

# Three new genera and species of crabs from the Lower Eocene London Clay of Essex, England

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## Abstract

Three new genera and species of crabs, *Londinimola williamsi* gen. et sp. nov., *Panticarcinus maylandiensis* gen. et sp. nov. and *Sharnia burnhamensis* gen. et sp. nov., are described from the Lower Eocene, (Ypresian) London Clay, of Essex, England. These species not only provide an important addition to our knowledge of London Clay crabs, but two of the new genera, *Londinimola* and *Panticarcinus*, represent the first known antecedents of the Recent genera *Mohola* Barnard, 1947, and possibly *Sphenocarcinus* A. Milne Edwards, 1875, respectively, in the fossil record. *Sharnia burnhamensis*, tentatively assigned to Etyidae Guinot and Tavares, 2001, represents the youngest known member of the family. Correlation of decapods now known from Essex, together with other occurrences of British London Clay species, is appended.

*Key words:* New crab genera and species, Lower Eocene, England

## Introduction

Since the appearance of the *Monograph of the Crustaceans of the London Clay* by Thomas Bell (1858), descriptions of new species of decapods from the Lower Eocene London Clay (Ypresian) of England have been published by Woodward (1867, 1871, 1873), Glaessner & Withers (1931), Quayle (1984), Quayle & Collins (1981) and Collins (2002). With the exception of Bell (1858), in which work species from north London were included, all the above papers have dealt with species from exposures in Hampshire, Isle of Wight, Kent and Surrey. Cooper (1974b) published a stratigraphical/geographical distribution of the English Palaeocene decapods in which two species from Aveley and one from Ongar, both Essex localities, were included; the record for Aveley was substantially extended by Williams (2002), but, apart from that, detailed accounts of crabs and lobsters from Essex have been largely neglected. Recent extensive collecting by members of the Essex Rock and Mineral Society has yielded numerous specimens of previously known and new species. With the description of the latter, together with an up to date stratigraphic review of Essex occurrences and geographic correlations, this paper seeks to redress the previous negligence.

Two of the new genera described herein, *Londinimola* and *Panticarcinus*, represent the earliest known antecedents of the Recent genera *Mohola* Barnard, 1947, and possibly *Sphenocarcinus* A. Milne Edwards, 1875, respectively, neither present in British waters. *Londinimola williamsi* has characters more befitting *Mohola* than the superficially similar *Paramola* Wood-Mason and Alcock, 1891, present in the fossil record by *Paramola pritchardi* Jenkins,

1977. In drawing attention to the 'extremely long pseudorostral horns' (p. 134) apparent in *pritchardi*, Schweitzer *et al.*, 2004, assigned it to *Dagnaudus* Guinot and Richer de Forges, 1995, although the reconstruction of the pseudorostral horns (Jenkins, 1977, fig. 2) seems to grossly exaggerate the preserved evidence (*ibid.*, fig. 3G). The granulated ornament of *pritchardi* distinguishes it from the spiny dorsal surface of *Londinimola*. *Mohola* is represented by seven species ranging from South Africa, Japan, California and Indian Ocean, and species have been taken from depths ranging from c. 40–800 m (Guinot & Richer de Forges, 1995).

*Sphenocarcinus* is now restricted to two American species, one on each side of the continent; *Sphenocarcinus corrosus* (A. Milne Edwards, 1875), on the Atlantic side and *Sphenocarcinus agassizi* Rathbun, 1893, on the Pacific side (Tavares, 1991). Both species have a contiguous rostrum, slightly bifurcate at the tip, thus differing from that of *Panticarcinus maylandiensis* which is infilled and deeply sulcate. Only *Sphenocarcinus agassizi* has marginal tubercles. These increase in size posteriorly while the third spine in *P. maylandiensis* is diminutive; the other tubercles are produced to robust spines, and additionally, there is a basi-lateral metabranchial spine.

Although imperfectly preserved, *Sharnia burnhamensis*, here tentatively assigned to the Etyidae, has much in common with *Xanthosia* species, particularly in relative length/width and orbitofrontal margin/width proportions; if projected, the damaged marginal edge would produce the required angular edge and the surface ornament - a variable character in *Xanthosia* - is in keeping

with than of *Xanthosia aspera* Rathbun, 1935. As such, *Sharnia* becomes the youngest known member of the Etyidae, extending the known geological range from the Lower Danian (Jakobsen & Collins, 1997).

### Stratigraphy

The Essex specimens are from four localities, of which three are natural, estuarine river exposures, where collecting is tide-restricted, and a quarry, at Aveley, now defunct. Although within a comparatively short distance of one another, the sections vary to a degree in both stratigraphy and fossil content.

The stratigraphy and fauna of the exposure at Aveley, which yielded the holotype of *Londinimola williamsi* gen. et sp. nov., exposed some 30–35 m of the lower London Clay, comprising Divisions B1, B2 and the lower levels of Division C (King, 1981), and has been fully documented by Williams (2002). Mention was made (p. 102) of an undescribed species of crab collected by A. Rundle, London, and listed by Cooper (1974b) as *Homolopsis* sp. as coming from “the ‘*Balanocrinus*’ (i.e., the crinoid *Isselicrinus subbasaltiformis* (Miller, 1821)) horizon”, and likewise the type-specimen was picked up from the excavation terraces adjacent to the *Isselicrinus* horizon that marks the B1/B2 boundary (King, 1981). The lobsters *Linuparus (Podocratus) scyllariformis* (Bell, 1858), *Hoploparia gammaroides* M’Coy, 1854, and *Homarus morrisoni* Quayle, 1987, are particularly common adjacent to this horizon along with occasional specimens of *Dromilites bucklandi* H. Milne Edwards, 1837, *Portunites incerta* Bell, 1858, and *Cyclocorystes pulchellus* Bell, 1858. By far the majority of *H. gammaroides* remains, here and elsewhere in the sections, are moults, suggesting inshore migration prior to ecdysis.

Recently, it has become apparent that *Londinimola* is by no means confined to the exposure at Aveley; J. S. has a fragmented carapace from Steeple Bay, Essex (TL 917 043), and others from Seasalter, Kent (TR 097 657) and Tankerton, Kent (TR 130 675) all exposures adjacent to the London Clay B1/B2 Boundary, or within Division B2 (Clouter *et al.*, 2000, p. 10). None preserve characters not apparent on the holotype.

The ascribed paratype specimen from Sheppey is enigmatic. Labelled simply as having been found at ‘Sheppey, Kent’, it was collected by D. Wood in the late 19<sup>th</sup> century. With no recorded horizon, it is impossible to know from where on Sheppey it was collected. The cliffs at Warden Point and Minster are exposures of upper Division C to E, and possibly an unlikely find-location for this species, which would otherwise appear to be confined to Division B. However, Division B1 is exposed at several locations on the south of the island (e.g., at Chetney Hill), which might well be a more likely origin for this specimen. London Clay B1/B2 exposures at Seasalter and Tankerton, where this species occurs, are nearby and it remains possible that this specimen may be incorrectly labelled.

