DECAPOD CRUSTACEANS FROM THE CRETACEOUS OF TEXAS

H. B. Stenzel

In the Tertiary and Cretaceous strata of Texas, decapod crustaceans are not uncommon, at least at some localities. There are even a few localities where these decapod crustaceans are amazingly abundant. California Crossing in Dallas County is one of these localities. The abundance and fine preservation of material from such localities present a challenge to the paleontologist, and this challenge is strengthened by the importance of much of the material.

So few fossil decapod crustaceans have been collected and described in this country that nearly every new locality also yields new species, and many of the genera are new to this country. In addition, the knowledge of decapod crustaceans here and abroad is very incomplete so that some of the finds result in significant extensions of the stratigraphic range of the genera.

It is fortunate that some of the species, notably *Cenomanocarcinus vanstraeleni* Stenzel, are represented by copious material, which makes it possible to describe nearly all parts of the animal — carapace, abdomen, and appendages. Such fully described species are very much needed as a firm standard around which may be grouped the less known species, that is, those described from isolated fragments. In such fully described species are the means of elucidating phylogenetic relations as, for instance, the relations between *Necrocarcinus* and *Cenomanocarcinus*. Also these fully known species may be used to correct misidentifications caused by insufficient material in other related species. A case in point is the recognition of the true nature of *Raninella (?) armata* Rathbun. Or the fully known species may be used to improve the understanding of related but less copious material. A case of this sort is the right manus of *Upogebia gamma* (Rathbun) which was originally described as the left manus.

These fossil crustaceans were collected partly by local enthusiastic collectors and partly by the staff of the Bureau of Economic Geology. The writer is indebted to the collectors for some of the finest specimens. Proper credit is given in the text to those who have helped to gather the material. The writer wishes to express his appreciation of their efforts and generosity.

NOTES ON THE COMPARATIVE ANATOMY OF THE MACRUROUS DECAPOD CRUSTACEANS

One of the clearly outstanding features of highly developed animals is the eye. Among many of these animals it is the eye which is the chief sense organ. Its proper function as an organ of vision aids the animal in protection from attack, in quest of food, in search for mates, and in other essential functions. Therefore, it is important that the eye be protected from any injury in fight or by accident. In the mammals this protection is afforded by bony structures surrounding the orbit of the eye. In those mammals which depend very much on the use of the eye — man is one of them — the orbit is protected by the bones of the nose, eyebrows, and cheeks. These bones encircle and surmount the orbit, so that the eye is freely movable and yet surrounded by hard ridges.

The same problem exists in crustaceans. The eye must be protected in those crustaceans in which the eye is of paramount importance as a sense organ. In the crustaceans, as in the mammals, this protection is accomplished by hard ridges. Naturally, the ridges are not composed of bones as in the mammals, because crustaceans do not have an interior bony skeleton. Among the crustaceans the ridges are parts of the exoskeleton. For example, the eye of a lobster (see text fig. 1) is surrounded by 11 protective spines. These spines form an oblong defense ring around the orbit, giving the eye the much needed protection from enemy or accident.

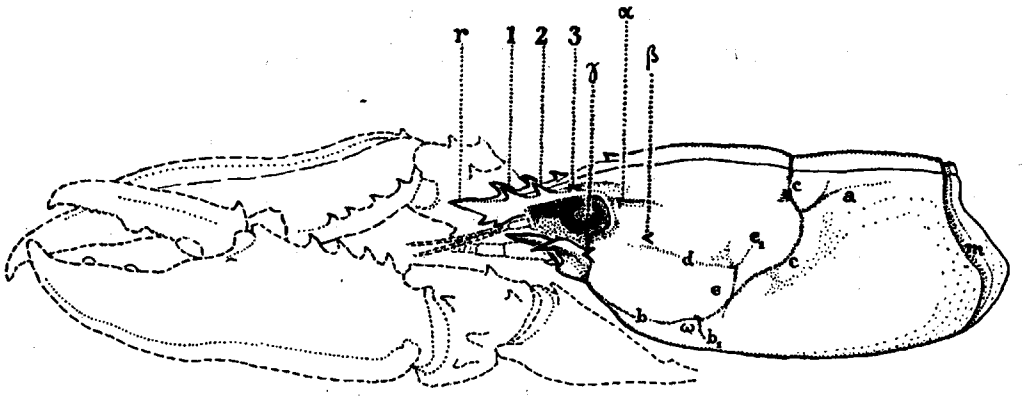


Fig. 1. The protection of the eye in an Astacuran crustacean, the American lobster, *Homarus americanus* H. Milne-Edwards, 2/3 of natural size.

For explanation of the symbols of the spines, see the text. Abbreviations of grooves on the carapace: a, branchio-cardiac; b, antennar; b_1, hepatic; c, postcervical; d, gastro-orbital; e-e_1, cervical; m, marginal. The position of the eminence omega is indicated by the Greek letter.

