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New and previously known decapod crustaceans from the Late Cretaceous of New Jersey and Delaware, USA

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Abstract

A collection of Late Cretaceous decapod crustaceans from the New Jersey State Museum has led to revisions of previously known species. One new genus, *Chondromaia*, and four new species, *Cenomanocarcinus robertsi*, *Chondromaia antiqua*, *Distefania lauginigeri*, and *Seorsus kauffmani* are recognized, the latter from the Late Cretaceous of New Mexico. The fauna from the Late Cretaceous of New Jersey and Delaware is diverse, embracing species from Astacidea, Axiidea, Dromiacea, Homoloida, Dakoticancroida, Raninoida, and Majoidea. The occurrence of a majid crab in the Late Cretaceous marks the oldest occurrence of the family. Burrows containing chelae of *Mesostylus mortoni* and fecal pellets are some of the only known occurrences of the tracemaker found within its burrow.

Key words: Decapoda, Brachyura, Maastrichtian, Campanian, New Jersey, Delaware

Introduction

The decapod crustacean fauna of New Jersey and Delaware has been documented since Van Rensselaer (1825) provided brief descriptions and illustrations of four of eight specimens of claws which he considered to be the first decapod remains recorded from the United States. His illustrations (1825, pl. 14, figs. 1, 3, and 4) show three callianassid claws and one claw of indeterminate type (pl. 14, fig. 2). Subsequently, Morton (1830) reported *Astacus* sp. presumably from the spoil piles of the Chesapeake and Delaware canal, and *Cancer* sp. from New Jersey. This latter reference was to the specimens noted by Van Rensselaer. In 1834, Morton provided the same information, and added that the New Jersey locality was in the region of Sandy Hook. Until 1901, no other references to the decapods of the region are known to us. In 1901, Pilsbry provided the first formal descriptions and illustrations of the Cretaceous decapods of New Jersey. He named *Callianassa mortoni, C. conradi*, *Hoploparia gabbi*, *H. gladiator*, and questionably *Cancer* (?) *whitfieldi*. Subsequently, Weller (1905) added *Tetracarcinus subquadratus* to the list of species from the area.

Roberts (1962) provided the most recent assessment of the fauna, wherein he described 18 species-level taxa, of which 11 were new. He also identified five other taxa to the level of genus, and noted other remains of questionable assignment. This work has been the benchmark study of New Jersey Cretaceous decapods until now.

Subsequent to Roberts' work, many changes in nomenclature and systematics have occurred and additional material has been collected, but was unstudied, in museum collections. Thus, the purpose of the present work is to review, illustrate, and revise the Cretaceous Decapoda from New Jersey and the nearby Chesapeake and Ohio canal site in Delaware. The study is based upon an unstudied collection of specimens, primarily donated by Mr. Ed Lauginiger to the New Jersey State Museum. In addition, some of Pilsbry's type specimens were borrowed from the Philadelphia Academy of Science, and additional specimens were examined in the U. S. National Museum of Natural History.

Localities and Geologic Setting

Most of the specimens described here were collected from spoil piles along the Chesapeake and Delaware (C and D) Canal, a 14 mile long waterway connecting the Delaware River and the Chesapeake Bay extending mostly through the state of Delaware. Dredging of the canal results in piles of Cretaceous material that amateurs have collected for many years. Because the piles contain a mixture of sediments, the precise formation from which the fossil came cannot be determined in many cases.

New fossils from Delaware described here were mostly collected from either the Merchantville or Marshalltown formations. A few were collected from the Englishtown Formation.

Merchantville Formation: The Merchantville is composed of quartz sand, silt, and clay with glauconite. The fossils occur in concretions (tin.er.usgs.gov/geology/state). Most authors regard it as early Campanian in age (Wolfe, 1976; Kennedy and Cobban, 1993). It underlies the Englishtown Formation.

Englishtown Formation: This formation is composed of cross-bedded quartz sand, gravel, clay, and carbonized plant material (tin.er.usgs.gov/

geology/state). It displays a gradational contact with the Merchantville Formation, and it is early Campanian in age (Wolfe, 1976).

Marshalltown Formation: Similar in composition to the Merchantville Formation, the percentages of the constituents varies from that formation (tin.er.usgs.gov/geology/state). It is middle to late Campanian in age (Sugarman et al., 1995). It overlies the Englishtown Formation.

The similar lithologies of the Merchantville and Marshalltown formations are apparently what make it difficult to differentiaite fossil concretions from one formation to another when found in spoils.

Deep Cut Locality: This locality is positioned about one kilometer east of Delaware Route 896 on the C and D Canal, at approximately, lat. 39°32′44″N, long. 75°42′57″W. The location here contains in situ material from all three formations. The locality is reported to no longer be accessible due to engineering work done by the United States Army Corps of Engineers in maintaining the canal.

Railroad Bridge Spoils: These spoil piles are located on the north side of the canal near a railroad bridge, at about lat. 39°32′49″N, long. 75°42′ 06″W. The Merchantville and Marshalltown formations are mixed here. These piles are reported to have yielded abundant and diverse decapod remains but are now difficult to access because they are overgrown. Other Marshalltown and Merchantville spoil piles historically have occurred along the north side of the canal, some proximal to St. Georges Bridge on Route 13, but these now appear to be inaccessible.

Red Area Spoils: Across from the apparently locally famous Biggs Farm locality, this spoil pile is still accessible. It produces hematitic concretions with dessication cracks and sometimes pyrite. It is supposed that the Marshalltown Formation crops out here.

Institutional Abbreviations

ANSP, Academy of Natural Sciences of Philadelphia, Academy of Natural Sciences of Drexel University, Philadelphia, Pennsylvania, USA

KSU D, Decapod Comparative Collection, Department of Geology, Kent State University, Kent, Ohio, USA

NJSM, New Jersey State Museum, Trenton, New Jersey, USA

USNM, United States Museum of Natural History, Smithsonian Institution, Washington, DC, USA

WFIS, Wagner Free Institute of Science of Philadelphia, Philadelphia, Pennsylvania, USA

Systematics

Order Decapoda Latreille, 1802

Infraorder Astacidea Latreille, 1802

Superfamily Nephropoidea Dana, 1852

Family Nephropidae Dana, 1852

Genus *Hoploparia* M'Coy, 1849

Type species: *Astacus longimanus* Sowerby, 1826, by subsequent designation of Rathbun (1926b).

Diagnosis: Subcylindrical carapace, smooth; rostrum long, with suprarostral spines; supraorbital spine present; scaphocerite present; subdorsal carina present; cervical groove and postcervical groove well-developed, postcervical groove extending from midline to about midheight of carapace where it joins hepatic groove to encircle adductor testis muscle attachment; branchiocardiac groove weak; terga smooth or weakly ornamented; subrectangular telson; exopodite of uropods with diaeresis; strong heterochely of pereiopod 1; major chelipeds with fingers with strong domal denticles on occlusal surfaces; minor chelipeds with finer spinose denticles on occlusal surfaces; pereiopods 2 and 3 chelate.

Discussion: Two species of *Hoploparia* have been identified in the Cretaceous of New Jersey, *H. gabbi* Pilsbry, 1901, and *H. gladiator* Pilsbry, 1901. Both were named on the basis of fragmentary chelae, with *H. gabbi* having a strong, apparently quadrate manus and a fixed finger with molariform denticles (Pilsbry, 1901, pl. 1, figs. 11, 12). A fragment of terga of four pleonites were also attributed to this species (Pilsbry, 1901, pl. 1, fig. 13). *Hoploparia gladiator* is based upon a specimen with a long, slender manus and apparently long, slender fingers with short, sharp denticles (Pilsbry, 1901, pl. 1, figs. 15, 16). At the time of naming, no carapace material was assigned to the two species. It was not until Roberts (1962) described the Cretaceous decapods of New Jersey that carapace material was assigned to the two species. Although he provided a succinct description of the carapaces, he did not justify the assignments. One is left to conclude that the larger, more robust carapace was assigned to *H. gabbi* because Pilsbry had assigned the more stout claw form to that species. By extension, the smaller, more gracile carapace illustrated by Roberts (1962, pl. 82, figs. 1, 2, and 7) and the slender claw illustrated by Pilsbry represented *H. gladiator*. Species of *Hoploparia* are heterochelous, and an equally strong argument could be made that the two claw forms originally defining the two species are, in fact, major and minor claws of the same species.

Recognition of two distinctly different carapaces, both known from the Merchantville Formation, does confirm the existence of two species; however, the assignment of the carapaces to the species as did Roberts (1962) cannot be sustained. Careful preparation of a specimen in the collections of NJSM, NJSM 22388, has revealed the merus, carpus, and nearly complete propodus and dactylus of a specimen with carapace and part of the pleon. This intimate association of first pereiopod and carapace represents a unique occurrence to our knowledge. The carapace of this specimen is nearly identical to the specimen WFIS 17085 illustrated by Roberts as *Hoploparia gladiator*; however, the chela closely conforms to the description and illustration of one of the type specimens of *Hoploparia gabbi*. Similarly the preserved part of the pleon illustrated by Pilsbry for *H. gabbi* (1901, pl. 1, figs. 13, 14) resembles that seen on the WFIS specimen. Thus, it must be concluded that the two species recognized by Pilsbry (1901) and later by Roberts (1962) are, in fact, discrete species, but that the names of the two as recognized by Roberts (1962) must be reversed.

Hoploparia gabbi Pilsbry, 1901

(Fig. 1)

Hoploparia gabbi Pilsbry, 1901, p. 115, pl.1, figs. 11–14; Weller, 1907, p. 846, pl. 110, figs. 12–15; Pilsbry, 1916, p. 90, 91, 361, pl. 10, figs. 14, 8, 9; Rathbun, 1935a, p. 24, pl. 5, figs. 10, 11.

Non Hoploparia gabbi Pilsbry; Davis and Leng, 1927, p. 47, pls. 2, 3 (fide Roberts, 1962, p. 165).

Hoploparia gladiator Pilsbry; Roberts, 1962, p. 166, pl. 82, figs. 1–2; *non* pl. 82, figs. 3, 4, 7, 8).

Original description: "Right propodite robust, evenly convex on both sides, but slightly more convex above than below, the surface slightly roughened everywhere by small flattened, separated, scale-like asperities; lower margin bluntly angular and marked by a slight

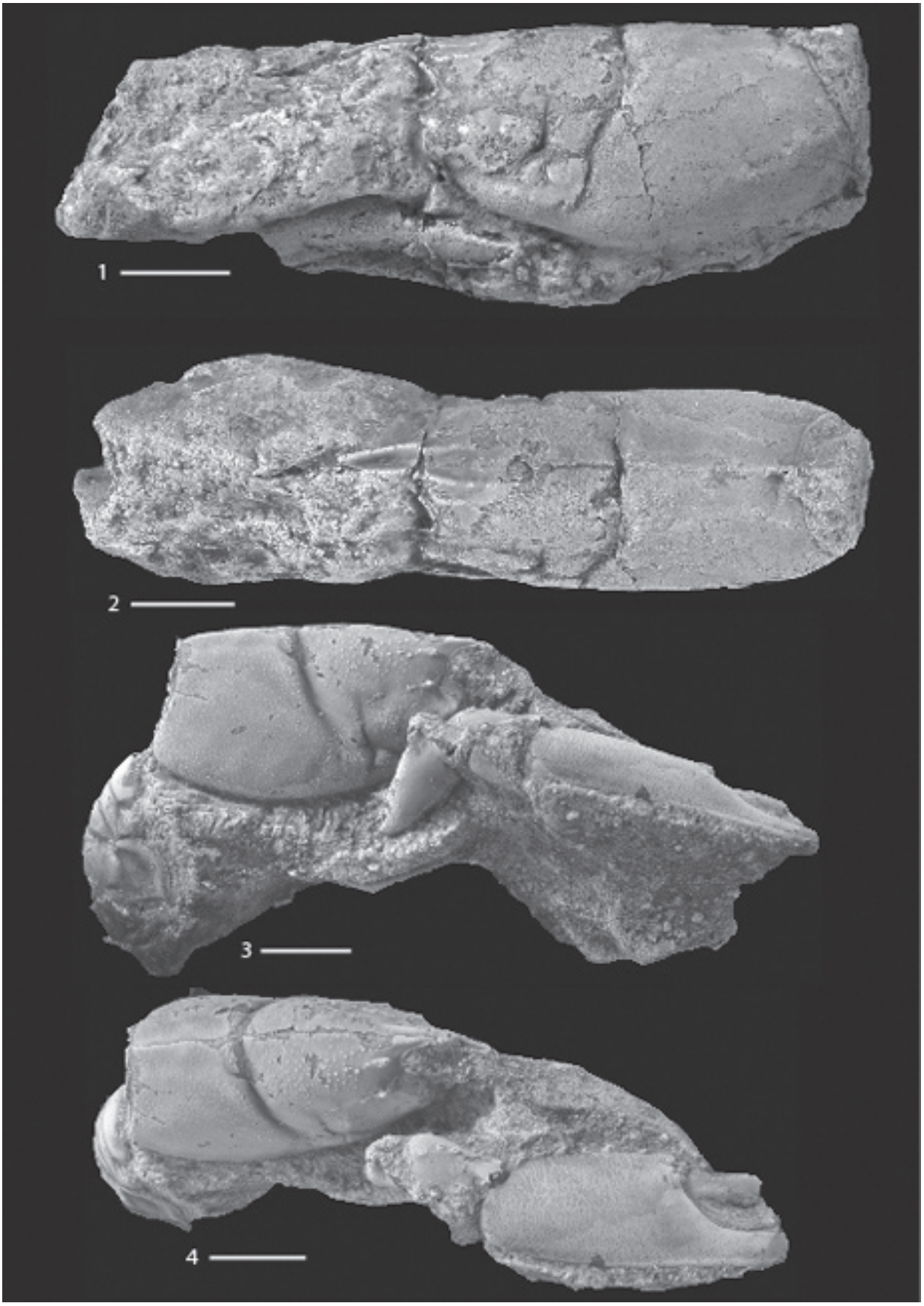

Fig. 1. *Hoploparia gabbi* Pilsbry, 1901. 1, 2, WFIS 17085, left lateral view (1) and dorsal view (2); 3, 4, NJSM 22388, right lateral view and chelipeds (3) and dorsal view and outer surface if chela (4). Scale bars = 1 cm.

groove; upper margin narrowly rounded, bearing a couple of short conic spines, inserted slightly below the edge and directed downward and forward; and on each side there is a rounded tubercle at the base of the dactylopodite. Fixed finger rather slender, with a series of coarse tubercles (worn flat) along its grasping edge.

Dactylopodite armed with a short conic spine near its base (continuing the row of similar spines on the upper margin of the propodite), its grasping face with a series of coarse tubercles, worn flat.

Carpopodite (?) irregularly cylindrical, gibbous, a little compressed and faintly grooved along the outer side, bearing a series of several short spines along the inner.

Pleonal somites (Pl. I, figs. 13, 14) with highly arched tergum, the surface punctuate." (Pilsbry, 1901, p. 115, 116).

Emendation to description: The rostrum is long and slender, downturned at the tip, granular on the lateral rostral keels. The rostral keels extend onto the cephalic region as discrete ridges. The dorsal part of the cephalic region is finely granular and a subtle carina terminating anteriorly in a small spine extends from the cervical groove anteriorly to the midpoint of the orbital reentrant. The dorsal surface of the branchial region is weakly punctate, as is the remainder of the branchiostegite, but is otherwise smooth. The pleuron of pereonite 2 is generally triangular with a posteriorly directed spine on the posteroventral corner. The pleura of pereonites 2 and 3 are triangular and terminate in a sharp spine. The smooth, punctate terga are separated from the pleura by a distinct, smooth longitudinal ridge.

The merus of the right first pereiopod is longer than high, attaining maximum height distally. The outer surface is smooth and the upper margin is tightly rounded. A blunt spine extends upward and distally for the distal end of the upper margin. A long, slender spine extends distally from the distal margin of the lower margin. The carpus is longer, 11.4 mm, than high, 7.5 mm, and is highest near midlength. The outer surface is smooth and the bears four small spines, one near the upper margin and three in a row at about midheight. The manus is longer, 22.7 mm, than high, 13.3 mm. The outer margin is sharp with a subtle sulcus paralleling the margin distally. The upper surface is smooth with an anastomosing pattern expressed on the surface. The inner margin bears six stout, distally directed spines increasing in size slightly proximally. The fixed finger is higher than the dactylus and tapers to broken distal end. The dactylus is more slender, with a round cross section and strong domal denticles on the occlusal surface.

Material examined: WFIS 17085; cast of WFIS 17085 catalogued as KSU D1391; NJSM 22388.

Occurrence: Roberts (1962) reported this species from the Merchantville Formation in New Jersey and Delaware. It has been reported from the Rail Road spoils. The locality for NJSM 22388 is simply reported as C and D Canal in Delaware.

Discussion: This form closely conforms to the type description in terms of the chelae given by Pilsbry and quoted above for *Hoploparia gabbi*. Thus, we refer this carapace to this claw. The two specimens studied herein and referred to *Hoploparia gabbi* are strikingly similar to one another in terms of the carapace morphology. Both are small, slender forms. The specimen illustrated by Roberts (1962, pl. 82, figs. 1–8, as *Hoploparia gladiator*) has a carapace length excluding the rostrum of 42.0 mm and a height of 22.9 mm. The cervical, antennal, and hepatic grooves are more deeply impressed than those on *H. gabbi* as described and illustrated by Roberts (1962).

***Hoploparia gladiator* Pilsbry, 1901**

(Fig. 2)

Hoploparia gladiator Pilsbry, 1901, p. 116, pl. 1, figs. 15, 16; Weller, 1907, p. 848, pl. 110, figs. 16, 17; Pilsbry, 1916, p. 90, 91, 362, pl. 10, fig. 6.

Hoploparia gabbi Pilsbry. Roberts, 1962, p. 165, pl. 81, figs. 1–4.

Description: "Propodite long and narrow, parallel-sided, its thickness more than half the width, about equally convex on the two sides, smoothish, showing scattered punctures and under a lens a very fine punctulation; on both sides of the hand a row of three or four small pointed tubercles runs lengthwise along the median convexity; lower edge bluntly biangular. Fixed finger nearly double the width of the dactylopodite, pyriform in section, with a row of tubercles along the grasping edge. Dactylopodite oval in section, also bearing pointed tubercles opposed to those on the fixed finger.

