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PRELIMINARY DESCRIPTIONS OF 25 NEW DECAPOD CRUSTACEANS FROM THE MIDDLE EOCENE OF THE CAROLINAS, U.S.A.

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CONTENTS

I. ABSTRACT

Twenty-three genera, 14 new, representing 12 families and comprising 25 new species of decapod crustaceans, are described from the middle Eocene Castle Hayne and Santee limestones of North and South Carolina. Of the nine existing genera, members of five, *"Paguristes," Cyrtorhina, Lophoranina, Calappilia,* and *Titanocarcinus,* had been reported previously from the Americas. The new taxa are: *"Paguristes wheeleri"* (Diogenidae); *Albunea hahnae,* the first American fossil species of the genus (Albuneidae); *Ameridromia,* type species *A. hyneorum,* and *Dromidia bedetteae,* the first fossil record for the latter genus (Dromiidae); *Prohomola katunai,* the first record of the genus outside of Japan (Homolidae); *Cyrtorhina fusseli,* the first named American species of this genus, *Lophoranina raynorae,* and *L. rossi* (Raninidae); *Titanodorippe,* type species *T. eocenica,* the largest known member of the Dorippinae (Dorippidae); *Calappilia sitzi, Eriosachila,* type species *E. petiti, Matutites,* type species *M. anthonyae,* and *Pseudohepatiscus,* type species *P. marinoi* (Calappidae); *Wilsonimaia,* type species *W. ethelae,* and *W. schneiderorum* (Majidae); *Santeecarcinus,* type species *S. harmatuki,* and *Sarahcarcinus,* type species *S. campbellorum* (Cancridae); *Acantholambrus,* type species *A. baumi* (Parthenopidae); *Viacarcinus,* type species *V. druidi,* the first fossil eumedonid and the first fossil or Recent eumedonid to be recorded from the Americas (Eumedonidae); *Eocarpilius,* type species *E. carolinensis, Eohalimede,* type species *E. walleri, Laevicarcinus dockeryi,* the first record for the genus outside of Hungary and the first American species of the genus, *Santeella,* type species *S. lillyae, Santeexanthus,* type species *S. wardi,* and *Titanocarcinus purdyi* (Xanthidae). The assemblage, as a whole, has greater affinities with the faunas of the Eocene of Hungary, Italy, and Spain than with known American Eocene faunas.

II. INTRODUCTION

On May 25, 1972, Druid Wilson, then of the Paleontology and Stratigraphy Branch, U.S. Geological Survey, and his assistants Barbara Bedette and the senior author, visited the Superior Stone Quarry (presently the M.M. Berkeley Quarry), Berkeley County, South Carolina, to study and collect from the rich fossil deposits known to occur there. Later that same year, D. Wilson handed W. Blow a very small crab that he had found in a sediment sample from the middle Eocene Santee Limestone that had been collected during their trip. This crab, *Viacarcinus druidi,* a new genus and species, became the catalyst for the more than two decades of the authors' field work and research that followed on the Eocene decapods of the Carolinas.

During that time, with the addition of each new taxon, it became clear that this was not only one of the most diverse Eocene decapod assemblages known, but that in North America, it was unique to the Carolinas. Only five genera of this assemblage, *"Paguristes," Lophoranina, Calappilia, Eriosachila,* and *Titanocarcinus,* and no species, are found elsewhere in the Americas. In time, the affinities of this assemblage would prove to be closer to those found in the Eocene deposits of Spain, Hungary, and Italy rather than to those of other American Eocene deposits.

Our study of this assemblage has grown far beyond initial expectations, thereby delaying the publication of our planned monograph. The following three factors have contributed to our decision to prepare this preliminary account of the new taxa found to date. Firstly, only two, fairly recent, preliminary reports have dealt with the fossil decapods of the Carolinas since Rathbun's 1935 report on the fossil Crustacea of the Atlantic and Gulf Coastal Plain, and most of the identifications given in both of these reports are incorrect. Secondly, much new information on European Eocene decapods has come to light in recent years through the work of L. Via Boada in Spain, J.S.H. Collins in England, Pal Müller in Hungary, and Claudio Beschin and his colleagues in Italy. Their work, like that of some earlier European workers, though very relevant to Carolinian Eocene decapods, is, for the most part, like Rathbun (1935), out of print and/or not available in most American libraries. And finally, during the past 10 years, fossil collecting has become increasingly popular, and thousands of people have joined local fossil clubs nationwide. Fossil clubs in the mid-Atlantic states are particularly active, and the scientific value of their work would be much enhanced by provision of accurate fossil identification guides.

This preliminary report is, therefore, intended to: correct the misidentifications of Carolinian Eocene decapods already in the literature; bring to light this diverse and very interesting assemblage; and satisfy the need, in part, of the amateur collector or student of paleontology by serving as a basic, interim guide to the Carolinian Eocene decapods.

The diagnoses given below will differentiate the new genera from other genera in the same family and will distinguish the new species from all other species in their respective genera.

Repositories: Primary types are deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C. Some paratypes, where indicated, are deposited in the Virginia Museum of Natural History, Martinsville, Virginia.

Abbreviations:

M.M., quarries owned and operated by Martin Marietta Aggregates

NMNH, National Museum of Natural History, Smithsonian Institution

P & S, the former Paleontology and Stratigraphy Branch, USGS

USGS, the U.S. Geological Survey (when used with a number indicates a locality; see locality register at end of paper)

USNM, abbreviation for catalogue numbers of the former U.S. National Museum, now the National Museum of Natural History

VMNH, Virginia Museum of Natural History

Measurements: Unless otherwise stated, all specimens are represented by the dorsal aspect of the carapace. The margins of many specimens are broken, eroded, or incomplete as indicated in a number of our figures. Measurements, therefore, represent the overall dimensions of the specimen in hand, complete or fragmentary.

Measurements are expressed in millimeters as follows: cl, carapace length, maximum longitudinal measurement; cw, carapace width, maximum transverse measurement; prl, propodus length, length of palm or combined length of palm and fixed finger; prh, propodus height; prt, propodus thickness; l, length, overall; w, width, overall.

Stratigraphic assignment: With the exception of only one specimen, the paratype of *Viacarcinus druidi,* USNM 484560, all specimens described in this paper were collected as spoil or float from their respective North and South Carolina localities. Stratigraphic assignment of these specimens, therefore, is based on the matrix associated with each specimen. All specimens have been determined to have been derived from either the middle Eocene Castle Hayne or Santee limestones. These assignments are given with each of the following species accounts.

III. ACKNOWLEDGMENTS

Many people have contributed their specimens, field, library, or other assistance to the authors in the preparation of this manuscript. Most of this assistance has been acknowledged throughout the text where appropriate. Among those cited in the text, we especially thank Druid Wilson, Gerald R. Baum, and Lauck W. Ward for their valuable insights on Carolinian Eocene stratigraphy and for opening up their respective collections to us. We are particularly grateful for the support of Thomas R. Waller, without which this project could not have been completed. Numerous discussions with Francis M. Hueber have greatly enhanced the quality of this paper. We are also particularly grateful to William O. Ross, Peter J. Harmatuk, and Judith R. Schneider for providing many of the specimens cited in this paper. This paper would not have been possible without the help of the many quarry owners and operators who have graciously allowed the authors and numerous others to collect in their quarries. In this regard we thank Martin Marietta Aggregates, of North and South Carolina, and the Billy B. Fussel Company, Inc., Rose Hill, North Carolina.

IV. SYSTEMATIC PALEONTOLOGY

Family DIOGENIDAE Ortmann, 1892

"PAGURISTES" WHEELERI, n. sp.
Plate 1, Figure 1

Diagnosis: Specimens of right and left propodi where of equal size nearly identical in terms of proportions and ornamentation, length of each about 1 1/2 times their width. Dorsal surface of each covered with large tubercles, ventral surface of each very inflated and covered with tubercles below prominent row of much larger tubercles arranged in shape of inverted Y. Dorsomesial border of palm with double row of very large tubercles along margin. Dorsolateral border of propodus with about 12 subquadrate, faintly bilobed teeth, forming carinate margin.

Etymology: This species is named for the late Walter H. Wheeler, in recognition of his contribution to the geology and paleontology of North Carolina, through his own research efforts and those of a number of students whose interest in Carolinian paleontology was stimulated by him during his tenure as a professor of geology at the University of North Carolina, Chapel Hill.

Holotype: Left propodus (USNM 484527), prl 19.5 mm, prh 14.7 mm, prt 8.2 mm.

Type locality: USGS 26874, Maple Hill (Lanier Pit), Pender County, North Carolina. Castle Hayne Limestone.

Paratypes: Left propodus (USNM 484528), prl 20.6 mm, prh 13.9 mm, prt covered; locality USGS 26883 M.M. Berkeley Quarry, Berkeley County, South Carolina. Left propodus (USNM 484529), prl 18.2 mm, prh 12.4 mm, prt 7.9 mm, locality USGS 26883, as above. Santee Limestone.

Right propodus (USNM 488556), prl 47.3 mm, prh 31.1 mm, prt 20.0 mm. Locality unknown.

Occurrence: Castle Hayne Limestone, North Carolina; Santee Limestone, South Carolina.

Remarks: We could find no species that might be confused with this species.

Family ALBUNEIDAE Stimpson, 1858

ALBUNEA HAHNAE, n. sp.
Plate 1, Figure 2

Diagnosis: Size small (cl 16.6 mm). Carapace obovate, slightly longer than broad, regions well-defined by distinct dorsal grooves. Anterior margin almost transverse, with deep median ocular sinus armed with small, median rostral spine. Outer angle of ocular sinus with strong spine, produced well beyond anterior outline, followed laterally by 6-7 stout spiniform teeth; outer angle of anterior margin unarmed. Postfrontal region bordered posteriorly by deep, sinuous trough extending from below outer ocular spine nearly to lateral margin. Prominent, broad, M-shaped depression situated between submedian extensions of trough and laterally-bilobed protogastric regions; surface of depression appearing braided to unaided eye. Cervical groove continuous, interconnecting with 2 posteriorly directed branchial furrows.

Etymology: This species is named for Carolyn S. Hahn, former reference librarian of the Natural History Branch, Smithsonian Institution Libraries, whose pleasant demeanor and incomparable knowledge of the library's holdings in natural history materially contributed to our research.

Holotype: (USNM 484530), cl 16.6 mm, cw 13.8 mm.

Type locality: USGS 26882, M.M. Berkeley Quarry, Berkeley County, South Carolina. Santee Limestone.

Occurrence: Santee Limestone, South Carolina.

Remarks: Of the three reported fossil species of *Albunea*, *A. hahnae* most closely resembles *A. cuisiana* Beschin and de Angeli, 1984 from the middle Eocene of northeastern Italy, from which it differs in having: (1) a much deeper median indentation of the postfrontal M-shaped groove; (2) a cervical groove continuous with the branchial groove; and (3) the lateral branchial margin above the *linea anomurica* appears more irregular.

This is the first American record for a fossil member of *Albunea*.

Family DROMIIDAE De Haan, 1833

AMERIDROMIA, n. gen.

