MACRUROUS DECAPODA FROM THE LOWER CRETACEOUS OF SOUTH-EASTERN ALEXANDER ISLAND

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BRIAN J. TAYLOR, B.Sc., Ph.D.

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ABSTRACT

A REASONABLY well-preserved macrurous decapod fauna from south-eastern Alexander Island represents the richest and most diversified of its kind so far known from the Lower Cretaceous of the Southern Hemisphere. Although the decapods are widely distributed, they are most numerous within three probably monotypic faunizones, one of which is of some local stratigraphical importance. The fauna comprises numerous small mecochirid-like forms, two species of *Glyphea* (*G. alexandri* sp. nov. and *G. georgiensis* sp. nov.), at least three species of *Palaeastacus* (*P. foersteri* sp. nov., *P.* cf. *sussexiensis* and *P. terraereginae*) as well as *Trachysoma* aff. *ornatum*, *Mecochirus* sp., *Protocallianassa antarctica* sp. nov., *Protocallianassa* sp., *Enoploclytia* sp., *Schlueteria carinata* sp. nov., and numerous appendages. Differences in the shape and size of the epimeres of the mecochirid-like forms are attributed to sexual dimorphism, and the stratigraphical and geographical ranges of *Schlueteria* have been extended. Associated ammonites indicate that the decapods probably range from Berriasian to Lower Aptian in age. The Glypheidae and Erymidae are similar to those from the Lower Cretaceous (Aptian–Upper Albian) of Queensland.

CONTENTS

I. INTRODUCTION

THE sedimentary rocks exposed in south-eastern Alexander Island between Pluto and Mercury Glaciers (lat. 71°07′–71°34′S.) (Fig. 1) form part of a thick, well-exposed and mainly argillaceous marine succession of Berriasian–Lower Albian age (Thomson, 1974). Macrurous decapods, probably in excess of those tabulated (Table I), occur at every locality between locality C and Waitabit Cliffs, and more doubtful occurrences have been recorded from Succession Cliffs (localities A and B). Associated ammonites (Thomson, 1971, 1974) indicate that the decapods collected range from Berriasian to Lower Aptian in age. An as yet unidentified cheliped, probably of Tithonian age, has been collected in the vicinity of Ablation Point (lat. 70°48′S., long. 68°22′W.), and more recently additional decapods have been found at other
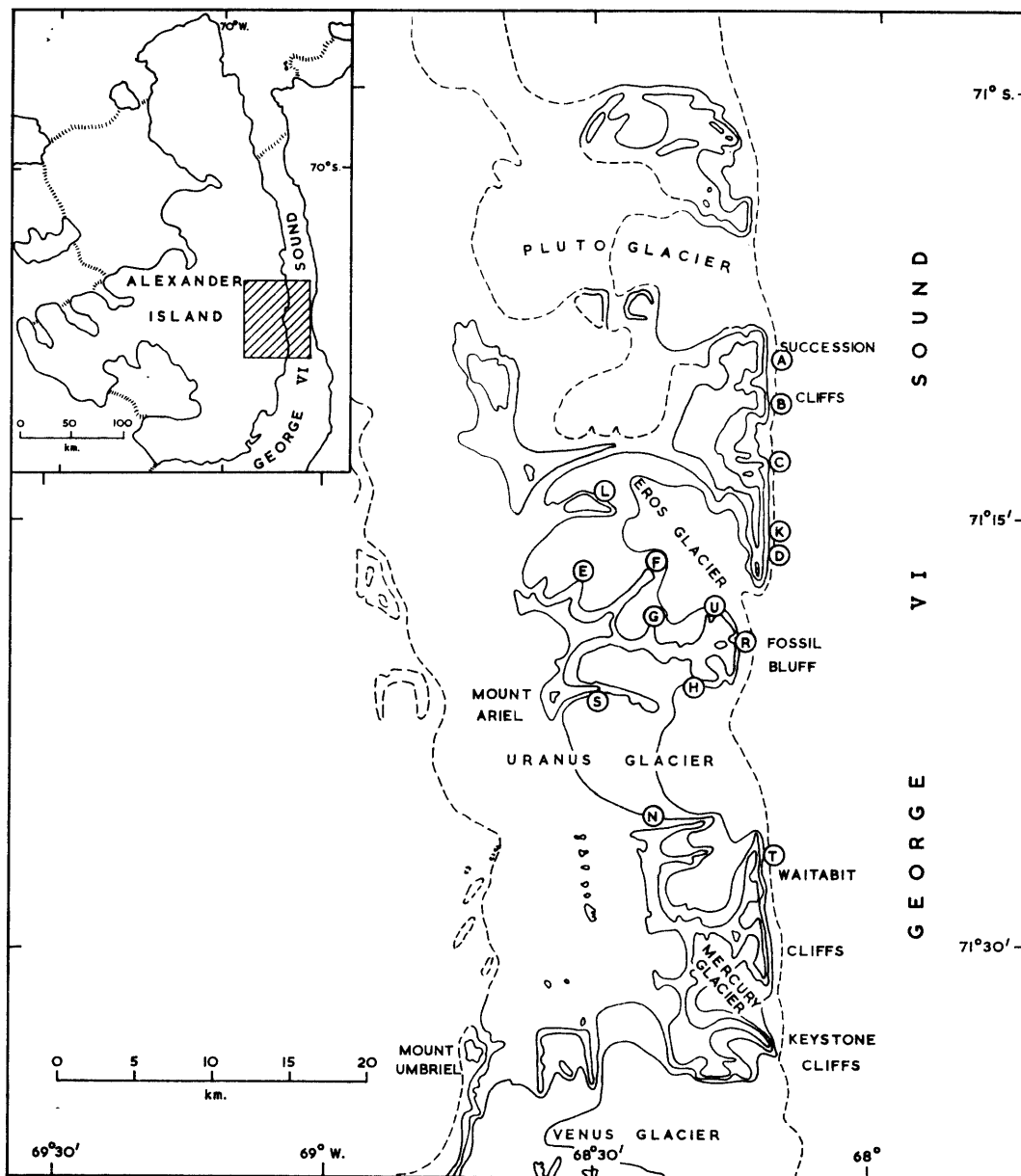

FIGURE 1

Sketch map of part of south-eastern Alexander Island showing the decapod localities.

TABLE I

OCCURRENCES OF MACRUROUS DECAPODS IN THE LOWER CRETACEOUS
OF SOUTH-EASTERN ALEXANDER ISLAND

Locality (see Fig. 1)		Specimen number	Unit number	Identification
C	1	KG.17.20	75	Chela
	2	Not collected and not *in situ*	188	—
K	1	KG.18.5	40	Protocallianassid propodus
	2	KG.18.21	64	Glypheid chela
	3	Not collected	71	Cephalothorax
	4	Not collected	73	—
	5	Not collected	75	Pereiopod joint
	6	Not collected	81	—
	7	KG.18.43	87	*Glyphea alexandri* (paratype)
	8	KG.18.44	87	*G. alexandri* (paratype)
	9	KG.18.45	87	*G. alexandri* (paratype)
	10	KG.18.46	87	*G. alexandri* (holotype)
D	1	KG.19.15	1	*G. georgiensis* (paratype)
	1	KG.19.16	1	*G. georgiensis* (holotype)
	2	Not collected	2	—
	3	Not collected	3	—
	4	Not collected	5	—
	5	Not collected	16	Fragment inside a concretion
	6	Not collected	19	Not *in situ*
	7	Not collected	21	—
	8	Not collected	32	—
	9	Not collected	49	—
	10	Not collected	52	—
	11	Not collected	59	—
	12	Not collected	60	Not *in situ*
	13	Not collected	61	—
	14	Not collected	71	—
	—	KG.19.34	Not *in situ*	Glypheid chela
L	1	KG.12.12	83	Chelae of *Schlueteria carinata* (holotype)
	2	Not collected	103	—
E	1	Not collected	121	—
F	1	KG.13.5	68	Chela
G	1	KG.5.18	47	Appendages
U	1	KG.4.1	4	"Tail fan"
	2	Not collected	5	Chela
	3	Not collected	22	Incomplete chela
	4	Not collected	31	Fragmented test
	5	Not collected	35	Chela
	6	KG.4.5	36	Articulated test of a (?) mecochirid
	7	KG.4.4	37	Articulated test of a (?) mecochirid
	8	KG.4.6	37	Articulated test of a (?) mecochirid
	9	Not collected	38	Fragmented test
	10	Not collected	39	Fragmented test
	11	Not collected	69	Fragmented test
R	1	KG.1.921–942	198	Mecochirid-like forms
	2	KG.110.4	In vicinity of unit 206	*Protocallianassa antarctica* (holotype)
	3	KG.110.5a and b	In vicinity of unit 206	*Protocallianassa antarctica* (paratypes)
	4	Not collected	223	—
	5	KG.1.828	275	(?) *Callianassa*
	—	KG.64.3	Not *in situ*	(?) Mecochirid
	—	KG.1.960	Not *in situ*	(?) Mecochirid

TABLE I—*continued*

Locality (see Fig. 1)		Specimen number	Unit number	Identification
H	—	KG.2.38	Not *in situ*	(?) *Enoploclytia*
	1	KG.2.139	191	Two chela
	2	KG.2.164	202	*Enoploclytia* sp.
	3	KG.2.167	204	Tail fan of *Enoploclytia*
	4	KG.2.170	204	*Enoploclytia* sp.
	5	KG.2.183	212	Pereiopods of *Trachysoma*
	—	KG.2.214a and b	Not *in situ*	*Enoploclytia* sp.
S	1	KG.3.11	44	*Palaeastacus*
	2	Not collected	228	Cephalothorax
	3	Not collected	246	Cephalothorax
	4	Not collected	247	Cephalothorax
	5	Not collected	250	—
	6	Not collected	259	Chela
	7	Not collected	273	Cephalothorax
N	1	Not collected	20	—
	2	Not collected	21	—
	3	KG.11.4	22	*Palaeastacus terraereginae*
	4	KG.11.8	39	*Trachysoma* aff. *ornatum*
	5	Not collected	42	—
	6	KG.11.16	53	*Trachysoma* aff. *ornatum*
	7	Not collected	62	—
	8	Not collected	71	—
	9	KG.11.26	75	Pereiopods of *P. foersteri*
	10	KG.11.30	89	Pereiopods of *Trachysoma*
	11	KG.11.39	90	*Mecochirus* sp.
	12	Not collected	92	—
	13	Not collected	93	—
	—	KG.50.4	Not *in situ*	Holotype of *Palaeastacus foersteri*
	—	KG.50.5	Not *in situ*	*P. foersteri* (paratype)
	—	KG.50.6	Not *in situ*	*P. foersteri* (paratype)
	—	KG.11.9	Not *in situ*	Pereiopods of *P. foersteri*
T	1	KG.6.14	15	Chela
	2	Not collected	36	Not *in situ*
	3	Not collected	47	—
	4	Not collected	56	—
	5	KG.6.20	59	Chela
	6	Not collected	60	—
	7	KG.103.14	9*	Chela
	8	KG.103.33	14*	Chela
	9	KG.103.134	Probably from unit 69*	*Palaeastacus* cf. *sussexiensis*
	—	KG.103.229	Not *in situ**	*Mecochirus* sp.

* From that part of the succession measured and notated by M. R. A. Thomson.

localities in south-eastern Alexander Island. The decapods described here are particularly common within three probably monotypic faunizones, one of which is of some local stratigraphical importance.

1. *Composition of the fauna*

67 specimens were collected from south-eastern Alexander Island (most of them from the three faunizones) and 45 more poorly preserved specimens were recorded in the field. The present collection represents part of a rich, reasonably well-preserved and diversified macruran fauna comprising the following: numerous, small mecochirid-like forms with thin cuticles, two species of *Glyphea* (*G. alexandri* sp. nov. and *G. georgiensis* sp. nov.), at least three species of *Palaeastacus* (*P. foersteri* sp. nov., *P.* cf. *sussexiensis* and *P. terraereginae*), a species of *Schlueteria* (*S. carinata* sp. nov.) together with *Trachysoma* aff. *ornatum*, *Mecochirus* sp., *Protocallianassa antarctica* sp. nov., *Protocallianassa* sp., *Enoploclytia* sp., and numerous appendages. Except for one large cheliped (KG.2.38) from locality H, most of the fossil decapods are of small individuals.

2. Distribution and biostratigraphy

Decapods are most numerous at localities N, U, D, K and Fossil Bluff (Fig. 1). Numerically, the commonest decapods are small and almost completely articulated mecochirid-like forms which occur within one stratum at Fossil Bluff and in a stratigraphically older 8 m. thick sequence at locality U; both occurrences are of limited stratigraphical importance. Of greater localized stratigraphical significance are relatively large numbers of glypheids in the uppermost 25 m. at locality K. These (together with the bivalve *Myophorella*) can be followed down dip to locality D, where they occur in the lowest exposed strata (Fig. 2). Less satisfactorily, the mecochirid near the top of the measured section at locality N could be tentatively correlated with a similar but larger specimen from the middle part of the section at Waitabit Cliffs. The glypheids indicate a Lower Cretaceous age for part of the succession, because in the Cretaceous of the Southern Hemisphere they have been recorded only in the Neocomian and the Aptian–Upper Albian of Tanzania and Queensland, respectively (Beurlen, 1933; Woods, 1957).

In addition to the decapods collected by the author, R. R. Horne collected five from the same area, one (?) mecochirid (KG.64.3) from Fossil Bluff, the abdomen of *G. georgiensis* (KG.19.15) from locality D and all three specimens (KG.50.4, 5 and 6) of *P. foersteri*, including the holotype, from locality N; none was *in situ*. M. R. A. Thomson collected *P.* cf. *sussexiensis* (KG.103.134), a cheliped (KG.103.33) and a dactylus (KG.103.14) from the northern part of Waitabit Cliffs, and a mecochirid-like form (KG.110.3) and three claws (KG.110.4, 110.5a and b) of *Protocallianassa antarctica* from Fossil Bluff. Dr. M. Rice collected a mecochirid (KG.103.229) from Waitabit Cliffs. The largest of the many fragmentary appendages (KG.2.38) was collected from locality H by J. P. Smith, who found an articulated (?) mecochirid (KG.1.908) at Fossil Bluff.

3. Preservation

The decapods collected in Alexander Island are more or less equally divided into fragmentary appendages and carapaces in various states of completeness. The latter usually occur as natural moulds, from which latex casts have been made. Several of the Erymidae and most of the small mecochirid-like forms are almost completely articulated but only a few decapods (Figs. 4b and 6) are preserved in the moulting position, i.e. lying on their sides with the abdomen detached and almost at right-angles to the cephalo-thorax. Exuviae buried in this attitude are usually found in deposits formed under quiet water conditions.

The relatively delicate decapods with thin cuticles, i.e. the mecochirids and mecochirid-like forms, were evidently prone to post-mortem changes. Many of their pereiopods overlap one another and overlie the cephalothorax (Fig. 4a; Plate IId) and the compressed carapaces often show parts of both sides of the abdomen, notably the epimeres (Fig. 7a and b). The overlapping of the pereiopods on to the cephalothorax probably took place almost immediately after the death of the decapod. One mecochirid-like decapod (Plate IIIa) represents either the endoskeleton or one recently emerged from ecdysis, and a mandible of *G. alexandri* (Plate Ic and d) is also preserved.

Striated muscle attachment areas occur on the hepatic groove and near the occluded apodermal mandibular lobe of *G. alexandri*, on the orbital margin, the inferior groove, the hepatic side of the cervical groove and the *Marginalwulst* of *P.* cf. *sussexiensis*, and on the inferior groove and adjacent parts of the cephalothorax of *Enoploclytia*.

The decapods of Alexander Island are not usually aggregated, but at Fossil Bluff numerous mecochirid-like forms occur in one particular stratum. The close proximity of this locality to the postulated Cretaceous shoreline (Horne, 1969, fig. 1) suggests that either the carapaces were winnowed by water action or the stratum represented a suitable spawning or moulting ground. It is perhaps unusual that, whereas vagile benthonic decapods in Alexander Island are relatively common and almost completely articulated, burrowing forms *sensu stricto* (p. 20) (with a high preservation potential) are represented by only four protocallianassid chelipeds. No burrows were found associated with these chelipeds.

In the field the decapods are easily distinguished from other invertebrates by their small amounts of often bluish white tuberculate cuticle—as opposed to non-tuberculate opalescent fish bone. The opalescence probably indicates the presence of vivianite, a hydrous iron phosphate often associated with phosphatic shells or bone. Microscopically, the cuticles of all the decapods sectioned are remarkably well preserved, showing all the major structural sub-divisions and vertical and horizontal components of extant decapods. The absence of tegumental ducts suggests that these cuticles were deposited epidermally (Taylor, 1973).
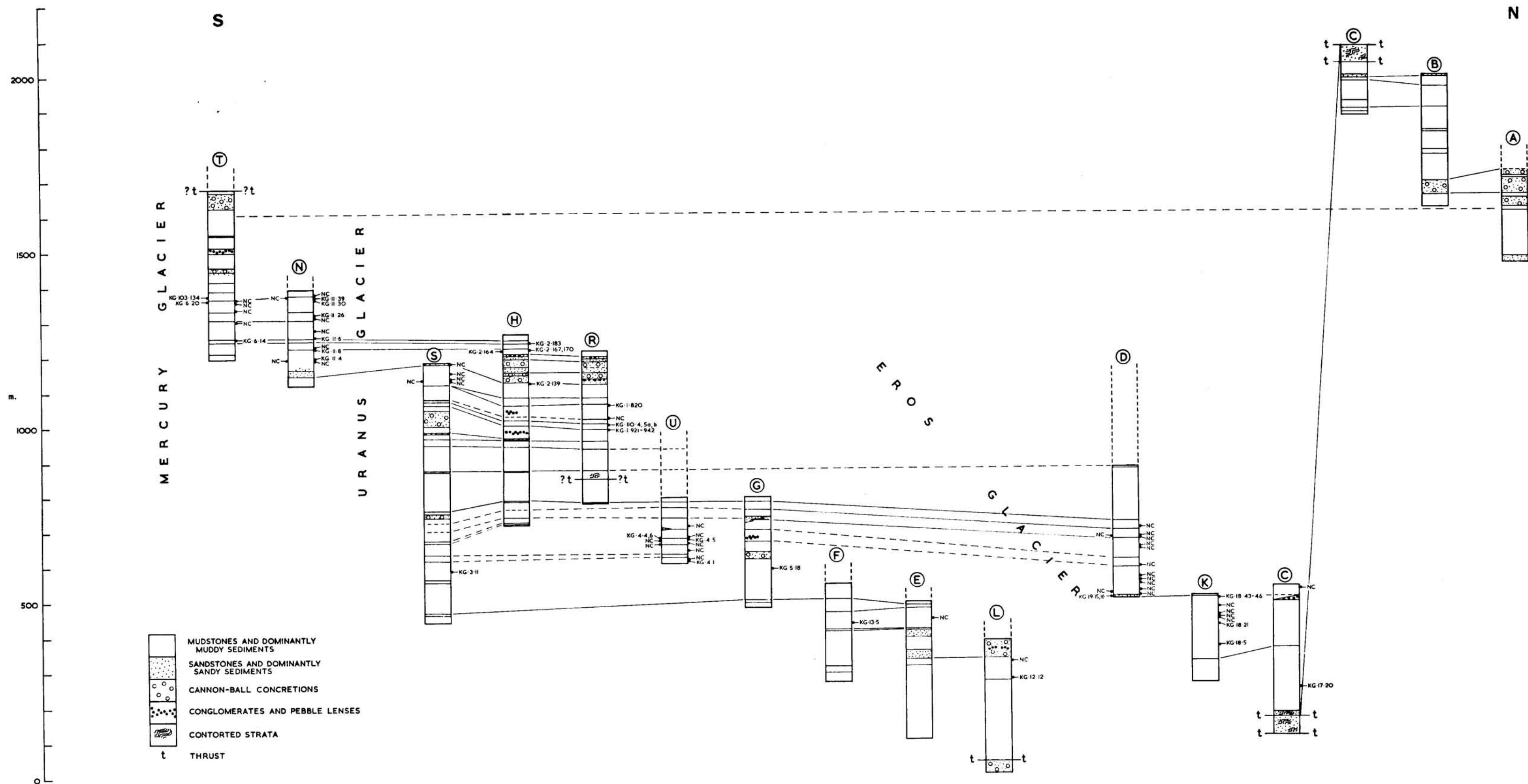
FIGURE 2

The distribution of decapods in the Lower Cretaceous succession of south-eastern Alexander Island. The diagrammatic representation of the measured stratigraphical sections is modified after Taylor (1971b, fig. 2) and Thomson (1971, fig. 2). Specimens not collected are indicated as NC, and part of the correlation scheme is also shown.

