove (b) which is also deeply incised and curved, extending towards the anterior margin of the carapace where it becomes broader and shallower. The junction of these grooves is intersected by the short, deep hepatic groove (b_1), forming the characteristic λ-shaped furrow with a well defined hepatic lobe (ω) below (Fig. 3A; Plate I, figs. 1, 3a). A broad, weak furrow extending from the top of the cervical groove towards the front may represent the gastro-orbital groove (d). The post-cervical groove (c) is deep and broad, crossing the dorsal surface at a point three-sevenths the distance from the posterior margin to the base of the rostrum. The dorsal part of the groove is flexed slightly backwards but curves forwards and downwards on the side, where it joins the hepatic groove. The posterior margin of the lateral part of the post-cervical groove is inflated into a rounded fold, and in some specimens the posterior margin of the dorsal part of the groove bears two stout spines situated close to the midline (Plate III, fig. 2). The branchio-cardiac groove (a) is indicated in some specimens, joining the post-cervical groove at the dorsolateral angle and extending obliquely upwards and backwards towards the posterior margin. A further shallow furrow extends from the post-cervical groove at the level of the base of the orbit, downwards and forwards towards the cervical groove, crossing the well developed lobe demarcated by the cervical, post-cervical and hepatic grooves. The ventral part of this lobe bears a prominent spine. The marginal furrow is deep and well marked, with a strong rim at the posterior margin which becomes broadest and best developed at the rear of the branchiostegites. The cephalothorax is ornamented with granules which are transversely elongated on the dorsal surface, whilst those near to the ventral and posterior margins are also slightly elongated but sub-parallel to the margins. The anterior of the cephalothorax is less densely granulated, but the granules on the dorsal surface are much coarser, especially towards the front.

Abdomen. The first segment is short and narrow with prominent lateral, anteriorly-directed, spinose bosses which overlap the posterior margin of the carapace. The tergite is ornamented with numerous transversely elongated pits.

The tergite of the second segment is inflated in front with low, but well-defined anterolateral bosses, which are divided from the pleura by longitudinal grooves. A transverse posterior groove, weakly developed in the middle of the tergite, is inclined obliquely backwards towards the lateral margins where it becomes deeper and continues onto the pleura. The tergite is ornamented with numerous, relatively large, transversely elongated pits, and in the posterior zone of In. 51780, with faint transverse striations.

The pleura of the second segment occur in two forms, though in both the length is about equal to the breadth. In specimens in the first category (In. 51772, In. 51778, In. 51779), each pleuron has almost straight anterior and lateral edges and a sharply rounded anterolateral angle (Plate I, figs. 3a, b, 4a). The posterior edge is gently curved and the posterolateral angle is produced into a backward projecting tooth. The margin is broad and inflated, bearing a stout spine at the posterolateral angle, and is elevated to form a small boss where the anterior part articulates with the posterior margin of the first segment. The margin is ornamented with tubercles arranged sub-linearly, increasing in size inwards, being largest at the anterolateral angle. A broad, smooth depression divides the margin from a prominent mediodorsal, laterally elongated, spinose boss which is ornamented with small tubercles.

In specimens in the second group (In. 51770, In. 51780, Ar. 46063), each pleuron has a more rounded anterolateral angle, the terminal tooth is more posteriorly situated, and the marginal zone is ornamented with small pits and granules; the stout lateral spine and tubercles of the first group are entirely lacking (Plate I, fig. 2b; Plate III, fig. 1). In both groups the pleura bear a prominent row of laterally elongated tubercles extending from the posterior of the elongated boss diagonally towards the anterolateral angle (Plate III, fig. 2).

The tergites of the third to fifth segments are similar to that of the second except that the anterolateral bosses become successively reduced, being hardly apparent in the fifth segment. Each pleuron has a rounded anterolateral angle, and the posterior edge is sinuously curved and produced laterally into a backward-directed, toothed prominence bearing a stout spine (Plate I, fig. 3b). This is lacking in In. 51780 (these segments are not preserved in In. 51770) but all bear an anteromedian spinose boss, though this is somewhat reduced in the fifth segment, and a diagonal row of laterally elongated tubercles like that of the pleuron of the second segment.

The pleuron of the sixth segment terminates in a sharply pointed angle which does not bear a spine; the mediodorsal boss forms a low, somewhat flattened dome, also without a spine.

The sternite of the sixth abdominal segment is present in In. 51780, though slightly crushed and the lateral margins lacking. It is a relatively long, narrow plate, the breadth being about one-third the width; the anterior margin is gently concave; the posterior margin is convex and paralleled by a transverse posterior groove. The lateral margins are ventrally flexed to unite with the margins of the pleura.

The telson is moderately elongate, the width being about two-thirds the length, and tapering slightly posteriorly. The lateral margins are gently curved, the posterior margin sub-convex, the posterolateral angles being rounded and armed with a sharp spine. A median triangular sulcus is bounded by two ridges which extend obliquely backwards to the posterolateral angles, where they are much reduced; the ridges are bordered by well-marked lateral grooves. The lateral parts of the telson are ornamented with pits; the ridges and central zone with coarse granules with pits posterior to them.

Appendages. Antennular and antennal peduncles with fragments of antennule and antenna are present, though imperfectly preserved, in In. 51772. The antennal peduncle is large, being about one-third the length of the carapace; the second segment (well preserved in the holotype) is particularly stout, with a long, anteriorly projecting spine. Fragments of antennule or antenna are present in other specimens, but it is not possible to estimate their total length.

Third maxillipeds are also present in In. 51772 and are strongly developed; their estimated length is about three-quarters that of the carapace. The ischium and merus have flattened lateral surfaces, the merus (also seen in the holotype and In. 51781) being triangular in section, with a ventral, toothed ridge; the other segments are round in cross-section. The ischium and merus are ornamented with granules and pits; the other segments are smoother and have faint pits.

The first peraeopods are strong (Plate I, fig. 1), shorter than the body and isochelous in the smaller (juvenile) specimens, equal to or longer than the body and heterochelous in the more adult forms, either the right or left chela being the larger. The large chela is proportionately broader in palm and fingers, the breadth of the palm being about half its length; the small chela is slender, the breadth of palm being less than half the length. The dorsal surface of the palm is gently transversely convex with a shallow, internal lateral groove which expands to form a broad, shallow depression at the base of the pollux; the ventral surface is strongly convex, especially posteriorly, with a broad internal lateral groove. The internal margin has a prominent broadly rounded carina; the external margin is more rounded with a slight carina. The carinae are more sharply defined in the slender chelae; the internal carina may be armed with a row of stout spines, or these may be reduced or absent. The palm bears a prominent lateral lip and stout dorsal and ventral processes at the articulation with the dactylus, which bears corresponding processes. The fingers of the large chela are relatively broad and somewhat flattened; those of the small chela are long, slender and more rounded, the dactylus having a slight outward curve. The fingers have sharp, inwardly curved, crossing tips, the inner margins being armed with teeth of varying size. The chelae are ornamented with coarse granules and pits, which become larger posteriorly and marginally. The carpus is long, a little less than the length of the palm and sub-triangular in cross-section. The dorsal surface is gently curved, having a maximum breadth about one-third the length, with broadly rounded lateral margins and a sharper ventral ridge. The margins bear rows of up to six stout spines, a further row occurring along the mid-line of the dorsal surface. The carpus is ornamented with coarse granules, pits and tubercles. The merus is about equal in length to the carpus, tapering slightly posteriorly; its maximum width is about one-third the length. It is sub-triangular in cross-section, rounded dorsally, flattened ventrolaterally with an internal ventral ridge bearing a row of spines; it also bears stout anterior lateral spinose processes. The surface of the merus is relatively smoother than that of the carpus, especially posteriorly, and is ornamented with granules, pits and tubercles. Traces of the newly-forming, pre-ecdysial test and what may be muscle strands occur in the interior of the merus of In. 51772. The ischium is about two-thirds the length of the merus, being compressed and having a gently domed ventral surface with a row of spines on the internal margin. The surface is ornamented with granules, pits and tubercles.

Peraeopods 2–5 are imperfectly preserved but they are long, slender and elliptical in transverse section. At least one of the anterior pairs bears small chelae. The surface is smooth and ornamented with small, scattered pits.

The uropods are imperfectly preserved (Plate I, figs. 1, 3a; Plate III, figs. 1, 2) but the basal segment is divided into two by a shallow groove, with a suggestion in In. 51779 and In. 51780 that the posterior portion terminates in a spine. The exopodite is elliptical and divided into two by a transverse suture at about one-quarter of the length from the posterior margin; the anterior part has a median longitudinal groove and fold. The dorsal surface is ornamented with scale-like granules and pits, the posterior ventral surface with small pits and faint longitudinal carinae. The endopodite is approximately bell-shaped, with a spine at the posterolateral angle and a median longitudinal groove and fold. Its dorsal surface is ornamented with scale-like granules and pits and faint longitudinal carinae at the posterior margin.

Distribution: Holotype, Stokes Collection of Antarctic Fossils in the Walker Museum, Chicago: Admiralty Sound, Snow Hill Island (given by Weller (1903*a*, *b*) as "Admiralty Inlet, Louis Philippe Land"). Matrix of fine-grained, dense, grey to buff-coloured sandstone; associated with *Gunnarites antarcticus* (Weller), Lower to Middle Campanian.

Croft Collection, all specimens occurring in nodules of grey, fine-grained, silty, calcareous sandstone, Lower to Middle Campanian: Station D.84.1; Dagger Peak col, The Naze, James Ross Island. Lat. 63°55.2′ S., long. 57°29′ W. (In. 51770). Station D.84.4; Dagger Peak col, The Naze, James Ross Island. Lat. 63°55.2′ S., long. 57°29′ W. Associated with *Meyeria crofti* sp. nov. (In. 51771). Station D.87.7; Dagger Peak col, The Naze, James Ross Island. Lat. 63°55.2′ S., long. 57°28.9′ W. (In. 51776). Station D.88.3; north-west side of Dagger Peak, The Naze, James Ross Island. Lat. 63°55.2′ S., long. 57°29.4′ W.

Associated with *Gunnarites antarcticus* (Weller) figured by Spath (1953, pl. 4, figs. 9a, b ; C.41360) (In. 51777–8). Station D.90.2; north-west side of Dagger Peak, The Naze, James Ross Island. Lat. 63°55.2′ S., long. 57°29.4′ W. (In. 51779). Station D.97.2; about two hundred yards north-east of Dagger Peak, The Naze, James Ross Island. Lat. 63°55.1′ S., long. 57°29′ W. (In. 51780). Station D.99.1; coast south-east of Dagger Peak, The Naze, James Ross Island. Lat. 63°55.4′ S., long. 57°28.9′ W. (In. 51781).

Swedish South Polar Expedition of 1901–3 Collection in the Swedish Museum of Natural History: upper plateau, Snow Hill Island (Ar. 46059–60). Locality 2, Snow Hill Island (Ar. 46064). Locality 4, Snow Hill Island (Ar. 46061a, b). Locality 5, Snow Hill Island (Ar. 46063). Locality 6, Snow Hill Island (Ar. 46062). Head of small valley, south-western part of Seymour Island (Ar. 46058a, b). Locality 12, Cockburn Island (Ar. 46065).

Remarks: In general configuration *H. stokesi* is very similar to the type species *H. longimana* (Sowerby) which occurs from the Aptian to the Lower Cenomanian in England (Woods, 1925–31, p. 92). The principal differences are in the detailed structure of the carapace furrows, the greater spinosity in *H. stokesi* of the anterior part of the carapace and especially the abdomen, and the proportions of the cephalothorax and of the merus and carpus of the first peraeopods. Nevertheless, the abdominal bosses and furrows of *H. stokesi* have their incipient structural counterparts in *H. longimana*, as do many of the spines and ridges of the cephalothorax, and the telson and uropods are closely similar. In both forms the rostrum is denticulate, a characteristic which in *H. longimana* has been consistently overlooked or denied, despite a clear affirmation by Woods (1925–31, p. 87) of the presence of spines in better preserved specimens. The shape of the abdominal pleura of *H. stokesi* closely resembles that of the smaller forms of *H. gammaroides* from the London Clay.

Other species of *Hoploparia* occurring in the southern hemisphere are *H. mesembria* Etheridge Jnr. (1917, p. 7; pl. 1, fig. 5; pl. 2, fig. 1) from the Lower Cretaceous of Queensland, and *H.? antarctica* Wilckens (1907, pp. 108–9; pl. 3, fig. 5) from the Upper Cretaceous of Patagonia. Unfortunately, both forms are poorly preserved and the descriptions and figures are inadequate to allow comparison with *H. stokesi.* Part of a chela of *? Hoploparia* has also been recorded by Wilckens (1922, p. 25) from the Upper Cretaceous of New Zealand.

An interesting feature of the *H. stokesi* faunule described here is that it is composed of individuals with one of two types of abdominal segments; the first group having a sub-angular outline to the pleura of the second segment and lateral spines at the pleural terminations, the second group having a more rounded outline to the pleura of the second segment, the pleural terminations not bearing lateral spines. It is most probable that this variation is due to sexual dimorphism rather than to specific or varietal difference. Although not previously recorded in the genus *Hoploparia*, similar though less pronounced dimorphism occurs in the abdomen of *Homarus gammarus*, the common British lobster, in which the pleura of the female are slightly broader and more rounded than those of the male and the sternites of the males bear a much more pronounced median spine than those of the females. By analogy, the specimens of *H. stokesi* with the more angular and spinose pleura are probably males, and those with the more rounded pleura, females. The absence in the females of lateral spines would facilitate the enrolment of the abdomen to protect the eggs attached to its underside. Although the abdomen of the holotype is poorly preserved, the outline of the pleura of the second segment suggest it is a male.

As is shown in Table I, the range in size of the material described is small compared with the great variation which is known in other genera of the family Homaridae. However, with increasing size and presumably age, changes occur in the relative proportions of various parts of the skeleton, particularly in the first peraeopods. In the juvenile forms the chelae are approximately the same size and the merus is somewhat longer than the carpus, but with increasing age the specimens become increasingly heterochelous and the length of the carpus equals that of the merus. Similarly, the ornamentation of the carapace becomes proportionately coarser.

The classification given above is that of Balss (1957), which is based upon the earlier classifications of Boas and Borradaile. In addition, the subfamiliar classification of Mertin (1941) is incorporated, but in view of the presence of coarse spines on the carapace and abdomen of *H. stokesi*, it has been necessary to amend Mertin's diagnosis of the Homarinae accordingly.

Division Anomura Borradaile, 1907

Tribe Glypheidea Van Straelen, 1925

Family Mecochiridae Van Straelen, 1925

Genus *Meyeria* McCoy, 1849

Type species: *M. ornata* (Phillips), 1829

Meyeria crofti sp. nov.

Fig. 3B; Plate II, figs. 1a, b.

Diagnosis: Cervical furrow extending obliquely forward, reaching the anterior margin immediately above a small rounded angle. Hepatic groove extending forward to reach anterior margin, front part being parallel with, and below the front of the cervical groove. Antennar groove lacking. Anterior of branchio-cardiac groove does not join the posterior of the hepatic groove. Anterior carinae situated dorsally.

Type material: Holotype; incomplete and broken cephalothorax, with fragments of the abdominal segments and appendages. Department of Palaeontology, British Museum (Nat. Hist.), In. 51769.

Material: The holotype.

Measurements: Length 17mm. (incomplete), width 8mm. (incomplete), height 8mm.

Description: The cephalothorax is sub-cylindrical, the posterior and anterior margins being gently rounded but incomplete. The anterior margin bears a small rounded angle, but since the margin above it is not preserved, it is not possible to determine whether it is the suborbital or antennal angle, though from its ventral position the latter seems most probable. Below and behind it, the margin of the carapace is gently indented, but again owing to incomplete preservation it is not possible to determine the presence or configuration of a pterygostomial angle, although there appears to be a sharp indentation where the inferior groove reaches the ventral margin (Plate II, fig. 1a). The region anterior to the cervical groove bears a broad, low mediodorsal carina which does not reach forward to the rostrum and becomes very weakly defined posteriorly towards the cervical groove (Plate II, fig. 1b). The rostrum is not preserved. Two carinae occur on each side of the mediodorsal carina, the upper sub-parallel to it and near to the mid-dorsal line, converging on the rostrum anteriorly but not reaching the cervical groove posteriorly; the upper carina is asymmetrical, the outer slope being much steeper and more sharply defined. The lower carina is sub-parallel to the upper, the posterior end swinging sharply upwards parallel to the cervical groove to join the posterior of the upper carina. The carinae and the anterior dorsal region of the carapace situated between the upper carinae are closely ornamented with anteriorly-projecting spinose tubercles; the rest of the anterior region is smooth, with a few small, scattered tubercles.