Length of propodite as broken 35 mm.; width 11.5, thickness 7 mm." (Pilsbry, 1901, p. 116, 117)

Emended description: The carapace bears a shallow, subtle cervical groove that extends in a nearly straight line ventrally to curve into a shallow antennal groove ventrally. The postcervical groove is deeply impressed and extends anteroventrally from the midline to below the midheight of the carapace where it joins the hepatic groove to curve around the moderately inflated adductor testis muscle attachment. The rostrum is absent on both specimens but the lateral rostral ridges are reflected on the carapace as granular ridges. The dorsal cephalic region bears distinct, forward directed granules and the dorsal surface of the branchial region is also granular.

The pleon has smooth terga separated from the pleura by an indistinct longitudinal ridge bearing granules; the most coarse granules are present on the second pleonite. The pleuron of pleurite 2 is quadrate; and the margin is bounded by a depression paralleling the outline of the pleuron. Pleura 3–5 are elongate with terminations drawn out into posteriorly curving, pointed terminations. The pleonite 6 is poorly preserved. The telson is quadrate, longer than wide, with a raised axis flanked by longitudinal depressions. The surface is scabrous. The exopod and endopod of the right uropod is broken, with scabrous surfaces.

Referred material: ANSP 19748; Cast, KSU D 1395 of ANSP 19748, illustrated by Roberts (1962, pl. 82, figs. 1, 2) as *Hoploparia gabbi*; NJSM 22553.

Occurrence: Roberts (1962) reported the species from the Merchantville Formation in New Jersey and Delaware. It has been reported from the Rail Road spoils. NJSM 22553 was collected from the Deep Cut locality.

Remarks: The specimen in the NJSM bears close resemblance to the specimen illustrated by Roberts (1962, pl. 81, figs. 1, 2). Both are large and relatively high. ANSP 19748 (Fig. 2.1, 2.2) has a carapace length, excluding rostrum of 50.5 mm and a height of 27.4 mm. Although compressed, the NJSM specimen (Fig. 2.3, 2.4) appears to have been strongly inflated as is the specimen illustrated by Roberts.

There is, in this discussion, the assumption that the carapace herein identified as *Hoploparia gladiator* and identified by Roberts (1962) as *H. gabbi* is, in fact, *H. gladiator*. The placement must be considered circumstantial, but reasonable. Pilsbry (1901) originally described two species of *Hoploparia*, and Roberts (1962) also recognized two species within the genus. However, the original descriptions were

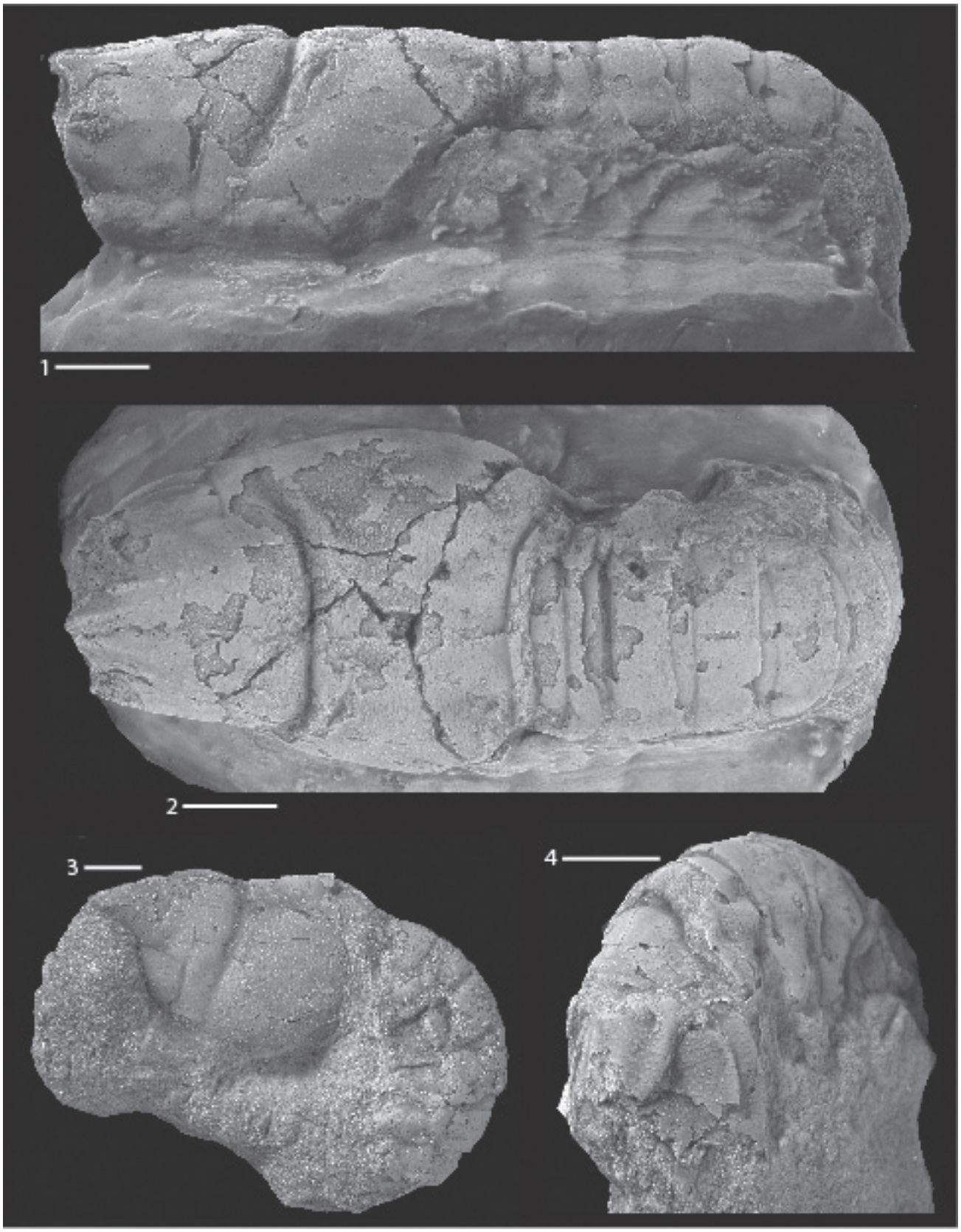

Fig. 2. *Hoploparia gladiator* Pilsbry, 1901. 1, 2, ANSP 19748, left lateral view (1) and dorsal view (2); 3, 4, NJSM 22553, left lateral view (3) and oblique posterior view showing telson, uropods, and pleon (4). Scale bars = 1 cm.

based upon claws and Roberts based his identification on carapace material. Because it is now possible to firmly relate a carapace to the claw morphology characteristic of *H. gabbi*, that species is secure. In the absence of evidence to the contrary, identification of the second carapace type recognized by Roberts (1962) as *H. gladiator* is the most parsimonious interpretation.

The features of the carapace and pleon of *Hoploparia gladiator* that most readily distinguish it from *H. gabbi* are the overall robust nature of the carapace of the former as contrasted with the smaller, more gracile form of the latter. *Hoploparia gladiator* has lateral rostral ridges that are granular whereas they are smooth on *H. gabbi*, and the dorsal surface of the cephalic region on the former is much more coarsely granular. The cervical, antennal, and hepatic grooves are less deeply impressed than they are on *H. gabbi*. The drawn out, acicular pleura of *H. gladiator* contrast markedly with the shorter, triangular pleura of pleonites 3 and 4 seen on *H. gabbi*. The latter species also exhibits a distinct spine on the posterolateral corner of the pleuron 2 which is not apparent on *H. gladiator*. Based upon these differences, the two species can be distinguished with ease. Unfortunately, no specimen of a carapace of this species is associated with a claw, so that it is not possible to contrast the claws of the two species.

It should be noted that the partial chelae illustrated by Roberts (1962, p. 81, figs. 3, 4, 7, 8) are not referred to *H. gladiator* herein, as there is no clear evidence that they are related. The specimen illustrated in plate 81, figs. 3 and 4, WFIS 17086, do bear some resemblance in outline to those illustrated by Pilsbry as the type of *H. gladiator*, but the similarity is questionable. Similarly, the claws illustrated as *H. gabbi* by Roberts (1962, pl. 81, figs. 5–7) cannot be assigned to either one of the genera with confidence and are best considered *Hoploparia* sp. at this stage. Thus, it seems most prudent to consider the claws to be in question.

Hoploparia? sp. 1

(Fig. 3.1)

Referred material: A single partial carapace and first pleonal somite, NJSM 11904, deposited in the New Jersey State Museum, Trenton.

Occurrence: The specimen was collected from the latest Cretaceous Lower Hornerstown Formation in the main fossiliferous layer of the Inversand Company Marl Pit, Sewell, Gloucester County, New Jersey. Collected with permission from O. Hungerford.

Discussion: A very small specimen, originally identified as a claw fragment, is a partial specimen of the carapace and first pleonal somite of a lobster possibly referable to *Hoploparia*. The specimen, NJSM 11904, has a carapace segment that is 22.2 mm long and 10.7 mm high and consists of a fragmented but nearly complete thoracic region and the posterior part of the cephalic region. The groove system consists of the ventral part of the postcervical groove, a deeply impressed, long inferior groove, and the hepatic groove. A segment of the strong, smooth posterior marginal carina is also preserved.

The form of the carapace is that of a homarine lobster and the specimen could be referred unquestionably to *Hoploparia* except that the carapace ornamentation is unlike that of any member of the genus known to us. Relative to the size of the specimen, the entire surface is covered by coarse, forward-directed spines (Fig. 3.1). Typically, the branchiostegite is smooth, punctuate, or only finely granular in typical member of the genus. Too little of the first pleonal somite is preserved to describe.

Given the fragmentary nature of the specimen, it is not prudent to name it. Suffice it that the great difference in size and the strong ornamentation of the carapace would seem to preclude placement in either *H. gabbi* or *H. gladiator*.

Hoploparia claws

(Fig. 3.2, 3.3)

Material examined: NJSM 11905, 11360 a and b (2 specimens), chelae.

Occurrence: The specimens were collected from the latest Cretaceous Lower Hornerstown Formation in the main fossiliferous layer of the Inversand Company Marl Pit, Sewell, Gloucester County, New Jersey. Collected with permission from O. Hungerford.

Discussion: Three claw fragments, NJSM 11905, and NJSM 11360a and b (two fragments), bear strong resemblance to the major, crusher claws typically seen of homarine lobsters, including *Hoploparia*. Two of the fragments (NJSM 11905 and 11360a) contain parts of the hand, one (NJSM 11360a) has both fixed and movable fingers. Only the proximal part of the fixed finger and the distal part of the hand are present of NJSM 11905 and 11360b). The hand is smooth on all surfaces, and the fingers bear stout, domal denticles with two small, apparently worn denticles proximally and at least two larger domed denticles distally. Although the configuration of the hand and fingers strongly suggests assignment to *Hoploparia*, there is no certain means by which they can be assigned to either *H. gabbi* or *H. gladiator*, and it is best to simply refer them to the genus.

Infraorder Axiidea de Saint Laurent, 1979

Superfamily Callianassoidea Dana, 1852

Family Callianassidae Dana, 1852

Genus *Mesostylus* Bronn and Roemer, 1852

Mesostylus Bronn and Roemer, 1852, p. 353.

Protocallianassa Beurlen, 1930a, p. 370 (part).

Type species: *Pagurus faujasi* Desmarest, 1822, by monotypy.

Included species: *Mesostylus faujasi*; *M. mortoni* (Pilsbry, 1901), as *Callianassa.*

Diagnosis: "Merus of major cheliped longer than high, upper margin convex, lined with large granules; large knob on distal margin articulation with carpus. Carpus longer than high, distal margin concave, serrate, lower distal margin with flange extending onto outer surface in weak rim separated from distal margin by prominent sulcus, distal margin of flange serrate. Proximal margin of manus at 100–110º angle to lower margin; upper and lower margins finely serrate; fingers with stout teeth on occlusal surfaces. Major chela exhibiting notable dimorphism; chelae stouter and more rectangular in presumed males, chelae more slender and higher proximally in presumed females.

Minor chela longer than high, highest proximally; fingers with parallel ridges.

Pleonal somites apparently smooth." (Quoted from Schweitzer and Feldmann, 2012, p. 17).

Mesostylus mortoni (Pilsbry, 1901)

(Fig. 4)

Callianassa mortoni Pilsbry, 1901, p. 112, pl. 1, figs. 1–7; Weller, 1907, p. 849, pl. 111, figs. 8–10; Pilsbry, 1916, p. 363, pl. 11, figs. 1–3; Rathbun, 1926a, p. 188, pl. 67, figs. 1, 2, 4–9; Rathbun, 1935a, p. 29.

Callianassa conradi Pilsbry, 1901, p. 114, pl. 1, figs. 8–10; Weller, 1907, p.

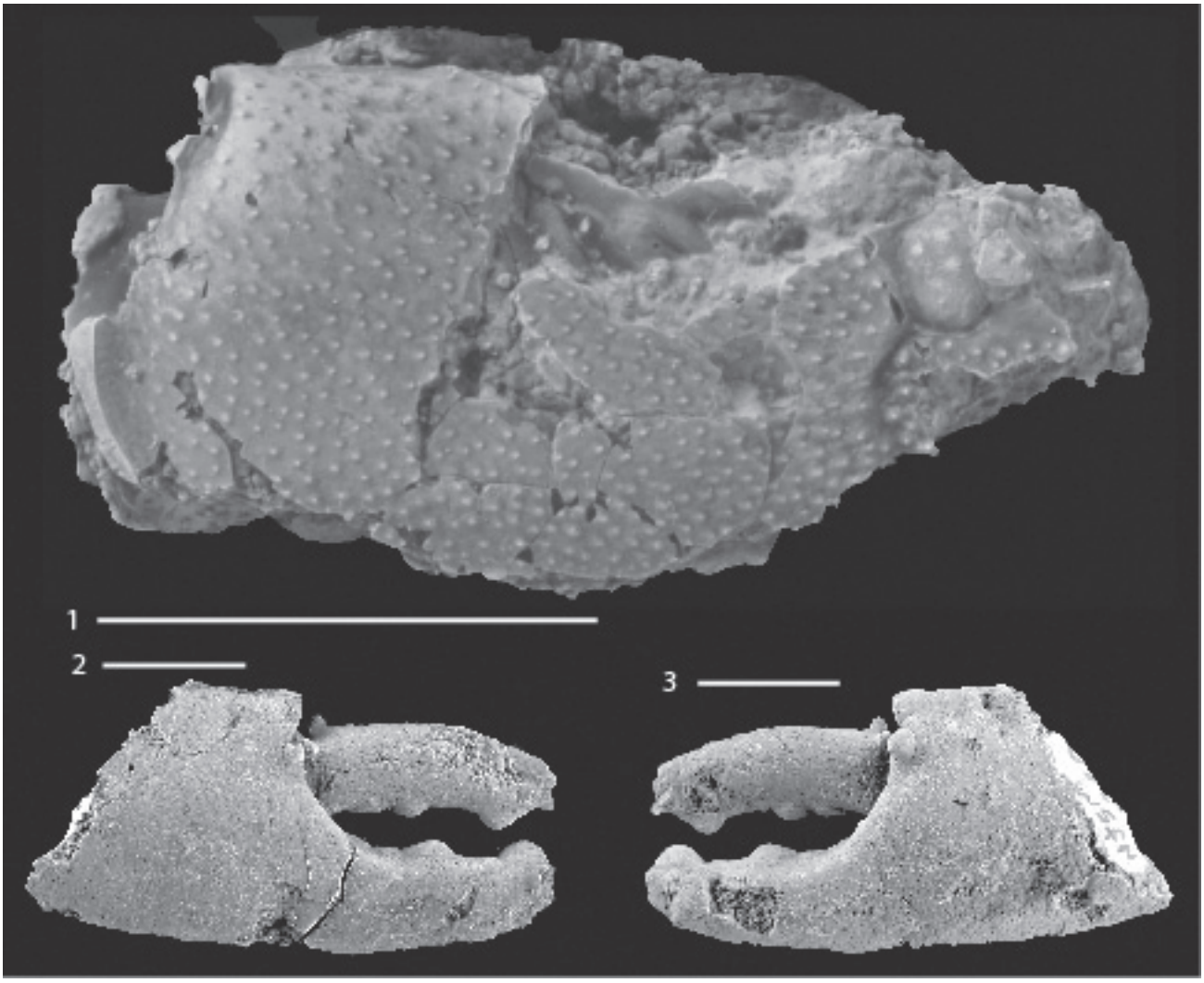

Fig. 3. *Hoploparia* spp. 1, right lateral view of spinose carapace, NJSM 11904; 2, 3, NJSM 11360, outer surface (2) and inner surface (3) of chela. Scale bars = 1 cm.

851, pl. 1110, figs. 18–22; Pilsbry 1916, p. 366, pl. 10, fig. 5; Schweitzer et al., 2010, p. 34.

Callianassa mortoni, var. marylandica Pilsbry, 1916, p. 366, pl. 11, figs. 9, 10.

Callianassa conradi var. *punctimanus* Pilsbry, 1916, p. 368, pl. 11, figs. 4, 5; Rathbun, 1935a, p. 30.

Callianassa clarki Pilsbry, 1916, p. 368, pl. 11, figs. 6–8.

Protocallianassa mortoni (Pilsbry, 1901). Mertin, 1941, p. 208; Roberts, 1962, p. 169, pl. 81, fig. 8, pl. 83, figs. 1–6; Schweitzer et al., 2010, p. 39.

Mesostylus mortoni (Pilsbry, 1901). Schweitzer and Feldmann, 2012, p. 19, fig. 3.1–3.5.

Diagnosis: The species has been recently diagnosed (Schweitzer and Feldmann, 2012, p. 19), and it will not be repeated here.

Material examined: NJSM 22497, 22505, 22512, 23022, and 23023, all from the Merchantville Formation, Deep Cut of C and D Canal, Delaware. It has been reported from the Rail Road spoils. NJSM 23341 was collected from the C and D Canal localities. NJSM 23314 and 23315 were collected in spoil piles of the Merchantville and Marshalltown formations along the north side of the canal, some proximal to St. Georges Bridge on Route 13, collected and donated by Ed Lauginiger.