Many of them have been bored by a saprotrophic fungus (Taylor, 1971a) similar to the so-called "crayfish plague" fungus (Unestam and Weiss, 1970). Provided the fungus was not heterotrophic, the articulated decapods must have lain uncovered long enough (presumably in quiet water conditions) for infestation to take place.

Although several dozen calcareous concretions in the sedimentary succession contain well-preserved fossils (including belemnite phragmocones), only one complete cheliped was found (p. 12). This is mineralogically similar to the other specimens but it contains fewer borings, probably because it was effectively protected by the syngenetic formation of the concretion. The palaeoecological environment of the decapods has been described elsewhere (Taylor, 1971a, 1973).

4. Epizoa

Decapods are one of the few fossil substrates in the sedimentary succession encrusted by epizoans. Open-coiled serpulid tubes $0 \cdot 2$–$0 \cdot 8$ mm. in diameter and circular in cross-section occur on the propodus of *G. alexandri* (Plate Ic), the cephalothorax of *P. terraereginae* (Plate IVg) and on the exopodite, protopodite and hepatic and antennal regions of *P. foersteri* (Plate IVb). The serpulids are best developed on *P. terraereginae* where they occur on the branchiostegite, the pterygostomial region and on the merus of the first pereiopod. One tube follows the course of the inferior groove. Unfortunately, most of the tubes on this particular specimen are partly eroded traces. Elsewhere in the succession, similar open-coiled serpulids encrust ammonite whorls, stem fragments and even cobbles within a conglomerate lens. Serpulids also encrust *Enoploclytia tenuidigitata* from the Aptian of Queensland (Woods, 1957, p. 166).

Without seeing the whole specimen and thus knowing the overall distribution of the epizoans, it is difficult to determine whether the serpulids (which are particularly common epizoans on live Macrura and Brachyura) encrusted the fossil decapods when the hosts were alive or dead.

5. Previous occurrences of Antarctic fossil decapods

The only fossil decapods previously recorded from Antarctica occur in Jurassic sediments near Mount Hirman, eastern Ellsworth Land (Laudon and others, 1969) and in the Upper Cretaceous Snow Hill Island Series (Lower–Middle Campanian) of the James Ross Island area (Ball, 1960; Bibby, 1966).

In eastern Ellsworth Land, several fragmentary specimens of *Cycleryon* occur in concretions in a black shale. The only other eryonoid so far recorded from the Gondwanaland continents is *Coleia* cf. *barrovensis* M'Coy from the Lower Cretaceous Vemavaram Shales of India (personal communication from M. V. A. Sastry).

Most of the Campanian decapods have been found in concretions composed of a fine-grained glauconitic and calcareous sandstone. Three species have been described: *Hoploparia stokesi* Weller, *Meyeria crofti* Ball and *Callianassa meridionalis* Ball. The commonest decapod is *H. stokesi* which often occurs in the moulting position. Morphological differences in the shape and ornamentation of its epimeres have been interpreted as secondary sexual characters (Ball, 1960, p. 12). Although Ball (1960, p. 29) has suggested that the whole fauna shares affinities with both Lower Cretaceous and Eocene forms, Förster (1971, p. 409) has maintained that *M. crofti*, in common with Albian Mecochiridae, very strongly resembles Jurassic species. The apparent absence of Brachyura from the succession may be an oversight in collecting as elsewhere these were evolving rapidly in the Upper Cretaceous; the small number of species recorded so far may also be due to this. The excellent state of preservation of these Campanian decapods (including the cuticle of *H. stokesi* (Taylor, 1973)) may indicate that the concretions which enclose them formed almost syngenetically, thus effectively protecting the exuviae or dead crustaceans from further disarticulation. No epizoans encrust these decapods.

II. SYSTEMATIC DESCRIPTIONS

INFRAORDER PALINURA
SUPERFAMILY GLYPHEOIDEA
FAMILY GLYPHEIDAE WINCKLER

Genus *Glyphea* von Meyer

Type species: *Glyphea münsteri* Voltz
Glyphea alexandri sp. nov.

Fig. 3a; Plate Ia–e

Material

Holotype (KG.18.46): a natural external mould of the right side of a cephalothorax and several articulated limbs probably belonging to the same decapod or one very similar to it. *Location:* decapod faunizone at locality K, approximately 8 km. north-north-east of Fossil Bluff. *Age:* probably Neocomian. *Paratypes:* three specimens from the same zone consisting of part of a crushed cephalothorax, an incomplete first pereiopod and other fragmentary limbs (KG.18.43), four incomplete pereiopods (KG.18.44) and the natural mould of part of a cephalothorax, an antenna, an antennal scale and a propodus (KG.18.45).
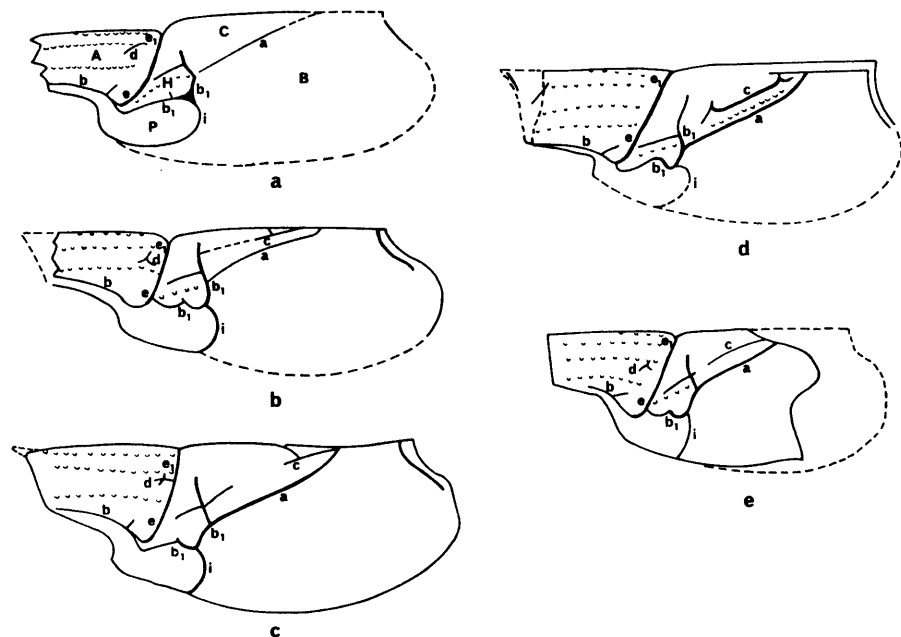

FIGURE 3

A comparison between the cephalothoraces of (a) the holotype of *Glyphea alexandri* (KG.18.46; ×2) with (b) the holotype of *Glyphea georgiensis* (KG.19.16; ×1) and (c) *Glyphea arborinsularis* Etheridge Jr. (×1) (after Woods, 1957, fig. 3a, p. 161), and between (d) the cephalothorax of *T.* aff. *ornatum* (KG.11.16; ×3) and (e) that of *Trachysoma* (*Glyphea*) *oculata* Woods (×1) (after Woods, 1957, fig. 4a, p. 162, pl. IV, fig. 4). The notation of the carapace grooves or furrows is: *a*, branchiocardiac; *b*, antennal; b_1, hepatic; *c*, post-cervical; *d*, gastro-orbital; e–e_1, cervical; *i*, inferior. The regional sub-divisions of the cephalothorax are: *A*, antennal; *B*, branchial region or branchiostegite; *C*, cardiac; *H*, hepatic; *P*, pterygostomial. The deeper grooves or parts of grooves are indicated by a thicker line.

Diagnosis

Junction between cervical and antennal grooves angular, pterygostomial region conspicuously lobate, sub-vertical part of hepatic groove deeply incised and branchiocardiac groove poorly impressed.

Measurements (of cephalothoraces)

Specimen number	Length of cephalothorax along mid-line (mm.)	Length of cephalothorax from posterior angle of orbit to cervical groove (mm.)	Height of cephalothorax at junction of post-cervical groove with dorsum (mm.)
KG.18.43	35*	—	—
KG.18.45	25*	—	—
KG.18.46	28*	9*	10*

* Incomplete measurement.

Description

Cephalothorax. The cephalothorax is sub-cylindrical, feebly convex and tapers anteriorly and posteriorly (Plate Ib). The length from the posterior margin to the base of the rostrum along the mid-dorsal line is approximately two and two-thirds the greatest height. The anterior part is approximately one-third the total length and the maximum height is mid-way along the length. A short incomplete rostrum curves dorsally.

The anterior or antennal region (A) is defined by an incised and ventrally narrowing cervical groove (e–e_1) (Fig. 3a; Plate Ib). There are at least two carinae which are tuberculate, asymmetrical and virtually straight. The tubercles on the lower carina are equidistant and elongated longitudinally; a few feeble tubercles also occur in the interspace between the carinae. A moderately incised gastro-orbital groove (d) encroaches on to the ventral side of the upper carina and a small bituberculate protuberance occurs below the groove. A third ridge near the dorsal margin of the cephalothorax may represent a dorsal carina.

The cervical groove (e–e_1) is deeply incised and trends obliquely forward before making an angular junction with the antennal groove (b). A tuberculate lobe and an irregular groove occur in the angle produced by these two grooves. The tubercles are elongated antero-ventrally. The antennal groove defines a narrow tuberculate extension of the pterygostomial region. Two detached, moderately convex, tuberculate and almost completely overlapping shield-shaped fragments below the orbital margin probably represent uropods.

The hepatic region (H) is bilobate. The triangular dorsal lobe tapers antero-ventrally and is bituberculate. A fairly broad and obliquely inclined groove separates the dorsal lobe from a more elevated and elongated lobe with a prominent ridged summit. The ventral side, which is divided by a short groove, is sparsely tuberculate. This lobe and part of the dorsal lobe are defined posteriorly by a deeply incised sub-vertical extension of the hepatic groove (b_1). The pterygostomial region (P) is elliptical and tuberculate. Muscle attachment areas are indicated by transverse striations on the hepatic groove.

Of the "back" furrows, only the branchiocardiac (a) is seen. The form of the groove is difficult to determine as the carapace appears to have been distorted along a line possibly coinciding with the groove. However, the groove was probably straight and feebly impressed. Because the post-cervical groove cannot be seen, it may either have been virtually confluent with the branchiocardiac (and therefore not easily differentiated from it) or it may have originated close to the dorsal margin. This area is virtually obscured by sediment. The cardiac region (C) is more coarsely tuberculate than the branchial region (B) or branchiostegite which is ornamented with dense and anteriorly directed tubercles; these coalesce and become smaller ventrally. The marginal lip or *Marginalwulst* is only partly exposed.

Appendages. Detached but associated with the cephalothorax are eight appendages (Plate Ia) representing the partly overlapping left and right sides of a decapod. Two appendages may be antennae or an antenna and antennule.

The longest (51 mm.) and best-preserved limb comprises at least three virtually complete joints and part of a fourth. Only the outline of the ischium is preserved but the merus is virtually intact with some cuticle attached. It is 22 mm. long, oblong and highest (5·5 mm.) near the mid-line. Sharply pointed spines occur along both dorsal and ventral margins and longitudinally elongated tubercles are randomly distributed over the exposed lateral side. The carpus and part of the (?) propodus are not so well defined, although the latter has a prominent ventral spine.

2

Paratype KG.18.45 (Plate Ic and d) consists of part of a cephalothorax, an antenna, an antennal scale and an elongated propodus. The rod-like antenna, which is at least 22 mm. long, is interrupted at fairly regular intervals by tubercles. The ensiform antennal scale, which is not completely exposed, has a curved tip.

Only parts of the hepatic, pterygostomial and branchial regions of the cephalothorax are preserved. The branchiocardiac groove is straight but moderately incised only where it joins the hepatic groove. The branchial and pterygostomial regions are coarsely tuberculate, whereas the internal mould of the bilobate hepatic region is smooth. A smooth, cylindrical and incompletely exposed mandible (Plate Ic and d), extending obliquely forward from beneath the antero-ventral part of the hepatic region, projects slightly below the ventral margin of the cephalothorax. The mandible is contracted opposite a horizontal and anteriorly flared projection probably corresponding either to part of the palp or to the epistomal articulation of the palinurid articular process (terminology of Snodgrass (1950, p. 38)). The junction of the mandible with the doublure of the carapace is not seen. Striations near the occluded apodermal lobe probably represent muscle impressions. The exposed part of the gnathal edge is smooth as in *Panulirus argus*.

The position of the propodus and fragmentary carpus suggest that these may be attached, although their junction with the cephalothorax is obscured by matrix. The 40 mm. long propodus is obovate in cross-section and spinose dorsally and ventrally. Distally, the dorso-lateral surface is coarsely tuberculate.

Four incomplete and partly haematitized appendages (KG.18.44), probably representing the second, third, fourth and fifth pereiopods (Plate Ie), were collected from the same glypheid stratum. All of them have slender, evenly tapering and gently curved dactyli which are dentate dorsally and ventrally. Each propodus, which is tuberculate and similarly dentate, has a prominent distal spine curved towards the dactylus. The fourth and fifth pereiopods are proportionately smaller than the second and third ones.

Remarks

The cephalothorax of *G. alexandri* is similar to that of *Glyphea arborinsularis* Etheridge Jr. from the Aptian of south-eastern Queensland* (Etheridge, 1917, pl. 1, fig. 6, pl. 2, figs. 2 and 3; Woods, 1957, pl. 4, figs. 2 and 3) in the position of the gastro-orbital groove, the slight antero-ventral curvature of one of the lateral carinae and the occurrence of a tuberculate lobe in the angle between the cervical and antennal grooves (Fig. 3a and c).

However, the angle between the cervical and antennal grooves is more acute in *G. alexandri* than in *G. arborinsularis*, the overall shape of the pterygostomial regions of the two decapods is dissimilar, the branchiocardiac groove in *G. arborinsularis* is more deeply incised and the post-cervical groove is clearly differentiated. The sub-vertical part of the hepatic groove is also more deeply incised in *G. alexandri* and together these differences (too numerous to be attributed solely to preservation) have been accorded specific status. As in *G. alexandri*, a weak or incomplete post-cervical groove occurs in other Cretaceous species of *Glyphea* (Woods, 1957, p. 158). There is no basis for a comparison between *G. alexandri* and *G. hennigi* Beurlen (Beurlen, 1933, figs. 3 and 4), the only other glypheid from the Lower Cretaceous of the Southern Hemisphere.

As the modern palinurid mandible is said to be variable in form and structure (Snodgrass, 1950, p. 38), the affinities of the fortuitously preserved fossil mandible are difficult to assess but its location "suggère d'interessantes explications sur le stade d'organisation céphalique atteint par les Glypheides, avec les répercussions que celui-ci entraîne sur la disposition des sillons de la carapace" (personal communication from S. Secretan).

<div align="center">

Glyphea georgiensis sp. nov.

Fig. 3b; Plate If and g

</div>

Material

Holotype: an antenna and the left side of a cephalothorax (KG.19.16) from the glypheid faunizone at locality D approximately 7 km. north-north-east of Fossil Bluff. *Age:* probably Neocomian. *Paratypes:* three overlapping uropods, two with diaereses (KG.19.22) and the dorsal mould of an almost complete abdomen (KG.19.15) from the southernmost end of the same outcrop at a height approximately equivalent

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* *Glyphea* cf. *G. arborinsularis* also occurs in the Albian of Northern Territory (Skwarko, 1966).

stratigraphically to that of the holotype. The close proximity of these three specimens suggests that they may belong to the same type of individual.

Diagnosis

Angle between cervical and antennal groove broadly rounded and coarsely tuberculate, hepatic region conspicuously bilobate, branchiocardiac and post-cervical grooves feebly indented, converging towards the dorsum.

Measurements

Specimen number	Length of cephalothorax along mid-line (mm.)	Length of cephalothorax from posterior angle of orbit to cervical groove (mm.)	Height of cephalothorax at junction of post-cervical groove with dorsum (mm.)
KG.19.16	49*	17*	17

Specimen number	Length of abdomen (mm.)	Width of second segment (mm.)	Length of telson (mm.)	Maximum width of telson (mm.)
KG.19.15	51	10	12	9

* Incomplete measurement.

Description

Cephalothorax. The cephalothorax is sub-cylindrical, feebly convex and tapers anteriorly and probably posteriorly (Fig. 3b; Plate If). The length from the posterior margin to the base of the rostrum along the mid-dorsal line is about two and two-thirds the greatest height. The anterior part is approximately one-third the total length of the cephalothorax. The maximum height is mid-way along the length. The impression of a flagellum at least 35 mm. long occurs above the cephalothorax.

The anterior region, which is defined by an incised and ventrally narrowing cervical groove $(e-e_1)$ is crossed by two prominent tuberculate carinae, both of which are slightly curved antero-ventrally (Fig. 3b; Plate If). A third carina, which is partly obscured, defines the dorsal margin. The interspace between the lower two carinae and the angle made by the antennal and cervical grooves are coarsely tuberculate. The tubercles are elongated longitudinally. A gastro-orbital groove (d) may be present. Although the orbital margin is incomplete, there is a feebly elevated carina.

The cervical groove $(e-e_1)$ is deeply incised and trends obliquely forward to form a well-rounded junction with the antennal groove (b). The latter defines a narrow extension of the pterygostomial region. The bilobate hepatic region has a relatively broad tuberculate dorsal lobe which is only moderately elevated and a more pronounced medio-ventral lobe which culminates in a tuberculate ridge. The two are separated by a shallow and obliquely inclined groove. Both lobes are differentiated from the branchiostegite by a moderately incised sub-vertical extension of the hepatic groove (b_1).

The pterygostomial region is lobate and tuberculate. The horizontal part of the hepatic groove (b_1) is relatively shallow and forms a λ-shaped indentation into the lower of the two hepatic lobes. Of the back furrows, only the branchiocardiac groove (a) is completely exposed. This groove, which is feebly convex towards the dorsum, becomes less deeply incised in this direction. Where it bends to meet the dorsum, the branchiocardiac is virtually confluent with the surface of the test. The post-cervical groove (c), which joins the branchiocardiac at the dorsal margin, is deeply incised dorsally but shallower ventrally. Near the dorsum, a subsidiary groove branches from the post-cervical. The branchiostegite is ornamented with dense and anteriorly directed tubercles which become smaller and more closely spaced ventrally. The marginal furrow is moderately incised whereas the *Marginalwulst* is only partly exposed.

Abdomen. Specimen KG.19.15 (Plate Ig) represents the dorsal view of an abdomen. It is attached to a branchiostegite and all six somites and part of the caudal fan are preserved. Several epimeres occur on the right side of the latex cast.

The branchiostegite is represented mainly by a marginal furrow and a *Marginalwulst* which is finely striated transversely. The first somite, which is incompletely exposed and virtually decorticated, is moderately convex transversely and grooved near the junction with the second somite. The second and third somites, which are pitted and coarsely tuberculate, are transversely rounded with prominent lateral bosses on the right side of the cast. Although partly obscured by matrix, the epimeres of the fourth and fifth somites are probably ensiform as the antero-lateral margins curve posteriorly to what may have been blunt spines. The surfaces are smooth except for a row of tubercles trending parallel to the antero-lateral margin.

