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Tertiary and Pleistocene crabs
from Barbados and Trinidad

^{1a} BY ^{1b}
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TERTIARY AND PLEISTOCENE CRABS FROM BARBADOS AND TRINIDAD

by J. S. H. COLLINS and S. F. MORRIS

ABSTRACT. A new species of *Hepatus* and one of *Thaumastoplax* are described from the Miocene of Trinidad; the geographical range of *Persephona* cf. *punctata* (Linné) is possibly extended southward; the geographical range of *Portunus oblongus* Rathbun is extended and a more complete description is given; *Necronectes proavitus* (Rathbun) is represented by a claw fragment. Two new species, *Falconoplax bicarinella* and *Pinnixa* (*Palaeopinnixa*) *perornata*, are described from the Lower or Middle Eocene Scotland Beds of Barbados. *Herbstia exserta* sp. nov. is described and a further eleven species in seven genera are recorded for the first time as fossils from the Pleistocene Coral Rock of Barbados. It appears that the extant species were well established in Pleistocene times and there has been little or no significant change in geographical distribution.

IN her researches on decapod Crustacea, particularly during the period 1919-1925, M. J. Rathbun made known a great number of species from the West Indies and summarized previous work. Withers (1926) added considerably to the list using material collected largely by the late Dr. C. T. Trechmann in Jamaica and Barbados. During his visits to Barbados (circa 1920-1964) Dr. Trechmann collected extensively from the Lower or Middle Eocene Scotland Beds and the Plio-Pleistocene Coral Rock from several localities about the island, and crabs were prominent in the collection of fossils received by the British Museum (Natural History) as the Trechmann Bequest (1964).

In 1956 the Trinidad Kern Oilfield Ltd. presented to the British Museum (Nat. Hist.) a considerable quantity of crab remains collected by Dr. N. Boutakoff and Dr. K. Glazewski from the Brasso Formation. This Formation was assigned by Kugler (1954, p. 411) to the neritic facies of the *Globorotalia fohsi* Zone (N. 12) which is considered by Berggren (1971, table 52.40) to belong to the Serravallian Stage of the Miocene, Zone N. 12 belonging in the Middle Miocene. The specimens are preserved in a friable rusty-brown sandstone with comminuted shell debris. They comprise mostly carapace and limb fragments of *Portunus oblongus* Rathbun. *Necronectes proavitus* Rathbun and *P. oblongus* have also been identified from the Lower Miocene San Sebastian Formation and Ponce Limestone of Puerto Rico by Gordon (1966). *N. proavitus* has been recorded from the Lower Miocene Loyola Formation of Ecuador (Morris 1973, p. 23) and Dr. R. Bristow has since sent us a specimen of *P. oblongus* from the Upper Miocene, Angostura Formation of Ecuador. The type locality for *N. proavitus* is the Middle Miocene, Gatun Formation, from Panama and *P. oblongus* was originally described from the Lower Miocene Cercado Formation of the Dominican Republic. Whilst *P. oblongus* ranges through the Miocene, *N. proavitus* is as yet known only from the Lower and Middle Miocene. In addition there is a single carapace of *Persephona* cf. *punctata* (Linné) and single carapaces of two new species described below as *Thaumastoplax intermedius* and *Hepatus nodosus*.

The crabs throw very little light on the age of the Scotland Formation except to confirm a probable Lower or Middle Eocene age. Guppy (1911) regarded the age of the Scotland Beds as Eocene. Bullen-Newton in a manuscript report (1922), the main conclusions of which were not published until 1932 (Matley), said that the mollusca suggested a Bartonian–Priabonian age. Trechmann (1925) thought that the mollusca from the Chalky Mount Conglomerate, Upper Scotland Formation, were high in the Middle Eocene to low in the Upper Eocene. Withers (1926) unfortunately thought that the presence of *Callianassa lacunosa*, a form described by Rathbun (1919a) from the Oligocene Culebra Formation of Haiti, indicated an Oligocene age for the Scotland Beds. Subsequently Davies and Vaughan (in Matley 1932) thought that the foraminifera and corals suggested an Eocene age for the beds. The stratigraphy of the Palaeogene of Barbados was revised by Senn (1940). He divided the Scotland Formation into five beds:

Mount All Beds	Morgan Lewis Beds
Chalky Mount Beds	Walkers Beds
Murphys Beds	

The Joes River Beds, which lie unconformably between the Scotland Beds and the Oceanic Formation, are shallow submarine mud flows. They contain erratic blocks that are of Cretaceous to Upper Scotland Formation in age. Senn collected from the lowest beds of the Oceanic Formation the foraminifer *Hantkenina*, which is an Upper Eocene indicator. The Scotland Formation thus cannot be younger than Upper Eocene. Senn later (1948) modified his views and he believed that the Scotland Beds were Lower and lower Middle Eocene. Cizancourt (1948), in her study of the nummulites from Barbados, found that by far the commonest species was *Nummulites (Operculinoides) bermudezi* which occurred in the Palaeocene erratic blocks and in the Chalky Mount Beds as well as the Murphys Beds. Of the ten species recorded from the Scotland Formation only two, *N. aster* and *N. pellatipsiroides*, were not found in the Palaeocene erratics from the Joes River Beds, but *N. pellatipsiroides* is known from the base of the Eocene in Mexico. Mme Cizancourt, concerned about the apparent long-ranging species, thought that care should be taken in interpretation since it was possible that secondary deposition might be involved. Two new crab species are described from these largely estuarine Scotland Beds. One is assigned to *Falconoplax*, a genus present in the Middle Eocene Jarillal Formation of Falcon Province, Venezuela (Guevara 1967) and the ?Palaeocene of Virginia, U.S.A. The second new species is a *Palaeopinnixa*, representing the second known species from the North American Eocene. All the crabs probably come from the Chalky Mount Beds.

The nummulites as well as the crab *Falconoplax* seem to suggest a Lower to Middle Eocene age for the Scotland Formation, rather than the previously thought Middle or Upper Eocene.

The Coral Rock Series occurs extensively in the central and north-western parts of Barbados, forming a cap some 61 m (200 ft) thick, resting on basal beds. The Coral Rock Series has usually been assigned to the Pleistocene but Trechmann (1937) believed the basal beds to be pre-Pleistocene, i.e. Pliocene. Trechmann considered that the presence of *Haliotis*, a form absent from the area at the present day, *Pleuroto-*

maria, and *Meiocardia* in the basal beds indicated that older beds were present. The more recent work on the molluscan fauna of Barbados by Jung (1968) supports Trechmann's view that the basal beds are indeed Pliocene in age. Mollusc fossils from these beds are internal moulds.