Occurrence: Schweitzer and Feldmann (2012, p. 19) summarized the occurrences of *Mesostylus mortoni*, and the occurrence discussed here does not expand that range. The species is known from early Campanian to Maastrichtian occurrences throughout the Atlantic and Gulf Coastal plains as well as the Mississippi Embayment.

Remarks: Sexual dimorphism within the species was first noted by Schweitzer and Feldmann (2012), based upon the specimens reillustrated herein (Schweitzer and Feldmann, 2012, figs. 3.1–3.3). NJSM 22497 and 22512 (Fig. 4.1, 4.2) are larger and more robust than NJSM 22505 (Fig. 4.3, 4.4). Consistent with the observations noted above, we support the conclusion that the robust specimens represent males and the more delicate form represents the female. It is noteworthy that there are no other sexually dimorphic features to confirm the genders.

Another character of the propodi of this species is that the minor claw is nearly as high and long, whereas the major claw is longer than high. This is well illustrated on NJSM 22505, which preserves both major and minor chelae (Fig. 4.3). The minor chela bears strong resemblance to the specimens assigned to *Callianassa conradi* by Pilsbry (1901, p.

Fig. 4. *Mesostylus mortoni* (Pilsbry, 1901). 1, NJSM 22497, outer surface of right major cheliped, male morphotype; 2, NJSM 22512, outer surface of right major cheliped, male morphotype; 3, NJSM 22505, inner surface of left major and outer surface of right minor chela of female morphotype; 4, NJSM 22505, outer surface of left major chelipeds of female morphotype; 5, NJSM 23022 A 267, burrow including fecal pellets and specimen of *M. mortoni* transverse to burrow; 6, NJSM 23023 A 267, ridged burrow with resting area transverse to main burrow shaft. Scale bars = 1 cm..

1, fig. 8), and the major claw is represented by the type specimens of *C. mortoni*. The difference in conformation of major and minor claws accounts for the synonymy of *C. conradi* with *C. mortoni* recognized by Roberts (1962).

In addition to the specimens discussed above, two fragments of callianassid burrows are also found in the collection, both of which contain partial remains of *Mesostylus mortoni* chelae. NJSM 23022 is the better preserved specimen. The surface of the burrow, which has a diameter of about 25.5 mm, exposes numerous fecal pellets with a length of up to 3.9 mm and a diameter of 1.0 mm (Fig. 4.5). Lying transverse to the burrow is a partial carpus and propodus of *M. mortoni* suggesting that the burrow and the fecal pellets are of its making. NJSM 22023 is of similar diameter but appears to be weathered on the surface, resulting in subtle, longitudinal, anastomosing ridges; no fecal pellets can be seen (Fig. 4.6). As with the other burrow, a partial chela lies transverse to the long axis of the burrow. The chela specimens in both cases lie at an angle of about 75º to the long axis of the burrow. It is possible that the orientation of the specimens reflects an enlarged "resting area" within the burrow complex.

In a previous study of a resting area within a burrow, Schweitzer et al. (2007) interpreted the resting area as being horizontal and concluded that the burrow into the resting area was inclined. The decapod specimen in their study, *Icriocarcinus xestos* Bishop, 1988c, was a crab, not a callianassid. However, it is quite possible that a similar interpretation of the orientation of the resting area would apply to the burrow constructed by *Mesostylus mortoni*.

Discovery of callianassid remains within their burrows is a relatively rare occurrence. Hyžný (2011) provided a list of 22 occurrences of callianassids within burrow structures in the fossil record. Thus, the occurrence of these burrows with not only the individuals but also the fecal pellets of the tracemaker is remarkable.

Infraorder Achelata Scholtz and Richter, 1995

Superfamily Palinuroidea Latreille, 1802

Family Palinuridae Latreille, 1802

Included fossil genera: see Feldmann et al. (2012).

Genus *Linuparus* White, 1847

Type species: *Palinurus trigonus* von Siebold, 1824, by monotypy.

Other fossil species: see Schweitzer et al. (2010).

Diagnosis: Carapace subrectangular with three longitudinal keels; rostrum absent; supraorbital spines close to median line, fused to form plate or separated by indentation; well marked cervical groove; longitudinal median carina extends from posterior margin to cervical groove; prominent ridges form swelling on flank just posterior to cervical groove. Pleon with variously spinose margins on pleurae and keeled terga. Pereiopod 1 stout; pereiopods 2–5 long, slender; telson subrectangular.

***Linuparus richardsi* Roberts, 1962**

(Fig. 5)

Linuparus (*Podocratus*) *richardsi* Roberts, 1962, p. 176, pl. 86, figs. 1–3.

Diagnosis: Supraorbital spines close set and fused, with single spine posterior to supraorbital spine; gastric region triangular, defined by five large spines; lateral keels on cephalic and thoracic region with anteriorly directed spines decreasing in size posteriorly; surface of cephalic region depressed, generally smooth; surface of thoracic region weakly depressed, irregularly granular.

Fig. 5. *Linuparus richardsi* Roberts, 1962, ANSP 19739, holotype, dorsal view. Scale bar = 1 cm..

Material examined: ANSP 19739, holotype; NJSM 23308, partial cephalic region.

Occurrence: The holotype was collected from the Graham Brick Company pit, Maple Shade, Burlington County, New Jersey, lat. 39º67′ 09″N, long. 074º69′34″W, from the Merchantville Formation. NJSM 23308 was collected from the Marshalltown/Merchantville spoils along the C and D Canal, Delaware.

Discussion: Roberts (1962) originally placed this species in the subgenus *Linuparus* (*Podocratus*), but examination of Mertin's diagnosis (1941, p. 215) suggests that the diagnostic characters of the subgenus are not in evidence on the holotype. The cephalic region on species Mertin assigned to *Linuparus* (*Podocrates*)[sic] strong swellings, whereas that region on *L. richardsi* is generally smooth except for the five spines outlining the gastric region. The essential characters defining the subgenus are present on the pleon; however, that region is absent on the type specimen. Holthuis (1991) considered *Podocratus* Geinitz, 1849, to be synonymous with *Linuparus*. Subgeneric divisions within the genus have fallen into disuse and, therefore, no attempt has been made to assign the New Jersey material to one.

It is noteworthy that the spelling of *Podocratus* has been confusing. Although several authors have spelled the genus *Podocrates*, this spelling seems to have stemmed from Schlüter (1862) and was perpetuated by Glaessner (1929). Geinitz (1849) consistently spelled the genus *Podocratus* (p. 96 and plate 2, fig. 6). His spelling must be taken as correct.

Infraorder Brachyura Linnaeus, 1758
Section Dromiacea De Haan, 1833
Superfamily Homolodromioidea Alcock, 1900
Family Goniodromitidae Beurlen, 1932

Included genera: see Karasawa et al. (2011).

Genus *Distefania* Checchia-Rispoli, 1917

Type species: *Distefania himeraensis* Checchia-Rispoli, 1917, by original designation.

Other species: *Distafania autissiodorensis* (Van Straelen, 1936a); *D. calva* Schweitzer and Feldmann, 2010; *D. centrosa* (Van Straelen, 1940); *D. cryptica* (Jagt, Van Bakel, and Fraaije, 2007); *D. dacia* Schweitzer and Feldmann, 2010; *D. incerta* (Bell, 1863); *D. lauginigeri* new species; *D. oxythyreiformis* (Gemmellaro, 1869); *D. renevieri* Tribolet, 1876; *D. sinuososulcata* (Wright and Collins, 1972); *D. transiens* (Wright and Collins, 1972).

Diagnosis: Front broadly triangular, anterior end straight, steeply downturned; orbits and small augenrest shallow or moderately deep, forwardly directed; fronto-orbital width about 55% to 65% maximum carapace width; cervical groove deep; well-defined mesogastric region; markedly spined anterolateral margins, with spines sometimes quadrate in shape; carapace ovate, widest at about 60% distance posteriorly; arcuate swellings lateral to cardiac region; posterolateral margin rimmed; postcervical groove and usually weaker branchiocardiac groove present.

Discussion: *Distefania* is one of the more ornamented genera within Goniodromitidae and shows some of the most distinctive regional development. The new species described below is placed within the genus based upon its possession of a long spatulate rostrum, orbits with a distinct rim and no intraorbital spines, numerous square anterolateral spines with subspinelets, and well-developed regions. It differs from other species of the genus in possessing very inflated regions with sparsely placed tubercles and less well-defined carapace grooves than other species.

The new species is the youngest of the members of *Distefania*, which may account for its somewhat divergent morphology. Several species were previously known from the Cretaceous (Cenomanian), including the type species, *D. himeraensis*, recovered from Italy, as well as *D. cryptica* from Belgium.

***Distefania lauginigeri* new species**

(Fig. 6)

Diagnosis: Carapace wider than long, maximum width about 70% the distance posteriorly; anterolateral margin with stout spines, anteriormost ones with square bases; posterior margin appearing to be entire; carapace regions strongly inflated, carapace grooves not well-defined; ornamentation consisting of large, sparsely placed tubercles.

Description: Carapace wider the long, length about 70 % carapace width, widest at position of last anterolateral spine about 70% the distance posteriorly on carapace; flattened transversely, moderately vaulted longitudinally especially in anterior one-third.

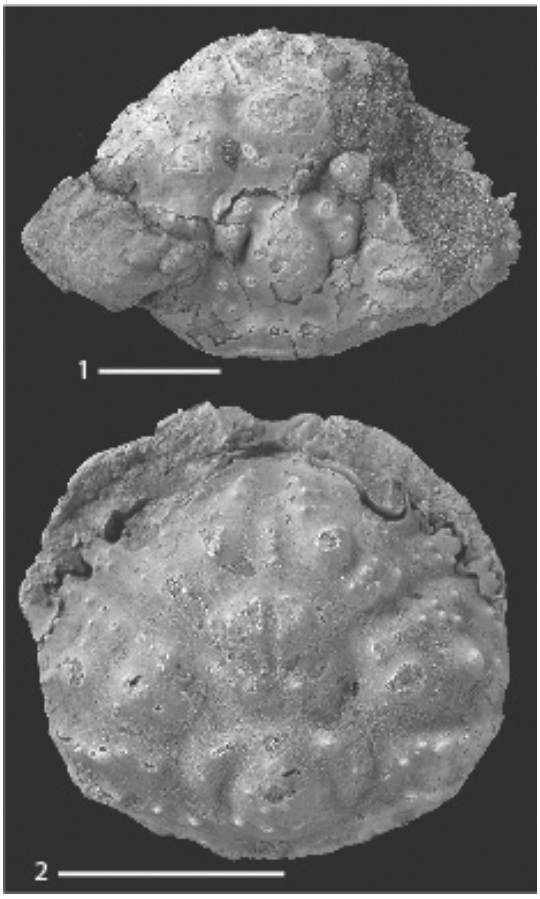

Fig. 6. *Distefania lauginigeri* new species. 1, NJSM 23303, holotype, dorsal carapace; 2, NJSM 23307, paratype, partial dorsal carapace. Scale bars = 1 cm.

Rostrum triangular, blunt-tipped, extending beyond orbits, strongly down-turned. Orbits rimmed, rim thickened axially, outer-orbital spine triangular, bifid. Anterolateral margin long, longer than posterolateral margin, with 6 or so spines; anterior-most spines rectangular at their bases, bifid or with multiple tubercles at tips. Posterolateral margin sinuous, weakly concave posteriorly, apparently entire. Posterior margin short, rimmed, concave; rim with small tubercles.

Protogastric regions elongate, longer than wide, longest axially, with row of tubercles along axial margin, one large tubercle posteriorly. Mesogastric region with long anterior process, row of tubercles on posterior half of process; two large tubercles on posteriorly widened area. Metagastric region wider than long, with oblique transverse tubercles on either side of axis. Urogastric region developed as a short depression. Cardiac region large, longitudinally ovate, covered with tubercles, flanked by reniform swellings which are ornamented with tubercles. Hepatic regions triangular, apex directed toward base of mesogastric region, ornamented with scattered small tubercles. Branchial regions broadly and unevenly inflated, 2 discrete quadrate swellings anteriorly, ridge-like swelling posterior to these, entire branchial region ornamented with scattered tubercles.

Cervical groove relatively well developed, originating posterior to second anterolateral spine including outerorbital spine, extending in arcuate forward path to posterolateral corner of mesogastric region, then extending straight along posterior border of mesogastric region.

Postcervical groove a straight segment between metagastric and cardiac regions paralleling urogastric region. Branchiocardiac groove weak, positioned between quadrate swellings and ridge on branchial regions.

Carpus of chelipeds short, ornamented with large tubercles. Manus of chelipeds longer than high, ornamented with rather closely spaced large tubercles, upper surface possible with spines.

Etymology: The trivial name honors Ed Lauginiger, Jr., who collected the specimens that form the bulk of this study and donated them to the New Jersey State Museum.

Measurements: Measurements (in mm) taken on specimens of *Distefania lauginigeri* new species: holotype NJSM 23303, maximum width (approximate), 39.6; maximum length (approximate), 27.4; fronto-orbital width, 13.8; length to position of maximum width, 19.6. Paratype NJSM 23304, maximum width, 21.6; fronto-orbital width, 11.9.

Types: The holotype is NJSM 23303, and paratypes include NJSM 23307 and 23063.

Occurrence: The specimens were collected from Marshalltown/ Merchantville spoil piles on the north side of the C and D Canal.

Discussion: None of the specimens is complete. The holotype is broken and abraded on all of the margins, so that the length and width measurements of the carapace must be taken to be approximate (Fig. 6.1). The rostrum and orbits are broken on the holotype. The paratype NJSM 23307 includes very well preserved rostrum and orbits and anterior half of the carapace, but the remainder is missing (Fig. 6.2). However, the specimens in combination clearly indicate placement in *Distefania*. The holotype includes some portions of one of the chelipeds, which are unusual if not unique for the genus. They display strong ornamentation reminiscent of some species of *Necrocarcinus*.

Section Homoloida Karasawa et al., 2011
Superfamily Homoloidea De Haan, 1839
Family Homolidae De Haan, 1839
Genus *Latheticocarcinus* Bishop, 1988b

Type species: *Latheticocarcinus shapiroi* Bishop, 1988b, by original designation.

Other species: *Latheticocarcinus adelphinus* (Collins and Rasmussen, 1992); *L. affinis* (Jakobsen and Collins, 1997); *L. atlanticus* (Roberts, 1962); *L. brevis* (Collins, Kanie, and Karasawa, 1993); *L. brightoni* (Wright and Collins, 1972); *L. centurialis* (Bishop, 1992b); *L. declinatus* (Collins, Fraaye, and Jagt, 1995); *L. dispar* (Roberts, 1962); *L. ludvigseni* Schweitzer, Nyborg, Feldmann, and Ross, 2004; *L. pikeae* (Bishop and Brannen, 1992); *L. punctatus* (Rathbun, 1917a); *L. schlueteri* (Beurlen, 1928b); *L. shapiroi* Bishop, 1988b (type); *L. spinigus* (Jakobsen and Collins, 1997); *L. transiens* (Segerberg, 1900).

Diagnosis: Carapace longer than wide (width measured between *lineae homolicae*), typically widest just posterior to intersection of cervical groove and *linea homolica* but relatively uniformly wide throughout entire length, surface granular, ornamented with discrete, large tubercles; rostrum bifid or singular, sulcate; often with small pseudorostral spines; usually with supraorbital spine; protogastric, hepatic, mesogastric, and cardiac regions ornamented with large tubercles; grooves defining lateral margins of mesogastric region deeply incised; cervical groove very deeply incised, arcuate, U-shaped, not typically sinuous, separating the carapace into distinctive anterior and posterior portions; branchiocardiac groove very deep anteriorly, beginning about midway between *linea homolica* and axis, extending axially, curving around and extending laterally to intersect *linea homolica*; *lineae homolicae* very well-developed, sub-hepatic and sub-branchial regions rarely preserved; cardiac region with two swellings positioned one beside another, sometimes with lateral ridges extending onto cardiac regions; cardiac region not well differentiated from branchial regions by deep groove.

Latheticocarcinus atlanticus (Roberts, 1962)

(Fig. 7.1, 7.3–7.6)

Homolopsis atlantica Roberts, 1962, p. 179, pl. 89, fig. 4.

Latheticocarcinus atlanticus (Roberts, 1962); Schweitzer et al., 2004, p. 136; Schweitzer et al., 2010, p. 68.

Diagnosis: Carapace including extralineal flanks; mesobranchial region with one large tubercle posteriorly and two obliquely ovate ones; cardiac region well-defined, with three large tubercles; tubercles ornamenting all regions very large; subepibranchial spine very large and long.

Description: Dorsal carapace including extralineal flanks broadly triangular anteriorly, quadrate posteriorly, slightly wider than long including flanks, widest at epibranchial region about 40% the distance posteriorly; width about 82% width excluding extralineal flanks, maximum width at position of epibranchial about half the distance posteriorly. Carapace regions well-defined.

Rostrum appearing to be triangular, downturned, axially sulcate, terminating in an acute point; margin weakly rimmed, the rim extending into orbits.

Orbits rimmed, angled anterolaterally at approximately 45º; rim with granules and possibly blunt spine axially; sub-orbital spine large; *linea homolica* intersecting orbit so that sub-orbital spine and augenrest are extralineal. Augenrest area flattened, sloping obliquely forward, with two sub-outer-augenrest spines.

Lineae homolicae very sinuous, extending from position axial to suborbital spine around hepatic region, very convex around epibranchial region, then distinctly concave posterior to epibranchial region, then extending weakly convex along remainder of branchial regions. Posterior margin gently concave in dorsal view, grading smoothly from posterolateral corner, evenly convex forward in posterior view; thinly rimmed. Carapace margin including extralineal regions sinuous, very large projecting anterolaterally spine on subepibranchial region, large tubercle on submesobranchial region, row of granules on submetabranchial region.

Epigastric regions distinct, each consisting of a large, blunt lobe, with numerous small granules on the summits.

Protogastric regions narrow, longer than wide, with one large tubercle; hepatic region longer than wide, subdivided into anterior and posterior sections, anterior section with 1 tubercle, posterior section with a large and a small tubercle. Mesogastric region well-defined; anterior process narrow, lanceolate, slightly constricted between protogastric tubercles, with blunt granulated ridge along the widest point, terminating between the epigastric regions; widening posteriorly, triangular, marked centrally by large, blunt triangular tubercle flanked posteriorly by two smaller elongate tubercles, all tubercles granulated on their summits.