The sixth somite has been distorted but an epimere on the right side of the cast is almost completely exposed. The antero-lateral angle curves backwards, whereas the postero-lateral margin is almost straight so that their junction is not produced. A row of small tubercles extends inwards from the centre of the antero-lateral margin towards the mid-line of the abdomen. The oblong telson tapers posteriorly. A short ridge extends along part of the anterior margin and there are four longitudinal ridges, two short ones partly defining the lateral margins and two inner, more extensive and posteriorly narrowing ridges which are separated from the outer ones by deep furrows. One of the lateral ridges is pitted. The median area of the telson is ornamented with coarse and longitudinally elongated tubercles which become narrower anteriorly. These tubercles are arranged along poorly defined ribs. A fairly deep median groove bisects the posterior part of the telson. A broad endopodite on the left side of the telson is transversed by fine riblets which radiate outwards from a median groove.

The length of *G. georgiensis* based on specimens KG.19.15 and 16 is 10 cm.

Remarks

The furrow pattern and the relative proportions of the carapace areas of *G. georgiensis* are quite unlike those of *G. alexandri* and *G. arborinsularis* (cf. Fig. 3a–c) but they are comparable in some respects with those of *Trachysoma* (*Glyphea*) *oculata* Woods from the Upper Albian of Queensland (cf. Fig. 3b and e). Although the respective cephalothoraces differ in size (*G. georgiensis* is almost twice the size of *T. oculata*), the proportions of the carapace areas are similar. However, the sub-vertical extension of the hepatic groove in *G. georgiensis* is more convex posteriorly, the angle between the cervical and antennal grooves is more obtuse, the antennal groove is more pronounced anteriorly and the post-cervical groove appears to join the sub-vertical part of the hepatic groove higher up the cephalothorax flank. The branchiocardiac groove of *T. oculata* is also more deeply incised and the ventral carina is convex towards the dorsum (Woods, 1957, p. 162). The abdomen of *T. oculata* is not known. The tubercles of *G. georgiensis* are coarser than those of *G. alexandri*.

Glyphea sp.

Material

A black-shelled propodus and dactylus (KG.19.34) preserved "in the round" within a calcareous concretion at locality D, and a left propodus and carpus (KG.18.21) from locality K.

Description

Specimen KG.19.34, which was used in a structural examination of the decapod cuticle (Taylor, 1973), is not described. The propodus of specimen KG.18.21 is 13 mm. long, 5 mm. high and obovate in cross-section. Both dorsal and ventral margins are spinose, the spines on the latter increasing in size distally before culminating in a prominent spike which curves downwards towards the dactylus; the dactylus is only exposed in longitudinal section. Although most of the large tubercles on the lateral surface appear to be arranged in longitudinal rows, there is a transverse row near the *Gelenkungszapfen* with the carpus and a similar row on the carpus itself. Distally, the ventral margin of the carpus bears a prominent spine with a slightly recurved apex.

The long dactyli of these two specimens, the longitudinal rows of tubercles on the propodi and the

strongly spinose ventral margins bearing one (or two) prominent distal spines are characteristic of the Glypheidae, to which the chelipeds undoubtedly belong.

Genus *Trachysoma* Bell

Type species: *Trachysoma* (*Orphnea*) *ornatum* Quenstedt
Trachysoma aff. *ornatum*

Fig. 3d; Plates Ih and IIa–c

Material

Natural external moulds of the right side of a cephalothorax and several fragmentary limbs (KG.11.8) and the left side of a cephalothorax (KG.11.16) from two strata at locality N. *Age:* probably Lower Aptian. Although these almost equidimensional cephalothoraces occur at different stratigraphical horizons, they are sufficiently alike to be considered conspecific. Several appendages (notably specimens KG.11.30 and 2.183) may belong to the same type of small decapod.

Measurements

Specimen number	Length of cephalothorax along mid-line (mm.)	Length of cephalothorax from posterior angle of orbit to cervical groove (mm.)	Height of cephalothorax at junction of post-cervical groove with dorsum (mm.)	Length of rostrum (mm.)
KG.11.8	16	7	7	1·5
KG.11.16	15	5·5	6	—

Description

Cephalothorax. The cephalothorax is small, sub-cylindrical and tapers anteriorly and probably posteriorly. The length from the posterior margin to the base of the rostrum along the mid-line is approximately twice the greatest height, which is mid-way along the length. The anterior region is between one-third and one-half times the length of the cephalothorax. The rostrum in specimen KG.11.8 is short and slightly curved dorsally. The anterior margin is probably not indented (Plate IIa).

The anterior area, which is defined by an incised and ventrally narrowing cervical groove (e–e_1), is crossed by three prominent, relatively straight, nearly equidistant and asymmetrical tuberculate carinae (Fig. 3d; Plate Ih). Both the sharply angled ventral carina (which is probably distorted) and the lower lateral carina are inclined ventrally, whereas the upper lateral carina is almost horizontal. Compression has probably accentuated the steep inclination of the interspace between the ventral carina and the antennal groove. The relatively coarse tubercles on the carinae are elongated longitudinally. The dorsal carina is represented by a row of tubercles inclined antero-dorsally above the upper lateral carina. A fairly prominent tuberculate lobe bisected by a short furrow occurs in the angle between the cervical groove and the antennal groove (b), and in specimen KG.11.8 a shallow gastro-orbital groove (d) may be present (Plate IIa).

The deeply incised cervical groove (e–e_1) trends obliquely forward before forming a rounded junction with the antennal groove. The antennal groove defines a rounded and apparently non-tuberculate antennal margin. Between the cervical and branchiocardiac grooves and defined posteriorly by a sub-vertical part of the hepatic groove (b_1) is a bilobed hepatic area. A triangular, bituberculate dorsal lobe is separated from a smaller lower lobe by a fairly broad and obliquely inclined groove. The ventral lobe, which is elongated longitudinally, culminates in a tuberculate ridge and its ventral margin is indented by a short extension of the hepatic groove. The partly exposed pterygostomial region is ornamented with numerous tubercles. The cardiac region is less densely tuberculate than the branchiostegite.

The branchiocardiac groove (a) is straight and deeply incised except where it changes direction to meet the dorsum. The post-cervical groove (c), which also reaches the dorsum and parallels the branchiocardiac groove, is only moderately incised and is not as extensive anteriorly as the branchiocardiac. A subsidiary

furrow from the post-cervical groove trends upwards and slightly anteriorly before joining with the dorsum. The crest of the elongated lobe between the two back furrows is tuberculate. The branchiostegite has dense and antero-ventrally inclined tubercles which become smaller and coalesce as they approach the venter. The cephalothorax posterior to the cervical groove is surrounded by a 0·6 mm. wide concave *Marginalwulst*, which is ornamented with a few longitudinally elongated tubercles.

Two incomplete pereiopods (KG.11.30; Plate IIb) represent the only appendages at locality N which are comparable in size with the two cephalothoraces. The propodi are tuberculate and dentate along both outer and inner margins, and a prominent spine near each distal end curves towards the dactylus. Both dactyli are spinose.

At locality H and at a height approximately equivalent stratigraphically to that of *Trachysoma* aff. *ornatum*, three imperfectly preserved pereiopods (KG.2.183; Plate IIc) were found. These are similar to the pereiopods associated with *Trachysoma*. The tuberculate propodus is somewhat crushed and the dactylus is broken off just below the inner margin. As in specimen KG.11.30, the propodus has a prominent spine near the distal end which is curved towards the dactylus. The 13 mm. long propodus is moderately convex. The carpus also has a large spine near its distal end, whereas the partly preserved merus has a spinose venter.

Remarks

According to the definitions of Beurlen (1928), the two small cephalothoraces from Alexander Island are more like *Trachysoma* [*Glypheopsis*] (Lower Lias–(?) Middle Eocene) than *Glyphea*. Particularly characteristic of *Trachysoma* is the parallel arrangement of the branchiocardiac and post-cervical grooves and their extent in an anterior direction, the longitudinal shape of the lobe between these two grooves, the sharp antennal angle and the relatively smooth appearance of the interspaces between the longitudinal carinae. By contrast, the two back furrows in *Glyphea* are usually oblique and diverge along the mid-line to enclose a triangular-shaped lobe and, according to Beurlen (1928, p. 130), the rostrum is bent downwards; however, this latter criterion is probably unreliable.

The first pereiopods of *Trachysoma* and *Glyphea* are usually acknowledged to be very similar. In both, the dactylus is usually short and spinose, the ventral margin of the propodus is very spinose and there is a prominent spine opposite the dactylus. In some species of *Trachysoma* (*T. heeri*; Oppel, 1862, pl. 15, fig. 1) the propodus is short and broad, whereas in others (e.g. *T. alpina* and specimen KG.2.183) the propodus is more elongated like that of *Glyphea*. Thus, the pereiopods associated with the Alexander Island specimens of *Trachysoma* are only affiliated on the basis of their small size and stratigraphical positions.

The Alexander Island specimens of *Trachysoma* share some similarities with *T.* [*Glyphea*] *oculata* Woods from the Upper Albian of Queensland (Woods, 1957, pl. IV, fig. 4) (Fig. 3e) but there are significant differences, notably in the weaker development of the post-cervical groove in *T. oculata*, the relative proportions of the respective pterygostomial regions and the occurrence in *T. oculata* of a gastro-orbital groove which may or may not be present in the Alexander Island material.

More satisfactory comparisons are possible with two Jurassic species, *T. vosinskyi* Lahusen from the Lower Volgian (Tithonian) of Russia (Gerasimov, 1955) and *T. ornatum* Quenstedt from the Callovian of southern France and Germany (van Straelen, 1925; Beurlen, 1928). In *T. vosinskyi*, the post-cervical groove is less deeply incised than in Fig. 3d and makes a U-shaped junction with the branchiocardiac groove (Gerasimov, 1955, pl. VIII, figs. 10–19). The area between the two back furrows is slightly clavate as in *Trachysoma* [*Glyphea*] *pustulosa* and the spacing and inclination of the carinae varies, many of the carinae trending dorsally. However, their inclinations may be due either to differences in preservation or the species itself may vary in this respect.

In *T. ornatum*, the tubercles are more widely spaced on the branchiostegite and less coarse on the cardiac region compared with the Antarctic specimens. Furthermore, an incomplete specimen from the Callovian of the Ardèche area of southern France indicates that the lower lateral carina may extend on to the hepatic area. Nevertheless, the Antarctic specimens are undoubtedly closely allied if not conspecific with *T. ornatum* despite discrepancies in their respective ages and geographical locations.

Comparisons with other species of *Trachysoma* suggest that the genus exhibited few morphological changes throughout the Jurassic and Cretaceous and thus retained more of the so-called "ancestral" characters, whereas *Glyphea* became diversified.

FAMILY MECOCHIRIDAE VAN STRAELEN

Genus *Mecochirus*

Type species: *Mecochirus longimanatus* Schlötheim, 1820
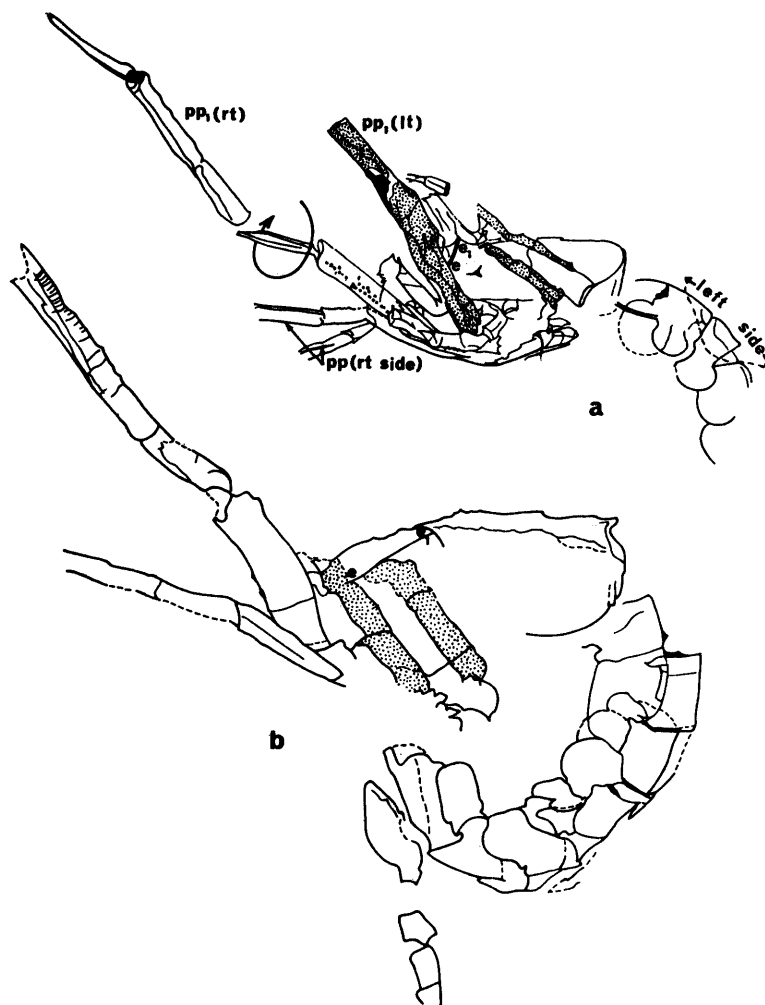*Mecochirus* sp.

Fig. 4a and b; Plate IId

FIGURE 4

a. *Mecochirus* sp. (KG.11.39) from locality N based on Plate IId showing a poorly exposed cephalothorax, an incomplete abdomen (both sides) and several pereiopods. Pereiopods from both sides overlap each other and overlie the cephalothorax, and the elongated first pereiopod on the right side has been rotated, probably at the carpus as indicated. For clarity, the pereiopods overlapping on to the cephalothorax are stippled; pp_1, first pereiopod; $\times 1 \cdot 7$.

b. *Mecochirus* sp. (KG.103.229) from Waitabit Cliffs in the moulting position showing an incomplete cephalothorax, several pereiopods (including a first pereiopod) and both sides of the abdomen. The pereiopods overlapping on to the cephalothorax are stippled; $\times 2$.

Material

Specimen KG.11.39, the natural external mould of several fragmentary pereiopods, a cephalothorax and an abdomen, was collected from unit 90 near the top of the measured stratigraphical section at locality N. The almost unflexed first pereiopod is exceptionally long. A second specimen (KG.103.229) was collected from the middle part of the section at the northern end of Waitabit Cliffs. Although not *in situ*, it may have

been derived from approximately the same stratigraphical level as specimen KG.11.39. Its first pereiopod is also strongly elongated. *Age:* probably Lower Aptian.

Measurements (of first pereiopod of specimen KG.11.39).
Overall length: 40 mm.

Merus		*Carpus*		*Propodus*		*Dactylus*	
Length (mm.)	*Height* (mm.)	*Length* (mm.)	*Height* (mm.)	*Length* (mm.)	*Height* (mm.)	*Length* (mm.)	*Height* (mm.)
12*	1·5	6	0·7	13	1	9	1

* Incomplete measurement.

Description

The cephalothorax of specimen KG.11.39 is poorly preserved and partly obscured by matrix and over-lapping appendages (Fig. 4a; Plate IId). However, an incomplete and moderately incised cervical groove (with muscle scars) and an incomplete (?) post-cervical groove (accentuated anteriorly by two sub-parallel ridges) occur. The cervical groove shallows ventrally. An incomplete hepatic area is tuberculate. Although incomplete, most of the abdominal somites are present. The first, which may be the smallest, is charac-terized by a prominent ridge extending along the length of the epimere.

There are at least seven limbs (including the left-sided first pereiopod), the best-preserved being the right-sided first pereiopod. The orientation of the dactylus and prominent ventral spine on the propodus of this limb indicate that these joints have been rotated, probably at the carpus, which is itself slightly disarticulated. However, the ornamentation on the merus suggests that this joint is unaffected.

The dactylus is ensiform and relatively flat-sided laterally. The propodus, which has a prominent distally located ventral spur, is long, slender and elliptical in cross-section. A prominent groove (probably caused by post-mortem compression) occurs above the mid-line and extends for approximately half the length. Several linearly arranged, relatively large and widely spaced tubercles occur above it. The carpus, which is about half the length of the propodus, may have been similarly ornamented. The ornament of the lateral margin of the merus, the best preserved of the joints, consists of randomly arranged small tubercles and at least one row of large tubercles above the mid-line.

Specimen KG.103.229 (Fig. 4b), which is twice the size of specimen KG.11.39, comprises a poorly preserved cephalothorax, an abdomen and several fragmentary limbs, including a first pereiopod. The cephalothorax is represented mainly by a branchiostegite with a *Marginalwulst* and an incomplete (?) cervical groove. The granulated first pereiopod comprises a manus, carpus and an incomplete propodus.

Remarks

The exceptionally long, slender, granulate and sub-chelate first pereiopods and the obviously thin carapaces suggest that the two decapods are mecochirids and that specimen KG.11.39, with its tuberculate hepatic area, probably belongs to *Meyeria* (Lower–Upper Cretaceous) rather than to *Mecochirus* (Lower–Upper Jurassic). However, recent detailed comparisons of the type species of both genera (*Mecochirus longimanatus* Schlötheim and *Meyeria ornata* Phillips) suggest that there is no justification for separating them (Förster, 1971) and that the so-called generic differences cited by Glaessner (1969, p. 464) merely indicate the variability within *Mecochirus*.

To date, only three species of *Mecochirus* (and several doubtful forms) are known from the Southern Hemisphere, i.e. *Mecochirus marwicki* Glaessner from the Upper Heterian (approximately equivalent to the Kimmeridgian) of New Zealand (Glaessner, 1960, p. 9), *Mecochirus [Meyeria] schwarzi* from the Uitenhage Series (Neocomian) of South Africa (Kitchin, 1908) and *Mecochirus [Meyeria] crofti* Ball from the Lower to Middle Campanian of James Ross Island, Antarctica (Ball, 1960). All three species have better-preserved cephalothoraces, and in *M. marwicki* the carpus is barrel-shaped and has several long spines. The appendages of *M. schwarzi* are not known.

(?) Mecochiridae

Genus and sp. indet.

Figs. 5–8; Plates IIe–h and IIIa–d

Material

27 specimens from two separate faunizones, three (KG.4.4, 5 and 6) from an 8 m. thick sequence at locality U and 22 (KG.1.921–942) from a stratigraphically higher stratum 213 m. above the lowest exposed beds at Fossil Bluff. Two loose specimens (KG.64.3 and 1.960) were probably derived from the same stratum. All of the specimens are of small, mostly articulated decapods with thin cuticles. Their pale yellow colour (probably limonite) accentuates them from their matrices. Age of the Fossil Bluff fauna, probably Lower Aptian.

Measurements (of representative specimens)

Specimen number	Overall length (unflexed) (mm.)	Length of cephalothorax (mm.)	Maximum height of cephalothorax (mm.)	Length of abdomen (including caudal fan) (mm.)
KG.4.5	25	10	6	15
KG.4.6	18	8	5	10
KG.1.928	37	13*	6	24
KG.1.937	27*	11	4*	16
KG.1.940	34	15	7	19

* Incomplete measurement.

Description

Cephalothorax. All of the cephalothoraces are poorly preserved, incomplete (particularly anteriorly) and partly obscured by overlapping appendages. Usually, they are obovate, broadest posteriorly and evenly tapering anteriorly and in at least one specimen, there is a rostrum (Fig. 5). However, in specimen KG.64.3 (Fig. 6) the cephalothorax is more rectangular, the orbital margin is convexi-concave and the rostrum is short and insignificant. A moderately incised cervical groove is present on three specimens (Figs. 6 and 7; Plate IIe and g), and on one of them (Fig. 6) it trends obliquely backwards and almost reaches the dorsum. Other transverse "grooves" on this particular cephalothorax cannot be notated satisfactorily.

Abdomen. Most of the abdomens are attached, flexed and almost complete. However, in the vicinity of the first two somites, they are poorly preserved and the morphology of these somites is often conjectural. Because these thin carapaces were prone to compression, both sides of the abdomen are usually seen (Fig. 7; Plates IIf–h and IIId). In at least three specimens, some variation in the overall shape of the epimeres is evident. In one specimen (Fig. 7b; Plate IIg and h), the fifth and sixth epimeres are elongated and well-rounded ventrally, whereas the second, third and fourth are shorter, more triangular and converge towards a point or blunt spine. The first and second somites may overlap one another. In specimen KG.1.922 (Fig. 7a; Plate IIId), the variations are less extreme although the fourth somite is mucronulate. Significantly different epimeres characterize specimen KG.64.3 (Figs. 6 and 7c) and probably specimen KG.1.937 (Plate IIIa). In the former, semi-circular epimeres overlapping by about a quarter of their width occur and the flanks of some somites are characterized by deep grooves.

