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# AN UPPER CRETACEOUS CRAB, *AVITELMESSUS GRAPSOIDEUS* RATHBUN

BY

ROBERT V. KESLING and IRVING G. REIMANN

MUSEUM OF PALEONTOLOGY
UNIVERSITY OF MICHIGAN
ANN ARBOR

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## VOLUME XIV

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CONTENTS



## INTRODUCTION

An exceptionally well-preserved specimen of the crab *Avitelmessus grapsoideus* Rathbun from the Upper Cretaceous Ripley formation shows distinct color markings and several details of the shape of the carapace that have not been previously described. The specimen, an immature female, consists of most of the dorsal and anterior parts of the carapace, the chelipeds, and the second, third, and fourth pereiopods of the right side as far as the ends of the meri. It reveals that the carapace, at least in this juvenile instar, has a very thick inflected part and well-defined dorsal areas, ornamented with small papillae and spines.

While collecting fossil invertebrates from the famous exposures of the Ripley formation on Coon Creek, Tennessee, the junior author found the crab described in this paper. He quarried out a large block of rock containing the specimen and brought it to the Museum of Paleontology of the University of Michigan. Almost all of the crab was embedded in dark bluish gray argillaceous siltstone; only the posterior part of the carapace and the dorsal part of one chela were exposed.

The extraction and preparation of the specimen presented many problems. The exoskeleton of the carapace readily exfoliated from the steinkern almost as soon as exposed because it was very thin and brittle.

It was necessary to cement each small fragment back into place before exhuming more of the specimen. A few small pieces were so fragile that they shattered and could not be reassembled. The chelae were particularly difficult to expose. Some of the teeth not only came out of their sockets but broke into small pieces; nevertheless, with few exceptions, they were replaced. Before the anterior region of the carapace could be cleaned, each of the chelipeds had to be disarticulated at the end of its merus and the distal part removed. Later, the distal parts were cemented back in their original positions.

Although this is one of the best specimens of *Avitelmessus grapsoideus* ever found, its carapace is somewhat distorted and several legs are incomplete. The ventral part of the carapace was badly crushed and encased in a very hard, dense, calcareous concretion; as a result, only a small part could be satisfactorily freed from the matrix. In the posterior region the dorsal part is split away from the inflected part of the thorax, and the abdomen has been displaced to the rear. In the anterior region the mouth parts are absent. Each of the second, third, and fourth pereiopods on the right side lacks the carpus, propod, and dactyl; each of the second and third pereiopods on the left side is broken through the merus; the fourth pereiopod on the left lacks the merus completely; and each of the fifth pereiopods is represented only by fragments of the basi-ischium.

Within the block of siltstone containing this nearly complete crab, and in close proximity to it, were two carpi and two propods, one with part of the dactyl attached. We do not know whether these leg pieces were part of the nearly complete specimen. Neither carpus now articulates distally with either propod or proximally with the merus of any of the pereiopods attached to the carapace. Furthermore, since only one specimen, the holotype, has been described in which the walking legs are complete as far as the propods, it is difficult to judge whether each of the detached leg parts has the proper size for articulation with one or another of the incomplete legs on the carapace. The fossil material may represent one crab or as many as five. Inasmuch as the legs were buried very near the carapace, and no other crabs were found nearby, we are inclined to believe that the specimens are parts of one animal. Each, however, has been catalogued separately.

We thank Dr. L. B. Kellum, Dr. C. A. Arnold, and Dr. G. M. Ehlers for helpful comments on the organization of this paper. The Horace H. Rackham School of Graduate Studies of the University of Michigan provided photographic equipment used in preparation of the plates.

All specimens are catalogued and deposited in the Museum of Paleontology of the University of Michigan.

## LOCALITY

Natural exposure in the bank of Coon Creek immediately above falls, about 1 foot above water level, on Dave Week's place about 250 yards east of the abandoned house; 3½ miles south of Enville, 7½ miles north of Adamsville, and ⅛ mile east of the main Henderson-Adamsville road, in the northeast part of McNairy County, Tennessee. Siltstone, bluish gray, containing numerous small flakes of thin mica, weathering to soft silty clay near the exposed surface. The lower half of the specimen encased in a very hard, dense, calcareous concretion. Upper Cretaceous, Ripley formation, Coon Creek tongue. Collected by I. G. Reimann on November 9, 1955.

## PREVIOUS DESCRIPTIONS

*Avitelmessus grapsoideus* was described by Mary Rathbun (1923, pp. 404–6) as the type species of her genus *Avitelmessus*. It is still the only known species of the genus. Rathbun (1923, pp. 403–4) assigned *Avitelmessus* to the family Atelecyclidae, superfamily Brachyrhyncha, and tribe Brachyura, and gave the following description:

"Carapace orbicular-oblong; fronto-orbital distance great; front very narrow; orbits wide, divided into 2 distinct fossae. Maxillipeds elongate, especially the ischium, exceeding the buccal cavity and almost as advanced as the front; exognath of good width. Chelipeds massive, of moderate length; fingers elongate. Ambulatory legs long and broad. Sternum broad. Male abdomen covering the space between the coxae of the feet of the last pair."

