NEW EOCENE CRABS FROM THE HAMPSHIRE BASIN

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ABSTRACT. Eocene crabs are described from the London Clay of Highgate and Sussex; the Elmore Formation, Brackelsham Group of Lee-on-the-Solent, Hampshire; the Barton Beds of Christchurch Bay and Alum Bay, Isle of Wight; and the Middle Headon Beds of Colwell Bay, Isle of Wight. Twenty species are represented, sixteen new, belonging to fifteen genera, one of them new. The new taxa are: *Dromilites simplex* sp. nov., *D. lamarckii humerosus* ssp. nov., *Calappilia scopuli* sp. nov., *Bartethusa hepatica* gen. et sp. nov., *Typilobus belli* sp. nov., *T. obscurus* sp. nov., *Leiolambrus? longifrons* sp. nov., *Parthenope* (*Pseudolambrus*) *pentagonus* sp. nov., *Montezumella scabra* sp. nov., *Portunites sylviae* sp. nov., *P. subovata* sp. nov., *Lobonotus vulgatus* sp. nov., *Panopeus kempi* sp. nov., *Branchioplax concinna* sp. nov., *Palaeograpsus depressus* sp. nov., *P. bartonensis* sp. nov. Species new to the British fossil record are *Calappilia dacica* Bittner, *Periacanthus horridus* Bittner, *Micromaia* cf. *tuberculata* Bittner and *Harpactoxanthopsis lutugini* (Likharev). Of the foregoing *D. simplex* is common to the London Clay and Elmore Formation and only *C. dacica*, *P. depressus* and *H. lutugini* are common to both the Elmore and Barton sections.

PREVIOUSLY described crabs from the English Eocene are almost entirely those species from the London Clay (Ypresian). From this Formation fourteen species were described and/or figured in the monographic work of Bell in 1858, although subsequently a total of four species of *Zanthopsis*—*leachii* Desmarest, *dufourii* (Milne-Edwards), *nodosa* M'Coy, and *unispinosa* M'Coy—were recognized in the material. *Necrozius bowerbanki* A. Milne-Edwards, 1865, has since been relegated to synonomy. Subsequent contributions by Woodward (1871, 1873) and Glaessner and Withers (1931) brought the total of known species to twenty. One more, *Harpactoxanthopsis* cf. *quadrilobata* (Desmarest), was recorded by Cooper (1974). We here add the new species *Dromilites simplex*, which ranges into the Bracklesham Group. As so far known, only two genera, *Dromilites* and *Portunites*, from those in the London Clay of England survived into the Bracklesham and Barton Beds of the Hampshire Basin.

In 1867 Woodward described *Goniocypoda edwardsi* from the Lower Eocene of Hampshire but as long ago as 1933 Burton (p. 138) included the only known specimen among the fauna of the Lower Barton Beds. Besides *G. edwardsi*, which, with a new species of *Goniocypoda*, are described by Crane (1981) Burton (1933, p. 162) also drew attention to the presence of chelae of '*Calappa* sp. not commonly found at Horizon A3' and of chelae, 'seldom exceeding 7 mm in length, and 3 mm in breadth at the widest portion' and to 'larger specimens 1 inch in length, of a xanthid crab'. Burton listed *Calappa* sp. (presumably chelae) from his Horizons E and F. Remains of two other decapod genera, *Callianassa* and *Ctenocheles*, have been found by the present authors; the former in Horizons A2, A3, and J, and the latter in Horizons A2, E, F, and J of the Barton Beds of Christchurch Bay and the Middle Barton of Alum Bay, Isle of Wight.

The Auversian and Bartonian of central and southwestern Europe have long been known to yield a rich crab fauna, described by Bittner (1893), Lörenthey (1898), and Lörenthey and Beurlen (1929). Via (1969) described additional material from the Upper Eocene of Spain and presented a supplementary list to Glaessner's Pars 41, Decapoda, of the Fossilium Catalogus (1929). Only four species—*Calappilia dacica*, *Periacanthus horridus*, *Micromaia* aff. *tuberculata*, *Harpactoxanthopsis lutugini*—are common to the Upper Eocene of Europe and the Hampshire Basin.

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STRATIGRAPHY

The foreshore at Lee-on-the-Solent (SU 569500) comprises sands and clays of the Elmore Formation (Kemp, *et al.* 1979), Huntingbridge Division, Bracklesham Group, which is absent from the nearby Selsey section of this Group. The majority of crabs obtained from this locality came from a thin bed (42 cm) of pale, blue-green sandy clay with siltstones and mudstones forming Unit 7 of the Elmore Formation. It follows the 90 cm of green sandy clay, with molluscs and corals, comprising Unit 6, and is overlain by 80 cm of pale blue, stiff clay forming Unit 8.

The type locality for the Barton Beds is in Christchurch Bay, Dorset and Hampshire; it extends from the west of Highcliff Castle (SZ 199928) to Taddiford Gap (SZ 261923), a distance of approximately 3·9 miles (6·3 km). Barton-on-Sea, from whence the deposits derive their name, is situated about midway between these localities.

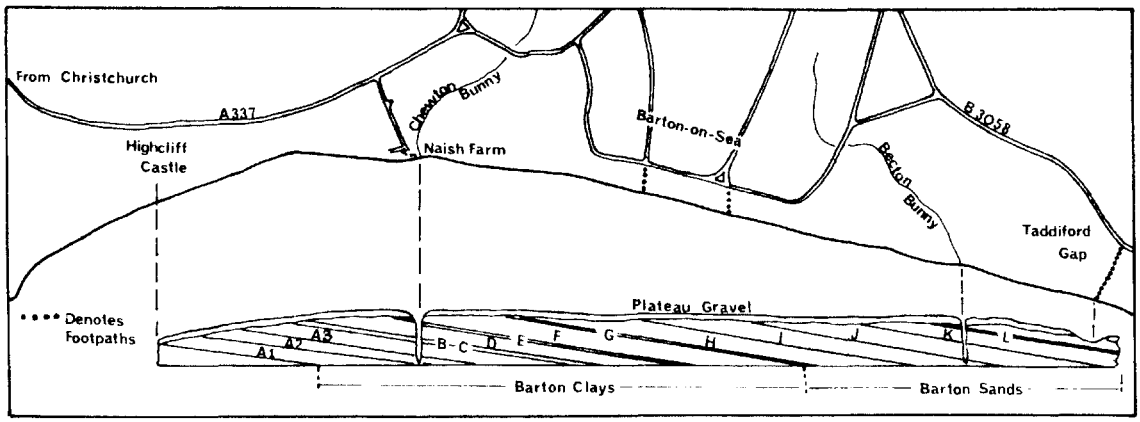
When mapping the relevant areas the Geological Survey (Reid, 1898) used the terms Barton Clay (Prestwich, 1847, pp. 334–335) and Barton Sands (Prestwich, 1857, p. 108) to define the section. Burton (1929), however, divided the Barton Beds into fourteen lettered Horizons, largely on their fossil assemblages, but the divisions coincide with distinct lithological changes, such as nodule bands. For the purpose of this work, we have used Burton's stratigraphic Horizons, which may be briefly summarized as follows:

	Horizon L	1·23 m	Black clay with crushed molluscs.
	K	6·10 m	Whitish sand with fossils at the top—the Long Mead End Bed.
Barton	J	7·93 m	Grey clay becoming sandier towards the top—the Becton Bunny Bed.
Sands	I	7·93 m	Unfossiliferous light coloured sands.
	H	5·49 m	Blue grey sandy clay—the '*Chama* Bed'.
	G	0·30 m	The 'Stone Band' containing reddish shell fragments.
	F	7·62 m	Brownish grey clay with a layer of congretions and drifts of shell fragments.
	E	1·52 m	Lower part composed of loosely compacted clay (in places marked by an oyster bed) passing into a hard brownish clay, topped by a band of septaria.
	D	6·10 m	Basal congretions followed by dark clays; at the top is the '*Corbula* Bed' of some authors.
Barton			
Clays	C	1·83 m	Gritty clay with septarian band at base.
	B	1·22 m	Stiff sandy clay.
	A3	3·05 m	Grey tenacious clay with sands (Highcliff Sands); fossils best preserved in sandy lenticles.
	A2	3·96 m	Clay with some lignite.
	A1	6·10 m	Dark grey clay passing into a sandier clay of lighter colour.

Crabs in the present collection have been found most frequently in Horizons A2, A3, F, and J and they are generally associated with echinoids of several species, e.g. *Hemiaster branderianus* (Forbes) in Horizon A2, *Eupatagus hastingiae* (Forbes) in F and *Echinopsis* cf. *edwardsi* (Forbes) in J. Association with an isopod occurs in Horizons A2 and A3. Four species of crabs have been found in the Middle Barton Beds of Alum Bay; the associated molluscan fauna closely approximates that encountered in Horizon F at the Type section.

From Lee-on-the-Solent only a few specimens of *Goniocypoda* sp. are as yet known, but it is by far the commonest genus in the Barton Beds. On the other hand, *Palaeograpsus depressus* is the commonest crab at Lee-on-the-Solent, where up to ten carapaces have been found in phosphatic nodules no more than 50 mm in length. In the lower Barton beds another species, *P. bartonensis*, occurs more frequently than *P. depressus*, which is not found again in any large numbers until Horizon J. *Palaeograpsus* is represented in the Bartonian of eastern Europe by *P. inflatus* Bittner and *P. loczianus* Lörenthey, the latter extending into Egypt.

Crabs in the English Upper Eocene so far restricted to the Bracklesham Group are: *Dromilites lamarckii humerosus*, *Micromaia* cf. *tuberculata* and *Panopeus kempi*. *D. l. humerosus* is probably



TEXT-FIG. 1. Coastal section and map of Barton-on-Sea, Dorset and Hampshire. Horizontal scale 2 cm to 1 km, vertical section not to scale.

descended from *D. lamarckii lamarckii* (Desmarest), a common London Clay crab. A single specimen referable to *Calappilia dacica* Bittner represents the earliest known member of this species, first described from the Bartonian of Siebenbürgen (Transylvania). Carapaces and claw fragments of *Harpactoxanthopsis lutugini*, previously known by only a single specimen from the Bartonian of the Donetz Basin, U.S.S.R., are quite common at Lee-on-the-Solent; the species also occurs spasmodically in the Barton section.

The most varied fauna from the Barton Beds comes from Horizons A2–A3; six species—*G. edwardsi*, *P. depressus*, *Calappilia scopuli*, *Lobonotus vulgatus*, *Portunites sylviae* and *Typilobus belli*—are of fairly common occurrence. *Montezumella scabra* is similar to the Hungarian Bartonian *Titanocarcinus elegans* Lörenthey, which should be transferred to *Montezumella*. The range of *Leiolambrus?*, hitherto known from two Recent species inhabiting the Atlantic and Pacific seaboards of Central America, is extended by a single specimen, *L.? longifrons*. *M. scabra*, *P. sylviae*, and *H. lutugini* are the only species found in both the clay and phosphatic nodules of these horizons. In Horizon F, *C. scopuli* appears to have been superseded by *C. dacica*, which ranges throughout the Bartonian of Hungary; only a single example of *P. sylviae* is known, but *L. vulgatus* occurs in much the same numbers as in earlier horizons, as do examples of *Goniocypoda*. *Branchioplax concinna* and *G. edwardsi* occur again in Horizon J, together with *P. sylviae* and *P. subovata*. The range of *B. concinna* possibly extends into the Middle Headon Beds.

Preservation. Crabs from the Barton Beds have been found with the original shell surface preserved intact or decorticated, but more frequently as internal moulds embedded in the clay; while none is yet known to occur in the septarian nodules, the small phosphatic nodules common to Horizon J have yielded one or two well-preserved specimens, and others are recorded from phosphatic nodules which probably came from Horizon A2 or A3. Details of the undersides are seldom preserved, and only the occasional carapace with associated limb fragments has been found. Preservation of the crabs from Lee-on-the-Solent is like that found in the London Clay of the Isle of Sheppey. All the specimens are disarticulated, and the nature of the preservation suggests that current action has formed pockets of crab exuviae, together with other debris, including fish remains and lobsters referable to *Hoploparia gammaroides* M'Coy.