Appendages. The pereiopods associated with the articulated carapaces and those found disarticulated but in the same stratum are relatively robust and spinose (Plate IIIc). However, as the propodi are often incomplete, it is not known how many appendages were chelate or sub-chelate. Most of the relatively short, slender legs are sub-chelate. Because many appendages overlap one another or overlie the cephalothorax, their notations cannot always be determined and, as no first pereiopods are completely preserved, their length ratio to the cephalothorax is not known.

In any one appendage, the propodus is oblong and finely denticulate dorsally and ventrally. In Plate IIf, the merus and propodus of the limb immediately below the cephalothorax are characterized by prominent
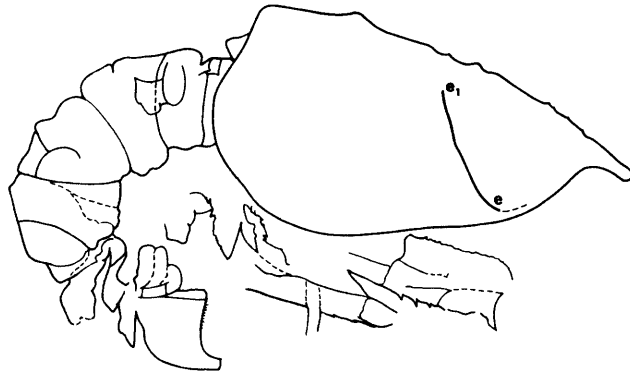
FIGURE 5

The smallest of the mecochirid-like decapods (KG.4.6) showing a transverse groove (probably the cervical groove) and the obovate shape of the cephalothorax. The drawing, compiled from Plate IIe and several photographs, may inadvertently include a number of artificial features (notably near the tail fan) derived from the matrix; ×7·5.
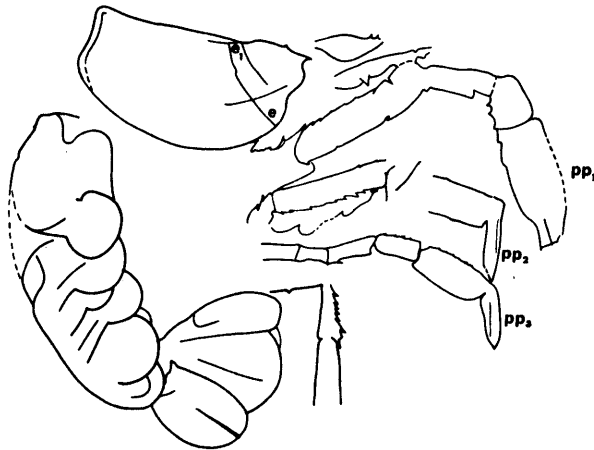

FIGURE 6

A mecochirid-like decapod (KG.64.3) from Fossil Bluff in the moulting position. The oblong cephalothorax is characterized by a cervical groove $(e-e_1)$ and a short rostrum; the detached abdomen has overlapping circular epimeres; pp_2, second pereiopod; pp_3, third pereiopod; ×2·5.
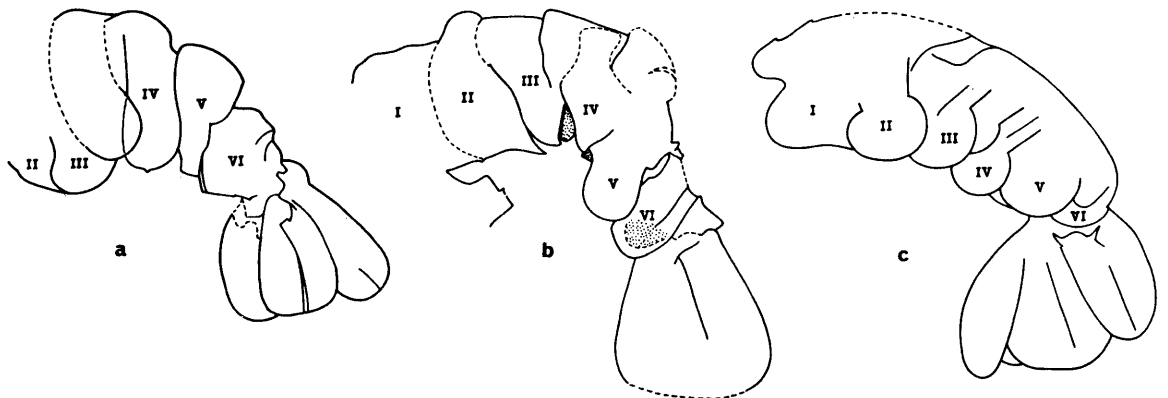
FIGURE 7

A comparison between the epimeres of three mecochirids (a, KG.1.922, ×3·7; b, KG.1.940, ×4·5; c, KG.64.3, ×3·4) from a stratum at Fossil Bluff. In at least two specimens (a and b), the epimeres on both the left and right sides are shown. In Fig. 7b the epimeres on the right side are stippled.

ventral spines. The carpus is wedge-shaped, probably more strongly spinose and flared anteriorly. The merus is usually not well preserved, although it appears to be as long if not longer than the propodus and dorsally and ventrally spinose. With some exceptions, the spines on the appendages appear to be equidimensional and equidistant throughout.

Remarks

In their general shape and small size, these decapods are comparable in overall morphology with several of the Penaeidae, Caridea, Mecochiridae and Thalassinidae, although many diagnostic features are either missing or masked by poor preservation. Although the Alexander Island decapods resemble some Cretaceous (Cenomanian) penaeids from Syria (Glaessner, 1945), such diagnostic features of the penaeids as a well-developed serrated rostrum and pronounced hepatic and antennal spines are not preserved and may or may not have been present. Similarly, the decapods are unlikely to be thallassinids because these possessed well-developed and strongly calcified claws even in the Upper Jurassic. Less significantly, none of these decapods was found in burrows, the normal habitat of thalassinids.

Comparisons with the Mecochiridae and Caridea are also somewhat unsatisfactory. Although the cervical groove (where present) is straight and moderately incised (as in the Mecochiridae) and the spinose and elongate appendages are comparable with some mecochirids (notably *Mecochirus* [*Meyeria*] *bolivari* van Straelen from the Lower Aptian of Spain (van Straelen, 1927, pl. 1)), no carinae, diaereses or ornament are preserved and the length ratio of the first pereiopod to the body length is not known. Less significantly, the specimens are more robust and spinose than other mecochirids in the succession.

Although the overlapping and semi-circular epimeres of some of the Alexander Island specimens compare with certain Caridea (notably *Udora* Munster; Middle–Upper Jurassic) and the flexed abdomens may represent a normal caridean swimming position rather than a moulting position, the epimere of the second somite, where it can be differentiated, does not appear to be broader and more well-rounded than the others. Furthermore, in most Caridea the epimeres of somites three to six progressively become narrower and more pointed posteriorly, whereas in some of the Alexander Island specimens the reverse is true. Caridea are unknown in the Lower Cretaceous, although families with uncertain affinities occur in the Jurassic and Upper Cretaceous.

Overall, the small thin-shelled decapods from Alexander Island appear to represent a *Mischtypus* with some characters common to the Mecochiridae, Caridea and perhaps the Penaeidae. The occurrence of a cervical groove and the robustness of the limbs would seem to favour their inclusion in the Mecochiridae. The limbs are comparable in robustness and spinosity with those of *M. bolivari* but the faunule may represent a new species or genus of mecochirid.

Evidence from extant decapods (e.g. Fig. 8) suggests that the morphological differences in the epimeres described here are sexual. Certainly, the large number of decapods from the Fossil Bluff stratum (in excess of those collected) implies that both sexes are present even though these are not easily differentiated. Similar examples of sexual dimorphism in other decapods have been demonstrated, notably in *Homarus*
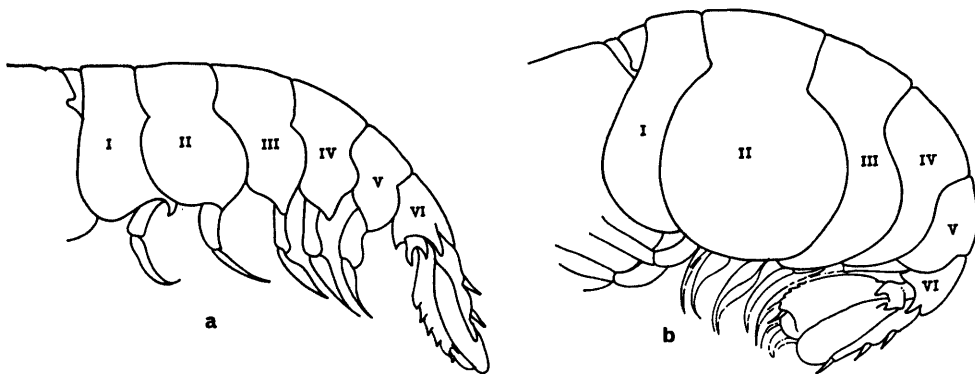

FIGURE 8

A comparison between the epimeres of male (a) and female (b) specimens of the caridean *Sylnapheus laevimanus* var. *longicarpus* Herrick. The differences, at least between respective somites II, are assumed to be sexual (after Coutière, 1899, figs. 360 and 361, p. 294).

gammarus and in the fossil species *Hoploparia stokesi* (from the James Ross Island area, Antarctica) (Ball, 1960, p. 12) and *Schlueteria menabensis* (Secretan, 1964, fig. 79, pl. XIV, figs. 2 and 6). In Ball (1960, fig. 2) the sexual symbols have been inadvertently transposed; see also Glaessner (1969, fig. 265, 4b and c, p. 459). A more doubtful case of sexual dimorphism is demonstrated by *Astacodes falcifer* Bell from the Speeton Clay (Woods, 1925–31; cf. pl. IX, fig. 1c with fig. 2b).

By analogy with Fig. 8, it is conceivable that specimen KG.64.3 (Figs. 6b and 7c) and perhaps specimen KG.1.937 (Plate IIIa) are females. Because the former has a more rectangular cephalothorax than the other decapods and was not found *in situ*, it may represent a different type of decapod.

It has been suggested (Förster, 1971) that the Mecochiridae lived in shallow burrows and that their elongated first pereiopods, which were used to grasp prey, gave them an advantage over their shorter-clawed neighbours such as *Eryma* and *Glyphea*. The isopod *Astacilla longicornis* Sowerby, while clinging to Hydrozoa and Bryozoa, seizes its prey with its "long pediform inferior antennae" (Sars, 1889, p. 89) in a way analogous to that proposed for the Mecochiridae. However, most sub-chelate limbs are used primarily for walking or climbing and Dr. Förster (personal communication) agrees with the author (who has used "working" models of *Mecochirus longimanatus*) that there are serious practical difficulties in transferring any prey to the mouth either directly or indirectly via the second pereiopods. Förster has therefore suggested that the first pereiopods (with their bristle seams on the dactylus) probably functioned as highly efficient sensors. In any event, the long limbs would have considerably extended the mecochirid's static or semi-static feeding area.

FAMILY CALLIANASSIDAE DANA
SUBFAMILY PROTOCALLIANASSINAE BEURLEN

Genus *Protocallianassa* Beurlen

Type species: *Protocallianassa archiaci* A. Milne-Edwards
Protocallianassa antarctica sp. nov.

Fig. 9a–c; Plate IIIe–g

Material

Holotype (KG.110.4): a natural mould of a right cheliped from a height of approximately 238 m. in the succession at Fossil Bluff. *Age:* probably Lower Aptian. *Paratypes:* natural moulds of two chelipeds 35 mm. apart on a specimen (KG.110.5) from the same location as the holotype. These chelipeds are differentiated "a" and "b".

Diagnosis

Propodus elongate, flat-sided and with sub-parallel margins. Surface smooth or finely granulated. Fingers strongly elongate. Dentate fixed finger with longitudinal carina. Dentition variable. The movable finger may also be carinate.

Measurements

Specimen number	*Manus*		*Immovable finger*		*Movable finger*	
	Length (mm.)	*Height* (mm.)	*Length* (mm.)	*Height* (mm.)	*Length* (mm.)	*Height* (mm.)
KG.110.4	11	9	10	1·5	16	1·5
KG.110.5a	10	9	10	1	13	2
KG.110.5b	9	7	9	1·5	12	1·5

Description

The manus of the holotype (Fig. 9a; Plate IIIe) is rectangular, flat-sided and incomplete proximally. Both dorsal and ventral margins diverge slightly distally. The fixed finger, which is two-thirds as long as the
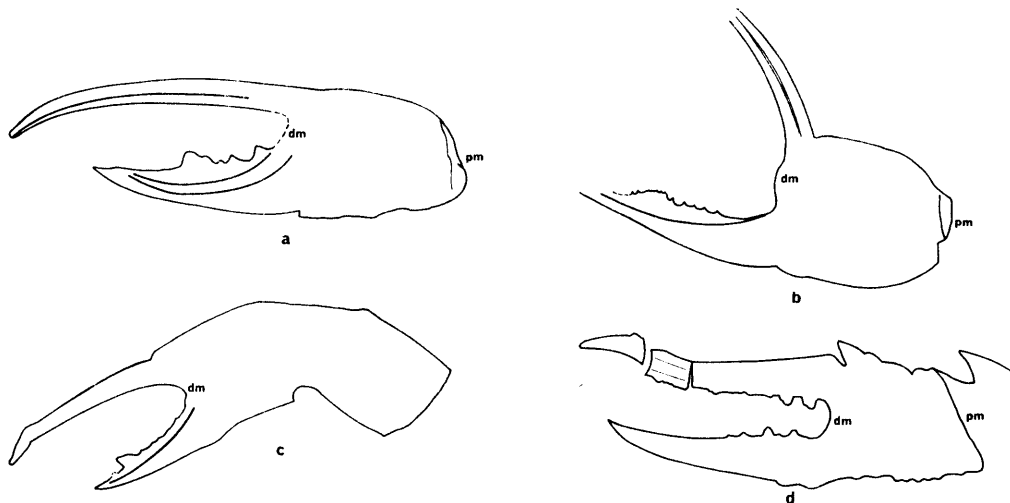
FIGURE 9

Specimens KG.110.4, 110.5a and 110.5b showing dissimilarities in the dentition between these three protocallianassid claws (×2). Fig. 9d is of an incomplete cheliped (KG.6.20) from the northern part of Waitabit Cliffs which is similar to that of *Eryma stricklandi* (×2).

movable finger, is relatively stout and gently curved upwards. The dorsal margin is accentuated by a prominent longitudinal carina which becomes less pronounced distally. A broad flange on the inner side of the carina is surmounted by several triangular teeth. The largest tooth may be bicuspidate. The movable finger is strongly elongated with a longitudinal carina accentuating the inner margin. No teeth are visible, although these may be buried by matrix.

In paratype KG.110.5a, the finely granulated manus is quadrate and both dorsal and ventral margins are moderately convex outwards (Fig. 9b; Plate IIIf). The longitudinal ridge on the fixed finger curves downward towards the apex which is missing. There are several equidimensional and symmetrical teeth and at least one large cuspidate tooth. The movable finger, which is strongly arched upwards (Fig. 9b), is also incomplete distally. It is more elongate than the fixed finger and has a medio-lateral ridge. No teeth are visible. In paratype KG.110.5b, the junction between the carpus and manus is not seen (Fig. 9c; Plate IIIg). The fingers are proportionate to those of the holotype but the dentition is dissimilar and the apex of the movable finger is distorted.

Remarks

Although all three claws are not thick-shelled,* their overall shape and size suggest that they undoubtedly belong to the Thalassinoidea. Their close proximity spatially implies that they may belong to the same type of heterochelous decapod.

The elongate manus resembles that of *Protaxius* and *Etallonia* but the shape and size of the respective fingers are different. In *Protaxius*, the movable finger is short and lacks teeth; in *Etallonia*, the movable finger is more robust and strongly curved, whereas the fixed finger is short and bifurcated (Oppel, 1862, pl. 12, fig. 6).

A more satisfactory comparison can be made with several long-fingered species of *Protocallianassa* ((?) Lower Cretaceous–Paleocene) from the Upper Cretaceous of Europe and North America, notably *Protocallianassa* [*Callianassa*] *elongata* Fritsch (Sturm, 1901, pl. III, fig. 3), *Protocallianassa* [*Callianassa*] *bohemica* Fritsch and some of the more elongate claws of *Protocallianassa antiqua* Roemer from the Kieslingswalde area of Poland (Mertin, 1941, fig. 17). However, an examination of the length/breadth ratios of the respective claws and the finger length/claw length ratios shows that the Antarctic specimens are more elongate than any of these. The only Cretaceous species possessing similar longitudinal carinae

* These protocallianassids (and the mecochirid-like decapods) may have been unable to calcify their cuticles and develop robust claws because of an insufficiency of lime (Taylor, 1973, p. 92).

and which is said to be different from most earlier protocallianassids (Mertin, 1941, p. 208)) is *Protocallianassa* [*Callianassa*] *aquilae* Rathbun from the lower part of the Upper Cretaceous Eagle Ford Formation of Texas and Louisiana (Rathbun, 1935, pl. 7). However, the dorsal margin of the manus of this species is dentate, both fingers are shorter than the manus and the fixed finger has only one (or two) large triangular teeth.

As most callianassid claws are smooth (with the so-called chagrin pattern) and tubercles are usually confined to sharpened edges, the fine and evenly distributed granular texture of the Alexander Island specimens may be unique. Furthermore, their strongly elongate fingers and the well-developed dentition of the fixed fingers suggest that these particular claws may have been better suited to grasping than exclusively to burrowing. These early protocallianassids may therefore have lived like hermit crabs with the claws and anterior parts clear of the burrow when searching for food. The complete withdrawal of the animal into a Domichnia probably occurred gradually with perhaps a few forms retaining the hermit-like existence. Extant callianassids are found in shallow water (0·9–60 m.).

Protocallianassa sp.

Plate IIIh

Material

An incomplete cheliped (KG.18.5) from 111 m. above the lowest exposed beds at locality K.

Measurements

Length of manus, 5 mm.*; height 7 mm.* Length of immovable finger, 4 mm.*

Description

Specimen KG.18.5 (Plate IIIh), a small left-sided cheliped, comprises a manus and part of the fixed finger. The manus, which is incomplete proximally, is feebly convex with a broad dorsal margin and a narrower ventral margin. It was probably quadrate in outline. The fixed finger was probably short and triangular in cross-section. Its approximate shape and size and those of the missing movable finger have been interpolated. The outer shell surface, which is partly preserved, is opalescent and relatively smooth, whereas the inner layers have a distinctive chagrin-like pattern produced by a series of transversely elongated and flattened "nodes".

Remarks

Although specimen KG.18.5 is incomplete, the distinctive reticulate shell ornament suggests that the cheliped is that of a callianassid, probably of the short-fingered type. Although similar chelae with quadrate propodi are common to various species of *Callianassa* and *Protocallianassa* of all ages, they are often indistinguishable from one another.

Short-fingered callianassid chelipeds are represented by only one specimen in the Lower Cretaceous of the Southern Hemisphere. Unfortunately, this Queensland *Callianassa* (?) sp. is too poorly described and figured for comparative purposes (Etheridge, 1917, p. 10, pl. 2, fig. 4). In the Upper Cretaceous of the Southern Hemisphere, the only comparable callianassid chela is that of *Protocallianassa* [*Callianassa*] *burckhardti* from the Senonian of Patagonia (Böhm, 1911, figs. a–e) which is larger than the Alexander Island specimen and tuberculate near the base of the fixed finger. Unfortunately, both fingers are missing.