The species is based on a holotype from the Peedee formation in eastern North Carolina and several specimens from the Ripley formation in Mississippi. The holotype is a large male with a carapace 97 mm. long. It has been broken diagonally through the middle, the dorsal part crushed down inside the lower half, and the posterior half deeply eroded into the steinkern. The chelipeds, although distorted, are complete. The second, third, and fourth pereiopods are present on the right, and the second and third on the left side. None of the walking legs has the dactyl preserved, but four contain all or nearly all of the propod. The only other specimen illustrated by Rathbun in the original publication was a male paratype showing the ventral side of the carapace (1923, Pl. 52, Fig. 4). Of the dorsal part of the carapace, Rathbun wrote (1923, p. 404), ". . . surface uneven, anterior branchial region depressed, surrounded by a low, circular ridge partly armed with short spines and tubercles; surface sparingly ornamented with flattened granules and a few sharp tubercles."

In 1926 (pp. 190–91, Pls. 69–70) Rathbun described and illustrated several specimens from western Tennessee, some of them from the same locality as our crab. The carapaces that she measured were 26.3, 28.8, and

59 mm. wide. One incomplete large male was estimated to have a length of 110 mm. Rathbun noted (p. 190) that, although the large type specimen had two strong spines along the anterolateral border (not counting the one at the junction of the anterior and anterolateral borders, which she called the orbital spine), the smaller specimens had five or six small spines. She also stated (p. 191): "The spines of the chelipeds are more numerous in the half-grown than in the old." The isolated leg fragments that Rathbun described as dactyls (p. 191) and illustrated (Pl. 70, Figs. 2–7, 11) appear to us to be crushed propods of the walking legs.

The best-preserved features on the specimens studied by Rathbun are the abdomen, sternum of the carapace, outer maxillipeds, and the eyestalk. Her specimens had very little of the exoskeleton on the dorsal part of the carapace and neither exoskeleton nor steinkern of the inflected part.

## DORSAL AREAS OF CARAPACE

Most of the terms used here are those employed by Pearson (1908) in his monograph on the genus *Cancer*. A few have been added from the glossary by Rathbun (1917, pp. 6–8). Because we cannot be certain about the position of the pleural groove in the anterior region of our specimen, we refer to the "dorsal" and "inflected" parts of the carapace rather than to the "terga" and "pleura."

The dorsal part of the carapace is nearly circular as seen in dorsal view (Pl. III, Fig. 1; Pl. IV, Fig. 1). It is strongly arched from front to rear, with the greatest convexity in the cephalic region, and less strongly arched from side to side. Each anterolateral border is evenly curved except for nine marginal spines directed outward and upward. On each side of the short rostrum, the anterior border has two concavities, one between the rostrum and the supraorbital lobe and another between the supraorbital lobe and the outer end of the orbit.

The dorsal part of the carapace is divided into cephalic and thoracic regions by a cervical groove (Pl. III, Fig. 2). The short median part of the groove is shallow, transverse, and nearly straight. The right and left branches of the cervical groove are essentially sigmoid, very distinct in the central part of the carapace (Pl. I, Fig. 2) but faint in the outer parts. They curve forward along the sides of the urogastric and metagastric areas and diverge toward the lateral borders, passing between the protogastric and epibranchial areas. The cervical grooves on the steinkern illustrated by Rathbun (1926, Pl. 69, Fig. 5) are much more prominent than those on the exoskeleton in our specimen. It appears that the exoskeleton is thicker through the cervical groove than elsewhere.

The cephalic region may be divided into the facial and gastric regions, although there is no sharp boundary in this species. The facial region, slightly less than half as wide as the entire carapace, contains the frontal and orbital areas (Pl. III, Fig. 2). The anterior margin of the facial region is ornamented by about 50 small, evenly spaced papillae. The frontal area contains a trough-shaped short rostrum (Pl. I, Fig. 2; Pl. III, Figs. 1–2). Between the rostrum and each supraorbital lobe, which marks the boundary with the orbital area, the anterior border is sharply concave. In each half of the frontal area, immediately behind the concavity of the anterior border, there is a gentle ridge (Pl. I, Fig. 2), decreasing in width and convexity toward the rear and terminating near the posterior boundary of the area. The frontal area is separated from the gastric region by a faint, shallow groove (Pl. I, Fig. 1). The orbital areas lie in the outer parts of the facial region without clear demarcation from adjacent areas. Each orbital area has a concave anterior border extending from the supraorbital lobe at its inner end to the junction with the anterolateral border. The spines at the anterolateral edges of the orbital areas project forward slightly farther than the end of the rostrum.

