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AXIOPSIS EXIMIA, A NEW THALASSINIDEAN SHRIMP (CRUSTACEA, DECAPODA, AXIIDAE) FROM THE MIDDLE EOCENE OF SOUTH CAROLINA

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ABSTRACT—*Axiopsis eximia*, a new species of thalassinidean shrimp, is described from an exposure of the Middle Eocene Lower Warley Hill Formation of South Carolina, U.S.A. Fossil axiids are rare, but this unique specimen is remarkably preserved as quartz free of enveloping matrix, having a nearly complete though distorted carapace, proximal parts of most thoracic appendages in situ but with distal articles missing, and extended abdomen with segments almost complete except for a few missing appendages. Presence of the bases of pleopods 1 and the elongate eyestalks surpassing the rostral apex, which it shares with the extant *Axiopsis caespitosa* group, place it provisionally in *Axiopsis*, which generally lacks first pleopods in males.

INTRODUCTION

THE FOSSIL record of the Axiidae (summarized by Glaessner, 1969) sheds very little light on the understanding of this diverse family containing about 19 extant genera. Of the six fossil genera, one is represented only by coprolites (*Palaxius* Brönnimann and Norton, 1960). *Axius reticulatus* Rathbun, 1919, from the Oligocene of Panama, is represented by a single incomplete chela. Placement in the genus *Axius* in this case was obviously a matter of convenience, the single chela providing no indication of the specimen's true systematic position. The remaining four genera, *Etallonia* Oppel, *Magila* Münster, *Protaxius* Beurlen, and *Schlueteria* Fritsch, are all from the Jurassic or Cretaceous of Europe. Specimens of these taxa are almost always laterally compressed, and the details of carapace and appendages needed for comparison and accurate placement within the family are rarely preserved. The taxonomic position of the present fossil specimen has, therefore, been established by comparison with extant forms.

SYSTEMATIC PALEONTOLOGY

Order DECAPODA Latreille, 1803
Suborder PLEOCYEMATA Burkenroad, 1963
Infraorder THALASSINIDEA Latreille, 1831
Superfamily THALASSINOIDEA Latreille, 1831
Family AXIIDAE Huxley, 1879
Genus AXIOPSIS Borradaile, 1903
AXIOPSIS EXIMIA n. sp.
Figures 3, 4

Collection.—Holotype, USNM 219431. One specimen from road cut on South Carolina route 261, 1.7 mi south of U.S. route 76, about 2 mi north of Wedgefield, Sumter County, South Carolina (Figure 1). Collected by F. S. MacNeil, U.S. Geological Survey Locality No. 25750, August 1950.

The locality was revisited by W. Blow (Smithsonian Institution) almost 30 years later. The small exposure (maximum vertical height about 2 m), cut into a low hill, yielded matrix containing molluscs, but no further crustacean fossils.

This exposure was determined to be an outlier of the Lower Warley Hill Marl (Figure 2). Definitions of the Warley Hill Marl and description of its type locality were reviewed by Siple (1959). The Warley Hill Marl is regarded as of middle Eocene age in western and central South Carolina (Keroher et al., 1966).

Preservation.—The specimen was taken from an iron-stained argillaceous, calcareous, medium-to-coarse quartz sandstone containing a roughly layered coquina, and is remarkably complete and free of matrix. The small sample of matrix collected

with the specimen contained a single species each of the bivalve molluscs *Cardita*, *Venericardia*, and "*Corbula*," the gastropod *Turritella*, and the scaphopod *Dentalium*.

The cephalothorax and abdomen of the shrimp are closely connected as in life, as are the mouthparts and proximal articles of the cephalic and thoracic appendages. It seems unlikely that the specimen is a molt, but it is likely that the animal was rapidly buried, perhaps during a storm, thereby preventing the disarticulation usually accompanying decay of the fragile parts. The high permeability of the matrix with its quartz content probably facilitated replacement with silica dioxide. In section, the exoskeletal material is replaced with a fine crystalline white quartz, while the inner region is replaced with a more translucent agatized quartz.