Material. Specimens prefixed BM are in the Palaeontological Department British Museum (Nat. Hist.) and, unless otherwise stated, were donated by W. J. and S. Quayle; SM, Sedgwick Museum; OUM, University Museum Oxford; JSQ, W. J. and S. Quayle collection.

SYSTEMATIC PALAEONTOLOGY

Section DROMIACEA de Haan, 1833
Superfamily DROMIOIDEA de Haan, 1833
Family DROMIIDAE de Haan, 1833
Genus *Dromilites* Milne-Edwards, 1837

1837*b* *Dromilite* [*sic*]; H. Milne-Edwards, p. 255.
1837*c* *Dromilite* [*sic*]; H. Milne-Edwards, p. 115.
1838 (publ. Dec. 1837) *Dromilite* [*sic*]; Milne-Edwards, *in* Lamarck, p. 482.)
1845 *Dromilites*; Reuss, p. 15.
1858 *Dromilites* Edwards [*sic*]; Bell, p. 27. And subsequent authors.

Type species. *Dromia bucklandii* Milne-Edwards, 1837*a*.

Remarks. *Dromilites*, in fact, was never published by Milne-Edwards with an included species; the sole references in 1837 are to 'Dromilite', in vernacular form, in a secretary's report of a meeting. There would be serious confusion if *Dromilites* Reuss, 1845, the earliest valid publication of the name, were taken into use and an application is being made to ICZN for action under the plenary powers to stabilize current usage.

Range. Lower Eocene to Miocene.

Dromilites simplex sp. nov.

Plate 104, figs. 1, 2, 3, 10

Derivation of name. From the simple, undifferentiated dorsal surface.

Diagnosis. Carapace subpentagonal in outline with feebly developed lateral spines; the regions largely undifferentiated. The posterolateral margins and a ridge bounding the lateral portion of the branchiocardiac furrows are sparsely granulated.

Material. Six incomplete carapaces. Holotype, a male, BM 34026 (Spencer coll.) London Clay, Highgate; Paratypes, BM In.28173 (Venables coll.) London Clay (Soft rock), Bognor Regis, Sussex; BM In.61700, In.61701 and JSQ LS/24, 25 from Unit 7 Elmore Formation, Lee-on-the-Solent, Hampshire.

Description. The carapace is subpentagonal in outline and a little longer than wide. Viewed from the side the cardiac region forms the highest part; there is a shallow urogastric depression and the downward curvature of the front is only a little less steep than the curve to the posterior margin. It is moderately arched in transverse section. The anterolateral margins are thin and weakly flared; the flare produced to a small spine anteriorly, has its posterior margin rounded in juvenile forms, but produced to a spine as growth advances. There is a shallow excavation before a short outer orbital spine. Behind the cervical notch a spine terminates similarly flared subparallel lateral margins and another spine bounds the much deeper notch for the branchiocardiac furrow. Short, almost straight posterolateral margins lead to broadly rounded angles which are slightly overlapped by a ridge bordering the wide, slightly convex posterior margin. The orbitofrontal margin occupies about two thirds the greatest carapace width; the slightly produced front is steeply downturned and its margins are raised and continuous with oblique upper orbital margins which have an obscure spine over the antennary orbital juncture. There is a spine on the lower orbital margin extending beyond the upper. The antennary fossae are large and ovate and the circular orbits are deep with a single notch in the lower margin.

The shallow cervical furrow is interrupted medially by a narrow extension of the urogastric lobe. On either side of this extension the furrow is broadly V-shaped; it then curves forward and outward to the lateral margin; on the specimens from the Elmore Formation it becomes almost obsolete before reaching the margin. From the widest point of the cardiac region, broad, rather deep branchiocardiac furrows run to the margin, crossing the side in a deep notch; they are bounded posteriorly by a low granulated ridge which continues down the lateral wall of the carapace. Of the gastric lobes only the extreme tip of the anterior mesogastric process is defined; on the type (largest) specimen it is set between very small epigastric lobes. Deep epimeral adductor muscle scars limit the lateral extent of the narrow, rectangular urogastric lobe and anterior of the tumid shield-shaped cardiac region. The epi- and mesobranchial lobes are confluent and tumid.

Anteriorly the dorsal surface is finely and evenly punctate, on the branchial region of the type, however, there

are traces of a coarse granulation strongly developed on *D. bucklandii* and *D. lamarckii* (Desmarest). Standing out on the brown-coloured inner shell layer on each protogastric lobe a little behind the orbit of the Elmore specimens is a patch of black coloured pits marking the sites of attachment of the antennar extensor muscles; a larger patch laying across the base of the mesogastric lobe marks the position of the posterior gastric muscles. The patches on the protogastric lobes are ovate, inclined a little inwards and composed of a cluster of small pits within a ring of larger ones; on the mesogastric lobe wedge-shaped pits enclose round ones of uneven size.

The chelipeds are about half as long again as the carapace length, the carpus being a little shorter than the merus and as long as the palm. The chelae are more or less even in size; the outer surface is smoothly rounded and the slightly down-turned fixed finger equals half the palmar length.

The male abdomen gradually increases in size to the 5th, widest, somite; the distal margins of the 1st-5th somites are broadly concave and the distal angles sharply pointed; the distal margin of the 6th somite is angularly convex to accommodate small, triangular intercalary pieces. The lingulate telson is rather more than twice the length of the 6th somite. The surface is finely punctate.

Discussion. The carapace length of *D. simplex* ranges from 15 mm to 22 mm and the absence of marked tuberculation throughout these stages, together with weakly developed, non-bifurcated marginal spines and lack of transverse tubercles on the urogastric lobe immediately distinguishes this species from *D. bucklandii*, the ontogeny of which was discussed by Bell (1858, p. 32). There appears to be some affinity to *D. vincensis* Cortinas from the Biarritzian of Spain, but this species has a more circular outline, the gastric lobes are moderately well-developed and the posterior part of the carapace is rather less domed in longitudinal section. On both *D. corvini* (Bittner), Middle Eocene, Hungary, and *D. pastoris* Via, from the Middle Lutetian of Spain, the epigastric lobes are rather lobate and both have a group of three tubercles on the cardiac region. Also, Via's figure (1969, text-fig. 10) of *D. pastoris* shows it to have a decidedly spiny lateral margin.

Groups of pits outlining the attachment of the posterior gastric muscles also occur on *D. bucklandii* and are particularly well displayed on carapaces from the London Clay of Aveley, Essex; those marking the antennar extensor muscles are somewhat less prominent than those on *D. simplex*. Similar groups of pits may also occur on *D. corvini* (vide Lörenthey and Beurlen, 1929, pl. 4, fig. 6*a*).

Dromilites lamarckii humerosus subsp. nov.

Plate 104, fig. 5.

Derivation of name. A shoulder—with reference to the broad, shoulder-like appearance of the subhepatic lobes.

Diagnosis. The carapace is sub-pyriform in outline with the front narrow and slightly produced; the subhepatic lobes are very bulbous with four tubercles laterally.

Material. Three incomplete carapaces. Holotype, BM In.61703, (Pl. 104, fig. 5) and paratypes, BM In.61702, JSQ LS/27. Horizon and locality, Unit 7, Elmore Formation, Lee-on-the-Solent, Hants.

Description. The carapace is sub-pyriform in outline, almost as long as wide and widest at about the posterior third; moderately arched transversely and the almost flat longitudinal section is relieved by prominent mesogastric and cardiac tubercles. The orbitofrontal margin is very narrow, barely half the carapace width and a little produced; both the width and forward projection is emphasized by very broad, robust shoulder-like subhepatic lobes, which in side view are almost ovate with a tubercle at each 'corner'. The lateral margins are straight and diverge posteriorly to broadly rounded lateral angles. The posterior margin is missing, but was probably not wider than the front. There is a blunted marginal spine behind a rather tumid epibranchial lobe and another near the posterior angle. The lateral edges are sharply downturned and the rather deep sides are slightly inclined inwards. The short, bluntly triangular rostrum is a little produced and downturned; its margins are slightly raised by a continuation of the upper orbital margin. The margins themselves are not well preserved, but there is a small spine at the inner angle separated by a notch from a similar spine above. The orbits are almost circular and directed forwards. From the lateral margin the cervical furrows curve broadly round the epibranchial lobes, then turning obliquely behind the mesogastic lobe, deepen and end in a pit on either side of the midline. There is a blunt tubercle close to the midline on each protogastric lobe and these, with one on each hepatic lobe form a curving row of four across the front. Another very small pointed tubercle occurs between the hepatic tubercle and the outer angle of the mesogastric lobe. The otherwise narrow anterior mesogastric process

broadens a little before terminating at the base of the rostrum. The mesogastric lobe is roughly lozenge-shaped, there is a large median tubercle and ridge-like tubercles line its posterior edges. These ridges are interrupted by a narrow extension of the urogastric and on either side that lobe is drawn up into similar ridges bordering the cervical furrow; it is depressed behind and confluent with the cardiac region. At the widest part of the elongate-oval cardiac region are two tubercles side by side and a smaller, median one lies behind. On each metabranchial lobe an obscure ridge extends from the widest part of the cardiac region towards the hindmost of the lateral tubercles; medially there is a low tubercle just above the ridge and another 'mesobranchial' one set in the angle formed by the urogastric and epibranchial lobes. The dorsal surface is crowded with numerous, more or less even-sized pits.

Discussion. D. lamarckii humerosus is probably derived from the London Clay species *D. lamarckii lamarckii* (Desmarest). There is close similarity particulary to juvenile forms of the latter, but these carapaces are more steeply arched in transverse section, rather than having the rounded section assumed by larger individuals. The frontal border of *D. lamarckii lamarckii* is proportionally wider in relation to carapace width, and the subhepatic lobe, although tumid, is not visible when viewed from above. On the nominative species the tubercles on the protogastric and hepatic lobes are set wider apart and there is a strong tubercle set obliquely to the widest part of the mesogastric, instead of the diminutive one found on *D. lamarckii humerosus*.

Section OXYSTOMATA H. Milne-Edwards, 1834
Superfamily DORIPPOIDEA de Haan, 1841
Family DORIPPIDAE de Haan, 1841
Subfamily DORIPPINAE de Haan, 1841
Genus BARTETHUSA gen. nov.

Type species. Bartethusa hepatica sp. nov.

Range. Upper Eocene.

Derivation of name. Abbreviation of Barton-on-Sea, Hants., and *Ethusa*, an allied Recent genus.

Diagnosis. A dorippid with the regions and lobes well defined; no lateral spines, but instead two obscure tubercles on the margin of the epibranchial lobes; the front is wide and quadridentate.

Remarks. The outline of the carapace of *Binkhorstia ubaghsi* (Binkhorst), the earliest known dorippid (Upper Senonian, Holland), is more quadrate than that of *Bartethusa hepatica*, which it resembles in the general disposition of the major furrows and, in particular the hepatic furrow, so prominently developed in later genera such as *Dorippe*, *Tymolus*, and *Ethusa*. No anterolateral spines, like those developed on *Dorippe*, are present on *Binkhorstia*, and this is also comparable with *Bartethusa*. Neither *Ethusa* nor *Ethusina*, both Recent genera, have lateral spines, but like *Bartethusa* have blunted tubercles on the margin of the epibranchial lobe. The large hepatic region of *Bartethusa*, however, serves to distinguish that genus from *Ethusa*, wherein the hepatic region is small (Rathbun, 1937); also, the front of *Ethusa* is more or less straight. A similar distinction also applies to *Ethusina*, which, in its extreme lateral displacement of the orbits because of large and swollen basal antennular segments (Rathbun, 1937, p. 89), is perhaps closer to *Bartethusa*. Rathbun (1937) notes that the present distribution of *Ethusa* is: 'east and west coasts of Middle America, eastern Atlantic and Mediterranean and Indo-Pacific Region'; and for *Ethusina*: 'in deep water from the Atlantic, Pacific and Indian Oceans.'

Bartethusa hepatica sp. nov.

Plate 104, fig. 4

Derivation of name. The trivial name refers to the rather prominent hepatic lobes.

Material. A carapace, Holotype, BM In.61704.