The only known specimen of *Sharnia burnhamensis* gen. et sp. nov. was found on the beach of the River Crouch, at Butts Cliff,

Essex; previous studies (Kirby, 1974; King, 1981, Hewitt, 1988) have identified the London Clay exposed at this location as belonging to the middle or upper level of Division D. There are two horizons at Butts Cliff that contain small phosphatic nodules containing fossils, crustacea being particularly numerous, both associated with, and usually occurring below, bands of large calcareous septarian nodules. The first, outcropping on the foreshore platform below high tide mark between approximately TQ 921 967 and TQ 923 966, consists predominantly of nodules 4–8 cm in length, containing specimens of *Zanthopsis leachii* (Desmarest, 1822), with rarer *Xanthilites bowerbanki* Bell, 1858, *Basinotopus lamarckii* (Desmarest, 1822) and *Campylostoma matutiforme* Bell, 1858. The second outcrops in the cliff itself, and while specimens weather out and collect at the foot of the cliff, the precise stratigraphy is confused by rotational slippage and often obscured by slumping. Small phosphatic nodules, 1–5 cm in length are particularly common at this level and commonly found to contain *Glyphithyreus wetherelli* Bell, 1858, often in the form of discreet carapaces with no appendages attached, occasional specimens of *Portunites stintoni* Quayle, 1984, and *Mithracia libinoides* Bell, 1858, also occurring. Other crab species recorded from ‘unstratified’ beach debris included *Goniochele angulata* Bell, 1858, and *Dromilites simplex* Quayle and Collins, 1981. Lobsters are extremely rare at this location, with only occasional finds of *H. gammaroides*, fragments of *H. morrisoni* and *Linuparus (Podocratus) eocenicus* Woods, 1925.

Longshore drift at this location tends to sweep small specimens weathering out of the clay from either horizon along beach, to accumulate in the shingle at the head of the beach toward the eastern end of the site, where the specimen of *Sharnia* was found, so it is impossible to know its precise horizon.

A temporary exposure of London Clay uncovered during landfill operations in the mid-1990s at Ropers’ Farm, Barling (TQ 926 903), 6 km to the south of Butts Cliff, was found to have a crustacean fauna almost identical to specimens recovered from the foreshore, and it would appear that a similar horizon is also present in the cliffs at Sheppey, Kent (some 25 km to the southeast) at a point between Warden Point and Barrow Brook, where a similar crustacean fauna, dominated by *X. leachii* and *G. wetherelli* is also encountered.

*Panticarcinus maylandiensis* gen. et sp. nov. is presently known from foreshore exposures along the River Blackwater at Maylandsea and Steeple Bay. At both locations an extensive platform of weathered London Clay is exposed at low tide and, although both sites are prone to extensive silting, occasional vigorous tidal erosion, particularly after winter storms, is continually bringing new material to the surface. At Maylandsea a low cliff, about 2 m high, also exposes London Clay alongside the beach level. Although the two sites are around 1.5 km apart the faunas are almost identical and appear to be from the same horizon marked by several bands of large calcareous septarian nodules, with concentrations of smaller phosphatic nodules found just below them, in which the crustaceans are commonly found. The crustacean fauna at both sites is dominated by *H. gammaroides*, with occasional specimens of *L. (P.)*

*scyllariformis* and the very rare *Glyphea scabra* (Bell, 1858); crabs are uncommon, but *D. bucklandi*, *P. incerta*, *X. bowerbanki* and *C. pulchellus* occur with about equal frequency, while *C. matutiforme* and *M. libinoides* are rare finds.

On a foreshore exposure of this type, the stratigraphy is difficult to ascertain. The occasional presence of rolled stems of *Issellicrinus subbasaltiformis* on the beaches at both locations, coupled with the known outcropping of the *Issellicrinus* horizon that marks the B1/B2 boundary (King, 1981) on the foreshore of Osea Island at around TL 908 061, 2 km NNW of Steeple Bay, would suggest that the exposure at both Maylandsea and Steeple Bay lay just above the Division B1/B2 boundary (George & Vincent, 1977b, 1982). This correlates well with the exposure of London Clay at Aveley (44 km SW of Steeple Bay) where a level dominated by *Hoploparia* likewise occurs approximately three metres above the *Issellicrinus* horizon (Williams, 2002).

The type and figured specimens referred to herein are deposited in the Department of Palaeontology, The Natural History Museum, London (BMNH).

### Systematic Descriptions

Order Decapoda Latreille, 1802

Infraorder Brachyura Latreille, 1802

Section Podotremata Guinot, 1977

Superfamily Homoloidea de Haan, 1839

Family Homolidae de Haan, 1839

Genus *Londinimola* gen. nov.

*Type species: Londinimola williamsi* sp. nov. designated herein. The only species known.

*Diagnosis:* Carapace subovoid, total width across metabranchial lobes from four fifths to almost as long as carapace; orbitofrontal margin less than half carapace width; rostrum triangular, sulcate, bounded by pseudorostral spines; posterior margin moderately concave to almost straight; dorsal regions well defined, antero-gastric lobes weakly tumid and spinose, mesogastric lobe subtriangular; urogastric lobe with median spine and lateral ridges; elongated lingulate cardiac lobe with three weak spines; two spines on epibranchial lobe, mesobranchial lobes spinose, becoming smoother as growth advances; nodes at meso-posterior angles of metabranchial lobes; *lineae homolicae* well defined.

*Derivation of name:* An abbreviation of Londinium (Roman London) + family suffix.

#### *Londinimola williamsi* sp. nov.

(Pl. 1, figs. 1a–2)

1974b *Homolopsis* sp., Cooper, 143.

2002 *Homolopsis* sp., Cooper; Williams, 120.

*Diagnosis:* As for genus.

*Material:* Holotype. Carapace, BMNH IC453 (R. J. Williams coll.), London Clay (Ypresian), Division B (probably B1/B2 boundary), No. 2 pit (landfill site) Sandy Lane, Aveley, Essex;

attributed paratype, an abraded carapace and part of ventral surface, BMNH 59716, London Clay, no recorded horizon, Isle of Sheppey, Kent. The specimen recorded by Cooper (1974b) has not been traced.

*Derivation of name:* In honour of R. N. Williams who collected the holotype.