Diagnosis: Size small (cw 8.7 mm). Carapace subpentagonal, strongly convex, length sube-

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PLATE 1

Figures

1. *"Paguristes" wheeleri* Blow and Manning, n. sp.
   1a. Holotype, left propodus in dorsal view, (USNM 484527), prl 19.5 mm, prh 14.7 mm, prt 8.2 mm. Scale = 2 mm.
   1b. Holotype in ventral view. Scale = 2 mm.
   Locality: USGS 26874, Maple Hill, Pender County, North Carolina. Castle Hayne Limestone.
2. *Albunea hahnae* Blow and Manning, n. sp.
   Holotype, incomplete carapace in dorsal view, (USNM 484530), cl 16.6 mm, cw 13.8 mm. Scale = 2 mm.
   Locality: USGS 26882, Berkeley County, South Carolina. Santee Limestone.
3. *Ameridromia hyneorum* Blow and Manning, n. gen. and sp.
   Holotype, incomplete internal mold of carapace in dorsal view (truncated posteriorly along branchial groove and posterior margin of cardiac region), (USNM 484532), cl 7.6 mm, cw 8.7 mm. Scale = 2 mm.
   Locality: USGS 26883, Berkeley County, South Carolina. Santee Limestone.
4. *Dromidia bedetteae* Blow and Manning, n. sp.
   Holotype, right half of carapace in dorsal view, (USNM 484531), cl 13.2 mm, cw 8.6 mm. Scale = 2 mm.
   Locality: USGS 26883, Berkeley County, South Carolina. Santee Limestone.
5. *Prohomola katunai* Blow and Manning, n. sp.
   Holotype, incomplete carapace in dorsal view (truncated anteriorly and terminating laterally along *linea homolica*), (USNM 484533), cl 27.9 mm, cw 21.5 mm. Scale = 2 mm.
   Locality: USGS 26882, Berkeley County, South Carolina. Santee Limestone.

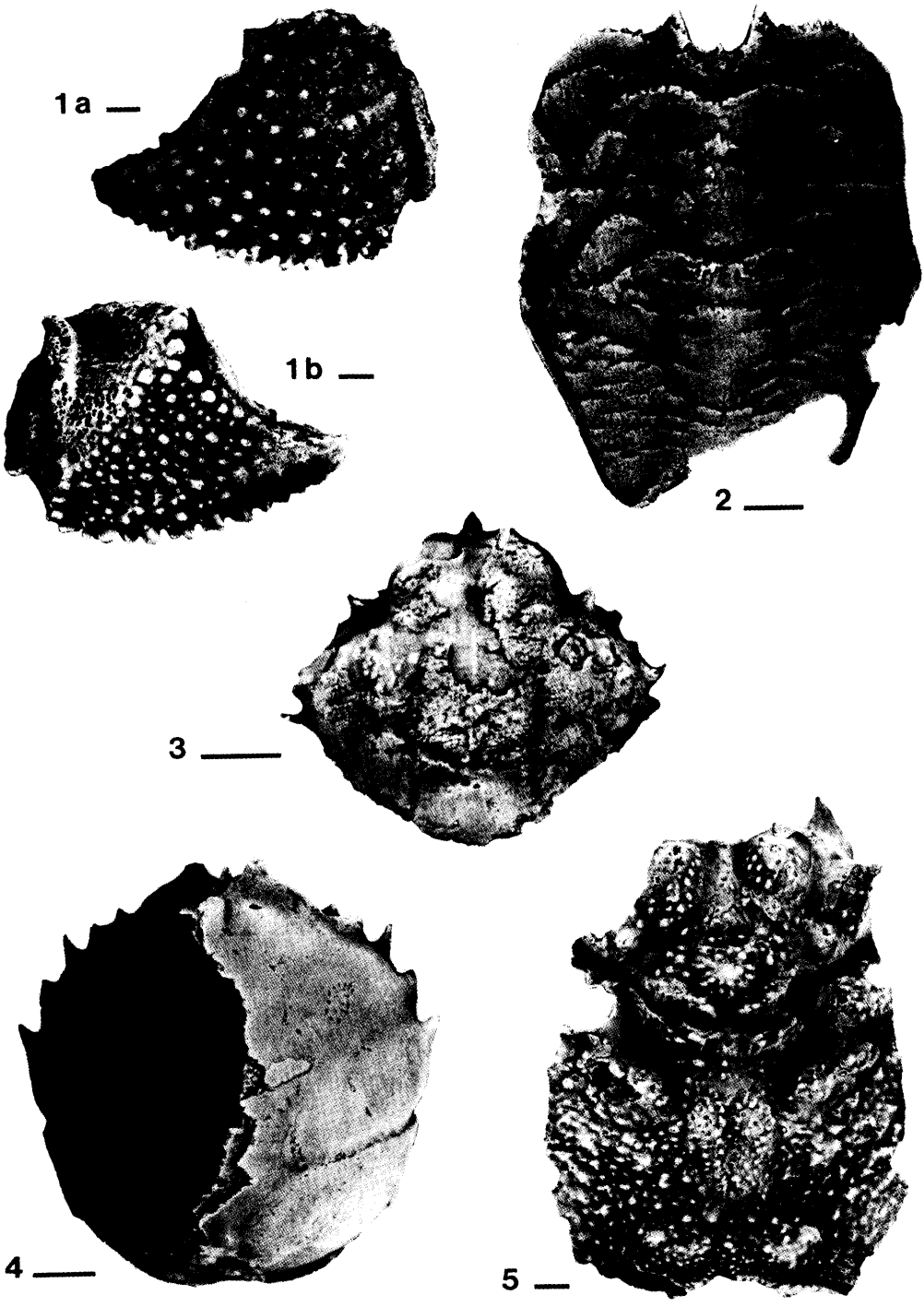


PLATE 1

qual to width. Regions moderately well-defined anteriorly. Surface sparsely pustulose and/or tuberculate anteriorly. Front tridentate, rostrum strongly projecting. Inner orbital lobe continuous with lateral frontal lobe, produced into broad, convex eave. Outer orbital lobe very strong. Anterolateral margins nearly vertical, strongly convergent anteriorly. Anterolateral teeth 4, conical in shape, first beginning well below and behind outer orbital lobe, third and fourth closely set, nearly paired.

Type species: Ameridromia hyneorum, n. sp., by present designation and monotypy.

Etymology: The name combines America and the generic name *Dromia.* Gender feminine.

Remarks: The characters of *Ameridromia* exclude this new genus from all known genera in the family Dromiidae (see McLay, 1993). These same features do, however, suggest much stronger affinities with Recent, more advanced members of this diverse family than with extinct forms.

AMERIDROMIA HYNEORUM, n. sp.
Plate 1, Figure 3

Diagnosis: As for genus.

Etymology: This species is named for Frank and Becky Hyne, of Greenville, North Carolina, in appreciation of their ongoing collecting efforts which have greatly benefited this paper and the NMNH collections.

Holotype: (USNM 484532), cl 7.6 mm, cw 8.7 mm.

Type locality: USGS 26883, M.M. Berkeley Quarry, Berkeley County, South Carolina. Santee Limestone.

Occurrence: Santee Limestone, South Carolina.

DROMIDIA BEDETTEAE, n. sp.
Plate 1, Figure 4

Diagnosis: Size small (cl 13.2 mm). Carapace strongly convex transversely, length slightly more than width, broadest at third anterolateral tooth, regions poorly defined. Fronto-orbital region about 2/3 width of carapace. Frontal region armed with 3 distinct, acute teeth. Median tooth deflexed below and not projecting beyond adjacent teeth of broadly triangular frontal lobes. Outer orbital lobe, strongly produced at external angle, but without spine. Suborbital lobe broadly triangular, strongly produced beyond orbital margin above. Lateral margin of carapace with 4 teeth, first strongest, spiniform, tip nearly reaching outer orbital angle. Second tooth broad, not spiniform like first and third nor as strong. Fourth tooth weak, set just behind branchial groove. Cardiac region with 3 minute tubercles which when connected form corners of an inverted triangle.

Etymology: This species is named for Barbara A. Bedette, formerly of the P & S Branch, USGS, in recognition of her many contributions to paleontology. In addition, Ms Bedette assisted in collecting some of the material described in this paper.

Holotype: (USNM 484531), cl 13.2 mm, cw 8.6 mm.

Type locality: USGS 26883, M.M. Berkeley Quarry, Berkeley County, South Carolina. Santee Limestone.

Occurrence: Santee Limestone, South Carolina.

Remarks: Dromidia bedetteae appears most closely allied to the Recent crab, *D. antillensis* Stimpson, 1859, from which it can be immediately distinguished by: (1) its strong, elongate first and third anterolateral teeth, the first of which extends almost to the tip of the outer orbital angle; and (2) the outer angle of the frontal lobe of *D. bedetteae,* unlike that of *D. antillensis,* is rounded and lacks a spine.

Dromidia bedetteae is the first recorded fossil member of this genus.

Family HOMOLIDAE White, 1847

PROHOMOLA KATUNAI, n. sp.
Plate 1, Figure 5

Diagnosis: Carapace distinctly longer than broad, regions well-defined. Dorsal surface anteriorly elevated, prominences coarsely tuberculate; posterior surface flattened, more densely tuberculate. Protogastric region divided into 3 distinct lobes; anterolateral lobe with very prominent, obliquely directed, acute spine. Mesogastric region basally divided into 3 lobes; medial lobe most prominent, longitudinally subovate, strongly inflated, coarsely granulate. Anterior process of mesogastric region narrow. Cardiac region longitudinally subobovate, with shallow, longitudinal depression, surface with fine tubercles.

Etymology: This species is named for Michael P. Katuna, Professor and Chairman of Geology, College of Charleston, Charleston, South Carolina for his contribution to South Carolina geology and paleontology through his teaching

and for his help in collecting a number of species described herein.

Holotype: (USNM 484533), cl 27.9 mm, cw 21.5 mm.

Type locality: USGS 26882, M.M. Berkeley Quarry, Berkeley County, South Carolina. Santee Limestone.

Paratype: (USNM 484534), l 24.6 mm, w 12.5 mm; locality USGS 26883, same quarry as above. Santee Limestone.

Occurrence: Santee Limestone, South Carolina.

Remarks: This species resembles the type species of the genus, *P. japonica* (Yokoyama, 1911), in general facies but can immediately be separated from *P. japonica* by: (1) the presence of a strong, acute spine on the anterolateral lobe of the protogastric region; (2) larger or much coarser, though fewer, granules on the carapace surface, especially anteriorly; and (3) a much broader, more elevated, and more coarsely granulated basal circular lobe of the mesogastric region.

This is the first American record as well as the first record of this genus outside of Japan.

Family RANINIDAE De Haan, 1841

CYRTORHINA FUSSELI, n. sp.
Plate 2, Figure 1

Diagnosis: Carapace obovate, widest anteriorly, just behind third anterolateral tooth. Front tridentate, base narrow, about 1/4 carapace width. Anterolateral margin with 3 stout spinulose teeth, distance from first to second distinctly less than distance from second to third. Lateral margin behind base of third anterolateral tooth, broad, coarsely tuberculate. Postfrontal region with irregular medial row of tubercles extending from narrow, transverse field of tubercles onto base of rostrum. Posterior margin of carapace distinctly greater than 1/3 of carapace width.

Etymology: This species is named for Billy B. Fussel, of Rose Hill, North Carolina, in appreciation of his support in making his quarry available to us for collecting and for sharing with us a number of specimens that he or members of his family had discovered.

Holotype: (USNM 484544), cl 27.7 mm, cw 25.0 mm.

Type locality: USGS 26870, M.M. Castle Hayne Quarry (formerly Superior Stone Quarry), Castle Hayne, North Carolina. Castle Hayne Limestone.

Paratype: (USNM 484545), cl 29.1 mm, cw 25.3 mm. Locality USGS 26876, Billy B. Fussel Company, Inc., Quarry, Rose Hill, North Carolina. Castle Hayne Limestone.

Occurrence: Castle Hayne Limestone, North Carolina.