Horizon and locality. Horizon A3, Barton Beds, Christchurch Bay.

Description. Carapace subquadrate in outline, widest at its posterior fourth, and nearly as long as broad. In longitudinal section all the frontal area, including most of the orbits, is flatly depressed, then after a steep rise the carapace is almost flat to the posterior margin; transversely it is gently arched. The orbits face obliquely outwards and occupy the extreme corners of the very wide orbitofrontal margin, broken edges suggest weak inner and outer orbital spines and the upper orbital margin is pierced by two notches. The front is a little produced and divided into four equidistant teeth of which the innermost pair, separated by a deep V-shaped sulcus, is the larger. The anterolateral margins are short, straight and converge towards the front somewhat more sharply than the straight lateral margins. The posterolateral angle is broadly rounded, becoming sightly excavated before the posterior margin. The posterior margin is about as wide as the front, slightly concave and bounded by a thin ridge. The cervical furrow is broad and deep; from a marginal notch at about mid-carapace length it passes obliquely downwards, then curving round the base of the large elliptical hepatic lobe it forms a sharp angle before continuing obliquely downwards to the mesogastric lobe where it becomes shallower and crosses the midline in a gentle curve. The branchiocardiac furrow is as wide and deep as the cervical; from a marginal notch it curves smoothly to the uro-cardiac juncture where it is interrupted by a ridge bordering deep epimeral adductor muscle scars. The mesogastric lobe is very small and triangular and the anterior process extends to the base of the transverse frontal depression. The hepatic lobes have a small, flattened triangular spine facing to the front and on each epibranchial lobe is a bluntly rounded spine followed by a similar one bordering the branchiocardiac notch. A low ridge on each protogastric lobe partially bounds then diverges away from the furrow separating them from the hepatic lobes. The urogastric lobe is subtriangular with an obscure tubercle set at each angle; it is separated by a deep groove from the broadly pentagonal cardiac lobe. The epi- and mesobranchial lobes are wide and confluent. A row of even-sized tubercles lines the lateral margin of the metabranchial lobe; becoming rounded and smoother the granules continue as a ridge-like elevation above the true margins then turns abruptly forwards to border the anterior part of the cardiac region. A longitudinal line of weaker granules extends from this 'posterior ridge' almost to the branchiocardiac furrow. A few scattered granules make up the surface ornament.

Superfamily CALAPPOIDEA de Haan, 1833
Family CALAPPIDAE de Haan, 1833
Subfamily CALAPPINAE de Haan, 1833
Genus CALAPPILIA A. Milne-Edwards, 1873

Type species. *Calappilia verrucosa* A. Milne-Edwards, 1873, by monotypy.

Range. Upper Eocene to Upper Oligocene.

Calappilia dacica Bittner, 1893

Plate 104, figs. 6, 9

1893 *Calappilia dacica* Bittner; p. 16, pl. 2, fig. 1.
1929 *Calappilia dacica* Bittner; Glaessner, p. 73 (see also for intermediate synonymy).
1929 *Calappilia dacica* Bittner; Lörenthey and Beurlen, p. 127, pl. 6, fig. 46.
1969 *Calappilia dacica* Bittner; Via, p. 359.

Range. Eocene, Upper Auversian to Upper Bartonian.

Material. Seventeen carapaces. BM In.61793–In.61798 (Curry collection); SM C.84872 *ex* JSQ coll; OUM, L381 *ex* JSQ coll; remainder JSQ coll.

Horizon and locality. Horizon F, Barton Beds, Christchurch Bay and the Middle Barton, Alum Bay, I.o.W.

Description. The carapace is almost circular in outline, just a little longer than wide with the greatest width near to midlength; it is more strongly vaulted in younger specimens. The short anterolateral margins are broadly rounded and lined with six weak tubercles. The lateral angles are bluntly rounded and the posterolateral margins are weakly concave to nearly straight, and armed with seven spines which become progressively stronger posteriorly to the fifth spine, the sixth and seventh are much reduced. There is a sharp spine on each posterolateral angle and an obscure median one on the narrow posterior margin. The orbitofrontal margin occupies about half the carapace width; the rostrum is produced, spatulate and a little sulcate. The small, almost circular orbits are close together, and somewhat inclined upwards. There are two notches in the rather narrow

upper margin and the small outer orbital spine is inturned. The cervical furrow is very weak where it crosses the midline of the carapace in an obtuse V about half the distance from the front; it is deep and broad bordering the mesogastric lobe, then becomes shallower as it forms two curves round the meso- and epibranchial lobes respectively. The hepatic groove is as broad and deep as the mesogastric portion of the cervical furrow. The urogastric lobe is small, subrectangular and barely separated from an ovate cardiac region. The branchial lobes are more or less confluent.

The dorsal surface is covered with numerous tubercles of uneven size which have a tendency towards grouping into rosette-like patterns, particularly on the cardiac region and mesogastric and metabranchial lobes. On each protogastric lobe are two or three tubercles which, with a smaller one at the base of the anterior process of the mesogastric lobe form a transversely curving row. The urogastric lobe has a median tubercle sometimes flanked by smaller ones and some specimens have a triangular formation of three tubercles on the intestinal region.

Discussion. Rosette-like arrangements of tubercles also form part of the ornament of *C. hondoensis* Rathbun from the Upper Eocene of Mexico, but in the latter the group on the branchial region is level with the urogastric lobe and rather more tubercles surround the median one on the cardiac region; the mesogastric lobe has only a single tubercle and the posterolateral margins are less spinose. None of our specimens conform to *C. dacica* var. *lyrata*, described by Lörenthey and Beurlen from the Bartonian of Hungary.

Calappilia scopuli sp. nov.

Plate 104, fig. 8

Derivation of name. Latin, of the cliff, with reference to Highcliff, Dorset.

Diagnosis. A *Calappilia* with the lateral margin fringed with spines; there is a spine at the posterior angles and a median one on the posterior margin. The median and other dorsal tubercles are not well developed.

Material. Fifteen more or less incomplete carapaces. Holotype, BM In.61705 (Pl. 104, fig. 8), Horizon A2, Barton Beds, Christchurch Bay. Paratypes, BM In.61706, SM C.84877 *ex* JSQ coll., JSQ A2/3, A2/2, and E/1.

Horizon and locality. Horizons A2, A3, and base of F (?E), Barton Beds, Christchurch Bay.

EXPLANATION OF PLATE 104

Figs. 1, 2. *Dromilites simplex* sp. nov., London Clay, Highgate. Dorsal and ventral view of Holotype, BM 34026, × 1.

Figs. 3, 10. *Dromilites simplex* sp. nov., Unit 7, Elmore Formation, Lee-on-the-Solent, Hants. 3. Paratype, BM In.61700, × 1·6. 10. View of the pits marking the attachment of the antennar extensor muscles. BM In.61700, × 5.

Fig. 4. *Bartethusa hepatica* gen et sp. nov., Horizon A3, Barton Beds, Christchurch Bay. Holotype, BM In.61704, × 2·8.

Fig. 5. *Dromilites lamarckii humerosus* ssp. nov., Unit 7, Elmore Formation, Lee-on-the-Solent, Hants. Holotype, BM In.61703, × 1·6.

Figs. 6, 9. *Calappilia dacica* Bittner, Horizon F, Barton Beds, Christchurch Bay. 6. JSQ coll., F/1, × 4·5. 9. View of the rostrum and orbits, BM In.6179, × 5.

Fig. 7. *Lobonotus vulgatus* sp. nov., Horizon A2, Barton Beds, Christchurch Bay. Holotype, BM In.61722, × 4.

Fig. 8. *Calappilia scopuli* sp. nov., Horizon A2, Barton Beds, Christchurch Bay. Holotype, BM In.61705, × 2.

Fig. 11. *Parthenope* (*Pseudolambrus*) *pentagonus* sp. nov., Horizon J, Barton Beds, Christchurch Bay. Holotype, BM In.61710, × 1·8.

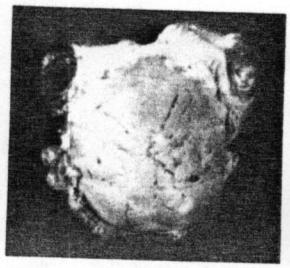
Fig. 12. *Typilobus belli* sp. nov., Horizon A2, Barton Beds, Christchurch Bay. Holotype, BM In.61707, × 2·8.

Fig. 13. *Typilobus obscurus* sp. nov., Colwell Bay, I.o.W. Holotype, BM 49664, × 2.

Fig. 14. *Periacanthus horridus* Bittner, Horizon A2, Barton Beds, Christchurch Bay. JSQ coll., A2/70, × 2.

Fig. 15. *Micromaia* cf. *tuberculata* Bittner, Unit 7, Elmore Formation, Lee-on-the-Solent, Hants. JSQ coll., LS/53, × 2·4.

Fig. 16. *Leiolambrus ?longifrons* sp. nov., Horizon A3, Barton Beds, Christchurch Bay. Holotype, BM In.61709, × 4·5.



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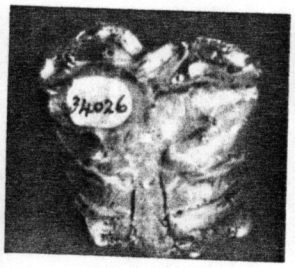

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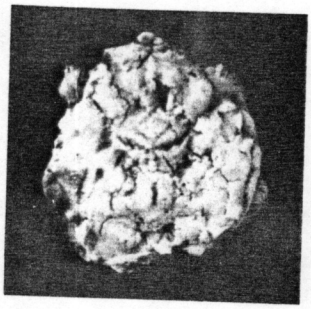

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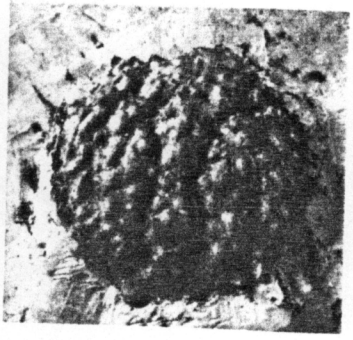

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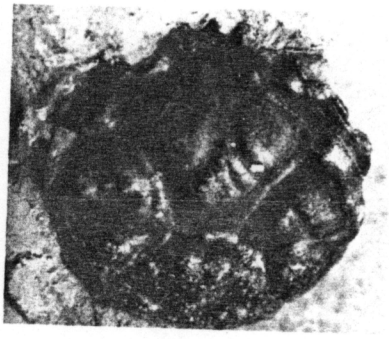

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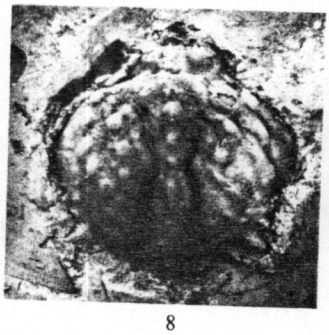

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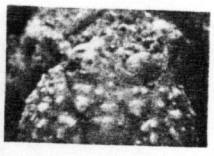

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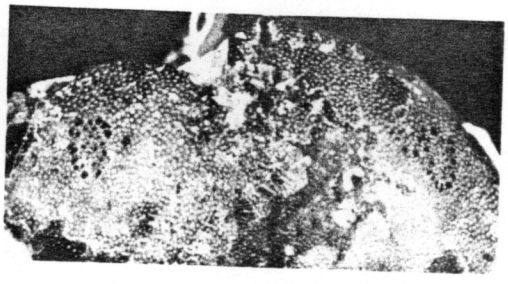

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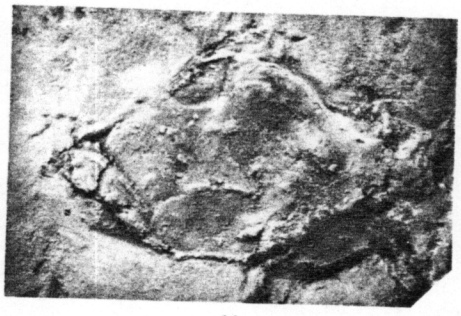

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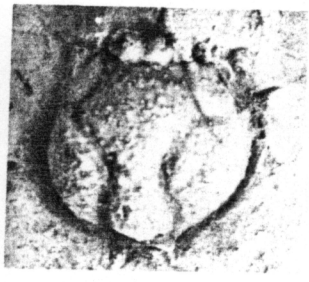