Metagastric region arcuate, consisting of two thin, elongate, obovate lobes, one on either side of the axis and situated directly behind the elongate tubercles of mesogastric region; lobes widest axially, separated by a depression approximately the width of the large mesogastric

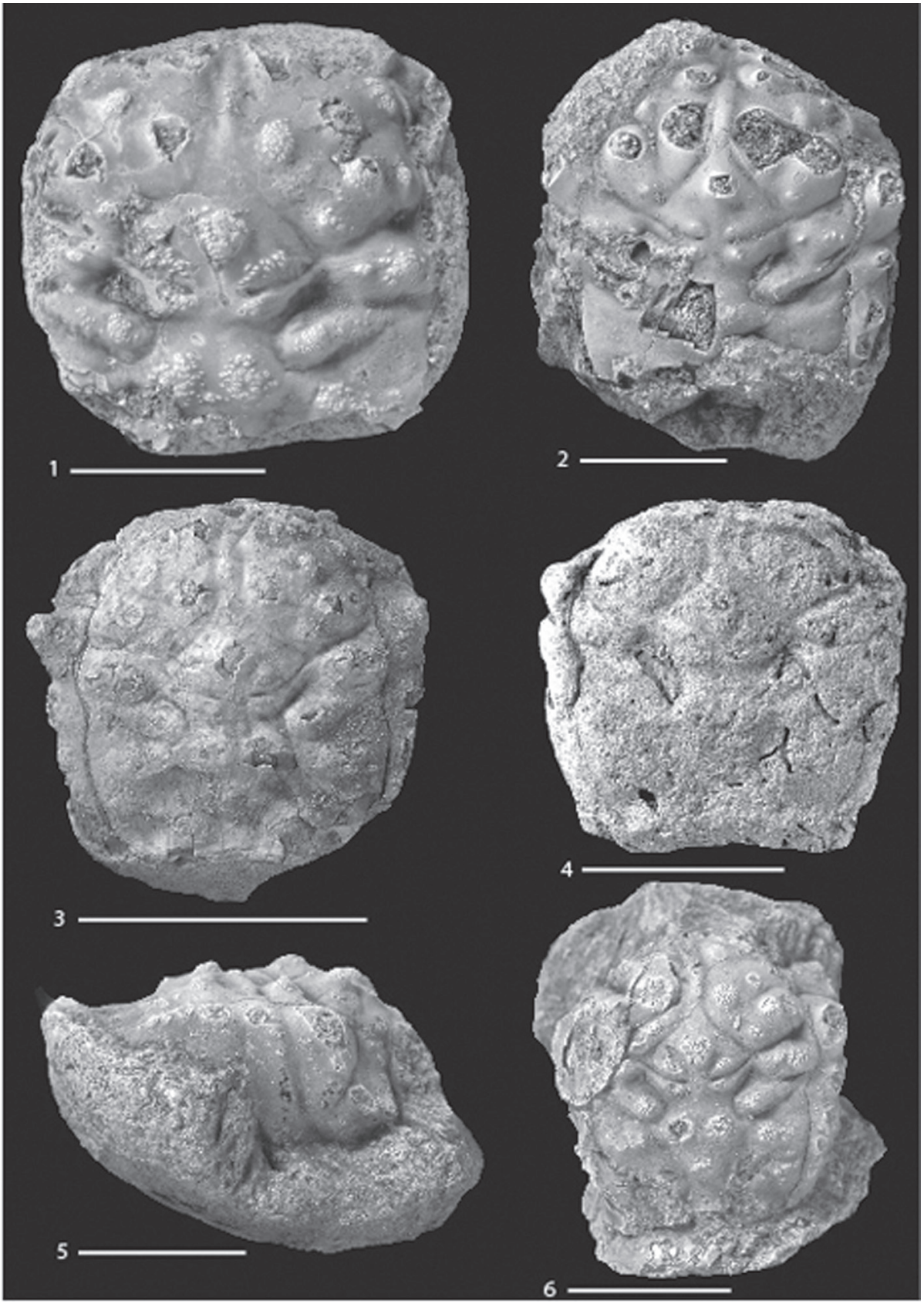

Fig. 7. *Latheticocarcinus* Spp. 1, *Latheticocarcinus atlanticus* (Roberts, 1962), ANSP 20029, holotype, dorsal surface; 2, *L. dispar* (Roberts, 1962), ANSP 20030, holotype, dorsal surface; 3, *L. atlanticus* NJSM 23306, dorsal carapace and well-preserved extralineal portions of carapace; 4, *L. atlanticus* NJSM 22690, deeply weathered dorsal carapace and well-preserved extralineal portions of carapace; 5, 6, *L. atlanticus,* NJSM 23316, flank of extralineal carapace (5) and dorsal carapace (6). Scale bars = 1 cm.

tubercle.

Urogastric region poorly defined, depressed; narrowest of axial regions.

Cardiac region pentagonal, narrowing posteriorly; two large rounded anterior tubercles and a slightly smaller posterior tubercle forming an equilateral triangle; surface mostly smooth but having a small number of granules scattered around. Intestinal region poorly defined, consisting of a smooth depression situated between the mesobranchial regions.

Cervical groove deeply incised, discontinuous across axis, concave forward around mesogastric region, concave forward around hepatic regions, extending across and then along *linea* and through augenrest, arcing anteriorly to bound ventral margin of subhepatic region. Postcervical groove deep laterally, concave forward, then extending obliquely to axis. Branchiocardiac groove shallow, parallel to cervical groove.

Epibranchial region well-defined anteriorly by cervical groove and posteriorly by postcervical groove; obovate, with blunt conical tubercle proximal to *linea*. Mesobranchial region inflated, obovate, marked by a large, blunt, coarsely-granulated tubercle axially, continuing laterally from anterior cardiac tubercle to *linea*. Metabranchial region with tubercle centrally and axially, extending into transverse ridge, with granular ridge or cluster of granules posterior to transverse ridge.

Table 1. Measurements (in mm) taken on the dorsal carapace of *Latheticocarcinus atlanticus* Bishop, 1988b.

Specimen (NJSM) Number	Length	Inter-*lineal* Width	Total Width	Fronto-orbital Width	Length to Maximum Width (Inter-*lineal* carapace)	Length to Maximum Width (Total carapace)
23316	21.0	17.2	19.3	10.6	11.5	8.8
3306	13.8	11.6	14.4	6.2	6.8	5.5
23332	22.1	18.2	23.0	10.6	12.3	9.5
23331	12.6	10.0	13.8	7.6	6.2	5.0

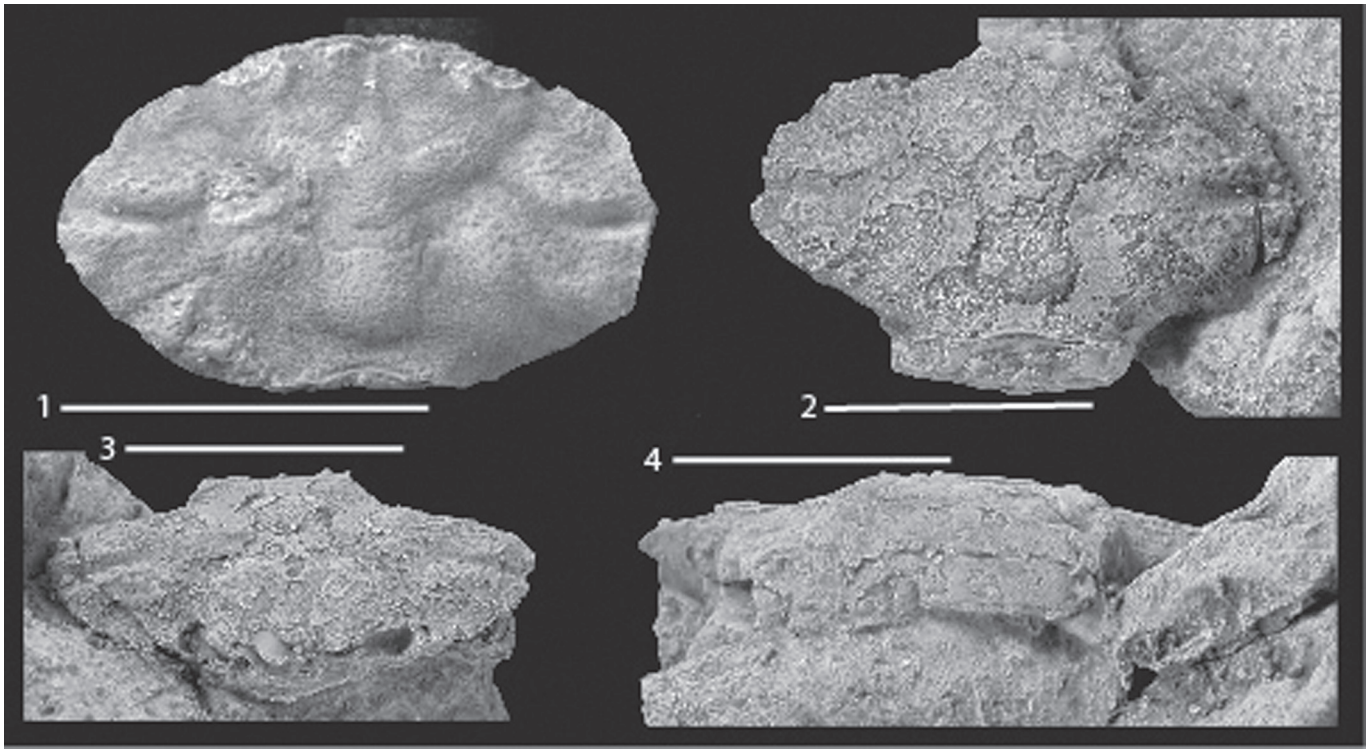

Fig. 8. *Xanthosia elegans* Roberts, 1962. 1, ANSP 20028, dorsal carapace lacking cuticle; 2-4, NJSM 22689, dorsal carapace (2), oblique anterior view showing orbits (3), and posterior view showing pleonal somites (4). Scale bars = 1 cm.

Extralineal regions half as tall as carapace is wide, widest and tallest at subepibranchial region, flanks deep throughout length. Subhepatic region weakly inflated, below augenrest, granular. Subepibranchial region wider dorsally, terminating ventrally in acute point where the subcervical and subpostcervical grooves meet; in dorsal view, with large anterolaterally-projecting spine. Submesobranchial region rectangular, bounded by subpostcervical groove and subranchiocardiac groove, row of small tubercles parallel to subpostcervical groove. Submetabranchial region with row of tubercles parallel to *linea*.

Ventral surface very poorly preserved; appendages not preserved.

Measurements: Measurements (in mm) taken on the carapace of *Latheticocarcinus atlanticus* are presented in Table 1.

Material examined: NJSM 22690, 22691, 23301, 23302, 23306, 23316, 23317, 23328, 23329, 23330, 23331, and 23332. *Homolopsis atlantica* Roberts, 1962, holotype, ANSP 20029, Maple Shade, New Jersey, Merchantville Formation (now assigned to *Latheticocarcinus*) (Fig. 7.1). *Homolopsis dispar* Roberts, 1962, holotype, ANSP 20030, Maple Shade, New Jersey, Merchantville Formation (now assigned to *Latheticocarcinus*) (Fig. 7.2).

Occurrence: The specimens reported here were collected from Marshalltown/Merchantville spoil piles on the north side of the C and D Canal in Delaware. The species has also been reported from the Deep Cut and Rail Road Spoils localities. Roberts (1962) reported this species from the Merchantville Formation in New Jersey.

Discussion: *Latheticocarcinus atlanticus* differs from other species of *Latheticocarcinus* in having more inflated regions and much larger tubercles. It also has somewhat different ornamentation, for example, three tubercles on the cardiac region instead of two as in most species of the genus. However, the differences do not seem great enough to warrant a new genus for *L. atlanticus* so we retain it in *Latheticocarcinus*.

Roberts (1962) named two species of what are now referred to *Latheticocarcinus*, *L. atlanticus* and *L. dispar*. Examination of the holotypes of the two species confirms that they are easily distinguishable and should be retained as separate species. *Latheticocarcinus dispar* is distinct from *L. atlanticus* in having much smaller tubercles, at times reduced to tiny, indistinct swellings, and a nearly smooth branchial region (Fig. 7.2).

Section Etyoida Karasawa et al., 2011
Superfamily Etyoidea Guinot and Tavares, 2001
Family Etyidae Guinot and Tavares, 2001
Genus *Xanthosia* Bell, 1863

Xanthosia elegans Roberts, 1962

(Fig. 8)

Material examined: NJSM 22689; ANSP 20028.

Occurrence: ANSP 20028, Maple Shade, New Jersey, Merchantville Formation; NJSM 22689, Marshalltown/Merchantville spoil piles on the north side of the C and D Canal in Delaware.

Discussion: Schweitzer et al. (2012) recently revised the section, family, and genus. Herein we provide new illustrations of *Xanthosia elegans* based upon the ANSP specimen (Fig. 8.1) and new views of NJSM 22689 (Fig. 8.2–8.4). ANSP 20028 retains no cuticle, giving it a smooth, unornamented appearance that makes it appear superficially different from other known specimens (Fig. 8.1).

Section Raninoida Ahyong et al., 2007
Superfamily Raninoidea De Haan, 1839
Family Cenomanocarcinidae Guinot, Vega, and Van Bakel, 2008

Included genera: *Campylostoma* Bell, 1858; *Cenomanocarcinus* Van Straelen, 1936a; *Hasaracancer* Jux, 1971.

Diagnosis: Carapace hexagonal to rounded; wider than long; orbits closely spaced, with two fissures; rostrum projected weakly beyond orbits, with five spines; anterolateral margins spinose; posterolateral margins with one or two spines; carapace moderately vaulted transversely and longitudinally; cervical and branchiocardiac grooves weak; carapace ornamented with longitudinal ridges ornamented with tubercles; maxillipeds very long, pediform; male sternum ovate, broadly concave; sternites 1–3 fused, forming a triangular shape; sternite 4 trapezoidal, longer than wide, with projections extending from anterior end, pereiopod 1 articulating from concavity at about midlength; sternal suture 4/5 deep, concave posteriorly laterally, becoming straight and oriented parallel to axis of animal axially; sternite 5 wider than long, articulating with pereiopod 2, with two tubercles on each side probably serving to hold pleon in place, directed posterolaterally; sternite six inclined at moderate angle to remainder of sternum; sternites 7 and 8 unknown; sternal sutures 6/5 and 6/7 complete; pleon of male moderately wide, telson much longer than wide, somites 5 and 6 with three spines, one axial and one on each side; pereiopod 5 much reduced in size (after Karasawa et al., 2011, p. 550).

Genus *Cenomanocarcinus* Van Straelen, 1936a

Type species: *Cenomanocarcinus inflatus* Van Straelen, 1936a, by monotypy.

Diagnosis: Carapace ovate or hexagonal, wider than long; two orbital fissures; rostrum sulcate, downturned, usually with trifid tip; tubercles of carapace arranged in ridges; three longitudinal ridges, one axial and one on each branchial region; two transverse gastric ridges.

Cenomanocarcinus robertsi new species

(Fig. 9)

Diagnosis: Orbits with open fissures; tubercles ornamenting carapace ridges large, broadly spaced; posterolateral margin with one spine; posterior margin with three spines, with one at each corner and one centrally; axial regions with large, distinct tubercles.

Description: Carapace wider than long, length about 75% carapace width, widest about half the distance posteriorly on carapace at position of last anterolateral spine; moderately vaulted transversely and longitudinally.

Rostrum long, extending beyond orbits, may have been axially sulcate. Orbits small, circular, directed forward; outer orbital angle developed into short spine; intraorbital spine short, bounded by open fissures.

Anterolateral margins incompletely known appearing to have been strongly convex, with at least five spines, first segment extending nearly straight laterally from orbits; posterolateral margin appearing to have been straight, with at least one spine. Posterior margin with a spine at each corner and 1 spine medially, slightly sinuous, weakly rimmed.

Protogastric region small, quadrate, with two large tubercles. Mesogastric region elongate, widened posteriorly, with large tubercle posteriorly, merging with metagastric region; metagastric region narrowing slightly posteriorly, with longitudinal tubercle; urogastric

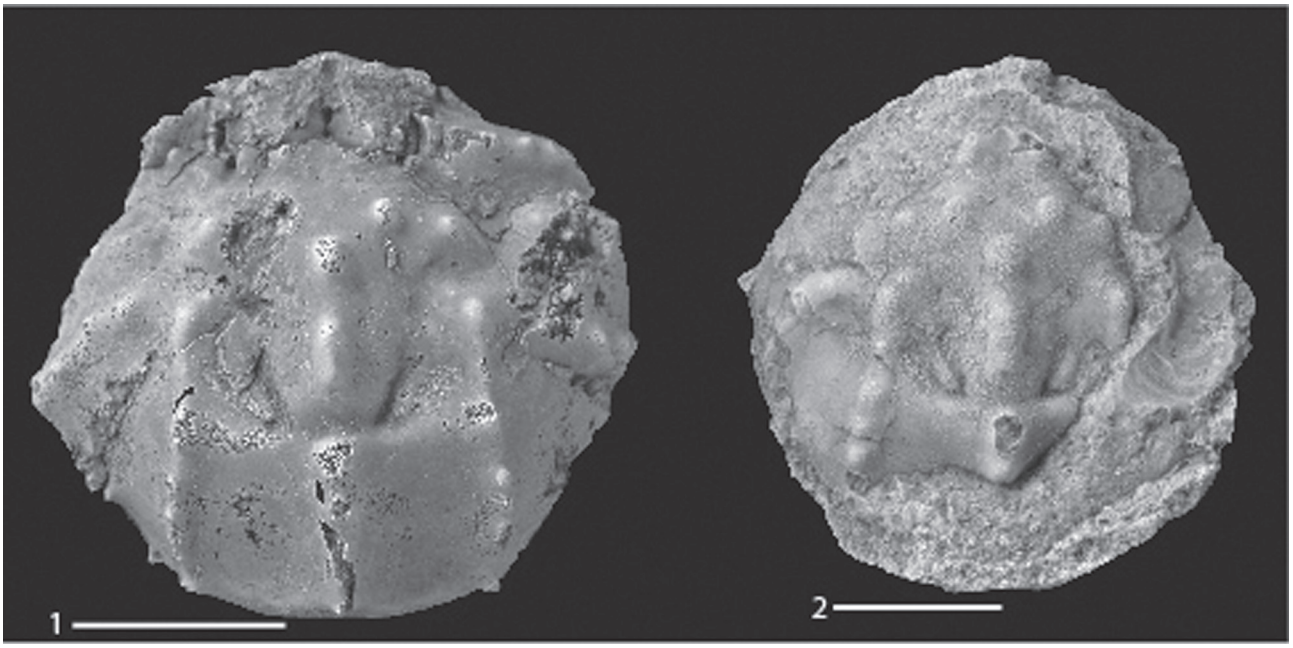

Fig. 9. *Cenomanocarcius robertsi* new species. 1, NJSM 23309, holotype, dorsal carapace; 2, NJSM 23310, paratype, dorsal carapace. Scale bars = 1 cm.

region a narrow, short, depression; cardiac region narrow, triangular, with two tubercles arranged linearly, tapering into a ridge intersecting posterior margin.