Measurements.—Total length from tip of rostrum to base of telson, 46.0 mm; length of rostrum, 3.0 mm; estimated carapace length including rostrum, 19.0 mm; abdomen, length in mid-dorsal line from anterior exposed part of segment one to posterior margin of segment six, 27.0 mm, maximum width, 8.0 mm, length of segment one, 2.4 mm, two, 4.2 mm, three, 5.1 mm (est.), four, 4.7 mm (est.), five, 4.6 mm, six, 6.0 mm.

Diagnosis.—Rostrum narrowly elongate triangular, dorsally concave, lateral margins bearing six well-developed teeth; gastric region bearing central elongate oval field of scattered sharp tubercles, median carina at base of rostrum crested with six spines anteriorly; postorbital margin bearing three tiny acute spines and at its lower limit a larger buttressed antennal spine; eyestalk exceeding rostrum by half its length; antennular peduncle with stout basal article tapering distally and bearing slender distolateral spine; second article subcylindrical, bearing slender distolateral spine; antennal peduncle with short basal article bearing ventral tubercles and spines, stout second article much longer and third article more slender, each bearing mesial and lateral spines.

Description.—Carapace collapsed posterior to region of cervical groove; left branchiostegite collapsed but surface tubercles visible; proximal parts of most cephalothoracic appendages present, arranged in normal position of repose but with distal articles missing; abdomen extended, segments almost complete, proximal articles of two pleopods present, uropods and posterior part of telson missing.

Rostrum narrowly elongate triangular, dorsally concave, acute tip reaching to distal third of second article in antennular peduncle; thin raised lateral margins with six well-developed teeth, distal teeth somewhat eroded, proximal teeth acute, erect; dorsal surface moderately troughlike, with transversely rounded concavity gradually broadening to juncture with gastric region; latter

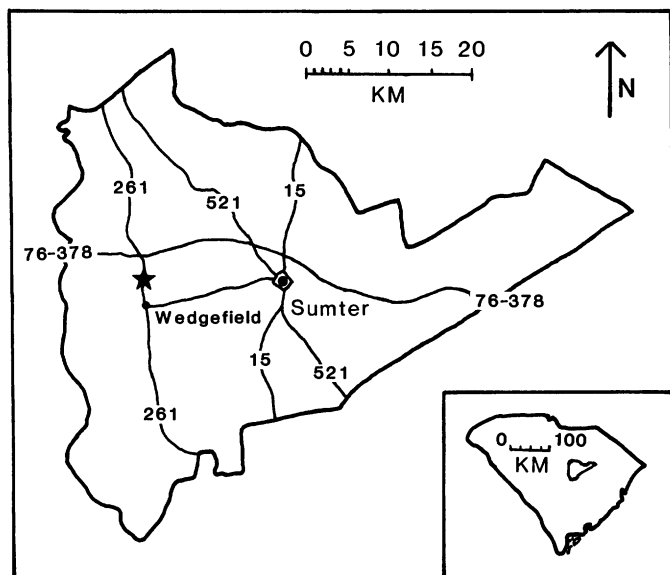


FIGURE 1—Location of type locality of *Axiopsis eximia* n. sp. in South Carolina.

with central elongate oval field of scattered sharp tubercles; median carina at base of rostrum rising to greatest development crested with six well-developed spines on anterior gastric region, becoming obsolete in tuberculate gastric field; latter flanked by submarginal spineless tract, crescentic row of spine-tipped granules, broader crescentic concave spineless tract confluent with dorsal surface of rostrum, and prominent lateral spiny ridge confluent with rostral margin. Each of these tracts trend slightly toward midline posteriorly, but collapse of carapace beyond that point prevents description. Postorbital margin confluent with lateral edge of rostrum at level of juncture with lateral gastric ridge, with three tiny acute postorbital spines, larger buttressed marginal antennal spine at lower limit; anterolateral angle rounded; cervical groove missing, except possibly for obscure sector on right side, but lateral surface anterior to it granulate; fragment of posteroventral part of carapace exhibits gently curved, entire, slightly raised margin.