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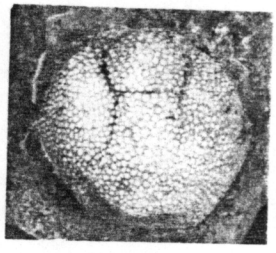

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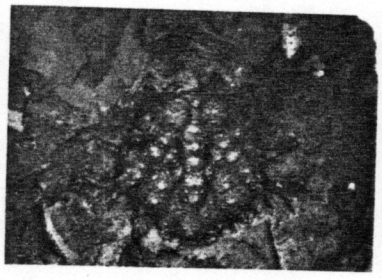

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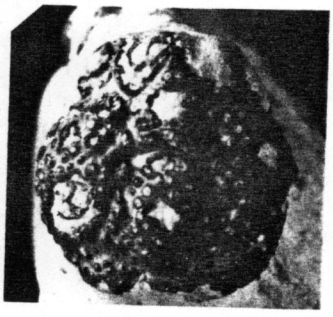

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16

QUAYLE and COLLINS, Eocene crabs

Description. The carapace is almost circular in outline, sometimes a little longer than wide, widest a little before midlength. It is moderately domed in longitudinal and transverse sections. Lining the posterolateral margins are three or four tubercles, followed by four spines; the first two spines are bluntly triangular, the third is sharply pointed and by far the largest, while the fourth is much reduced in size. There is a small spine at the posterior angles and another, median one on the narrow posterior margin. The orbitofrontal margin occupies rather less than half the carapace width. The orbits are close together, broadly ovate and somewhat inclined upwards. The very thin, raised upper orbital margin is pierced by two notches. The rostrum is not well preserved on any of the specimens seen, but probably took up about one third of the orbitofrontal margin, barely produced beyond the outer orbital spines, straight-sided and flanked by inner orbital spines of moderate size. The cervical furrow is broad and deep medially, becoming indistinct towards the margin; it is obtusely V-shaped where it crosses the midline rather less than halfway from the front, then inclining sharply forwards it runs in a broad curve towards the lateral margin. Deep furrows delineate the urogastric and cardiac lobes from the largely undifferentiated branchial region. The urogastric lobe forms a narrow bar with steeply sloping sides and is barely separated from the subovate cardiac region. The intestinal region is transversely ovate and wider than the cardiac region. The median tubercles are generally subdued and in line; there are two on the mesogastric and one on each of the urogastric and cardiac lobes. Of the two tubercles of each protogastric the foremost lies close to the midline and together they form a curving row of four across the front. On the branchial regions six, sometimes seven tubercles are arranged elliptically and of these, the foremost (on the mesobranchial lobe) and that one in line with the mesogastric lobe have a slightly smaller 'satellite'-tubercle immediately above. A line of coarse granules extends midway between the branchial tubercles and the lateral margin. Scattered granules of several diameters complete the surface ornament.

Discussion. C. scopuli is closely related to *C. diglypta* Stenzel (Middle Eocene, Texas) but differs in the arrangement of the posterolateral spines, of which the first five on *C. diglypta* are rather more tubercular than spiny (Stenzel, 1934), there are five median tubercles instead of four as in *C. scopuli*, and a greater number of branchial tubercles. *C. scopuli* also shows some similarity to *C. brooksi* Ross and Scolaro (Upper Eocene, Florida); the spines lining the anterolateral margins of *C. brooksi* are much larger so that the increase in size posteriorly is more gradual, and all the spines are rounded apically. Among differences in tuberculation, *C. brooksi* has a rosette-like arrangement of tubercles bordering the hepatic and epibranchial lobes and a circlet of granules surrounds the foremost of three tubercles on the cardiac region.

Family LEUCOSIIDAE Samouelle, 1819
Subfamily PHILYRINAE Rathbun, 1937
Genus *Typilobus* Stoliczka, 1871

Type species. Typilobus granulosus Stoliczka, 1871, by monotypy.

Range. Middle Eocene to Middle Miocene.

Typilobus belli sp. nov.

Plate 104, fig. 12

Derivation of name. In recognition of Professor T. J. Bell.

Diagnosis. A *Typilobus* with a short spine on the lateral margin and another, stronger one at each posterior angle.

Material. Six carapaces. Holotype, BM In. 61707 (Pl. 104, fig. 12), Horizon A2, Barton Beds, Christchurch Bay. Paratypes, BM In.61708, JSQ A2/44, A2/47, A2/58.

Horizon and locality. Horizons A2 and A3, Barton Beds, Christchurch Bay.

Description. The carapace is small and almsot circular in outline with the widest part posterior to midlength. In longitudinal section it is flat behind the front then rises in a moderate curve to the highest point about midlength before curving steeply down on either side of the protuberant cardiac region; transversely it is evenly rounded. The anterolateral margins are convex and rather deeply indented at the cervical notch. Behind the notch is a short blunt spine and the lateral angles curve broadly into the posterolateral margins; these become a little

recurved before the posterior angles which are produced to short, blunt spines. The posterior margin is nearly straight and bounded by a thin ridge. The orbitofrontal margin is slightly produced and occupies rather more than half of the carapace width; the front, comprising the middle third, is nearly straight and there is a deep medial depression leading sharply down to form the rostrum. A cleft separates the front from the upper orbital margin and although damaged there are indications of a weak outer spine. With the exception of the one separating the almost rectangular urogastric region, the furrows delineating the regions are deep and well developed. The cardiac region is very tumid, transversely subovate, rather wider than the base of the mesogastric lobe and posteriorly does not quite reach the posterior margin.

The dorsal surface is densely covered in granules which tend to become somewhat less coarse medially and towards the lateral margins.

Discussion. The flattened front and spines at the posterior angles serve to distinguish *T. belli* from the contemporary Hungarian species, *T. semseyanus* Lörenthey, on which the gastro-cardiac groove is stronger. Of Via's two species from the Lutetian of Spain, *T. boscoi* is the closer to *T. belli* and may well represent the ancestral stock from which *T. belli* evolved. It differs, however, in having prominent lateral spines and in the greater width of the anterior border of the cardiac region in relation to the carapace width. No lateral spines are developed in *T. modregoi* Via, but in the species the orbito-frontal margin is wider and not produced; the furrows are less prominent and the surface ornament is considerably finer.

Typilobus obscurus sp. nov.

Plate 104, fig. 13

Derivation of name. From the vaguely developed hepatic furrows.

Diagnosis. The carapace is subglobose, the hepatic furrows are vestigial and the lateral margins are devoid of spines or tubercles.

Material. Four carapaces. Holotype BM 49664 (Pl. 104, fig. 13), Colwell Bay, I.o.W., paratype BM 49855 (Both Edward's collection); JSQ. CB/1 and CB/2.

Horizon and locality. Colwell Bay, I.o.W. and Brockenhurst, Hampshire.

Description. The entire frontal area of the subglobose, almost circular carapace is missing, but it was probably no more than half the carapace width. In side view, there is the merest indication of a postfrontal depression. There is a shallow constriction of the short, convex anterolateral margins at the cervical notch and the posterolateral margins, devoid of any spiny processes, lead by acute posterior angles to the posterior margin. The posterior margin is straight to slightly concave and about as wide as the front. The cervical furrow is feebly developed laterally and only the basal portion, represented by little more than a line between the surface granules, of the hepatic furrows is present. The tumid, rounded-pentagonal cardiac region is wider than the urogastric lobe and does not overhang the posterior margin. An exceedingly fine groove bounding the posterior margin just isolates a narrow, strip-like intestinal region which has a node at each corner. The surface ornament consists of numerous granules interspersed with smaller ones; as the granules decrease in size laterally, so the difference between the sizes remains more or less constant.

Discussion. The weak lateral development of the cervical furrow, virtual absence of hepatic furrows and shorter anterolateral margin immediately distinguishes *T. obscurus* from the foregoing species. In *T. semseyanus* Lörenthey, Bartonian of Hungary, the hepatic furrows are fully developed, there is a small marginal tubercle and the cardiac region appears to overhang the posterior margin. *T. modregoi*, from the M. Lutetian of Spain, lacks marginal spines, but is ovate in outline, smoother and much flatter in transverse section; the outline of *T. boscoi*, also from the Spanish Lutetian, has a similar convexity to *T. obscurus*, but has distinct marginal spines. The rounded outline, absence of marginal spines and weakening furrows of *T. obscurus* are all characters tending towards some Miocene members of the genus, and younger leucosiid genera—particularly *Philyra*.

Section OXYRHYNCHA Latreille, 1803
Family MAJIDAE Samouelle, 1819
Subfamily MAJINAE Samouelle, 1819
Genus PERIACANTHUS Bittner, 1875

Type species. Periacanthus horridus Bittner, 1875 by monotypy.

Range. Middle to Upper Eocene.

Periacanthus horridus Bittner, 1875

Plate 104, fig. 14

1875 *Periacanthus horridus* Bittner, p. 77, pl. 2, fig. 1.
1969 *Periacanthus horridus* Bittner; Via, p. 175, pl. 12, fig. 2. (See also for intermediate synonymies.)

Material. A carapace. JSQ A2/70.

Horizon and locality. Horizon A2, Barton Beds, Christchurch Bay.

Remarks. The carapace is of a young individual, about half the size of those figured by Bittner (1875), Via (1969) *et al.* These figures depict a certain degree of variation of the lateral spines and surface ornament; the present specimen fits well within these latitudes. Details of the front and orbital roof are obscured by matrix. *P. dallonii* Via (Lutetian, Spain), the only other member of the genus, differs largely in having fewer marginal spines and in details of the front.

Subfamily MICROMAIINAE BEURLEN, 1930
Genus MICROMAIA Bittner, 1875

Type species. Micromaia tuberculata Bittner, 1875 by monotypy.

Range. Middle Eocene to Lower Oligocene.

Micromaia cf. *tuberculata* Bittner, 1875

Plate 104, fig. 15

cf. 1875 *Micromaia tuberculata* Bittner, p. 76, pl. 2, fig. 2.
cf. 1969 *Micromaia tuberculata* Bittner; Via, p. 162, pl. 11, figs. 1–4. (See also for intermediate synonymies.)

Material. A water rolled carapace. JSQ LS/53.

Horizon and locality. Unit 7, Elmore Formation, Lee-on-the-Solent, Hants.

Range. Lutetian to Bartonian.

Remarks. The specimen is a water-rolled carapace lacking the entire front and details of the mesogastric lobe. In the arrangement of the grooves and the dense, more or less even-sized tubercles, it is close to the specimen of *M. tuberculata* figured by Via (1969, pl. 11, fig. 3) from the Lutetian of Italy. On the same plate is figured (figs. 5–10) examples of *M. margaritata* Fabiani from the Middle Lutetian of Spain; this is a relatively slimmer species differing from *M. tuberculata* in details of the front and in having fewer and more variably sized tubercles. The lateral margins of *M. pustulosa* Lörenthey (Bartonian, Hungary) are sinous with a conspicuous contraction posteriorly. A narrow bifid rostrum and large epibranchial lobes are among characters distinguishing *Micromaia* from *Mithracia*, a closely allied genus known only from the London Clay (Ypresian).

Family PARTHENOPIDAE Macleay, 1838
Subfamily PARTHENOPINAE Macleay, 1838
Genus LEIOLAMBRUS A. Milne-Edwards, 1878

Type species. Leiolambrus punctissimus (Owen, 1839) *spinosissima*, by error.

Range. Upper Eocene to Recent.

Leiolambrus? longifrons sp. nov.

Plate 104, fig. 16; text-fig. 2B

Derivation of name. Alluding to the produced front.

Diagnosis. The carapace is depressed, without spines behind the lateral spine; the front is broad, produced and feebly trilobed.