The cervical groove (e–e_1) is well defined, extending obliquely forward to reach the anterior margin immediately above a rounded angle (Fig. 3B). The lower margin of the groove forms a pronounced flange ornamented with tubercles, which becomes constricted into a narrow carina anteriorly, where it is bounded below by the front of the hepatic groove (Plate II, fig. 1a). The antennar groove is lacking. The branchio-cardiac groove (a) is weakly defined, swinging sharply downwards in front and continuing parallel to the upper part of the inferior groove for a short distance. Owing to incomplete preservation of the carapace, the posterior portion of the groove is not preserved. The post-cervical groove (c) is weak, parallel to the branchio-cardiac groove, with a short groove extending obliquely forwards and upwards to the mid-dorsal line from a point estimated to be about midway along its length. The carapace between the anterior parts of the post-cervical and branchio-cardiac grooves forms a slightly inflated zone, which becomes constricted downwards into a short, rounded carina separating the anterior terminations of the branchio-cardiac and inferior grooves. The hepatic groove (b_1) follows a somewhat sinuous course; the posterior is sharply defined, forming with the upper part of the inferior groove a deep, Y-shaped depression, and demarcating the ventral margin of a small elevated lobe. The posterior branch of the Y does not join the branchio-cardiac groove, but extends parallel with it for a short distance before dying out in the elevated region between the post-cervical and branchio-cardiac grooves. The mid part of the hepatic groove becomes much broader and less sharply defined, narrowing again anteriorly where it runs parallel to the cervical groove. The upper part of the inferior groove (i) is distinct, extending obliquely backwards and downwards towards the ventral margin, where it becomes less well defined. Except for the anterior dorsal region, the carapace is largely smooth and ornamented with a few small, scattered, spinose tubercles.

Fragments of the abdominal segments and head and thoracic appendages are present but insufficiently preserved to permit description.

Distribution: Station D.84.4; Dagger Peak col, The Naze, James Ross Island. Lat. 63°55′ S., long. 57°29′ W. Preserved in a nodule of grey, fine-grained, silty, calcareous sandstone; associated with *Hoploparia stokesi* (Weller), Lower to Middle Campanian.

Remarks: Of the small number of species of *Meyeria* so far described, all occur in the Lower Cretaceous (Valanginian–Aptian). Of these, only one is recorded from the southern hemisphere, *M. schwarzi* Kitchin, from the Uitenhage Series of South Africa (Kitchin, 1908, pp. 212–8; pl. 7, fig. 22; pl. 9, figs. 4, 4a, 5; pl. 10, figs. 4, 4a, 4b). Thus the occurrence of *M. crofti* marks a considerable extension in the vertical and horizontal range of the genus.

The principal difference between the species previously described (with the possible exception of *M. schwarzi*) and *M. crofti* is in the course of the cervical groove which in the latter cuts the anterior margin obliquely and dorsally to the anterior angle; the antennar groove is entirely lacking. In the other species the cervical groove merges into the antennar groove, which cuts the anterior margin ventral to the anterior angle. Thus the configuration of the cervical groove in *M. crofti* is similar to that occurring in the genus *Mecochirus*. A further distinction is that in *M. crofti* the anterior carinae are more dorsally situated. Unfortunately, the anterior portion of the carapace of *M. schwarzi* figured by Kitchin (*op. cit.*, pl. 8, fig. 22) is incomplete, but it would appear to closely approach that of *M. crofti*, as does the configuration of the cervical groove; in addition, both are small forms. However, the position of the anterior carinae differs considerably in the two species. The course of the branchio-cardiac and inferior grooves and the hepatic groove in *M. crofti* is similar to that in *M. mexicana* Rathbun (1935, pp. 17–18; pl. 26, figs. 1–4) from the Upper Aptian of Mexico. Also in this apparently unique specimen, the anterior part of the carapace is not exposed.

The supra-generic classification listed above necessitates some comment, being based essentially upon those of Boas (1880) and Borradaile (1907), revised by Balss (1957). Early classifications included the genus *Meyeria* within the family Glypheidae Winckler. Subsequently, van Straelen (1925) created the tribe Glypheidea, comprising the families Glypheidae and the newly erected Mecochiridae. Woods (1925–31) accepted the early classification but incorporated van Straelen's tribe Glypheidea, though not his family Mecochiridae, both the genera *Mecochirus* and *Meyeria* being included within the family Glypheidae. Regarding these genera, Woods (*op. cit.*, p. 68) noted that "*Meyeria* closely resembles *Mecochirus*, but detailed comparison is difficult on account of the unsatisfactory state of preservation of the specimens of the latter genus". Beurlen (1928) essentially retained van Straelen's classification, though reducing the tribe to family status and the families to subfamilies. He also stated (*op. cit.*, p. 141) that it seemed probable that *Meyeria* should be included with the Mecochirinae, but that he was unable to affirm this with certainty since he had not been able to examine sufficient material. In contrast, Glaessner (1929) placed *Meyeria* within the family Glypheidae. A major revision of the classification of the Decapoda was subsequently undertaken jointly by Beurlen and Glaessner (1930), and in this *Meyeria* is included within the family Mecochiridae. However, in his most recent review of the classification of the decapods, Balss (1957) places *Meyeria* with the Glypheidae. Though the Balss classification is used here, following Beurlen and Glaessner, *Meyeria* is here regarded as forming part of the Mecochiridae.

It is unfortunate that, as defined by the authors quoted above, the status of the taxon "tribe" is not in accordance with modern taxonomic usage, in which the tribe is regarded as being of inferior status to the subfamily. Similarly, the term "division" is not an accepted taxonomic unit. However, any emendations could only be undertaken as part of a re-consideration of the taxonomy of the whole of the class Crustacea.

This species is named after the late W. N. Croft, by whom the single representative (to date) was found.

TRIBE THALASSINIDAE DANA, 1852

FAMILY CALLIANASSIDAE BATE, 1888

SUBFAMILY CALLIANASSINAE BORRADAILE, 1903

Genus *Callianassa* Leach, 1814

Type species: *Callianassa subterranea* (Montagu), 1808

Callianassa meridionalis sp. nov.

Plate II, figs. 3–5.

Diagnosis: Propodus small, quadrate; margins sub-parallel. Upper margin rounded with a sharp, obliquely inclined, distal ridge, immediately outside which is a row of up to six pits and on the inside a row of 6–9 sockets, rounded proximally, transversely elongated distally. Lower margin sharp, with a row of rounded pits on the outside and a row of over fourteen closely spaced, longitudinally elongated pits on the inside. Surface smooth with a few small, isolated sockets on the inner and outer surfaces. Fingers short.

Type material: Holotype; right propodus with part of immovable finger, shell missing from the outer surface. Department of Palaeontology, British Museum (Nat. Hist.), In. 53260.

Material: Holotype and five imperfect propodi, two right and three left. Department of Palaeontology, British Museum (Nat. Hist.), In. 53261–5.

Measurements:

Specimen	*Palm*			*Immovable Finger*		*Movable Finger*	
	Length	*Height*	*Thickness*	*Length*	*Height*	*Length*	*Height*
In. 53265. Left	6	6	2.5	1*	2	—	—
In. 53263. Left	9	8	—	3.5*	2.5	5	2.5
In. 53264. Left	10	7	3	2*	3	—	—
In. 53261. Right	7.5	6	3	—	—	—	—
In. 53262. Right	10	7	4	2.5*	2*	—	—
In. 53260. Right. Holotype ...	10	9	4	2*	3*	—	—

Measurements are given in millimetres, those marked with an asterisk being incomplete. The length of the palm is that of the outer surface from the proximal margin to the base of the interdigital sinus.

Description: The propodus is small and quadrate; the length may be equal to or greater than the breadth. The upper and lower margins are sub-parallel, slightly converging distally. The upper margin is straight or very slightly convex, and moderately broadly rounded. A sharp ridge extends from the proximal end of the margin on the inner side of the crest of the marginal fold and is obliquely inwardly inclined (Plate II, fig. 3c). It is gently sinuously curved, becoming broader and weaker between half or three-quarters way along the margin, and dying out towards the distal end. Immediately on the outer side of the ridge, between it and the crest of the marginal fold, there is a row of up to six small, round pits, commencing about a quarter of the length from the proximal end and ending about the same distance from the distal margin. Directly below the distal margin and in line with the row of pits is an obliquely inclined, elongate socket. On the inner side of the ridge is a row of six to nine sockets with a slightly inflated posterior edge, rounded proximally, becoming transversely elongated and slit-like distally (Plate II, figs. 3b, e).

The lower margin is gently convex with a slight concavity at the distal end below the base of the immovable finger. It is sharp and gently sinuously curved, though less so than the upper margin (Plate II, fig. 3d). In no specimen is the lower margin wholly preserved, but in the holotype a row (incomplete) of fourteen closely spaced, longitudinally elongated, slit-like pits occurs immediately on the inner side (Plate

II, fig. 3b), whilst on the outer side of In. 53261 part of a row of small rounded pits is preserved. The proximal margin is normal to the upper and lower margins, the posterior portions of which are gently rounded and flexed inwards to form slight curved flanges. The outer surface is broadly longitudinally arched; the median area of the inner surface is slightly longitudinally arched, with shallow lateral depressions inside the latero-posterior flanges.

The fingers are short; the immovable finger curves gently downwards and inwards, forming an isosceles triangle in cross-section with a sharp ridge between the outer and transverse faces. The angle between the inner and transverse surfaces consists of a more broadly rounded ridge which extends for a short distance onto the inner surface of the palm. A small tubercle occurs near the base of the outer angle in the inter-digital sinus. The movable finger is short and curved downwards, the height being about one-third that of the palm (Plate II, fig. 2).

The surface of the shell is smooth when completely preserved. On the inner surface of the palm, about one-quarter the length from the distal margin and a little below the midline, occurs a single small, rounded socket. A further larger, transversely elongated socket is situated immediately below and in the middle of the distal edge. On the outer surface of In. 53261 occur three small, broadly spaced, transversely elongated sockets arranged linearly a little below the midline (Plate II, fig. 5a). About the same distance above the midline, a little less than half the length from the distal margin, occurs a very small isolated socket and in line with it near to the distal margin is a small, sub-rounded socket.

Distribution: Station D.422.5; coast east of Lachman Crags, James Ross Island. Lat. 63°50.8′ S., long. 57°47.1′ W. Specimens occurring in nodules of grey, fine-grained, silty, calcareous sandstone associated with beds containing *Gunnarites kalika* (Stoliczka) and *G. rotundus* Spath, Lower to Middle Campanian (In. 53260–5).

Remarks: The Callianassidae are soft-shelled forms and are rarely preserved complete. Most of the comparatively large number of species described (over 140, plus some 40 specimens without a specific name), ranging from Lower Oxfordian to Recent, are based solely on the chelae which may vary in size within individuals and between the sexes. Of over 20 forms recorded from the Senonian, only one, other than the specimen now described, occurs in the southern hemisphere. This is *Callianassa burckhardti* Böhm (1911, pp. 39–41; figs. a–e) from the Senonian of Patagonia, a sub-quadrate chela differing from *C. meridionalis* in the greater degree of curvature of the upper and lower margins, the inner and outer surfaces being more arched and ornamented with tubercles.

Other quadrate chelae occurring in the southern hemisphere include *Callianassa* (?) sp. recorded by R. Etheridge Jnr. (1917, p. 10; pl. 2, fig. 4) from the Lower Cretaceous of Queensland, which is insufficiently well described and figured to allow comparison, and *Callianassa americana* Woods (1922, p. 115; pl. 17, figs. 5, 6) from the Eocene of Peru, differing from *C. meridionalis* in being more quadrate, the fixed finger more slender and the surface ornamented with tubercles. Recorded from the Eocene of South West Africa is *Callianassa erecta* Böhm (1926, p. 74; pl. 31, figs. 5a, b) which is broadly similar to *C. meridionalis* in outline, though it is much larger and both the upper and lower margins are sharp and slightly more curved, approaching each other more closely distally.

In his discussion and expansion of the diagnostic characteristics of the subfamily Protocallianassinae with the single genus *Protocallianassa*, both erected by Beurlen (1930) and restricted to the Upper Cretaceous, Mertin (1941, pp. 208–9) notes that whilst the protocallianassids were evolving in the Eastern U.S.A.–European areas, there were already in existence in the Pacific and perhaps Southern Atlantic regions, callianassids more akin to Tertiary forms. In this context it is interesting to note that *C. meridionalis* shares several similarities with two Tertiary species. These are *Callianassa anguillensis* Rathbun (Withers, 1924, pp. 226–7; pl. 6, figs. 3–5) from the Upper Oligocene of Anguilla, and particularly, *Callianassa matsoni* Rathbun (1935, pp. 102–3; pl. 24, figs. 23–28) from the Lower Miocene of Florida, which are like *C. meridionalis* in the shape of the palm and in that the upper margin is carinate for at least half its length. Furthermore, the position, number, size and shape of the pits on the inner side of the lower margin of the palm is closely alike in both *C. matsoni* and *C. meridionalis*.

2. PHYLUM ANNELIDA LAMARCK, 1809

CLASS POLYCHAETA GRUBE, 1850

FAMILY SERPULIDAE BURMEISTER, 1837

SUBFAMILY SPIRORBINAE CHAMBERLIN, 1919

Genus *Rotularia* Defrance, 1827

Type species: *Rotularia* [*Serpula*] *spirulaea* (Lamarck), 1818

Rotularia callosa (Stoliczka)

Fig. 4A; Plate IV, figs. 2–4; Plate V, figs. 1–11; Plate VI, figs. 1–12; Plate VII, figs. 1–5.

Tubulostium callosum Stoliczka, 1868, p. 241; pl. 18, figs. 26–32.
Tubulostium callosum Stoliczka, Weller, 1903, pp. 416–7; pl. 1, figs. 6–17.
Tubulostium fallax Wilckens, 1910, pp. 7–11; pl. 1, figs. 3a–c, 4a–c.
Tubulostium discoideum Stoliczka, Bonarelli and Nágera, 1921, p. 20; pl. 2, figs. 1–3.
Tubulostium ornatum Wilckens, 1922, p. 25; pl. 5, figs. 10a–c, 11a–b, 12.
Tubulostium ornatum Wilckens, Camacho, 1949, pp. 250–1; pl. 1, fig. 1.
Tubulostium andinum Camacho, 1949, p. 251; pl. 1, fig. 2.
Rotularia sp., Cox, 1953, p. 13; pl. 2, fig. 12.

Diagnosis: Form of tube highly variable; spirally coiled, ranging from discoidal to conical; coiling sinistral, rarely dextral. Profile of whorls variable, periphery commonly with tri-carinate keel; tube commonly thickened by coarse callosity, especially on the umbilical surface. End of tube frequently projecting as a straight, tangential extension; aperture circular.

Type material: Syntypes in the Collection of the Geological Survey of India.

Material: About 140 specimens in the collection of the Department of Palaeontology, British Museum (Nat. Hist.); A. 7004–5, A. 7008, A. 7960–8006, A. 8012–31, A. 8040–62, A. 8064, A. 8081–3, A. 8084–7, A. 8094–9, A. 8305–11.

Measurements: Diameter ranging from 4.5–23 mm., averaging between 12–20mm.; height ranging from 1.5–14mm., averaging between 8–11mm.