The Coral Rock Series rises to 334 m (1100 ft) O.D. in a series of steep wave-cut terraces which contain fossils of living species of molluscs, corals, and brachiopods, as well as crabs. We have given the terrace heights above O.D. as recorded by Trechmann. Unfortunately, it has been impossible to match these terrace heights with recent work on the chronostratigraphy of the terraces (Broecker *et al.* 1968; Matthews 1972; Bender *et al.* 1973).

Outstanding among the youngest material present is a new species of *Herbstia* whose nearest relative appears to be *H. pyriformis* (Bell), a Recent species from the Galapagos Islands. Other finely preserved oxyrhynchs include five extant species of *Mithrax*, *M. spinosissimus* (Lamarck), *M. hemphilli* Rathbun, *M. verrucosus* Milne-Edwards, *M. hispidus* (Herbst), *M. caribbaeus* Rathbun, and *M. (Mithraculus) ruber* (Stimpson). Also included are *Carpilius corallinus* (Herbst) and *Actaea rufopunctata nodosa* Stimpson, both represented by more or less complete carapaces; two species of *Portunus* and a *Pilumnus* are represented by limb fragments. None of the extant species has previously been recorded as a fossil. The genus *Mithrax* has only once before been recorded in a fossil state, from the Pleistocene of Haiti (Rathbun 1924). The Recent habitat of *Mithrax* species in this collection is generally near the shore, although some have been taken from depths ranging to 98 fathoms: they have been taken from bottoms varying from coral reefs to sand or mud. Since the degree of prominence of spines and tubercles about the carapace is subject to some variation among individuals of Recent species of this genus it would, with the limited material in the present collection, be unwise to regard the slight differences noted in *M. hispidus*, for example, as indicative of any evolutionary tendencies.

Rathbun 1925*a*, 1930, or 1937 should be consulted for intermediate synonymies of previously established species.

SYSTEMATIC DESCRIPTIONS

Infraorder BRACHYURA Latreille, 1803
 Section OXYSTOMATA H. Milne-Edwards, 1834
 Superfamily DORIPPOIDEA de Haan, 1841
 Family TYMOLIDAE Alcock, 1896
 Genus FALCONOPLAX Van Straelen, 1933

Type species. Falconoplax kugleri Van Straelen by original designation.

Falconoplax bicarinella sp. nov.

Plate 18, fig. 7

Diagnosis. Carapace with bilobed front, sharp lateral margins with two incipient spines, and a weak longitudinal ridge on each metabranchial lobe.

Holotype. A part internal mould, part decorticated carapace. In. 61353 (Pl. 18, fig. 7).

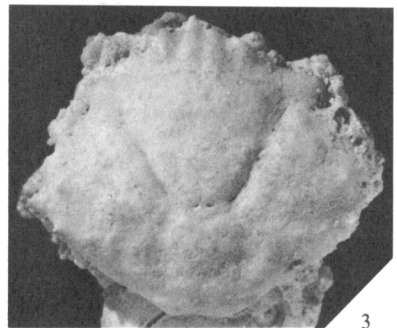
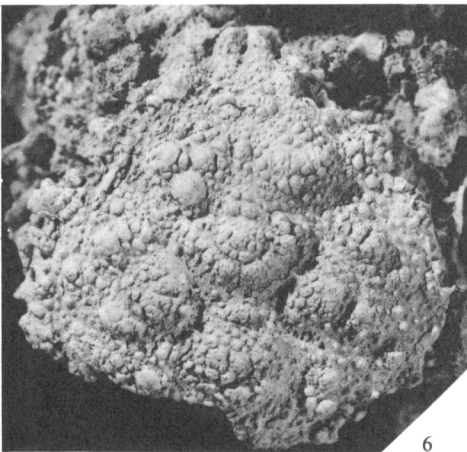
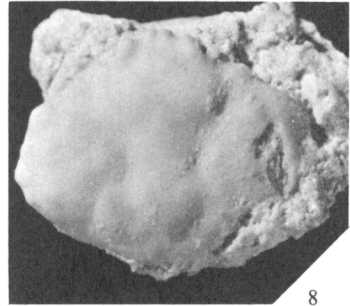
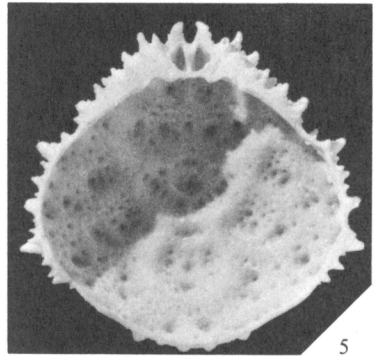
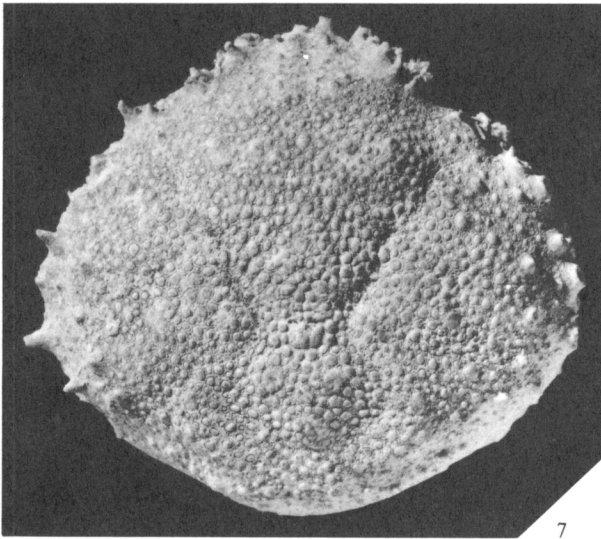
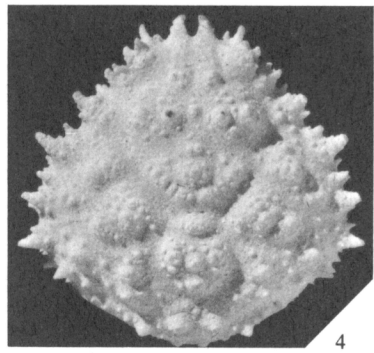
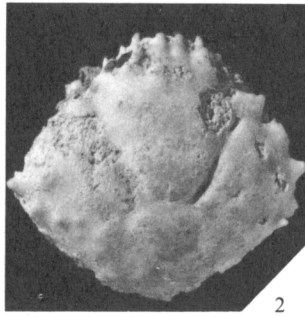
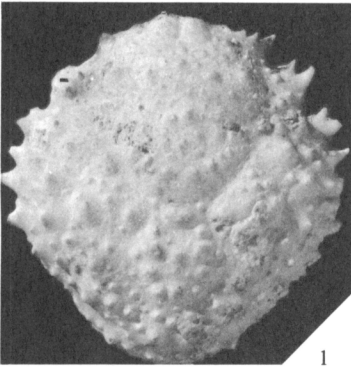
Horizon and locality. Lower or Middle Eocene, Scotland Beds, Spa, Barbados.