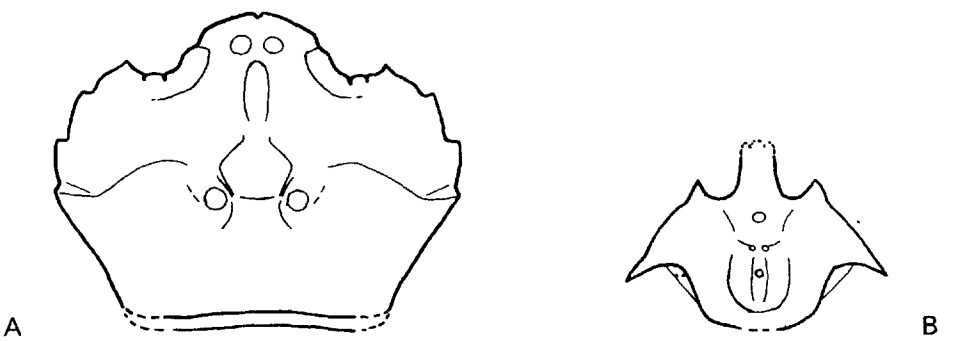
Material. Carapace: Holotype BM In.61709.

Horizon and locality. Horizon A3, Barton Beds, Christchurch Bay.

Description. The carapace is hexagonal in outline, a little more than three fourths longer than wide; longitudinally nearly flat, in transverse section the median gastric and cardiac regions form a low, elevation flanked on either side by a broad depression. The anterolateral margins are arcuate and, from the evidence of basal scars, lined with coarse granules. The lateral spine is strongly produced, triangular, slightly upturned and directed a little backwards. The posterolateral margins are only a little shorter than the anterolateral, nearly straight and converge rapidly to the posterior margin. The posterior margin is not well preserved, but appears to be as wide as the front and nearly straight. The orbitofrontal margin occupies half the total width. The front is produced and truncate, but with a feeble median tooth; it is moderately sulcate with the raised edges enclosing an infilled median notch. The orbits occupy the outer third of the orbitofrontal width; the upper orbital margin is thinly raised and terminates in a prominent triangular outer orbital spine.

The median gastric and the cardiac regions are tumid; the mesogastric lobe is pyriform and bounded behind by the shallow, broadly V-shaped median portion of the cervical furrow. There are two obscure nodes set medially on the mesogastric and one on the urogastric lobe. Small rounded epigastric lobes, the meso- and lateral part of the metabranchial lobes are very weakly tumid. There is a low, thin, slightly convergent branchial ridge on either side of the cardiac region.

Discussion. Hitherto *Leiolambrus* has been represented by only two species, *L. punctissimus* (Owen) from California and Mexico, and *L. nitidus* Rathbun from Peurto Rico and Jamaica (Rathbun, 1925, pls. 198, 199, 281). While *L. punctissimus* has been taken from about 25 fathoms, *L. nitidus* is recorded from about 4 to 40 fathoms and has been found on bottoms varying from sand to sticky mud.



TEXT-FIG. 2. A. A reconstruction of *Panopeus kempi*, ×2.
B. *Leiolambrus longifrons*, ×4.

The front of *L.? longifrons* is rather more produced and somewhat wider than that of either of the extant species, in *L. punctissimus* it occupies about a half and in *L. nitidus* a little less than half of the orbitofrontal width. Stout spines are present on the poterolateral margin and the posterior angles of *L. punctissimus* and in the absence of these, *L.? longifrons* is closer to *L. nitidus* in which only the posterolateral spine may be freely developed. The branchial ridge occurs nearer the lateral margin in both Recent species. The very wide, open orbits distinguishes this genus from *Merocryptus* A. Milne-Edwards, a superficially similar Recent leocosiid genus.

Genus PARTHENOPE Weber, 1795
Subgenus PSEUDOLAMBRUS Paulson, 1875

Type species. Lambrus calappoides Adams and White, 1848 by original designation.

Range. Upper Eocene to Recent.

Parthenope (Pseudolambrus) pentagonus sp. nov.

Plate 104, fig. 11

Derivation of name. With reference to the pentagonal outline of the carapace.

Diagnosis. Carapace subpentagonal with the regions and lobes distinct and tumid; the posterolateral margins are ridged.

Material. Three carapaces. Holotype, BM In.61710 (Pl. 104, fig. 11). Paratypes, JSQ. J/41 and J/55.

Horizon and locality. Horizon J, Barton Beds, Christchurch Bay.

Description. The carapace is almost pentagonal in outline, the width being about one and a half times the length; in transverse section it rises steeply from the margins and becomes fractionally depressed towards the midline, longitudinally it curves steeply up from the front as far as the mesogastric lobe, then is more or less flat to the cardiac region before sloping gently down to the posterior margin. The anterolateral margins are about one fifth longer than the posterolateral margins; they are weakly convex anteriorly, but become a little concave towards the lateral angle which is produced to a sharp point. The posterolateral margins are straight and topped by four, more or less even-sized, tubercles giving rise to a low granulated ridge curving forward towards the lateral angle. The posterior angles are acute and the posterior margin, raised above the level of the front, is about as wide, straight to weakly concave and bounded by a thin ridge. The front is much depressed, a little produced and broadly rounded with a feeble median notch. The poorly preserved orbits were probably circular; the upper orbital margins are ridged.

The basally rounded, very tumid protogastric lobes are attenuated into a ridge-like process converging towards the front and terminate at the tip of the long, narrow anterior mesogastric process. There is a transverse pair of small tubercles near the centre of the subovate mesogastric lobe. The hepatic regions are reduced to a small node at the base of the protogastric lobes and almost equally tumid elongate nodes forming the epibranchial lobes, the latter set parallel with the anterolateral margins. The urogastric lobe is confluent with the subtriangular cardiac region, across the anterior part of which is a thin medially divided ridge. The mesobranchial lobe is represented by a low node level with the widest part of the cardiac region. Bordering the posterolateral margins the metabranchial lobes are drawn up into a strong ridge lined with a single row of granules; against this ridge rests the merus of the ?5th limb.

The tumid areas are rather coarsely granulated and much finer granules are scattered over the remaining surface; an inner shell-layer is finely pitted.

On the right hand side of In.61710, the merus of the fifth, or perhaps fourth limb lies against the posterolateral margin; it is about twice as long as wide, flattened laterally and has a ridge bordering the lower margin.

Discussion. Parthenope is first known from the Lower Cretaceous of France, represented by *P. neocomiensis* Robineau-Desvoidy, and is represented in the Eocene by *P. eocaena* (Bittner) and *P. ?nummulitica* (Bittner) from the Lutetian of Italy. The subgenus *Pseudolambrus* is known from the Bartonian of Roumania by *P.* (*P.*) *corallinus* Bittner; the absence of ridges bordering the posterolateral margins and a less strongly depressed front readily distinguishes it from *P.* (*P.*)

pentagonus. Among Recent members of the subgenus, *P.* (*P.*) *excavata* Stimpson, recorded from Mexico and Panama, is close to *P.* (*P.*) *pentagonus*, but here, the lateral angle is set further back, the epibranchial node is larger and less separated from the protogastric lobe, and no metabranchial ridge is developed.

Section CANCRIDEA Latreille, 1803
Family ATELECYCLIDAE Ortmann, 1893
Subfamily ATELECYCLINAE Ortmann, 1893
Genus MONTEZUMELLA Rathbun, 1930

Type species. *Montezumella tubulata* Rathbun, 1930 by subsequent designation of Glaessner, 1969.

Range. Middle Eocene to Upper Oligocene.

Montezumella scabra sp. nov.

Plate 105, fig. 1

Derivation of name. The trivial name is derived from the rather coarse ornamentation of the carapace.

Diagnosis. The carapace is pentagonal in outline with the posterolateral margins straight and slightly convergent; the sides of the anterior process of the mesogastric lobe taper uninterruptedly towards the apex.

Material. Two more or less entire carapaces. Holotype, BM In.61711 (Pl. 105, fig. 1) and Paratype, JSQ. A2/35.

Horizon and locality. Horizon A2, Barton Beds, Christchurch Bay.

Description. The carapace is pentagonal in outline, rather wider than long and widest at midlength; it is almost flat both transversely and longitudinally. There is a short, forewardly projecting spine at the lateral angle and three basal scars lining the short, rounded anterolateral margin indicate the presence of a similar number of spines common to other members of the genus. The posterolateral margins are nearly straight and converge on shallow incisions for the fifth coxae. The posterior margin is about as wide as the front, moderately concave and bounded by a thin ridge. The orbitofrontal margin is incomplete, but was about two thirds of the carapace width. The regions are well defined by broad but shallow furrows. From the margin the cervical furrow curves sharply upwards and inwards to meet the furrow separating the protogastric lobe from the somewhat depressed hepatic lobe; turning down, it runs straight as far as the mesogastric lobe, where becoming narrower it crosses the midline at an obtuse angle. The branchiocardiac furrow is weaker; from the same marginal notch as the cervical it turns abruptly down to run parallel with the lateral margin before turning sharply inwards towards the midline. The mesogastric lobe is broadly trapezoidal in outline and partially divided posteriorly by a faint depression; the anterior process is broad at its base with slightly convex sides tapering gradually to a rounded apex depressed between the protogastric lobes. The protogastric lobes are each divided anteriorly by a shallow depression extending from the front. An obscure groove divides the urogastric lobe into a narrow anterior part with inwardly sloping sides, from a longer rectangular part barely separated from the lingulate cardiac region. A furrow separates very small epibranchial lobes from larger, subdivided mesobranchial lobes.

The surface ornament consists of numerous granules of unequal size; on the cardiac and posterior half of the metabranchial lobes they become smaller with a tendency to form short transverse curving lines or ridges. There are two low ridges on the very narrow subhepatic region. The pterygostomian process is broadly trapezoidal and the straight buccal margins converge a little posteriorly. The endognath of the third maxilliped is just twice as long as wide and has a deep longitudinal groove set slightly nearer the opposing side; the exognath is slender and of about the same length as the endognath.

Discussion. *M. scabra* is closely related to *M. amenosi* Via, from the Lutetian of Spain, but differs in having the anterior mesogastric process tapering gradually towards the front; the posterior part of the urogastric lobe is narrower in *M. scabra* and the mesogastric lobe is less obviously subdivided. Similar distinctions apply to *M. tubulata*, but in this species the anterior mesogastric process is constricted close to the main body of the lobe and is then drawn out towards the front in two quite distinct tapering stages; also, the surface ornament is more separately granulated.

Titanocarcinus elegans Lörenthey and Beurlen (1929, pl. 11, fig. 3) from the Lower Bartonian of Hungary has, in the pentagonal outline of the carapace, the downward passage of the branchiocardiac furrow after commencing from the same notch as the cervical furrow, the narrow median lobes and weakly divided mesogastric lobe, together with the linear ornament of the branchial region, all the characters essential to *Montezumella* and is herein included in that genus. *M. scabra* is close to *M. elegans*, but in the latter the cardiac lobe is more circular and is wider than the more distinctly-divided mesogastric lobe.

Via (1969) considered that all the Recent and fossil species included in the subfamily Atelecyclinae probably had their origins in *Montezumella fraasi* (Lörenthey), Lutetian, Egypt, and that the group rapidly spread to Spain (*M. amenosi* Via). It reached the Atlantic Region by the Upper Eocene (*M. rutheni* Van Straelen, Dutch Antilles) and the Pacific Region by Upper Eocene and Upper Oligocene times (*M. tubulata* Rathbun, Mexico and *M. casayetensis* Rathbun, Panama). It is now probable that a simultaneous north and north-westerly migration occurred during the Upper Eocene.

Section BRACHYRHYNCHA Borradaile, 1907
Superfamily PORTUNOIDEA Rafinesque, 1815
Family PORTUNIDAE Rafinesque, 1815
Subfamily CARCININAE Macleay, 1838
Genus PORTUNITES Bell, 1858

Type species. Portunites incerta Bell, 1858 by monotypy.

Range. Eocene to Miocene.

Portunites sylviae sp. nov.

Plate. 105, fig. 4

Derivation of name. This species is named after Mrs. Sylvia Quayle.

Diagnosis. A *Portunites* with the anterolateral spines flatly triangular and increasing in length posteriorly; the urogastric lobe is narrow, elevated to form a low ridge and devoid of tubercles.