Reg. No. of Specimen	*Diameter in mm.*	*Height in mm.*	*Form of Spiral*
A. 8083	4.5	1.5	Juvenile
A. 8081	5.5	2.5	,,
A. 8082	9.5	2.5	,,
A. 8095	14.5	6.0	Discoidal
A. 8016	21.0	8.5	,,
A. 8311	23.0	7.5	,,
A. 8096	17.0	8.0	Low spiral
A. 7992	18.0	7.5	,,
A. 8061	19.0	9.0	,,
A. 8022	13.0	13.0	High spiral
A. 7961	18.0	11.0	,,
A. 8305	18.0	14.0	,,

Description: The tube is tightly coiled, ranging from discoidal to an elevated spiral with wide variation in the apical angle. In a sample of 120 specimens 14% were discoidal (Plate V, figs. 1–4), 52% formed low spirals (height less than half the diameter, Plate V, figs. 5–10), and 34% high spirals (height more than half the diameter, Plate VI, figs. 1–12). The spirals are composed of $3\frac{1}{2}$–$4\frac{1}{2}$ whorls, successively partially or wholly overlapping each other, the final whorl being the only one entirely visible; the initial whorls are commonly lacking. The coiling is usually sinistral, the tube being orientated with the apex uppermost (Wrigley (1951, p. 180) asserts that this orientation should be reversed, but this is discussed below). The basic profile of the whorls is highly variable but tends to be related to the form of the spiral, ranging from a >-shape in the discoidal forms (Plate V, figs. 1b, 3b, 4b) to sub-quadrangular in the high spiral forms (Plate VI, fig. 8b). However, there is a wide range in variation between these limits and some discoidal forms have a basically quadrangular profile (Plate V, fig. 2b), whilst that of some high spiral forms is sub->-shaped (Plate VI, fig. 4b). Furthermore, the shape may differ on opposite sides of a whorl, especially with a change in the plane of the coiling (Plate V, fig. 5b).

Another factor influencing the profile of the whorls is the presence of a keel formed of up to three carinae which show considerable variations in relative size, shape and position. The middle carina is generally the most strongly developed and may itself bear subsidiary ridges and furrows (Plate V, fig. 3; Plate VI, fig. 3), and in one instance is subdivided by a median furrow into two, the periphery appearing to be composed of four carinae (Plate VI, fig. 6). The carinae may be broadly rounded (Plate VI, fig. 3b) or angular (Plate V, figs. 1b, 4b; Plate VI, fig. 1b) or a combination of both, and individual carinae may vary along their length; one or both of the lateral carinae may be reduced to varying degrees or be absent (Plate V, figs. 4, 7, 10; Plate VI, figs. 4, 9). The lateral carinae are separated from the middle carina by depressions which may form deep grooves (Plate V, fig. 2) or broad furrows (Plate V, figs. 1, 9). Similarly, the keel is itself delimited by spiral depressions which may form sharply defined grooves (Plate VI, fig. 3) or broad furrows (Plate V, fig. 3). Between these depressions and the whorl sutures the tube is considerably thickened by callous deposits, the surface of which may be flat (Plate V, fig. 7b) or form an angular (Plate V, fig. 1) or tumid (Plate V, fig. 2) spiral ridge, with a considerable range between these extremes. The degree of development and shape of the ridges is frequently different on the apical and umbilical surfaces, the umbilical ridges being much more inflated, whilst in the higher spiral forms the apical ridges may form sharp shoulders (Plate V, fig. 11). In addition, individual ridges may vary in shape along their length. Further subsidiary spiral grooves and ridges may occur on both surfaces. The tube is ornamented with transverse growth-lines which vary widely in degree of development, ranging from very coarse (Plate V, fig. 2) giving the tube a rugose appearance, to fine (Plate VI, fig. 3) and commonly varying within individuals. The growth-lines are commonly sigmoidally curved though they may be sharply angled (Plate V, fig. 1), being concave backwards on the inner, inflated parts of the tube, gently convex in the spiral depressions, swinging backwards towards the keel, sometimes projecting onto it causing the carinae to appear serrated (Plate V, fig. 4). The intersection of the transverse and spiral ornamentation may give the tube a sub-tuberculate appearance (Plate V, fig. 3).

The spiral ridges of callosity may partially or wholly overlap the preceding whorls and on the umbilical surface produce a very constricted umbilicus. The profile of the spiral is commonly stepped, but the deposition of callosity over the whorl sutures may produce a relatively smooth conical spiral (Plate VI, fig. 9). The plane of coiling of the last whorl and the position of the aperture vary; the aperture may be in the plane of the preceding coil, above or below it (Plate V, fig. 1b; Plate VI, figs. 3b, 12). The final whorl frequently terminates in a straight extension, projecting tangentially from the spiral (Plate VII, figs. 4, 5). It may also taper towards the aperture (Plate V, fig. 3) which is circular with a diameter commonly less than half that of the tube, both decreasing backwards towards the initial whorls.

As a consequence of these variable factors which may be variously combined, there is such diversity between individuals that, as observed by Wilckens (1910, p. 8), no individual is quite the same as another.

In thin section the tube is seen to be composed of two layers, a very thin inner layer lining the lumen, and a thick outer layer. The inner layer is brown and structureless, and is not always preserved. The outer layer is composed of successive lamellae, the disposition of which varies according to the form of the whorl and the direction of sectioning. In median longitudinal sections of discoidal forms the lamellae are sub-concentric with a fan-like expansion at the whorl sutures, whilst in similar sections of high-spiral forms the lamellae are broadly tear-drop shaped (Plate IV, figs. 3, 4). In horizontal section the lamellae of the external wall of the whorls are parabolic, V-ing towards the aperture. Each lamella consists of a short internal limb inclined forwards at an acute angle to the lumen, sharply recurved at the apex of the parabola, with a long external limb which forms an acute angle with the peripheral margin (Fig. 4A; Plate IV, fig. 2). The lamellae of the internal wall of the whorl occur as a succession of planes inclined forward at an acute angle, becoming parabolic only in the straight terminal extensions of the tube.

Three juvenile specimens are present in the assemblage, all bearing remnants of the initial apical growth (A. 8081–3; Plate VII, figs. 1–3). This is best preserved in A. 8081, although slightly damaged during preparation, and consists of a short, straight, thin-walled tube continuing tangentially and slightly upwards from the first whorl (Plate VII, figs. 2a, b). All possess a complete umbilical perforation and are similar in shape and shell profile, the keel consisting of a single, sharp carina with a narrow, concave groove below. The upper surface of the tube is gently convex with an apical depression intervening between the convexity and the keel. A slight ridge occurs within the depression and this may become inflated and form the upper carina of the adult keel. The lower margin of the narrow groove of the keel forms a marked angle with the bottom of the tube, and is succeeded on the underside by a spiral groove which becomes more strongly defined towards the aperture; the angle may also become more prominent and form the lower carina of the adult keel. Differences in the form of the tube are apparent in the juvenile stage, A. 8081 being relatively more tumid, whilst the transverse and spiral markings are more strongly developed in A. 8082, in which the backward sweep of the growth-lines at the keel is particularly well shown (Plate VII, fig. 1). The diameter of the lumen is proportionately much larger in relation to the total diameter of the tube in the juvenile stages than in the adult.

Distribution: Station E.151.7–8; Fossil Bluff, Alexander Land. Lat. 71°21′ S., long. 68°21′ W. Aptian (A. 7004): associated with *Aporrhais* (*Tessarolax*) *antarctica* Cox, *Rotularia australis* Cox, *Phylloceras* sp. and ? *Georgioceras* sp. Station E.153.6; moraine half a mile south of Fossil Bluff, Alexander Land (not *in situ* but presumed to be derived from the sediments of Fossil Bluff). Lat. 71°21′ S., long. 68°21′ W. Aptian (A. 7005): associated with *Aucellina radiato-striata* Bonarelli and Nágera, *Aucellina andina* Feruglio and "*Pecten*" cf. *argentinus* Stanton. Station E.720.10B; north face of Ablation Point, Alexander Land. Lat. 70°47′ S., long. 68°22′ W. Aptian (A. 7008): associated with *Aucellina radiato-striata* Bonarelli and Nágera, *Aucellina alexandri* Cox, and "*Pecten*" cf. *argentinus* Stanton.

Stations 4679–4700; Humps Islet. Lat. 63°59.3′ S., long. 57°25.4′ W. Associated with ammonites of Lower to Middle Campanian age (A. 7960–81). Stations 4704, 4709–16; half-way up the north side of Humps Islet. Lat. 63°59.4′ S., long. 57°25.3′ W. Lower to Middle Campanian (A. 7982–90). Stations 4846–54; The Naze, James Ross Island. Lat. 63°56′ S., long. 57°30.9′ W. Lower to Middle Campanian (A. 7991–9). Stations 5011–17; beach on south side of snow point, five miles north of Cape Gage, James Ross Island. Lat. 64°05.8′ S., long. 57°09.4′ W., (A. 8000–6). Stations 5314–31; The Naze, James Ross Island. Lat. 63°56′ S., long. 57°30.9′ W., (A. 8012–29). Stations 5412, 5420; low cliffs behind the 15 ft. raised beach on the north side of Cape Gage, James Ross Island. Lat. 64°09.7′ S., long. 57°04.6′ W. Associated with ammonites of Lower to Middle Campanian age (A. 8030–31).

Station D.87.10; Dagger Peak col, The Naze, James Ross Island. Lat. 63°55.2′ S., long. 57°28.9′ W. Associated with *Rotularia shackletoni* (Wilckens) and *Rotularia dorsolaevis* sp. nov. (A. 8040–62). Station D.97.3; approximately 200 yards north-east of Dagger Peak, The Naze, James Ross Island. Lat. 63°55.1′ S., long. 57°29′ W. Associated with *Rotularia dorsolaevis* sp. nov. (A. 8064). Station D.422.1; coast east of Lachman Crags, James Ross Island. Lat. 63°50.8′ S., long. 57°47.1′ W. Associated with *Rotularia shackletoni* (Wilckens) (A. 8081–3). Stations D.529.2, D.533.3, D.535.2; north side of Humps Islet. Lat. 63°59.4′ S., long. 57°25.2′ W. Associated with beds containing ammonites of Lower to Middle Campanian age (A. 8084–7; A. 8094; A. 8095–8). Station D.541.2; coast north-west of Terrapin Hill, James Ross Island. Lat. 63°56.5′ S., long. 57°33.2′ W. (A. 8099).

Station D.2026.1–2; fine sands at base of cliffs, at foot of valley immediately south-west of Nordenskjöld's hut, Snow Hill Island. Lat. 64°22′ S., long. 57°00′ W. (A. 8308–9). Station D.2036.1; fine sands in small valley on the south coast of Seymour Island. Lat. 64°19′ S., long. 56°54′ W. (A. 8305–7). Station D.2040.4; fine sands at the foot of the easternmost of the larger buttresses, Sanctuary Cliffs, Snow Hill Island. Lat. 64°27′ S., long. 57°10′ W. Associated with *Gunnarites antarcticus* (Weller) and *Tetragonites* (*Saghalinites*) *cala* (Forbes), Lower to Middle Campanian (A. 8311). Station D.2042.2a; fine sands at the lowest point of the western half of Sanctuary Cliffs, Snow Hill Island. Lat. 64°27′ S., long. 57°10′ W. Associated with *Gunnarites antarcticus* (Weller), Lower to Middle Campanian (A. 8310).

Remarks: The nomenclature and systematics of the genus *Rotularia* Defrance have been discussed by Wrigley (1951) and more fully by Schmidt (1955*a*), and its priority over *Tubulostium* Stoliczka established. Stoliczka (1868, p. 237) erected his genus for what he regarded as a group of vermetid gastropods, and the specific name *Tubulostium callosum* was proposed for forms characterized by a trochoid, spirally coiled tube, with great development of callosity at the whorl sutures, and a tri-carinate periphery (*op. cit.*, p. 241; pl. 18, figs. 26–32). The whorls are noted as being "generally sinistral", though a dextrally coiled specimen is figured (*op. cit.*, pl. 18, figs. 29, 29a). These specimens come from the Utatur group of Cenomanian age.

Specimens collected by Stokes from Snow Hill Island (see Introduction) were described and figured by Weller (1903*a*, pp. 416–7; pl. 1, figs. 6–17) and attributed by him to *Tubulostium callosum* Stoliczka, although pointing out that the Antarctic specimens ". . . show a regular gradation from the more discoidal to the more heliciform shells, and without doubt all are members of a single species. All of the Antarctic specimens are sinistral; . . ." as opposed to the trochoid form of the Indian specimens which also include dextrally coiled forms. Following Weller, Andersson (1906, p. 35) states that "*Tubulostium callosum* Stoliczka is one of the most common Snow Hill fossils". Subsequently in the same paper (*op. cit*, pp. 40, 41, 42) he appears to have telescoped the generic and specific names and refers to "*Callostium*" from the Cretaceous strata. Wilckens (1910) in his description of the fauna collected by the Swedish South Polar Expedition, erected the new species *Tubulostium fallax* including the forms previously described by Weller as *Tubulostium callosum*, basing his distinction upon the spiral of *T. fallax* having a smaller height, the absence of callosity which occurs on the earlier whorl of *T. callosum* Stoliczka, and by the regular sinistral coiling (1910, p. 10). However, Wilckens noted that both species were alike in possessing a tri-carinate keel, an inflated zone on the underside and their size ratio.

An outstanding feature of the Antarctic specimens is the wide range in the form of the individuals, a range which includes specimens so similar to the syntypes of *Tubulostium callosum* (Stoliczka, 1868, p. 241; pl. 18, figs. 26–32) that, despite the lack of a corresponding range of variation in the Indian fauna, both the Indian and Antarctic forms must be regarded as being conspecific. With regard to the distinctions between the two faunas drawn by Wilckens, the maximum dimensions of individuals in both approximate closely, as do the earlier whorls; only the presence of dextrally coiled forms in the Indian fauna appears to be a valid distinction. However, several serpulid species are composed of both sinistrally and dextrally coiled individuals in varying proportions, e.g. a low ratio (57% to 43%) as in *Rotularia shackletoni* (see below), or a high ratio (95% to 5%) as in *R. bognoriensis* (Wrigley, 1951, p. 181). Stoliczka provides no quantitative information regarding the proportion of dextral to sinistral forms in the Indian fauna, but only the qualitative observation "generally sinistral". Thus, the Antarctic fauna appears to be wholly sinistrally coiled, the Indian fauna generally so, and since this appears to be the only valid distinction which can be made between them, it is insufficient to warrant their separation into different species.

It might be objected that, despite the close morphological similarity between the two forms, they are so widely separated geologically and geographically as to warrant some distinction, the Indian fauna being of Cenomanian age and the Antarctic fauna Campanian. However, included in the Aptian fauna of Alexander Land were specimens described by Cox 1953, p. 13; pl. 2, fig. 12) as *Rotularia* sp., which are identical with the Campanian forms from James Ross Island, varying in height and diameter and possessing a tri-carinate keel, spiral furrows and a pronounced umbilical callosity.* Thus the Indian fauna forms a time-link between the two Antarctic occurrences, whilst with regard to the geographical range, a feature of Recent serpulid faunas is that they are composed of a small number of species widely distributed.

Rotularians with an elevated spire appear to be relatively common in the Cretaceous strata of the southern hemisphere. Wilckens (1922, p. 25; pl. 5, figs. 10–12) erected the species *Tubulostium ornatum* for forms from the Upper Senonian of New Zealand, differentiating it from his species *Tubulostium fallax* largely on the absence of a tri-carinate keel in the adult whorls. However, the prominent rounded keel of one of the figured specimens (*op. cit.*, pl. 5, figs. 10a–c) shows two faint lateral grooves and compares closely with specimen A. 8085 (Plate VI, figs. 5a–c), and it is evident from the description and figures that *T. ornatum* falls within the range of variation exhibited by the Antarctic *Rotularia callosa*. †Moreover, they occur in beds of Campanian age which are very like those of Graham Land faunally, petrologically and in the mode of preservation of the fossils. Although inadequately described, the figures indicate that the specimens from the Albian of Patagonia attributed by Bonarelli and Nágera (1921, p. 20; pl. 2, figs. 1–3) to *Tubulostium discoideum* Stoliczka are more probably *Rotularia callosa* (Stoliczka) and this is indirectly confirmed by Camacho (1949, p. 251), who has examined the specimens and assigned them to *Tubulostium ornatum* Wilckens. The status of *Tubulostium kitchini* Bonarelli and Nágera (1921, p. 20) is confused, but as pointed out by Cox (1953, p. 12) it appears to have been proposed for the South African form from the Uitenhage

*Since the preparation of this report, two further specimens of *Rotularia callosa* (Stoliczka) from Alexander Land have come to light. They were collected by the British Graham Land Expedition 1934-37, and are from the same area and of the same age as those described by Cox (1953, p. 13), i.e. Fossil Bluff, Aptian. The detailed localities are:—B.G.L.E. No. 564 (A.8382); right wall of the unnamed glacier immediately north-west of Fossil Bluff and about 500ft. above the ice shelf. B.G.L.E. No. 603 (A.8383); moraine near Fossil Bluff.