*Description:* Carapace subovoid, transversely and longitudinally gently arched, widest across metabranchial lobes about five sevenths distant from the front; the forwardly directed orbitofrontal margin takes up less than half the carapace width, the shallow orbits occupy the outer thirds; rostrum not well preserved, but evidently triangular, weakly produced and downturned, terminating in pseudorostral spines above obliquely ovate orbits; the upper orbital margin is thin and weakly raised. A fine spine at the lower orbital angle is visible from above. The posterior margin is about as wide as the front, moderately concave medially to nearly straight.

The *lineae homolicae* are well defined, widest about five sevenths from the front, weakly sinuous anteriorly, being a little more indented at the cervical and just behind the branchiocardiac notches.

The cervical furrow crosses the midline a little anterior to midlength in a broadly rounded V, wide and deep behind the mesogastric lobe, it curves round the hepatic region and continues smoothly to the *lineae homolicae* and recurves on the side to unite with the deeper branchiocardiac furrow below vertically bifid hinder posterolateral spines (Guinot & Richer de Forges, 1995, fig. 1) The branchiocardiac furrow runs subparallel to the urogastric lobe where it recurves sharply round a pair of tubercles on the mesobranchial lobe. A long narrow, parallel sided anteromesogastric process extends shortly beyond protogastric lobes, each having a forwardly directed spine behind a lower, smooth node, just posterior and lateral to these on the hepatic regions is a similar spine encircled by three nodes. The subtriangular mesogastric lobe has median spine and two basi-lateral tubercles which unite into ridges as growth advances. On the urogastric lobe a low ridge either side of the midline attenuates to the mesogastric angle, and there is a median spine before a poorly defined elongate-lingular cardiac region which has three nodes in an inverted triangle; an intestinal lobe is little more than a granule set between nodes at the base of the metabranchial lobe. The epibranchial lobes have three tubercles decreasing in size medially. There are seven tubercles encircling a median tubercle on the metabranchial lobes, numerous granules of several diameters form a secondary ornament.

On the sides, tumid subhepatic lobes have five tubercles distributed round the margin; two spines are vertically placed between the groves and eight or nine posteriorly, three of which border the *lineae* margin; there is also a secondary granular ornament.

The carpopgnath of third maxilliped is subtriangular, width about one third of length; the outer margin convex, inner margin deeply excavated at base to receive the basio-ischiognath; ischiognath subrectangular with a median ridge, width about one third length, outer margin slightly concave, inner margin coarsely granulate;

merognath at least half the length of ischiognath and of similar width. The exognath is about half the width of the ischiognath and extends at least one fourth length of merognath.

Paratype: sub-rhomboidal 1<sup>st</sup>/3<sup>rd</sup> sternites are concave in cross section, the basal angles overlapping the flatter 4<sup>th</sup> sternites; raised, nearly straight lateral margins of which have a weak indentation in the spur-like coxal condyle for articulation with the cheliped; the 5<sup>th</sup> sternites are about half the width of the 4<sup>th</sup>, a deep U-shaped concavity separates elongated, similarly excavated condyles from those of the 4<sup>th</sup>; the basal angle of slightly narrower 6<sup>th</sup> sternites is obliquely directed. Sutures 3/4, 4/5 and 5/6 are lateral and very short; suture 6/7 is entire and regularly convex. A small, ovate homalium button for abdominal maintaining on sternite 4 occurs close to steep sterno-coxal depression d5; sterno-coxal depression 6 is equally steep and both are bounded by a ridge.

The right, slightly down-curving cheliped ischium is subcircular in section, the width about one sixth of the length. The ischium of pereopod 2 is flatter, the length of (broken) merus at least six times the width. The articulation of P4 is isolated from the carapace and level with the *linea homolica*; P5 articulates in a shallow excavation in the basal margin, the limb possibly resting parallel with the *linea homolica*.

*Discussion:* *Londinimola* appears to be closest to *Mohola* Barnard, 1947, an extant genus with, hitherto, no recorded apparent fossil antecedents. The position of all major lateral spines agrees in principle with the figure of *Mohola* (Guinot & Richer de Forges, 1995), although the basal scars remaining of the pseudorostral spines indicate a less robust development. There is agreement in the course of the *lineae homolicae*, particularly in the indentations about the cervical and branchiocardiac notches. By and large, surface ornament approximates that of *Mohola granperrini* Guinot & Richer de Forges, 1995 (figs. 33a, b), from the Maldive Islands, even to the 'circular' arrangement of spines on the metabranchial lobes.

The superficially similar extant genus, *Paramola* Wood-Mason and Alcock, 1891, differs in that the *lineae homolicae* of *Mohola* have straighter lateral borders with aligned spines (*vide* Guinot &

Richer de Forges, 1995) and a less robust dorsal surface ornament.

Family Etyidae? Guinot and Tavares, 2001

Genus *Sharnia* gen. nov.

*Type species:* *Sharnia burnhamensis* sp. nov. designated herein. The only species known.

*Diagnosis:* Carapace wider than long, lateral margin rounded with four obscure spines; weakly arched in both sections; orbitofrontal margin more than half carapace width; regions well defined; dorsal surface bilaterally granulated.

*Range:* Lower Eocene.

*Derivation of name:* In honour of Siân Johnson, wife of finder.

***Sharnia burnhamensis* sp. nov.**

(Pl. 1, fig. 5)

*Diagnosis:* As for genus.

*Material:* Holotype. A fragmentary carapace, BMNH IC454 (R. Johnson Coll.), Lower Eocene, London Clay, Division D, River Crouch estuary at Butts Cliff, Essex (TQ 924 965), between Althorne and Burham-on-Crouch (both sites quoted in Literature).

*Derivation of name:* From the type area.

*Description:* Carapace incomplete, length rather more than half the width; weakly arched in transverse and longitudinal sections. The orbitofrontal margin is a little more than half the width; orbital cavity, oblique to midline (160 degrees), is septate, into circular fossae, the ocular being about half the size of the antennal. The very narrow rostrum, possibly triangular and sulcate, the sides leading back to raised, possibly granulated, upper orbital margins; basal scars suggest a short, robust outer orbital spine. Abraded lateral margins indicate a thin, slightly upturned edge with four 'spines' separated by notches, of which that between the first and second 'spines' is the cervical. An obscure, granulated ridge extending from the rostrum forms the anteromesogastric process and terminates on the shield-shaped urogastric lobe wider than the mesogastric lobe. Interrupted at the midline the cervical furrow is narrow and weakly concave to the basal mesogastric angles, becoming wider and deeper, it is distinctly sinuous to the margin. A

## Plate 1

Fig. 1. *Londinimola williamsi* gen. et sp. nov. Holotype; BMNH IC453. Lower Eocene, London Clay, Division B, Aveley, Essex. A, dorsal surface; b, right lateral view; c, frontal view.  $\times 1.5$ .