Material. Ten carapaces. Holotype, BM In.61713 (Pl. 105, fig. 4), Horizon J, Barton Beds, Christchurch Bay. Paratypes, BM In.61712, BM In.61714, SM C.84874, OUM, L382 *ex* JSQ coll.; JSQ, J/45, J/46, J/49, J/50, and F/17.

Horizon and locality. Horizons A3, F and J, Barton Beds, Christchurch Bay.

Description. The carapace is subhexagonal in outline and one third broader than long. It is moderately arched in longitudinal section and transversely moderately arched medially, becoming flattened towards the margins. The orbitofrontal margin occupies rather more than half the carapace width. The front is feebly separated by notches from weak inner orbital spines and takes up about one third of the frontal border; it is straight, slightly produced and four lobed, of which the inner pair are set so close together as to appear like a single median tooth, they are broadly sulcate behind; the space between the inner and bluntly rounded outer pair is concave. The thin, slightly upturned orbital margin is pierced by two rather deep notches. On the weakly rounded anterolateral margins are five forwardly directed triangular spines becoming progressively longer and narrower posteriorly; the foremost forms the outer orbital spine and hindmost becomes rather more drawn out as growth advances. The strongly concave posterolateral margins are deeply excavated—even to the extent of forming a spiny process on the margin—for the incision of the fifth coxae. The posterior angle is narrowly rounded and the nearly straight posterior margin is about as wide as the front; it is bounded by a thin rim which continues round the coxigeal incisions. The regions are clearly defined. The tumid, rounded-pentagonal mesogastric region is sometimes weakly bilobed and the bluntly rounded tip of its anterior process extends to the base of small, ovate epigastric lobes. The urogastric lobe is very short, almost ridge-like, and the cardiac region is tumid, with three large, more or less convergent nodes. The protogastric lobes are subtriangular, weakly bilobed anteriorly and separated by a broad, but shallow furrow from contrastingly depressed hepatic regions. Between the urogastric and cardiac regions a small reniform boss represents the mesobranchial lobe; from it and separated by a narrow groove, the epibranchial lobes are strongly developed into ridges arching forwards and outwards to reach the margin at the fifth lateral spine. The otherwise depressed metabranchial lobes are drawn up into narrow, rounded ridges partially surrounding the cardiac region. Atop each ridge are three obscure nodes. The dorsal surface is densely and minutely granulated.

Discussion. P. sylviae generally reaches only about half the size of *P. eocaenica* Lörenthey and Beurlen, from the Lower Bartonian of Hungary; it differs only in the slight attenuation of the 5th lateral spine and in having a smooth, non-tuberculated urogastric lobe. These dissimilarities could well be attributed to differences in growth size. As Lörenthey and Beurlen (1929) pointed out, however, there are certain discrepancies in their figure (1929, pl. 5, fig. 2) and the description of *P. eocaenica* is not sufficiently detailed for accurate comparison. Unfortunately, the single specimen of *P. eocaenica* cannot now be traced (Dr. P. Müller, Geological Institute, Budapest, pers. comm.) and until this specimen, or others from its type locality are found, it is preferable to regard the English specimens as a distinct species.

The more strongly tumid median gastric regions, the broadening of the anterolateral spines towards the front, together with the deeply concave posterolateral margins and coxigeal incisions readily distinguishes *P. sylviae* from *P. incerta* Bell from the London Clay of the Isle of Sheppey and elsewhere, and all other species of *Portunites*. The median pair of frontal teeth on the Oligocene, *P. alaskensis* Rathbun are set fairly close to the midline, the distance between them and the outer pair, however, is greater than in *P. sylviae* and the intervening margin is straighter.

Portunites subovata sp. nov.

Plate 105, fig. 2

Derivation of name. From the outline of the carapace.

Diagnosis. The carapace is subovate in outline with four slender spines increasing in size posteriorly, the fourth much attenuated; the regions and lobes are well defined and there is a divergent row of three low tubercles on the branchial lobes.

Material. Four incomplete carapaces. Holotype, BM In.61715 (Pl. 105, fig. 2), Horizon A2, Barton Beds, Christchurch Bay. Paratypes, JSQ J/43, A2/63 and A2/71.

Horizon and locality. Horizons A2 and J, Barton Beds, Christchurch Bay.

Description. The carapace is subovate in outline, rather longer than the width taken between the 3rd/4th lateral spines and gently arched both in longitudinal and transverse section. On the gently rounded anterolateral margins are four slender, tapering spines increasing in length and robustness posteriorly, the 4th spine, at the lateral angle, is much attenuated. The posterolateral margins are somewhat longer than the anterolateral margins, they are almost straight and converge on acute posterior angles and lead by shallow coxigeal incisions to the posterior margin. The posterior margin is nearly straight and bordered by a fine ridge, it appears to be as wide as the orbitofrontal margin, of which no precise details are preserved.

The cervical furrow runs in a broad semicircle from the margin to the outer angle of the mesogastric lobe where it turns sharply backward and crosses the midline some two thirds distant from the front; on the internal mould it terminates in a pair of oblique gastric pits set close to the midline. The regions and lobes are well defined and weakly tumid. The mesogastric lobe is subpentagonal and the tip of its long tapering anterior process lies at the base of feeble, ovate epigastric lobes. The epibranchial is a large ovate lobe bearing the 4th lateral spine, from the base of which a narrow ridge, more steeply inclined anteriorly curves inwards towards the small, rounded mesobranchial lobe. The urogastric lobe is subquadrate and barely separated from an elongate urn-shaped cardiac region. Large, triangular metabranchial lobes are well separated from the uro-cardiac lobes by distinct grooves. On either side three low tubercles form a slightly diverging line; the first of the tubercles is on the mesogastric, the second on the metabranchial opposite the urogastric lobe and the third is elongated against the coxigeal incision. Another tubercle is situated close to the margin of the metabranchial lobe a little closer to the posterior margin than to the lateral angle and a much smaller tubercle occurs on either side of the midline on the cardiac lobe.

A view of the upper margin of the chelipeds indicates their length more or less equalled the carapace width; the walking legs were long and slender with only a little reduction in size posteriorly.

Discussion. The attenuated lateral spine immediately distinguishes *P. subovata* from the foregoing species and from *P. incerta*; the longitudinal 'ridges' seen on the metabranchial lobes of the two aforementioned species is not developed on *P. subovata*. This feature, together with the lateral spines

and linear arrangement of the tubercles, is like *P. triangulum* Rathbun from the Oligocene of the U.S.A., but apart from being somewhat broader in relation to length, this species has no marginal tubercle on the metabranchial lobes, but instead, one on either protogastric lobe.

Superfamily XANTHOIDEA Dana, 1851
Family XANTHIDAE Dana, 1851
Genus HARPACTOXANTHOPSIS Via, 1959

Type species. Harpactoxanthopsis quadrilobata (Desmarest, 1822) by original designation.

Range. Middle Eocene to ?Middle Oligocene.

Harpactoxanthopsis lutugini (Likharev, 1917)

Plate 105, figs. 5, 6

1897 *Xanthopsis hispidiformis* Lutugin; pp. 132, 137.
1917 *Xanthopsis Lutugini* Likharev; pp. 14, 21, pl. 1, figs. 1–4.
1969 *Harpactoxanthopsis lutugini* (Likharev); Via, pp. 295, 300. (See also for intermediate synonymies.)

Range. Upper Eocene, Bartonian.

Material. Thirty water rolled and fragmentary carapaces. BM In.61716 (Pl. 105, figs. 5, 6), In.61717–In.61721; SM C.84882–C.84884 *ex* JSQ coll.; OUM, L383–L385 *ex* JSQ coll.; JSQ LS/3–LS/10, A2/28 and A2/43.

Horizon and locality. Unit 7, Elmore Formation, Lee-on-the-Solent, Hants; Horizon A2, Barton Beds, Christchurch Bay.

Description. The carapace is rounded pentagonal in outline, almost as wide as long and widest at about midlength. It is moderately arched transversely and steeply rounded in longitudinal section. The lateral angles are set somewhat posterior to midlength and form a slight projection or blunted tubercle from which the anterolateral margins progress forward almost parallel to one another for a short distance before curving broadly to the front. The lateral edges are thinly rounded and inclined steeply inwards. The posterior margins are longer than the anterolateral margins, they are weakly sinuous and converge rapidly to the posterior margin, which was probably as wide as the front. The almost circular orbits take up rather less than the outer fourths of the orbitofrontal margin which occupies about half the carapace width. The upper orbital margin is thickened by a rounded ridge. The front is divided by four blunt spines, of which the two outer ones form the inner orbital spines; the inner pair are somewhat protruding and separated from one another by a broadly rounded notch. The lobes are not well defined. The protogastric lobes are slightly tumid and unite just behind the front to enclose an almost circular depression in which the anterior mesogastric process is vaguely elevated. Deep grooves broadening posteriorly into depressions, separate the slightly tumid urogastric lobe and almost circular cardiac region from the branchial regions. The epi- and mesobranchial lobes are of much the same size, circular and barely elevated above the general surface.

The dorsal surface is covered with numerous small pits; they are largest and most distinct medially and on the epibranchial lobes. The spaces between the pits are crowded with very fine granules; towards the anterolateral margins the interstices between the pits become generally thinner and the pits frequently coalesce. The pterygostomian processes are finely granulated and without pits.

The part of the sternum corresponding to the first and second sternites is triangular, steep-sided and depressed below the level of the tumid third sternites, which are triangular and divided medially by a weak depression; a deep groove separates the 3rd from subquadrate 4th sternites, the median depression widens and opens posteriorly into the abdominal trough. The 5th and 6th sternites are flat, subtriangular and only about half the length of the 4th sternites. Neither the 7th/8th sternites nor abdomina are preserved.

Likharev (1917, p. 22) described the chelipeds: 'The right claw is considerably more solid than the left one and is 1½ times wider. Both fingers are broken off at the base. On the lower surface of the hand at its inner margin one can see two tubercles: the anterior a large one situated at or near the base of the immoveable finger, and the posterior which is considerably smaller and at the opposite end of the hand.' Only fragments of the right-hand claw are preserved on the Lee-on-the-Solent specimens examined; it is about one-third longer than its distal height and the outer surface is broadly convex with an obscure longitudinal ridge extending to the base of the fixed finger. As preserved, there is no sign of the two tubercles on the lower inner surface. The fingers (seen on

specimen JSQ A2/28 from Horizon A2, Barton Beds) are three fourths the length of the palm, slightly incurved with the tips of the fingers slightly overlapping. On the opposing margin of the fixed finger there is a large medial cusp, followed by a smaller one distally and several pits line the base of a median groove extending the length of the inner surface of both fingers.

Discussion. Two other Bartonian species, *H. bittneri* Lörenthey from Hungary, and *H. quadrilobata* Desmarest, from Italy, have been described; *H. lutugini* differs from these and all other known members of the genus by the subparallel course of part of the anterolateral margins and by the presence of tubercles on the inner margin of the chela. Via's statement (1969, p. 295) regarding the tubercles being on the upper margin of the hand, is not in keeping with Likharev's 1917 description (above).

Genus LOBONOTUS A. Milne-Edwards, 1864

Type species. Lobonotus sculptus A. Milne-Edwards, 1864, by monotypy.

Range. Lower Eocene to Upper Miocene.

Lobonotus vulgatus sp. nov.

Plate 104, fig. 7

Derivation of name. With reference to the fairly common occurrence of this species at the type locality.

Diagnosis. A *Lobonotus* with well-developed lateral spines; the mesogastric lobe is divided posteriorly by a weak furrow and there is a space between the epibranchial node and the lateral margin.

Material. Nineteen carapaces. Holotype, BM In.61722 (Pl. 104, fig. 7.), Horizon A2, Barton Beds, Christchurch Bay. Paratypes, BM In.61723; SM C.84875 *ex* JSQ coll.; OUM, L386 *ex* JSQ coll.; JSQ A2/30-33, A2/61, A2/65, A3/11-14, F/14-16, AB/8 and AB/13.

Horizon and locality. Horizons A2, A3, and F, Barton Beds, Christchurch Bay, and the Middle Barton of Alum Bay I.o.W.