†Since the completion of the manuscript, an examination of specimens from the Senonian of Amuri Bluff, Marlborough, South Island, New Zealand (A.8454-5), confirms that they are conspecific with the Antarctic *Rotularia callosa*.

Series recorded by Kitchin (1908, p. 63; figs. 1, 1a) as *Serpula* cf. *concava* (J. Sowerby). The position of the Patagonian form *Tubulostium* cf. *kitchini* Bonarelli and Nágera (1921, p. 20) is also uncertain since the authors give no description and the alleged figure (*op. cit.*, pl. 2, fig. 3) is according to Camacho the reverse of the specimen figured in the same work (pl. 2, fig. 1) as *Tubulostium discoideum* Stoliczka. Other serpulids from South America include those from the Albian of Tierra del Fuego, assigned by Camacho (1949, pp. 250–1; pl. 1, fig. 1) to *Tubulostium ornatum* Wilckens, on the basis of the presence in young individuals of three carinae of which the middle is the most strongly developed, separated by two furrows which become reduced and disappear in the adult stage. Camacho also erected the new species *Tubulostium andinum* for a specimen with a more elevated spiral, but like the preceding forms it is most probably conspecific with *Rotularia callosa*. Weller (1903*a*, p. 417) suggests that *Tubulostium pupoides* Stanton (1901, pp. 30–31) from the Lower Cretaceous of Patagonia is somewhat closely allied to *T. callosum*, but it has not proved possible to confirm this. Thus it is evident that in the Cretaceous of the southern hemisphere there is a variable but distinctive group of rotularians which have hitherto been described as a number of species, but which can best be regarded as constituting a single species for which the name *Rotularia callosa* (Stoliczka) has priority.

Wrigley (1951, p. 183) gives the stratigraphical range of the genus *Rotularia* as being Cretaceous to Lower Oligocene. Schmidt (1955*a*, p. 178) restricts it to Upper Cretaceous–Eocene with a maximum in the Eocene, and also states that it is uncertain whether specimens assigned to the genus occurring outside these limits are true *Rotularia*, including *Rotularia callosa* within this category. However, since it has now been established that *Rotularia callosa* is correctly designated, the range of the genus is extended to the Lower Cretaceous. Moreover, an examination of the collection of Serpulidae in the British Museum (Nat. Hist.) has confirmed that two of the species regarded by Schmidt as being of dubious affinity with the genus *Rotularia*, i.e. the forms recorded as *Serpula compressa* Young and Bird (1828, p. 250; pl. 11, fig. 25; = *Vermetus concinnus* J. Sowerby, 1829, p. 195; pl. 596, fig. 5) from the Upper Lias of Yorkshire, and *Vermetus tumidus* J. Sowerby (*loc. cit.*, fig. 4) from the Corallian, can be correctly assigned to the genus *Rotularia*. Thus the stratigraphical range of the genus appears to be Upper Lias–Eocene, ? Lower Oligocene, with a world-wide distribution. Several of the species and notably the type species *Rotularia spirulaea* (Lamarck) are composed of individuals in which the form of the tube varies widely as in *R. callosa*, whilst *Rotularia tobar* (Gardner) (1933, pp. 281–2; pl. 26, figs. 1–5) includes forms in which the number of peripheral carinae varies between two and three. But none appear to have such a wide geological or geographical range as *R. callosa* which occurs in the Aptian and Campanian of Graham Land, the Albian and possibly younger strata of the Argentine, the Cenomanian of India, and the Campanian of New Zealand.

The direction of coiling of serpulid tubes is commonly stated with reference to the apex of the spiral orientated above, as for gastropods. Wrigley (1951, p. 180) has strongly advocated that the orientation should be reversed, basing his argument on a specimen which is attached by the apex to another and growing so that the umbilical surface of the shell and the aperture are uppermost, an observation also made by Wilckens (1910, p. 9). However, this is true only for specimens attached to upward-facing surfaces, and since serpulids attach themselves to surfaces in random positions including downward-facing ones, Wrigley's argument immediately becomes negated. Moreover, the orientation is essentially arbitrary and since, as with gastropods, the direction of coiling is almost invariably quoted with reference to the apex uppermost, this orientation is retained here.

Schmidt has discussed the construction of the tube wall in the family Serpulidae (1951, 1955*b*) and more specifically in the genus *Rotularia* (1955*a*), and has shown that it consists of a thin, inner, structureless layer and a thick, outer, lamellar layer, the lamellae being concentric in longitudinal section and parabolic in horizontal section. However, it is evident that this broad generalization must be qualified since thin sections of *R. callosa* show that the form of the lamellae varies with that of the whorls and that the parabolic structure is not developed in the internal wall of the whorls (Fig. 4A).

The mode of preservation of the successive zones of the tube wall differs in the James Ross Island fauna. The inner layer is very thin and is not always preserved, the surface of the lumen frequently being abraded. The lamellar construction of the inner zone of the thick, outer layer is commonly well-preserved and the zone is somewhat milky in appearance, but there is commonly a loss in continuity in structure and texture on the outside of the parabola angle and the lamellae are faintly apparent in the thicker outermost zone. Moreover, the outer zone may in part be preserved as clear calcite and commonly shows a radiating fibrous structure owing to the recrystallization of the calcite, which may give rise to a granular texture in the zones of callosity. This contrast in the mode of preservation probably reflects difference in the original structure of the tube, the inner milky zone incorporating a higher proportion of organic material than the outer zone. A comparison of thin sections of *Rotularia callosa* (Plate IV, figs. 2–4) with those of *Rotularia spirulaea* (Lamarck) (Plate III, figs. 10, 11), the type-species, shows that they are very similar in structure and the discontinuity at the parabola angle is even greater in the latter than in the former. In addition, there may be a slight discontinuity in structure on the inside of the parabola angle, which when well developed may cause the apices of the parabolas to appear as a distinct sub-zone of the outer layer.

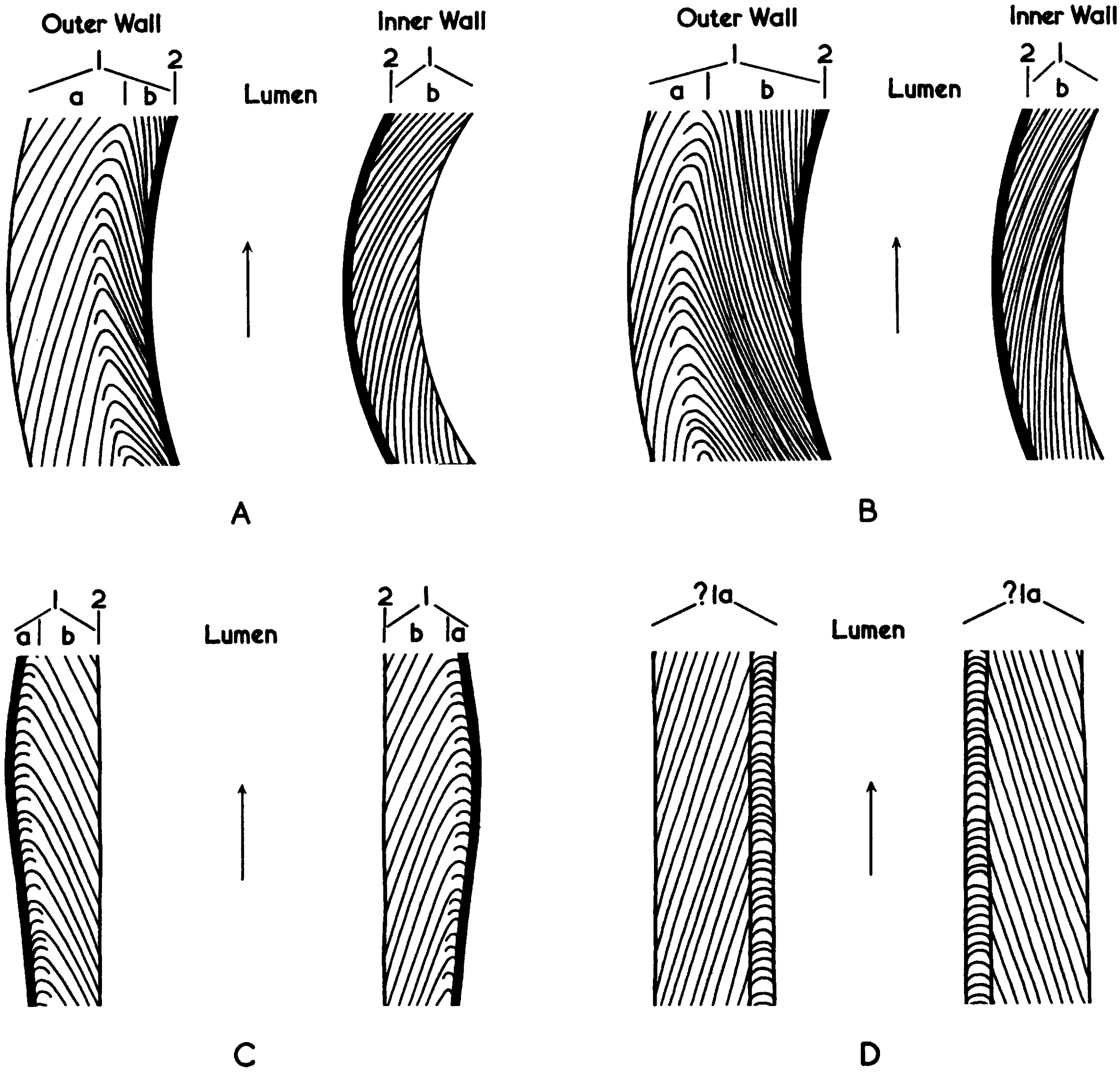

FIGURE 4

Diagrammatic transverse sections of serpulid tubes showing variations in the construction of the walls, particularly in the form of the parabola. 1. Outer lamellar layer; a, outer zone; b, inner zone. 2. Inner structureless layer. The arrows indicate the direction of the aperture.

A. *Rotularia callosa* (Stoliczka) in median horizontal section, the plane separating the inner and outer zones of the outer layer occurring on the outside of the parabola apices, which are situated towards the lumen. Though the inner wall is here shown to consist only of the inner, structureless layer and the inner zone of the outer layer, secretion of the outer zone occurs where the tube projects as a straight, terminal extension.

B. *Rotularia shackletoni* (Wilckens) in median horizontal plane, the parabola apices being situated nearer to the periphery. The inner wall behaves like that of *R. callosa*.

C. *Ditrupa varicosa* sp. nov. in vertical plane, the parabola apices being situated close to the periphery, the outer zone being apparently structureless.

D. *Ditrupa plana* (J. Sowerby) in vertical plane, the parabola apices forming a distinct inner " layer " surrounding the lumen.

The structure of the tube is recorded by Wilckens (1910, p. 8) as being three-layered, consisting of an inner, milky layer, a thick, middle layer, and a thin, brown, outer layer. His inner and outer layers can obviously be equated with the zones formed by the lamellar layer, whilst a number of specimens do appear to possess a third, outer, brown layer. However, on close examination this proves to be a thin irregular zone of iron-staining on the surface of the lamellar layer. Some of the lamellae are similarly stained, probably marking a pause in the growth of the tube.

As suggested by Wilckens (1910, p. 9), during the initial ontogenic stages it is probable that the animals were sedentary, the larvae attaching themselves to any suitable object or surface projecting above the muds and sands of the sea-floor and secreting the initial apical growth. It is evident from the juvenile specimens that only this initial part of the tube was cemented to the substratum and that the whorls became detached at a relatively early stage as the weight of the tube became too great for the fragile apical portion to support, the animal then assuming a free-living existence on the sea-floor. The secretion of the tube-wall took place sometimes slowly and evenly forming a smooth tube with faint growth-lines, or discontinuously when the growth-lines become more strongly apparent. There is evidence of considerable breaks in the deposition sometimes involving a change in direction of coiling, this also being effected by continuation of secretion after the end of the tube has been broken off. In A. 8310, after such a pause, with the resumption of secretion the peripheral carinae do not coincide, the lower carina of the new portion being continued in the plane of the middle carina of the old, with the consequent displacement of the other carinae. In another pathological specimen (A. 8305; Plate VI, fig. 7) the aperture has become constricted owing to injury to the tube. It seems probable that the wide variation in the form of the spiral and of the tube may in part be due to the influence of environmental conditions on the sea-floor during ontogeny, as well as primary genetic factors.

Rotularia shackletoni (Wilckens)

Fig. 4B; Plate IV, figs. 1a, b; Plate VII, figs. 6–12.

Serpula (Burtinella ?) shackletoni Wilckens, 1910, pp. 6–7; pl. 1, figs. 1, 2a–c.

Diagnosis: Tube large, robust, tumid, with marked callosity; coiling dextral or sinistral. Whorl profile and height of spiral variable; umbilicus small, aperture round.

Type material: Syntypes in the collection of the Swedish Museum of Natural History, Stockholm.

Material: Fourteen specimens in the collection of the Department of Palaeontology, British Museum (Nat. Hist.); A. 8008–10, A. 8063, A. 8071–80.

Measurements: Diameter ranging from 11–37mm., averaging between 22–26mm.; height ranging from 5–25mm.

Reg. No. of Specimen	*Diameter in mm.*	*Height in mm.*	*Form of Spiral*
A. 8079	11	5	Juvenile
A. 8078	13	8	,,
A. 8071	24	10	Discoidal
A. 8075	24	12	,,
A. 8073	22	13	Low spiral
A. 8063	37	22	,,
A. 8074	23	16	High spiral
A. 8010	26	25	,,
A. 8009	34	23	,,

Description: The tube is tightly coiled and tumid; ranging from discoidal to an irregular, elevated spiral, commonly composed of up to $4\frac{1}{2}$ whorls. The initial whorls are wholly lacking. Coiling is both sinistral and dextral; of 14 specimens, 8 are coiled dextrally, 6 sinistrally (orientated with the apex of the spiral uppermost). The whorl profile varies from rounded to sub-angular, the latter particularly in the high spiral forms, and such variation may occur within an individual (Plate VII, figs. 8, 12). In the discoidal forms the periphery of the tube is commonly rounded and is delimited by spiral depressions on the upper and lower surfaces, the inner margins being considerably inflated (Plate VII, fig. 6). In the higher spiral forms the peripheral zone commonly becomes more sharply rounded and displaced downwards (Plate VII, fig. 12); the upper spiral groove becomes much broader and the marginal zone may also be broader and less tumid. The tube is considerably thickened by callosity particularly at the whorl sutures, and this may completely overlap some of the preceding whorls, and produce on the lower surface a very constricted umbilicus.

The tube may be ornamented with sigmoidal, transverse, growth-lines concave backwards on the inflated marginal zones, swinging forward towards the spiral grooves, whilst at the periphery they may be straight, gently convex or concave. The growth-lines may be coarse or fine, and in some specimens are hardly apparent. The spiral profiles are widely variable as are the planes of coiling of the whorls and the position of the aperture, which may be in the plane of coiling of the final whorl, above or below it (Plate VII, figs. 6a, b, 9b, 10a). The aperture may be relatively large and ovoid, tapering backwards to the rounded lumen of the tube (Plate VII, fig. 8), or consist of a straight extension projecting tangentially from the spiral (Plate VII, fig. 6).

In thin section the tube-wall is seen to consist of two layers, a thin, inner, brown layer surrounding the lumen, and a very thick outer layer. The outer layer is composed of lamellae which in median transverse section are sub-concentric, round to pear-shaped in high-spiral forms (Plate IV, fig. 1a). In median horizontal sections of the outer wall the lamellae are parabolic, V-ing towards the aperture, the inner limb of each parabola being the longer (Fig. 4B; Plate IV, fig. 1b). The lamellae of the inner wall of the tube are inclined at an acute angle to the lumen, towards the aperture. The outer layer is markedly sub-divided into two zones at the parabola angle. The inner zone, which corresponds to the inner limbs of the parabolas, is the thicker and is translucent, light-brown to milky in colour and when viewed macroscopically is ivorine in texture and appearance. The outer zone, corresponding to the outer limbs of the parabolas, is more irregular in thickness and is faintly milky to clear; viewed macroscopically it has a waxy appearance.