Abdomen with smooth terga; terga of segments 3 and 4 imperfectly preserved; moderate lateral ridge defining juncture of terga and pleura of segments 1–5, becoming obsolete anterolaterally on segment 6; segment 1 pleuron narrow, drawn to ventral point, anterior margin oblique, much longer than posterior margin; segment 2 pleuron broadly rounded, flared anterior edge narrowly overlapped by that of segment 1; segment 3 pleuron not well preserved, margins appearing essentially equal, slightly convex, drawn to obtuse ventral tip as are pleura of segments 4 and 5; segment 6 pleuron flared laterally into broad, obliquely horizontal structure separated by deep, narrowly rounded notch from smaller subtriangulo-rectangular posterolateral continuation, both parts forming stop for extended uropods. Only lyre-shaped proximal part of telson preserved, median tract less elevated than parts to either side, basal part ornamented with rugae, sharp granules, pair of small submedian spines; ventral aspect with longitudinally oblique submarginal thin ridge near anterolateral corner, evidently interlocking with extended uropods.

Appendages unusually well preserved and exposed; left eyes-talk (right missing), originating near base of rostrum, with slight lateral curve near base, thereafter nearly straight, exceeding ros-

Series	Group	Formation	
E O C E N E	Jackson	Barnwell	
	C l i b o r n	Upper	Castle Hayne limestone
		Middle	McBean Santee limestone
	e		Warley Hill marl
	Lower	Congaree	

FIGURE 2—Stratigraphic position of *Axiopsis eximia* n. sp. in Eocene rocks of South Carolina.

tral tip by nearly one-third length, not including missing corneal bulb evidently at least one-fourth wider than shaft of stalk.

Antennular peduncle with stout basal article tapering abruptly in distal fourth of length, exceedingly slender distolateral spine on shoulder of tapering basal part; second article subcylindrical, exceeding rostrum by at least half its length, row of three spines on mesiodorsal aspect; elements distal to this fragmentary or missing, bases of two flagella visible.

Antennal peduncle with short, triangularly prismatic basal article bearing few blunt ventral tubercles and three spines; stout second article much longer, bearing slender acute anteromesial spine on inflated mesial margin exceeded by strong anterior spine on dorsolateral ridge, lateral aspect broadly rounded, row of six or seven tubercles/spines on ventromesial margin; third segment much more slender, distal margin bearing mesial spine exceeding rostral tip, spines or tubercles scattered on mesial, dorsal, and lateral aspects; elements distal to this fragmentary or missing; antennal scale/spine missing.

Mouth region partially exposed; epistomial plate with triangularly acute apex preceded by margins raised to thin sharp edges; lateral apices of plate drawn to a spine buttressed by posterolateral margin; surface of plate uneven, elevated and irregularly spined anterolaterally.

Basal remnants of labrum visible; broken remnants of mandibles visible under overlying maxillipeds; endopod of first maxillipeds exposed, smoothly arched, apparently submarginally setose on cupped mesial aspect, basal curved remnant of endite present.