In the Lower Cretaceous of Europe small callianassid-like claws with quadrate propodi and short fingers are more numerous and one of them (*Callianassa uncifera* Harbort (Harbort, 1908, p. 35, figs. 3 and 4)) from the Upper Hauterivian and Barremian may be a forerunner of the genus *Protocallianassa* (Mertin, 1941). In the Upper Cretaceous many callianassid propodi are punctate along both the dorsal and ventral margins, the punctae presumably being occupied by bristles.

* Incomplete measurement.

FAMILY AXIIDAE HUXLEY

Genus *Schlueteria* Fritsch

Type species: *Schlueteria tetracheles* Fritsch, 1887
Schlueteria carinata sp. nov.

Plate IVa

Material

Holotype: a natural mould (KG.12.12) comprising two partly overlapping pereiopods from locality L. *Age:* probably Neocomian.

Diagnosis

Second pereiopod with strongly spinose and carinate merus and strongly spinose, sub-circular carpus. Flat-sided manus with medio-lateral tuberculate carina. Movable finger quadrate, carinate and probably larger than fixed finger.

Measurements

	Manus	Immovable finger	Movable finger	Carpus	Merus
Length (mm.)	9	9	9	3	5*
Width (max.) (mm.)	8	4	5·5	3·5	3

* Incomplete measurement.

Description

The manus of the lower pereiopod is flat-sided and progressively increases in width distally. It is divided by a prominent median carina ornamented with transversely elongated tubercles. The ventral margin is spinose whereas the ornament of the dorsal margin is not preserved.

Both fingers are relatively flat and their inner margins have equidimensional teeth. The movable finger, as indicated by a semi-circular hinge, is large, quadrate and characterized by a short, tuberculate lateral ridge that parallels that on the manus. The finger may also have been coarsely tuberculate and spinose antero-dorsally. By contrast, the fixed finger tapers distally and its row of grinding teeth may have been slightly inset. The apex is not preserved but the ventral margin is spinose.

The carpus is small, almost circular and coarsely spinose. The merus, which is better preserved on the uppermost pereiopod, is broadest distally and, like the propodus, it is characterized by a median tuberculate carina. The dorsal margin is not exposed but near the strongly spinose venter there is a row of large tubercles. The spines increase in size distally. Behind the merus is a segmented area probably representing part of the abdomen.

Remarks

Because the distal and dorso-lateral margins of the movable finger are incomplete, the full extent of the hinge dorsally is not known. Furthermore, the configuration of the dorsal margin and its relationship (if any) to the dorsally located tuberculate ridge and spur may be interpreted several ways; hence, the configuration of the whole finger is dubious.

If the hinge extends only as far as shown thus (Plate IVa, *a*), both fingers are virtually equidimensional and the tuberculate ridge and spur must belong to another limb. However, if the dorsal margin of the propodus is extrapolated dorsally (pecked lines), it seems to coincide with these two features and thus suggests that the movable is the larger of the two fingers.

These flat-sided second pereiopods are most like those of *Schlueteria* (Turonian–Upper Senonian), a view shared by Drs. S. Secretan and H. B. Roberts, who kindly examined latex casts of the specimen.

They differ from those of *Schlueteria tetracheles* Fritsch (Fritsch and Kafka, 1887, fig. 53, pl. 6, fig. 4, pl. 7, figs. 1 and 2, pl. 9, fig. 8) in being carinate and in having a shorter, more circular and spinose carpus and a less robust and more elongated immovable finger. Likewise, the carpus of *Schlueteria menabensis* Secretan (Campanian–Santonian) from the Malagasy Republic is more elongated and the lateral surfaces of the propodus are smooth apart from a row of tubercles along the grinding edge of the dactylus (Secretan, 1964, p. 143, pl. XV, fig. 4). Both European forms resemble one another more closely than they do the Antarctic species.

The occurrence of prominent tuberculate carinae on the manus and merus of *S. carinata* distinguish it from previously known species. As *Schlueteria* has previously been recorded only from the Upper Cretaceous of Europe, the genus may have evolved in the Southern Hemisphere and migrated northward to Bohemia before moving to the Malagasy Republic.

INFRAORDER ASTACIDEA
FAMILY ERYMIDAE VAN STRAELEN

The Erymidae, which have been revised by Förster (1966), are well represented in south-eastern Alexander Island. There are at least 12 specimens which can be affiliated either with *Eryma*, *Enoploclytia* or *Palaeastacus* and more fragmentary material in the same succession may belong to one or other of the same three genera.

Although these genera are long established and well known, it is evident from a review of the literature that some difficulty is often experienced in differentiating between them, especially between *Enoploclytia* and the other two. Some confusion undoubtedly arises when specimens share the diagnostic characters of more than one genus. For example, both *seitzi* and *granulicauda* were included by Förster (1966) in *Enoploclytia* because of the slim shape of their pincers but Förster (personal communication) now maintains that their furrow patterns are more like *Palaeastacus* or *Eryma*. The furrow pattern of the cephalothorax is another source of possible confusion and conflicting interpretation, particularly when grooves are difficult to follow, coalesce or vary in their relative prominence. As a result, the furrow pattern of a particular decapod may be interpreted in more than one way by different authors.

The carapace grooves

Some confusion has often arisen over the status of the groove arising from the sub-horizontal part of the hepatic furrow and extending obliquely upwards and backwards behind the protuberance (*x*) to join with either the post-cervical or branchiocardiac furrows. Woods (1925–31), in describing several species of *Eryma* and *Enoploclytia*, referred to the anterior half (of the hepatic furrow) as either "curving upward to join the cervical groove" or being bent upwards anteriorly to partly surround the protuberance (*w*). However, Woods made no mention of the hepatic furrow joining with either of the two back furrows. Alternatively, van Straelen (1925), in describing such species as *Enoploclytia edwardsi*, *Phlyctisoma perroni* and *Phlyctisoma* [*Enoploclytia*] *pseudobabeaui* (in which the branchiocardiac groove is considerably reduced) used the term hepatic furrow to refer to the more ventral part of the post-cervical groove as well as the sub-horizontal groove extending from the inferior to the cervical groove. In forms such as *Eryma elegans*, van Straelen confined the term to the sub-horizontal part, whereas in *Eryma greppini* (where the two back furrows are joined half-way down the cephalothorax flank), he used the term to designate the groove resulting from the coalescing of these two back furrows as well as the sub-horizontal part joining the inferior with the cervical groove.

However, Glaessner (1960, p. 39, fig. 18) clearly implied that in such forms as *Eryma bedelta*, *Enoploclytia leachi* and *Hoploparia longimana*, the hepatic furrow may be regarded as a ventral extension of the branchiocardiac groove. This is also the usage of Förster (1966), who maintained that the hepatic groove not only separates the hepatic region from the pterygostomial region but also defines the protuberance (*x*) posteriorly. Thus, the groove divides the branchial region from the cephalothorax flank. In *Eryma* and *Palaeastacus* (where the post-cervical groove is more deeply incised than the branchiocardiac and apparently coalesces with it), the upwardly inclined part of the hepatic groove joins with the branchiocardiac. However, in *Phlyctisoma* and *Enoploclytia*, the branchiocardiac groove is foreshortened and the hepatic furrow coalesces with the post-cervical groove, as in some Glypheocarida.

Not to be confused with the hepatic furrow is "der Hepatikalfurche aufwärtsgerichtete Depression" which occurs in nearly all forms of *Eryma* and *Palaeastacus*. This depression, which resembles a furrow, develops in front of the protuberance (*x*) and extends obliquely upwards and backwards; occasionally, it continues as far as the post-cervical furrow. Such an *apparent* continuation of the post-cervical furrow leading to the complete enclosure of (*x*) is found only in *Lissocardia*. In *Palaeastacus*, where the post-cervical groove extends low down on to the cephalothorax flank, the depression (referred to here as c_1) often coalesces with it to give the impression of a continuous post-cervical furrow. According to Förster (personal communication), this depression is best interpreted as the remains of an original and continuous post-cervical furrow, a conclusion shared by Secretan (1964) who referred to the depression as branch (*x*) of the post-cervical groove. The depression is particularly well shown in *Enoploclytia tenuidigitata* and most species of *Palaeastacus* (Plate IVb).

The carapace grooves have been given different notation systems by various authors, the post-cervical groove, for example, having been referred to either as "*c*" or "*x–y*". Secretan (1964) used the double letter notation "*x–y*" because she believed that the post-cervical groove represents the fusion of two grooves which, in the more "primitive" species of Erymidae, were dissociated ventrally.

The genus Enoploclytia

The genus *Enoploclytia* was originally erected by M'Coy (1849) for *Astacus leachi* from the English Cretaceous. It is rather difficult now to reconcile this author's diagnosis with more recent descriptions of the genus, particularly the prominence given by later authors to the branchiocardiac and post-cervical grooves. According to M'Coy, these two grooves are of equal length and appear to join with one another ventrally, whereas the more recent diagnoses of Secretan (1964) and Förster (1966) emphasized that the branchio-cardiac groove is reduced and ends on the flanks of the cephalothorax.

There seems little doubt that M'Coy's original diagnosis, especially that part referring to the carapace grooves, was based on imperfect specimens because it has since been shown that in most species of *Enoploclytia* the branchiocardiac groove is foreshortened, whereas in *Eryma* (which is similar to *Enoploclytia*) it joins with the inferior groove and the post-cervical groove is foreshortened. Although *Enoploclytia* has been differentiated from *Eryma* on the basis of the coarser ornament of the antennal region (Woods, 1925–31), the more pronounced carapace grooves, the presence of a gastro-orbital groove and the size of the pincers, the two genera are not easily separable. This also applies to *Enoploclytia* and *Palaeastacus*, particularly in Australia, North America and Alexander Island where the Erymidae may represent a mingling of diverse trends with some branches remaining close to the "ancestral type" even in the Upper Cretaceous (Secretan, 1964, p. 95). However, Secretan may have included representatives of *Eryma* and *Palaeastacus* in her concept of the genus *Enoploclytia*.

Following M'Coy's diagnosis, the genus *Enoploclytia* was extended by van Straelen (1925) to include several Jurassic species subsequently transferred by Förster (1966) to *Phlyctisoma*, *Palaeastacus* or *Eryma*. Later, Mertin (1941) divided *Enoploclytia* into two sub-genera based on the size of the first chelipeds, the thick pincered types representing the sub-genus *Palaeastacus* and the slim ones the sub-genus *Enoploclytia*. More recently, Förster (personal communication) has suggested that he would include in the genus *Enoploclytia* only *E. wintoni*, *E. leachi*, *Enoploclytia* sp. Stenzel, *E. collignoni* and possibly *E. tumimanus*. Better-preserved material is required before *E. seitzi*, *E. granulicauda* and *E. minor* can be categorized satisfactorily. Certainly, *E. walkeri*, *E. triglyptus* and *E. kimzeyi* should be transferred to *Palaeastacus* as suggested by Förster (1966).

According to Secretan (1964, p. 94), *Enoploclytia* originated in the Upper Jurassic of Europe, but Förster (1966, p. 146) maintained that the genus occurs only in the Cretaceous and regarded *Enoploclytia tenuidigitata* from the Aptian (Roma Formation) of Queensland as the first certain representative of a genus which, in the Upper Cretaceous, became almost cosmopolitan, occurring in British Columbia, Texas, New Jersey, Delaware, Europe, Australia and the Malagasy Republic. However, *Enoploclytia* has not been recorded from North Africa, the Balkans, Asia or South America (Förster, 1966, p. 158).

Förster has also suggested that *Enoploclytia* was forced to migrate from a sub-littoral environment to deeper water due to the explosive development of the Nephropidae and the Brachyura, and postulated either the Atlantic or the Pacific as the most likely areas of origin.

Because *Enoploclytia* is represented by only a few species, it might be hazardous to suggest trends in the

3

evolution of the carapace grooves. However, it is evident that throughout the Cretaceous, the cephalo-thorax and cardiac region became enlarged, the cervical furrow became less oblique, and the branchio-cardiac and post-cervical grooves were reduced. The prominence of the lobes (x) and (w) may have been caused by an increase in the size of the pincers and a strengthening of the corresponding muscles (Glaessner, 1960; Förster, 1966).

Palaeastacus, which also occurs in Alexander Island, first appeared in Europe where it became very common, particularly in the Upper Cretaceous. The genus is also known from North America, Australia, British Columbia and Texas, North American and European Upper Cretaceous forms being so similar that a close tie has been inferred (Förster, 1966). *Eryma*, which kept to its particular habitat despite increased competition from the Nephropidae and Brachyura, eventually became extinct in the Lower Cretaceous.

Genus *Palaeastacus* Bell

Type species: *Palaeastacus sussexiensis* Mantell
Palaeastacus foersteri sp. nov.

Figs. 10a and 11; Plate IVb and c

Material

The *holotype* (KG.50.4; Fig. 10a; Plate IVb), collected as a scree fragment from locality N at lat. 71°27'S., long. 68°22'W., is the natural external mould of the right side of a carapace comprising a cephalothorax, an articulated abdomen, a caudal fan and several fragmentary limbs. The decapod is preserved in a dark grey siltstone. Unflexed, the holotype (excluding the appendages) is 62 mm. long. *Age:* probably Lower Aptian.

The *paratypes*, all from locality N, comprise the following: a cephalothorax, articulated abdomen and caudal fan (KG.50.5), a partly exposed cephalothorax (KG.50.6) and several disarticulated pereiopods and uropods (KG.11.9 and 26). Only specimen KG.11.26 (Plate IVc) was found *in situ*.

Diagnosis

Rostrum curved and tuberculate. Perpendicular orbital margin with prominent carina. Tuberculate gastro-orbital carina. Carapace grooves and inferred attachment position of adductor testis muscle accentuated. Coarsely tuberculate ornament. Prominent bosses on epimeres.

Measurements of holotype

		Specimen KG.50.4
Cephalothorax:	length along mid-line	26 mm.
	length from posterior angle of orbit to cervical groove	9 mm.
	height at junction of post-cervical groove with dorsum	15 mm.
	breadth	—
Rostrum:	length	6 mm.
Abdomen:	length (unflexed)	24 mm.
	width at second segment	—
Telson:	length	9 mm.
	width (maximum)	—

Description

Cephalothorax. The cephalothorax of the holotype is sub-cylindrical, feebly convex and tapers both anteriorly and posteriorly. The length from the posterior margin to the base of the rostrum along the mid-dorsal line is one and two-thirds the greatest height. The anterior area is approximately one-third of the total length of the cephalothorax. The maximum height is mid-way along the length.

The rostrum, which is slender and only partly exposed, is at least one-fifth the length of the cephalo-thorax. It is gently curved downwards (Fig. 10a) and there are several prominent, regularly spaced and
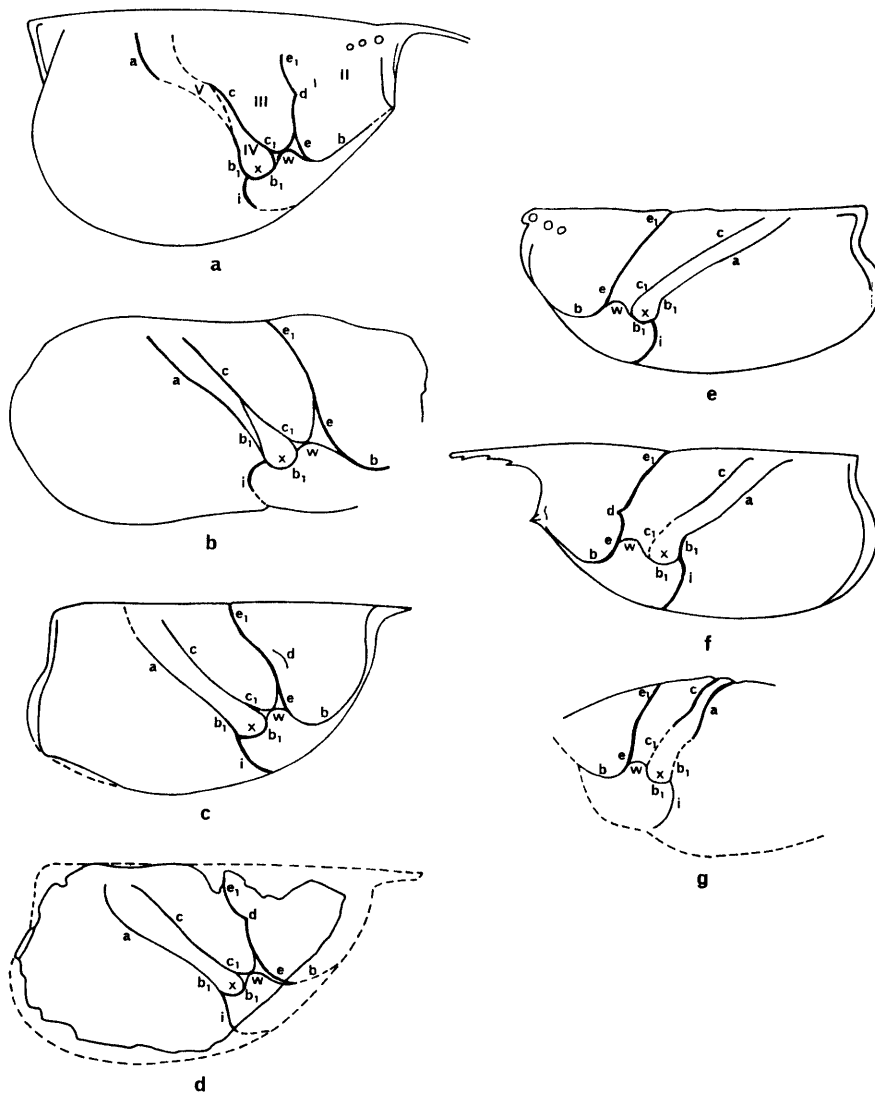
FIGURE 10

a–d. A comparison between the cephalothoraces of (a) the holotype of *Palaeastacus foersteri* (KG.50.4; ×2) with (b) *Eryma madagascariensis* Secretan (×2) (modified after Secretan, 1964, pl. III, fig. 2), (c) *Palaeastacus terraereginae* (×1) (modified after Woods, 1957, fig. 6, p. 167, pl. IV, figs. 5 and 8) and (d) *Enoploclytia tenuidigitata* (×1) (modified after Woods, 1957, fig. 5, p. 165, pl. V, fig. 4). The notation of the carapace grooves is similar to that in Fig. 3 except that *w* represents the *Hepaticalhöcker* or protuberance covering the mandibular joint, *x* the area of attachment of the adductor testis muscle, while c_1 is the depression in front of *x* which often imperceptibly joins the post-cervical groove.

e–g. A comparison between the cephalothoraces of (e) specimen KG.103.134 (×1·5), (f) *Palaeastacus sussexiensis* (after Förster, 1966, p. 127, fig. 24) and (g) *Palaeastacus triglyptus* (×0·5) (after Stenzel, 1945, fig. 6, p. 415, pl. 37, fig. 2).
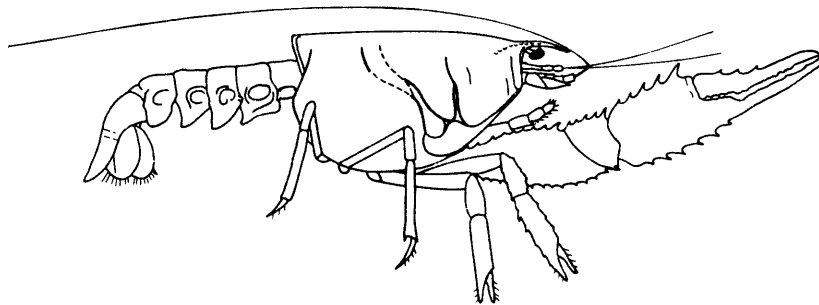
FIGURE 11

A reconstruction of *P. foersteri* (slightly enlarged) partly based on that of *Eryma* (after Förster, 1966, pl. 20).

anteriorly directed tubercles along the ventro-lateral margin. Neither the tip nor the dorsal margin of the rostrum are seen. The rostrum is continued posteriorly for a short distance on to the cephalothorax as a prominent, tuberculate supra-orbital ridge, the three tubercles decreasing in size in a posterior direction. The orbital margin is straight and almost perpendicular. A deeply incised and almost vertical groove parallel to the orbital margin probably represents the forward extension of the antennal groove (b). Immediately behind this vertical groove are two parallel rows of coarse tubercles, which are divided medially by a shallow groove. Apart from an aureole around the gastro-orbital ridge, coarse tubercles and a few irregular punctae ornament the antennal and gastric regions. Parallel to the cervical groove is a shallow furrow which may be artificial.