Two juvenile specimens are present in the assemblage, but in neither are the first whorls or the initial apical growth preserved, although the termination of the spiral in A. 8079 suggests that as in *R. callosa* the apical growth consisted of a straight, fragile tube (Plate VII, figs. 11a, b). Similarly, the early whorls are relatively much thinner and the diameter of the lumen greater than in the adult. In A. 8079 there is a complete umbilical perforation, but this is absent in the slightly larger A. 8078 owing to a change of axis of the spiral and a greater deposition of callosity on the whorl sutures.

Distribution: Stations 5279–80, 5291; The Naze, James Ross Island. Lat. 63°55.1′ S., long. 57°29.1′ W. (A. 8008–10).

Station D.87.10; Dagger Peak col, The Naze, James Ross Island. Lat. 63°55.2′ S., long. 57°28.9′ W. Associated with *Rotularia callosa* Wilckens and *Rotularia dorsolaevis* sp. nov. (A. 8063). Station D.417.4; coast east of Lachman Crags, James Ross Island. Lat. 63°50.8′ S., long. 57°47.5′ W. (A. 8071–4). Station D.422.1; coast east of Lachman Crags, James Ross Island. Lat. 63°50.8′ S., long. 57°47.1′ W. (A. 8075–80). Lower to Middle Campanian.

Remarks: Andersson (1906, p. 35) records the presence of specimens of *Tubulostium* larger than those of *T. callosum* from the Cretaceous strata of Seymour Island. These were subsequently described by Wilckens (1910, pp. 6–7; pl. 1, figs. 2a–c) as *Serpula* (*Burtinella ?*) *shackletoni.* Wilckens associated his species with the group which is represented in the Jurassic by *Serpula convoluta* Goldfuss and in the Lower Cretaceous by *Serpula phillipsi* Roemer. However, *Serpula* (*Burtinella ?*) *shackletoni* can readily be distinguished by the greater degree of enrolment of the spiral, the small umbilicus, the form of the initial coils of the spiral and the callosity, and on the basis of these characteristics can be more readily assigned to the genus *Rotularia.* As noted by Wilckens (*op. cit.*, p. 7), *Serpula phillipsi* is recorded by Behrendsen (1891, p. 418) from the Aptian of Argentina, but since it is neither figured nor described its relationship with *Rotularia shackletoni* cannot be ascertained.

The tube of *R. shackletoni* is larger and thicker than in any other species of the genus and there is also a high proportion of dextrally to sinistrally coiled individuals. The inner layer of the tube is not always preserved and the parabola angle of the lamellar layer is situated near to the periphery. As in other species of *Rotularia*, there is a sharp contrast in the mode of preservation of the zones formed by the inner and outer limbs of the parabolas, occurring immediately outside the parabola angle. This is further emphasized in some specimens by the outer zone having broken away along the plane of the apices of the parabolas. However, the continuity of individual lamellae in both zones is affirmed by lamellae which have become iron-stained, probably during a prolonged pause in growth. In several specimens a few adventitious detrital grains have been incorporated into the substance of the tube (Plate IV, fig. 1a). The aperture varies from large and ovoid, when the termination forms part of the spiral, to round and of the same diameter as the lumen when the tube forms a straight terminal extension. The tangential extension of the tube occurs in specimens of varying ages and is probably a response to environmental conditions rather than an expression of maturity.

As with *R. callosa*, the early phase of ontogeny of *R. shackletoni* was marked by the formation of a fragile apical tube attached to some suitable object. The base of a meandering tube is present on one specimen (Plate VII, fig. 6c) which may represent the remains of an apical tube similar to that described by Wrigley (1951, pp. 180–1), or alternatively a small *Serpula*. The spiral must have become detached from the apical growth at an early stage. Many of the tubes have been bored by other organisms and in one instance several tubes, of which at least one is spirally coiled, have attached themselves to the penultimate whorl. Their presence has resulted in the marked outward and downward displacement of the final whorl by which they are partly overlapped and the aperture of one of the adherent tubes has induced a bisected funnel-shaped depression in the final whorl (Plate VII, fig. 10b). It is evident that the rate of growth of the adult stage was relatively slow since the adherent tubes were able to establish themselves, the spiral tube being composed of three whorls, before being overlapped by the final whorl. A further specimen also shows a marked depression where a spirally-coiled tube had been attached to it (Plate VII, figs. 9b, c).

Rotularia dorsolaevis sp. nov.

Plate III, figs. 3–9.

Diagnosis: Tube discoidal, spirally coiled; initial whorls lacking. Periphery flat or slightly convex with sharp lateral angles. Lateral margins of tube with well-defined spiral ridges.

Type material: Holotype; Department of Palaeontology, British Museum (Nat. Hist.); A. 8088.

Material: Holotype and about 35 specimens in the collection of the Department of Palaeontology, British Museum (Nat. Hist.); A. 8007, A. 8033–9, A. 8065–70, A. 8088–93.

Measurements: Holotype; diameter 9mm., height 3mm. Range in diameter 3–13mm., averaging between 5–10mm.; height ranging from 1–4mm., averaging between 2–3mm.

Description: The tube is discoidal, spirally coiled and commonly composed of three whorls of which the innermost is incomplete and wholly overlapped by the second; the initial whorls are wholly lacking. The periphery of the whorls is flat or very slightly convex (Plate III, figs. 3b, 6, 7b, 8), with sharp lateral angles which may be produced to form fine obliquely inclined carinae. These appear to be fibrous in structure and are developed like twin crests from a point a little distance behind the aperture; owing to their fragility they are commonly completely eroded. Both lateral margins of the tube bear a median spiral ridge demarcated by sharply defined grooves. The ridge may expand and become tumid towards the aperture of the tube. The inner lateral margin of the outer whorl may also be gently inflated. The walls of the tube vary in thickness, particularly the lateral spiral ridges (Plate III, figs. 3, 7) and as a consequence the relationship of the height to the diameter is variable.

The whorls are commonly coiled in one plane, but there may be small undulations in the coiling and the whorls may become slightly asymmetrical and the width of the peripheral margin may vary. The outer whorl largely overlaps the inner, the position of the median spiral ridge broadly corresponding to that of the whorl suture. The tube may be ornamented with transverse growth-lines which are concave posteriorly on the inner part of the lateral surfaces, V-ing sharply forward in the outer spiral groove, being again gently concave posteriorly between the groove and the lateral angles, and straight or gently convex across the peripheral zone. The growth-lines vary from very fine to coarse, commonly being coarsest on the lateral ridges. At high magnification the surface of the tube, particularly the callosity, has a finely pitted appearance, and the spiral ridges of some specimens have a fine sub-reticulate ornamentation.

The aperture is circular and the tube broadly tapers towards it (Plate III, fig. 9), the peripheral zone slightly overhanging it like a hood. In two of the largest specimens the terminal part of the tube appears to project tangentially from the spiral for a short distance (Plate III, fig. 4). The diameter of the lumen is relatively large in relation to that of the tube.

The tube-wall is seen in thin section to consist of two layers, a thin, inner brown layer lining the lumen and a thick outer layer. The outer layer is composed of successive laminae and is broadly sub-divided into two zones of approximately equal width, the inner being more translucent than the outer and milky to light-brown in colour, the outer zone being clear but commonly with a thin, irregular zone of iron-staining at the surface. In median transverse section the lamellae are sub-concentric, fanning out at the whorl sutures where the lamellae forming the callosity may be considerably iron-stained (Plate III, fig. 6). In median horizontal section the lamellae of the outer wall of the whorls are parabolic, V-ing towards the aperture. The parabola angle occurs about midway in the wall but the outer limb of each parabola is longer than the inner. The inner wall of the tube is thinner than the outer and is composed of a succession of laminae inclined at an acute angle to the lumen towards the aperture. When the terminal part of the tube projects from the spiral, the inner layer becomes considerably thickened beneath the mouth of the aperture and the lamellae assume a parabolic structure (Plate III, fig. 5).

Distribution: Station 5266; The Naze, James Ross Island. Lat. 63°55.1′ S., long. 57°29.1′ W. (A. 8007). Station D.87.10; Dagger Peak col, The Naze, James Ross Island. Lat. 63°55.2′ S., long. 57°28.9′ W. Associated with *Rotularia callosa* (Stoliczka) and *Rotularia shackletoni* (Wilckens) (A. 8033–9). Station D.97.3; approximately 200 yards north-east of Dagger Peak, The Naze, James Ross Island. Lat. 63°55.1′ S., long. 57°29′ W. Associated with *Rotularia callosa* (Stoliczka) (A. 8065–70). Station D.533.3; north side of Humps Islet. Lat. 63°59.4′ S., long. 57°25.2′ W. Associated with *Rotularia callosa* (Stoliczka) and with beds containing ammonites of Lower to Middle Campanian age (A. 8088–93).

Remarks: In his description of his species *Tubulostium fallax*, Wilckens (1910, p. 9) makes the following observations:

> "Von 'Ross Insel, Lok. 7', liegen relativ kleine Schalen vor, die flach, ohne erhabenes Gewinde, oben und unten fast ganz gleich sind und keinen dreifachen Kiel, sondern nur einen abgeflachten, relativ breiten Schalenrücken haben. Von derselben Lokalität liegen auch Schalen von der gewöhnlichen Ausbildung vor. Ob es sich eine Varietät oder um eine andere Art handelt, möchte ich unentschieden lassen, für eine eventuelle neue Species aber den Namen *T. dorsolaeve* vorschlagen."

It is now evident that this small form does constitute a distinct species for which the name proposed by Wilckens is retained. Several small discoidal species of *Rotularia* with a broad peripheral margin have been described, including the form described as *Tubulostium discoideum* by Stoliczka (1868, pp. 240–1; pl. 18, figs. 20–25) from the Cenomanian Utatur Series of India. Though not designated as the type species of the genus *Tubulostium* by Stoliczka, *T. discoideum* was subsequently so defined by Rutsch (1940, p. 233). However, as has been demonstrated by several authors including Wrigley (1951) and Schmidt (1955*a*), the generic name *Rotularia* Defrance takes priority over *Tubulostium* Stoliczka, and the type species for the genus is *Rotularia* [*Serpula*] *spirulaea* (Lamarck).

A comparison of *Rotularia dorsolaevis* with *Rotularia discoidea* (Stoliczka) shows that in the former the spiral ridges are situated near to the middle of the lateral margins of the whorls, the outer whorl considerably overlaps the preceding whorls and the callous deposits frequently merge with the crest of the spiral ridge of the preceding whorl. In contrast, the spiral ridges in *R. discoidea* are situated near to the whorl sutures and the tube has a distinct "stepped" appearance. In some specimens the lateral margins are markedly concave, the small carina occurring at the angle with the peripheral surface projecting laterally rather than obliquely as in *R. dorsolaevis*. Moreover, except in the largest specimens, the aperture of *R. dorsolaevis* has a hooded form (Plate III, fig. 9) whereas in *R. discoidea* it is produced into a short tube. The tube of *R. discoidea* is smooth and from the slight asymmetry in the plane of coiling it is evident that it is sinistrally coiled, and it may consist of up to five whorls. It has not proved possible to ascertain a direction of coiling in *R. dorsolaevis*, and no tube has been found with more than the three final whorls.

A number of broad-keeled, discoidal forms occur in the Eocene of the southern United States. These include *Rotularia dickhauti* (White), first recorded by White (1881, p. 161) as *Spirorbis ? dickhauti*, later amended to *Tubulostium dickhauti* (White, 1882, figs. 12, 13), occurring in the Midway Group (Eocene, though recorded by White as Cretaceous), a form in which the peripheral zone bears three small carinae. A tube described by Gardner (1933, pp. 281–2; pl. 26, figs. 1–5) as *Tubulostium tobar* from the Eocene of Texas is also tri-carinate but extremely variable, and as pointed out by Gardner some of the individuals approach closely *Tubulostium mcglameryae* Gardner (1939, pp. 18–19; pl. 6, figs. 11–13). However, by analogy with

Rotularia callosa with its wide variation, it is possible that both of Gardner's species are conspecific with *Rotularia dickhauti* (White) which appears to be more closely allied to *R. discoidea*, like which it is sinistrally coiled, than to *R. dorsolaevis*.

The structure of the tube as seen in thin section is similar to that of *R. callosa*, especially in the mode of preservation of the lamellar layer. The inner zone is more translucent than the outer which is clear and commonly has a radiating fibrous structure, owing to the recrystallization of the calcite (Plate III, figs. 5, 6). It seems probable that this contrast in the mode of preservation reflects differences in the original structure of the tube, the inner zone including a higher proportion of organic material. The tubes show some degree of variation in shell height and ornamentation. In no instance is the initial apical part of the spiral preserved and it is probable that, as with *R. callosa*, it consisted of a fragile tube cemented to some suitable object above the muds of the sea-floor. With increased growth, the weight of the tube became too great for the apical portion to support and the spiral became detached, assuming a random position on the sea-bed. This is evidenced by a specimen (A. 8007) in which a number of individuals are variously orientated in what is presumed to be a life assemblage, since some still bear the extremely fragile lateral carinae which could not have withstood any degree of transportation.

Subfamily Serpulinae Rioja, 1925

Genus *Ditrupa* Berkeley, 1832–34

Type species: *Ditrupa cornea* (Linnaeus), 1758

Ditrupa varicosa sp. nov.

Fig. 4C; Plate IV, figs. 6a–c.

Ditrupa sp., Wilckens, 1910, p. 11.

Diagnosis: Tube small, slender, gently curved with nodular swellings and more rarely, annular constrictions. Wall with lamellae inclined outwards at an acute angle to the axis of the tube towards the aperture; parabola apices near the outer surface.

Type material: Syntypes; about twenty specimens contained within a nodule of calcareous sandstone. Department of Palaeontology, British Museum (Nat. Hist.); A. 8032.

Material: In addition to the syntypes, about thirty specimens incorporated into a nodule of calcareous sandstone. Department of Palaeontology, British Museum (Nat. Hist.); A. 8011.

Measurements: Maximum length 19mm. (incomplete); diameter ranging from 0.25–1.5mm.; thickness of wall from 0.05–0.75mm.

Description: The tube is small, gently curved, tapering gradually, and generally with nodular swellings which may be closely or widely spaced and occur at irregular or sub-regular intervals along the length. The nodules vary in size and shape and may be elongated and bulbous or compressed forming a sharply defined ring. The tube may also show sharply incised, annular constrictions (Plate IV, fig. 6a). At the aperture the tube may either be very slightly tapered, or expanded when the aperture occurs at one of the nodose swellings. The thickness of the wall and the diameter of the lumen increase gradually from the posterior of the tube towards the aperture. The tube-wall has a thin transparent or translucent outer zone surrounding the translucent or opaque zone which forms the greater part of the wall. The surface of the inner zone is ornamented with a succession of very fine transverse striations.

In thin section the tube is seen to be composed of two layers. The innermost is very thin and structureless and only intermittently preserved; the outer layer is comprised of two zones, a thick, inner lamellar zone, commonly brown and translucent on the inside, pale brown on the outside, the junction being irregular, and a thin clear outer zone. In transverse horizontal section (Plate IV, fig. 6c) the lamellae of the inner zone appear as alternate dark and light annulations, and in median longitudinal sections they are parabolic forming alternately dark and light planes inclined outwards at an acute angle from the lumen towards the aperture, becoming markedly recurved at the outer surface of the zone (Fig. 4C; Plate IV, fig. 6b).

Distribution: Station 5313; The Naze, James Ross Island. Lat. 63°55.1′ S., long. 57°29.1′ W. Associated with *Rotularia shackletoni* (Wilckens) and *Rotularia dorsolaevis* sp. nov. (A.8011). Station D.86.6; Dagger Peak col, The Naze, James Ross Island. Lat. 63°55.2′ S., long. 57°28.9′ W. Lower to Middle Campanian (A.8032).