Remarks: Cyrtorhina fusseli appears most similar to *C. globosa* Beschin *et al.*, 1988, from the Eocene of northern Italy from which it can be separated as follows: (1) the carapace of *C. fusseli* is widest anteriorly, just behind the third or posteriormost anterolateral tooth, not posterior to midlength as in *C. globosa;* (2) the width of posterior margin of the carapace of *C. fusseli* is distinctly greater than 1/3 of the carapace width, but it is narrower, less than 1/3 of the carapace width in *C. globosa;* (3) the tubercles making up the transverse field of tubercles on the postfrontal region of *C. fusseli* appear larger, more advanced anteriorly, and have an irregular medial row of tubercles extending onto the rostrum, characters unlike those seen on the illustrations of *C. globosa.*

This is the first named record of a fossil or Recent species of *Cyrtorhina* from the Americas.

LOPHORANINA RAYNORAE, n. sp.
Plate 2, Figure 3

Diagnosis: Carapace broadly obovate, widest at anterolateral angle. Front broad, strongly biconcave, width half width of fronto-orbital region. Lateral frontal lobes strongly produced laterally into sharp, acute angle. Outer orbital lobe with strong lateral spine slightly deflected anterolaterally. Anterolateral margin with 2 flattened, subequal, hook-like spines behind outer orbital lobe. Dorsal surface ornamented with numerous, short, interrupted, transverse, pectinate ridges, anastomosing irregularly. Ridge elements exceeding 200 in number.

Etymology: This species is named for Judith A. Raynor Schneider, of Garner, North Carolina, who collected the type material and brought this unique new crab to the senior author's attention.

Holotype: (USNM 484541), cl 43.5 mm, cw 37.2 mm.

Type locality: USGS 26870, M.M. Castle Hayne Quarry, Castle Hayne, North Carolina. Castle Hayne Limestone.

Paratypes: (USNM 484542), cl 28.3 mm, cw 24.6 mm; locality USGS 26870, as above; (USNM 484543), cl 29.7 mm, cw 23.5 mm; locality USGS 26871, same quarry as 26870, above. Castle Hayne Limestone.

Occurrence: Castle Hayne Limestone, North Carolina.

Remarks: This species can be distinguished from all other species in the genus by the presence of two narrow, hooked, anterolateral teeth and a dorsal surface ornamented with numerous, short, interrupted, transverse, pectinate ridges, anastomosing irregularly; no ridges completely cross the carapace. Unlike the transverse ridges found in other species of *Lophoranina,* the ridge elements of *L. raynorae* appear fragmented and are numerous, exceeding 200 in number; some appear castellate and/or capillate.

The two species of *Lophoranina* named here double the number of recognized American species of the genus.

LOPHORANINA ROSSI, n. sp.
Plate 2, Figure 4

Diagnosis: Carapace broadly obovate, widest behind anterolateral angle. Anterolateral margin produced anteriorly into 2 broad, blade-like teeth separated from outer orbital lobe by 2 small teeth. Dorsal surface ornamented with numerous transverse, pectinate ridges, numbering 20 to 25 on midline. Ridges widely spaced and more or less complete anteriorly, closely spaced and anastomosing posteriorly. Pectinate ridges straightening anteriorly. Inferior margin of palm of right chela produced into 4 large, blade-like, subparallel teeth. Superior, inner, distal angle of articulated carpus armed with very long, narrow, inwardly directed spine.

Etymology: This species is named for William O. Ross, formerly of the P & S Branch, USGS, in recognition of his many contributions to paleontology and with particular appreciation for collecting much of the material described in this paper.

Holotype: (USNM 484535), cl 35.7 mm, cw 31.5 mm; prl 17.7 mm, prh 12.5 mm.

Type locality: USGS 26878, M.M. Georgetown Quarry, Georgetown County, South Carolina. Santee Limestone.

Paratypes: (USNM 484536), cl 47.1 mm, cw 34.2 mm; (USNM 484537), cl 44.2 mm, cw 38.9 mm; (USNM 484540), cl 23.8 mm, cw 36.0 mm; (USNM 484536-484537 & 484540), locality USGS 26878, as above; (USNM 484538), cl 35.1 mm, cw 28.4 mm; (USNM 484539), cl 44.2 mm, cw 36.9 mm; (USNM 484538-484539), locality USGS 26880, same quarry as locality USGS 26878, above. Santee Limestone. In addition, three paratypes have been deposited in the VMNH.

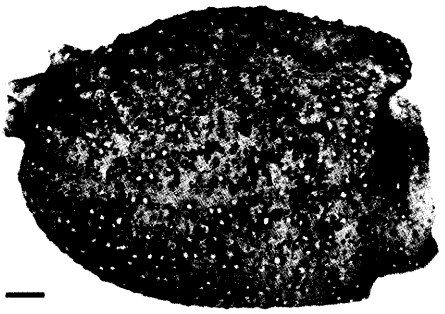
Occurrence: Santee Limestone, South Carolina.

PLATE 2

Figures

1. *Cyrtorhina fusseli* Blow and Manning, n. sp.
   Holotype, incomplete carapace in dorsal view (fronto-orbital region lacking), (USNM 484544), cl 27.7 mm, cw 25.0 mm. Scale = 2 mm.
   Locality: USGS 26870, Castle Hayne, North Carolina. Castle Hayne Limestone.
2. *Titanodorippe eocenica* Blow and Manning, n. gen. and sp.
   Holotype, incomplete right propodus in outer view, (fixed finger and dactylus lacking), (USNM 488557), prl 46.5 mm, prh 31.9 mm, prt 22.0. Scale = 4 mm.
   Locality: USGS 26884, Berkeley County, South Carolina. Santee Limestone.
3. *Lophoranina raynorae* Blow and Manning, n. sp.
   3a. Holotype, incomplete carapace in dorsal view (rostrum incomplete, right orbit and right anterolateral margin lacking), (USNM 484541), cl 43.5 mm, cw 37.2 mm. Scale = 2 mm.
   3b. Holotype, close-up of left fronto-orbital and anterolateral margins. Scale = 2 mm.
   Locality: USGS 26870, Castle Hayne, North Carolina. Castle Hayne Limestone.
4. *Lophoranina rossi* Blow and Manning, n. sp.
   4a. Holotype, incomplete carapace in dorsal view (rostrum lacking and posterior margin incomplete), (USNM 484535), cl 35.7 mm, cw 31.5 mm. Scale = 2 mm.
   4b. Holotype, close-up of left fronto-orbital and anterolateral margins. Scale = 2 mm.
   Locality: USGS 26878, Georgetown County, South Carolina. Santee Limestone.

1 —



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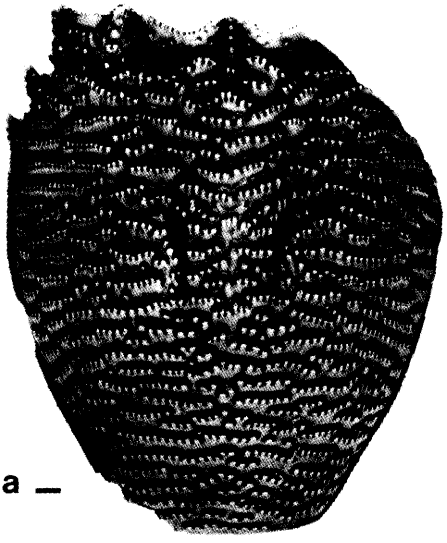

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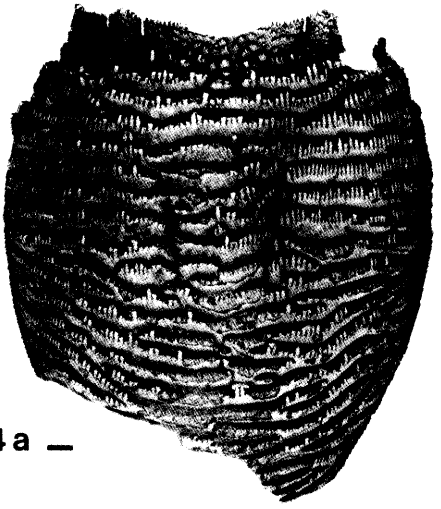

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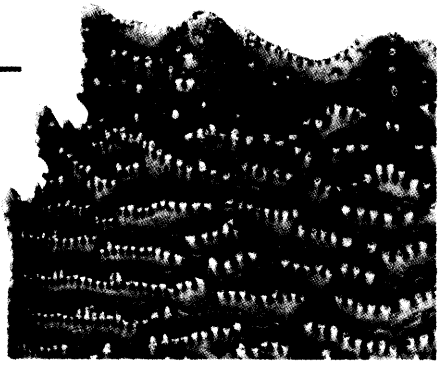

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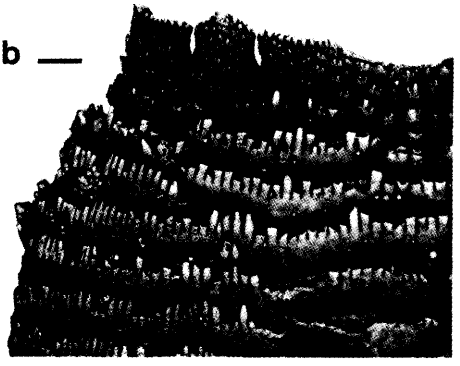


PLATE 2

Remarks: This species most closely resembles *L. laevifrons* (Bittner, 1875) from the Eocene of Italy, from which it can be easily separated by its: (1) broader, more ornate post fronto-orbital surface; (2) less interrupted anterior dorsal ridges; and (3) two broad, flattened, ear-like anterolateral teeth.

Lophoranina rossi can be readily separated from *L. straeleni* Via Boada, 1959, from the Eocene of Spain, with which it was tentatively identified by Bishop and Whitmore (1986, p. 299), by its: (1) narrower post fronto-orbital dorsal surface; (2) straight, not concave, less interrupted anterior ridges; and (3) two broader, more flattened, ear-like anterolateral teeth.

Family DORIPPIDAE de Haan, 1841
Subfamily DORIPPINAE de Haan, 1841

TITANODORIPPE, n. gen.

Diagnosis: Size very large (prl 46.5 mm) for dorippids, much larger than any Recent genus of the Dorippidae.

Type species: Titanodorippe eocenica, n. sp., by present designation and monotypy.

Etymology: From the Greek, *Titan,* gigantic or colossal, alluding to the apparent large size of the type species, in combination with the generic name *Dorippe.* Gender feminine.

Remarks: The single palm of an adult male agrees in all respects except size with the larger palm of adult males of Recent members of the genera *Dorippe* Weber, 1795, and *Medorippe* Manning and Holthuis, 1981.

The largest male of a *Dorippe* reported by Holthuis and Manning (1990) has a carapace width of 43 mm, much smaller than the projected carapace width of 62 mm based on a propodus height of 31.9 mm in *T. eocenica,* assuming a 2:1 ratio of carapace width/propodus height. We have found no intact carapace, legs, or fragments of a dorippid this large in our collections.

In the Recent Dorippinae, the smaller male chela and the female chelae all have a single longitudinal groove in the upper third of the outer surface. Although their palms are typically smooth and shiny, lacking tubercles or spines, both palms in the male may be covered with granules, as in *D. irrorata* Manning and Holthuis, 1986 (see Holthuis and Manning, 1990, p. 17; granules not shown fig. 4d).

This is largest known member of the Dorippinae and the first described member of the subfamily from the Americas.

TITANODORIPPE EOCENICA, n. sp.
Plate 2, Figure 2

Diagnosis: Palm with inner and outer surfaces inflated, completely covered with granules. Palm highest in middle, height about half maximum outer length of palm, about 2/3 dorsal length. Distal edge of palm with more than 25 distinct denticles.

Etymology: The specific name is based on the Eocene stratigraphic occurrence of the type species.

Holotype: (USNM 488557), prl 46.5 mm, prh 31.9 mm, prt 22.0 mm.

Type locality: USGS 26884, M.M. Berkeley Quarry, Berkeley County, South Carolina. Santee Limestone.

Occurrence: Santee Limestone, South Carolina.

Remarks: The size of the propodus of this species distinguishes it from all known dorippids.