The gastric region has sharp grooves bounding certain areas and only very faint depressions bounding others. The deepest grooves separate the mesogastric area from the protogastric areas on either side (Pl. I, Fig. 2; Pl. II, Figs. 1–2; Pl. III, Fig. 2). These grooves extend forward from their junction with the cervical groove and converge in the frontal area, where they continue as one groove in the middle of the rostrum. The rear edge of the mesogastric area lies in a faint transverse depression. The central and posterior parts of this area are ornamented by numerous low papillae. These papillae, like others on the exoskeleton of the carapace, are of two kinds: the smaller are bluntly acuminate, but the larger are crater-like with a low rim around the outside and a very small sharp tip in the center. In most of the large papillae the central tip rises only to the level of the rim, but in a few it is slightly higher.

Each of the protogastric areas is indistinctly separated from the hepatic area on its anterolateral border, although it has sharp grooves along its inner and rear borders. Within each of these areas there is a crescentic low ridge, roughly parallel to the inner and posterior borders, ornamented with numerous low papillae (Pl. I, Fig. 2; Pl. III, Fig. 2). The central and anterolateral parts of each area are slightly concave and smooth. The hepatic areas are elongate and slightly concave. They have short spines along the inner (Pl. I, Fig. 1) and posterior (Pl. I, Fig. 2; Pl. II, Figs. 1–2; Pl. III, Fig. 2) borders and large spines along the anterolateral borders. The metagastric and urogastric areas have only a shallow depres-

sion between them. They are ornamented, particularly along the mid-line, with low papillae.

The thoracic region is divided into median cardiac and intestinal areas and lateral branchial areas (Pl. III, Fig. 2). The branchiocardiac grooves, along the sides of the cardiac area, are sharply defined (Pl. I, Fig. 3; Pl. II, Figs. 1–2; Pl. IV, Fig. 1). The cardiac area is roughly triangular, posteriorly acuminate, and convex. Nearly all the exoskeleton is missing from this area on our specimen. The branchiocardiac groove on the left, which lies in the exoskeleton, is about the same depth as that on the right, which lies in the steinkern. The intestinal area is subtriangular. The specimen is crushed in the posterior part of this area, and the junction with the abdomen is not well exposed. The intestinal area is separated from the metabranchial areas by grooves, which are continuous with the branchiocardiac grooves but somewhat shallower (Pl. III, Figs. 1–2).

The branchial region of the thorax contains the branchial lobes, epibranchial, mesobranchial, and metabranchial areas on each side. Each branchial lobe is separated from the metagastric and urogastric areas by the cervical groove and from the epibranchial area by a distinct groove. It is a well-defined ridge, terminated posteriorly by an obliquely elongate pit (Pl. I, Fig. 3; Pl. III, Figs. 1–2). Each epibranchial area is bounded by conspicuous grooves and by the lateral border of the carapace. It is separated anteriorly from the cephalic region by the cervical groove, proximally from the branchial lobe by a deep groove, and posteriorly from the mesobranchial area by a shallow but clearly defined, slightly sinuous groove. The most conspicuous feature of the epibranchial area is a low, large U-shaped ridge parallel to the inner, rear, and outer borders, and lying on three sides of a smooth concave area (Pl. I, Figs. 2–3; Pl. II, Figs. 1–2; Pl. III, Figs. 1–2). The inner limb of this ridge is broad and ornamented with numerous low papillae, but the rear and outer limbs are narrow and ornamented with a row of large spines curved upward and slightly outward. At the posteroproximal end of each epibranchial area there is a subquadrate node, which has the exoskeleton sharply folded in along its outer and rear edges (Pl. I, Fig. 3; Pl. III, Figs. 1–2). In the mesobranchial and metabranchial areas on each side, the specimen is mostly steinkern with only a few fragments of the exoskeleton. The boundary between the mesobranchial and metabranchial areas is tentative for most of its length; near the posterolateral border of the carapace, however, there is a faint depression which we interpret as the boundary. The anterolateral part of each mesobranchial area is smooth and slightly concave. The rest of the mesobranchial area and the adjacent metabranchial area have numerous small, sharp papillae on the steinkern, which

are believed to be internal molds of papillae like those on the exoskeleton in other areas. Along the posterolateral border of the carapace, the mesobranchial area has several spines, somewhat shorter than those on the borders of the epibranchial and hepatic.

### INFLECTED PART OF CARAPACE

The inflected part of the carapace is incomplete. The part around the oral region has been broken off. The posterior part on each side is split away from the dorsal surface, and some of it is obscured by the matrix lying next to the pereiopods.

As seen in anterior view (Pl. I, Fig. 1) the inflected part of the carapace is made up of parallel bands with ornamented ridges at their junctions. The part of the carapace which we were able to expose has three bands, which appear to reach to the sternum of the carapace, although we cannot be certain that the crab did not have a narrow fourth band.