Remarks: The presence of impressions of fine tubes in fragments of rock from Snow Hill Island is recorded by Wilckens (1910, p. 11), who observed that they resemble the small tubes of *Ditrupa bagualensis* which he had described previously from the Upper Cretaceous of Patagonia. However, it is evident that this is a misquotation for *Ditrupa antarctica* occurring at Baguales (Wilckens, 1907, pp. 56–57; pl. 9, fig. 7), the specimens of which were insufficiently well-preserved to allow a detailed description or enable a comparison to be made with *Ditrupa varicosa.*

Species of *Ditrupa* showing nodular swellings occur at several horizons in the Tertiary, including *D. plana* (J. Sowerby) from the London Clay, but a comparison of the structure of the tube-wall of the latter with that of *D. varicosa* shows considerable differences. The structure of the tube-wall in the genus *Ditrupa* has been described amongst others by Götz (1931), Wrigley (1951) and Schmidt (1951, 1955*b*), and shown to consist of two layers, an outer, thicker, dark layer surrounding an inner, thinner, lighter layer, a feature which can commonly be so readily distinguished by the naked eye as to prompt Meznerics (1944, p. 44) to suggest it as a characteristic of the genus. The outer layer is composed of lamellae inclined obliquely to the tube axis and tilted inwards in the direction of the aperture. It is suggested by Schmidt (1951, p. 380) that in several genera of serpulids, including *Ditrupa*, there are no parabolic lamellae in the outer layer, or if these are developed the parabola apex is displaced so far towards the inner side that the inner limb of the parabola is no longer evident

("Bei manchen Serpulidae, insbesondere den Gattungen *Placostegus* Philippi, *Protula* Ricco und *Ditrupa* Berkeley finden sich keine Parabellamellen in der äusseren Schichte, sondern es zeigen sich nur mehr oder weniger schief zur Röhrenachse verlaufende, in der Richtung zur Röhrenmündung nach innen weisende Lamellen, wobei der Unterschied zwischen äusserer und innerer Schicht fast völlig verschwinden kann. Soferne in diesen Fällen überhaupt Parabellamellen entwickelt werden, was keineswegs erwiesen ist, so ist hier der Parabelscheitel soweit nach innen verrückt, dass der innere Parabelschenkel nicht mehr deutlich in Erscheinung tritt").

An alternative suggestion for the apparent lack of parabolic structure in the wall of some serpulids is made by Götz (1931, p. 393), namely that the limbs of each parabola are parallel and the apex is no longer evident. Moreover, she notes (*op. cit.*, p. 394) that amongst the serpulids the genera *Pyrgopolon* and *Ditrupa* also show parabolic structure, but that this is difficult to make out and they may be mistaken for Vermetids.

However, typical specimens of *Ditrupa plana* (J. Sowerby) from localities in the London Clay (Eocene), in which the outer and inner layers are clearly apparent to the naked eye and there is a sharp line of demarcation between the layers (Plate IV, fig. 5b), the lamellae show a well-developed parabolic structure when seen in median, longitudinal thin section. The outer layer is composed of the inwardly inclined lamellae which form the external limbs of the parabolas, though these may be obscured by subsequent recrystallization, whilst in the inner layer occur the apices of the parabolas (Fig. 4D; Plate IV, fig. 5a); the internal limbs of the parabolas are not developed. By analogy with the typical serpulid wall structure it seems likely that the two "layers" comprising the wall of *D. plana* are in fact equivalent to the outer zone of the outer layer and the apices of the parabolas of the genus *Rotularia*. It has already been shown (p. 22) that in both *R. callosa* and *R. spirulaea* the apices may appear to form a separate sub-zone of the parabola layer and it seems that this trend has been developed to its logical conclusion in *D. plana*, in which the apices of the parabolas form a distinct and well-defined zone. As yet it has not proved possible to confirm the presence of the thin inner, structureless layer in the specimens examined.

In contrast with *D. plana*, both layers are present in *D. varicosa* and in thin section the outer layer can be seen to consist of a thin, clear, outer zone, seemingly structureless but possibly corresponding to the less obviously lamellar outer zone of the rotularians described above, and a thicker, translucent, inner zone composed of outwardly inclined laminae with the apices of the parabolas occurring at the outer margin (Plate IV, fig. 6b). Thus in at least two species of *Ditrupa* parabolic lamellae are present, though in one (*D. plana*) the apices of the parabolas occur on the inside of the tube and the outer limbs of the parabolas are developed to the exclusion of the inner, whilst in the other (*D. varicosa*) the reverse is true (Figs. 4C, D). Similar variations in the position of the parabola apex and thus in the degree of development of the parabola limbs occur in other serpulids, including the genus *Rotularia* (Figs. 4A, B), and it seems probable that this tendency has been developed to an extreme degree in *Ditrupa*. Furthermore, the contrasting modes of preservation of the zones of the parabola layer with a sharply defined interface occurring between them is a feature common to both genera, and probably reflects original differences in the structure of the tube-wall.

Wrigley (1951, p. 192) has recorded *Ditrupa* as being exclusively Tertiary and Recent, but it is evident that this range must be extended to include the Upper Cretaceous.

C. AGE OF THE FAUNA

WITH the exception of one species, all the forms constituting the fauna described in this report are at present known only from the area of James Ross Island, and are apparently restricted to a relatively narrow stratigraphical horizon. The elements of which the fauna is composed show affinities with both Lower Cretaceous and Eocene forms, some possessing transitional features. Thus *Hoploparia stokesi* (Weller) has characters which link it with both *H. longimana* (Aptian–Albian) and *H. gammaroides* (Eocene), whilst the structure of the anterior part of the cephalothorax of *Meyeria crofti* sp. nov. suggest it as being a specialized end-member of a genus hitherto restricted to the Lower Cretaceous. In contrast, *Callianassa meridionalis* sp. nov., though a member of a genus with a wide stratigraphical range, shows affinities with Tertiary forms.

Of the annelids, *Rotularia shackletoni* (Wilckens) includes the largest individuals of the genus hitherto recorded and appears to bear no extra-territorial affinities, whilst small discoidal rotularians similar to *Rotularia dorsolaevis* sp. nov. are known from the Lias to Eocene. The wall structure of *Ditrupa meridionalis* sp. nov., with its well-developed parabolas of the basic serpulid pattern, suggest it as being a precursor of the possibly more specialized Tertiary forms in which parabolas are apparently lacking. The single species not restricted to the Graham Land area is *Rotularia callosa* (Stoliczka) which occurs also in India, New Zealand and Patagonia, and ranges from the Aptian to Upper Senonian.

On assessing the total characteristics of the fauna a broadly Upper Cretaceous age is indicated. However, owing to its fortunate association with ammonites of Lower to Middle Campanian age (Howarth, 1958) it is possible to define its stratigraphical position much more accurately. Since, with the exception of *Rotularia callosa*, the remainder of the fauna appears to be restricted to this horizon, it may well prove to be of zonal value where ammonites are lacking.

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PLATE I

Hoploparia stokesi (Weller)

1 An artificial cast from the natural mould, showing part of the cephalothorax, the dorsal surface of the chelae and a portion of a uropod; × 1, coated (In. 51777). Station D.88.3.

2a–c 2a, b. Dorsal and lateral views of a form with a rounded anterolateral angle on the pleuron of the second segment (? ♀); × 1. 2c. Rostrum, dorsal aspect; × 4.5 (In. 51780). Station D.97.2.

3a, b 3a. An artificial cast from the natural mould showing the left side of the carapace, including the uropod; × 1, coated. 3b. An oblique view of the abdominal pleura, the second having a sharply rounded anterolateral angle (? ♂); × 1.5, coated (In. 51779). Station D.90.2.

4a, b Artificial casts from the natural moulds (? ♂); 4a. Left side, × 1.25; 4b. Right side; × 1.5, both coated (In. 51772). Station D.86.3.

5 Holotype; showing the strongly developed first spine of the rostrum and the sharply rounded anterolateral angle of the second abdominal pleuron (? ♂); × 1.5, coated (Palaeontological Colln. No. 9705, Walker Museum, Chicago).

PLATE I

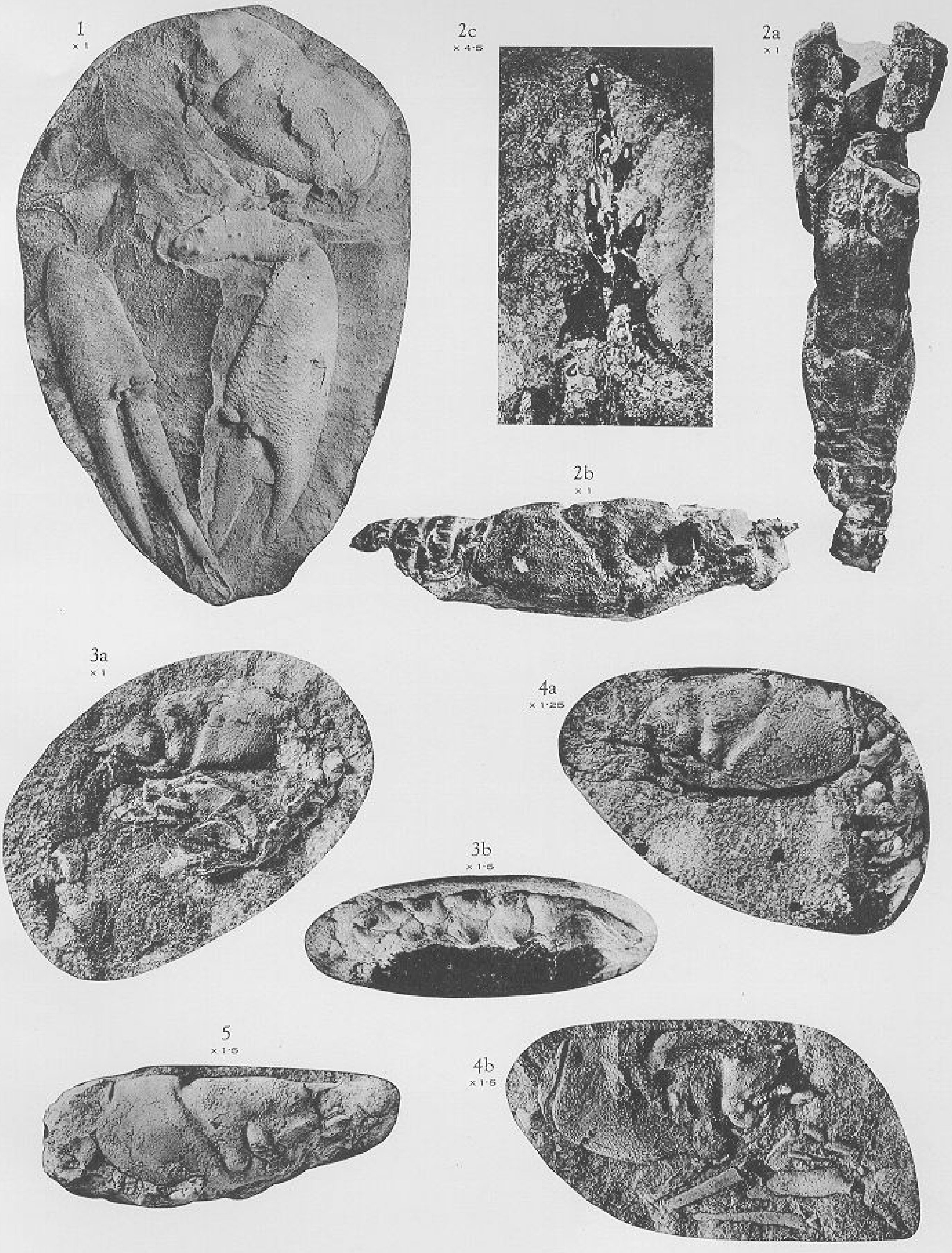


PLATE II

Meyeria crofti sp. nov.

1a, b Holotype; 1a. Lateral view, × 3.5; 1b. Dorsal view of the anterior part of the cephalothorax showing the dorsal carinae and the tuberculate ornamentation, × 5 (In. 51769). Station D.84.4.

Callianassa meridionalis sp. nov.

2 Inner surface of a quadrate, left propodus, with the movable finger; × 4 (In. 53263). Station D.422.5.

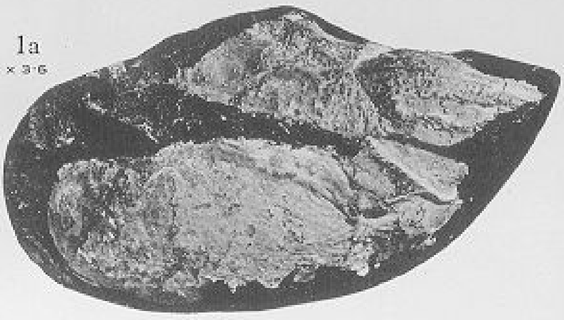
3a–e Holotype, right propodus; 3a. Outer surface, shell largely missing; 3b. Inner surface showing the pits; 3c. Upper margin; 3d. Lower margin; all × 5. 3e. Portion of the upper margin showing some of the pits, rounded on the outside of the margin, slit-like on the inside with slightly inflated posterior edges; × 13.5 (In. 53260). Station D.422.5.

4a, b Outer and inner surfaces of an elongate, left propodus, the shell being largely absent except for the proximal and distal margins; × 5 (In. 53264). Station D.422.5.

5a, b Outer and inner surfaces of a quadrate, right propodus, showing the reticulate pattern of the deeper layers of the shell; × 6 (In. 53261). Station D.422.5.

PLATE II

1a
× 3·5

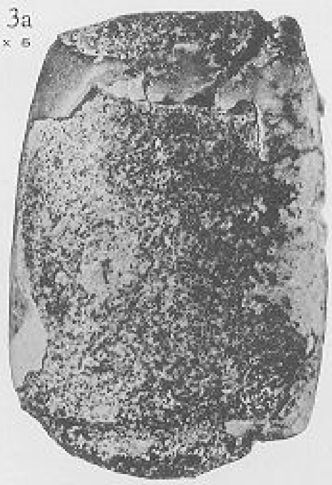


1b
× 5

2
× 4

3e
× 13·5

3a
× 5



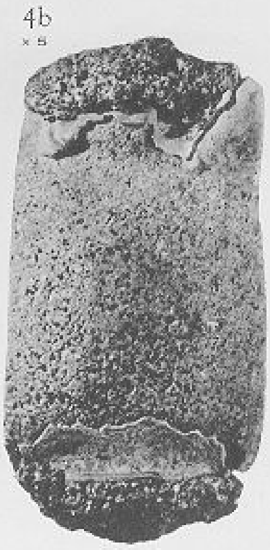
3b
× 5

3c
× 5

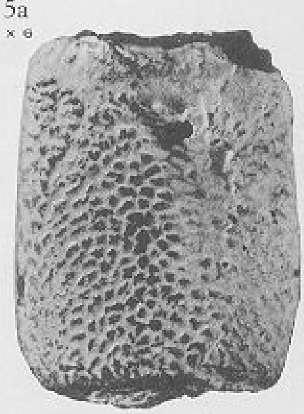
3d
× 5

4a
× 5

4b
× 5



5a
× 6



5b
× 6

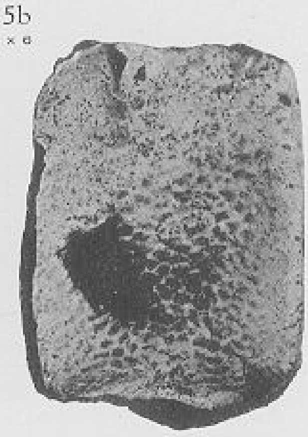


PLATE III

Hoploparia stokesi (Weller)

1 An artificial cast from the natural mould of a form with a rounded anterolateral angle on the pleuron of the second abdominal segment (? ♀). The rostrum is well preserved but has suffered post-mortem fracturing; × 1, coated (Ar. 46063, Swedish Museum of Natural History).

2 The left side of the carapace, the pleura of the second and third abdominal segments showing the diagonal series of laterally-elongated tubercles; × 2 (Ar. 46062, Swedish Museum of Natural History).

Rotularia dorsolaevis sp. nov.

3a–c Holotype; right, apertural and left views; × 2 (A.8069). Station D.97.3.

4 Form with an elongate, terminal extension; × 2 (A.8068). Station D.97.3.

5 Section in median horizontal plane of the apertural portion, showing the parabolic structure of the outer layer, the outer zone having a fibrous appearance owing to recrystallization. The lamellae of the inner layer become parabolic below the aperture; × 9 (A.8093). Station D.533.3.