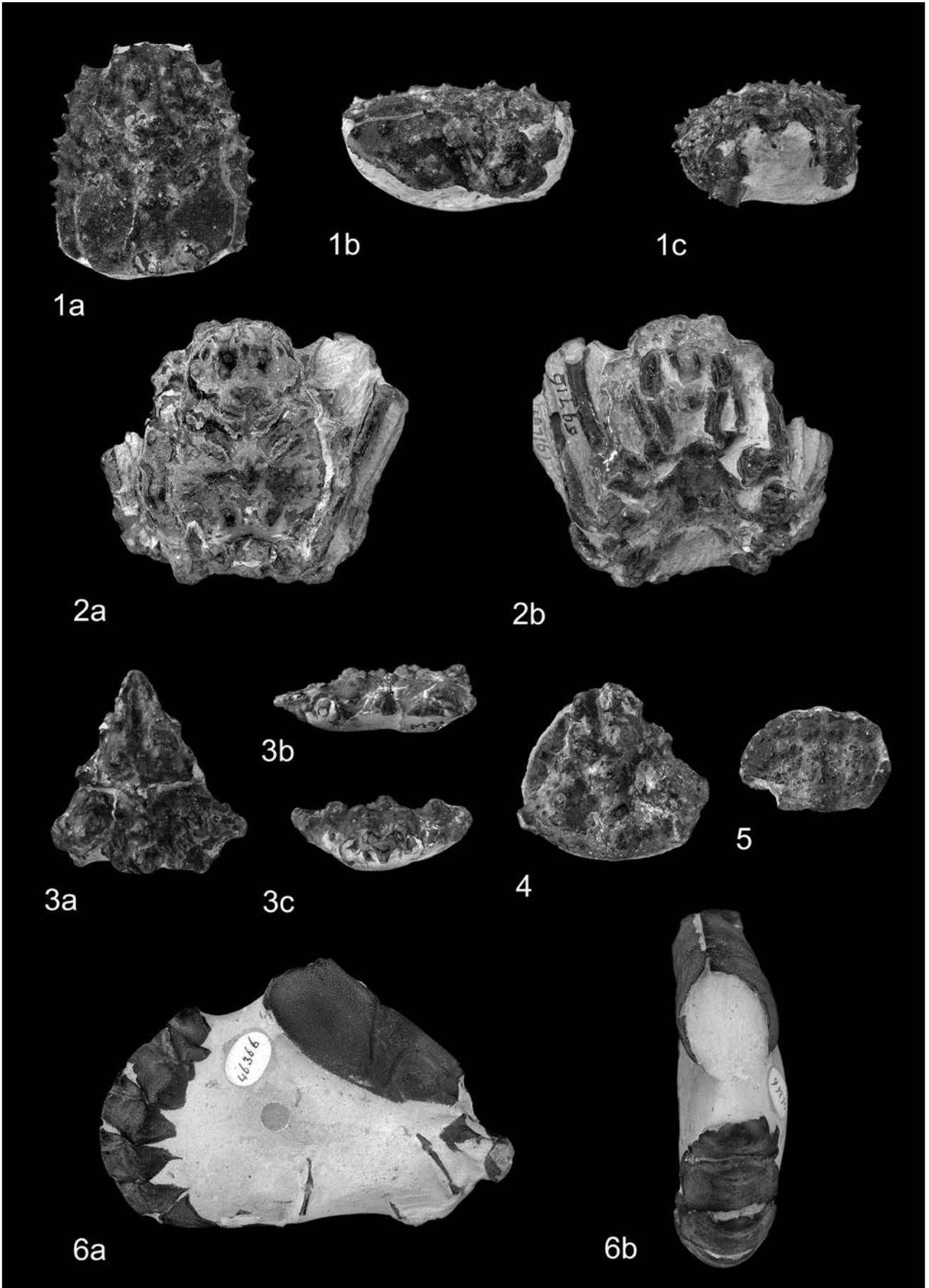
Fig. 2. ? *Londinimola williamsi* gen. et sp. nov. BMNH 59716. Lower Eocene, London Clay, Isle of Sheppey, Kent. a, dorsal surface; b, ventral surface.  $\times 1.0$ .

Fig. 3. *Panticarcinus maylandiensis* gen. et sp. nov. Holotype; BMNH IC455. Lower Eocene, London Clay, Division B2, Maylandsea, Essex. a, dorsal surface; b, left lateral view; c, frontal view.  $\times 1.5$ .

Fig. 4. *Panticarcinus maylandiensis* gen. et sp. nov. Paratype; BMNH IC456. Lower Eocene, London Clay, Division B2, Steeple Bay, Essex.  $\times 1.5$ .

Fig. 5. *Sharnia burnhamensis* gen. et sp. nov. Holotype; BMNH IC454. Lower Eocene, London Clay, Division D. Butts Cliff, Essex. Dorsal surface.  $\times 1.5$ .

Fig. 6. *Hoploparia gammaroides* M'Coy. Neotype of Quayle (1987, p. 589); BM 46366. Lower Eocene, London Clay, Isle of Sheppey, Kent. a, right lateral view, a moult in typical 'lobster open moult position'; b, posterior view showing displacement of carapace to the right.  $\times 1.0$ .



short, equally wide protogastric furrow reaches the upper orbital margin above the ocular fossa. Thin branchiocardiac furrows incline straight from the basal mesogastric angle to a weak epi-mesobranchial 'groove' and become obsolete before reaching the margin. Immediately behind the rostrum a pair of granules constitute the epigastric lobes; prominent granules are distributed, two on each subtriangular protogastric lobe, one on each ovate hepatic region; three epi-mesobranchial granules form an oblique line parallel with three on each metabranchial lobe and granules encircle a median node on the circular urogastric lobe. Smaller mesogastric/urogastric granules form a line sub-parallel to the median ridge. Other granules are bilaterally scattered with proportions.

*Discussion:* Although imperfectly preserved the basic outline of the carapace of *Sharnia* has much in common with that of *Xanthosia* spp. particularly in the length/width and orbitofrontal margin width/carapace proportions. A projection of the (abraded) anterolateral margin would produce the required angular edge and the anterolateral 'spines', lacking extremities in the present case, would, judging from the preserved 1<sup>st</sup> left 'spine', be obscure nodose, rather than spiny - a condition seen in, e.g., *Xanthosia granulosa* (M'Coy, 1854), *Xanthosia similis* (Bell, 1863), and *Xanthosia fossa* Wright & Collins, 1972. The broadly V-shaped median and sinuous lateral course of the cervical furrow is typical of *Xanthosia*. The less well defined branchiocardiac furrow is in keeping with that seen in *X. granulosa*, to which carapace outline that of *Sharnia* closely resembles. The surface ornament is rather denser than that of known *Xanthosia* species; there is a superficial resemblance to *Xanthosia similis* (Albian, England), but more closely approaches the more or less contemporary *Xanthosia aspersa* Rathbun, 1935 (Texas), in which species the median granules are more distinct and the cervical furrow is straighter. *Etyus* Leach, 1822, has a rounded marginal edge and a much reduced orbitofrontal margin; mammillated craters of several diameters are bilaterally arranged on the dorsal surface.