Description. Carapace subovate in outline, about one-third wider than long, with the widest point a little more than three-quarters of the carapace length from the front; it is moderately rounded longitudinally and transversely almost flat. The orbito-frontal margin is just under half the carapace width. The front is slightly produced and bilobed with the extremities somewhat thickened. The orbits are ovate, rather deep, and facing forward; the upper orbital margin is thin, slightly upturned with just a trace of a notch and a blunt spine forms the outer orbital angle. The anterolateral margin is short and rounded; there is a small blunt spine forward of the cervical notch and another one behind leading to a beaded line of fine granules along the posterolateral margin. The posterior angles are broadly rounded. The posterior margin is broken, but was probably almost straight and bounded by a thin ridge. The lateral margins are sharp with the sides inclined almost at right angles behind the cervical notch and inclined slightly inwards in front of it. The regions and lobes are fairly distinct on the cast. The cervical furrow is broad and deep; from the margin it is inclined slightly forward before turning sharply back to unite with the urocardiac groove. The branchiocardiac furrow is narrower and almost parallels the downward slope of the cervical. The hepatic region is small and depressed. The somewhat tumid protogastric area is barely differentiated from the mesogastric; there is a low node close to the hepatic and another at the downward turn of the cervical. The anterior process of the mesogastric area is thin and depressed between small ovate epigastric lobes. The urogastric region is subquadrate and almost confluent with the rather urn-shaped cardiac region. The epi- and mesobranchial lobes together are shaped like a scalene triangle with the angles bluntly rounded. The epimeral adductor muscle scars are seen as two deep pits between the urogastric and mesobranchial lobes. On each metabranchial lobe a ridge composed of beaded granules nearly parallels the lateral margin. On the median side of this ridge the lobe is rounded while on the outside it is flatly depressed. The elevated parts of the carapace are densely covered in granules; on the branchial lobes they tend to become arranged in rows. The granules give way to small pits on the lateral margins and at the bases of the grooves.

A natural mould of the right chela lies along the right front of the specimen. A cast shows the hand to have been robust and more or less equal to the carapace length; the fixed finger is two-thirds the length of the palm and there is evidence of a proximal spine on the movable finger and two on the fixed finger; the basal margin

EXPLANATION OF PLATE 17

- Fig. 1. *Mithrax (Mithrax) spinosissimus* (Lamarck), p. 118, Pliocene, Coral Rock; Blower's Gully, north of Bridgetown, Barbados. Dorsal view of carapace. In. 61355, $\times 1$.
- Figs. 2, 3. *Mithrax (Mithrax) hispidus* (Herbst), p. 119, Pliocene, Coral Rock 30.5 m (100 ft); Gibbons, Barbados. 2, dorsal view of carapace. In. 61191, $\times 1$. 3, dorsal view of carapace. In. 61192, $\times 1.1$.
- Figs. 4-6. *Mithrax (Mithrax) hemphilli* Rathbun, p. 118, Pleistocene Coral Rock 104 m (340 ft); Highgate, Barbados. 4, dorsal view of carapace. In. 61208, $\times 1.5$. 5, ventral view of carapace. In. 61208, $\times 1.5$. 6, dorsal view of carapace. In. 61213, $\times 1.5$.
- Fig. 7. *Mithrax (Mithrax) verrucosus* H. Milne-Edwards, p. 119, Pliocene, Coral Rock 30.5 m (100 ft); Gibbons, Barbados. Dorsal view of carapace. In. 61200, $\times 1.5$.
- Fig. 8. *Mithrax (Mithraculus) ruber* (Stimpson), p. 120, Pliocene, Coral Rock 30.5 m (100 ft); Gibbons, Barbados. Dorsal view of internal mould of carapace. In. 61198, $\times 1.5$.



COLLINS and MORRIS, crabs

is sinuous and the palmar surface is finely pitted. The trivial name is derived from the weak ridges on the metabranchial lobes.

Discussion. The new species differs from the type, *F. kugleri*, in having weak marginal spines at the cervical notch, clearly defined lobes, and the presence of longitudinal ridges on the metabranchial lobes. An undescribed species from the ?Palaeocene of Virginia, U.S.A. has subdued metabranchial ridges and the epi- and mesobranchial lobes are less well developed than are those of *F. bicarinella*.

Superfamily CALAPPOIDEA de Haan, 1833
Family CALAPPIDAE de Haan, 1833
Subfamily MATUTINAE McLeay, 1838
Genus HEPATUS Latreille, 1802

Type species. *Calappa angustata* Fabricius, 1798 by original designation.

Range. Miocene to Recent.

Hepatus nodosus sp. nov.

Plate 19, figs. 5, 6

Diagnosis. Front notched medially, not produced beyond line of suborbital cavities; anterolateral margins divided into four blunt teeth; regions marked by ovate nodes.