The uppermost band of the inflected part is nearly vertical, and the others are successively turned in slightly. As a result of this arrangement, the carapace is very high in the cephalic region. Very few crabs have such a box-shaped carapace. Most have the inflected part of the carapace turned in sharply at the junction with the dorsal part, as in the well-known edible crab, *Callinectes sapidus* Rathbun, of the Atlantic coast of North and South America, or in the edible crab of Europe, *Cancer pagurus* Linnaeus. One species of the family Atelecyclidae, *Bellia picta* Edwards, now living off the coast of Peru, has a carapace inflected much in the same manner as that of *Avitelmessus grapsoideus* (see Rathbun, 1930, Pl. 79, Fig. 1).

The uppermost band, approximately 10 mm. wide, is nearly vertical and slightly concave. Along its upper edge, at the contact with the dorsal part of the carapace, is the row of spines already discussed as part of the anterolateral border. Along its ventral edge is a low ridge bearing several small spines which, on the right side of the specimen, curves upward at the rear and joins the anterolateral border a little behind the position we interpreted to be the distal end of the cervical groove (Pl. I, Fig. 1; Pl. III, Figs. 1–2). It seems significant that the right side is broken just below this band and that the left side has a small groove in about the corresponding position, although it is indistinct at some places. The break on the one side and the groove on the other may represent the pleural grooves. We cannot be certain. If these are pleural grooves, the uppermost band of the inflected part of the carapace is part of the tergum and could be called the subhepatic area. In the thoracic region the carapace is split

on both the right and left sides at the junction of the dorsal and inflected parts. This suggests that the pleural groove continues posteriorly along the upper edge of the inflected part of the thorax, and that all of the inflected part in this region is pleura.

On each side the second band of the inflected part of the carapace, which we suggest is pleura and, therefore, could be properly termed the pterygostomian area, is about 8 mm. wide. It is nearly flat, slightly concave, and slopes inward at a slight angle from the band above, It is terminated ventrally by a low rounded ridge bearing scattered small blunt spines.

The third, or ventral, band is about 7 mm. wide and slopes inward at an angle of about 45 degrees to the dorsal surface of the carapace. It is concave and has a rounded ridge along its ventral margin, which is ornamented with small tubercles.

Although this specimen is somewhat distorted, it appears to us that the carapace in this species is very high anteriorly, the dorsal part slopes downward in its posterior half, the sternum is nearly flat, and the inflected part tapers posteriorly between the convex dorsal part and the sternum. If we are correct in our interpretation of the pleural grooves, the tergum includes the dorsal and subhepatic area in the cephalic region and only the dorsal part of the carapace in the thoracic region. This is the arrangement in all living crabs.

### COLOR MARKINGS

Although color markings have been reported in very few fossil crabs, they show up very clearly in this specimen. We have no way to determine whether the colors are the same as they were when the animal was alive. We strongly suspect that the colors have changed somewhat, but that the pattern has been rather faithfully retained.

The color in the exoskeleton of crabs is concentrated in a definite layer. According to Pearson (1908, pp. 48–49), the exoskeleton or integument is composed of four layers. The outer layer, called the cuticle, is very thin, structureless, and chitinous. The second, the pigmented layer, is moderately thick, laminated parallel to the surface, and calcified. The third, the calcified layer, is thick, colorless, laminated, and strongly calcified. The inner, the noncalcified layer, is very thin, soft, and is composed of delicate laminae; it forms only after the other layers have attained their maximum thickness.

The latest work on preservation of the exoskeleton in crabs is by Schäfer (1951), who stated (p. 236) that the carapace was made of three laminated layers: "Der Panzer decapoder Krebse wird von drei aus

gebündelten Fibrillen-Lagen aufgebauten Schichten gebildet, einer dünnen Aussenlage, einer mächtigen (oft verkalkten) Hauptlage und einer dünnen Innenlage." He further noted (p. 236) that the main cause of brittleness in fossil carapaces was not calcification but solution of the substances binding the layers together: "Nicht Entkalkung ist die Ursache für das Brüchigwerden, sondern der Zerfall der Haupt- und Innenlage der Chitinlamellen in einzelne Schollen durch Lösung der die Lamellen verbindenden Kittsubstanz."

We believe the thin outer layer referred to by Schäfer is the pigmented layer. Schäfer's explanation of the breaking up of carapaces may account for the paucity of preserved color markings. He stated (p. 237): "Die Zerstörung des Panzers in kleinste Bruchstücke beruht auf Lösung der Kittsubstanz, welche die den Panzer aufbauenden Chitinlamellen miteinander verbindet."

The color in the carapace and pereiopods of our specimen consists of a medium background, dark spots and blotches, and light lines. The background ranges from a very light yellowish umber to a medium light umber. The preserved parts of the exoskeleton on the carapace are lighter on the mesogastric area and the ridges of the protogastric areas than elsewhere. In the chelipeds the meri are lighter below than above, the carpi are lighter on the side near the body, and the chelae are lighter on the proximal faces. In the walking legs the meri are lighter on the sides and bottoms than on the dorsal surface. On the carapace the background is interrupted by a dense labyrinthic pattern of very small light lines, which can be seen only under magnification.