Section Eubrachyura de Saint Laurent, 1980

Superfamily Majoidea Samouelle, 1819

Family Epialtiidae? MacLeay, 1838

Genus *Panticarcinus* gen. nov.

*Type species:* *Panticarcinus maylandiensis* sp. nov. designated herein. The only species known.

*Diagnosis:* Carapace elongate subpentagonal, deeply channelled and nodose; rostrum triangular, sulcate, about one fourth carapace length; lateral margins with four nodose spines, the third diminutive.

*Range:* Lower Eocene, London Clay.

*Derivation of name:* From Pante, Saxon for the River Blackwater + *carcinus*.

***Panticarcinus maylandiensis* sp. nov.**

(Pl. 1, figs. 3, 4)

*Diagnosis:* As for genus.

*Material:* Both specimens are from the London Clay, Division B2

exposed in the estuary of the River Blackwater, Essex between Maylandsea, approximately TL 907 033, and Steeple Bay (TI 907 037). Holotype. A carapace, BMNH IC455 from Maylandsea; paratype an incomplete carapace BMNH IC456, Steeple Bay. (J. Saward Coll.)

*Derivation of name:* From Maylandsea.

*Description:* Carapace elongate subpentagonal in outline, widest posteriorly, almost as long as broad. Of four, including the postorbital, lateral spines the third, smallest, rises from the base of the fourth, largest, spine, and there is an enlarged spine at the basi-lateral corner of the metabranchial lobe. With the exception of the third, the spines are abraded; but their robustness suggests considerably development. The posterior margin, not well preserved, appears to be gently convex. The orbitofrontal margin is about one third carapace width (c. 35.0 percent); the rostrum, taking up almost one fourth the length of the carapace, is bluntly triangular and deeply sulcate, thickened sides have a small node near the tip, a larger, obliquely-lateral node midlength and one, largest, upright at the base standing above the upper orbital margin, is followed by three granules leading to a large protogastric node; a median granule on the mesogastric lobe closes the sulcus. An obscure notch between granules on the thickened upper orbital margin precede a blunt pre-ocular node. The outer orbital spine projects at an angle of 52 degrees from the midline. The orbits are circular; spherical base of orbital peduncle is constricted from a cylindrical extremity. The cervical furrow is thin and transverse across the midline, its depth accentuated by a pair of granules close to the midline on the triangular mesogastric lobe, and an anterior ridge on the urogastric and narrow epi- mesobranchial lobes, becoming wider, it curves sharply forwards and outwards to the margin. An equal sized node occurs on the mesogastric and urogastric lobes and a larger one on the cardiac lobe. Two obliquely placed nodes, the anterior the larger on each metabranchial lobe, are more or less fused together. Granules are sparsely scattered between and on the nodes.

*Discussion:* While agreeing by and large in outline and distribution of primary tubercles with *Sphenocarcinus*, and in particular to *Sphenocarcinus agassizi* Rathbun, 1893, (Gulf of California-Panama), the triangular, sulcate rostrum instead of the part fused/part bifid rostrum peculiar to *Sphenocarcinus* immediately distinguishes *Panticarcinus maylandiensis*; furthermore, with the exception of the epibranchial spine, the postorbital spine, other lateral spines and that at the basi-lateral angle are absent or less strongly developed in *Sphenocarcinus*.

**Acknowledgements**

Our warmest thanks are extended to Robert J. Williams and Richard Johnson, both of Essex, for kindly donating their specimens, to D. Savage and F. Mignon and J. Everett, all of Essex, who kindly provided information and/or comparative material, and members of the Essex Rock and Mineralogical Society, the Tertiary Research Group and Medway Lapidary & Mineral Society, whose willingness

to share the finds and knowledge for assistance have revolutionised our understanding of the London Clay facies and fauna. We are grateful, also, to Daniéle Guinot, Paris, who proffered much useful advice and literature. The photographs were prepared by Phil Crabb and the plate prepared by Andy Ross, both Department of Palaeontology, Natural History Museum, London. The MS benefited from an astute review by Steve Donovan, Leiden.