The cervical groove (e–e_1), which is biconcave towards the anterior and deeply incised, has a rounded junction with the antennal groove. The sub-horizontal part of the hepatic groove (b_1) anteriorly forms a short link between the cervical and post-cervical grooves and posteriorly joins the post-cervical with the branchiocardiac groove. Only the dorsal half of the pterygostomial region is exposed.

Unfortunately, because the cardiac region is poorly preserved, the trends of both the post-cervical and branchiocardiac grooves dorsally may be interpreted in several ways. However, their probable course is indicated by pecked lines in Fig. 10a. Near the dorsal margin, the branchiocardiac groove is moderately incised for a short distance.

The depression c_1 extending obliquely upwards and backwards from the hepatic groove (b_1) is moderately incised and almost imperceptibly merges with the post-cervical groove (c) near the mid-dorsal line. A rather weak branch from the post-cervical groove extends downwards to join both the ventral part of the branchiocardiac groove and the sub-vertical part of the hepatic groove (b_1) which is deeply entrenched. Because the depression c_1 and the hepatic groove (b_1) are both deeply incised, the protuberance (x), representing the area of attachment of the adductor testis muscle, is accentuated, whereas the protuberance (w), representing the projection covering the mandibular joint, is not so prominent. The hepatic and cardiac regions and the two protuberances are coarsely tuberculate. On the branchiostegite, coarse tubercles are surrounded anteriorly by crescent-shaped punctae. Part of the posterior carina is visible in front of the first abdominal somite.

Abdomen. The abdomen, which is inclined at a moderate angle behind the cephalothorax, comprises all six somites, one of which shows part of the intersegmental hinge area. The first somite, which is also the smallest, is quadrate with an irregular, longitudinal and punctate boss defining the ventral margin. A short blunt spine (*Gelenkungsdorn*) occurs at the posterior end of the boss. The second somite, also quadrate but almost twice as high as the first, has a much larger oval boss which occupies a medio-lateral position. The boss is surrounded on three sides by furrows. The epimere has a rounded antero-lateral angle, a slightly sinuous ventral margin and a sharply pointed postero-ventral margin which is slightly curved dorsally. The ventral margin is elevated above a narrow smooth border. A short blunt spine abuts against that of the first somite. The whole of the second somite is punctate. The third somite is ensiform, narrowing ventrally to a point. The boss and its surrounding furrows are less accentuated but the *Gelenkungsdorn* is more pronounced and projects outwards before abutting against the *Gelenkungspfanne* of the second somite. The fourth and fifth somites are both ensiform, tapering ventrally to backward-projecting apices which are not produced. Both somites are bounded by a narrow smooth border. The boss on the fourth somite is oblong and surrounded dorsally and posteriorly by a deep furrow, whereas that on the fifth somite is dome-shaped and more feebly convex. The *Gelenkungsdornen* of both somites are relatively large and project outwards before abutting against the respective *Gelenkungspfannen*. Only part of the sixth somite is preserved.

Caudal fan. The caudal fan comprises a partly exposed telson and overlapping inner and outer uropods. The telson is articulated to the sixth somite but the ovate uropods and their imperfectly preserved protopodites may be slightly detached. The endopodite has a median longitudinal furrow and feebly convex tubercles which are punctate ventrally. The exopodite is also probably divided by a longitudinal furrow and there are faint radiating riblets. A diaeresis may be present.

Appendages. Below the cephalothorax is a small detached chela, several joints of a pereiopod and the merus and part of the carpus of the first pereiopod. The propodus of the cheliped is crushed but both fingers, which are long and slender, are articulated. No teeth are visible but part of the lower margin of the fixed finger is spinose and striated near its junction with the movable finger. The merus of the first pereiopod is crushed and incompletely exposed but at least one row of stout spines occurs along the coarsely tuber-

culate dorsal margin. By contrast, the lateral margin is relatively smooth except for a few small punctae.

The appendages are best seen in two paratypes (KG.11.9 and 26). The merus in specimen KG.11.26 (Plate IVc) is approximately 19 mm. long and 5 mm. high with a gently rounded dorsal surface and a narrow venter. Both the dorsum and venter have at least one row of outwardly directed stout spines, whereas the lateral surfaces are smoother with small tubercles and occasional punctae. At least one row of coarse tubercles also occurs along the ventro-lateral margin.

Remarks

Because the cardiac area of *P. foersteri* is poorly preserved and the trend of the two back furrows in a dorsal direction can only be inferred, the species is difficult to categorize satisfactorily. The postulated trend of the aforementioned furrows is similar to that in both *Eryma* and *Palaeastacus* but the coarse ornament suggests a closer affinity with *Palaeastacus*—even though the tubercles are not arranged in rows on the gastric region. The coarse punctae on the abdomen of *P. foersteri* are unlike both *Eryma* and *Enoploclytia* (which usually have smooth abdomens with fine punctae) and also unlike that of *Palaeastacus* which is normally partly smooth and partly studded with coarse tubercles. According to Förster (1966), only the caudal fan of *Palaeastacus* is coarsely sculptured.

The relatively high relief of the protuberances *x* and *w* in *P. foersteri* may be due to fossilization as these features are particularly prone to diagenetic alteration. However, generally speaking, the protuberance *x* is more pronounced than *w* in *Enoploclytia* and vice versa in *Eryma* and *Palaeastacus*.

Palaeastacus foersteri shares some similarities with three species, *Eryma madagascariensis* Secretan from the Lower Kimmeridgian of the Malagasy Republic (Secretan, 1964, p. 61) and *Enoploclytia tenuidigitata* Woods and *Palaeastacus terraereginae* Etheridge *Jr.* from the Aptian and Upper Albian, respectively, of Queensland (Woods, 1957). In all three species the cephalothorax is conspicuously furrowed (Fig. 10). *P. foersteri* differs from *E. madagascariensis* (Fig. 10b) in the following ways:

i.   In *P. foersteri* there is a gastro-orbital ridge and the rostrum is tuberculate and bent ventrally. In *E. madagascariensis* (according to a reconstruction) the ventral margin of the rostrum is serrated and the tip is tilted dorsally.

ii. In *P. foersteri* the orbital margin is straight, whereas in *E. madagascariensis* it is thought to be concave towards the anterior.

iii. In *E. madagascariensis*, the cervical groove is convex towards the anterior and joins the dorsum, whereas in *P. foersteri* the groove is biconcave and fails to reach the dorsal margin. Furthermore, both the post-cervical* and branchiocardiac grooves in *E. madagascariensis* are more linear.

iv. The height of the cephalothorax at the post-cervical groove is greater in *P. foersteri* than in *E. madagascariensis*.

v.   The abdominal somites of *E. madagascariensis* have no bosses.

In *P. terraereginae*, the rostrum is short, the cervical groove reaches the dorsal margin and the post-cervical and branchiocardiac grooves are more linear than those in *P. foersteri* (Fig. 10c). Moreover, *P. terraereginae* has no supra-orbital ridge, the inferior groove slopes more acutely towards the antennal margin and the epimeres are demarcated by smooth, shallow sub-horizontal furrows (Woods, 1957, p. 167). Because the post-cervical furrow in *P. terraereginae*, which seems to coalesce with the depression c_1, is dorsally more strongly developed than the branchiocardiac and the imperfectly preserved carapace has coarse spines on the dorsal gastric and cardiac regions, the species should be included with *Palaeastacus* rather than *Enoploclytia* as suggested by Woods (1957). The uniform sculpture of the branchiostegite and the prominent pincers support this view (Förster, 1966).

In *E. tenuidigitata* (Fig. 10d), which is very similar to *Enoploclytia granulicauda* (Förster, 1966, p. 151), the cervical groove is more extensive dorsally than in *P. foersteri*, the two back furrows are straighter and appear to extend farther across the branchiostegite and the branchiocardiac groove is better developed. In *P. foersteri*, the branchiocardiac groove may join the sub-vertical part of the hepatic groove near the mid-dorsal line.

* Förster, who has examined the original specimen of *E. madagascariensis*, disagrees with Secretan over the prominence of the post-cervical groove in this species. He maintains that the groove clearly ends on the cephalic flank rather than continuing forwards to meet the cervical groove and that the dorsally ascending depression (c_1) does not reach the post-cervical groove (personal communication from R. Förster). Förster is also of the opinion that "*c*" is connected by a deep depression with the posterior part of *b*, and that some of the characters on the cephalothorax of *E. madagascariensis* may have been overemphasized through fossilization.

The differences between *P. foersteri* and the other decapods mentioned above are such that a new species is warranted. The trivial name is in recognition of the help and encouragement of Dr. Förster, who has extended his diagnosis of *Palaeastacus* thus: "beide Furchen (i.e. post-cervical and branchiocardiac) vereinigen sich nicht; Postcervikalfurche relativ tief herabziehend, häufiger mit der von der Hepatikalfurche aufsteigenden Depression verbunden und dann zum Teil eine durchgehende Furche vortäuschend."

Palaeastacus cf. *sussexiensis*

Fig. 10e; Plate IV d–f

Material

Specimen KG.103.134 (Plate IVd–f), comprising an almost complete carapace, was collected from a height of approximately 305 m. in the stratigraphical succession at the northern part of Waitabit Cliffs. Several other more poorly preserved decapods were found at the same locality but these were not collected. Unflexed, the length of the specimen excluding the appendages is 60 mm. *Age:* probably Lower Aptian.

Measurements

		Specimen KG.103.134
Cephalothorax:	length along mid-line	30 mm.
	length from posterior angle of orbit to cervical groove	10 mm.
	height at junction of post-cervical groove with dorsum	15 mm.
	breadth	—
Abdomen:	length (unflexed)	30 mm.
	width at second segment	—
Telson:	width (maximum)	10 mm.

Description

Cephalothorax. The sub-cylindrical cephalothorax is feebly convex and tapers anteriorly and posteriorly. The length from the posterior margin to the base of the rostrum along the mid-dorsal line is twice the greatest height which is mid-way along the length. The anterior area is one-third the total length of the cephalothorax (Plate IVe).

The rostrum is only partly exposed but a supra-orbital ridge surmounted by three large tubercles is present (Fig. 10e). The orbital margin, which appears to be unindented and gently curved outwards, is characterized by obliquely inclined striae. A shallow groove probably representing the forward extension of the antennal groove (b) is similar to a more deeply incised groove in *Palaeastacus foersteri* (p. 28). The gastro-orbital groove may occur as a slight depression branching medially from the cervical groove. The anterior area is ornamented with widely spaced tubercles and a few ovate shallow punctae. The gastric region, which is more tuberculate than the antennal region, may have two irregular rows of tubercles.

The slightly sinuous and moderately incised cervical groove (e–e_1) becomes shallower before joining with the antennal groove in a broadly rounded angle. On the hepatical side of the cervical groove are several sub-vertical striae. The sub-horizontal part of the hepatic groove (b_1) forms a short link between the cervical and branchiocardiac grooves and the striated inferior groove (i) is moderately incised. The pterygostomial and cardiac areas are tuberculate.

The post-cervical groove (c) begins at, or very near, the dorsal margin and trends obliquely forward, being slightly convex towards the anterior. Although the groove is only partly exposed, it appears to be feebly indented, particularly near the rounded protuberance (x) where the groove may join with the depression (c_1). The branchiocardiac groove (a), which is parallel to the post-cervical, is also somewhat poorly preserved and feebly indented. Near the mid-dorsal line, the branchiocardiac groove probably coalesces with the sub-vertical part of the hepatic groove which, because it is moderately incised, tends to

accentuate the protuberance (x). However, the *Hepaticalhöcker* (w) is virtually indistinguishable from the pterygostomial region. The branchiostegite is tuberculate and bordered dorsally and posteriorly by a deep furrow (0·25 mm. wide) and a *Marginalwulst*. Both the furrow and the *Marginalwulst* show striated muscle attachment areas.

Abdomen. The abdomen is slightly detached and bent almost at right-angles to the cephalothorax (Plate IVd and f). The first somite is not exposed but it is assumed to be present. Smooth intersegmental areas are associated with the second, third and fifth somites. The V-shaped second somite has a prominent rounded boss which is surrounded by a shallow groove, striated antero-laterally and ornamented by several large and widely spaced punctae. The third somite is equidimensional with the second but better preserved. The medio-lateral boss is smaller and more elongated but the surrounding furrow is deeper postero-laterally. The epimere is curved backwards to form a blunt spine. The posterior half of the boss and the remainder of the somite are punctate. The lateral bosses of the fourth and fifth somites are even less pronounced and the surrounding grooves are more feebly indented. The ensiform epimeres curve backwards to culminate in a point. A narrow border extends along both the anterior and posterior margins. A few well-rounded tubercles and more numerous punctae characterize these somites, the punctae being less dense dorsally. The sixth somite is smaller and more quadrate. The anterior margin is curved backward, whereas the posterior margin is almost straight and thus no spine is produced. Parts of the telson and endopodite are visible and the left-sided exopodite is almost completely exposed. The ovate exopodite is punctate and tuberculate with a diaeresis and closely spaced longitudinal grooves and riblets on the posterior half.

Appendages. The first pereiopod, the best preserved appendage, is probably attached although the basiischium is not exposed. The ischium, which is approximately half the length of the merus, is only partly exposed. The upper margin is spinose and the distal margin is obliquely striated. Several large punctae also occur. The merus, 14 mm. long and 5·6 mm. high, has been compressed laterally but it is the best preserved of the joints. Above a row of punctae (which are defined posteriorly by tubercles) the dorsal surface is gently curved towards a row of outwardly directed prominent spines. The flank of the merus, particularly distally, is ornamented with obliquely arranged asymmetrical punctae, some defined posteriorly by tubercles. The ventral margins of the merus and carpus are incomplete. The carpus is approximately 8 mm. long, 7 mm. high at the anterior end and with a moderately convex lateral margin. Large distal spines on the dorsal margin and the proximal end of the ventral margin may have either pointed downwards or backwards. The exposed proximal end of the propodus has been crushed.

Below the first pereiopod are two fragmentary limbs, one of which is spinose along at least the dorsal margin. Several incomplete appendages also lie between the first pereiopod and the cephalothorax.

Remarks

Specimen KG.103.134, which is coloured black, is the best preserved of the decapods so far known from Alexander Island. Although it is similar in size to the holotype of *P. foersteri*, it is significantly different on several counts, notably the ornamentation of the anterior area, the depth of the groove representing the forward extension of the antennal groove, the feeble indentation of the hepatic groove, the form of the post-cervical and branchiocardiac grooves and the relative prominence of the protuberances x and w. The first abdominal somite of *P. foersteri* is also proportionately smaller and both this and the second somite are quadrate rather than triangular.

The writer agrees with Dr. Förster that specimen KG.103.134 (and Fig. 12a) "entsprechen weitgehend *Palaeastacus* nicht nur im Furchenverlauf, sondern auch in der Skulptur." Because the ornament of the cardiac region is poorly preserved and the pincers are obscured by matrix, it is difficult to compare satisfactorily specimen KG.103.134 with other forms of *Palaeastacus* such as *P. sussexiensis** and *P. scaber* from the Lower Chalk and Gault of England with which the Antarctic specimen has much in common. The ornament and furrow patterns of both *P. sussexiensis* and *P. scaber* are practically identical with one another but the cephalothorax of *P. scaber* is smaller (2·6–8 cm. compared with 2·7–10 cm.) and the pincers are more slender (Förster, 1966, p. 133). Although the cephalothorax of specimen KG.103.134 is within

the size ranges of both *P. sussexiensis* and *P. scaber*, an affiliation with the more cosmopolitan *P. sussexiensis* is preferred. There are some differences, however, notably in the shape of the orbital margin of *P. sussexiensis*, the presence of an antennal spine and the extent of the antennal groove anteriorly (Fig. 10f).

As in most Cretaceous forms, the abdomen of *P. sussexiensis* is coarsely tuberculate, whereas in specimen KG.103.134 and in the Jurassic species *P. fuciformis* it is punctate. However, in *P. fuciformis*, the furrows, particularly the cervical furrow, are more posteriorly located than those of *P. sussexiensis*, the cervical furrow meeting the dorsum medially and thus foreshortening the branchial region (Förster, 1966, p. 131).

P. triglyptus (Fig. 10g) from the Coniacian of Texas differs from specimen KG.103.134 in that the dorsal margin of the gastric region slopes ventrally and the cervical, post-cervical and branchiocardiac grooves do not extend as far across the cephalothorax. The pterygostomial region is also deeper and the antennal margin appears to be slightly convex outwards (Stenzel, 1945, fig. 6, p. 37, fig. 2).

Palaeastacus terraereginae Etheridge *Jr.*

Fig. 12a and b; Plate IVg and h

Material

Specimen KG.11.4 (Fig. 12a; Plate IVg), collected 91·5 m. above the lowest exposed stratum at locality N, is a natural mould of two fragmentary limbs and the right side of a cephalothorax. Specimen KG.3.11 (Fig. 12b; Plate IVh), which was collected from 148 m. at Mount Ariel, is a mould of the right side of an incomplete cephalothorax together with several fragmentary limbs which underlie the cephalothorax. The specimen is fractured and partly distorted. Because specimen KG.3.11 may represent an exuviae of an individual similar to specimen KG.11.4, the two decapods are described separately. *Age:* probably Lower Aptian.
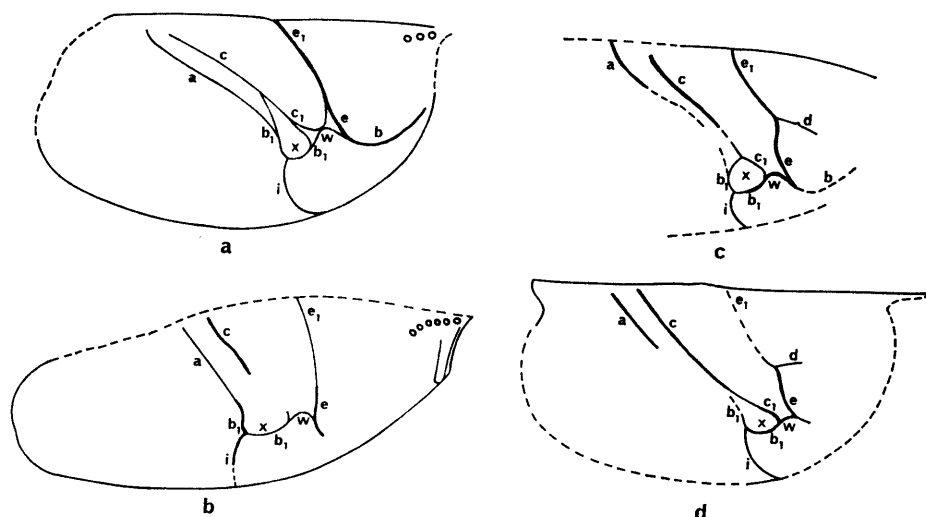
FIGURE 12

A comparison between the cephalothoraces of (a) specimen KG.11.4 (×1·5) and (b) specimen KG.3.11 (×2·5), and between those of (c) specimen KG.2.164 (×1·5) and (d) specimen KG.2.214b (×1·5).

Measurements

Specimen number	Length of cephalothorax along mid-line (mm.)	Length of cephalothorax from posterior angle of orbit to cervical groove (mm.)	Height of cephalothorax at junction of post-cervical groove with dorsum (mm.)
KG.11.4	31*	13	18
KG.3.11	21*	7*	9*

* Incomplete measurement.

Description

The sub-cylindrical cephalothorax of specimen KG.11.4 tapers anteriorly and its length from the esti-mated position of the posterior margin to the base of the rostrum is about twice the greatest height which occurs mid-way along the length. The anterior region, representing one-fourth to one-fifth the total length, is characterized by an antennal spine and an extensive antennal groove (b), which may have accentuated the orbital margin. Both this margin and the gastro-orbital ridge are incomplete. The large tubercles ornamenting the anterior area are more widely spaced in the gastric region where they may have been arranged in rows slightly oblique to the dorsal margin.