The carapace is marked with dark umber spots, which differ in size, shape, and spacing on various parts of the exoskeleton (Pl. IV, Figs. 1–2). The spots in the concave parts of the protogastric and epibranchial areas and in the hepatic areas are larger, more elongate, and much more distantly spaced than those in other areas.

The carpus of each cheliped has dark blotches on the upper and distal surfaces and small discrete spots arranged in rosettes on the proximal surface. The chelae have scattered small, rather indistinct, irregular dark markings. The meri of the walking legs have transverse dark blotches on their sides.

### PEREIOPODS

The chelipeds in this specimen are nearly complete (Pl. I, Figs. 2–3; Pl. II, Figs. 1–2; Pl. III, Fig. 1). The exoskeleton is missing only from part of the distal face in the right chela. The chelipeds are symmetrical. Each merus is large, nearly triangular in cross section, and transversely

constricted a short distance proximal to and parallel to the distal end (Pl. I, Fig. 3). Most of the short spines are confined to the inner ventral, outer ventral (Pl. I, Fig. 1), and dorsal edges, but a few are scattered on its ventral and proximal sides. There are several sharp tubercles along the dorsal part of the distal rim. The sides of the distal end of the merus are extended to form sockets, which articulate with spines on the carpus (Pl. I, Figs. 1–3).

The carpus of each cheliped is very broad but not thick. Its ventral surface is nearly flat, the inner surface flat or slightly concave (Pl. I, Fig. 2), the dorsal surface convex but crossed diagonally by a broad groove (Pl. I, Fig. 3), and the outer surface acutely round. Both edges of the inner surface bear rows of short spines, and the dorsal and outer surfaces have scattered short spines and tubercles except in the diagonal groove. The outer edge of the distal rim is nearly vertical (Pl. II, Fig. 2). The proximal rim has blunt lateral spines, which fit into the sockets on the end of the merus.

Each propod is large and strong, with a short palm and a long fixed finger. Most of the inner surface of the propod is smooth and concave from base to tip; it bears a few small tubercles in its ventral half. The inner and dorsal surfaces meet at a sharp ridge bearing a few tubercles (Pl. I, Fig. 3). The dorsal surface is smooth and shallowly concave in its inner half, but tuberculate and convex in its outer (Pl. II, Figs. 1–2). The outer surface of the palm is gently convex and bears blunt tubercles in its ventral half, more or less arranged in rows parallel to the ventral edge. The fixed finger is directed slightly downward, so that the ventral edge of the propod is concave at the junction of the palm and finger. It has rows of tiny tubercles along its two converging ventral edges and a low tuberculate ridge on the middle of the outer surface. The five teeth are discrete. The tip of the fixed finger turns upward.

The dactyl, or movable finger, is about the same length as the fixed finger on the propod. The edges of the upper surface have a few indistinct tubercles. The cross section near the base is nearly triangular. The teeth are discrete.

The meri of the second and third pereiopods of the left side are thicker than those on the right (Pl. I, Fig. 3). The meri of these pereiopods are smooth on the sides and spinose on only the dorsal surface (Pl. II, Figs. 1–2). The meri on the right side are complete, and have pockets extending laterally from the distal end. The meri are constricted a short distance behind the end, which has small tubercles along the dorsal part of the rim.

The merus of the fourth pereiopod is present on the right side of the specimen. It is covered with small sharp spines except along the front side, which is smooth.

The two carpi found isolated from the large specimen (Pl. II, Figs. 3–4, 9–10) are probably part of it. We can only deduce from their size and shape that they are from walking legs on the right side.

The two propods found isolated are also thought to belong to the more complete specimen. Both are from the right side. Insofar as we can judge from Rathbun's illustration of the holotype (1923, Pl. 101, Fig. 1), the longer one (Pl. II, Figs. 5–6) probably came from the second or third pereiopod and the shorter (Pl. II, Figs. 7–8) from the fourth pereiopod. It is possible that the shorter came from the fifth pereiopod; however, nothing is known with certainty about this pereiopod in *Avitelmessus grapsoideus*. The longer propod is slightly crushed in along the sides. It is smooth except for very low, numerous papillae along its dorsal surface. The shorter pereiopod has part of the dactyl attached. It has flat sides, with the anteroventral side smooth and the posterodorsal side ornamented with small spines. The spinose side, as well as the length, convince us that this propod came from one of the two rear legs. The part of the dactyl that has been preserved is of particular interest, because it differs distinctly from the fragments which Rathbun (1926, p. 191, Pl. 70, Figs. 2–7, 11) interpreted as dactyls, but which we believe to be propods. The dactyl in this specimen is rather flat, subquadrate in cross section, with sharply concave sides and front. It is smooth except for a small narrow proximo-ventral area on the front surface, which has very small spines.

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## EXPLANATION OF PLATE I

(All figures × 1)

*Avitelmessus grapsoideus* Rathbun

FIG. 1. Anterior view of Hypotype No. 33406. For this photograph, each cheliped was disarticulated at the end of the merus, and the distal part removed to expose the inflected part of the carapace.