Description. In adult forms the carapace is generally subhexagonal in outline with the width slightly exceeding the length and transversely and longitudinally flattened. Juvenile forms are somewhat more rounded in outline and weakly arched in both sections. The orbitofrontal margin is gently rounded and occupies rather more than two-thirds of the carapace width. The front is slightly produced and nearly straight with a broad U-shaped median notch; in larger specimens the angles flanking the notch are raised up into small spines. A narrow cleft separates the upper orbital margin which is sinuous and pierced by two narrow fissures. The ovate orbits take up the outer fourths of the orbitofrontal margin. The outer orbital spine is triangular and there are four upturned spines of much the same size on the somewhat arcuate anterolateral margins. The posterolateral margins are nearly straight and lead by fairly broad angles into the wide, almost straight posterior border.

The major furrows are generally broad with well-rounded edges, but the cervical weakens and becomes much narrower as it passes across the midline. The regions are well differentiated and tumid; the mesogastric lobe is subtriangular and divided by a weak longitudinal furrow or depression; the anterior process extends to the base of small ovate epigastric lobes. Trapezoidal protogastric lobes are rendered almost bilobed by a broad depression extending from the front. On each hepatic region are two nodes of which the anterior is usually the larger, although in some specimens they become almost fused together. The urogastric lobe is narrow and depressed. On the heart-shaped cardiac region are three nodes set in an inverted triangle and there is a small elongated node between this region and the triangular metabranchial lobes. The epibranchial lobes are obliquely elongate and there is a space between them and the lateral angle. The intestinal region occupies the whole width of the posterior margin and becomes narrower to obsolete as it passes round the base of the cardiac region. The tumid areas of the dorsal surface are granulated, the granules becoming coarser posteriorly.

Fragments of limbs are preserved on a large specimen from Horizon A2 (A2/61 JSQ coll.). The length of the palms of the chelipeds (seen only in plan view) is about one third of the carapace width. The fingers are preserved as impressions; they are as long as the palms and a little incurved. The somewhat shorter carpus has a stout spine on the inner margin above the upper articulating facet with the hand. The meri of the 2nd-5th walking legs are of similar size and about as long as the palm.

Discussion. The upper Eocene. *L. mexicanus* Rathbun is close to *L. vulgatus*, but differs in having shorter, stouter lateral spines, larger metabranchial lobes and the sides of the major furrows are more steeply inclinded. *L. vulgatus* is also like *L. orientalis* Collins and Morris (Middle Eocene, Pakistan) but differs in having a rather more pentagonal outline to the carapace and the lobes flanking the cardiac region are more distinctly separated. The proto- and mesogastric lobes of *L. bakeri* (Rathbun) and *L. natchitochensis* Stenzel, from the Middle Eocene of Louisiana and Texas respectively, are not divided, and both species may be further distinguished from *L. vulgatus* in having poorly developed lateral spines.

Genus PANOPEUS H. Milne-Edwards, 1834

Type species. Panopeus herbstii H. Milne-Edwards, 1834 subsequently designated by Fowler, 1912.

Range. Palaeocene to Recent.

Panopeus kempi sp. nov.

Plate 105, figs. 7, 8; text-fig. 2A.

Derivation of name. After D. J. Kemp, Gosport Museum.

Diagnosis. A *Panopeus* with weakly defined lobes; the epibranchial lobe is feebly ridged and the 3rd and 4th anterolateral spines are oblong rather than triangular.

Material. Fifteen water-rolled carapaces. Holotype, BM In.61724 (Pl. 105, fig. 7). Paratypes. BM In.61725 (Pl. 105, fig. 8), In.61726, In.61727, In.61728; SM C.84879–C.84881 *ex* JSQ coll.; OUM, L387–L389 *ex* JSQ coll.; the remainder JSQ coll.

Horizon and locality. Unit 7, Elmore Formation, Lee-on-the-Solent, Hants.

Description. The carapace is subpentagonal in outline with the length about three-fourths of the width and widest at its anterior third. The lateral edges are sharp and the sides are steeply inclined inwards. Viewed from the front it is slightly excavated at the margins, then rises in a moderate arch medially; in longitudinal section it is moderately arched, curving downwards rather more steeply in front. The anterolateral margins are short and rounded; of the five marginal spines, the first, forming the outer angle of the orbit is small and triangular, the second is generally also small and triangular, but on some specimens it is very poorly developed, appearing as no more than a rounded portion of the margin. The third and fourth spines are of much the same size as one

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EXPLANATION OF PLATE 105

Fig. 1. *Montezumella scabra* sp. nov., Horizon A2, Barton Beds, Christchurch Bay. Holotype, BM In.61711, ×1·5.

Fig. 2. *Portunites subovata* sp. nov., Horizon A2, Barton Beds, Christchurch Bay. Holotype, BM In.61715, ×2·8.

Fig. 4. *Portunites sylviae* sp. nov., Horizon J, Barton Beds, Christchurch Bay. Holotype, BM In.61713, ×4.

Figs. 5, 6. *Harpactoxanthopsis lutugini* (Likharev), Unit 7, Elmore Formation, Lee-on-the-Solent, Hants. Dorsal and ventral view of carapace, BM In.61716, ×1.

Figs. 7, 8. *Panopeus kempi* sp. nov., Unit 7, Elmore Formation, Lee-on-the-Solent, Hants. 7. Holotype, BM In.61724, ×2. 8. Paratype, BM In.61725, ×2.

Figs. 9, 3. *Branchioplax concinna* sp. nov., Horizon J, Barton Beds, Christchurch Bay. 9. Holotype, BM In.61729, ×1·4. 3. JSQ coll., J/2, ×1.

Fig. 10. *Palaeograpsus bartonensis* sp. nov., Horizon A2, Barton Beds, Christchurch Bay. Holotype BM In.61733, ×3.

Figs. 11, 12. *Palaeograpsus depressus* sp. nov., Unit 7, Elmore Formation, Lee-on-the-Solent, Hants. 11. Holotype, BM In.61735, ×3·5. 12. Ventral view of female carapace to show oviducts, BM In.61738, ×5.

Fig. 13. *Palaeograpsus depressus* sp. nov., Horizon A2, Barton Beds, Christchurch Bay. Paratype with a *cardita* sp across front, BM In.61734, ×2·5.

Description. The carapace is subhexagonal in outline and a little wider than long. In side view it is moderately curved in front, and becomes flatter posteriorly; it is flatly arched in transverse section. The orbitofrontal margin occupies about two-thirds of the carapace width; the broad, slightly projecting front has narrowly rounded outer angles and is weakly concave on either side of a U-shaped median notch. An almost closed fissure separates it from a very small inner orbital spine. The rather wide orbits open to the front and the upper orbital margin and fore-edge of the front are narrowly rimmed. Of the three spines on the short, rounded anterolateral margins, the first forms the incurved outer orbital, the second, separated from it by a notch is triangular and forwardly directed, the third spine takes up almost the entire epibranchial lobe and is considerably smaller, weakly conical and directed outwards. An incipient spine occurs immediately behind the epibranchial lobe. The posterolateral margins are nearly straight where they border the mesobranchial lobes, but become gently rounded as they converge a little to broadly rounded posterior angles. The posterior margin is narrower than the orbitofrontal margin, weakly convex and bounded by a thin ridge.

From the margin the cervical furrow runs down a short distance to unite with a short epibranchial furrow before curving broadly towards the midline which it crosses rather more than half the distance from the front. A weaker branchiocardiac furrow, seen to better advantage on the internal mould, more or less parallels the cervical furrow. The lobes are well-defined and fairly deep epimeral adductor muscle scars separate the urocardiac from the branchial regions. The slender anterior process of the subtriangular mesogastric lobe is parallel sided and extends almost to the front. A broad furrow separates the tumid protogastric lobes from smaller, depressed hepatic regions. The urogastric lobe is rather short and the cardiac region is rounded-pentagonal in outline, although on the mould it appears somewhat trilobate. A small triangular lobe lies at the base of the mesobranchial close to the urogastric lobe.

A row of coarse granules lines the base of the mesogastric lobe and others of similar size extend along the posterolateral margins and shortly on to the metabranchial lobes. Much finer granules cover the remaining dorsal surface.

Discussion. While placing this species in *Branchioplax* we have been conscious of its similarity to *Pilumnoplax* Stimpson, an extant genus ranging from the Eocene. In *Pilumnoplax*, however, the carapace is generally more depressed and, with straighter posterolateral margins more nearly approaches a pentagonal outline; also, the orbits are generally rather smaller. *B. concinna* is close to *B. washingtoniana* from the Eocene/Oligocene of the U.S.A., but is somewhat wider in relation to length; the sides of the anterior mesogastric process are parallel, whereas in *B. washingtoniana* they taper gradually towards the apex. The granules lining the base of the mesogastric lobe are common to both species, but the pairs of granules adorning the cardiac region and the anterior part of the mesogastric lobe are absent on *B. concinna*.

A carapace, SM C.2947, from the Middle Headon, Roydon Zone of Whitecliff Bay, I.o.W., was referred to as *Diaulax?* by Carter (1898, p. 20); the specimen lacks the marginal spines and details of the front, but otherwise closely approximates *B. concinna* and with reservation we include the Headon specimen in this species.

Family GRAPSIDAE Macleay, 1838
Genus PALAEOGRAPSUS Bittner, 1875

Type species. Palaeograpsus inflatus Bittner, 1875, subsequent designation by Glaessner, 1929.

Palaeograpsus depressus sp. nov.

Plate 105, figs. 11, 12, 13

Derivation of name. Alluding to the transverse median depression on the dorsal surface.

Diagnosis. Carapace with the lateral margins slightly convex and subparallel or diverging posteriorly; the median part of the dorsal surface is transversely depressed.

Material. Numerous carapaces and or associated abdominal sternites. Holotype, a carapace BM In.61735 (Pl. 105, fig. 11). Paratypes, BM In.61738 (Pl. 105, fig. 12, female sternites), BM In.61736–In.61747; SM C.84878 (nodule with *c.* 10 specimens); OUM, L390–L396 *ex* JSQ coll.; remainder JSQ coll., Unit 7, Elmore Formation, Lee-on-the-Solent; BM In.61734 (Pl.105, fig. 13); OUM, L397 *ex* JSQ coll.; remainder JSQ coll., Barton Beds, Christchurch Bay.

Horizon and locality. Unit 7, Elmore Formation, Lee-on-the-Solent, Hants; Horizons A2, F, and J, Barton Beds, Christchurch Bay and the Middle Bartons of Alum Bay, I.o.W.

Description. The carapace is subrectangular in outline, the length being about three-fourths of the width and widest posteriorly; it is flatly arched transversely and there is a distinct median depression in longitudinal section. The short anterolateral margins are rounded smoothly into short, sharp outer orbital spines. There is an incipient epibranchial spine and the lateral margins may be either nearly straight or diverge posteriorly to acute posterolateral angles. A thin, beaded rim borders long, but shallow depressions for the fifth coxae and continues across the slightly concave posterior margin. The posterior margin is nearly straight and narrower than the front. The orbits are rounded and take up the outer thirds of the orbitofrontal margin which occupies about two thirds of the greatest width. The upper orbital margin is sinous and raised into a thin rim. The front is straight with a moderately deep median notch, produced and strongly downturned; viewed from above its sides are smoothly rounded into the upper orbital margin. The cervical furrow is very weak on the dorsal surface, where, from a marginal notch it is deflected against a low ridge on the epibranchial lobe; it is deeper on the side and runs obliquely forwards for a short distance before passing round a rather tumid subhepatic lobe to the front. The postcervical furrow is strongest where it crosses the midline in a gentle curve; weakening at the outer angles of the mesogastric lobe, it curves forwards and outwards to the lateral margin. Short, deep epimeral adductor muscle scars, each surmounted by a pit, separate the uro-cardiac from the branchial regions; from the widest part of the cardiac region, shallow branchiocardiac furrows run back, then forwards and outwards for a short distance. On the dorsal surface a low, interrupted 'ridge' extends across the epibranchial, protogastric and anterior part of the mesogastric lobes; a similar ridge is formed by tumid portions of the mesobranchial and cardiac lobes and the two ridges enclose a depressed rhomboidal area. The mesogastric lobe is broadly ovate and its short triangular anterior process is flanked on either side by ovate epigastric lobes. The urogastric and cardiac lobes are more or less confluent and subpentagonal in outline. The metabranchial lobes are much reduced and medially continuous with the mesobranchial, but become separated laterally by a furrow running parallel with the coxigeal incision.