The deep, slightly sinuous cervical groove (e–e_1) extends obliquely forwards to form a rounded junction with the antennal groove which defines a narrow and coarsely tuberculate extension of the pterygostomial region. The sub-horizontal part of the hepatic groove (b_1) forms a characteristic λ-shaped furrow anteriorly joining the cervical groove with the depression c_1 and posteriorly interconnecting this depression with the branchiocardiac groove (a). Anteriorly directed tubercles ornament the pterygostomial region. The protuberances x and w are fairly pronounced and the hepatic region is accentuated.

The moderately incised and almost straight post-cervical groove (c) extends obliquely forward to meet the depression c_1, whereas a subsidiary branch appears to join the branchiocardiac groove near the mid-dorsal line. The branchiocardiac groove, which parallels the post-cervical groove, is not so deeply incised, particularly ventrally. Although neither of these two transverse grooves may reach the dorsum, the branchiocardiac undoubtedly changes direction and veers towards this margin. The branchiostegite is coarsely tuberculate.

Immediately below the cephalothorax are parts of the merus and (?) carpus of the first pereiopod and two other more fragmentary appendages. The merus is ornamented with anteriorly punctate tubercles and isolated punctae.

Remarks

The configuration of the grooves in specimen KG.11.4 (Fig. 12a) is very similar to that of the incomplete holotype of *Eryma madagascariensis* (Secretan, 1964, pl. III, fig. 2) (Fig. 10b). Whereas the fine granulation and punctation of *E. madagascariensis* is typical of *Eryma*, the coarse ornament of specimen KG.11.4 (particularly on the gastric area) is more characteristic of *Palaeastacus* to which the specimen probably belongs.

The closest specific match is with *Palaeastacus terraereginae* Etheridge Jr. from the Upper Albian of Queensland which has a similarly shaped cervical groove and an extensive antennal groove (Woods, 1957, pl. IV, figs. 5 and 8) (Fig. 10c). Although the curvature and relative prominence of the two back furrows in *P. terraereginae* are different, the Queensland species appears to be variable in this respect, either because of intraspecific differences or slight modifications following the death or moult of the decapod.

In specimen KG.3.11 (Fig. 12b; Plate IVh) the anterior area is partly defined by a straight and back-wardly inclined orbital margin. Behind this is a narrower groove, a pronounced orbital carina and a moderately deep and broadly rounded groove which may extend down to the antennal groove (b). Behind an incomplete rostrum is a prominent, tuberculate gastro-orbital carina which is inclined backwards at an oblique angle. Large widely spaced tubercles and occasional punctae ornament the gastric region, whereas in the antennal region the tubercles and punctae are more closely spaced and tend to coalesce. Most of the comma-shaped punctae occur anterior of the tubercles.

Dorsally, the cervical groove (e–e_1) is not completely exposed but ventrally it is moderately incised and the junction with the antennal groove is rounded. The two back furrows are straight and parallel with one another but their full extent across the cephalothorax is not known because the specimen is incomplete dorsally. Where they occur, the post-cervical groove (c), which is more deeply incised than the branchio-cardiac (a), appears to terminate near the mid-line and merge almost imperceptibly with a shallow de-pression (c_1) extending obliquely upwards and backwards from the horizontal part of the hepatic groove (b_1). The sub-vertical part of the hepatic groove behind the protuberance x is moderately incised as is the inferior groove (i) defining the posterior margin of the pterygostomial region. The sub-horizontal part of the hepatic groove joins the cervical with the inferior groove. The protuberances x and w are only feebly accentuated. Small tubercles and numerous lunate-shaped punctae ornament the branchiostegite. The appendages beneath the cephalothorax cannot be differentiated.

Remarks

It has been suggested that Fig. 12b may represent an exuvia of a young individual similar to Fig. 12a (*P. terraereginae*), and that decalcification may have given rise to the pronounced crack extending across the branchial and pterygostomial regions, the more feeble sculpture and the moderately deep impression made by the hepatic groove (personal communication from R. Förster). It is also possible that the marked difference in ornament between the branchial region and the remainder of the cephalothorax may be attributed to decalcification. Although such a pronounced difference in sculpture is not found in any other specimen from Alexander Island, it has been reported in several European species, notably *Eryma bedelta* and *Eryma sulcata* (Förster, 1966, pl. 14, fig. 2, pl. 17, fig. 4).

Because most of the dorsal area of specimen KG.3.11 is incomplete and the whole cephalothorax may have been distorted, this particular decapod is difficult to categorize satisfactorily. Apart from the ornamentation, the almost perpendicular course of the cervical groove is unique so far as the Alexander Island fauna is concerned. However, the occurrence of orbital and gastro-orbital carinae suggests that the specimen may be affiliated to *P. foersteri* or *P.* cf. *sussexiensis* even though the furrow patterns of the three decapods are dissimilar (cf. Fig. 10a and e with Fig. 12b).

Genus *Enoploclytia* M'Coy

Type species: *Enoploclytia leachi* Mantell
Enoploclytia sp.

Fig. 12c and d; Plate Va–c

Material

All of the specimens were found in the upper part of the succession at locality H. An incomplete (?) branchiostegite (KG.2.170) and the natural mould of a caudal fan (KG.2.167; Plate Vc) were found in the same stratum and only 3 m. from a loose fragment of an incomplete cephalothorax (KG.2.164; Plate Va). All three specimens probably comprise parts of the same decapod. Two other specimens (KG.2.214a and b; Plate Vb) represent counterparts of a compressed cephalothorax. *Age:* probably Lower Aptian.

Measurements

Specimen number	Length of cephalothorax along mid-line (mm.)	Length of cephalothorax from posterior angle of orbit to cervical groove (mm.)	Height of cephalothorax at junction of post-cervical groove with dorsum (mm.)	Length of rostrum (mm.)
KG.2.214b	27*	13*	14*	9*
KG.2.164	27*	13	16*	—

* Incomplete measurement.

Description

The sub-cylindrical cephalothorax tapers anteriorly and posteriorly, and its estimated length is at least twice the greatest height. The maximum height occurs mid-way along the length. The anterior region represents one-third of the total length. The rostrum (of specimen KG.2.214b) is straight, tuberculate, at least 9 mm. long and may have been tilted gently upwards. The anterior margin is indented but sub-orbital and antennal angles cannot be differentiated. A *Marginalwulst* is preserved in specimen KG.2.214.

The cervical groove, which is biconcave anteriorly and moderately incised, changes direction where it joins a relatively prominent gastro-orbital groove (*d*) which is inclined either ventrally (KG.2.164) or dorsally (KG.2.214). A prominent lobe beneath the gastro-orbital groove in specimen KG.2.214 may be a post-mortem effect. The anterior area is ornamented with antero-ventrally directed tubercles which are

very coarse in specimen KG.2.214b and surrounded antero-ventrally by deep lunate-shaped punctae (Plate Vb).

The post-cervical groove (c), which is more incised than the branchiocardiac (a), probably meets the dorsal margin. Ventrally, it merges almost imperceptibly with the depression c_1 which extends obliquely upwards and backwards from the hepatic groove (b_1). The latter forms a typical λ-shaped furrow and joins the cervical with the branchiocardiac and inferior grooves. The branchiocardiac groove parallels the post-cervical groove but it is feebly incised ventrally and difficult to follow in both specimens, although it probably joins the sub-vertical part of the hepatic groove. The tubercles ornamenting the narrow area between the two back furrows are punctate antero-ventrally. The prominence x is more pronounced than w and the inferior groove (i) and adjacent parts of the cephalothorax are characterized by striated muscle attachment areas. Coarse tubercles and lunate-shaped punctae ornament the pterygostomial and branchio-stegite regions.

Specimen KG.2.167 is the natural mould of the sixth abdominal somite and a caudal fan (Plate Vc). A latex cast represents the dorsal view. Approximately two-thirds of the somite is preserved. The dorsum is feebly convex transversely and it is ornamented with widely spaced and transversely elongated punctae. A fairly pronounced longitudinal boss separates the somite from an epimere. The epimere has an out-wardly convex antero-lateral margin, a rounded postero-lateral angle and a slightly concave postero-lateral margin. Several widely spaced tubercles, which may be punctate posteriorly, ornament the epimere.

The V-shaped telson is moderately elongate, the width being two-thirds the length. A moderately convex and transversely elongated boss surmounted by two medial tubercles defines the antero-medial margin. The lateral margins, which are gently curved outward, have two short antero-lateral folds. These are parallel to two broader and posteriorly narrowing folds which extend to the postero-lateral angles. The telson is ornamented by shallow punctae and broken tubercles which are coarsest medially. The endo-podites, which are more ovate than the telson, are each divided by a prominent median fold. Posteriorly, punctate tubercles occur on the antero-lateral area of one of them. The posterior margin is broadly rounded. The partly hidden expodites are broadly rounded, punctate and have at least one curvilinear fold.

Remarks

The strongly differentiated gastro-orbital and post-cervical grooves, the accentuation of "x" and the weak development of the branchiocardiac groove suggest that these two decapods belong to *Enoploclytia*. The closest specific match is with *E. tenuidigitata* although there are differences, notably in the more pronounced gastro-orbital groove in the Alexander Island specimens, the weaker development of the branchiocardiac groove ventrally and the coarser ornament. In *Enoploclytia collignoni*, the cervical groove is convex anteriorly and almost perpendicular, the gastro-orbital groove is feebly developed and the post-cervical groove is less deeply incised dorsally (Secretan, 1964).

The telson is similar to that of *Palaeastacus terraereginae* in having an antero-medial boss but the longi-tudinal ridges are more pronounced and the ornament is coarser. The exopodite of *P. terraereginae* also has a slightly oblique diaeresis (Woods, 1957, p. 168).

(?) *Enoploclytia* sp.

Plate Vd

Material

A loose, weathered natural mould of an incomplete left cheliped (KG.2.38) from 61 m. above the lowest exposed stratum at locality H. Overall length, 53 mm.; height, 16 mm.

Description

The tuberculate carpus, which is only preserved dorsally, has a dentate margin. The wedge-shaped manus is slightly longer than high, moderately convex transversely, dentate dorsally and ventrally and coarsely tuberculate. The fingers, which are incomplete distally, converge slightly, are of moderate length (23 mm.), evenly tapered and of equal proportions. Both fingers, which were probably equidimensional, have a number of short, parallel, moderately deep longitudinal furrows. Several large teeth are incompletely exposed.

Remarks

The cheliped is by far the largest decapod appendage so far known from south-eastern Alexander Island. Its short stout manus and long robust fingers are comparable with the first pereiopods of *Pseudastacus* Oppel ((?) Middle–Upper Jurassic) and *Enoploclytia*. The specimen is twice as large as that of *Pseudastacus pustulosus* (*Bolina pustulosa*) (Oppel, 1862) and the manus appears to be proportionately shorter and more dentate.

The relatively coarse ornament and strong dentition are more in agreement with *Enoploclytia*, the only decapod found *in situ* at the same locality.

III. PALAEOGEOGRAPHY

THE macruran decapods of south-eastern Alexander Island represent the richest and most diversified fauna of its kind so far known from the Lower Cretaceous of the Southern Hemisphere. Its origins and that of other Southern Hemisphere macruran faunas and their dispersal are difficult to determine although some evidence is available.

Although decapods may have been overlooked in the field in certain areas such as Patagonia, it is evident that in the Southern Hemisphere, during the Jurassic, macrurous decapods were probably most common (relatively speaking) in the vicinity of the southern Indian Ocean and New Zealand. In the Malagasy Republic there are four specimens, a Coleiidae (*Coleia incerta* Secretan) of Upper Tithonian age and three Erymidae, *Eryma madagascariensis* and *Eryma granulifera* (both Kimmeridgian) and *Erymastacus australis* (Portlandian) (Secretan, 1964). In the Tendagura Beds (Upper Oxfordian–Aptian) of south-eastern Tanzania, at least one decapod (*Protaxius* sp.) is Kimmeridgian and two others (*Eryma* cf. *bedelta* and *Erymastacus* cf. *ornatus*) may also be Upper Jurassic in age. However, *Glyphea hennigi* Beurlen from the same beds is probably Middle Neocomian (Beurlen, 1933, p. 92). A cheliped, probably of Tithonian age, has also been recorded from Alexander Island (p. 3).

A slightly larger number of Jurassic decapods is known from New Zealand. These comprise three species, *Trachysoma* (*Glypheopsis*) *antipodum* Glaessner, *Mecochirus marwicki* Glaessner and *Mecochirus* sp. (Glaessner, 1960). However, the only decapods so far known from the Cretaceous are Maestrichtian.

Therefore, the earliest decapods of probable Lower Cretaceous age in the Southern Hemisphere are *Mecochirus* [*Meyeria*] *schwarzi* from the Uitenhage Series (Lower Neocomian) of South Africa (Kitchin, 1908), *Glyphea hennigi* and several decapods described in this report. In the Aptian, decapods seem to be more common, particularly in north and south-east Queensland and south-eastern Alexander Island. In Queensland there are at least three species in the Aptian Roma Formation (*Glyphea arborinsularis*, *Enoploclytia tenuidigitata* and *Enoploclytia* sp.) and a specimen of *Callianassa* (?) originally obtained from near either the Mitchell or Walsh Rivers may be of a similar or earlier age. In Alexander Island the Aptian decapod fauna is more diverse and represented by considerably more specimens. No decapods of Albian age have so far been collected from Alexander Island (i.e. at Succession Cliffs, Keystone Cliffs and the upper part of the succession at Waitabit Cliffs) but in Queensland Macrura may have co-existed with Brachyura in the Upper Albian Tambo Formation (Woods, 1953, 1957).

No Cenomanian decapods have so far been recorded from the Southern Hemisphere but at least one Turonian form from Colombia, *Hoploparia columbiana*.Beurlen, is known (Camacho, 1966, p. 477). Following the Aptian–Albian phase, decapods became common again in the Campanian, notably in the Malagasy Republic and the James Ross Island area of west Antarctica. Although both faunas are Lower to Middle Campanian, the Malagasy Republic one is considerably larger and more diverse with both Macrura and Brachyura, although most of these specimens are disarticulated. The only genus common to both faunas is *Hoploparia*, and *Hoploparia sculpta* Secretan is said to closely resemble *Hoploparia stokesi* Weller from Antarctica (Secretan, 1964, p. 107). (?) *Hoploparia* has also been described (Wilckens, 1922, p. 25) from the Upper Cretaceous of New Zealand where only five Mesozoic species are known, the remaining 25 being Cainozoic (Glaessner, 1960). The majority of these are Brachyura.

The probability that any decapods in the Upper Jurassic or Lower Cretaceous of South America may have been overlooked or ignored is an important factor in determining the origin and subsequent dispersal of the decapod fauna of south-eastern Alexander Island. Excluding Patagonia, therefore, it seems likely that the Lower Cretaceous faunas of both Alexander Island and Queensland may have originated from the

Indian Ocean or New Zealand. There may, too, have been a migration of faunas between Alexander Island and Queensland as there are similarities between the two, i.e. between the respective Glypheidae and Erymidae. The later arrival of the Erymidae in Australia may indicate that these particular forms migrated from Antarctica rather than vice versa. The absence (to date) of any Brachyura in Antarctica is rather problematical because elsewhere fossil crabs evolved rapidly, particularly in the Upper Cretaceous.

IV. CONCLUSIONS

THE macrurous decapods of south-eastern Alexander Island probably evolved in the Upper Jurassic in the vicinity of either the Indian Ocean or New Zealand. The fauna, which is reasonably well preserved and composed mainly of benthonic forms, flourished in temperate quiet water conditions to become the richest and most diversified of its kind so far known from the Lower Cretaceous of the Southern Hemisphere.

The fauna consists mainly of (?) Mecochiridae and Erymidae, and fewer Glypheidae and Thalassinoidea. The Glypheidae and Erymidae resemble those from the Lower Cretaceous (Aptian–Upper Albian) of Queensland and some dispersal from Antarctica to south-eastern Australia probably occurred. Although *G. alexandri* and *G. georgiensis* share some affinities with Queensland species, *Trachysoma* aff. *ornatum* from Alexander Island more closely resembles the European (Callovian) type species than *T. antipodum* from the Liassic of New Zealand, the only other Southern Hemisphere representative of this conservative genus. Similarly, the long-fingered protocallianassids, which may be amongst the earliest of their type, are more comparable with Northern Hemisphere (mainly European) Upper Cretaceous forms. *Schlueteria*, which has previously been recorded only from the Upper Cretaceous of the Northern Hemisphere, may have evolved in the Southern Ocean before migrating to the Malagasy Republic via Bohemia.

Differences in the shape and size of the epimeres amongst a probably monotypic faunule of small (?) mecochirids may represent secondary sexual characters.

In the absence of more reliable data, the decapods as a whole would prove somewhat unreliable indices of age. However, the affinities of some of the Erymidae with Aptian–Albian forms from Queensland and the occurrence of the glypheids, which in the Southern Hemisphere Cretaceous occur only in the Neocomian of Tanzania (Beurlen, 1933) and the Aptian–Upper Albian of Queensland (Woods, 1957), suggest a Lower Cretaceous age.

V. ACKNOWLEDGEMENTS

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PLATE I

a. Mainly the natural mould (with some adhering cuticle) of the right side of the cephalo-
    thorax of *Glyphea alexandri* sp. nov. together with several partly overlapping pereiopods;
    P, propodus; *C*, carpus; *M*, merus; *I*, ischium; pp_1, first pereiopod; pp_2, second pereiopod;
    pp_3, third pereiopod. The pereiopods probably formed part of the same decapod; $\times 0 \cdot 9$
    (KG.18.46).

b. A latex cast of *G. alexandri* showing the carapace grooves and ornament. (?) Uropods
    (arrowed) occur below the orbital margin; $\times 2 \cdot 8$, coated (KG.18.46).

c. A latex cast of *G. alexandri* showing an incomplete cephalothorax, an antenna (*A*),
    antennal scale (*AS*), a propodus and part of the endoskeleton including the mandible
    (arrowed). An open-coiled serpulid encrusts the propodus (lower left); $\times 1 \cdot 8$, coated
    (KG.18.45).

d. An enlargement of Plate Ic showing the mandible and an anteriorly flared projection
    corresponding either to the palp or to the epistomal articulation of the palinurid articular
    process; $\times 4$, coated (KG.18.45).

e. Part of specimen KG.18.44 showing three pereiopods, two with prominent dactyli. The
    median pereiopod has two distal spines curved towards the dactylus; $\times 3$.

f. The left side of the cephalothorax of *Glyphea georgiensis* sp. nov. A flagellum (arrowed)
    occurs above the gastric and cardiac regions; $\times 2$ (KG.19.16).

g. A latex cast of the abdomen of *G. georgiensis* viewed dorsally and showing all of the
    abdominal somites, the telson and an inner uropod; $\times 1 \cdot 7$, coated (KG.19.15).

h. A latex cast of *Trachysoma* aff. *ornatum* showing the left side of the cephalothorax. The
    linearity and deep incision of the two back furrows are well shown; $\times 5$, coated
    (KG.11.16).