Second maxilliped with triangular basis; merus elongate,

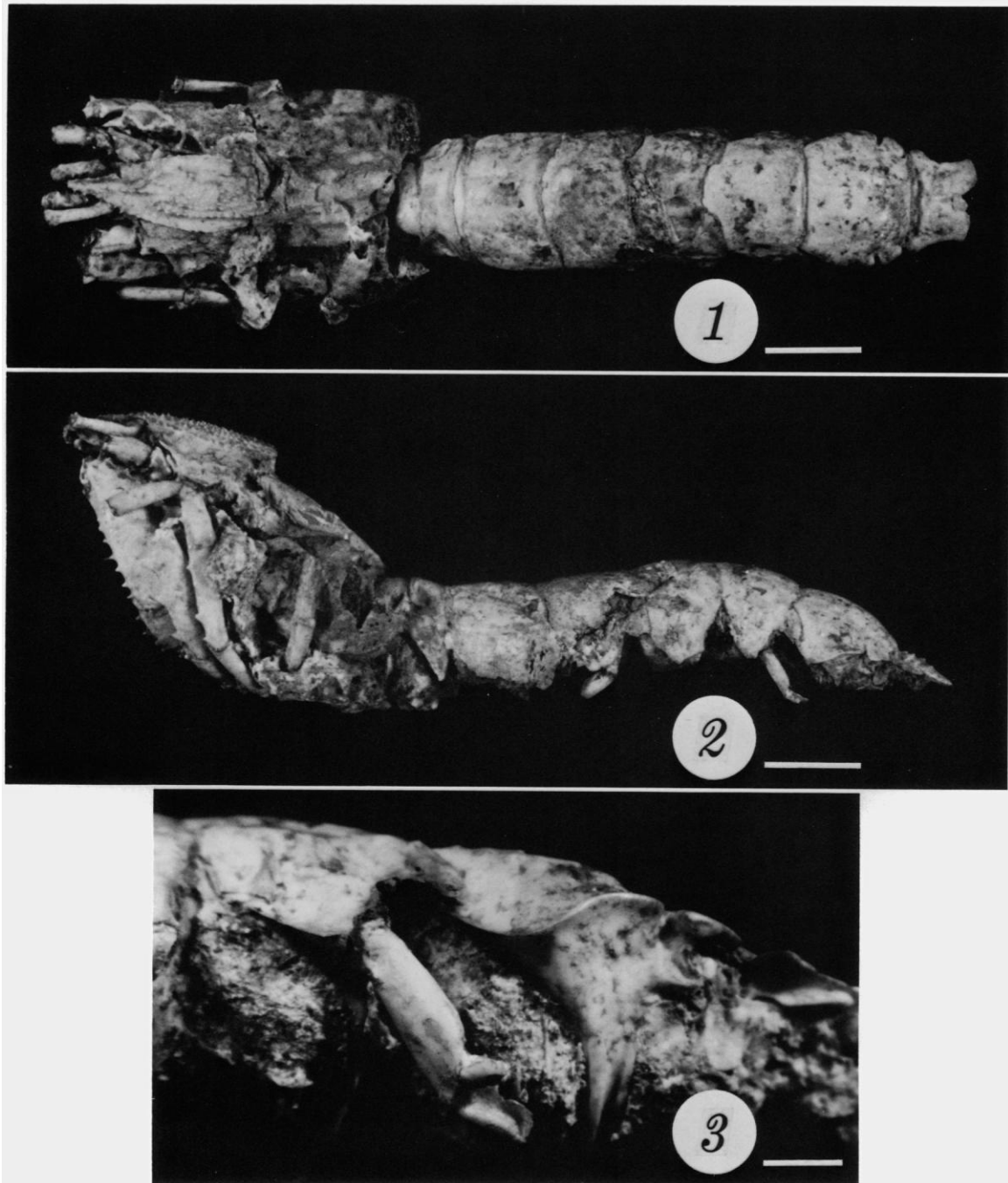
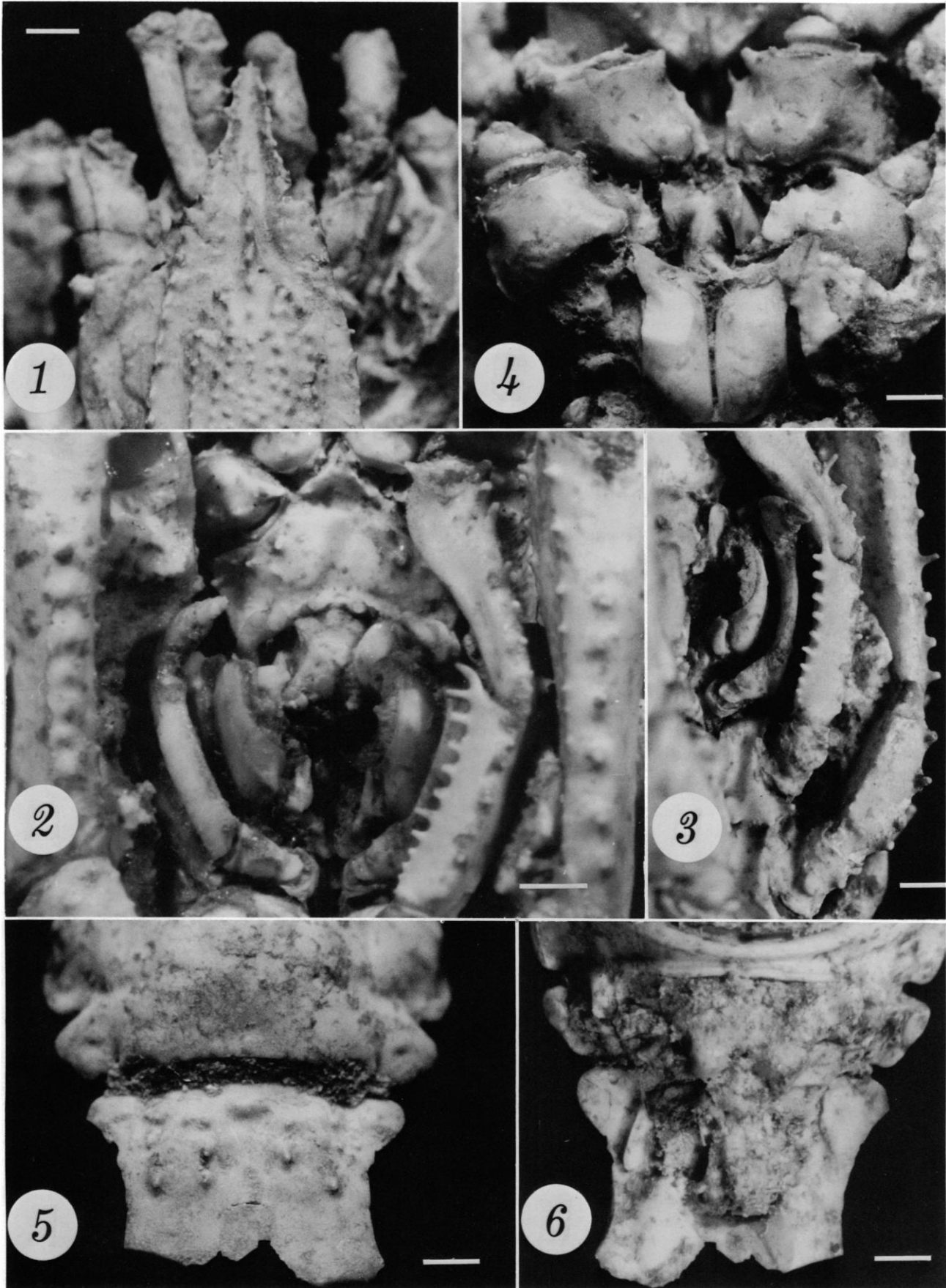