Family CALAPPIDAE de Haan, 1833
Subfamily CALAPPINAE de Haan, 1833

CALAPPILIA SITZI, n. sp.
Plate 3, Figure 1

Diagnosis: Carapace subpentagonal, strongly convex, length slightly less than width, broadest at midlength. Anterolateral margin armed with about 11 small to minute teeth, acute, unequal, alternating in size. Posterolateral margin greatly expanded, winglike, armed with 5 to 6 medium to moderately large, acute, very coarsely granulated teeth. Posterior margin coarsely granulate, trilobate. Protogastric region with 1 central protuberance; mesogastric protuberance elongate, greatly elevated; urogastric region with 1 central protuberance; cardiac region with 1 strong central protuberance; hepatic region with 2 to 4 protuberances; branchial region with 3 very strong protuberances adjacent and subparallel to gastrocardiac groove, bordered laterally by a second row of 8 slightly smaller protuberances.

Etymology: This species is named for Thomas O. Sitz, Professor of Biochemistry, Virginia Tech, Blacksburg, Virginia, in appreciation for

his many years of field support and encouragement of the senior author, and in recognition of his own extensive contribution to science and education.

Holotype: (USNM 484546), cl 15.9 mm, cw 16.6 mm.

Type locality: USGS 26874, Lanier Pit, Maple Hill, Pender County, North Carolina. Castle Hayne Limestone.

Paratypes: (USNM 484547) cl 11.7 mm, cw 12.1 mm; (USNM 484548) cl 12.3 mm, cw 14.1 mm; (USNM 484549) cl 17.4 mm, cw 16.5 mm; (USNM 484550) cl 12.4 mm, cw 13.5 mm; (484547-484550) locality USGS 26874, as above. Castle Hayne Limestone.

Occurrence: Castle Hayne Limestone, North Carolina.

Remarks: Calappilia sitzi was confused with *C. brooksi* Ross and Scolaro, 1964, from the upper Eocene of Florida by Bishop and Whitmore (1986, p. 300, fig. 3I).

Calappilia sitzi differs from *C. brooksi* in having: (1) a more subpentagonal carapace outline; (2) broader posterolateral teeth; (3) weaker, less pronounced anterolateral teeth; (4) a greatly elevated, elongate mesogastric protuberance; (5) a single, medially-placed urogastric tubercle; and (6) the presence of large protuberances posteriorly.

Calappilia sitzi is similar in outline and in the distribution of its largest protuberances to *C. diglypta* Stenzel, 1934, from the middle Eocene of Texas. It can, however, be immediately distinguished from *C. diglypta* by: (1) its trilobate posterior margin as opposed to the condition in *C. diglypta* in which the posterior margin is produced into three closely spaced spines; and (2) its 20 or more branchial protuberances compared to only 12 in *C. diglypta.*

Subfamily MATUTINAE Alcock, 1896

ERIOSACHILA, n. gen.

Diagnosis: Carapace sub-octagonal, length slightly less than width, broadest at second or third anterolateral tooth; dorsal surface very uneven, regions well defined, surface with 8 large protuberances; those of protogastric and mesogastric regions forming raised platform. Front weakly projecting, bilobed, with deep, open, median incision, width about 1/4 carapace width; lobes truncate, divergent, anterior margins denticulate. Orbit small, subcircular, marginal. Orbit bordered below and laterally by narrow, flattened, broadly triangular, vertical, suborbital flank. Anterolateral margin divided into 4 distinct, lobe-like teeth; teeth separated by closed incisions. Posterolateral margin with 3 teeth. Posterior margin very narrow, width equal to or slightly less than width of front.

Type species: Eriosachila petiti, n. sp., by present designation.

Etymology: The name is formed by adding the Greek, *eri,* early, to the generic name *Osachila.* Gender feminine.

Included species: Eriosachila rathbunae (Maury, 1930), n. comb., Eocene, Venezuela; *Eriosachila terryi* (Rathbun, 1937), n. comb., upper Eocene, Panama; and *Eriosachila petiti,* n. sp., middle Eocene, South Carolina, USA.

Remarks: In carapace outline; number and position of lateral teeth; the presence of eight large dorsal protuberances, of which the paired mesobranchial are weakest; and the greatly elevated, protogastric, mesogastric and epibranchial regions, *Eriosachila* appears most closely allied to *Osachila* Stimpson, 1871, s.s., and other related Western Atlantic species. It differs from *Osachila*, however, in having an anteriorly broader, more truncate, much less projecting denticulate front. In addition, the frontal lobes of *Eriosachila,* unlike *Osachila,* are separated by a relatively deep, open incision and the anterior margins of the lobes are weakly divergent. In contrast, the front of *Osachila* is strongly projecting, relatively narrow anteriorly, and each lobe is distinctly rounded or acute anteriorly.

Some members of *Eriosachila* have been confused with species of *Hepatiscus* Bittner, 1875, from which they can be readily separated. In *Eriosachila,* as in *Osachila* s.s., the anterolateral margins are divided by closed incisions into four distinct lobe-like teeth, and the posterolateral margins into three teeth. In contrast, the lateral margins of *Hepatiscus* s.s., as described and figured in Bittner's original account of its type species, are wholly entire ("Der Seitenrand ist vollstandig ganzrandig") (Bittner, 1875, p. 75-76), continuous, not divided into teeth or lobes.

ERIOSACHILA PETITI, n. sp.
Plate 3, Figure 2

Diagnosis: As for genus except: dorsal protuberances relatively low, very rounded, epibranchial protuberance most prominent, distinctly laterally placed. First posterolateral tooth weak; second very strong; third largest, most prominent of all lateral teeth.

Etymology: This species is named for Richard E. Petit, malacologist, of North Myrtle Beach, South Carolina, in recognition of his contribution to Atlantic Coastal Plain paleontology and in appreciation for his years of support of the senior author's research.

Holotype: (USNM 484551), cl 8.7 mm, cw 9.7 mm.

Type locality: USGS 26878, M.M. Georgetown Quarry, Georgetown County, South Carolina. Santee Limestone.

Paratypes: (USNM 484552), cl 13.2 mm, cw 14.2 mm; locality USGS 26878, as above; (USNM 484553), cl 17.5 mm, cw 20.4 mm; locality USGS 26881, same quarry as above. Santee Limestone.

Occurrence: Santee Limestone, South Carolina.

Remarks: Eriosachila petiti differs from *E. rathbunae* in having lower, more rounded dorsal protuberances of which, unlike those of *E. rathbunae,* the epibranchial protuberance is most prominent and more laterally placed. In addition *E. petiti* differs from *E. rathbunae* in having a much weaker mesobranchial protuberance, and the third posterolateral tooth of *E. petiti* is much stronger than the same, though rudimentary, tooth in *E. rathbunae. Eriosachila petiti* can be readily separated from *E. terryi* by its more rounded and more laterally placed epibranchial protuberance. Also, in *E. petiti,* the first posterolateral tooth is weakest and third strongest and most prominent in contrast to those in *E. terryi* where the first posterolateral tooth is strongest and third weakest.

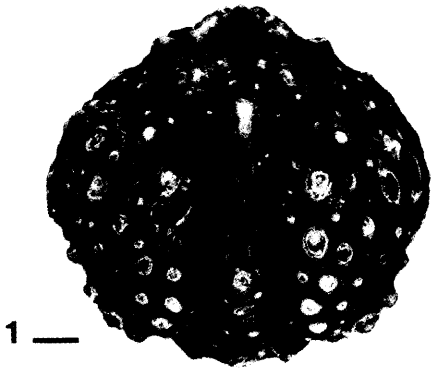
MATUTITES, n. gen.

Diagnosis: Carapace broadly obovate, length slightly less than width, broadest at third anterolateral denticle; dorsal surface weakly elevated, uneven, regions defined by 8 large pro-

PLATE 3

Figures

1. *Calappilia sitzi* Blow and Manning, n. sp.
   Holotype, weathered carapace in dorsal view, (USNM 484546), cl 15.9 mm, cw 16.6 mm. Scale = 2 mm.
   Locality: USGS 26874, Maple Hill, Pender County, North Carolina. Castle Hayne Limestone.
2. *Eriosachila petiti* Blow and Manning, n. gen. and sp.
   Holotype, internal mold of carapace in dorsal view (surface with remnants of weathered cuticle), (USNM 484551), cl 8.7 mm, cw 9.7 mm. Scale = 2 mm.
   Locality: USGS 26878, Georgetown County, South Carolina. Santee Limestone.
3. *Matutites anthonyae* Blow and Manning, n. gen. and sp.
   Holotype, internal mold of left half of carapace in dorsal view (surface with remnants of weathered cuticle), (USNM 484554), cl 17.5 mm, cw 15.1 mm. Scale = 2 mm.
   Locality: USGS 26883, Berkeley County, South Carolina. Santee Limestone.
4. *Pseudohepatiscus marinoi* Blow and Manning, n. gen. and sp.
   Holotype, carapace in dorsal view (front incomplete), (USNM 484555), cl 11.5 mm, cw 12.5 mm. Scale = 2 mm.
   Locality: USGS 26879, Georgetown County, South Carolina. Santee Limestone.
5. *Wilsonimaia ethelae* Blow and Manning, n. gen. and sp.
   5a. Holotype, weathered carapace in lateral view (rostrum truncated near base), (USNM 484561), cl 36.4 mm, cw 18.5 mm. Scale = 2 mm.
   5b. Holotype, in dorsal view. Scale = 2 mm.
   Locality: USGS 22329, Pender County, North Carolina. Castle Hayne Limestone.
6. *Wilsonimaia schneiderorum* Blow and Manning, n. gen. and sp.
   Holotype, incomplete carapace in dorsal view (truncated anteriorly just behind orbits), (USNM 484562), cl 37.3 mm, cw 24.2 mm. Scale = 2 mm.
   Locality: USGS 26872, New Hanover County, North Carolina. Castle Hayne Limestone.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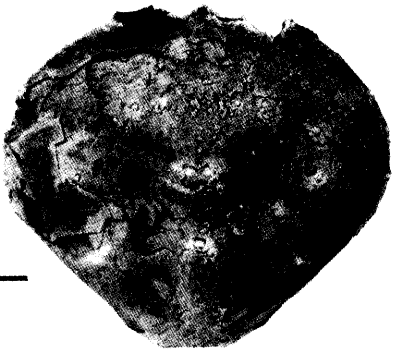
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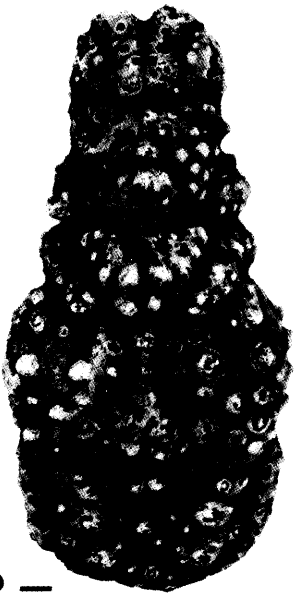
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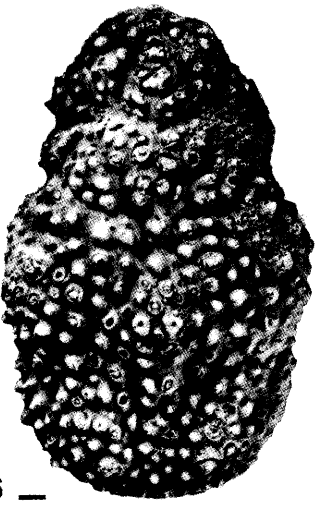
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PLATE 3

tuberances. Front weakly projecting, quadridentate, with shallow median depression, width slightly less than 1/4 carapace width. Fronto-orbital width subequal to half carapace width. Orbit subcircular, marginal, produced at exorbital margin. Anterolateral margin entire, not divided into teeth or lobes by incisions, distinctly scalloped along edge in lateral view; margin with 3 denticles, third very strong, tooth-like. Anteriorly, marginal carina not reaching orbit, terminating below it. Posterolateral margins distinctly convex, strongly convergent posteriorly, armed with 1 prominent carinate lobe. Posterior margin truncate, very narrow, width subequal to front.