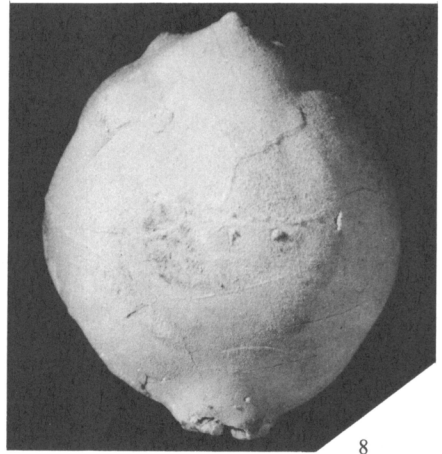
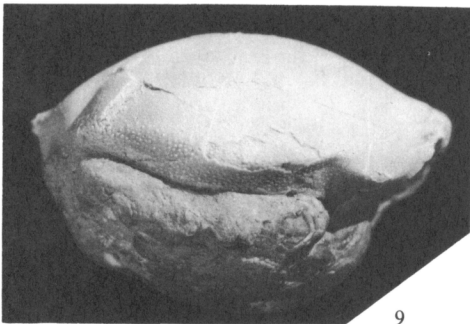
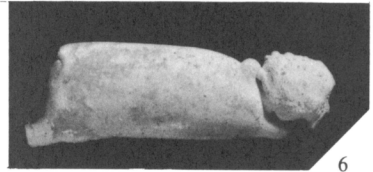
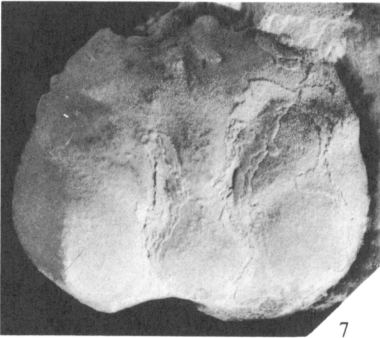
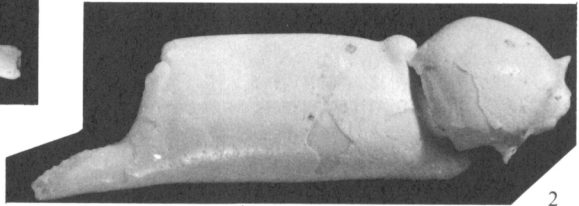
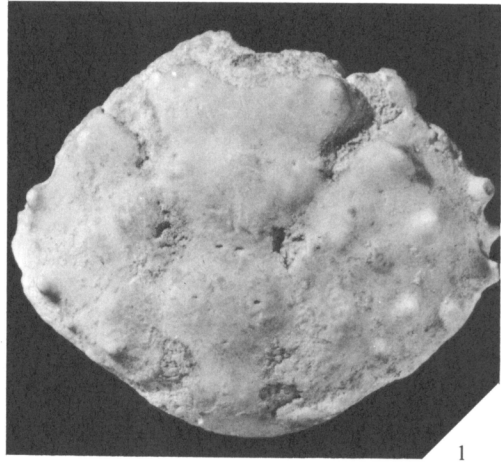
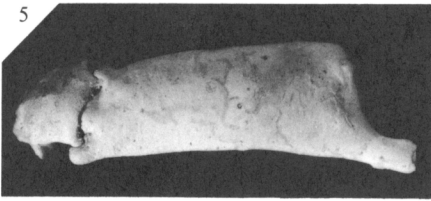
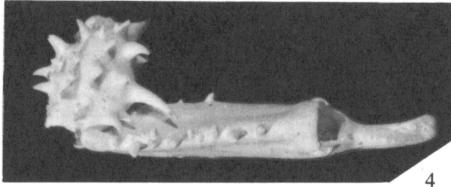
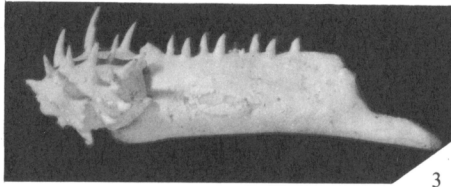
Holotype. An internal mould of a carapace. In. 59947 (Pl. 19, figs. 5, 6).

Horizon and locality. Middle Miocene, Brasso Formation, 'Crab Claw' Beds; Manzanilla Bay, Trinidad.

Description. Carapace sub-oblong in outline, the width a little more than twice the length; longitudinally it is strongly arched and moderately so transversely. The anterolateral margin is evenly rounded, lined with granules, and divided into four by even-sized blunt spines (but probably not so markedly as the damaged edge indicates). It forms a rounded angle with the straight front where it divides, the lower

EXPLANATION OF PLATE 18

- Fig. 1. *Mithrax (Mithrax) caribbaeus* Rathbun, p. 120, Pliocene, Coral Rock 30.5 m (100 ft); Gibbons, Barbados. Dorsal view of carapace. In. 61197, $\times 1.5$.
- Fig. 2. *Mithrax (Mithrax) caribbaeus* Rathbun, p. 120, Pleistocene, Coral Rock 104 m (340 ft); Highgate, Barbados. Lateral view of left cheliped showing crenellated cutting edge of the fixed finger. In. 61358, $\times 1.3$.
- Figs. 3, 4. *Mithrax (Mithrax) spinosissimus* (Lamarck), p. 118, Pleistocene, Coral Rock 104 m (340 ft); Highgate, Barbados. 3, lateral view of right hand and carpus outstretched. In. 61207, $\times 1$. 4, dorsal view of right hand and carpus folded. In. 61207, $\times 1$.
- Fig. 5. *Mithrax (Mithrax) verrucosus* H. Milne-Edwards, p. 119, Pleistocene, Coral Rock; Clapham, Barbados. Lateral view of right hand and carpus. In. 61357, $\times 0.75$.
- Fig. 6. *Mithrax (Mithrax) verrucosus* H. Milne-Edwards, p. 119, Pleistocene, Coral Rock; 6.1 m above sea-level, Garrison, Barbados. Lateral view of left hand and carpus. In. 61364, $\times 0.75$.
- Fig. 7. *Falconoplax bicarinella* sp. nov., p. 109, Lower or Middle Eocene, Scotland Beds; Spa, Barbados. Dorsal view of carapace. In. 61353, $\times 2$.
- Figs. 8, 9. *Persephona* cf. *punctata punctata* (Linné), p. 116, Middle Miocene, Brasso Formation, 'Crab Claw' Beds; Manzanilla Bay, Trinidad. 8, dorsal view of carapace. In. 59960, $\times 2.3$. 9, right lateral view of carapace. In. 59960, $\times 2.4$.