6 Section in median transverse plane, showing the subconcentric lamellae fanning out at the whorl sutures, and radiating fibrous structure of the outer zone owing to recrystallization; × 7.5 (A.8092). Station D.533.3.

7a–c Right, apertural and left views of a tumid form; × 2 (A.8088). Station D.533.3.

8 Apertural view of a specimen with slightly convex periphery; × 2.5 (A.8007). Station 5266.

9 Oblique lateral view of a form with a "hooded" aperture; × 5 (A.8007). Station 5266.

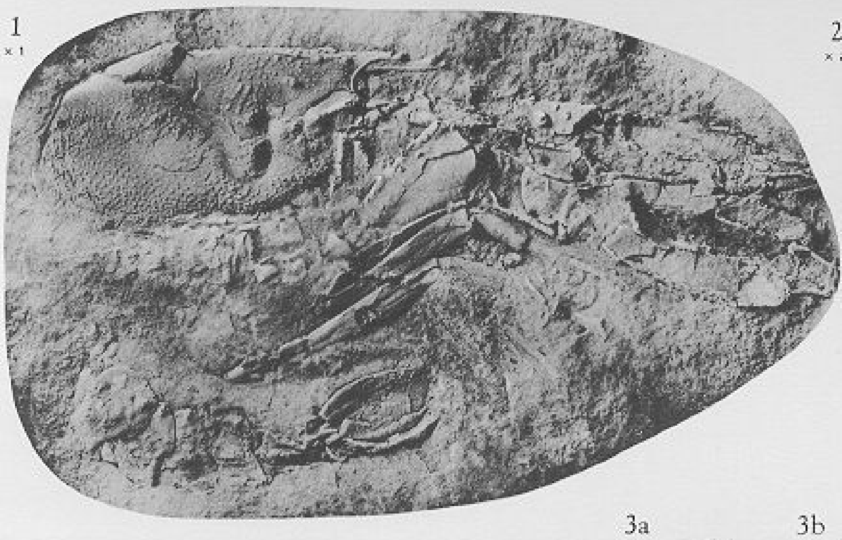
Rotularia spirulaea (Lamarck)

10 Section in median transverse plane; the substance of the tube has been largely recrystallized into clear calcite; × 3 (A.8379). Lower Eocene; Bos d'Arros, France.

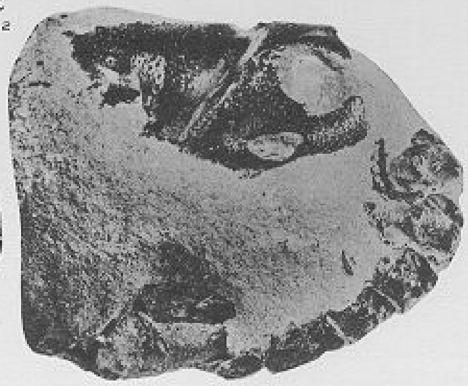
11 Section in median horizontal plane, showing the parabolic structure of the outer wall, with marked discontinuity between the inner and outer zones of the outer layer at the apices of the parabolas; × 4 (A.8380). Lower Eocene; Bos d'Arros, France.

12 The outer surface of a calcareous nodule showing numerous typical trace fossils; × 0.75 (In. 51778). Station D.88.3.

1
×1



2
×2



4
×2

3a
×2

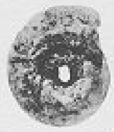
3b
×2

3c
×2

5
×9

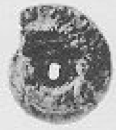
8
×2·5

7a
×2

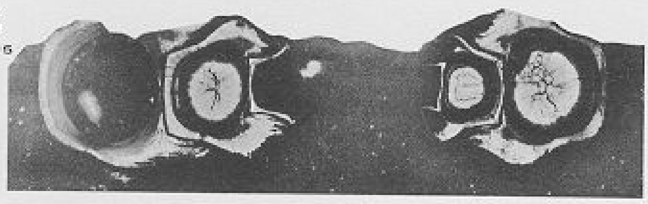


7b
×2

7c
×2



6
×7·5



10
×3

9
×5

11
×4

12
×0·75

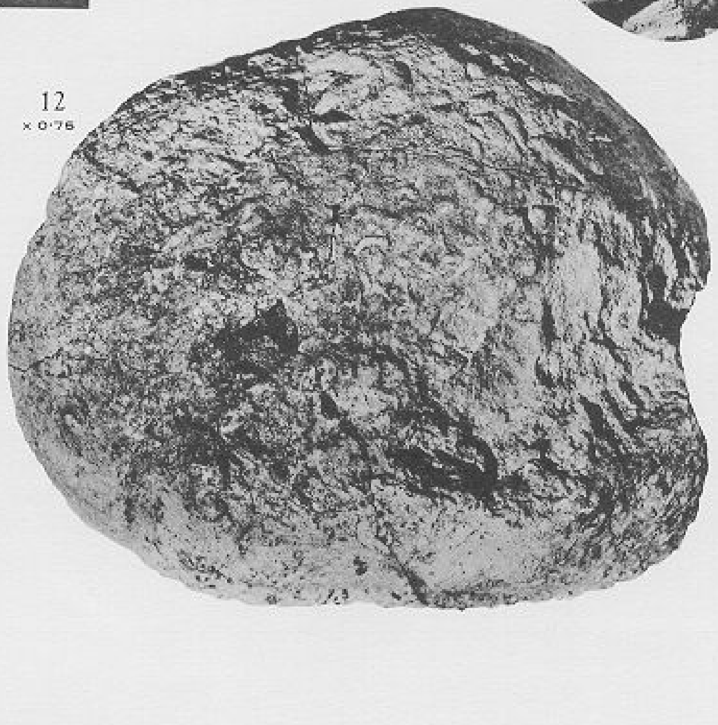


PLATE IV

Rotularia shackletoni (Wilckens)

1a, b 1a. Section in median transverse plane of a form with tear-drop shaped lamellae and incorporated adventitious mineral grains; × 3. 1b. Section in median horizontal plane; × 4 (A.8008). Station 5279.

Rotularia callosa (Stoliczka)

2 Section in median horizontal plane showing the parabolic structure of the outer wall of the whorl, some of the parabolas being iron-stained; × 5 (A.8031). Station 5420.

3 Section in median transverse plane of a high spiral form; × 5 (A.7969). Station 7988.

4 Section in median transverse plane of a low spiral form; × 5 (A.7996). Station 4851.

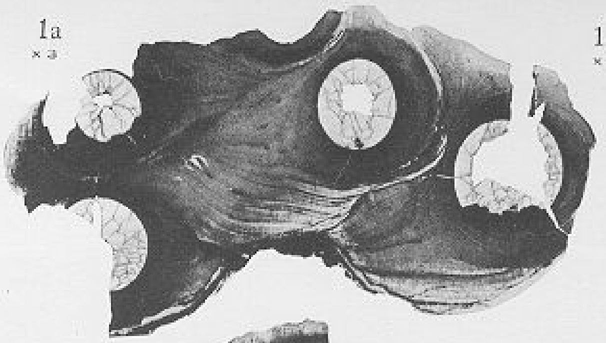
Ditrupa plana (J. Sowerby)

5a, b 5a. Vertical section of a tube-wall, interior to the left, showing the apices of the parabolas in the inner zone. Owing to recrystallization the lamellae of the outer zone are not apparent; × 55. 5b. Horizontal section of a tube, showing the thin inner and thicker outer zones, some replacement by iron minerals occurring at the outer surface; × 32 (A.810). London Clay (Eocene); Hampstead.

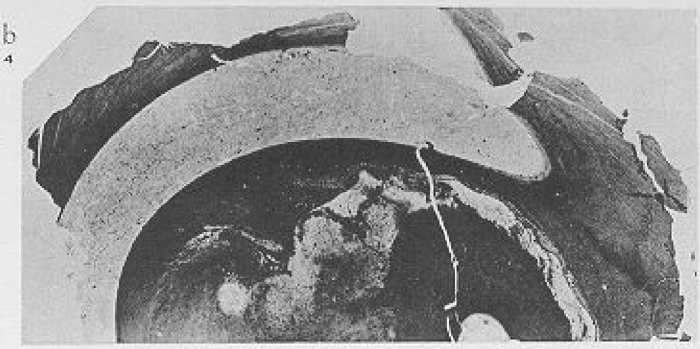
Ditrupa varicosa sp. nov.

6a–c Syntypes; 6a. Specimens and natural moulds showing the nodose form of the tube; × 2. 6b. Vertical section of part of a tube-wall, interior to the right, showing the clear outer zone and the thicker, inner parabola zone of the outer layer. The inner layer is lacking; × 130. 6c. Horizontal section of a tube, the concentric structure of the lamellae being obscured by partial recrystallization. The lamellae are more apparent in the adjacent portion of tube-wall which is sectioned obliquely; × 50 (A.8032). Station D.86.6.

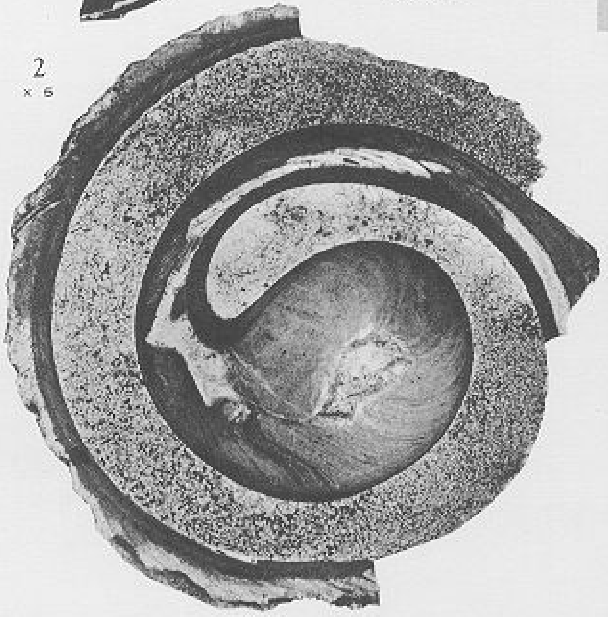
1a
× 3



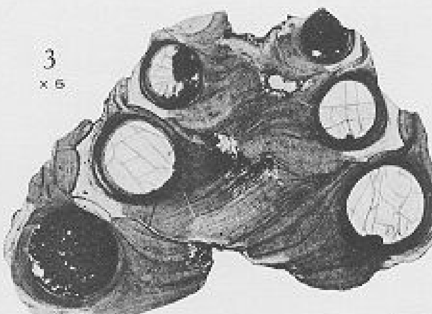
1b
× 4



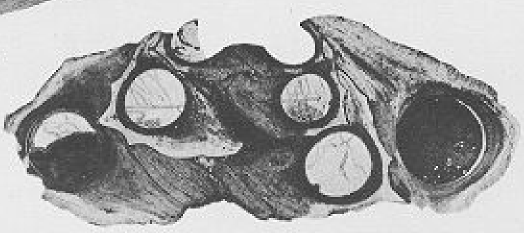
2
× 6



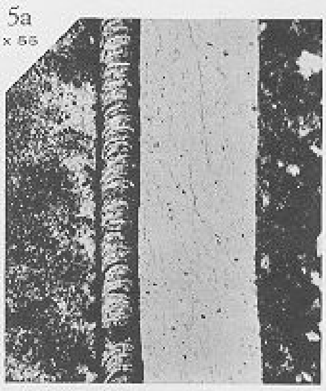
3
× 5



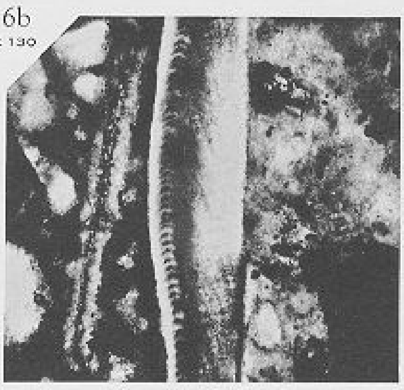
4
× 5



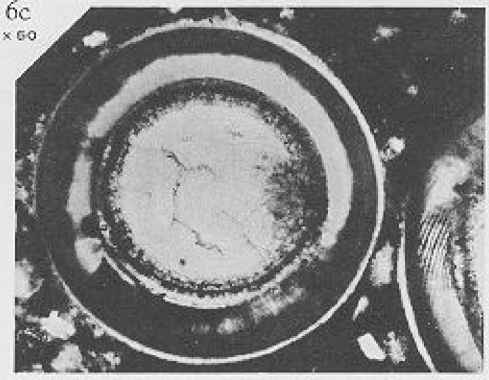
5a
× 55



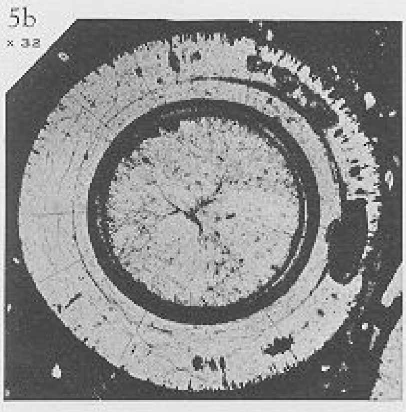
6b
× 130



6c
× 50



5b
× 32



6a
× 2

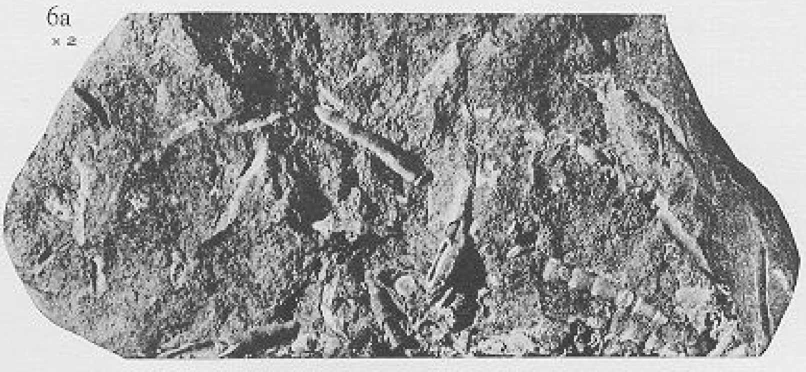


PLATE V

Rotularia callosa (Stoliczka)
(All figures × 1.5)

1a–c Apical, apertural and umbilical views of the most perfectly discoidal form, with angular carinae, spiral ridges and growth-lines (A.8311). Station D.2040.4.

2a–c Apical, apertural and umbilical views of a discoidal form with inflated, broadly-rounded carinae – though the periphery of the median carina is in part flattened – and tumid spiral ridges (A.8016). Station 5318.

3a–c Apical, apertural and umbilical views of a discoidal form. Median carina inflated with, in part, subsidiary ridges and furrows. Lateral carinae angular, spiral ridges with subsidiary ridges and grooves (A.8097). Station D.535.2.

4a–c Apical, apertural and umbilical views of a discoidal form with angular carinae, the lateral carinae much reduced and becoming absent towards the aperture (A.8095). Station D.535.2.

5a–c Apical, apertural and umbilical views of a low spiral form in which the carinae are reduced, sub-rounded to angular, and the spiral zones of callosity are largely flat. The spiral profile alters towards the aperture owing to a change in the plane of coiling of the last whorl (A.8084). Station D.529.2.

6a–c Apical, apertural and umbilical views of a low spiral form in which the carinae are reduced and angular, and the spiral ridges broadly rounded (A.7992). Station 4847.