Type species: Matutites anthonyae, n. sp., by present designation and monotypy.

Etymology: Formed by combining the generic name *Matuta* with the ending reserved for fossil taxa, *-ites.* Gender masculine.

Remarks: In general appearance *Matutites* is reminiscent of the genus *Matuta* Weber, 1795, from which it can be readily separated by the absence of a strong spine at the anterolateral angle of the carapace (see Galil and Clark, 1994).

Matutites superficially resembles *Hepatiscus* s.s. from which it can at once be differentiated by: (1) its scalloped anterolateral margin (visible in lateral view); (2) the presence of eight dorsal protuberances, as opposed to six in *Hepatiscus;* (3) its strong tooth at the anterolateral angle; (4) the presence of a very strong, carinate posterolateral lobe; and (5) the absence of a suborbital flank like that found in *Hepatiscus, Eriosachila, Osachila, Hepatus* Latreille, 1802, and *Hepatella* Smith, 1869.

Matutites is somewhat similar to *Pseudohepatiscus,* n. gen., in carapace outline, but it differs from the latter in having: (1) convex, not straight posterolateral margins; (2) a single large carinate lobe on the posterolateral margin in contrast to the absence of teeth or lobes on the posterolateral margin; (3) paired mesobranchial lobes situated well inside the posterolateral margin unlike those of *Pseudohepatis-cus* which are submarginal; and (4) the anterolateral margin separated from the orbit by a sulcus unlike the anterolateral margin of *Pseudohepatiscus* which is continuous with the orbit.

MATUTITES ANTHONYAE, n. sp.
Plate 3, Figure 3

Diagnosis: As for genus.

Etymology: This species is named for Irene C. Anthony, former reference librarian of the Natural History Branch, Smithsonian Institution Libraries, in appreciation for her years of extraordinary library assistance to the authors.

Holotype: (USNM 484554), cl 17.5 mm, cw 15.1 mm.

Type locality: USGS 26883, M.M. Berkeley Quarry, Berkeley County, South Carolina. Santee Limestone.

Occurrence: Santee Limestone, South Carolina.

PSEUDOHEPATISCUS, n. gen.

Diagnosis: Carapace broadly obovate, length slightly less than width, broadest at fourth anterolateral denticle; dorsal surface uneven, regions defined by 8 large protuberances, posterior 2 submarginal. Front appearing weakly projecting, width slightly less than 1/4 carapace width. Fronto-orbital width subequal to half carapace width. Orbit subcircular, marginal, produced at exorbital margin. Anterolateral margin continuous with orbit, entire, not divided into teeth or lobes by incisions, distinctly scalloped along edge in lateral view, margin with single row of denticles; row interrupted by 5 equally spaced, larger denticles, latter at high points of scalloped edge in lateral view. Posterolateral margins straight, strongly convergent posteriorly, lacking teeth or lobes. Posterior margin truncate, very narrow, width less than width of front.

Type species: Pseudohepatiscus marinoi, n. sp., by present designation and monotypy.

Etymology: Pseudo, from the Greek, *pseudos,* fallacy or lie, in combination with the generic name *Hepatiscus.* Gender masculine.

Remarks: Pseudohepatiscus can be differentiated from *Hepatiscus* s.s. at once by: (1) its carapace outline which shows a steeper more convergent, anterolateral margin and a straight, not concave as in *Hepatiscus* s.s., posterolateral margin; (2) its scalloped anterolateral margin (as seen in lateral view); (3) the presence of eight, dorsal protuberances, not six as in *Hepatiscus;* and (4) the absence of a suborbital flank like that found in *Hepatiscus,*

Eriosachila, Osachila, Hepatus, and *Hepatella.*

The relationship of *Pseudohepatiscus* to *Matutites* was discussed above. *Pseudohepatiscus* differs from *Eriosachila* in lacking the suborbital flank distinctive of the latter genus and its allies.

PSEUDOHEPATISCUS MARINOI, n. sp.
Plate 3, Figure 4

Diagnosis: As for genus.

Etymology: This species is named for Cesare R. Marino, anthropologist, NMNH, in appreciation for his translation of scientific Italian, which contributed significantly to this paper.

Holotype: (USNM 484555), cl 11.5 mm, cw 12.5 mm.

Type locality: USGS 26879, M.M. Georgetown Quarry, Georgetown County, South Carolina. Santee Limestone.

Occurrence: Santee Limestone, South Carolina.

Family MAJIDAE Samouelle, 1819

WILSONIMAIA, n. gen.

Diagnosis: Size moderately large (cl more than 36.4 mm). Carapace very elongate, bottle- or flask-shaped, strongly arched transversely, flattened adjacent to posterior margin, length, measured from base of rostral notch, about 2 times width. Regions well-defined, separated by deep grooves. Fronto-orbital margin slightly more than half carapace width. Orbits only slightly produced laterally, moderately small. Dorsal surface very uneven, with numerous unequal tubercles. Urogastric and cardiac regions unusually long, combined length about half length of carapace. Posterior gastric pits situated just anterior to cervical groove, well anterior to midline or about 2/3 distance from posterior margin.

Type species: Wilsonimaia ethelae, n. sp., by present designation.

Etymology: This genus is named for Druid Wilson, stratigrapher and paleontologist, formerly of the P & S Branch, USGS, and the NMNH, in recognition of his numerous contributions to Atlantic and Gulf Coastal Plain stratigraphy and paleontology. In addition, Druid Wilson discovered the type specimen of the type species.

Included species: Wilsonimaia ethelae, n. sp. and *W. schneiderorum,* n. sp.

Remarks: Among fossil crabs, *Wilsonimaia* superficially resembles only one genus, *Micromaia* Bittner, 1875, from which it can be immediately distinguished on the basis of its carapace proportions alone. The ratio of cl to cw of *W. ethelae* is about 0.49; if its rostrum were complete this ratio might be as low as 0.44. In contrast, the cl to cw ratios for species of *Micromaia* range from a high of 0.86 to a low of 0.66. Beschin *et al.* (1985) figure all of the then known species of *Micromaia* and give cl to cw ratios for each.

Wilsonimaia is distinct from all known living majid genera.

WILSONIMAIA ETHELAE, n. sp.
Plate 3, Figure 5

Diagnosis: Very similar to *Wilsonimaia schneiderorum* in carapace outline but with fewer, shorter, less prominent, and more widely spaced tubercles.

Etymology: This species is named for the late Ethel Wilson, wife and field companion of many years to Druid Wilson, in recognition of her significant contribution to the collections of the NMNH through her husband, and in appreciation for her encouragement and support of the senior author's research.

Holotype: (USNM 484561), cl 36.4 mm, cw 18.5 mm.

Type locality: USGS 22329, Irrigation pit, about 0.2 km W of Northeast Cape Fear River, Pender County, North Carolina. Castle Hayne Limestone.

Occurrence: Castle Hayne Limestone, North Carolina.

Remarks: Wilsonimaia ethelae differs from *W. schneiderorum* in having: (1) about 1/3 fewer dorsal tubercles; (2) longer, more prominent tubercles; and (3) more inflated mesogastric, urogastric, and cardiac regions

WILSONIMAIA SCHNEIDERORUM, n. sp.
Plate 3, Figure 6

Diagnosis: Very similar to *Wilsonimaia ethelae* in carapace outline but with more numerous, closely spaced dorsal tubercles.

Etymology: This species is named for Judith Raynor Schneider and her husband, Vincent Schneider, of Garner, North Carolina for their contribution to North Carolina paleontology.

Judith Schneider collected the holotype of this new taxon.

Holotype: (USNM 484562), cl 37.3 mm, cw 24.2 mm.

Type locality: USGS 26872, Ideal Cement Company Quarry, New Hanover County, North Carolina. Castle Hayne Limestone.

Occurrence: Castle Hayne Limestone, North Carolina.

Remarks: Wilsonimaia schneiderorum is easily separated from *W. ethelae* by: (1) a distinctly greater number of dorsal tubercles, about 1/3 more than *W. ethelae;* (2) low, blunt tubercles in contrast to the longer, more prominent tubercles found on *W. ethelae;* and (3) its less inflated mesogastric, urogastric and cardiac regions.

Family CANCRIDAE Latreille, 1803

SANTEECARCINUS, n. gen.

Diagnosis: Palm short, thin, highest distally. Superior surface produced into greatly incurved, crest-like margin with 2 strong marginal spines. Outer surface of palm granulate. Ventral margin incurved. Inner surface of palm very convex; superior margin with broad, moderately deep sulcus; inferior margin with very deep, narrow sulcus. Carpus short, subquadrate with very strong spine at inner superior angle.

Type species: Santeecarcinus harmatuki, n. sp., by present designation and monotypy.

Etymology: The name is formed by combining the first word of the stratigraphic unit, Santee Limestone, with the generic name *Carcinus.* Gender masculine.

Remarks: In general outline, *Santeecarcinus* compares well with a number of the figures of both fossil and living representatives of the genus *Cancer* Linnaeus, 1758, presented by Nations (1975).

Other characters that might support its placement in or near the genus *Cancer* include: (1) the very incurved, somewhat

PLATE 4

Figures

1. *Santeecarcinus harmatuki* Blow and Manning, n. gen. and sp.
   Holotype, carpus and incomplete propodus of right chela in outer view (fixed finger and dactylus lacking), (USNM 488558), combined length 34.1 mm, prh 18.2 mm, and prt 7.8 mm. Scale = 2 mm.
   Locality: USGS 26873, New Hanover County, North Carolina. Castle Hayne Limestone.
2. *Sarahcarcinus campbellorum* Blow and Manning, n. gen. and sp.
   Holotype, incomplete right half of carapace in dorsal view, (USNM 488559), cl 13.5 mm, cw 12.3 mm, cw (to midline) 9.4 mm. Scale = 2 mm.
   Locality: USGS 26883, Berkeley County, South Carolina. Santee Limestone.

3-4. *Acantholambrus baumi* Blow and Manning, n. gen. and sp.

3. Holotype, left half of incomplete carapace in dorsal view, (USNM 484556), cl 21.7 mm, cw 27.5 mm. Scale = 2 mm.
   Locality: USGS 26882, Berkeley County, South Carolina. Santee Limestone.
4. Paratype, right carapace margin with nearly complete branchial projection in dorsal view, (USNM 484557), cl 18.9 mm, cw 28.2 mm. Scale = 2 mm.
   Locality: USGS 26883, Berkeley County, South Carolina.
   Santee Limestone.

5. *Viacarcinus druidi* Blow and Manning, n. gen. and sp.
   Holotype, carapace in dorsal view (front and orbits incomplete), (USNM 484559), cl 7.3 mm, cw 10.1 mm. Scale = 2 mm.
   Locality: USGS 26883, Berkeley County, South Carolina. Santee Limestone.
6. *Laevicarcinus dockeryi* Blow and Manning, n. sp.
   Holotype, incomplete carapace in dorsal view (front and right anterolateral margin lacking), (USNM 484579), cl 12.8 mm, cw 17.9 mm. Scale = 2 mm.
   Locality: USGS 26883, Berkeley County, South Carolina. Santee Limestone.
7. *Eohalimede walleri* Blow and Manning, n. gen. and sp.
   Holotype, silicone cast of incomplete external mold of carapace in dorsal view (front lacking), (USNM 484580), cl 11.8 mm, cw 15.2 mm. Scale = 2 mm.
   Locality: USGS 26883, Berkeley County, South Carolina. Santee Limestone.