Hepatic region with transverse ridge, subparallel to anterolateral margin, ornamented with large, broadly spaced tubercles. Branchial region with oblique transverse ridge intersecting last anterolateral spine, ornamented with large, widely space tubercles; longitudinal ridge subparallel to axis, ornamented with 5 or so large, widely spaced tubercles.

Cervical groove weakly developed, best indicated along posterior margin of protogastric regions; postcervical groove well marked, developed as deep grooves parallel to lateral margins of metagastric region and across urogastric region; branchiocardiac groove indistinct.

Carapace surface, where layers of cuticle preserved, finely and densely granular, granules larger on summits of tubercles.

Measurements: Measurements (in mm) taken on dorsal carapace of holotype NJSM 23309 of *Cenomanocarcinus robertsi* new species: carapace length excluding rostrum, 24.0; carapace width excluding last anterolateral spines, 29.5; fronto-orbital width, 9.5; length to position of maximum width excluding rostrum, 11.5.

Etymology: The trivial name honors Henry B. Roberts, who named and described many species from Late Cretaceous deposits of the mid-Atlantic Coastal Plain.

Types: The holotype is NJSM 23309, and one paratype is numbered NJSM 23310.

Occurrence: The specimens were collected from Marshalltown/ Merchantville spoils on the north side of the C and D Canal in Delaware.

Discussion: *Cenomanocarcinus robertsi* new species from the Late Cretaceous of Delaware differs from all other species of *Cenomanocarcinus* in several ways. The tubercles ornamenting the carapace ridges are large and broadly spaced; the posterior margin has three spines, with one at each corner and one centrally; and the axial regions have large, distinct tubercles. Other species are ornamented with ridges with finer tubercles that are more closely spaced (*C. vanstraeleni*, *C. siouxensis*; *C. inflatus*) or lack a well-developed ridge on the hepatic region (*C. armatus*; *C. oklahomensis*; *C. renfroae*). *Cenomanocarcinus beardi* is similar to the new species in ornamentation but the branchial longitudinal ridges terminate along the posterolateral margins so that the posterior margin lacks spines on the corners. The new species, along with *C. siouxensis*, is the youngest member of the genus. *Cenomanocarcinus* was already well-known from the Gulf Coastal Plain, Western Interior, and from Atlantic marginal occurrences (Nigeria, Collins, 2010) so the new species does not expand the geographic range of the genus.

Family Necrocarcinidae Förster, 1968

Included genera: *Corazzatocarcinus* Larghi, 2004; *Cristella* Collins and Rasmussen, 1992; *Necrocarcinus* Bell, 1863; *Hadrocarcinus* Schweitzer, Feldmann, and Lamanna, 2012; *Paranecrocarcinus* Van Straelen, 1936a; *Polycnemidium* Reuss, 1859; *Pseudonecrocarcinus* Förster, 1968; *Shazella* Collins and Williams, 2004.

Diagnosis: "Carapace circular or ovate, about as long as wide or slightly wider than long, widest at position of last anterolateral spine, moderately vaulted longitudinally and transversely; regions well defined, usually with longitudinal ridges or rows of tubercles on axial and branchial regions; rostrum narrow, sulcate at tip or with small spines; orbits small, circular, with two fissures, directed forward; inner-orbital, intra-orbital, and outer-orbital spines well developed; fronto-orbital width typically between 30–45% maximum carapace width but rarely over half in some species; anterolateral margins long, usually with numerous spines; posterolateral margin entire or with spines; cervical and branchiocardiac grooves well developed, usually parallel to one another. Sternum narrow, sternites 1–3 fused and quadrate;

anterior portion of sternum at low angles to one another, sternum deep posteriorly, with flanks at high angle to one another, lateral margins raised and granular; sternite 4 long, with widely raised lateral margins, axially deep, episternal projections short, suture 4/5 incomplete; sternal suture 4/5 deep, concave posterolaterally, becoming straight and oriented parallel to axis of animal axially; sternite 5 wider than long, articulating with pereiopod 2, directed laterally; sternite 6 similar to sternite 5; sternite 7 directed ventrolaterally; sternite 8 directed ventrolaterally, much smaller than sternite 7; sternal sutures 5/6 and 6/7 complete. All pleonites free, with blunt axial spines, somite 6 much longer than wide, telson long; pereiopods 4 and 5 apparently reduced in size" (Schweitzer, Feldmann and Lamanna, 2012:149).

Genus *Necrocarcinus* Bell, 1863

Type species: *Orithyia labeschei* Eudes-Deslongchamps, 1835, by subsequent designation.

Other species: *Necrocarcinus angelicus* Fraaije, 2002; *N. avicularis* Fritsch and Kafka, 1887; *N. bispinosus* Segerberg, 1900; *N. davisi* Bishop, 1985; *N. inornatus* Breton and Collins, 2011; *N. insignis* Segerberg, 1900; *N. labeschei* Eudes-Deslongchamps, 1835; *N. olsonorum* Bishop and Williams, 1991; *N. olssoni* Rathbun, 1937; *N. ornatissimus* Forir, 1887; *N. perlatus* Fritsch and Kafka, 1887; *N. pierrensis* Rathbun, 1917; *N. rathbunae* Roberts, 1962; *N. senonensis* Schlüter and Von der Marck, 1868; *N. tauricus* Ilyin and Alekseev, 1998; *N. texensis* Rathbun, 1935a; *N. undecimtuberculatus* Takeda and Fujiyama, 1983; *N. woodwardi* Bell, 1863.

Diagnosis: Carapace ovate, hexagonal, or subquadrate, wider than long; rostrum downturned, weakly projecting beyond orbits, with three or four small spines; orbits round, forwardly directed, often with intraorbital and outerorbital spines and two fissures; anterolateral margin with two or more spines; posterolateral margin sometimes with spines; protogastric region well-marked, wider than long; cervical groove deep, sinuous, notches at lateral margin where is intersects it; branchiocardiac groove less well-developed; postcervical groove deep, short, straight across midline, then with segments at each end at nearly right angles to axial segment; axial regions well-marked, cardiac region elongate-ovate; dorsal carapace with large tubercles or spines often arranged into longitudinal rows, sometimes not arranged into rows.

Material examined: *Paranecrocarcinus gamma* Roberts, 1962, holotype, ANSP 20031, Maple Shade, New Jersey, Merchantville Formation.

Discussion: Roberts (1962) described two species referable to Necrocarcinidae, *Necrocarcinus rathbunae* and *Paranecrocarcinus gamma*. We concur with his generic referrals for *Necrocarcinus rathbunae* and suggest that *Paranecrocarcinus gamma* might be better placed within *Pseudonecrocarcinus*. It should be noted that we consider *Paranecrocarcinus* and *Pseudonecrocarcinus* as distinct and separate genera. Fraaije (2002) synonymized the two genera based upon the possession of distinctive, epigastric, slit-like depressions in both genera, a position reiterated by Fraaije et al. (2008) and van Bakel et al. (2012) and which formed the basis for a subfamily, Paranecrocarcininae Fraaije et al., 2008. Schweitzer et al. (2010) retained the two genera separately based upon the distinct differences between them. *Paranecrocarcinus* has an ovate carapace, ornamented with large, singular swellings; *Pseudonecrocarcinus* is more hexagonal and is ornamented with scattered granules or clusters of granules. *Pseudonecrocarcinus* has numerous anterolateral and posterolateral spines, whereas those margins of *Paranecrocarcinus* have fewer spines and in the case of the posterolateral margin, it is usually entire or with one spine. *Pseudonecrocarcinus* has a more flattened carapace than *Paranecrocarcinus*, which is more vaulted similar to *Necrocarcinus*. Each genus has multiple species that fall into these two categories of morphology, suggesting that they are distinct. For these reasons we retain the two genera. Such slit-like depressions are seen in other genera, including *Polycnemidium* so synonymy based upon possession of such slits is insufficient.

Paranecrocarcinus gamma has a flattened carapace and possesses two pairs of slit-like depressions in the epigastric region, has 6 anterolateral spines excluding the outer-orbital spine, three posterolateral spines or granules, and has paired tubercles situated on swellings (Fig. 10.5). This group of characteristics seems to fit better with *Pseudonecrocarcinus* than *Paranecrocarcinus*.

Necrocarcinus rathbunae Roberts, 1962

(Figs. 10.1–10.4)

Necrocarcinus rathbunae Roberts, 1962, p. 181, pl. 85, fig. 12, pl. 87, figs. 1, 2. Schweitzer et al., 2010, p. 81.

Diagnosis: Carapace rounded-hexagonal, moderately vaulted transversely and longitudinally; rostrum extending moderately beyond orbits; anterolateral margins with 5 spines excluding outer-orbital spines, spines granular; posterolateral margin with one spine positioned close to anterolateral corner; posterior margin deeply concave, thickly rimmed; branchiocardiac groove weak, deep axially and developed as arcuate pits; carpus of cheliped with large, granular tubercles on outer surface; manus with large granular tubercles on outer surface, proximal margin at acute angle to lower margin; pleonal somites 1–3 with granular axial and lateral swellings.

Description: Carapace rounded-hexagonal, moderately vaulted transversely and longitudinally, slightly wider than long excluding rostrum, length about 95% width excluding rostrum, width about 95% length including rostrum; position of maximum width about 41% the distance posteriorly on carapace at position of last anterolateral spine; prominent tubercles present in all regions.

Rostrum broad and sulcate medially. Orbits subcircular, forwardly directed; with wide, upturned rim; with two closed, shallow upper orbital fissures; one suborbital fissure; outer-orbital spine small; fronto-orbital margin about half maximum carapace width. Anterolateral margins with five small, triangular spines of equal size excluding outer-orbital spine, spines ornamented with granules, equally spaced; posterolateral margin moderately convex, entire except for one small blunt spine posterior to anterolateral angle. Posterior margin broadly and deeply concave, widely rimmed. Regions moderately defined, each bearing prominent tubercles. Branchiocardiac groove defined as a pair of oblique, elongate pits; cervical groove weak laterally stronger axially, not crossing midline.

Mesogastric region not well-defined, with short anterior process, characterized by two large tubercles posteriorly. Protogastric region wide, defined by four variably sized tubercles, largest along mesogastric region. Hepatic region small, with one large tubercle. Epibranchial region arcuate, with one tubercle close to the lateral margin of the carapace. Remainder of branchial region undifferentiated, with two tubercles at midwidth forming a ridge parallel to axis. Urogastric region

Fig. 10. Necrocarcinidae. 1, 2 *Necrocarcinus rathbunae* Roberts, 1962, NJSM 23319, dorsal carapace (1) and posterior view of pleonal somites 1–4 (2); 3, *N. rathbunae*, NJSM 23311, dorsal carapace and chelipeds; 4, *N. rathbunae,* NJSM 22692, dorsal carapace with eroded lateral margins but well-preserved posterior margin; 5, *Pseudonecrocarcinus gamma* (Roberts, 1962), holotype, ANSP 20031, dorsal carapace. Scale bars = 1 cm.

Table 2. Measurements (in mm) taken on specimens of *Necrocarcinus rathbunae* Roberts, 1962.

Specimen (NJSM) Number	Length excluding rostrum	Width	Fronto-Orbital Width	Width of base of rostrum	Length to position of maximum width	Length including rostrum
23311	14.4	15.5	8.2	3.8	6.1	17.0
23319	17.9	18.2	8.5		7.7	
23304	14.3	15.8	7.3	3.8	5.8	16.6
23333	18.1	18.5	10.0		6.0	19.1
22693	15.6	16.1	8.5		5.7	

long and wide; cardiac region circular; urogastric and cardiac tubercles larger than other carapace tubercles. Dorsal surface of carapace covered with small setal nodes.

Flanks sub-vertical, slightly curved under carapace; pterygostomial region finely granular.

Pleonal somites 1–3 with granular axial and lateral swellings. Carpus of cheliped with large, granular tubercles on outer surface; manus with large granular tubercles on outer surface, proximal margin at acute angle to lower margin; movable finger with rows of tiny granules

Measurements: Measurements (in mm) taken on specimens of *Necrocarcinus rathbunae* are presented in Table 2.

Material examined: NJSM 9517, 22692, 22693, 22694, 23299, 23300, 23304, 23305, 23311, 23312, 23319, 23320, 23333.

Occurrence: Roberts (1962) reported this species in New Jersey from the Woodbury Formation and from spoil piles one quarter mile east of Summit Bridge, north side of C and D Canal, Delaware. The latter locality is close to the Deep Cut Locality. The specimens described herein were collected from Marshalltown/Merchantville spoils on the north side of the C and D Canal, Delaware. It has also been collected from the Rail Road Spoils locality.

Discussion: The new specimens are referred to *Necrocarcinus rathbunae* based upon their long rostrum; large axial and branchial tubercles; position of maximum width about 40% the distance posteriorly; and granular cuticle overall. They differ from the holotype illustrated by Roberts (1962) in having a very concave, thickly rimmed posterior margin and in having much more apparent, ornamented anterolateral spines. Thus, it appears that the new specimens exhibit much better preservation than those available to Roberts (1962). *Necrocarcinus rathbunae* may have been quite a setose crab, based upon the presence of numerous setal nodes that cover the upper surface of the carapace. Setae are used for camouflage and distraction of predators by gathering sediment (Ng, Guinot, and Davie, 2008).

Roberts (1962) also described *Paranecrocarcinus gamma*, now referred to *Pseudonecrocarcinus*, from Cretaceous deposits of Delaware and New Jersey. It differs from *N. rathbunae* and the new specimens in possessing distinctive slit-like depressions in the epigastric regions.

Family Palaeocorystidae Lőrenthey in Lőrenthey and Beurlen, 1929

Included genera: *Cenocorystes* Collins and Breton, 2009; *Cretacoranina* Mertin, 1941; *Eucorystes* Bell, 1863; *Ferroranina* Van Bakel et al., 2012; *Joeranina* Van Bakel et al., 2012; *Notopocorystes* M'Coy, 1849.

Diagnosis: Carapace obovate, widest at position of third or fourth anterolateral spine; frontal margin wide; anterolateral margin with 3 or 4 spines; carapace surface ornamented with ridges, straps, or tubercles; sternites 1–3 fused, 1 and 2 directed downward; sternite 4 long, pereiopod 1 articulating near posterior corner, moderately wide, lateral margins concave; sternal suture 4/5 sinuous laterally, then turning abruptly anteriorly parallel to axis; sternite 5 long, moderately wide, with tubercles on episternal projection for attachment of pleon; sternal suture 5/6 complete; all female pleonites free, pleonite 6 long, pleonites 2–5 with central spine, entire pleon reaching to level of base of coxae of first pereiopods; male pleon narrower, telson triangular, somite 6 long, reaching to level of base of coxae of pereiopods 2; chelae with long fingers; female gonopore coxal, small, round.

Genus *Cretacoranina* Mertin, 1941

Diagnosis: Carapace obovate; rostrum extending beyond orbital margin, tip bifid, with spine just posterior to each spine at tip for a total of four, short spines to either side of rostrum forming inner-orbital spines; intraorbital spine bifid, bounded by fissures; outer-orbital spine bifid; anterolateral margin with 3 spines, becoming smaller posteriorly; branchiocardiac groove developed as arcs on either side of axis; anterolateral margin shorter than posterolateral margin, posterolateral margin somewhat concave; dorsal carapace ornamentation developed as fungiform pillars overall but ending in indistinct scalloped termination nearly on orbital margin and anterolateral spines.

Discussion: van Bakel et al. (2012) revised several genera within the Palaeocorystidae, including *Cretacoranina*. They restricted the genus to those taxa with fungiform ornamentation over the entire carapace, ending in a scalloped termination on the anterolateral spines. *Cretacoranina* was also defined as lacking a cervical groove and a medial carina and possessing a groove on the rostrum and branchiocardiac grooves. These features were considered to differentiate *Cretacoranina* from other

genera within Palaeocorystidae and are apparently based upon the type species of the genus, *C. schloenbachi* (Schlüter, 1879).

Cretacoranina schloenbachi is not consistently known. The original description of Schlüter (1879) indicates a specimen lacking an anterior and posterior margin but with lateral margins narrowing anteriorly and posteriorly; with an anterolateral margin shorter than a posterolateral margin; with four anterolateral spines; and with cuticles bearing a distinctive fungiform ornamentation. His illustration shows a rectangular specimen that narrows in the posterior half and narrows rapidly anteriorly. Mertin (1941) later illustrated an incomplete specimen and a drawing as well as providing a more detailed description of the species. His photographic illustration showed a specimen with a hexagonal shape, narrowing from a position about one-third the distance posteriorly and narrowing anteriorly from the same position. There appear to be discernible on this same illustration some rostral and orbital spines. The drawing provided by Mertin shows a carapace with the same general shape as the photographic illustration, except with concave posterolateral margins and four clear anterolateral spines. The drawing also shows an outer, intra-, and inner orbital spine as well as a short cervical and branchiocardiac groove. Jagt et al. (2003) reported that they were unable to locate the type specimens but referred well-preserved specimens to the species. These specimens correspond to Mertin's drawing in many ways. The specimens are more or less hexagonal, they have four anterolateral spines and complex orbital ornamentation. They differ in having a more ovate carapace, especially anteriorly, in which the anterolateral margin is convex, not straight. The anterolateral spines of the Jagt et al. specimens are quite large as compared to those drawn by Mertin. The anterolateral margins of these specimens also appear to be longer than that drawn by Mertin. The diagnosis for *Cretacoranina* provided by van Bakel et al. (2012) indicates that the cervical groove is lacking, but the Mertin illustration indicates its presence. Thus, the German specimens referred to *C. schloenbachi* are all similar in many ways but also differ from one another in some ways. All of the specimens referred to *C. schloenbachi* by these authors were from the Coniacian–Campanian of Germany (Jagt et al., 2003). Thus, we consider the German specimens at this time to be representative of the morphology of *C. schloenbachi* and to best represent the morphology of *Cretacoranina*, as the type species.