FIGURE 3—*Axiopsis eximia* n. sp. 1, dorsal view showing rostrum confluent with spinose gastric region on cephalothorax; collapsed carapace posterior to cervical groove; proximal parts of cephalothoracic appendages in normal position of repose; extended abdomen with terga of segments 1–6 almost complete, but uropods and posterior part of telson missing; 2, left lateral view showing rostrum and spinose gastric region in profile; collapsed carapace posterior to cervical groove; proximal parts of eyestalk, antennal peduncle, pereopods 1–4; abdominal segments 1–6 with pleura almost complete; part of telson; fragment of pleopods 3 and 5; 3, enlargement of abdominal segment 5 with pleopod attached, segment 6 showing notched lateral margin and proximal part of telson ridged ventrally for interlocking with extended uropod, ventrolateral view. Scales: 1, 2 = 5 mm; 3 = 1 mm.

FIGURE 4—*Axiopsis eximia* n. sp. 1, dorsal view of rostrum, part of spinose gastric region, left eyestalk (corneal bulb missing), parts of antennular and antennal peduncles, and pereopods 1 and 2; 2, 3, mouth field showing epistomial plate; parts of mandibles; basal part of labrum; second maxilliped with curved merus and very short carpus-dactyl at right angle to it; third maxilliped with triquetrous ischium bearing mesial row of spines, followed by portion of volute merus; 4, pair of broad sternal plates between coxae of pereopods 4, preceded by sternum and coxae of pereopods 3; 5, part of abdominal segment 6 with notched lateral margin for reception of extended uropods, and anterior telson, dorsal view; 6, same in ventral view showing submarginal anterolateral ridge on telson for interlocking with extended uropods. Scales = 1 mm.



curved, slightly twisted; short carpus bent at nearly right angle; propodus compressed, broadened; dactyl compressed, almost circular.