## References

- Barnard, K. H. (1947), Description of new species of South African Decapod Crustacea, with notes on synonymy and new records. *Ann. Mag. nat. Hist.*, (11), **13**, 361–392.
- Bell, T. (1858–63), A monograph of the fossil malacostracous Crustacea of Great Britain. Part I. Crustacea of the London Clay. 44 pp.; A monograph of the fossil malacostracous Crustacea of Great Britain. Part II, Crustacea of the Gault and Greensand. *Palaeontogr. Soc. [Monogr.]*, viii + 40 pp.
- Bishop, G. A. (1986), Taphonomy of the North American Decapods. *Crust. Biol.*, **6**(3), 326–355.
- Böhm, J. (1918), Über *Raniniodes gotteshei*, n. sp. Aus dem Eocäne von Hemmoor. *Z. dtsh. Geol. Ges.*, **70**, 35.
- Collins, J. S. H. (2002), A taxonomic review of British decapod Crustacea. *Bull. Mizunami. Fos. Mus.*, **29**, 81–92.
- Clouter, F., Mitchell, T., Rayner, D. and Rayner, M. (2000), London Clay Fossils of the Isle of Sheppey. *Medway Lapidary and Mineral Society*.
- Cooper, J. (1974a), Report of Field Meeting to High Ongar, Essex. *Tertiary Times*, **2**(1), 18–22. Reprinted 2004 *Tertiary Research*, **22**, 97–101.
- Cooper, J. (1974b), The stratigraphical distribution of the English Palaeocene Decapoda. *Tertiary Times*, **2**(2), 83–85. Reprinted 2004, *Tertiary Research*, **22**, 142–143.
- Daniels, M. C. (1971), Report of field meeting to Wrabness, Essex. *Tertiary Times*, **1**(3), 67–70.
- Desmarest, A. G. (1822), *Les Crustacés prominent dits. in Histoire Naturelle des Crustacés fossiles*, 67–142, Paris.
- George, W. and Vincent, S. (1976), Some river exposures of London Clay in Suffolk and Essex. *Tertiary Research*, **1**(1), 25–28.
- George, W. and Vincent, S. (1977a), Further river exposures of London Clay in Suffolk and Essex. *Tertiary Research*, **1**(2), 51–52.
- George, W. and Vincent, S. (1977b), A foreshore exposure of London Clay at Steeple, Essex. *Tertiary Research*, **1**(4), 105–108.
- George, W. and Vincent, S. (1978), Notes on the London Clay of the Okendon Clay Plant, South Okendon, Essex. *Tertiary Research*, **2**(1), 5–8.
- George, W. and Vincent, S. (1982), An exposure of the London Clay at Maylandsea (Lawling Creek), Essex. *Tertiary Research*, **4**(2), 39–43.
- Glaessner, M. F. (1969), *Decapoda*. In (Moore, R.C. & Teichert, C.; eds), *Treatise on Invertebrate Paleontology*, Part R, *Arthropoda*, 4(2), R399–R533, R626–628. *Geological Society of America and University of Kansas Press*. Boulder & Lawrence.
- Glaessner, M.F. and Withers, T. H. (1931), On London Clay crabs of the family Raninidae. *Ann. Mag. nat. Hist.*, ser. 10, **8**, 484–493.
- Guinot, D. (1977), Propositions pour une nouvelle classification des Crustacés Décapodes Brachyours. *C. C. R. Acad. Sci. Paris*, **D285**, 1049–1052.
- Guinot, D. and Richer de Forges, B. (1995), Crustacea, Decapoda Brachyura : Revision of the family Homolidae de Haan, 1839 In Crosnier, A. (ed.), *Résultats des Campagnes MUSORSTOM*. **13**, *Mém. Mus. nat. Hist. nat., Paris, n.s., sér. A, Zool.* **163**, 283–517.
- Guinot, D. and Tavares, M. (2001), Une nouvelle famille de Crabes du Crétacé, et la notion de Podotremata Guinot 1977 (Crustacea, Decapoda, Brachyura). *Zoosystema*, **23**(3), 507–546.
- Haan, W. de (1833–50), Crustacea. In P. F. von Siebold. *Fauna Japonica sive Descriptio Animalium quae in Itinere per Japoniam. Jussu et Auspiciis Superiorum, Notis, Observationibus et Adumbrationibus Illustravit*. i–xvii, 1–24 1833; 25–61 1835; 67–72 1837; 73–108 1839; 109–164 1841; i–xxxii, 165–243 1849; vii–xvii, 1850. Lugduni-Batavorum, Leiden.
- Hewitt, R. A. (1988), The London Clay Formation of the country around Southend (Essex, England). *Tertiary Research*, **10**(2), 83–86.
- Jakobsen, S. L. and Collins, J. S. H. (1997), New Middle Danian species of anomuran and brachyuran crabs from Fakse, Denmark. *Bull. Geol. Soc. Denmark*, **44**, 89–100.
- Jenkins, R. J. F. (1977), A new fossil homolid crab (Decapoda, Brachyura), Middle Tertiary, southeastern Australia. *Trans. R. Soc. S. Aust.*, **101** (1), 1–10.
- King, C. (1981), The Stratigraphy of the London Clay and associated deposits. *Tertiary Research Special Paper*, **6**, 158 pp.
- Kirby, R. I. (1974), Report of Field Meeting to Burnham-on-Crouch, Essex. *Tertiary Research*, **22**, 89–92.
- König, C. (1825), *Icones Fossilium Sectiles*. London, 4 pp.
- Latreille, P. A. (1802–1803), *Histoire naturelle, générale et particulière, des Crustacés et des Insectes*, **3**, F. Dufart, Paris, France.
- Leach, W. E. (1822), In Mantell, G. A., *The fossils of the South Downs; or Illustrations of the geology of Sussex*. xiv + 372 pp., London.
- McCoy, F. (1849), On the classification of some British fossil Crustacea with notices of new forms in the University Collection at Cambridge. *Ann. Mag. nat. Hist.*, (2), **4**, 161–179.
- McCoy, F. (1854), On some new cretaceous Crustacea. *Ann. Mag. nat. Hist.*, (2), **14**, 116–122.
- MacLeay, W. S. (1838), On the Brachyurous Decapod Crustacea brought from the Cape by Dr Smith, 53–71. In, *Illustrations of the Annulosa of South Africa: being a portion of the objects of natural history collected during an expedition into the interior of South Africa, under the direction of Dr. Andrew Smith, in the year 1834, 1835 and 1836; fitted out by The Cape of Good Hope Association for Exploring Central Africa*. London.
- Mantell, G. A. (1822), *Fossils of the South Downs; or illustrations of the geology of Sussex*. xiv + 327 pp.
- Milne Edwards, A. (1863), Crustacés de la famille des Cancériens. *Ann. Sci. Nat. Zool.*, ser. 4, **20**, 273–324.
- Milne Edwards, H. (1834–37), *Histoire naturelle des Crustacés, comprenant l'anatomie, la physiologie et l'classification des ces animaux*. **1**, xxxv + 468 pp.; **2**, 532 pp. Roret, Paris.
- Quayle, W. J. (1984), A new crab, *Portunites stintoni*, (Crustacea, Decapoda) from the London Clay. *Tertiary Research*, **5**(4), 173–178.
- Quayle, W. J. (1987), English Eocene Crustacea (Lobsters and Stomatopod). *Palaeontology*, **30**(3), 581–612.
- Quayle, W. J. and Collins, J. S. H. (1981), New Eocene crabs from the London Clay. *Palaeontology*, **24**(4), 733–758.
- Rathbun, M. J. (1893), Descriptions of new species of crabs from the West Coast of America and the Sandwich Islands. *Proc. U. S. Nat. Mus.*, **16**, 23–260.
- Rathbun, M. J. (1935), Fossil Crustacea of the Atlantic and Gulf Coastal Plain. *Spec. Pap. Geol. Soc. America*, **2**, I–vii + 1–160.
- Schweitzer, C. E., Nyborg, T. G., Feldmann, R. M. and Ross, L. M. (2004), Homolidae de Haan, 1839 and Homolodromiidae Alcock, 1900 (Crustacea; Decapoda; Brachyura) from the Pacific Northwest of North America And a reassessment of their fossil records. *J.*