Van Bakel et al. (2012) illustrated specimens from the Campanian of Spain and Germany that they referred to *Cretacoranina schloenbachi*. The German specimen seems to agree well with the other German specimens, although the posterolateral margins are not concave as are those in other examples. The specimen from Spain seems to have somewhat different shapes of rostral, intraorbital, and outerorbital spines and anterolateral margins as those of the German specimens. It may be a different species.

Cretacoranina testacea (Rathbun, 1926a), originally referred to *Raninella*, was moved to *Cretacoranina* apparently based upon its similarity to the type species, *C. schloenbachi* (Schlüter, 1879) (Van Bakel et al., 2012). *Cretacoranina testacea* appears to differ in some regards from the type species: it is considerable less ovate than some specimens of *C. schloenbachi*; the anterolateral spines of *C. schloenbachi* appear to be needle-like and projected anterolaterally, whereas those of *C. testacea* are smaller, triangular, and directed anterolaterally; *C. schloenbachi* has ornamentation that seems to end in a ridge on the base of the anterolateral and orbital spines, whereas that in *C. testacea* seems to simply grade into a smooth surface; and *C. testacea* narrows quite considerably posteriorly which differs from at least some specimens of *C. schloenbachi*. However, due to the variable nature of *C. schloenbachi*, placement in *Cretacoranina* as currently defined seems to be the best option at this time for *Cretacoranina testacea*..

Cretacoranina schloenbachi (Schlüter, 1879)

Original description [translated from German]: In this crab remains only a cephalothorax and likewise this has incomplete preservation, whereas particularly the front and the posterior margin are absent. Preserved is the left lateral margin and the right lateral margin, whereupon in the illustration the outline is correspondingly complete. The at present weak curvature is probably, from the compression this shell suffered, from which also a pair of cracks have occurred.

The cephalothorax is as long as wide and in the anterior part wider, just as in the posterior, while in the anterior third itself the anterolateral margin narrows swiftly to the rostrum, the posterolateral margin, however, narrows slowly to the posterior margin, so that each lateral margin makes a very short corner, the posterolateral margin is considerably longer than the anterolateral margin is.

In the middle of the anterolateral margin are two rounded spines and over and under these margins one yet observes an impression that it originally presented four spines, with which the drawing is presented.

The shell, only partly preserved, is to the naked eye smooth and without conspicuous sculpture. In the middle of the cephalothorax are the branchial regions defined through a short pair curved furrows. Under the loup one can see small, round granules, which are flat and crowded or impressed and then forming rings. Where the shell is absent and only the mold of the interior is on hand, the small granules are somewhat further apart.

Discussion: The original description is not very detailed because it is based upon an incomplete specimen. It does note the short anterolateral and long posterolateral margins; the probable presence of four anterolateral spines; and the distinctive ornamentation on the carapace associated with several palaeocorystid taxa. It is provided for comparative purposes.

Cretacoranina testacea (Rathbun, 1926a)

(Fig. 11)

Raninella testacea Rathbun, 1926a, p. 190, pl. 67; Glaessner, 1929, p. 370; Rathbun, 1935a, p. 50; Schweitzer et al., 2010, p. 75.

Cretacoranina testacea (Rathbun, 1926a); Tucker, 1998, fig. 5, table 4; Waugh et al., 2009, p. 20; van Bakel et al., 2012, p. 19.

Diagnosis: Carapace longer than wide, widest about one third the distance posteriorly at position of last anterolateral spine; moderately vaulted transversely and longitudinally. Anterolateral margins convex, with four spines excluding bifid outerorbital spine, shorter than concave posterolateral margins. Outerorbital spines not extending as far anteriorly as bifid-intraorbital spines, intra-orbital spines separated from outerorbital spines and rostrum by open fissures; rostrum triangular, base composed of inner orbital spines, axial spine with axial groove. Surface covered with subhexagonal granules, visible to naked eye. Crescentic furrows at middle of carapace define inner limit of branchial region.

Description of material: The carapace is nearly complete with minor erosional damage to the right posterior ventral surface. The posterior

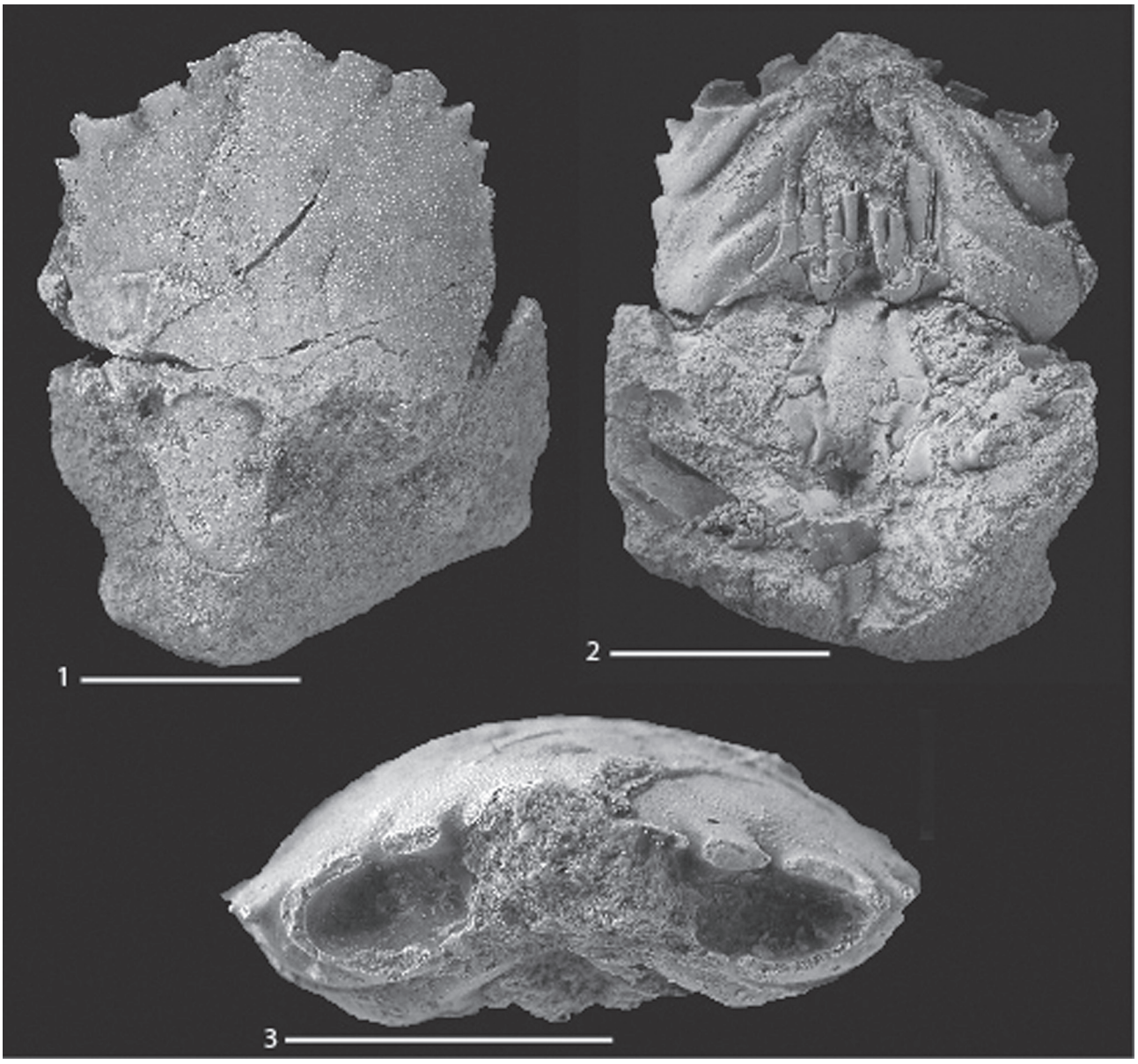

Fig. 11. *Cretacoranina testacea* (Rathbun, 1926a), NJSM 23313, dorsal carapace (1), ventral surface including maxillipeds and portion of sternum (2), and anterior view of orbits (3). Scale bars = 1 cm.

margin is surrounded by matrix however both dorsal and ventral surfaces are clearly visible. The left anterior spines are broken and the right anterior spines are relatively intact. The sternum is visible. The specimen has been fractured and glued together, not perfectly as there is minor asymmetry from right to left. The venter, pleon and appendages not preserved.

Material examined: NJSM 23313; holotype USNM 73121 and USNM 335986 from the Coon Creek locality of the Ripley Formation, Tennessee; USNM 327238, illustrated specimen of Roberts (1962).

Occurrence: The type material was collected from the Ripley Formation in Tennessee. Another specimen was collected from the Navesink Formation in New Jersey (Roberts, 1962). NJSM 23313 was collected from Marshalltown/Merchantville spoils on the north side of the C and D Canal, Delaware.

Discussion: *Cretacoranina testacea* was originally described from the Late Cretaceous Ripley Formation, from a unit now referred to as the late Campanian–early Maastrichtian Coon Creek Formation in Tennessee and the Coon Creek Tongue in Mississippi (Cobban and Kennedy, 1991; Dunagan and Gibson, 1993; Harrison, 1999). Roberts (1962) later reported it from the Navesink Formation of New Jersey. His specimen is incomplete, lacking a rostrum and the posterior portion of the carapace. It seems to be quite similar to the type material of *C. testacea* in its possession of four anterolateral spines, a bifid outer-orbital spine, and hexagonal plates in the cuticle. The new specimen referred to *C. testacea* also possesses these features. Because both Roberts' specimen and the new specimen are incomplete, it seems best to refer them to *C. testacea* at this time. What appear to be minor differences in spine length and ornamentation may simply be due to preservation.

Family Raninidae de Haan, 1839

Subfamily Lyreidinae Guinot, 1993

Genus *Bournelyreidus* van Bakel et al. 2012

Type species: *Hemioon eysunesensis* Collins and Rasmussen, 1992, by

Fig. 12. *Bournelyreidus tridens* (Roberts, 1962), ANSP 19737, holotype, dorsal carapace. Scale bar = 0.5 cm.

original designation.

***Bournelyreidus tridens* (Roberts, 1962)**

(Fig. 12)

Raninella tridens Roberts, 1962, p. 187, pl. 88, figs. 5, 6; Schweitzer et al., 2010, p. 75.

Bournelyreidus tridens (Roberts) ; van Bakel et al., 2012, p. 83, fig. 28B.

Material examined: ANSP 19737, holotype.

Discussion: van Bakel et al. (2012) erected *Bournelyreidus* to embrace several species with an elongate carapace; two anterolateral spines; a marked, protruding front; two orbital fissures; and distinctive sternal features. With the exception of the sternal features, these same characteristics describe *Macroacaena* Tucker, 1998. van Bakel et al. (2012) did not provide a sternal description for *Macroacaena*. It is possible that the two genera may be synonymous. For now, we accept the placement of *Raninella tridens* into *Bournelyreidus* (van Bakel et al., 2012) until more comprehensive analysis of genera within Lyreidinae can be undertaken.

Section Dakoticancroida Karasawa et al., 2011

Superfamily Dakoticancroidea Rathbun, 1917

Family Dakoticancridae Rathbun, 1917

Included genera: *Avitelmessus* Rathbun, 1923; *Dakoticancer* Rathbun, 1917; and *Tetracarcinus* Weller, 1905.

Diagnosis: Carapace quadrate, as wide as long or longer than wide; rostrum narrow, bilobed; orbits well developed, rimmed; eyes sheltered by orbits when retracted; anterolateral margins entire; posterior margin nearly straight; medial part of cervical groove weakly developed; gastric regions poorly separated from cardiac and intestinal regions; branchiocardiac groove well developed; pleural sutures located on sides of carapace; fifth pereiopods very reduced, subdorsal; sternum broad, sternites visible to posterior of carapace, sternite 4 with ridge parallel to anterior end, sternites 5, 6, and 7 with granular transverse ridges; sternum of female without longitudinal grooves; lateral portion of posterior part of sternites visible; male pleon with all somites free, lateral terminations on pleonites rectangular, telson rounded triangular; female pleon wide, with long epimeres, all pleonites free; coxae of pereiopods at same level as sternum; first pereiopods isochelous (Karasawa et al., 2011, p. 556).

Genus *Tetracarcinus* Weller, 1905

Table 3. Measurements (in mm) taken on the dorsal carapace of *Tetracarcinus subquadratus* Weller, 1905. Maximum widt was measured at approximately the position one-third the distance posteriorly on the carapace, usually at the position of th epibranchial regions of the carapace.

Specimen Number	Maximum Length	Maximum Width	Frontal Width	Fronto-orbital Width	Posterior Width
NJSM 23335	19.0	18.6	6.5	10.1	8.6
NJSM 23336	19.5	20.0	7.6	12.6	11.6
NJSM 23337	17.7	17.3	4.9	8.6	6.4
NJSM 23338	13.6	13.3	5.2	8.4	7.4
NJSM 23339	9.5	8.0	1.9	5.5	4.6
KSU D 2091	26.5	28.1	8.3	15.8	13.2
KSU D 2092	29.3	30.1	8.4	15.7	11.4

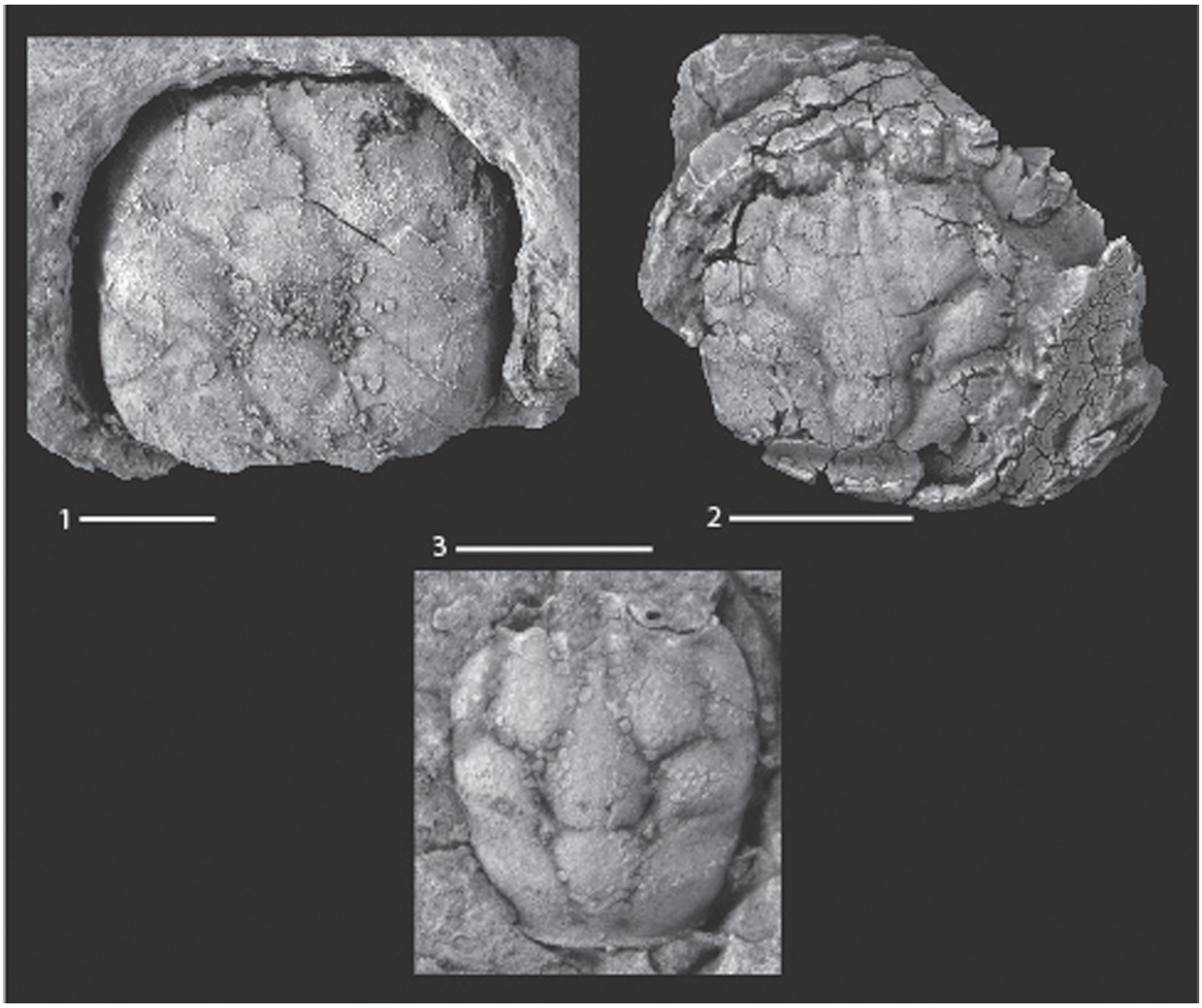

Fig. 13. *Tetracarcinus subquadratus* (Weller, 1905). 1, KSU D 2097, large dorsal carapace; 2, NJSM 23337, crushed dorsal carapace; 3, NJSM 23339, dorsal carapace. Scale bars for 1 and 2 = 1 cm. Scale bar for 3 = 0.5.

Type species: *Tetracarcinus subquadratus* Weller, 1905, by monotypy.

Diagnosis: Carapace generally small, subquadrate, length nearly equal to width, widest at position of epibranchial regions; orbits rimmed; lateral margins sinuous; posterior margin rimmed; cervical groove shallow medially and poorly developed distally; regions flattened, weakly inflated; epibranchial and metabranchial regions separated by broad depression enclosing narrow mesobranchial region; epibranchial regions transversely weakly inflated; cardiac region with posterior tubercle; first pereiopods isochelous.