Detached, undersides, in close proximity to carapaces, show that that part of the sternum corresponding to the 1st/2nd thoracic sternites is subtriangular and bounded anteriorly by a ridge. A weak transverse groove delineates them from much wider, almost triangular 3rd sternites and these in turn are separated by deep notches leading to prominent grooves from the 4th sternites. The 4th sternites are large with somewhat rounded lateral margins and the 5th/8th are chordate in outline. Cratered openings of the female gonoducts occur on the 6th sternites just within the angle of the abdominal trough which is broad and moderately deep between the 4th/8th sternites, becoming much shallower on the 3rd. The abdominal trough of the male is narrower and more triangular in outline. With the exception of the abdominal trough the surface is minutely granulated.

Discussion. The narrow, produced front immediately distinguishes *P. depressus* from the two species, *P. inflatus* Bittner and *P. loczianus* Lörenthey, from the Bartonian of Hungary; *P. inflatus* has rounded transverse ridges, but the hinder one is closer to the front than is that on *P. depressus*; *P. loczianus* has a rounded outline and is more strongly arched in longitudinal section. A more produced and straight-sided front, together with partly confluent meso- and metabranchial lobes serves to distinguish *P. depressus* from the closely related *P. guerini* Via from the Middle Lutetian of Spain and Italy. Via's figures (1969, pl. 37, figs. 7, 8) of *P. guerini* show two distinct forms of carapace—one with more or less parallel lateral margins, the other with divergent lateral margins. Carapaces of similar outline are present among specimens of *P. depressus* and may well indicate an example of sexual dimorphism.

Palaeograpsus bartonensis sp. nov.

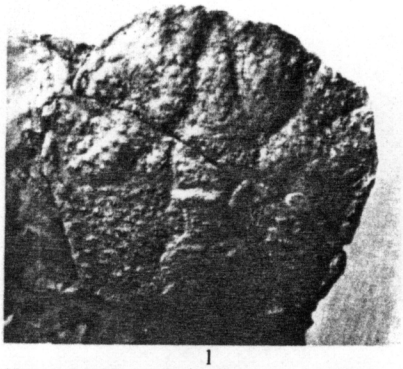
Plate 105, fig. 10

Derivation of name. From Barton-on-Sea, Hampshire.

Diagnosis. The carapace is subquadrate in outline; the front is produced with a shallow median depression and shallow ocular constrictions; there is a small but distinct outer orbital spine.

Material. Three carapaces. Holotype, BM In.61733 (Pl. 105, fig. 10), Horizon A2, Barton Beds, Christchurch Bay; Paratypes, JSQ A2/37 and J/28.

Horizon and locality. Horizons A2 and J, Barton Beds, Christchurch Bay.



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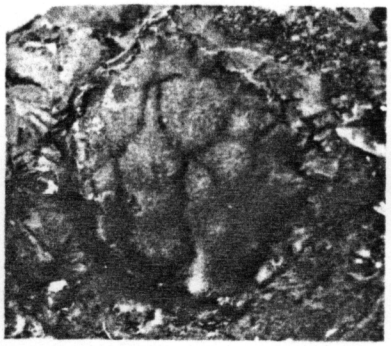

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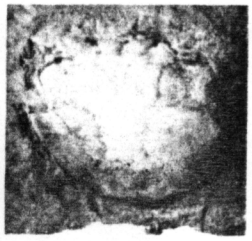

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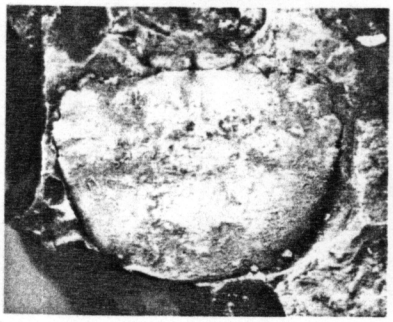

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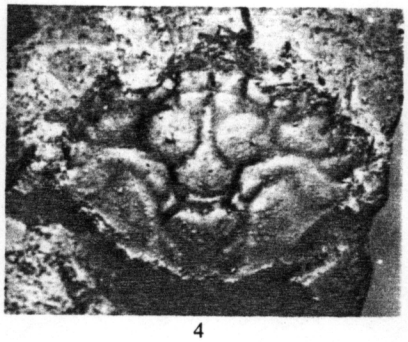

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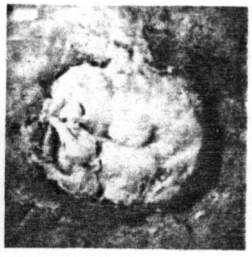

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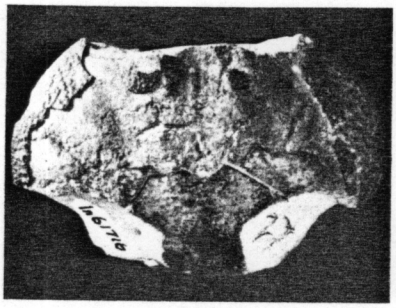

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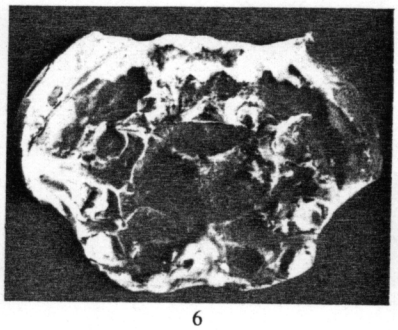

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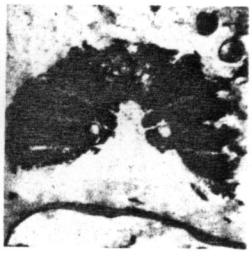

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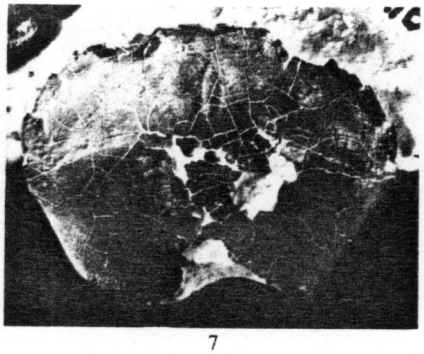

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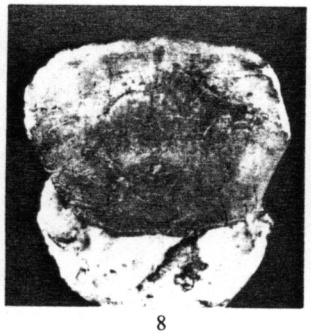

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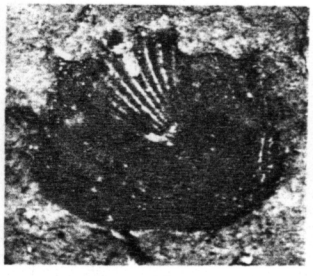

13

QUAYLE and COLLINS, Eocene crabs

another, flattened and rather oblong in outline with only the forward angle sharp and slightly upturned, the hinder margins are rounded. The fifth spine, abraded on all specimens examined, was probably triangular. The posterolateral margins run straight back, converging to the distinctly ridged posterior margin which is about as wide as the front and slightly concave. The front, which takes up about a half of the orbitofrontal margin, is slightly produced and nearly straight with a small V-shaped median notch; it is separated by an oblique cleft from the upper orbital margin. The orbits are deep and broadly ovate and the thin upper orbital margin is pierced by two notches.

The regions are usually not well defined, but sometimes may be slightly tumid. The cervical furrow is very weak; from small pit on either side of the midline it runs towards the lateral margin in two forwardly directed loops. The mesogastric lobe is subtriangular in outline and the tip of its slender anterior process extends fractionally beyond the protogastric lobes to the level of the outer orbital spine. In some, especially larger specimens, small ovate frontal lobes coalesce with the protogastric lobes. The urogastric lobe is depressed, but otherwise confluent with the subpentagonal cardiac region; the depression is accentuated by a slight ridge bordering fairly deep, oblique muscle scars. A low forwardly curving ridge, steeper anteriorly, extends across each epibranchial lobe.

The dorsal surface is densely crowded with fine granules which become coarser towards the margins and particulary on the surface of the lateral spines: interspersed anteriorly are numerous pits slightly larger in diameter than the surrounding granules.

On the ventral surface the front curves downwards and backward to meet the head of the rather narrow epistome, the ridged margins of which meet in a point. The subhepatic and pterygostomian regions are finely granulated and a line of coarser granules accentuates the pleural suture. The buccal margins are slightly convex and bounded by a smooth ridge continuing round the sternal border.

One specimen has a swelling on the right-hand metabranchial lobe similar to that caused by the parasitic isopod, *Bopyrus*; it appears to be very unusual among xanthid crabs.

Discussion. Of the four Palaeocene species of *Panopeus*, *P. jerseyensis* Roberts, from the Vincentown Formation is known only from limb fragments; the others are of Danian age and have well-defined regions. *P. estellensis* Rathbun is also represented by limb fragments from the Eocene of Alabama; *P. vincentinus* Bittner, from the Italian Vincentian Formation, also has well-defined regions. By and large *P. kempi* is more closely allied to *P. africanus* A. Milne-Edwards, but all the lateral spines of this Recent West African species are triangular in outline. The present distribution of *Panopeus* extends along the Atlantic coasts of Africa, the East and West coasts of North America and the Pacific Ocean.

Family GONEPLACIDAE Macleay, 1838
Subfamily CARCINOPLACINAE H. Milne-Edwards, 1852
Genus BRANCHIOPLAX Rathbun, 1916

Type species. Branchioplax washingtoniana Rathbun, 1916 by original designation.

Range. Palaeocene to Oligocene.

Branchioplax concinna sp. nov.

Plate 105, figs. 3, 9

?1898 Diaulax sp. Carter, p. 20.

Derivation of name. From the Latin, handsome.

Diagnosis. The carapace is subhexagonal with three anterolateral spines; cervical and branchiocardiac furrows weak and the front is straight with a U-shaped median notch.

Material. Ten carapaces. Holotype, BM In.61729 (Pl. 105, fig. 9.). Horizon J, Barton Beds, Christchurch Bay; Paratypes, BM In.61731, In.61732; JSQ J/2 (Pl. 105, fig. 3), J/3-J/5, J/59, and J/60; ?SM C.2947; Middle Headon, 'Royden Beds' (*Voluta geminata Zone*), Whitecliff Bay, I.o.W.

Horizon and locality. Horizons A2, A3, and J, Barton Beds, Christchurch Bay; Middle Headon Beds, Whitecliff Bay, I.o.W.

Description. The carapace is subquadrate in outline, a little wider than long and widest at the posterior angles. In longitudinal section it is depressed between flattened ridges across the mesogastric and epibranchial lobes and a similar ridge across the metabranchial lobes. The lateral margins are straight, hardly at all indented by a cervical notch and diverge to broadly rounded posterior angles. The posterior margin is slightly convex and about twice the width of the front. The front occupies about one fourth of the very wide orbitofrontal margin, it is produced, weakly convex on either side of an obscure median notch and has weak ocular constrictions; the broadly sinuous upper orbital margin terminates in a short spine not extending beyond the orbital margin. A narrow beaded rim extends round the frontal border, continuing along the anterolateral margin and part way down the posterolateral margins.

Apart from the median portion of the post cervical, the furrows are poorly defined. There is a distinct depression between flatly rounded ridges extending discontinuously across the epibranchial and mesogastric lobes anteriorly and metabranchial lobes posteriorly. The anterior process of the ovate mesogastric lobe lies between small epigastric lobes at the base of the front. Small nodes representing the mesobranchial lobes are situated close to the narrowest part of the broadly pentagonal cardiac region.

The surface ornament is composed of fine, densely crowded granules.

Discussion. While close to *P. depressus*, *P. bartonensis* differs in having a rather more extended, less downturned front with sides slightly constricted before passing into the upper orbital margin and a more strongly developed outer orbital spine, also the transverse ridges are subdued and the lobes more clearly defined.

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