FIG. 2. Anterodorsolateral view of same specimen. This view shows particularly well the rostrum and the mesogastric area. As seen at the broken end, the merus of the left third pereiopod is elongate oval in cross section.

FIG. 3. Posterodorsal view of same specimen. Although the meri of the second and third pereiopods on the left side are broken, it can be seen that they differ in shape from those on the right. In the upper half of the photograph, the distal concave areas of the carapace are parts of the epibranchial areas. The branchiocardiac grooves are clearly defined, both on the exoskeleton at the left and on the steinkern at the right.

PLATE I

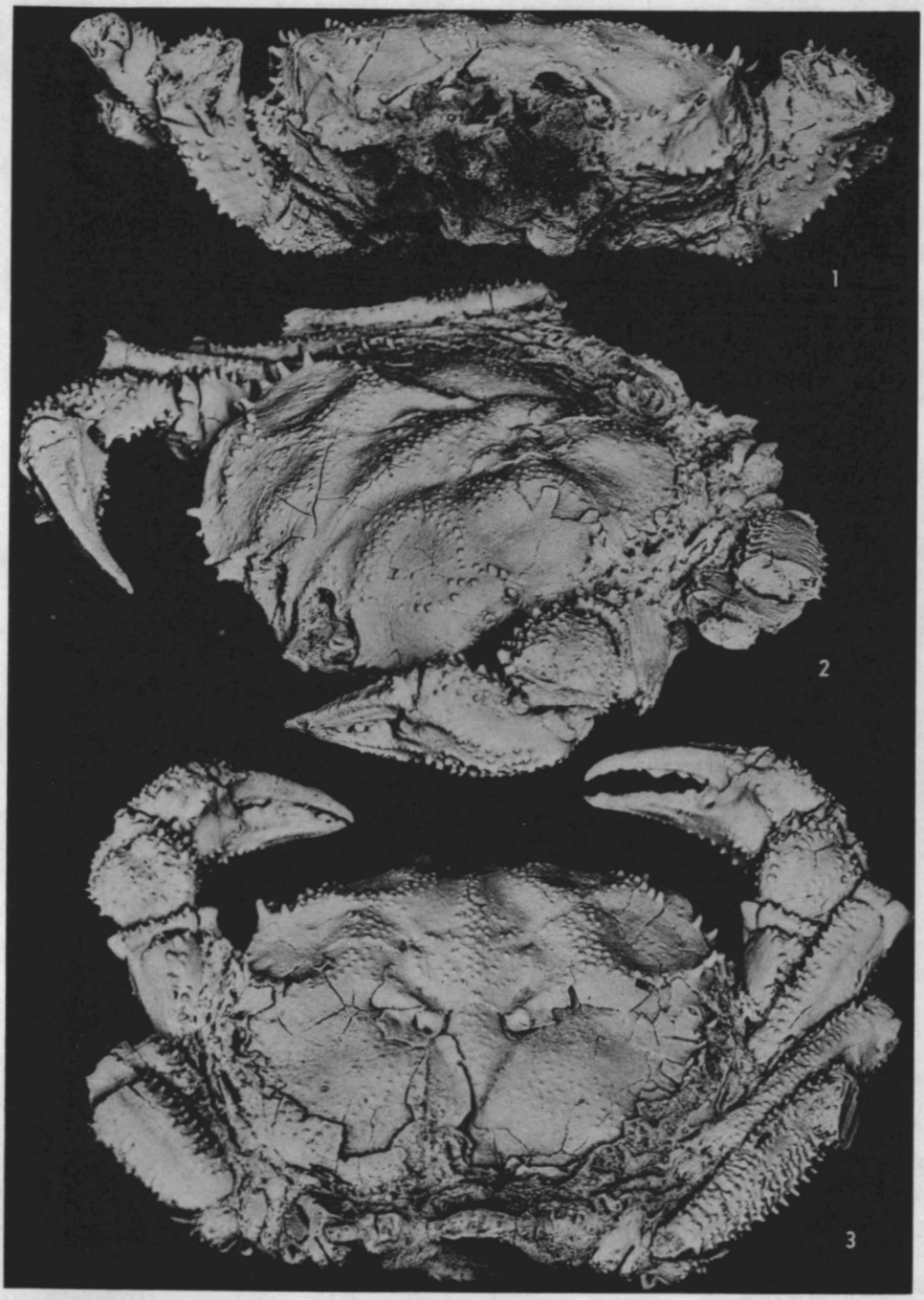


PLATE II

## EXPLANATION OF PLATE II

(All figures × 1)

*Avitelmessus grapsoideus* Rathbun

FIGS. 1–2. Right and left posterodorsolateral views of Hypotype No. 33406, showing particularly well the chelae, pereiopods, and branchial lobes. The cervical groove can be discerned in each of these photographs (compare with Pl. III, Fig. 2).

FIGS. 3–4. Dorsal and ventral views of carpus of a pereiopod on the right side, Hypotype No. 33407. This is thought to be part of the nearly complete specimen shown in Figs. 1–2, inasmuch as they were found close together.