Tetracarcinus subquadratus Weller, 1905

(Fig. 13)

Tetracarcinus subquadratus Weller, 1905, p. 328, figs. 4–6; Schweitzer et al., 2010, p. 58.

Diagnosis: As for genus.

Material examined: NJSM 9500 (includes 8 specimens); NJSM 23335–23339; KSU D 2091, 2092.

Measurements: Measurements (in mm) taken on the dorsal carapace of specimens of *Tetracarcinus subquadratus* are presented in Table 3.

Occurrence: This species is widely distributed in New Jersey (Roberts, 1962). NJSM 9500 and 23335-23339 were collected from the Woodbury Clay Formation in Lorillard, New Jersey, east of Keyport in Monmouth County. Specimens KSU D 2091 and 2092 were collected from the Red Area Spoils locality.

Discussion: *Tetracarcinus subquadratus* has a known range from the northern Atlantic Coastal Plain, "from the Magothy Formation at Cliffwood, Woodbury Formation at Lorillard, and Merchantville Formation of the Delmarva Peninsula; from the Mississippi Embayment from the Coon Creek Formation of Union County, Mississippi; and from the Western Interior Seaway from one specimen from the Lewis Shale of Wyoming," (Bishop et al., 1998, p. 244). As far as the geologic age is concerned, the species is Late Cretaceous in age and ranges from late Santonian through early Maastrichtian.

Of the specimens studied, several are preserved in a relatively soft, light brown to dark brown, clay substrate. Due to the soft nature of the sediment in which these fossils were deposited, it appears as though some underwent slight deformation of the carapace. The deformation that has left some specimens misshapen was likely due to compaction by overburden of heavier sediments over the softer clay that ultimately contained these fossils. The harder, darker substrate of specimen NJSM

23337 may indicate deformation by dewatering of the clay, as it appears highly fractured (Fig. 13.2).

Three specimens exhibit a carapace that is larger than that typically associated with *Tetracarcinus* (Fig. 13.1). These three specimens varied in their preservation or degree of weathering, as well as in their substrate. Although NJSM 23337 came from the New Jersey State Museum with various other samples, the substrate was much darker and harder than the other samples that were preserved in softer, more orange-brown clay. Although NJSM 23337 appears highly fractured, the fossil itself has pronounced detail of the carapace (Fig. 13.2). The other two specimens, KSU D 2091 and 2092, were collected by an amateur in New Jersey. KSU D 2091 is the only specimen not preserved in a substrate and shows tremendous detail regarding the granulated decoration of the carapace. KSU D 2092 was originally preserved in a hard, hematitic nodule that is brick-red in color. The specimen was finely prepared in order to view its carapace and although it is significantly weathered, the morphological characteristics of the genus and species can still be identified in the carapace. Although the two KSU specimens are larger than typical *Tetracarcinus*, they exhibit the relatively featureless carapace regions and equant carapace typical of that taxon, which differentiates them from *Dakoticancer* and *Avitelmessus*, which have ridges and other ornamentation on the carapace regions.

Family Ibericancridae Artal et al., 2008

Included genera: *Ibericancer* Artal et al., 2008; *Seorsus* Bishop, 1988a; *Sodakus* Bishop, 1978.

Diagnosis: Carapace subrectangular, about as long as wide, generally widest just under half the distance posteriorly but may be at position two-thirds the distance; rostrum narrow, downturned, bilobed or quadrilobed; orbits square, directed forward, fronto-orbital width ranging from about 40–70% maximum width but usually about half; branchiocardiac groove deep, cervical groove discontinuous; axial regions well defined and distinct; sternum narrow, deep sterno-pleonal cavity, sternite five with pleonal locking mechanism, sternal sutures 4/5 through 7/8 interrupted; female gonopore on coxa of pereiopod 3, male gonopore on coxa of pereiopod 5, spermatheca of female at sternal suture 7/8; male pleon very narrow, all somites free, female pleon wider, all somites free; pereiopods 4 and 5 apparently subdorsal, 5 reduced in size (After Karasawa et al., 2011, p. 557).

Discussion: Karasawa et al. (2011) tentatively placed *Seorsus* and *Sodakus* into the Ibericancridae. Examination of several specimens from the Cretaceous of North America suggests than the placement should be confirmed for *Sodakus* and remains tentative for *Seorsus*.

Sodakus was originally placed within Dorippidae. Schweitzer and Feldmann (2011) removed it from that family and tentatively placed it within Ibericancridae, based upon the narrow sternum and deep sterno-pleonal cavity. Herein, we confirm placement of *Sodakus* within Ibericancridae based upon its narrow sternum, narrow sterno-pleonal cavity, fused sternites 1–3, long sternite 4 with concave lateral margins, male pleon with apparently all free somites, subdorsal pereiopod 5, rectangular carapace, well-defined branchiocardiac groove and moderately defined cervical groove, and well-defined axial regions. It differs from the type genus of the family, *Ibericancer*, in having its maximum width in the posterior half of the carapace, a wider fronto-orbital width, a more subdivided branchial region, and a possibly visible eighth sternite. *Sodakus* is known from only one species, *S. tatankayotakaensis* Bishop, 1978, from the Maastrichtian of South Dakota.

Bishop (1988a) erected the genus *Seorsus* based upon specimens from the Cretaceous of Mississippi. Karasawa et al. (2011) referred *Diaulax millerae* Bishop, 1992, from the Cretaceous of Delaware to *Seorsus*. Specimens studied herein from New Jersey, also referable to *D. millerae*, suggest placement within Ibericancridae based upon the narrow sternum, narrow sterno-pleonal cavity, fused sternites 1–3, long sternite 4 with concave lateral margins, male pleon with all somites free, subdorsal pereiopods 4 and 5, rectangular carapace, well-defined branchiocardiac groove and moderately defined cervical groove, and well-defined axial regions. *Seorsus* differs from the type genus of the family, *Ibericancer*, in having a wider fronto-orbital width, better defined regions and deeper grooves, and in being somewhat longer than wide and narrowing posteriorly instead of being square as in *Ibericancer*. *Seorsus* thus has a rather different shape than does *Ibericancer*.

Seorsus includes three species at this time, *S. wadei* Bishop, 1988a, from the Maastrichtian of Mississippi; *S. millerae* (Bishop, 1992a), from the Campanian of Delaware and New Jersey; and a new species named below from the Cretaceous of Colorado. Thus, the Ibericancridae as known at this time ranges from the Campanian to Maastrichtian, with occurrences in Spain (Campanian), the east coastal USA (Campanian), Gulf Coastal USA (Maastrichtian), and the Western Interior USA (Maastrichtian).

Genus *Seorsus* Bishop, 1988a

Type Species: *Seorsus wadei* Bishop, 1988a, by original designation.

Other Species: *Seorsus kauffmani* new species; *S. millerae* (Bishop, 1992a).

Diagnosis: Carapace slightly longer than wide, width about 93% maximum carapace width, width at position of single anterolateral spine about 40–50% the distance posteriorly on carapace; rostrum long, with four blunt spines including inner-orbital spines; orbits square, rimmed, with intraorbital spine, fronto-orbital width ranging from half to 70% maximum carapace width; well-defined branchiocardiac groove and moderately defined cervical groove, and well-defined axial regions; sternum narrow, sterno-pleonal cavity narrow, sternites 1–3 fused, sternite 4 long, with concave lateral margins, sternal suture 4/5 incomplete; male pleon with all somites free, subdorsal pereiopods 4 and 5; major chela granular; propodus bulbous, two nodes at articulation with carpus; carpus granulated with X-shaped groove; fixed finger and dactylus thin, delicate.

Discussion: The carapace of *Seorsus millerae* shares many carapace features with *Seorsus wadei* Bishop, 1988a. They are both subquadrate and longer than wide, narrowing posteriorly; the fronto-orbital margin is about half of the carapace width; and the axial and epibranchial regions are very similarly developed. The two species differ in some ways. In *Seorsus wadei*, the regions are more inflated and the protogastric region is more defined. *Seorsus millerae* also has a blunt lateral spine at the widest part of its carapace, whereas in *Seorsus wadei*, these spines have not been noted. *Seorsus wadei* was collected in Union County, Mississippi (Bishop, 1988a). It was found in the late Campanian to early Maastrichtian Coon Creek Formation. *Seorsus millerae* was collected from localities along the Chesapeake and Delaware Canal in the late Campanian Merchantville Formation (Bishop, 1992a).

Seorsus millerae (Bishop, 1992a)

(Fig. 14.1–14.3)

Diaulax millerae Bishop, 1992a, p. 556; Schweitzer et al., 2010, p. 66.

Seorsus millerae (Bishop, 1992a); Karasawa et al., 2011, p. 557.

Diagnosis: Carapace slightly longer than wide, width about 92% maximum carapace width at position of single anterolateral spine about 45–50% the distance posteriorly on carapace; base of rostrum about 18% maximum carapace width; orbits square, rimmed, with intraorbital spine, fronto-orbital width half maximum carapace width; well-defined branchiocardiac groove and moderately defined cervical groove, well-defined axial regions; sternum narrow, sterno-pleonal cavity narrow, sternites 1–3 fused, sternite 4 long, with concave lateral margins, sternal suture 4/5 incomplete; male pleon with all somites free, subdorsal pereiopods 4 and 5; major chela granular; propodus bulbous, two nodes at articulation with carpus; carpus granulated with X-shaped groove; fixed finger and dactylus thin, delicate.

Description: Carapace subquadrate, longer than wide (W/L = 0.92), widest about half the distance posteriorly; dorsal surface smooth to finely granulated; weakly vaulted longitudinally, weakly vaulted centrally transversely with upturned edges.

Base of rostrum about 18% maximum carapace width, tip broken. Fronto-orbital margin half maximum carapace width; orbits directed forward, square, rimmed; outer orbital spine triangular; intraorbital spine located medially from outer orbital spine. Anterolateral margin tightly curved anteriorly, then becoming straight and parallel, terminating in single anterolateral spine; posterolateral margins straight, converging slightly posteriorly, may be reentrant at posterolateral corner; posterior margin straight, rimmed.

Epigastric regions elongate, narrowing posteriorly; protogastric regions longer than wide; mesogastric region long, with very long anterior process, widened posteriorly; metagastric region broadly v-shaped, wider than long; urogastric region separated from metagastric region by short depression; urogastric region rectangular; cardiac region elongate-triangular, with swellings at each apex; intestinal region long, depressed.

Hepatic region longer than wide, somewhat more inflated posteriorly than anteriorly; epibranchial region forming sinuous arc from lateral spine to axial regions, bounded axially by sinuous, discontinuous cervical groove, posteriorly by sinuous branchiocardiac groove. Remainder of branchial regions long, undifferentiated.

Third maxillipeds longer than wide. Sternum long, narrow, sterno-pleonal depression moderately deep. Sternites 1–3 fused, longer than wide, triangular, no evidence of sutures between sternites. Sternite 4 longer than wide, widening posteriorly, separated from sternite 4 by groove, lateral margins concave, swelling at posterolateral corner; suture 4/5 discontinuous. Sternite 5 wider than long, short episternal projection articulating with pereiopod 2. Sternite 6 about as long as wide, sternite 7 narrow, longer than wide; sternite 8 not visible.

Pleon of male? with all somites free; somite 1 short and wide, somite 2 long, wide, widest of all somites; somites 3 and 4 narrower and shorter than somite 2; somite 5 narrower and longer than somite 4; somite 6 about as long as somite 5, narrower; telson unknown. Somites 4–6 with transverse axial swelling.

Element of pereiopod 1 with long, blunt spine. Pereiopods 4 and 5 subdorsal, 5 apparently reduced in size based upon cross-section of coxae.

Cheliped granular; propodus bulbous, two nodes at articulation with carpus; carpus granulated with X-shaped groove; fixed finger and dactylus thin, delicate; fixed finger has four grooves from base to tip of finger, papilla shaped teeth on inside of fixed finger.

Material Examined: NJSM 23318, 23322, 23325, 23326, 23327.

Occurrence: Bishop (1992a) reported this species from spoil piles in Newcastle County, Delaware, along the C and D Canal, of the Merchantville Formation. The specimens reported here were recovered from Marshalltown/Merchantville spoils from the north side of the C and D Canal in Delaware.

Discussion: NJSM 23318 is a complete specimen, providing important information on the sternum and pleon of this species and genus (Fig. 14.3). The rostrum was not present on any of the material, nor was it present on the type material of Bishop (1992a). There was some cuticle visible on the complete specimen located near the cardiac region and also at the base of the flanks. This species may have exhibited carrying behavior. This can be inferred by the way the legs are positioned on the underside of the body. The first pereiopod is located beside sternite 4 and is near the widest part of the carapace. This suggests that the rest of the legs are also located under the posterior carapace. The fourth and fifth pereiopods appear to be have been carried subdorsally. The fifth pereiopod is reduced in size to about half the width of the others.

Seorsus kauffmani new species

(Fig. 14.4)

Diagnosis: Carapace slightly longer than wide, width about 96% maximum carapace width at position of single anterolateral spine about 40% the distance posteriorly on carapace; base of rostrum about 23% maximum carapace width, rostrum long, with four blunt spines including inner-orbital spines; orbits square, with intraorbital spine, fronto-orbital width 70% maximum carapace width; well-defined branchiocardiac groove and moderately defined cervical groove, well-defined axial regions; well defined pterygostomial region.

Description: Carapace subquadrate, longer than wide, longer than wide (W/L = 0.96), widest about 40% the distance posteriorly; dorsal surface smooth but is interior mold, no cuticle remains; weakly vaulted longitudinally, weakly vaulted centrally transversely with upturned edges.

Base of rostrum about 23% maximum carapace width, rostrum long, with four blunt spines including inner-orbital spines. Fronto-orbital margin 70% maximum carapace width; orbits directed forward, square, rimmed, shallow, outer orbital spine triangular; intraorbital spine not present on interior mold. Anterolateral margin tightly curved anteriorly, then becoming straight and parallel, terminating in single anterolateral spine; posterolateral margins straight, converging slightly posteriorly; posterior margin straight, rimmed.

Epigastric regions elongate, narrowing posteriorly; protogastric regions longer than wide; mesogastric region long, with very long anterior process, widened posteriorly; metagastric region broadly v-shaped, wider than long; urogastric region separated from metagastric region by short depression; urogastric region rectangular; cardiac region elongate-triangular, with swellings at each apex; intestinal region long, depressed.

Hepatic region longer than wide, somewhat more inflated posteriorly than anteriorly; epibranchial region forming sinuous arc from lateral spine to axial regions, bounded axially by sinuous, discontinuous cervical groove, posteriorly by sinuous branchiocardiac groove. Small mesobranchial region ventral to epibranchial region. Metabranchial

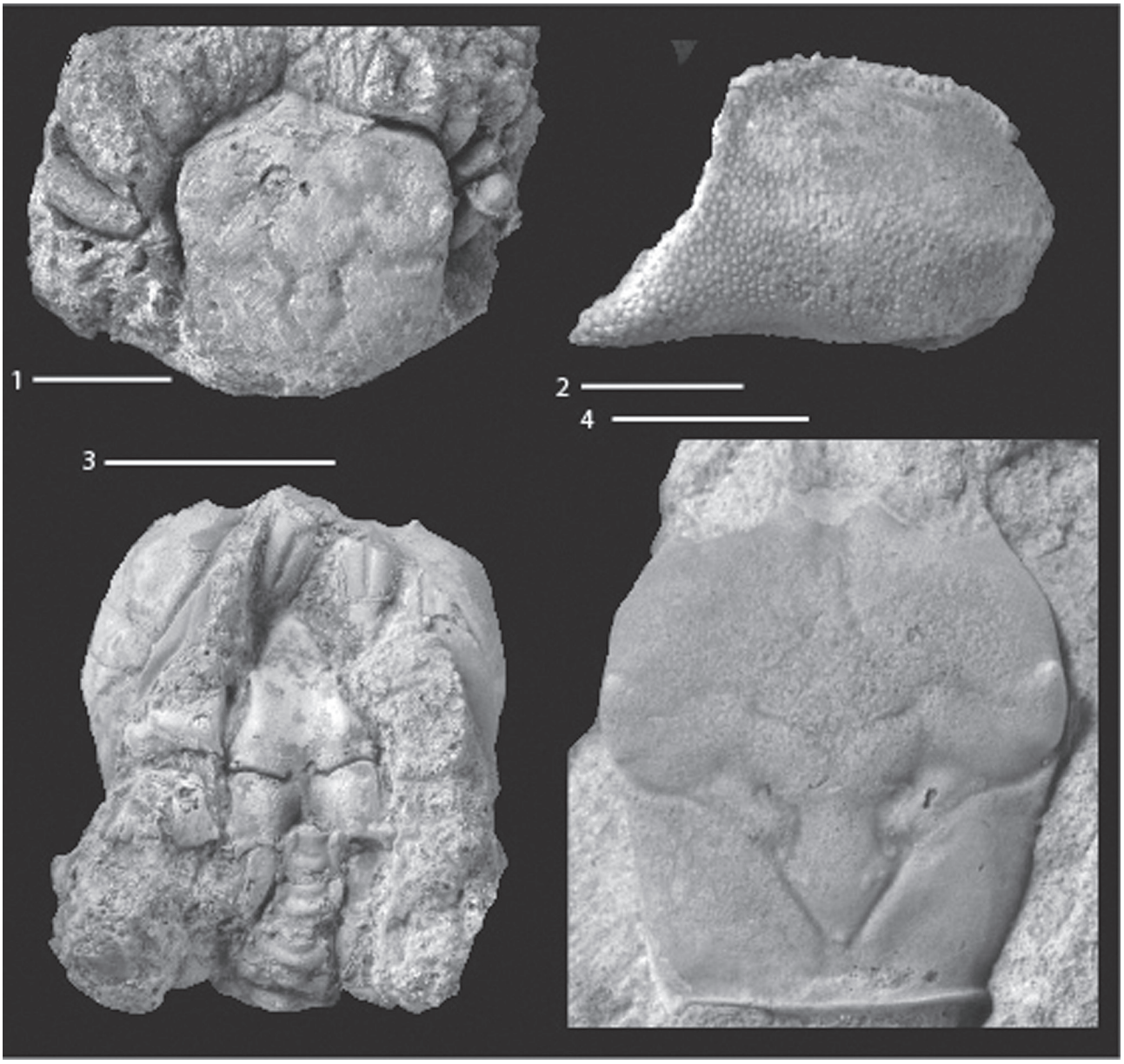

Fig. 14. *Seorsus* spp. 1, *Seorsus millerae* Bishop, 1992a, NJSM 23326, dorsal carapace and basal elements of some pereiopods; 2, *S. millerae*, outer surface of left chela; 3, *S. millerae,* NJSM 23318, ventral surface including third maxillipeds, sternum, and abdomen; 4, *Seorsus kauffmani* new species, USGS 25873, holotype, dorsal carapace. Scale bars = 1 cm.

region broad, flattened.