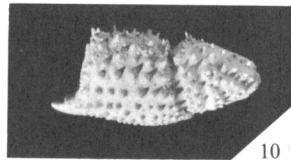
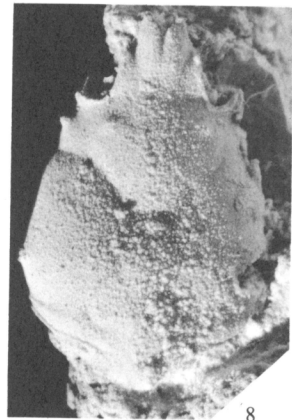
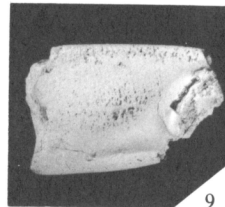
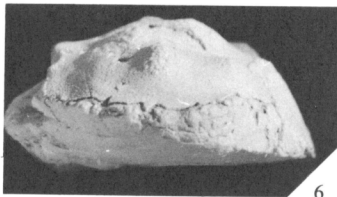
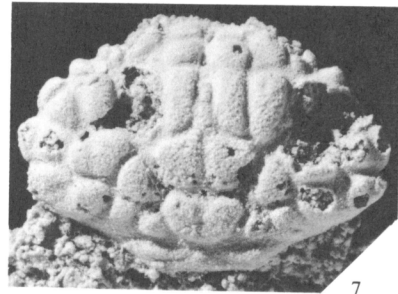
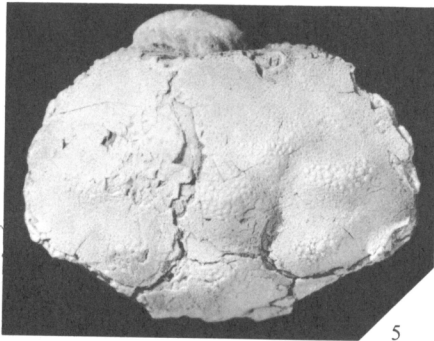
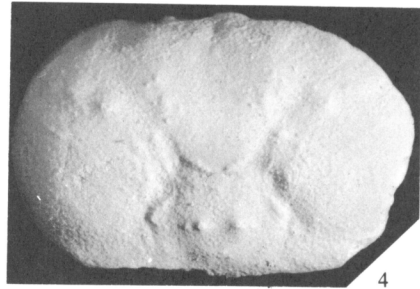
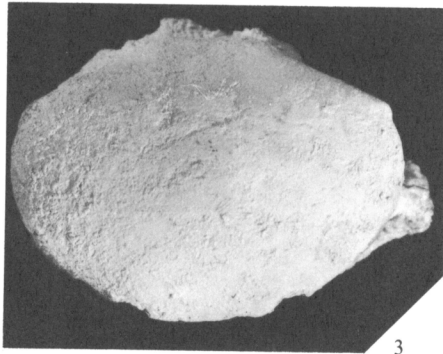
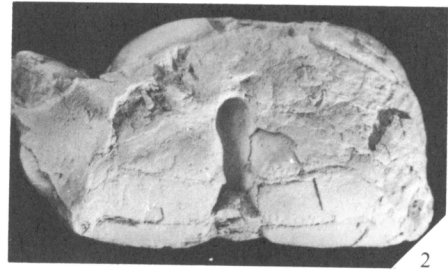
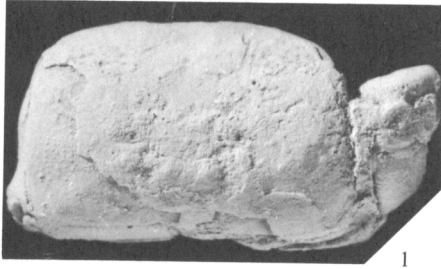
portion continuing beneath the orbit to the buccal margin and the upper leads to, and is more or less continuous with, the upper orbital margin. Both the edges are coarsely granulated while the enclosed suborbital cavities are somewhat depressed and densely covered in fine granules. The orbitofrontal margin occupies a quarter of the carapace width; it is raised above the level of the lateral margin; there is a small median notch in the front which is not advanced beyond the suborbital margin. The orbits are small and rounded. The lateral angles are set far back and the steeply undercut posterolateral margins, lined with granules along the upper edge, converge rapidly backwards. The posterior margin is about as wide as the front.

The regions and lobes are mostly well defined; the hepatic region forms a small rather depressed triangle. The rounded mesogastric area forms the highest part of the carapace; its anterior process is depressed between tumid protogastrics, while posteriorly it is barely separated from the narrow depressed urogastric lobe. A broad depression either side of the urogastric and anterior part of the lingulate cardiac region separates them from the branchial region. The meso- and metabranchial lobes are formed by ovate even-sized nodes; the rear of the former is forward of the rear of the mesogastric, while the longer axis of the metabranchial node is level with the urocardiac juncture. Small pits of several diameters crowd the carapace surface with the exception of the nodes which are covered in irregular-sized granules.

Discussion. The narrow raised front with orbits at the same level, together with sub-orbital cavities not visible from above, clearly places this species within the genus as defined by Rathbun (1937) and Glaessner (1969) and serves to distinguish it from the superficially similar *Hepatella* (Upper Oligocene–Miocene, Recent) in which the front is prominent (Rathbun 1937; Glaessner 1969) and has no depression below the orbit (Rathbun 1937). The arrangement of the nodes on the dorsal surface of *H. nodosus*

EXPLANATION OF PLATE 19

- Figs. 1, 2. *Thaumastoplax intermedia* sp. nov., p. 128, Middle Miocene, Brasso Formation, 'Crab Claw' Beds; 1.5 km south of Brasso on road to Gauracara, Montserrat, Trinidad. 1, dorsal view of carapace. In. 60008, $\times 2$. 2, ventral view of carapace. In. 60008, $\times 2$.
- Fig. 3. *Carpilius corallinus* (Herbst), p. 126, Pliocene, Coral Rock 30.5 m (100 ft); Gibbons, Barbados. Dorsal view of carapace. In. 61202, $\times 1.5$.
- Fig. 4. *Pinnixa (Palaeopinnixa) perornata* sp. nov., p. 127, Lower or Middle Eocene, Scotland Beds; Spa, Barbados. Dorsal view of carapace. In. 61361, $\times 6$.
- Figs. 5, 6. *Hepatus nodosus* sp. nov., p. 112, Middle Miocene, Brasso Formation, 'Crab Claw' Beds; Manzanilla Bay, Trinidad. 5, dorsal view of carapace. In. 59947, $\times 2$. 6, left lateral view of carapace. In. 59947, $\times 2$.
- Fig. 7. *Actaea rufopunctata nodosa* (Stimpson), p. 125, ?Pleistocene, Coral Rock; Barbados. Dorsal view of carapace. In. 61359, $\times 3$.
- Fig. 8. *Herbstia exserta* sp. nov., p. 117, Pliocene, Coral Rock 30.5 m (100 ft); Gibbons, Barbados. Dorsal view of carapace. In. 61199, $\times 4$.
- Fig. 9. *Necronectes proavitus* (Rathbun), p. 125, Middle Miocene, Brasso Formation, 'Crab Claw' Beds; Manural River, near Caparo Saca Manteca, Trinidad. Lateral view of inner margin of palm of left chela. In. 59989, $\times 0.8$.
- Fig. 10. *Pilumnus* sp., p. 126, Pleistocene, Coral Rock 91 m (300 ft); Clapham, Barbados. Outer lateral view of left propodus and carpus. In. 61360, $\times 1$.



COLLINS and MORRIS, crabs

is similar to the Recent *H. lineatus* Rathbun, but that species differs in having a more circular outline with the front slightly advanced, and a finely spinose lateral margin.

The trivial name is derived from the nodular dorsal surface of the carapace.

Family LEUCOSIIDAE Samouelle, 1819

Genus PERSEPHONA Leach, 1817

Type species. *P. latreillii* = *Cancer punctatus* Linné, 1758 by subsequent designation Rathbun, 1922. (ICZN Opinion 73.)

Range. Miocene to Recent.

Persephona cf. *punctata punctata* (Linné)

Plate 18, figs. 8, 9

cf. 1758 *Cancer punctatus* Linné, p. 630.

cf. 1859 *Persephona punctata* (Linné); Stimpson, p. 70.

cf. 1937 *Persephona punctata punctata* (Linné); Rathbun, p. 152, pl. 43, figs. 2, 3.

Range. Middle Miocene to Recent.

Material. A nearly complete carapace. In. 59960 (Pl. 18, figs. 8, 9).