- Paleont.*, **78**(1), 133–149.
- Saint Laurent, M. de (1980), Sur la classification et la phylogenie des Crustacés Decapodés Brachyours. I. Podotremata et Eubrachyura sect. nov., *C. R. Acad. Sci., Paris*, (D), **290**, 1317–1320.
- Samouelle, G (1819), *The entomologist's useful compendium, or an Introduction to the knowledge of British Insects, etc.* 1–496. T. Boys, London.
- Sowerby, G. B. (1826), Description of a new species of *Astacus*, found in a fossil state at Lyme Regis. *Zool. J.*, **2**, 493–494.
- Tavares, M. S. (1991), Redéfinition des genres *Rochinia* A. Milne Edwards, *Sphenocarcinus* A. Milne Edwards et *Oxypleurodon* Miers, et établissement du genre *Nassutocarcinus* gen. nov. (Crustacea, Brachyura, Majidae). *Bull. Mus. natl. Hist.*, Paris, 4<sup>e</sup> sér. 13, sec. A, nos. 1–2, 159–179.
- Ward, G. R. (1978), London Clay fossils from the M11 motorway, Essex. *Tertiary Research*, **2**(1), 17–21.
- Williams, R. J. (2002), Observations on the London Clay excavation, at Aveley Essex. *Tertiary Research*, **21**(1–4), 95–112.
- Wood-Mason, J. In Wood-Mason, J. and Alcock, A. (1891), A note on the result of the last season's deep sea dredging: natural history notes from H. M. Indian Marine Survey Steamer 'Investigator' Commander R. F. Hoskyn, R. N., Commanding, no. 21. *Ann. Mag. Nat. Hist.*, ser. 6, **7**, 258–272.
- Woods, H. (1925–1931), A monograph of the fossil macrurous Crustacea of England. *Mon. Palaeont. Soc. London*, 122 pp.
- Woodward, H. (1867), On a new genus of shore crab, *Goniocypoda Edwardsi*, from the lower Eocene of Hampshire. *Geol. Mag.*, **4**, 529–531.
- Woodward, H. (1871), On some new Eocene crustaceans from Portsmouth. *Quart. J. geol. Soc. London*, **27**, 90–92.
- Woodward, H. (1873), Further notes on Eocene crabs from Hampshire. *Quart. J. geol. Soc. London*, **29**, 25–31.
- Woodward, H. (1879), Contributions to the knowledge of Fossil Crustacea. *Quart. J. geol. Soc. London*, **27**, 90–92.
- Wright, C. W. & Collins, J. S. H. (1972), British Cretaceous crabs. *Palaeont. Soc. [Monogr.]*, 114 pp.

Manuscript accepted on July 7, 2006

Table 1. The locations cited in this Table do not include the various temporary exposures recorded during excavations and road construction works, especially the M1 Motorway (see Ward, 1978), nor those inland and coastal locations Table is intended to represent those London Clay sites in Essex from which collecting over the last thirty years, or so, has allowed a worthwhile faunal list to be recorded, and a few historical locations, likewise with reliably documented crustacean remains. It is worth noting that various exposures of Division A in the northeast of the county do not generally produce fossil crustaceans, although other groups are well represented at these horizons. Occasional finds of rolled and polished crab and lobster fossils at these sites, at the base of the overlying Pliocene Crag deposits, especially at Walton-on-the-Naze, Wrabness and Harwich, are apparently all derived from Pliocene erosion of higher London Clay sequences (Daniels, 1971).

Notes	Locations	South Ockendon(1)	Roxwell(2)	Little Canfield(3)	Osea Island(4)	Maylandsea	Steeple Bay	Stansgate Abbey Farm	Aveley No.2 pit(5) Lower section	Aveley No.2 Pit Upper section	Ongar(6)	Butts Cliff(7)	barling(8)	Southend-on-Sea(9)
	Stratigraphy	Div. A3/B1	Div. B1/B2?	Div. B1/B2?	Div. B1/B2	lower Div. B2			Div. B1/B2	lower Div. C	upper Div. C	middle/upper Div. D	Div. D	upper Div. D
	<b>Macrura-Lobsters</b>													
	<i>Archeocarabus bowerbanki</i> (M'Coy, 1849)									X	X			
	<i>Glyphea scabra</i> (Bell, 1858)				X	X	X		X					
10	<i>Homarus morrisi</i> (Quayle, 1987)			X	X		X	X	X			X		
11	<i>Hoploparia gammaroides</i> (M'Coy, 1849)	X	X	X	X	X	X	X	X	X	X	X		
	<i>Linuparus scyllariformis</i> (Bell, 1858)		X		X	X	X	X		X				
	<i>Linuparus eocenicus</i> (Woods, 1925)											X		
12	<i>Scyllarides tuberculatus</i> (König, 1825)											X		
13	Underscribed sp.					X	X	X	X		X	X		
	<b>Brachyura-Crabs</b>													
14	<i>Basinotopus lamarckii</i> (Desmarest, 1822)											X	X	
	<i>Campylostoma matutiforme</i> . (Bell, 1858)					X	X					X		
15	<i>Cyclocorystes pulchellus</i> (Bell, 1858)					X	X		X					
16	<i>Dromilites bucklandi</i> (H. Milne Edwards, 1837)		X		X	X	X	X	X					
	<i>Dromilites simplex</i> (Quayle & Collins, 1981)									X		X		
	<i>Glyphithyreus wetherelli</i> (Bell, 1858)											X		X
	<i>Goniochele angulata</i> (Bell, 1858)					X				X		X		
	<i>Laeviranina gottschei</i> (Böhm, 1918)											X		
	<i>Londinimola williamsi</i> Collins & Saward, sp. nov.						X		X					
	<i>Mithracia libinoides</i> (Bell, 1858)					X	X					X		
	<i>Pantarcinus maylandiensis</i> Collins & Saward, sp. nov.					X	X							

	<i>Portunites incerta</i> (Bell, 1858)	X	X			X	X	X		X	X			
17	<i>Portunites stintoni</i> (Quayle, 1984)										X			
	<i>Sharmia burnhamensis</i> Collins & Saward, sp. nov.										X			
18	<i>Xanthillites bowerbanki</i> (Bell, 1858)					X	X	X	X	X	X	X	X	X
	<i>Zanthopsis leachii</i> (Desmarest, 1822)									X	X	X	X	X
	<i>Zanthopsis unispinosa</i> (M' Coy, 1849)										X			
	<b>Stomatopoda – Mantis shrimp</b>													
	<i>Bathysquilla wetherelli</i> (Woodward, 1879)										X			X