Measurements: Measurements (in mm) taken on dorsal carapace of *Seorsus kauffmani* new species: maximum carapace width = 15.0; maximum carapace length including rostrum = 17.7, excluding rostrum = 15.6; fronto-orbital width = 10.5; width of base of rostrum = 3.4; length to position of maximum width = 6.3.

Type: The holotype, USNM 553513, was originally designated USGS (United States Geological Survey) 28873.

Etymology: The trivial name honors Erle G. Kauffman for his massive contributions to the paleontology and stratigraphy of the Western Interior of the USA, and who collected the specimen.

Occurrence: The specimen was collected from the early middle Turonian Mancos Shale, from the Semilla Sandstone Member, at USGS Mesozoic Locality 28873, in Sandoval County, New Mexico (Kennedy et al., 2001).

Discussion: The new species differs from all other species of *Seorsus* in having a very wide fronto-orbital width and rostrum as compared to the maximum width of the carapace. It also possesses a well-developed mesobranchial region which the other two species lack. It is the oldest species of the genus.

Section Eubrachyura de Saint Laurent, 1980

Superfamily Majoidea Samouelle, 1819

Family Majidae Samouelle, 1819

Diagnosis: Carapace generally pyriform or triangular, usually narrowing anteriorly and rounded posteriorly, smooth to ornamented with tubercles or spines; rostrum variable; orbits complete or nearly complete; basal antennal article broad, may or may not form floor of orbit; epistome large surrounding quadrate buccal cavity; legs spiny or granular; chelipeds variable; male and female pleons with

unfused somites; male gonopod straight or curved, aperture terminal or subterminal. (modified from Davie, 2002, p. 277).

Subfamily Majinae Samouelle, 1819

Diagnosis: Eyes with complete or nearly complete orbit composed of a supraorbital eave which may be ornamented with an antorbital spine, a postorbital lobe, and often an intercalated spine; basal antennal article broad but not forming floor of orbit; male gonopod slender, curved, aperture usually subterminal (modified from Poore, 2004, p. 366, after Griffin and Tranter, 1986).

Discussion: Placement of fossil spider crabs within appropriate families and subfamilies is often difficult owing to incomplete preservation. Form of the rostrum and conformation of the orbital region are particularly important characters of the dorsal carapace. The specimen at hand does not exhibit a complete rostrum, although it appears to be axially sulcate and downturned. Whether it is bifid or not cannot be determined. However, the dorsal and posterior portions of the orbital region are complete enough to support placement within the Majinae. There is a supraorbital eave bearing a small spine on the posterior end. The eave extends only a short distance over the orbital cavity. A short, blunt intercalated spine lies between, and is separated from, the supraorbital eave and postorbital lobe. The conformation of the orbital structures coupled with the pyriform outline and heavily ornamented, well-defined regions permit placement within Majinae.

Genus *Chondromaia* new genus

Type species: *Chondromaia antiqua* new species, by original designation and monotypy.

Etymology: The generic name is derived from the Greek *chondros* = granular and *maia* = crab. *Maia* is also the name of the type genus of Majidae. The gender is feminine

Diagnosis: Carapace pyriform, slightly wider than long; regions well defined, most bearing strong central spine surrounded by a circlet of granules; frontal area sulcate, downturned; supraorbital eave does not extend far over orbit and bears a small spine on posterior corner, intercalated spine short, blunt; postorbital lobe with granular rim.

Discussion: *Chondromaia* is the oldest member of Majidae. The oldest records previously are from the Eocene. The genus is distinguished from others within the subfamily on the basis of the orbital architecture. The orbital configuration consists of a supraorbital eave which, although abraded, shows no evidence of an anterior spine but does bear a small spine on the posterior corner of the eave (Fig. 15.2). The intercalated spine, which is short, is clearly separated from the supraorbital eave and the postorbital lobe (Fig. 15.2). The postorbital lobe forms a shallow cup for reception of the eye; but in combination with the other parts of the orbital array would not completely conceal the eye. The postorbital lobe has a granular rim and lacks prominent spines (Fig. 15.3). No postorbital spine is present. Thus, the rather diminutive size of the supraorbital eave and the granular rim of the postorbital lobe distinguish the genus from other members of the family. In addition, the central spine on the mesogastric, cardiac, and epibranchial lobes, surrounded by a circlet of granules, is also a distinctive feature.

***Chondromaia antiqua* new species**

(Fig. 15)

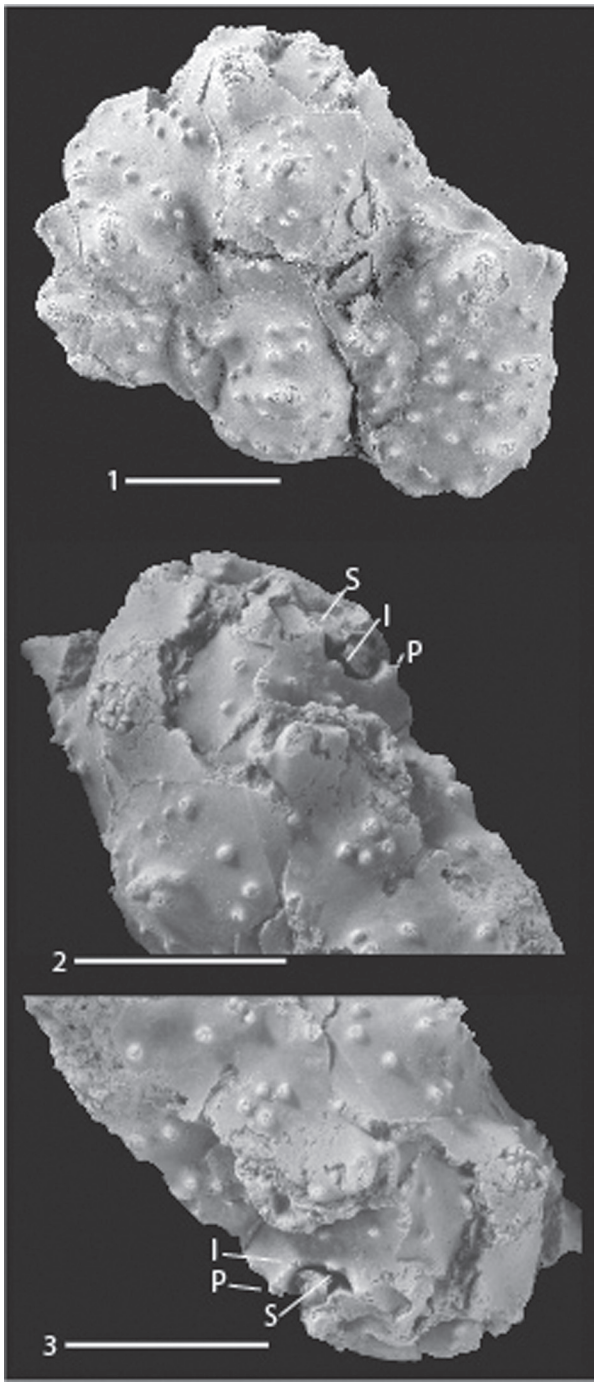

Fig. 15. *Chondromaia antiqua* new species, NJSM 23340, holotype. 1, dorsal carapace; 2, oblique lateral view showing orbit; 3, oblique anterior view showing orbit. S = supraorbital eave; I = intercalated spine; P = postorbital spine. Scale bars = 1 cm.

Diagnosis: As for genus.

Description: Carapace pyriform, wider, 36.4 mm measured by doubling half-width, than long, >30.5 mm; greatest width attained in mesobranchial region. Regions well defined, strongly inflated, most bearing central spine surrounded by granules. Front narrow, distance between supraorbital eaves ca. 10 mm, axially sulcate, bounded by longitudinal rows of granules. Rostrum broken, appears to be downturned. Orbits incomplete; supraorbital eave does not extend far over orbit and bears a small spine on posterior corner, intercalated spine

short, blunt; postorbital lobe with granular rim. Protogastric region elevated, with central spine with flattened, granular top. Hepatic region not inflated, with granular surface. Mesogastric region circular, highest elevation on carapace with prominent central spine with granular termination surrounded by circlet of granules. Metagastric region indistinct with transverse row of about five granules. Urogastric region smooth, depressed. Cardiac region pyriform with prominent central spine bearing granular termination surrounded by circlet of granules. Epibranchial region with central spine and smaller spine on lateral margin; remainder of region granular. Mesobranchial region with two spines near lateral margin and row of nodes and granules flanking cardiac region; remainder of surface granular. Metabranchial region and intestinal region not preserved.

Ventral surface, pleon, and appendages not preserved.

Holotype: The holotype and sole specimen, NJSM 23340, consists of an incomplete dorsal carapace deposited in the New Jersey State Museum, Trenton, New Jersey. The specimen was collected by Mr. Wayne Cancro, Jersey City, New Jersey.

Etymology: The trivial name alludes to the age of the occurrence. This represents the first known member of Majinae.

Occurrence: The specimen was collected from the Mount Laurel Formation, along Hop Brook, Holmdel Township, Monmouth Co., New Jersey.

Age: Early Maastrichtian, Late Cretaceous.

Discussion: Although the specimen is broken and partial, a sufficient part of the carapace is present to recognize diagnostic features and to distinguish it from other Majinae. The only regions that are not preserved are the ends of the rostrum and the posterior including the metabranchial and intestinal regions.

Majoidea, family, genus, and species indeterminate
Indeterminate claw

(Fig. 16)

Description: Specimen is left cheliped. Dactylus missing, tip of fixed finger broken. Hand rectangular, broadens distally. Distal margin with inflated, smooth rim. Upper margin bears seven main tubercles followed by rows on either side of about seven smaller tubercles. Inner surface of hand slightly convex with three longitudinal rows of tubercles flanking midline; middle row has larger tubercles. Granules at distal end of inner surface and continue down fixed finger. Fixed finger deflected downward and inward. Lower margin has roughly three rows of six tubercles. Innermost row with largest tubercles curves slightly upward proximally toward articulation node. Outer surface convex with three longitudinal rows of tubercles flanking midline. All tubercles and granules have small pustules at their apices; larger tubercles having multiple pustules. Occlusal surface with two smooth ridges bounding a depressed midline, otherwise edentulous. Length of specimen (omitting fixed finger) 27.9 mm, height 14.4 mm.

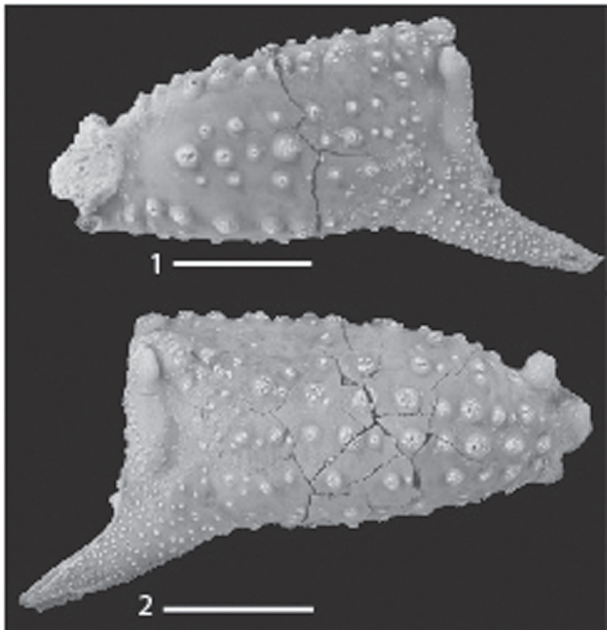

Fig. 16. Majoidea, family, genus, and species indeterminate, NJSM 23323, chela, inner surface (1), and outer surface (2). Scale bars = 1 cm.

Material examined: A single specimen, NJSM 23323, a complete left propodus.

Occurrence: The specimen was recovered from Marshalltown/ Merchantville spoils from the north side of the C and D Canal in Delaware.

Discussion: This distinctive claw has eluded identification. The specimen is extremely well preserved, but it does not seem to conform to the characteristics of other faunal elements in the assemblages under consideration. The one possibility that cannot be demonstrated but must be considered is that it is a spider crab. Members of the Majoidea exhibit a broad range of forms of propodi of the first pereiopod. An elongate hand bearing rows of tubercles with a relatively short, edentulous fixed finger would certainly fit within the array of morphologies exhibited in majoids. The fixed finger is downturned somewhat more than that of spider crabs with which we are familiar, but that does not exclude the specimen from the group categorically.

The discovery and description herein of the first majoid from the Cretaceous of Delaware and New Jersey, *Chondromaia antiqua*, introduces the intriguing possibility that this claw is also a majoid. Absence of any tangible evidence of an association with *Chondromaia antiqua*, makes it unrealistic to associate the claw with that species. In the absence of evidence to the contrary, it seems reasonable to questionably assign the enigmatic claw to Majoidea.

Miscellaneous chelae

Discussion. *Prehepatus* Rathbun, 1935a, currently referred to Aethridae Dana, 1851, is known only from claws, and has been assigned to that family based upon the similarity of the claws to extant aethrids. However, more recent work shows that the claws assigned to *Prehepatus* are in fact similar to those of a variety of families, including Aethridae, Necrocarcinidae, and possibly other groups. In addition, comparison of *Prehepatus dilksi* Roberts, 1962 (Fig. 17.3, 17.4) with *Xanthias*? *lenolensis* Rathbun, 1935b, (Fig. 17.1, 17.2) which has been referred to *Prehepatus* also (Schweitzer et al., 2010), indicates that there is a broad range of morphology within *Prehepatus*. The genus may be a form genus. For now, we refer *Xanthias*? *lenolensis* back to its original genus but questionably, realizing that it probably does not belong within *Xanthias*.

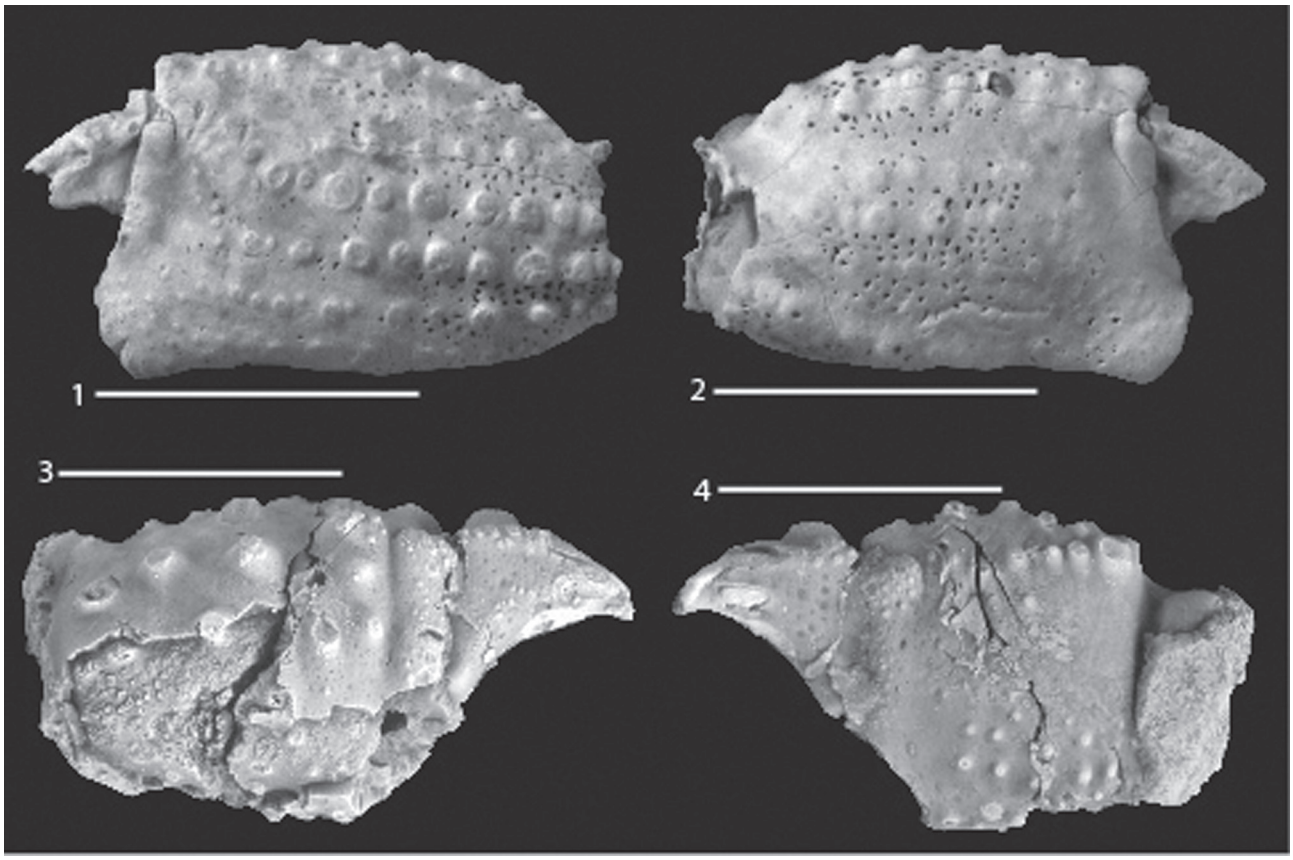

Fig. 17. Miscellaneous chelae. 1, 2, *Xanthias*? *lenolensis* Rathbun, 1935b, NJSM 23324, outer surface (1) and inner surface (2); 3,4, *Prehepatus dilksi* Roberts, 1962, ANSP 19728, holotype, outer surface (3) and inner surface (4). Scale bars = 1 cm.

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