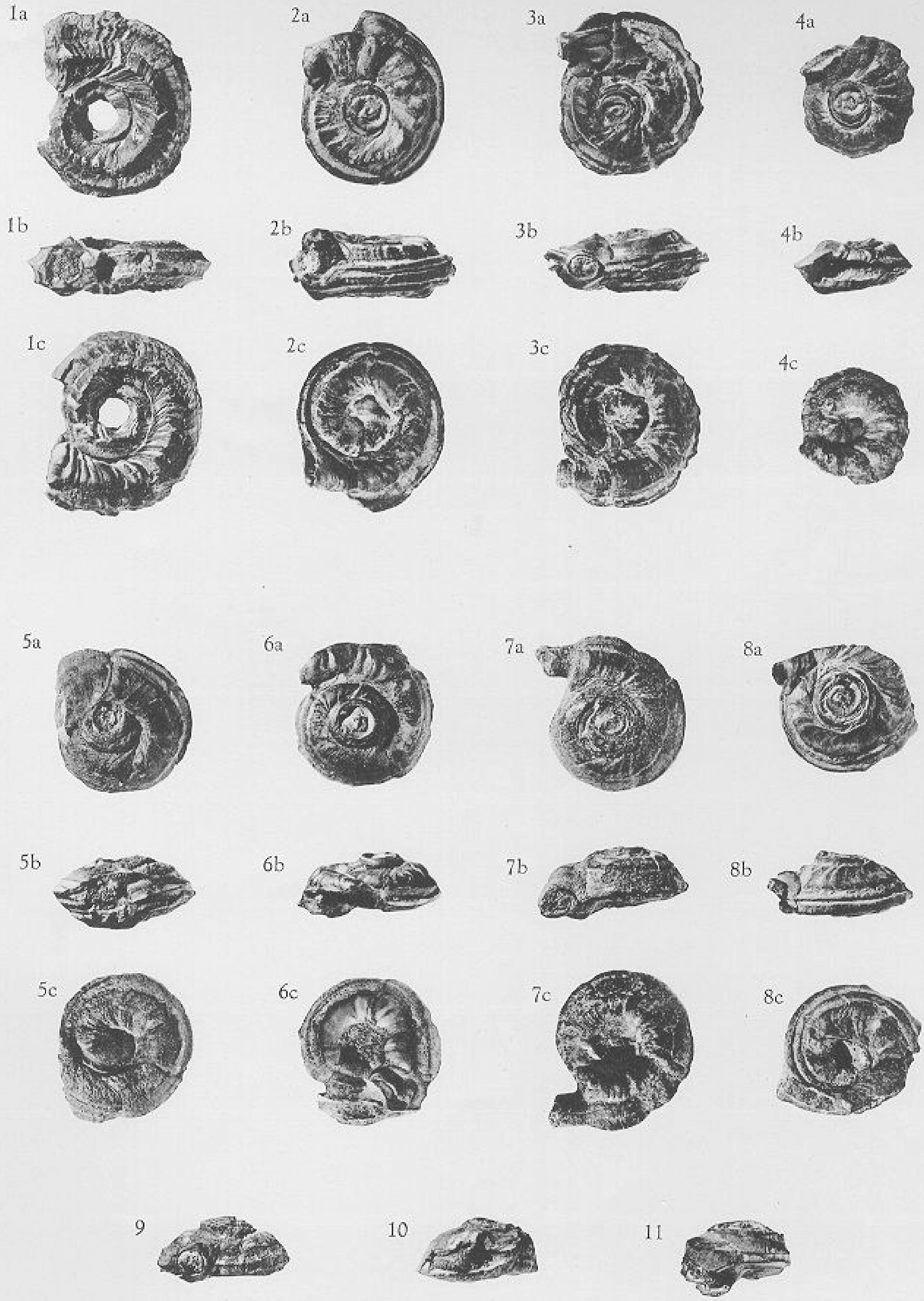
7a–c Apical, apertural and umbilical views of a low spiral form in which the lateral carinae are absent, and the apertural portion of the final whorl projects as a straight, tangential extension (A.8061). Station D.87.10.

8a–c Apical, apertural and umbilical views of a low spiral form with an inflated median carina and angular, reduced lateral carinae; apical zones of callosity flat (A.8099). Station D.541.2.

9 Apertural view of a low spiral form in which the carinae are equally developed, but much reduced and angular (A.8096). Station D.535.2.

10 Lateral view of a low spiral form with a sub-quadrate profile and no lateral carinae (A.7986). Station 4712.

11 Lateral view of a high spiral form in which the apical spiral ridge forms a sharp shoulder giving the whorl a quadrate profile. The carinae are equally developed but much reduced and angular (A.8308). Station D.2026.1–2.



All figures x 1·5

PLATE VI

Rotularia callosa (Stoliczka)
(All figures × 1.5)

1a–c Apical, apertural and umbilical views of a high spiral form with angular carinae, the median becoming much more developed towards the aperture. The apical spiral ridges form angular shoulders and the whorl profile becomes more symmetrical towards the aperture (A.7969). Station 4689.

2a–c Apical, apertural and umbilical views of a high spiral form with reduced and angular carinae and thick spiral developments of callosity, the apical being sub-angular (A.8000). Station 5011.

3a-c Apical, apertural and umbilical views of a high spiral form with tumid carinae, the median bearing subsidiary ridges and furrows. Considerable change occurs in the plane of coiling of the last whorl (A.8014). Station 5316.

4a–c Apical, apertural and umbilical views of a high spiral form with lateral carinae reduced, becoming absent, the median carina forming a sub-angular "keel"; a thick development of callosity occurs on the inside of the final whorl (A.8040). Station D.87.10.

5a–c Apical, apertural and umbilical views of a high spiral form, the periphery of the final whorl forming a sub-rounded keel, the carinae being much reduced; thick callosity occurs on the inside of the whorl towards the aperture (A.8085). Station D.529.2.

6a–c Apical, apertural and umbilical views of a high spiral form with reduced and angular carinae, the median being subdivided by a central groove, the whorl profile becoming more symmetrical towards the aperture and the spiral ridges more pronounced and tumid (A.8306). Station D.2036.1.

7a–c Apical, apertural and umbilical views of a high spiral form with the earlier whorls well preserved and an essentially quadrate profile. The aperture is constricted owing to damage to the tube during life (A.8305). Station D.2036.1.

8a–c Apical, apertural and umbilical views of a high spiral form with a quadrate profile and very much reduced carinae (A.7961). Station 4680.

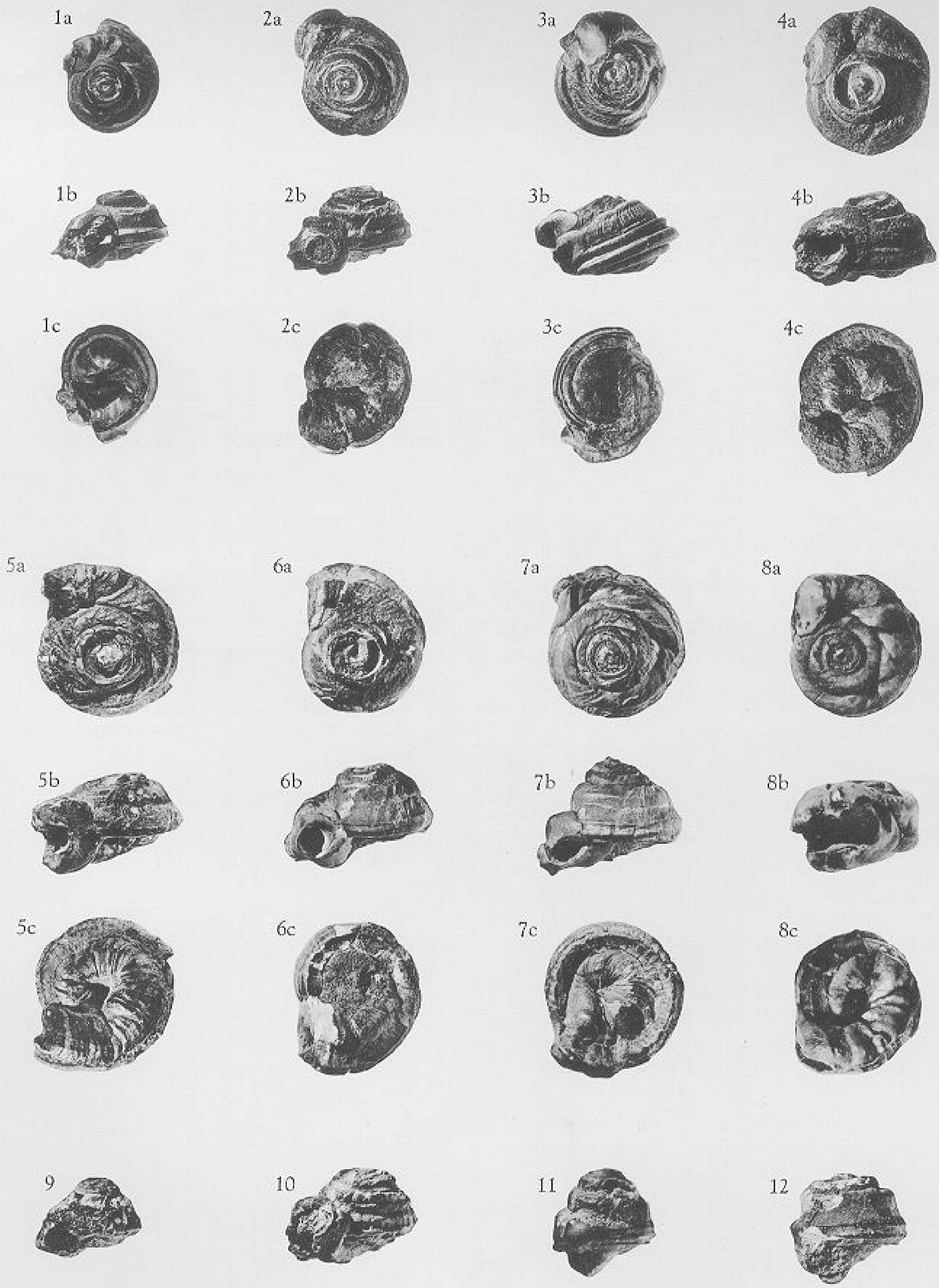
9 Apertural view of a high spiral form with the lateral carinae very much reduced, becoming absent towards the aperture (A.8045). Station D.87.10.

10 Apertural view of a high spiral form with subsidiary ridges and grooves on the spiral ridges (A.8030). Station 5412.

11 Apertural view of a high spiral form with a quadrate profile, showing change in plane of coiling of the last whorl (A.8022). Station 5324.

12 Apertural view of a high spiral form with a markedly quadrate profile and change in plane of coiling of the final whorl (A.8309). Station D.2026.1–2.

PLATE VI



All figures x 1·5

PLATE VII

Rotularia callosa (Stoliczka)

1a–c Apical, apertural and umbilical views of a juvenile form; × 2 (A.8082). Station D.422.1.

2a–c Apical, apertural and umbilical views of a juvenile form, 2a, b showing remnants of the initial apical growth; × 2 (A.8081). Station D.422.1.

3a–c Apical, apertural and umbilical views of a juvenile form; × 2 (A.8083). Station D.422.1.

4 An adult form with a tapered tangential extension occurring with the natural mould of a specimen possessing a terminal extension which, though incomplete, measures 13mm.; × 1.5 (A.8062). Station D.87.10.

5 An adult form with a broad, tangential terminal extension; × 1.5 (A.8046). Station D.87.10.

Rotularia shackletoni (Wilckens)

6a–c Lateral, apertural and umbilical views of a dextrally coiled, discoidal form, with a straight, tangential terminal extension; × 1.5 (A.8075). Station D.422.1.

7a–c Apical, apertural and umbilical views of a dextrally coiled, juvenile form, 7a showing the remnants of the initial apical growth; × 2 (A.8078). Station D.422.1.

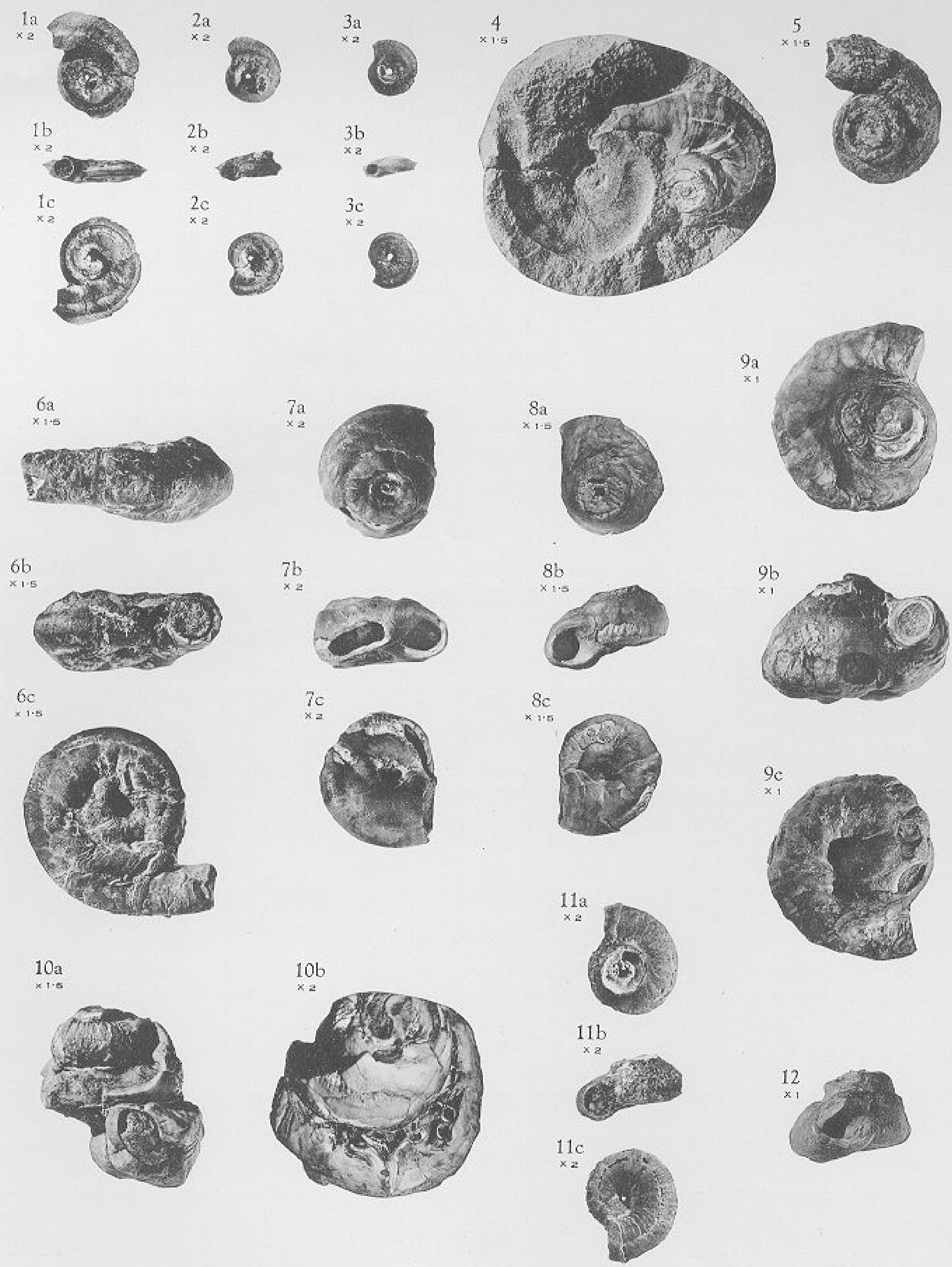
8a–c Apical, apertural and umbilical views of a sinistrally coiled, low spiral form in which the profile becomes more rounded towards the aperture, which is relatively large and ovoid; × 1.5 (A.8073). Station D.417.4.

9a–c Apical, apertural and umbilical views of a large dextrally coiled form which shows change in the plane of coiling of the final whorl; 9b, c show a depression on the final whorl marking the point of attachment of a spirally coiled tube; × 1 (A.8009). Station 5280.

10a, b Apertural and oblique views of a dextrally coiled form, 10b showing a number of tubes attached to the penultimate whorl which has become partly overlapped by the final whorl. The presence of the tubes has caused a violent change in the plane of coiling of the final whorl; 10a × 1.5, 10b × 2 (A.8010). Station 5291.

11a–c Apical, apertural and umbilical views of a sinistrally coiled, juvenile form; × 2 (A.8079). Station D.422.1.

12 Apertural view of a sinistrally coiled juvenile form in which the profile becomes more rounded towards the aperture; × 1 (A.8074). Station D.417.4.


1a ×2
2a ×2
3a ×2
4 ×1·5
5 ×1·5
1b ×2
2b ×2
3b ×2
1c ×2
2c ×2
3c ×2
9a ×1
6a ×1·5
7a ×2
8a ×1·5
6b ×1·5
7b ×2
8b ×1·5
9b ×1
6c ×1·5
7c ×2
8c ×1·5
9c ×1
11a ×2
10a ×1·5
10b ×2
11b ×2
12 ×1
11c ×2