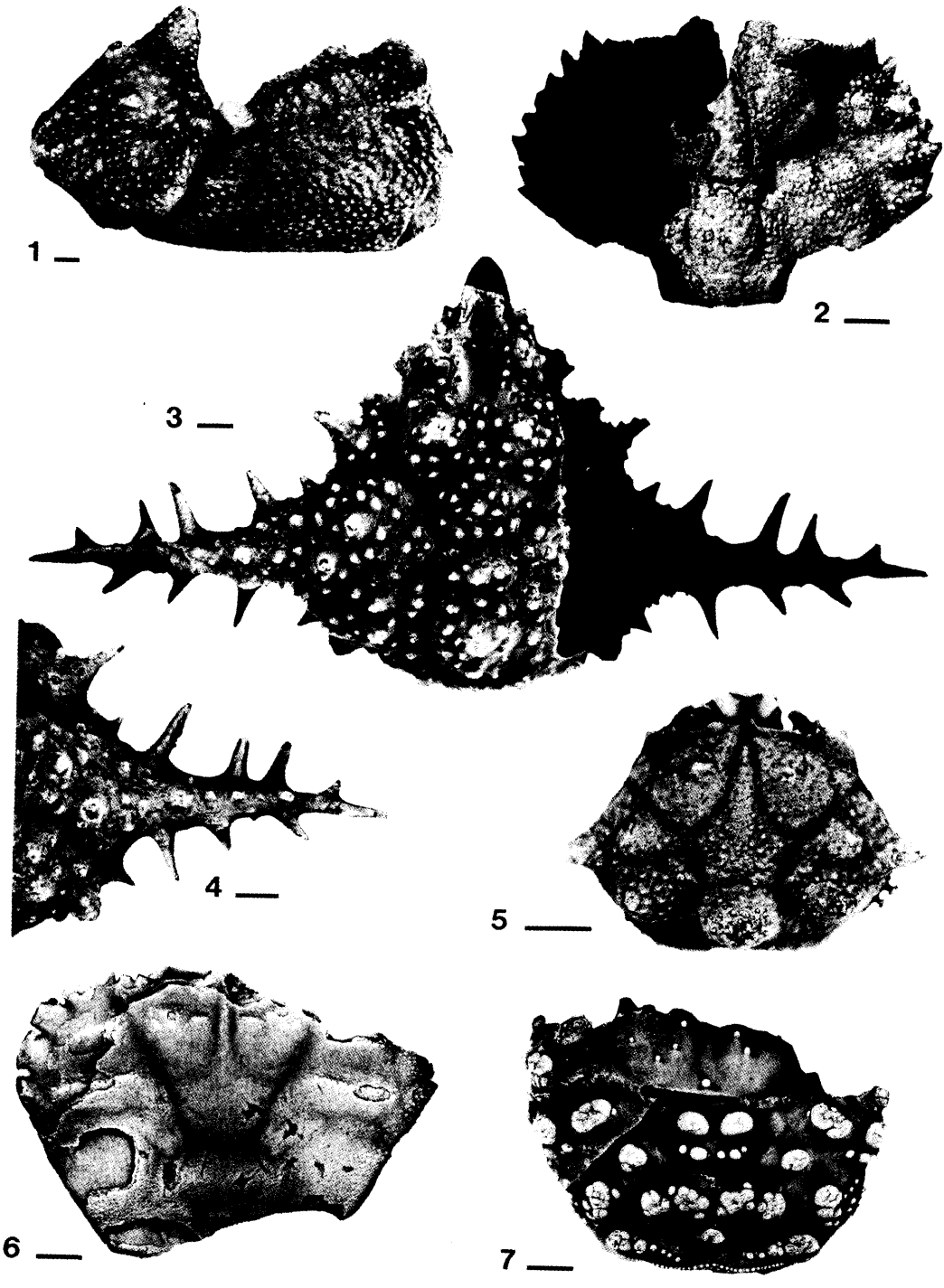

PLATE 4

flattened superior surface of the palm, which is produced into a crest-like margin; (2) its very prominent carpal spine; (3) the uneven or roughened appearance of its carpus, and (4) the granulated outer surfaces of both its carpus and palm. However, the two strong spines on the margin of the ridge of its superior surface and the very deep sulcus along its inner, inferior margin are both very atypical of the genus *Cancer.* It is principally on the bases of these latter two points that we erect this new genus.

SANTEECARCINUS HARMATUKI, n. sp.
Plate 4, Figure 1

Diagnosis: As for genus.

Etymology: This species is named for the collector of the holotype, Peter J. Harmatuk, in appreciation of his tireless efforts to enrich the collections of the NMNH.

Holotype: Right carpus and propodus (USNM 488558), combined length of carpus and propodus 34.1 mm, prh 18.2 mm, prt 7.8 mm.

Type locality: USGS 26873, Ideal Cement Company Quarry, New Hanover County, North Carolina. Castle Hayne Limestone.

Occurrence: Castle Hayne Limestone, North Carolina.

SARAHCARCINUS, n. gen.

Diagnosis: Carapace broadly subhexagonal, broadest at fifth anterolateral tooth; outer orbital tooth and 7 upturned, acute, anterolateral teeth paired on 4 broad lobes separated by deep fissures. Fronto-orbital margin broad, about 2/3 carapace width; orbit very broad. Regions well-defined, strongly elevated along and adjacent midline; urogastric and cardiac regions separated from branchial region by deep grooves; cardiac region medially sulcate, forming 2 distinct ridges. Dorsal surface coarsely granulate nearly everywhere, distinctly depressed behind anterolateral teeth.

Type species: Sarahcarcinus campbellorum, n. sp., by present designation and monotypy.

Etymology: This genus is named for Sarah Cottrill Campbell, in recognition of her contribution to Atlantic Coastal Plain paleontology.

Remarks: The inherent characters of *Sarahcarcinus* strongly suggest affinities with the family Portunidae, but it lacks the transverse ridge leading to a strong lateral tooth found on so many portunids. In addition its rough, coarsely granulate, uneven dorsal surface, highly elevated regions along and adjacent to its midline, including a very high cardiac region with a median sulcus (separating 2 ridges), and paired anterolateral teeth are atypical of members of the Portunidae. Combinations of these characters are more typical of some species included in the diverse genus *Cancer* Linnaeus, 1758. Based on these similarities with *Cancer,* we place *Sarahcarcinus* in the family Cancridae with some reservation, given the absence of a complete front, orbit and associated chela for this new genus. *Sarahcarcinus campbellorum* like a number of species included in the genus *Cancer,* differs dramatically from the type of the genus, *C. pagurus* Linnaeus, 1758, and on this basis we erect this new genus.

SARAHCARCINUS CAMPBELLORUM, n. sp.
Plate 4, Figure 2

Diagnosis: As for genus.

Etymology: This species is named for the family of Lyle D. Campbell, his wife Sarah and their three sons David, Matthew, and Andrew, all paleontologists, of Spartansburg, South Carolina, in recognition of their combined contribution to Atlantic Coastal Plain paleontology.

Holotype: (USNM 488559), cl 13.5 mm, cw 12.3 mm, cw (to midline) 9.4 mm.

Type locality: USGS 26883, M. M. Berkeley Quarry, Berkeley County, South Carolina. Santee Limestone.

Paratype: (USNM 488560), cl 12.3 mm, cw 18.0 mm; locality USGS 26883, as above. Santee Limestone.

Occurrence: Santee Limestone, South Carolina.

Family PARTHENOPIDAE MacLeay, 1838

ACANTHOLAMBRUS, n. gen.

Diagnosis: Carapace broadly ovate-pentagonal, with extremely long, thorny, laterally-directed branchial projections. Length of carapace, equal to half greatest width (including projections). Regions well-defined, inflated; medial spine of hepatic, protogastric, cardiac, and metabranchial regions very prominent; surface uneven, very spinous. Front subtriangular, broad at base, strongly projecting anteriorly. Orbital hiatus broad, deep, apparently extending to base of suborbital lobe; basal antennal

article missing, no evidence of its fusion to suborbital lobe or front visible. Orbits small, subcircular, composed of 4 lobes; sub-marginal supraorbital eave separated from laterally produced, post-orbital lobe by distinct intercalated spine. Carapace constricted behind orbits.

Type species: Acantholambrus baumi, n. sp., by present designation and monotypy.

Etymology: The name is formed by combining the Latin *acanthus,* thorny, with the generic name *Lambrus.* Gender masculine.

Remarks: The carapace outline, including the very long branchial projections, and the strong intercalated spine of the orbit of *Acantholambrus* immediately distinguish it from all other extinct and Recent genera of the family Parthenopidae.

Acantholambrus has the longest branchial projections of any parthenopid known to us. In outline its shape is rivaled only by that of the European Eocene majid *Periacanthus* Bittner, 1875.

ACANTHOLAMBRUS BAUMI, n. sp.
Plate 4, Figures 3-4

Diagnosis: As for genus.

Etymology: This species is named for Gerald R. Baum, stratigrapher, University of South Carolina, Columbia, in recognition of his contribution to the stratigraphy of the middle Eocene of North and South Carolina. In addition, Gerald Baum helped collect the holotype of this new taxon.

Holotype: (USNM 484556), cl 21.7 mm, cw 27.5 mm.

Type locality: USGS 26882, M.M. Berkeley Quarry, Berkeley County, South Carolina. Santee Limestone.

Paratypes: (USNM 484557), cl 18.9 mm, cw 28.2 mm; (USNM 484558) cl 15.9 mm, cw 17.4 mm; (484557-484558), locality USGS 26883, same quarry as above. Santee Limestone.

Occurrence: Santee Limestone, South Carolina.

Family EUMEDONIDAE Neumann, 1878

VIACARCINUS, n. gen.

Diagnosis: Carapace broadly pentagonal with prominent, short spine at each anterolateral angle where carapace broadest; regions well-defined, surfaces covered with mushroom-like tubercles. Subhepatic regions swollen, extending well beyond carapace outline; subhepatic and protogastric regions each with remnants of a single blunt protuberance; protogastric regions unusually large; mesogastric region broad, distinctly pentagonal basally, length about 2/3 length of carapace; anterior extension unusually broad. Cardiac region greatly inflated, hemispherical. Orbit weakly projecting, composed of 4 lobes; suborbital lobe very prominent.

Type species: Viacarcinus druidi, n. sp., by present designation and monotypy.

Etymology: A combination of the surname Via with the generic name *Carcinus.* This genus is named for the late Father Luis Via Boada. Gender masculine.

Remarks: Among the Recent Eumedonidae, *Viacarcinus* most closely resembles the genus *Eumedonus* H. Milne Edwards, 1834, and, in particular, *E. granulosus* MacGilchrist, 1905. *Viacarcinus* can be, however, immediately separated from *Eumedonus* on the bases of its: (1) distinctive pentagonally shaped and proportionally longer and broader mesogastric region; and (2) greatly inflated subhepatic regions. In addition, the more complex and more projecting orbital margin of *Viacarcinus* is composed of four lobes in contrast to the simple, nearly uninterrupted marginal orbit of *Eumedonus.* Also, the orbits of *Viacarcinus* are situated more anteriorly than the orbits in *Eumedonus,* and unlike *Eumedonus* and nearly all members of the Eumedonidae, the anterolateral margin of *Viacarcinus* is distinctly longer than its posterolateral margin.

Viacarcinus represents the first fossil member of the family Eumedonidae to be recognized as well as the first North American member of the family.

VIACARCINUS DRUIDI, n. sp.
Plate 4, Figure 5

Diagnosis: As for genus.

Etymology: This species is named for Druid Wilson, formerly of the P & S Branch, USGS, who discovered it.

Holotype: (USNM 484559), cl 7.3 mm, cw 10.1 mm.