FIGS. 5–6. Posterodorsal and anteroventral views of propod of a pereiopod on the right side, Hypotype No. 33408. Probably part of the specimen shown in Figs. 1–2.

FIGS. 7–8. Posterodorsal and anteroventral views of propod and part of dactyl of a pereiopod on the right side, Hypotype No. 33409. Probably part of the specimen shown in Figs. 1–2.

FIGS. 9–10. Dorsal and ventral views of carpus of a pereiopod on the right side, Hypotype No. 33410. Probably part of the specimen shown in Figs. 1–2.

## EXPLANATION OF PLATE III

(Both figures slightly larger than × 1)

*Avitelmessus grapsoideus* Rathbun

FIG. 1. Dorsal view of Hypotype No. 33406, coated with sublimated ammonium chloride. Compare with Pl. IV, Fig. 1, in which the specimen is coated only with a thin layer of shellac.

FIG. 2. Dorsal view of part of same specimen with the following areas of the dorsal surface of the carapace labeled: frontal, orbital (orb.), hepatic, protogastric, mesogastric, metagastric (metag.), epibranchial, mesobranchial, metabranchial, intestinal (intest.), branchial lobe (br. lobe), and cervical groove.

## PLATE III

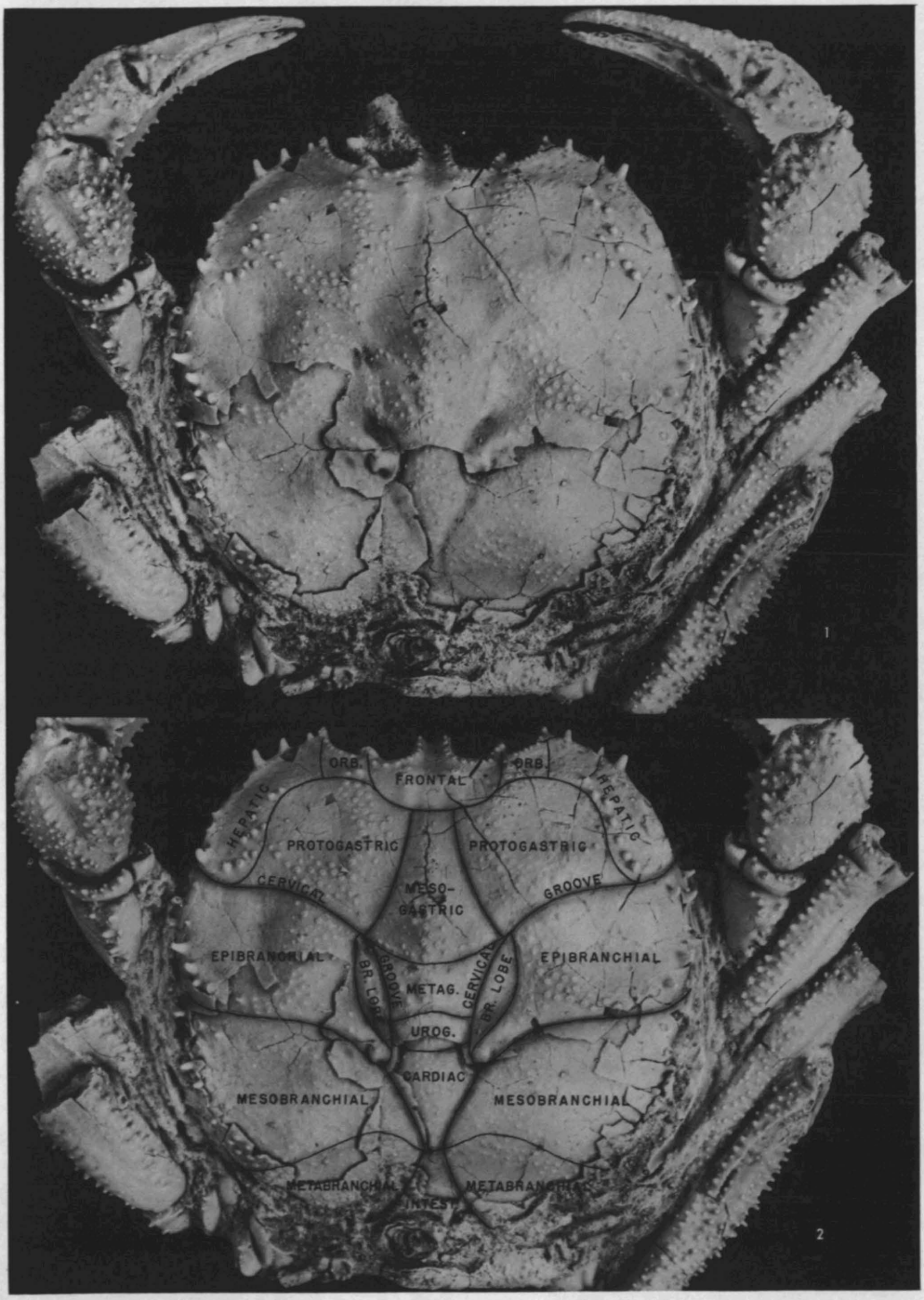
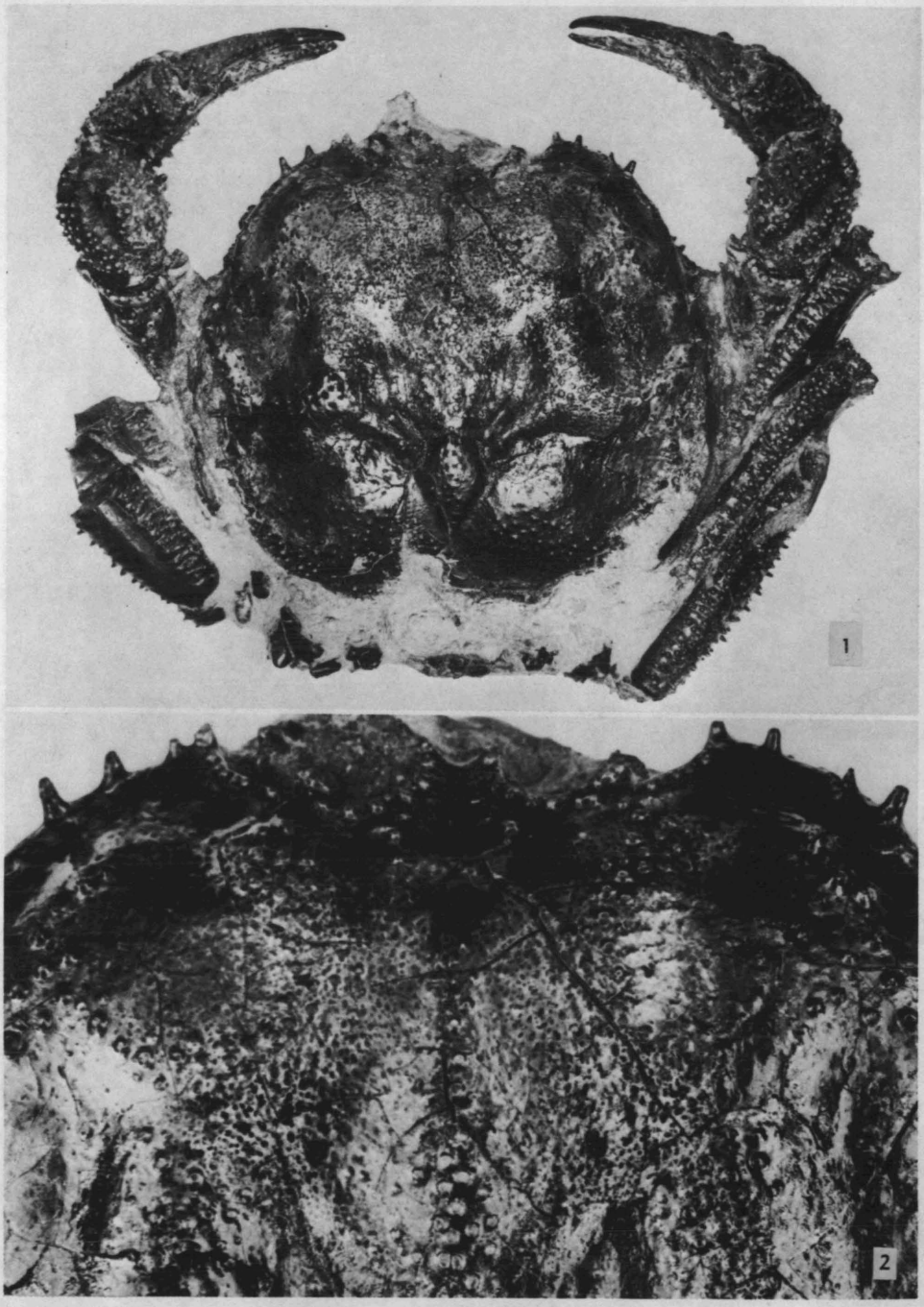

ORB.
FRONTAL
ORB.
HEPATIC
HEPATIC
PROTOGASTRIC
PROTOGASTRIC
CERVICAL
MESO-
GASTRIC
GROOVE
EPIBRANCHIAL
EPIBRANCHIAL
METAG.
UROG.
CARDIAC
MESOBRANCHIAL
MESOBRANCHIAL
METABRANCHIAL
METABRANCHIAL
INTEST.
1
2

PLATE IV



## EXPLANATION OF PLATE IV

*Avitelmessus grapsoideus* Rathbun

FIG. 1. Dorsal view of Hypotype No. 33406, coated thinly with shellac. In the anterior half of the carapace, the color markings of the exoskeleton can be seen. In the posterior half, the branchiocardiac grooves are clearly defined. × 1.

FIG. 2. Dorsal view of anterior part of same specimen, showing color markings and ornamentation. Approximately × 2.4.