Horizon and locality. Middle Miocene, Brasso Formation, 'Crab Claw' Beds; Manzanilla Bay, Trinidad.

Remarks. The specimen, which retains the large sixth abdominal somite of a female, conforms reasonably well with Rathbun's (1937) description and figures: the hepatic processes are less prominent on the fossil and, whereas the outer pair of posterior spines are missing, the basal scars suggest they were slenderer and approaching *P. townsendi* (Rathbun) which has sharp hepatic spines. The fossil is also remarkably close to Rathbun's figure (1937, pl. 43, fig. 4) of *P. subovata* (Rathbun) which is the Pacific analogue of *P. punctata punctata*. Rathbun's subspecies *P. p. aquilonaris*, which ranges from New Jersey to Texas, is more coarsely granulose and has a narrower front than the nominate subspecies.

In 1919a Rathbun described some limb fragments from the lower Miocene of San Domingo as *P. prepunctata*. She remarked that while resembling *P. punctata* they were more granulose and approached *P. townsendi*. Later (1935) Rathbun listed some limb fragments as *P. punctata* from the Yorktown Formation of Virginia, ?Yorktown of North Carolina and the Upper Miocene of South Carolina, but did not refer to her earlier work.

No persephonid limb fragments are among the present collection but as the Trinidad carapace has certain affinities with *P. townsendi* (to which Rathbun referred when discussing *P. prepunctata*) it may prove to be synonymous with *P. prepunctata*.

Section OXYRHYNCHIA Latreille, 1803

Family MAJIDAE Samouelle, 1819

Subfamily PISINAE Dana, 1852

Genus HERBSTIA H. Milne-Edwards, 1834

Type species. *Herbstia condyliata* (Fabricius), 1787 by monotypy.

Range. Pliocene to Recent.

Herbstia exserta sp. nov.

Plate 19, fig. 8

Diagnosis. Carapace pyriform with three anterolateral spines and a prominent intestinal spine.

Holotype. An almost complete carapace. In. 61199 (Pl. 19, fig. 8).

Horizon and locality. Pliocene Coral Rock 30.5 m (100 ft) level; Gibbons. Barbados.

Description. Carapace pyriform in outline, almost flat longitudinally, depressed at the urogastric lobe, and gently curved towards the posterior margin; it is slightly arched transversely with the side narrow and almost straight. The length, including the rostrum, is one and a half times the greatest width. The short rostrum is about as broad as long, consisting of two flattened slightly divergent teeth separated by a V-shaped cleft leading to a furrow between raised backward extensions of the teeth. The orbits are small and circular with sharp pre-orbital spines extending to the base of the rostrum; the upper orbital margin is slightly ridged with a thin notch; the post-orbital spine is short. Most of the antennary region is obscured by matrix, but there is a short sharp spine on the posterior part of the basal article. The anterolateral margin is very short, occupied almost entirely by a spiniform tubercle on the small triangular hepatic lobe; a similar tubercle occurs behind the cervical furrow and a larger somewhat rounded one at the widest part of the carapace almost two-thirds the distance from the front. Two or three granular tubercles are in line with and below the larger marginal tubercles. The posterior margin is strongly produced. The cervical furrow is deep, curving back from the margin it turns abruptly inwards to cross the mid-line at about a half the carapace length. The gastric lobes are barely differentiated; there is a very weak tubercle on the mesogastric and a flattened tubercle on each protogastric lobe close to the orbital margin and a weak furrow which separates the protogastric from the hepatic lobe. The urogastric forms a narrow depressed transverse bar and has a weak median tubercle bordering the cardiac lobe. The branchial region is smooth and separated from the cardiac and intestinal regions by weak grooves. The intestinal lobe is attenuated and has a low rounded suberect median tubercle overhanging the basal margin.

Remarks. *H. exserta* is quite unlike other Atlantic members of the genus, but is undoubtedly analogous with the extant Pacific species, *H. pyriformis* (Bell) from which it differs mainly in having a tubercle on the protogastric and not on the mesobranchial lobes, and a somewhat blunter intestinal tubercle. Rathbun (1925a) recognizes only one other pair of *Herbstia* as analogous species on opposite side of America *H. depressa* Stimpson, Atlantic and *H. tumidus* (Stimpson), Pacific.

The trivial name refers to the protruding posterior margin of the carapace.

Subfamily MITHRACINAE Balss, 1929

Genus MITHRAX Desmarest, 1823

Subgenus MITHRAX

Type species. *Cancer aculeatus* Herbst, 1790 - *Mithrax pilosus* Rathbun, 1892 by subsequent designation
H. Milne-Edwards, 1837.

Range. Pliocene to Recent.

Mithrax (Mithrax) spinosissimus (Lamarck)

Plate 17, fig. 1; Plate 18, figs. 3, 4

1818 *Maia spinosissima* Lamarck, p. 241.1832 *Mithrax spinosissimus* (Lamarck); H. Milne-Edwards, pls. 2, 3.1925a *Mithrax (Mithrax) spinosissimus* (Lamarck); Rathbun, p. 383, pl. 135.*Range.* Pliocene to Recent.*Material.* A carapace. In. 61355 (Pl. 17, fig. 1); Pliocene Coral Rock. Blower's Gully, north of Bridgetown, Barbados. Hand of left cheliped and an articulating carpus. In. 61207. Pleistocene Coral Rock 104 m (340 ft); Highgate, Barbados. (Plate 18, figs. 3, 4) two fragments of meri. In. 61354, In. 61384. As above. Carpus. In. 61203. Pliocene Coral Rock 30.5 m (100 ft); Gibbons, Barbados.*Remarks.* The carapace is of a young individual 28 mm in width between the fourth to fifth anterolateral spines; the frontal region is missing as far as the postorbital spine. Two small spines are preserved on the upper orbital margin in front of the postorbital spine on the right-hand side; the pair of tubercles behind the rostral horns are well developed and in line with the postorbital spines. Both the first (hepatic) and the second (epibranchial) anterolateral spines are sharply double; the fifth spine, slightly below the line of the others, is more or less in line with the gastro-cardiac groove.This is the largest species of *Mithrax*, with the carapace in Recent specimens reaching about 170 mm over-all length by 184 mm in total width. Young and medium-sized individuals are relatively longer (Rathbun 1925a, p. 384) and in this respect the outline approaches that of *M. (M.) cornutus* Saussure, which may be distinguished from *M. spinosissimus* in having much longer rostral horns with the post-rostral tubercles set in advance of the postorbital spine and having only four anterolateral spines, the first being trifold and the fourth in line with the gastro-cardiac groove.The limb fragments agree in general with Recent specimens in the British Museum (Nat. Hist.). The hand (Pl. 18, figs. 3, 4) differs from that of *M. (M.) cornutus* in having the spines on the upper margin arranged not in pairs but issuing alternately inwards and outwards from a ridged margin and in the presence of three short spines in line on the proximal half of the palmar, or inner surface. Rathbun (1925a, p. 384) states that two to four spines may be present. In *M. (M.) pilosus* Rathbun the spines are alternately arranged but extend only a short way along the upper margin.Rathbun (1923) described a carapace fragment from the Pleistocene of Mole St. Nicholas, Haiti; although the specimen was not sufficiently well preserved to name she compared it with *M. spinosissimus*.*Present distribution.* Carolina to West Indies in fairly shallow water down to 98 fathoms.*Mithrax (Mithrax) hemphilli* Rathbun