Type locality: USGS 26883, M.M. Berkeley Quarry, Berkeley County, South Carolina. Santee Limestone.

Paratype: (USNM 484560) cl 7.0 mm, cw 10.0 mm; locality USGS 25865, same quarry as above. *In situ,* near the top of the Santee

Limestone.

Occurrence: Santee Limestone, South Carolina.

Family XANTHIDAE Dana, 1851

EOCARPILIUS, n. gen.

Diagnosis: Carapace transversely oval, very convex, length about 3/4 carapace width, broadest just anterior to midline; regions not defined. Anterolateral margin entire, narrow, decorated with a single row of small beads. Front broad, more than 1/3 carapace width, greatly deflexed, quadrilobate. Orbit sub-circular, marginal; margin entire, not raised or thickened, outlined by single row of small beads. Antennae missing; basal antennal article apparently short, narrow anteriorly, robust at base, as inferred from length and shape of orbital hiatus. Chela unequal in males; major chela of male massive, palm short, distinctly highest distally; fixed finger with two teeth; minor chela of male much smaller and more narrow than major, highest at proximal end.

Type species: Eocarpilius carolinensis, n. sp., by present designation.

Etymology: The name is formed by combining the Greek *eos,* dawn, with the generic name *Carpilius.* Gender masculine.

Included Species: Eocarpilius carolinensis and *Eocarpilius anomala* (Rathbun, 1935), n. comb., middle Eocene, North Carolina.

Remarks: Eocarpilius is remarkably similar to the extant genus *Carpilius* Leach, *in* Desmarest, 1823, with which it appears most closely allied. It can, however, be separated immediately from *Carpilius* on the basis of its anterolateral angle alone, which lacks the strong tooth and accompanying short, transverse, dorsal ridge distinctive of *Carpilius.* In addition, *Eocarpilius* differs from *Carpilius* in having: (1) a transversely more highly arched carapace; (2) a relatively narrow anterolateral margin; (3) a weak postorbital angle lacking the strong, postorbital tooth distinctive of *Carpilius;* (4) weak orbital margins; (5) well separated, submedial frontal lobes unlike those of *Carpilius* which are produced into a single, thickened, upturned process; and (6) two teeth on the fixed finger of the right chela.

Eocarpilius can also be easily distinguished from *Palaeocarpilius* s.s., which it resembles superficially. Unlike *Palaeocarpilius,* the carapace of *Eocarpilius* has: (1) no dorsal transverse ridge at the anterolateral angle; (2) no anterolateral teeth or lobes; (3) a distinctly quadrilobate front, with the submedial lobes well separated and only slightly extending below the lateral lobes; and (4) a relatively short

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PLATE 5

Figures

1-2. *Eocarpilius carolinensis* Blow and Manning, n. gen. and sp.
1. Male holotype, articulated specimen in ventral view, (USNM 484563), cl 53.4 mm, cw 69.2 mm; right propodus prl 50.1 mm, prh 28.5 mm, prt 15.7 mm; left propodus prl 34.3 mm, prh 14.5 mm, prt (covered). Scale = 4 mm.
Locality: USGS 26883, Berkeley County, South Carolina. Santee Limestone.
2a. Paratype, carapace in dorsal view, (USNM 484565), cl 41.7 mm, cw 53.2 mm. Scale = 4 mm.
2b. Paratype, carapace in anterior view, (USNM 484565). Scale = 4 mm.
Locality: USGS 26884, same quarry as 26883 above. Santee Limestone.

3. *Santeella lillyae* Blow and Manning, n. gen. and sp.
Holotype, internal mold of carapace in dorsal view (surface with remnants of weathered cuticle), (USNM 484578), cl 4.4 mm, cw 5.2 mm. Scale = 0.5 mm.
Locality: USGS 26883, Berkeley County, South Carolina. Santee Limestone.

4. *Santeexanthus wardi* Blow and Manning, n. gen. and sp.
Holotype, incomplete carapace in dorsal view (right orbit and right anterolateral margin lacking), (USNM 484575), cl 13.3 mm, cw 18.9 mm. Scale = 2 mm.
Locality: USGS 26883, Berkeley County, South Carolina. Santee Limestone.

5. *Titanocarcinus purdyi* Blow and Manning, n. sp.
Male holotype, internal mold of carapace in dorsal view (surface with remnants of weathered cuticle), (USNM 484571), cl 19.5 mm, cw 21.5 mm. Scale = 2 mm.
Locality: USGS 26883, Berkeley County, South Carolina. Santee Limestone.

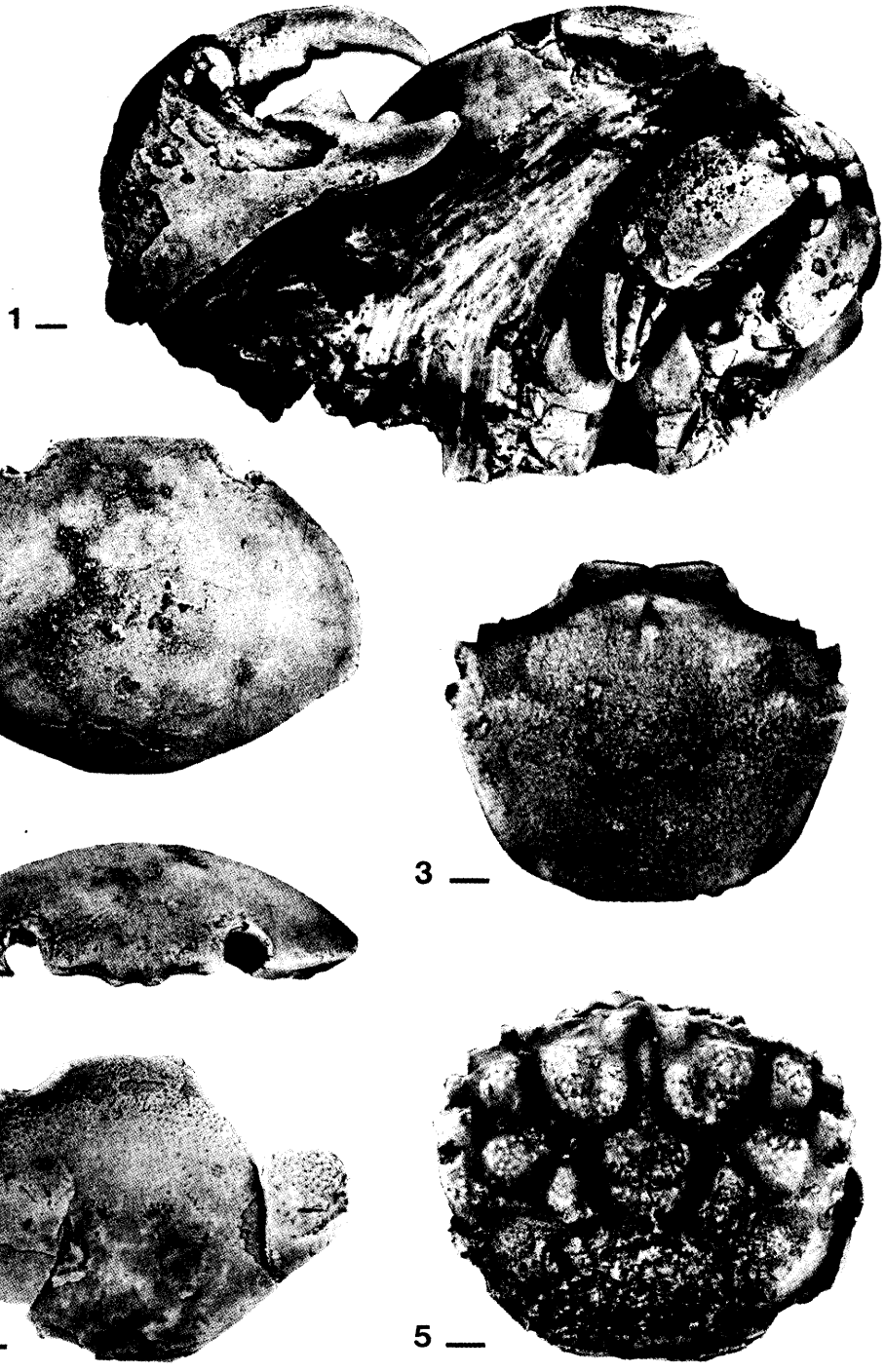

PLATE 5

orbital hiatus and an apparent, broad antennal base.

EOCARPILIUS CAROLINENSIS, n. sp.
Plate 5, Figures 1-2

Diagnosis: As for genus. Exception, see remarks below.

Etymology: The specific name *carolinensis* refers to the states of North and South Carolina in which this species is commonly found.

Holotype: (USNM 484563), cl 53.4 mm, cw 69.2 mm; right propodus prl 50.1 mm, prh 28.5 mm, prt 15.7 mm; left propodus prl 34.3 mm, prh 14.5 mm, prt (covered).

Type locality: USGS 26883, M.M. Berkeley Quarry, Berkeley County, South Carolina. Santee Limestone.

Paratypes: (USNM 484565), cl 41.7 mm, cw 53.2 mm; locality USGS 26884, same quarry as USGS 26883, above. Santee Limestone.

(USNM 484566), cl 38.9 mm, cw 49.3 mm; (USNM 484567) cl 42.3 mm, cw 58.5 mm; (USNM 484568), cl 29.4 mm, cw 41.5 mm, estimated cw 42.6 mm; (USNM 484569), cl 25.1 mm, cw 24.8 mm; estimated cw 32.1 mm; right propodus (USNM 484570), prl 32.5 mm, prh 23.7 mm, prt 12.5 mm; right propodus (USNM 488561) prl 32.5 mm, prh 23.1 mm, prt 12.3 mm; (USNM 484566-484570 and 488561), locality USGS 26878, M.M. Georgetown Quarry, Georgetown County, South Carolina. Santee Limestone.

(USNM 484564), cl (estimate) 60.0 mm, cw (estimate) 82.0 mm; right propodus prl 65.4 mm, prh 36.3 mm, prt 18.5 mm; locality USGS 26875, Atlantic Limestone Co., Maple Hill, Pender County, North Carolina [locality data suspect]. Castle Hayne Limestone.

In addition, two paratypes have been deposited in the VMNH.

Occurrence: Castle Hayne Limestone, North Carolina; Santee Limestone, South Carolina.

Remarks: The palm of the major or right chela of our new species, *E. carolinensis,* agrees in general form with the incomplete right palm of the holotype and only specimen of *E. anomala* (Rathbun) (see Rathbun, 1935, p. 87, as *Menippe anomala*). It is so similar to Rathbun's species that we initially regarded it as conspecific with her species. *Eocarpilius carolinensis,* however, differs from *E. anomala* in having: (1) much smaller, more numerous and more closely spaced tubercles along its superior margin; (2) a slightly steeper slope to its superior margin; and (3) the inner surface of the palm of *E. carolinensis* is less inflated than that of *E. anomala.*

EOHALIMEDE, n. gen.

Diagnosis: Carapace suboctagonal, width greater than length, broadest at anterolateral angle; regions well-defined, surfaces finely granulate; dorsolateral, medial, and posterior surfaces ornamented with large, mushroom-shaped prominences, appearing cauliflower-like dorsally. Fronto-orbital width much more than half carapace width. Frontal width about 1/3 carapace width. Protogastric region broadly subcircular, not subdivided into lobes. Anterolateral margin with 3 mushroom-shaped prominences.

Type species: Eohalimede walleri, n. sp., by present designation and monotypy.

Etymology: The name is formed by adding the Greek *eos,* dawn, to the generic name *Halimede.* Gender feminine.