PLATE I

a

b
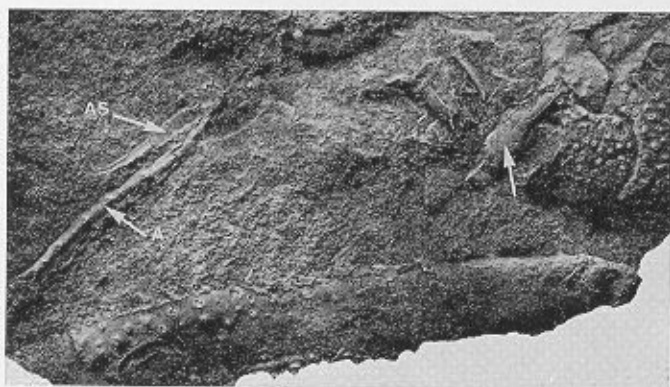
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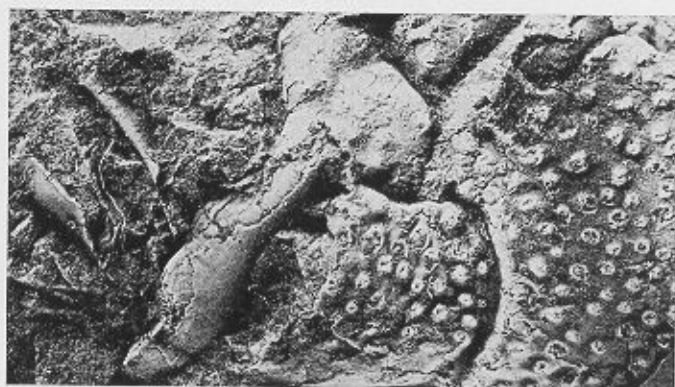
d

e
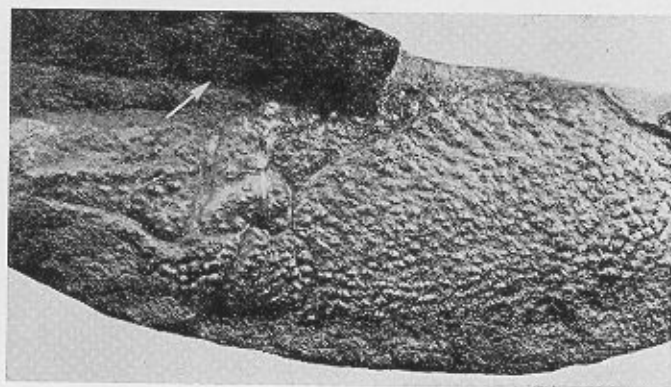
f

g
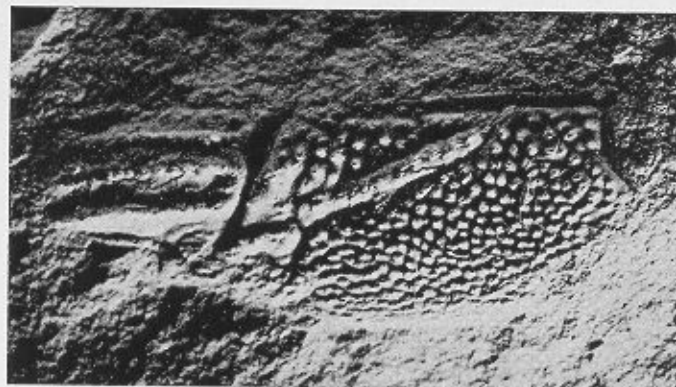
h

PLATE II

a. Mainly a natural mould of the left side of the cephalothorax of *T.* aff. *ornatum* showing the rostrum, the outline of the orbital margin and the gastro-orbital groove (*d*). Much of the cardiac area is unexposed. The orientation of the specimen has been reversed so that it corresponds with Plate Ih; $\times 4 \cdot 7$ (KG.11.8).

b. Two glypheid pereiopods proportionately similar in size to the cephalothorax of *T.* aff. *ornatum*; $\times 4 \cdot 2$ (KG.11.30).

c. Three imperfectly preserved pereiopods from a stratum at locality H approximately equivalent stratigraphically to that of *T.* aff. *ornatum*. The propodus is elongated; $\times 3 \cdot 6$ (KG.2.183).

d. A latex cast of several pereiopods, a cephalothorax and an incomplete abdomen of *Mecochirus* sp. Pereiopods from both sides overlap each other and the cephalothorax, and the elongated first pereiopod on the right side has been rotated, probably at the carpus as indicated; $\times 1 \cdot 6$, coated (KG.11.39).

e. An almost completely articulated mecochirid-like decapod from locality U showing a cervical groove (e–e_1) and pleopods (*Plp*); $\times 6 \cdot 6$ (KG.4.6).

f. An almost completely articulated mecochirid-like decapod from Fossil Bluff. Pereiopods from both sides and parts of both sides of the abdomen are shown; pp_4, fourth periopod; *Mxp*, maxilliped; $\times 3 \cdot 2$ (KG.1.928).

g. A specimen from the same stratum as Plate IIf with short pointed epimeres on somites two, three and four but elongated well-rounded epimeres on somites five and six. Pereiopods (arrowed) partly overlap on to the cephalothorax, notably across the dorsal part of the branchiostegite. A cervical groove (e–e_1) is present; $\times 3 \cdot 1$ (KG.1.940).

h. An enlargement of Plate IIg showing differences in the morphology of the epimeres. Both sides of the abdomen are exposed. The epimeres of the first and second somites cannot be differentiated satisfactorily; $\times 5 \cdot 6$ (KG.1.940).
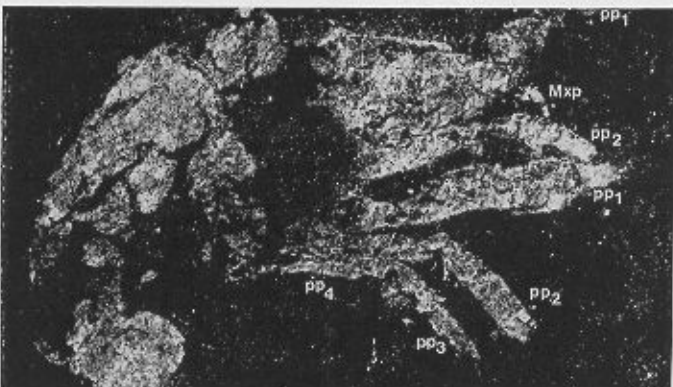
PLATE II

a
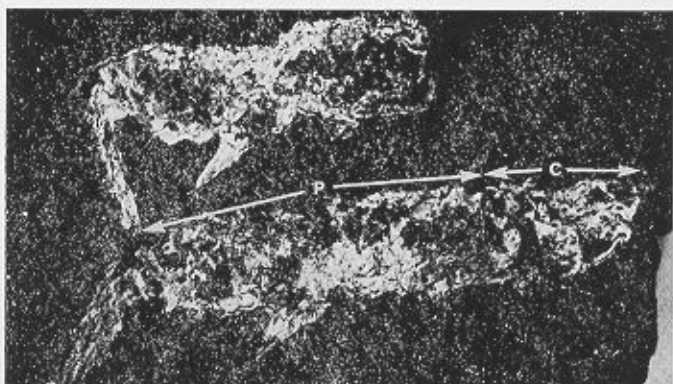
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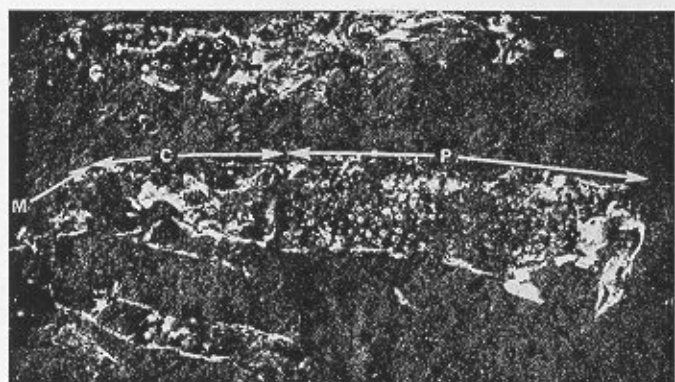
c

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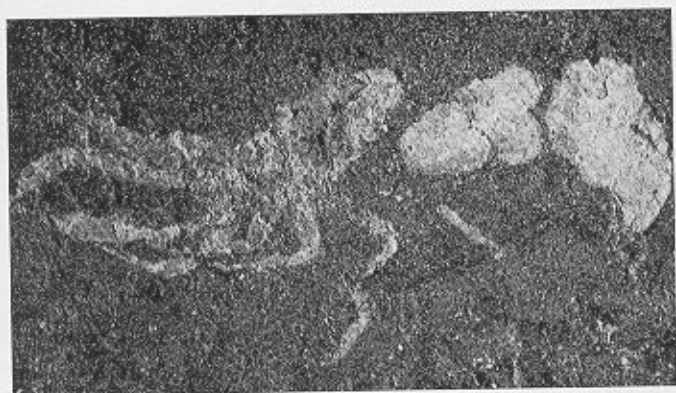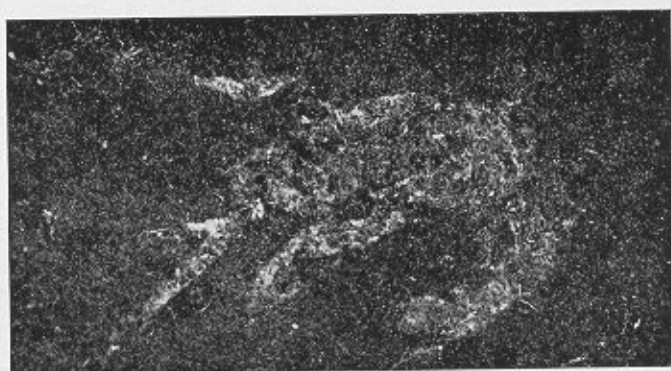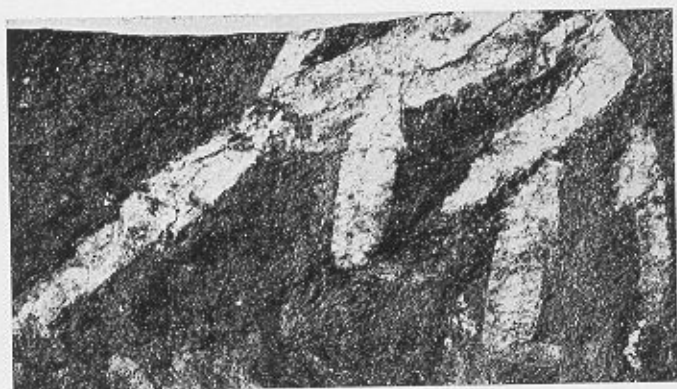## PLATE III

a. An incomplete mecochirid-like decapod from Fossil Bluff representing either the endo-skeleton or one recently emerged from ecdysis; ×2·9 (KG.1.937).

b. A dorsal view of an almost completely articulated mecochirid-like decapod from Fossil Bluff; ×3·6 (KG.1.908).

c. Relatively robust sub-chelate pereiopods associated with the mecochirid-like decapods from Fossil Bluff. The carpus of each limb is strongly spinose; ×4·6 (KG.1.931).

d. An incomplete abdomen of a mecochirid-like decapod from Fossil Bluff showing the tail fan and differently shaped epimeres. At least one epimere (pecked line) from the other side is exposed; ×6 (KG.1.922).

e. A latex cast of the holotype of *Protocallianassa antarctica* sp. nov. from Fossil Bluff, showing the strongly elongated movable finger and the dentate and carinate fixed finger; ×2·8, coated (KG.110.4).

f. A latex cast of part of *P. antarctica* showing a finely granulated quadrate manus. The movable finger (upper centre) is strongly arched upwards; ×3·3, coated (KG.110.5a).

g. A latex cast of *P. antarctica* showing a quadrate manus and carpus. The apex of the movable finger has been distorted; ×3·3, coated (KG.110.5b).

h. A short-fingered protocallianassid claw from locality K showing the reticulate or chagrin pattern of the deeper layers of the cuticle. The movable finger has been interpolated; ×6·7 (KG.18.5).

PLATE III
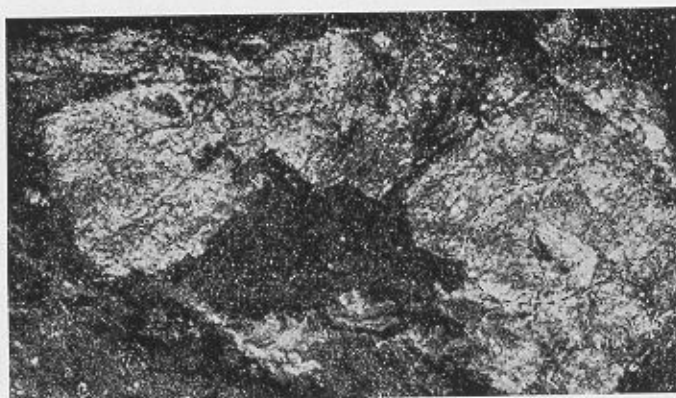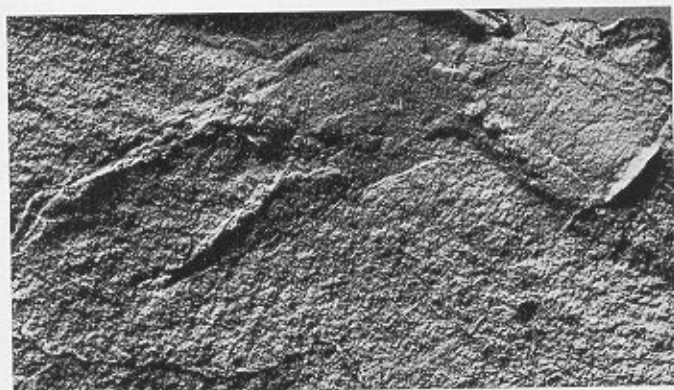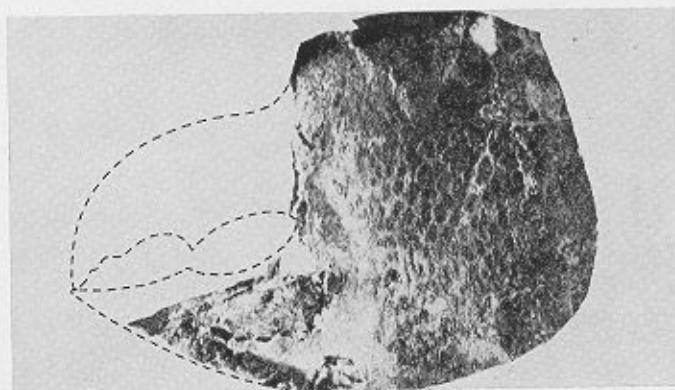

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PLATE IV

a. A latex cast of the holotype of *Schlueteria antarctica* showing the diagnostic ridge extending along the mid-line of the propodus and a less pronounced ridge on the movable finger. Solid and pecked lines indicate two possible trends for the dorsal margin of the movable finger; $\times 2 \cdot 8$, coated (KG.12.12).

b. A latex cast of the right side of the holotype of *Palaeastacus foersteri* from locality N emphasizing the coarse tubercles on the cephalothorax, the accentuation of the protuberance x (Fig. 10a), the *Gelenkungsdornen* (*Gd*) and the large punctate bosses on the abdomen. Serpulids (arrowed) encrust the exopodite or outer uropod and hepatic region; $\times 1 \cdot 7$, coated (KG.50.4). A reconstruction of the holotype of *P. foersteri* is shown in Fig. 11.

c. A latex cast of an incomplete pereiopod collected from the same locality as the holotype of *P. foersteri*; $\times 4 \cdot 4$, coated (KG.11.26).

d. *Palaeastacus* cf. *sussexiensis* from the northern part of Waitabit Cliffs showing the blade-like form of the epimeres, the *Marginalwulst* (*Mw*), the ischium, merus and carpus of the first pereiopod and a diaeresis (arrowed) on the outer uropod; $\times 1 \cdot 7$, coated with glycerine (KG.103.134).

e. An enlargement of Plate IVd showing the trend of the carapace grooves, the configuration of the orbital margin and the coarse tubercles of the gastric region; $\times 2 \cdot 6$ (KG.103.134).

f. Part of the abdomen of *P.* cf. *sussexiensis* showing the punctate ornament and the ensiform shape of the epimeres; $\times 3 \cdot 7$ (KG.103.134).

g. A latex cast of *Palaeastacus terraereginae* from locality N showing the right side of a cephalothorax and the ischium and merus of the first pereiopod. Serpulids encrust the branchiostegite; $\times 2$, coated (KG.11.4).

h. A latex cast of the right side of an exuvium of a specimen similar to specimen KG.11.4 (*P. terraereginae*) showing a dissimilarity in ornament between the completely punctate branchiostegite and the remainder of the cephalothorax. A gastro-orbital or post-orbital carina (arrowed) is also shown; $\times 3 \cdot 8$, coated (KG.3.11).

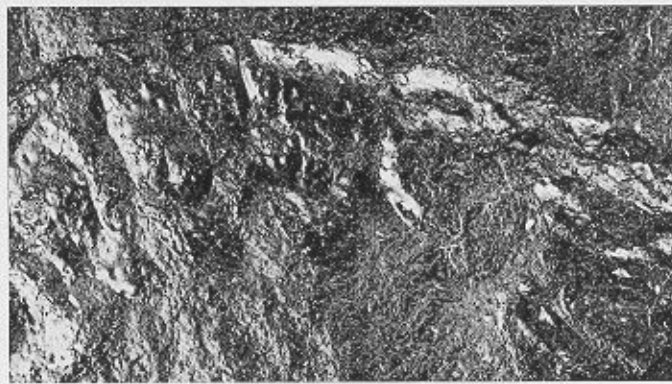PLATE IV
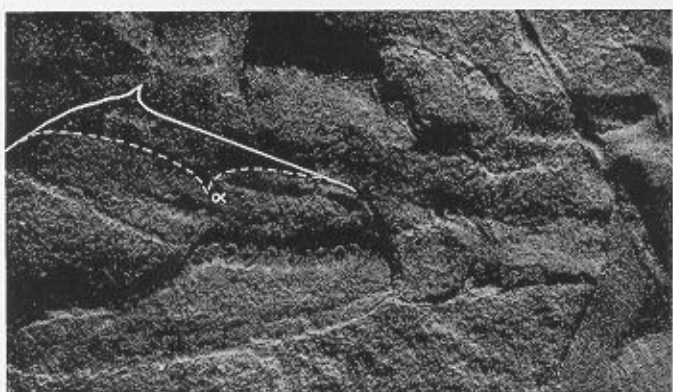
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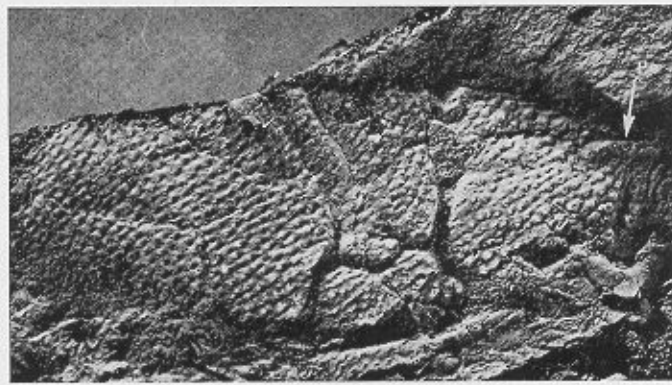

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PLATE V

a. *Enoploclytia* sp. from locality H showing part of the right side of a cephalothorax. The post-cervical groove is pronounced; ×3 (KG.2.164).

b. A latex cast of part of the left side of a cephalothorax of *Enoploclytia* sp. from locality H; ×3, coated (KG.2.214b).

c. A latex cast consisting of part of the sixth abdominal somite and a caudal fan, probably of *Enoploclytia*; ×4·2, coated (KG.2.167).

d. A latex cast of the left cheliped of (?) *Enoploclytia* sp. characterized by a short stout manus and long robust fingers; ×2·2, coated (KG.2.38).
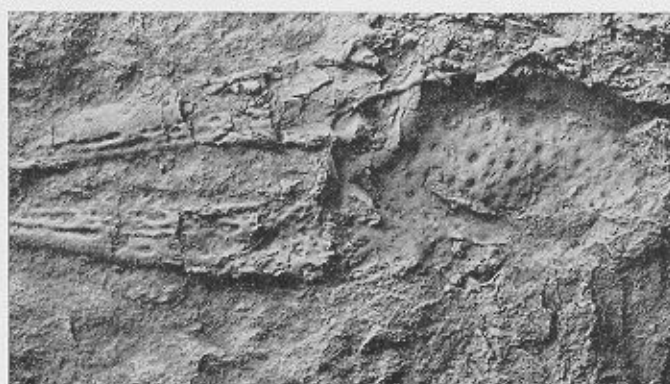
PLATE V

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