**Notes.**

- The weathered upper slopes of the former clay pits at TQ 608 827 & TQ 607 826 formerly produced a fauna of *Hoploparia gammaroides* and *Portunites incerta*, in association with *Isselicrinus subbasaltiformis*, indicative of an exposure in the upper B Division, above the A3 division clays exposed in the adjacent Ockenden Clay Plant pit, which were devoid of crustacean remains (see George & Vincent, 1978).
- A working gravel pit at Roxwell (around TL 665 095), deepened to reveal the underlying London Clay, has produced a small number of crustacean fossils from the resultant spoil heaps. The fauna strongly suggests an exposure somewhere in the B Division, probably in the lower B2. Thanks to D. Turner for information on this locality.
- The former gravel pit at Crumps Farm Landfill site, Little Canfield, near Great Dunmow (TL 582 211), was deepened in 1991 to reveal the underlying London Clay. Now landfilled, it likewise produced a small number of crustacean fossils. The fauna also strongly suggested an exposure somewhere in the B Division. Thanks to G. Lucy for information on this location.
- J. S. has collected regularly at Osea, Maylandsea, Steeple and Stansgate since the late 1980s. These finds, combined with occasional visits from other collectors, especially members of ERMS, supported by the 1976, 1977a, b and 1982 papers by George and Vincent, provide extensive documentation of the exposures on the River Blackwater B1/B2 boundary. The exposures at Maylandsea, Steeple and Stansgate are a little higher, in the bottom few metres of Division B2, and there is a subtle difference in the fauna. Osea tends to produce larger specimens of *Hoploparia gammaroides* and a higher percentage of *Homarus morrisoni*.
- See Williams (2002). Here, the full sequence is split to show the species found in different divisions. The lower levels of the pit expose a full sequence of the B Division, the upper levels opposing the lower section of the C Division. Thanks to R. Williams for access to his extensive collection from this location.
- See Cooper (1974). More recent and extensive collecting has been carried out by D. Breedon and R. Williams, to whom thanks go for specimens and information on species recorded.
- See Kirby (1974). J. S. has collected regularly at this location since the late 1980s and these visits, combined with those from other collectors, provide extensive documentation for this location.
- J. S. collected a number of specimens from this location during landfill operations at Roper's Farm (TQ 926 903) during 1992 and 1993. A former gravel extraction site, the pit was then deepened to reveal around 4–5 m of underlying London Clay, before being backfilled with landfill. Most specimens were collected from the adjacent excavated clay spoil-heap, used for capping refuse. The walls of the pit revealed several septarian nodule bands; the associated phosphatic nodules were very similar to those found on the foreshore exposure at Butts cliff.
- See Bell (1858) and Hewitt (1988). This tentative fauna is reconstructed from reports of 19<sup>th</sup> century collectors. The former sea-cliffs at Southend-on-Sea (between the Cliffs Pavilion and Pier Hill, circa TQ 852 872 to TQ 851-881) were landscaped in the late 19<sup>th</sup> century and collecting from this location ceased. However, recent landslips have produced further specimens (J. S. collection), with the potential for further material when the projected repair work is carried out.  
Large specimens of homarid lobsters from the London Clay have been commonly identified as *Homarus morrisoni* (Quayle, 1987), although some authors (e.g., Clouter *et al.*, 2000, p. 42) preferred to regard them as adult stages of *Hoploparia gammaroides* (McCoy, 1849). Controversy, here, is to some extent understandable; the juxtaposition of the cervical furrow to the gastro-orbital furrow has become one of the distinguishing characters between *Hoploparia* and *Homarus*, with the cervical furrow, 'clearly developed above and below the gastro-orbital furrow in *Hoploparia* and clearly developed only below the gastro-orbital furrow in *Homarus*' (Glaessner, 1969, R459). However, apart from that area of the carapace often being poorly preserved, the distinctiveness of the gastro-orbital furrow in individual specimens of both genera varies from well developed to vague, bordering on obscurity, and after examination of Quayle's type specimens, much the same can be said for those assigned to *Homarus morrisoni*. (It is not mentioned in Quayle's description, nor included in the figure, which casts no disparagement on Quayle's observations.) The massive chelipeds and serrate rostrum of *Homarus morrisoni* remain distinctive, although Woods (1930) was inclined to doubt the reliability of the rostrum as a distinctive character. Suffice it to say that Essex was not included among Quayle's localities for *H. morrisoni*, as it would have, had he been convinced of its presence in the county.
- Specimens of this, one of the commonest decapods in the London Clay of Essex, are almost invariably of moults. Discussing the moulting habits of macrurans, Glaessner (1969, R431), said that in *Homarus*, 'the moulting animal rests on its side, the integument opens between the carapace and first abdominal segment, the carapace splits dorsally along the midline ....'. However, an observation that he and other authors (e.g., Bishop, 1986) omitted, is that not only are the remains preserved laterally in the, 'Lobster open moult position' of Bishop (1986, p. 333), *i.e.*, with the carapace raised above or at an angle to the abdomen, but it is also inclined vertically to the abdomen - a condition readily seen in posterior view. Also the dorsal suture on the outer angle, collapsed side, is invariably depressed and slightly under the other side. The deflection caused by the lifting side putting a certain amount of pressure on the resting side. Left, or right side preservation occurs in about equal numbers and specimens of the Albian *Hoploparia longimana* (G. B. Sowerby, 1826) are preserved similarly.
- Several specimens of this species have been found on the foreshore of the River Crouch at TQ 930 948, a small exposure of London Clay 1

km to the east of Butts Cliff. This location has produced specimens of *Zanthopsis leachii* and *Homarus morrissi*, and would appear to expose a slightly lower horizon to that of the Cliff itself. Thanks are extended to J. Everett for information and specimens.

13. A number of slender claw fragments with distinctive comb-like teeth, tentatively ascribed to *Ctenocheles* sp. (Cooper, 1974b), have been recorded from London Clay sites in Essex. However, fragmentary specimens found in recent years, especially from Maylandsea and Steeple, of carapaces with associated abdomens and chelae (J. S. Collection), suggest that, in lacking a *linea thalassinica* and having distinctive inflated chelae, these specimens may be more closely allied to the Recent genus *Thaumastocheles*. Further specimens are needed before a definite conclusion can be reached.
14. Previous records of this species (formerly *Dromilites lamarckii*) from Division B in Essex surely refer to *Dromilites bucklandi*, as recent collecting at these localities has failed to produce any further specimens of *Basinotopus lamarckii*, although *D. bucklandi* is commonly encountered.
15. A certain amount of confusion surrounds the identity of this species. Despite distinctive differences, particularly in characters of the fronts of the two species, it is apparent that some records refer to juvenile specimens of *Xanthilites bowerbanki*. It would appear that *Cyclocorystes pulchellus* in Essex is confined to those localities with exposures in Division B1 or the lower part of B2, where it remains a rare species.
16. See Note 14 - likewise, there is considerable confusion in early papers concerning the identification of this species. References to *Dromilites bucklandi* at Division D sites in Essex are surely in error, as *B. lamarckii* and the extremely rare *D. simplex* are the species found by present collectors.
17. Previous records of *Portunites incerta* at Butts cliff are probably incorrect. All recently collected specimens of *Portunites* from this location seen by J. S. would appear to be referable to *Portunites stintoni*, although crushed, or rolled specimens can be difficult to ascribe accurately. Likewise, all specimens of *Portunites* from the Essex B and C Division sites would appear to be identifiable as *P. incerta*.
18. Practically all specimens of this species from Essex Division B localities are juveniles, often with carapaces less than 20 mm wide. Larger specimens are found at Division D exposures where juveniles are very rare.