Remarks: Eohalimede is remarkably similar to the Recent genus *Halimede* de Haan, 1835. It appears to be the closest fossil relative of *Halimede. Eohalimede* differs from *Halimede* s.s. in having: (1) a broader fronto-orbital width which is much greater than half the carapace width; (2) a broader frontal width which is about one-third the carapace width; (3) broadly subcircular protogastric regions which are neither subdivided nor covered with large prominences; and (4) three anterolateral, equally spaced, dorsally rounded, mushroom-shaped prominences.

EOHALIMEDE WALLERI, n. sp.
Plate 4, Figure 7

Diagnosis: As for genus.

Etymology: This species is named for Thomas R. Waller, paleomalacologist, NMNH, in recognition of his contribution to paleobiology and with particular appreciation for his encouragement, advice, and for sharing his laboratory space with the authors.

Holotype: (USNM 484580), cl 11.8 mm, cw 15.2 mm.

Type locality: USGS 26883, M.M. Berkeley Quarry, Berkeley County, South Carolina. Santee Limestone.

Paratypes: (USNM 484581), cl 12.1 mm, cw 11.9 mm; locality USGS 26882, same quarry as

USGS 26883, above. Santee Limestone.

Occurrence: Santee Limestone, South Carolina.

LAEVICARCINUS DOCKERYI, n. sp.
Plate 4, Figure 6

Diagnosis: Carapace subhexagonal, flattened, width much greater than length, regions distinct. Fronto-orbital width about half carapace width. Anterolateral margin divided into 4 broad teeth separated by deep incisions; second tooth only about half width of first. Posterolateral margins with distinct notch placed well behind fourth anterolateral tooth. Dorsal surface punctate, lateral teeth and lateral margins coarsely granulate. Cervical groove well marked, forming broad V on carapace. Hepatic and epibranchial regions each with a single, long, coarsely granulated, oblique transverse ridge. Protogastric region with 2 short, unaligned, granulated ridges.

Etymology: This species is named for David T. Dockery, Mississippi Geological Survey, in recognition of his contribution to the paleontology and stratigraphy of the Paleogene deposits of the southeastern United States, with an emphasis on Mississippi.

Holotype: (USNM 484579), cl 12.8 mm, cw 17.9 mm.

Type locality: USGS 26883, M.M. Berkeley Quarry, Berkeley County, South Carolina. Santee Limestone.

Occurrence: Santee Limestone, South Carolina.

Remarks: Laevicarcinus dockeryi closely resembles the type and only other remaining, recorded species of *Laevicarcinus, L. egerensis* Lörenthey, in Lörenthey and Beurlen, 1929, from the late Eocene of Hungary, a species from which it can be easily separated. *Laevicarcinus dockeryi,* unlike *L. egerensis,* has: (1) a second anterolateral tooth only about half the width of the first; (2) two, short, unaligned ridges on each protogastric region; and (3) coarsely granulated anterolateral and posterolateral margins.

This is the first record outside of Hungary for a member of this genus as well as the first American record for the genus.

SANTEELLA, n. gen.

Diagnosis: Size very small (cl 4.4 mm). Carapace subhexagonal, flattened transversely, length more than 4/5 width, broadest at third anterolateral tooth; regions not strongly defined. Front strongly produced anteriorly, transverse, bilobed, width less than half carapace width. Orbit wide, sloping posteriorly; outer orbital tooth minute. Anterolateral margin divided into 4 distinct teeth, all anterior to midlength. Posterolateral margins steep, not strongly convergent posteriorly.

Type species: Santeella lillyae, n. sp., by present designation and monotypy.

Etymology: The name is formed by combining the first word of the stratigraphic unit, Santee Limestone, with the diminutive suffix *-ella.* Gender feminine.

Remarks: Given its small size and the limited information provided by its internal mold, *Santeella lillyae* cannot be placed in any living or fossil genus or family with certainty at this time. It resembles some members of both the families Goneplacidae and Xanthidae. We place this new genus in the family Xanthidae with some reservation and base this family placement principally on the similarities of its orbit and anterolateral margin to those characteristic of members of this family.

SANTEELLA LILLYAE, n. sp.
Plate 5, Figure 3

Diagnosis: As for genus.

Etymology: This species is named for Lilly King Manning, in recognition of her vast contribution to systematic crustacean research through her thousands of scientific illustrations and in appreciation for her ongoing support.

Holotype: (USNM 484578), cl 4.4 mm, cw 5.2 mm.

Type locality: USGS 26883, M.M. Berkeley Quarry, Berkeley County, South Carolina. Santee Limestone.

Occurrence: Santee Limestone, South Carolina.

SANTEEXANTHUS, n. gen.

Diagnosis: Carapace transversely oval; length about 2/3 carapace width; regions indistinct; dorsal surface without grooves or furrows, densely punctate anteriorly. Fronto-orbital

margin about 2/3 carapace width. Anterolateral margin nearly straight, cristate, divided into 3 lobes and single distinct dentiform tooth.

Type species: Santeexanthus wardi, n. sp., by present designation and monotypy.

Etymology: The name is formed by combining the first word of the stratigraphic unit, Santee Limestone, with the generic name *Xantho.* Gender masculine.

Remarks: The overall appearance of *Santeexanthus* clearly suggests that it is a member of the family Xanthidae, but it compares poorly with all known fossil genera of this family. It more closely resembles some Recent xanthids, such as *Paratergatis longimanus* Sakai, 1965, but on close inspection these similarities are only superficial.

SANTEEXANTHUS WARDI, n. sp.
Plate 5, Figure 4

Diagnosis: As for genus.

Etymology: This species is named for Lauck W. Ward, stratigrapher and paleontologist, Virginia Museum of Natural History, Martinsville, Virginia, in recognition of his significant and ongoing contribution to the paleontology and stratigraphy of the Atlantic Coastal Plain with an emphasis on Virginia and North Carolina. In addition, Lauck Ward provided some of the specimens cited in this paper.

Holotype: (USNM 484575), cl 13.3 mm, cw 18.9 mm.

Type locality: USGS 26883, M.M. Berkeley Quarry, Berkeley County, South Carolina. Santee Limestone.

Paratypes: (USNM 484576), cl 10.9 mm, cw 15.2 mm; (USNM 484577) cl 17.0 mm, cw 24.6 mm; all locality USGS 26883, as above. Santee Limestone. In addition a paratype has been deposited in the VMNH.

Occurrence: Santee Limestone, South Carolina.

TITANOCARCINUS PURDYI, n. sp.
Plate 5, Figure 5

Diagnosis: Carapace subquadrate, width slightly greater than length, broadest at third lateral tooth, regions well-defined, moderately swollen; cervical groove distinct. Fronto-orbital width much more than half carapace width. Frontal lobes separated by very deep sinus, latter flanked by strongly projecting frontal spines followed laterally to orbit by smaller spines. Lower orbital margin with 5 acute spines. Anterolateral margin slightly longer than posterolateral margin; lateral margin with 5 primary teeth. Outer orbital tooth through third lateral tooth armed anteriorly with thin, branching, apically blunt, projections; fourth and fifth lateral teeth incomplete. Dorsal surface punctate, superior surfaces of regions often appear granulate and/or armed with short, blunt spines. Protogastric region longitudinally sulcate to base, length about 1/4 carapace length. Mesogastric region low, flattened, greatest width about 1/4 carapace width; anterior extension narrow, long.

Etymology: This species is named for Robert W. Purdy, paleontologist, NMNH, in recognition of his contribution to Atlantic Coastal Plain paleontology and in particular for his contribution of specimens to this study.

Holotype: (USNM 484571), cl 19.5 mm, cw 21.5 mm.

Type locality: USGS 26883, M.M. Berkeley Quarry, Berkeley County, South Carolina. Santee Limestone.

Paratypes: (USNM 484572), cl 23.5 mm, cw 25.8 mm; (USNM 484573), cl 15.9 mm, cw 17.2 mm; (USNM 484574), cl 15.9 mm, cw 13.4 mm: all locality USGS 26883, as above. Santee Limestone.

Occurrence: Santee Limestone, South Carolina.

Remarks: Titanocarcinus purdyi can be distinguished from the only other American species, *T. natchitochensis* (Stenzel, 1935) (originally described in *Lobonotus* A. Milne Edwards, 1863), from the middle Eocene of Louisiana, in having a much smaller, more rounded epibranchial region and the upper surfaces of its regions appear granulate or finely spinous while those of *T. natchitochensis* are covered with large, closely spaced pustules.

The carapace of *T. aculeatus* Busulini *et al.,* 1984, figured by those authors (1984, pls. 1-3), unlike a number of its congeners, is fully intact and represented by the original cuticle. The long fronto-orbital and lateral spines seen in these figures of *T. aculeatus* are very similar to those found in the limestone surrounding the internal mold of the holotype of *T. purdyi. Titanocarcinus purdyi* can, however, be easily separated from *T. aculeatus* by its more quadrate carapace and much nar-

rower mesogastric and cardiac regions. In addition, the fronto-orbital and lateral spines of *T. purdyi* are not as long or acute as those of *T. aculeatus,* and, unlike *T. aculeatus,* they are sometimes bifurcate on the lateral margin.

V. LOCALITY DATA

The following are USGS Cenozoic locality numbers. Locality numbers, where combined, indicate only that their respective collections were made at the same geographic locality; collectors, collecting dates, and stratigraphic horizons and/or locations within a quarry may vary between locality numbers. All specimens were collected as "spoil" unless otherwise indicated.

NORTH CAROLINA: CASTLE HAYNE LIMESTONE

USGS 26870. M.M. Castle Hayne (formerly Superior Stone Company) quarry, N side secondary road 1002, 2.2 miles (3.5 km) E 25° N of US 117 and secondary road 1002 intersection in Castle Hayne, New Hanover Co., N.C.

USGS 26871. Locality as USGS 26870 above. W end of pit.

USGS 26872, 26873. Ideal Cement Company quarry, N side of secondary road 1002, (quarry center) 4.2 miles (6.7 km) E 20° N of US 117 and secondary road 1002 intersection in Castle Hayne, New Hanover Co., N.C.

USGS 22329. Spoil bank of irrigation pit about 0.1 mile (0.2 km) S on W side of first dirt road turning off N.C. Rte. 210 (Lane Ferry Road) at a point about 0.1 mile (0.2 km) W of Northeast Cape Fear River, Pender Co., N.C.

USGS 26874. Maple Hill (Lanier Pit), 2.6 miles (4.1 km) S 23° E of NC Rte. 50 and secondary road 1520 intersection in Maple Hill, and 0.75 mile (1.2 km) S 20° W of NC Rte. 50 and secondary road 1532 intersection, Pender Co., N.C.

USGS 26875. Maple Hill (Atlantic Limestone Quarry), Pender Co., N.C. (locality data suspect).

USGS 26876. Billy B. Fussel Company, Inc., quarry, 1.5 miles (2.4 km) S of US 117 and secondary road 1102 intersection in Rose Hill, and 0.5 mile (0.8 km) W of US 117 on S side of secondary road 1148, Duplin Co., N.C.

SOUTH CAROLINA: SANTEE LIMESTONE

USGS 26878, 26879, 26880, 26881. M.M. Georgetown (= Jamestown) quarry, approx. 2.8 mile (4.5 km) N 33° E of Jamestown, on W side U.S. 17A, Georgetown Co., S.C.

USGS 26882, 26883, 26884. M.M. Berkeley (= Cross) quarry, approx. 5.3 miles (8.5 km) SE of Eutawville, and about 2.2 miles (3.5 km) S 20° E of S.C. Rtes. 6 and 45 intersection with secondary hwy 59 (Berkeley-Orangeburg Co. line road) on E side of secondary hwy 59, Berkeley Co., S.C.

USGS 25865. Locality as 26882 above. *In situ:* Top 9 inches of soft Santee Limestone, about 4 feet below overlying Cross Formation.

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