Plate 17, figs. 4-6

1892 *Mithrax hemphilli* Rathbun, p. 263, pl. 37, fig. 2.1925a *Mithrax (Mithrax) hemphilli* Rathbun; Rathbun, p. 395, pl. 139; pl. 259, fig. 2.*Range.* Pleistocene to Recent.*Material.* Six more or less complete carapaces. In. 61208-61213.*Horizon and locality.* Pleistocene Coral Rock 104 m (340 ft); Highgate, Barbados.

Remarks. The arrangement of all the surface markings more or less agree with Rathbun's description (1925a, p. 395). The dorsal surface of the largest carapace (In. 61213, Pl. 17, fig. 6) is much more coarsely granulated than the smaller ones; a fragment of a robust merus on the right side, possibly of the cheliped, is armed with long sharp spines on the upper, outer, and inner margins and suggests the specimen to be a male.

This group of specimens is among the finest preserved in the present Pleistocene collection; in specimens In. 61208–61210 both the dorsal and ventral surfaces of the carapace are entirely free from matrix.

Present distribution. Rathbun (1925a) does not record this species from Barbados, but the range appears to be from Florida Keys to Rio de Janeiro.

Mithrax (Mithrax) verrucosus H. Milne-Edwards

Plate 17, fig. 7; Plate 18, figs. 5, 6

1832 *Mithrax verrucosus* H. Milne-Edwards, pl. 4.

1925a *Mithrax (Mithrax) verrucosus* Milne-Edwards: Rathbun, p. 400, pl. 144.

Range. Pliocene to Recent.

Material. Five more or less complete carapaces. In. 61200 (Pl. 17, fig. 7). In. 61201. Pliocene, Coral Rock 30.5 m (100 ft); Gibbons, Barbados. In. 61356. Pliocene, base of Coral Rock, *Amphistegina* Bed; Cluffs, Barbados. In. 61357. Pleistocene, Coral Rock; Silversands, Barbados. In. 61385. No data; Barbados. In. 61388–61389. Hands of two chelipeds, Pleistocene, Coral Rock 104 m (340 ft); Highgate, Barbados. In. 61364 (Pl. 18, fig. 6). Hand and articulating carpus. Coral Rock 6.2 m (20 ft); Garrison, Barbados.

Remarks. The width of the carapace ranges in size from 17.5 mm to 45.0 mm between the spines at the lateral angle, the largest not quite reaching the known largest size (*circa* 51.0 mm) of Recent forms. The granulation on the smallest specimen (In. 61201) is a little more flattened on the gastric region than the branchial where the spinulose granules are more conspicuous than in larger individuals. The surface ornament is rather similar to that of *M. (M.) pilosus* Rathbun, but this species has distinct spinules on the mesogastric, mesobranchial, and intestinal lobes in addition to those bordering the anterolateral spines and the four across the frontal part of the gastric region which are weakly developed in *M. verrucosus*.

Of the chelae assigned to this species, two (In. 61364, In. 61357, a left and right hand respectively, Pl. 18, figs. 5, 6) retain an articulating carpus of which the bluntly rounded tubercles along the upper margin and flattened tubercles over the outer margin of the carpus, together with the unornamented upper margin of the hand, provide readily distinguishing features from other Atlantic members of the genus. The analogous Pacific species *M. (M.) bellii* Gerstaecker has similar chelipeds.

Present distribution. From South Carolina to Fernando Noronha, Brazil. It is a nocturnal species living near the shore, hiding in holes in rocks.

Mithrax (Mithrax) hispidus (Herbst)

Plate 17, figs. 2, 3

1790 *Cancer hispidus* Herbst, p. 245 (by error, 247), pl. 18, fig. 100.

1832 *Mithrax hispidus* (Herbst); H. Milne-Edwards, (13).

1925a *Mithrax (Mithrax) hispidus* (Herbst); Rathbun, p. 406, pls. 145, 146, 147, fig. 3.

Range. Pliocene to Recent.

Material. Six carapaces. In. 61191-61196.

Horizon and locality. Pliocene Coral Rock; Gibbons, Barbados.

Remarks. These specimens agree in general principles with Rathbun's (1925a) description and figures, but the first branchial spines, where preserved, do not appear to be as deeply bifurcated, and the line of tubercles across the gastric region is rather less prominent.

Distinguishing features between this species and *M. (M.) caribbaeus* Rathbun are discussed below.

Present distribution. Delaware Bay to São Paulo, Brazil, in shallow water to 30 fathoms.

Mithrax (Mithrax) caribbaeus Rathbun

Plate 18, figs. 1, 2

1920 *Mithrax caribbaeus* Rathbun, p. 23.

1925a *Mithrax (Mithrax) caribbaeus* Rathbun; Rathbun, p. 409, pls. 148, 149.

Range. Pliocene to Recent.

Material. A carapace. In. 61197 (Pl. 18, fig. 1). Pliocene Coral Rock 30.5 m (100 ft); Gibbons, Barbados. Part of a cheliped. In. 61358 (Pl. 18, fig. 2). Pleistocene Coral Rock 104 m (340 ft); Highgate, Barbados.

Remarks. Although the front and marginal spines on the left side of the carapace are missing, the two parallel transverse rows of the branchial tubercles which characterizes this species and provides a distinguishing feature from *M. (M.) hispidus*, discussed above, are clearly developed.

The cheliped (Pl. 18, fig. 2) is represented by a left-hand and articulating carpus. The crenellated cutting edge extending to the base of the fixed finger distinguishes this limb from that of *M. (M.) hispidus* in which the surface before the terminal cap is entire.

Present distribution. The northern Atlantic coast of America and West Indies, in depths ranging from about 2 to 12 fathoms.

Subgenus MITHRACULUS White, 1847

Type species. *Mithraculus coronatus* White, 1847 (not *Cancer coronatus* Herbst, 1785) – *Maia sculpta* Lamareck, 1818.

Range. Pliocene to Recent.

Mithrax (Mithrax) ruber (Stimpson)

Plate 17, fig. 8

1871 *Mithraculus ruber* Stimpson: 118.