Third maxilliped with polygonal coxa spined on posterior margin; ischium triquetrous; ventral spine on basis followed by row of five irregularly spaced spines on ventral ridge of ischium, latter with cluster of small spines near mesioproximal end, comb of 13 strong spines on mesial aspect, distalmost pair of spines growing from common base; merus volute, row of six spines on ventrolateral margin stronger distally; elements distal to this missing.

Proximal articles of pereopods strong and spiny; pereopod 1 with coxa spined on margin of alate posteromesial plate nearly meeting opposite member in midline, with slender erect spine on posteromesial rim of basi-coxal joint; basis with single stouter ventral spine; ischium with row of four stout spines on ventral ridge, row of smaller spines or tubercles mesioventrally; elongate merus with double row of spines ventrally, lateral row stronger but longer mesial row extending to mero-carpal joint, crest of spines distally on extensor surface and strong lateral spine at mero-carpal joint; articles distal to this missing; pereopod 2 with similar coxa; basis smaller, with strong ventral spine; ischium with ventral row of three strong spines, three smaller spines mesioventrally; merus with three very strong ventral spines; distal elements missing; pereopod 3 with moderately bulbous coxa bearing two mesioventral spines, small spines on rim of basi-coxal joint; basis short; ischium elongate, scattered obsolescent spines anteroventrally; elongate merus with four spines scattered along ventral aspect, two near base, one in middle, one subdistal; carpus with three obsolescent spines on extensor surface; distal elements missing; pereopod 4 held over back, bulbous basis with two ventral spines, ischium and merus with suggestion of obsolescent rugae, former with row of obsolescent spines anteroventrally; distal elements missing; pereopod 5 missing; pair of short crestlike sternal plates between coxae of pereopods 3 and 4; broad pair of sternal plates separated by narrow fissure between coxae of pereopods 4 and 5.

Abdomen with bases of small pleopod 1 present; fragment of pleopod present on left side of segments 3 and 5; elongate basal element somewhat flattened, endopod stouter than exopod, drawn into dorsolateral vane.

Remarks.—Even with loss of the distal parts of the appendages and damage to the carapace, the quality of preservation of this specimen, with replacement by quartz, would demand description.

While the generic composition of the Axiidae is still in considerable confusion (de Saint Laurent, 1979; Kensley and Simmons, 1988), the present specimen must be placed in *Axiopsis*, albeit with some reservation. Configuration of the serrate rostrum and anterior carapace, antennular and antennal peduncles, pleon, and telson, all closely resemble the circumtropical type species *Axiopsis serratifrons* (A. Milne Edwards) (Kensley, 1980, fig. 1). Unfortunately, such diagnostic features as the shape of the antennal spine, the chelae of the first and second pereopods, and the uropods are missing. Although the spination and tuberculation of the rostrum and anterior carapace are very similar to those of *A. serratifrons*, the spination of the proximal pereopods is heavier in *A. eximia*. Presence of the bases of pleopods 1 and lack of a genital aperture on the coxa of pereopod 3 indicate that the specimen was a male. First pleopods being absent in males of *Axiopsis* (s.s.), this specimen must be placed in one of the groups of species of *Axiopsis* in which pleopod 1 is present in the male. This feature, along with the elongate eyestalks surpassing the rostral apex, is reminiscent of *A. caespitosa* Squires, 1979, from Pacific Colombia, in which the eyestalks are longer than the rostrum and the cornea wider than

the stalk. The narrow rostrum and carapacial spination of the Pacific species, however, easily distinguish it from the present fossil. Until the unsatisfactorily understood composition of *Axiopsis* is resolved, the present specimen must remain in this genus.

This specimen represents the first occurrence of an axiid whose preservation allows close comparison with extant forms. Its resemblance to forms such as *Axiopsis caespitosa* indicates that at least one of the extant axiid genera (even if not officially designated) had already evolved by the Eocene.

Etymology.—The specific name is from the Latin *eximius*, choice, exceptional, extraordinary, with reference to the unparalleled quality of preservation.

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