1925a *Mithrax (Mithraculus) ruber* (Stimpson); Rathbun, p. 432, pl. 157.

Range. Pliocene to Recent.

Material. A carapace. In. 61198.

Horizon and locality. Pliocene Coral Rock 30.5 m (100 ft); Gibbons, Barbados.

Remarks. The specimen differs from Rathbun's (1925a, p. 432) Gibbons, Barbados description in that the branchial and cardiac tubercles are not so prominent; of those across the mesogastric only the outermost pair is present and the pair behind the rostral horns is somewhat inconspicuous.

The specimen may be distinguished from *M. (Mithrax) tortugae* Rathbun in having blunter, rounder lateral processes and the cervical furrow crosses the mid-line of the carapace nearer the front.

Present distribution. From Cuba to Barbados and Curacao; from $\frac{1}{2}$ to 84 fathoms on bottoms varying from sandy, muddy, or rocky to coral reefs.

Section BRACHYRHYNCHA Borradaile, 1907
Superfamily PORTUNOIDEA Rafinesque, 1815
Family PORTUNIDAE Rafinesque, 1815
Genus PORTUNUS Weber, 1795

Type species. *Cancer pelagicus* Linné, 1758 by subsequent designation Rathbun, 1926. (ICZN Opinion 394.)

Range. Lower Miocene to Recent.

Portunus oblongus Rathbun

Plate 20, figs. 1-8

1920 *Portunus oblongus* Rathbun, p. 383, pl. 25, fig. 3, 3a.

1966 *Portunus* cf. *oblongus* Rathbun; Gordon, p. 185, text-fig. 2.

Range. Lower to Middle Miocene.

Remarks. This species was founded on a single fragmentary specimen (328229 USNM) of a male from the Lower Miocene Cercado Formation of the Dominican Republic. Since the new material shows features not present in the type and also includes specimens of females, a revision of the description, incorporating Rathbun's original remarks where appropriate, is given.

Horizon. Middle Miocene, Brasso Formation, 'Crab Claw' Beds.

Material. Fifty-nine specimens, largely fragmentary, from three localities: In. 59948-60006, Manzanilla Bay, Trinidad; In. 60001, Navarro River, Manzanilla Bay, Trinidad; In. 60009, 6.5 km (4 miles) south of Caparo Sta., Montserrat, Trinidad.

Description. Carapace length a little less than two-thirds of the width measured in front of the lateral spines. The lateral spine (In. 60006, Pl. 20, fig. 1) is long, stout, and almost conical at the base and curving upwards and forwards. The spines on the anterolateral margin are small, more or less even in size, flattened and upturned; they have slightly convex posterior and concave anterior margins. The orbitofrontal margin is a little more than half the carapace width with the front occupying about a quarter of this distance. There are four bluntly rounded spines on the front; the median pair, separated by a V-shaped sinus is a little in advance of the lateral pair and the distance measured at the outer bases of the inner pair is about a third of the frontal width. The orbital margin from the triangular inner orbital spine to a notch on the outer third is more advanced than the lateral portion; there is a thinner notch close to the outer orbital spine which is a little larger than the succeeding marginal

spine. The posterior margin is a little narrower than the orbitofrontal margin. The surface of the carapace is very uneven with the proto- and mesogastric lobes tumid and the epibranchial ridge leading to the lateral spine is prominent. The cardiac region is divided anteriorly by a cleft, the portions on either side forming rounded nodes which with two others of similar size on the branchial region form a semicircle round the depressed urogastric lobe. The anterior gastric ridge is nearly straight. Fine granules of several diameters crowd the elevated parts of the dorsal surface; they become sparser posteriorly, and laterally give way to pits; both dorsal and ventral surfaces of the anterolateral spines are granulose. On the holotype the posterior of the carapace is decorticated and the exposed shell layer is rather coarsely granulated.

The ischium of the third maxilliped shows a deep furrow which is situated near the inner third and does not reach the posterior end; the basal width of the exopodite is about half that of the endopodite.

The sternum between the chelipeds is extremely wide, giving the whole sternum a more oblong shape than usual; its margin opposite the anterior base of the cheliped bears a few granules; the sternum in front of the articulating condyle of the cheliped is depressed, the line between the depression and the elevation behind it being nearly transverse, not V-shaped. The male abdomen exclusive of the first two somites is largely triangular; the length of the coalesced somite (third, fourth, and fifth combined), measured on the median line, from the transverse ridge to the distal end is two-thirds of its distal width; the sixth somite is half as wide on its distal as on its proximal margin, while the length is three-quarters of the proximal width; the telson is triangular, its width a little greater than its length. The third to sixth somites of the female abdomen are semi-elliptical in outline; the third, fourth, and to a lesser extent the fifth somites have a transverse median ridge. The median length of the sixth somite is two-fifths of its proximal width.

The chelipeds are robust. The ischium is triangular in section with two sharp spines on the upper and two smaller ones on the lower margin. The carpus is short, triangular in section with a short curved ridge running towards the middle of the outer margin and there is a sharp distal spine on the upper and lower margins. The hand is twice as long as the carpus; there are four sharp carinae extending the length of the hand on the outer margin and two on the inner; the third outer and median inner ones not reaching the distal edge but terminating in a blunt spine; the areas between the carinae

EXPLANATION OF PLATE 20

Figs. 1-8. *Portunus oblongus* Rathbun, p. 121, Middle Miocene, Brasso Formation, 'Crab Claw' Beds; Manzanilla Bay, Trinidad. 1, dorsal view of internal mould of carapace. In. 60006, $\times 0.5$. 2, dorsal view of internal mould of carapace. In. 59949, $\times 0.75$. 3, ventral view of female abdomen. In. 59998, $\times 0.9$. 4, ventral view of male abdomen. In. 59971, $\times 0.8$. 5, lateral view of outer margin of right propodus and carpus. In. 59952, $\times 0.75$. 6, lateral view of inner margin of right propodus and carpus. In. 59952, $\times 0.75$. 7, lateral view of outer margin of left propodus. In. 59983, $\times 0.75$. 8, lateral view of inner margin of left propodus. In. 59983, $\times 0.75$.

Figs. 9-11. *Portunus gibbesii* (Stimpson), p. 124, Pleistocene Coral Rock 104 m (340 ft); Highgate, Barbados. 9, lateral view of inner margin of left propodus. In. 61204, $\times 1$. 10, lateral view of outer margin of left propodus. In. 61204, $\times 1$. 11, lateral view of fragment of left propodus. In. 61205, $\times 1$.

Fig. 12. *Portunus vocans* (A. Milne-Edwards), p. 124, Pleistocene Coral Rock 104 m (340 ft); Highgate, Barbados. Lateral view of right propodus. In. 61206, $\times 2$.