These protective circum-orbital spines are distributed in *Homarus americanus* H. Milne-Edwards as follows:

2 median spines on ventral surface of rostrum (unpaired)
1 tip of rostrum (unpaired)
3 spines at lateral edges of rostrum (paired)
3 spines on the carapace (paired)
1 spine on distal end of exopodital scale of antenna (paired)
1 spine on distal end of second protopodite segment of antenna (paired)

The two orbits together have 19 spines, because the 2 median spines on the ventral surface and the tip spine of the rostrum are unpaired. The 2 median spines of the ventral surface of the rostrum are present in *Homarus americanus* H. Milne-Edwards but are absent in *Homarus vulgaris* H. Milne-Edwards and in fossil species of the genus. Therefore, they will henceforth be omitted from consideration. The spines on the segments of the antenna are rarely preserved in fossil specimens. Thus are left the following spines:

1 tip of rostrum, unpaired (r)
3 lateral spines of rostrum, paired (1, 2, 3)
3 spines on carapace, paired (α, β, γ)

These 13 spines are preserved and recognizable in many fossil species of *Homarus*. However, their importance lies not only in their occurrence in this one genus but also in their occurrence in many genera. In other words, it is possible to find homologous structures in nearly all macrurous crustaceans.

In order that an unequivocal terminology may be used, these spines were labelled by Boas[1] with letters or numbers. His terminology has been used to advantage by other paleontologists and is retained here. In addition, a set of names is used for the spines.

Terminology of the circum-orbital spines of macrurous crustaceans.

Boas	*This paper*	
r	tip spine of rostrum	
1	first lateral rostral spine	on rostral ridge
2	second lateral rostral spine	on rostral ridge
3	third lateral rostral spine	on rostral ridge
α	supra-orbital spine	on carapace
β	sub-orbital spine	on carapace
γ	antennar spine	on carapace

In many instances the spines are developed from longitudinal ridges. The rostral spines are portions of the two rostral ridges (ρ), which extend along the lateral margins of the rostrum and unite in the tip spine. The supra-orbital, sub-orbital, and antennar spines are the anterior ends of more or less well-developed, longitudinal ridges or keels, which bear the terms supra-orbital, sub-orbital, and antennar ridges or keels respectively. In addition, there may be a median ridge

[1]Boas, J. E. V., Studier over Decapodernes Slaegtskabsforhold: K. danske vidensk. selsk. skr., 6 raekke, naturvid. math. Afd., vol. 1, art. 2, pp. 23-210, pls. 1-7, 1880.

(μ) along the midline of the rostrum and the carapace.

It has been mentioned above that the importance of these structures lies not only in their occurrence in the genus *Homarus* but also in their occurrence in many genera. The diagram (fig. 1) may serve to indicate the shape and arrangement of these features in the tribe *Astacura.*

The tribe *Palinura* differs from the *Astacura* in several features, among which the shape of the carapace is of concern to the present study. The carapace of the *Astacura* is subcylindrical, whereas the carapace of the *Palinura* is depressed. The shape of the carapace determines the relative position of the eyes or rather the relative distance from one eye to the other. If the carapace is subcylindrical, as in the *Astacura,* the eyes are relatively close together; if, on the other hand, the carapace is depressed, as in the *Palinura,* the eyes are comparatively far apart. If the eyes are close together they can be protected very effectively by a prominent rostrum projecting halfway between them. On the other hand, if the eyes are far apart they can not be protected effectively by a median rostrum unless the rostrum becomes unusually broad, in which case the rostrum may interfere with the essential function of the eyes. Therefore, if the eyes of the *Palinura* were to be protected, there was the choice of either broadening the median rostrum to fit the enlarged distance between the eyes or letting another organ take over their protection. In the latter case the rostrum would lose its prime function, that is, the role of protector of the eyes, and become reduced in size or even suppressed. That is precisely the condition among the *Palinura.* In this tribe the rostrum is either small or wanting (except in *Palinurellus* and the *Glypheidea*), the protection of the eyes is taken over by the supra-orbital spines (α), and the eyes are far apart. In addition, the depression of the carapace has put the antennar spines (γ) into a much more prominent and exposed position, namely, at the antero-lateral corner of the carapace. Such an exposed position necessitated the enlarging of these spines. Thus, the *Palinura* (with some exceptions) have as the most prominent features of the frontal part of the carapace the supra-orbital (α) and the antennar (γ) spines, between which the eyes find adequate protection. The diagram (fig. 2) shows the protection of the eye in *Astacodes* as an example of the *Palinura.*

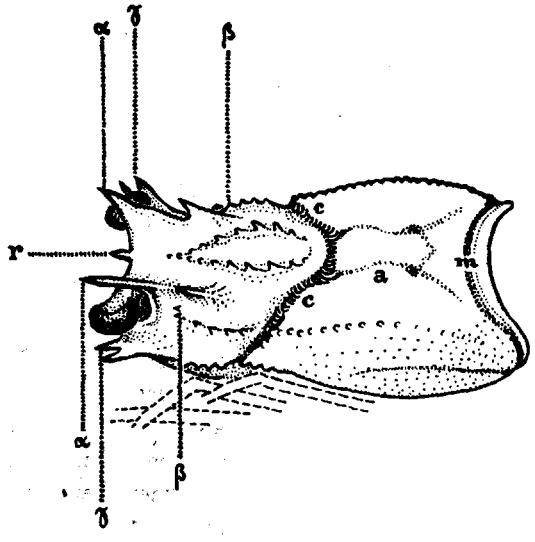
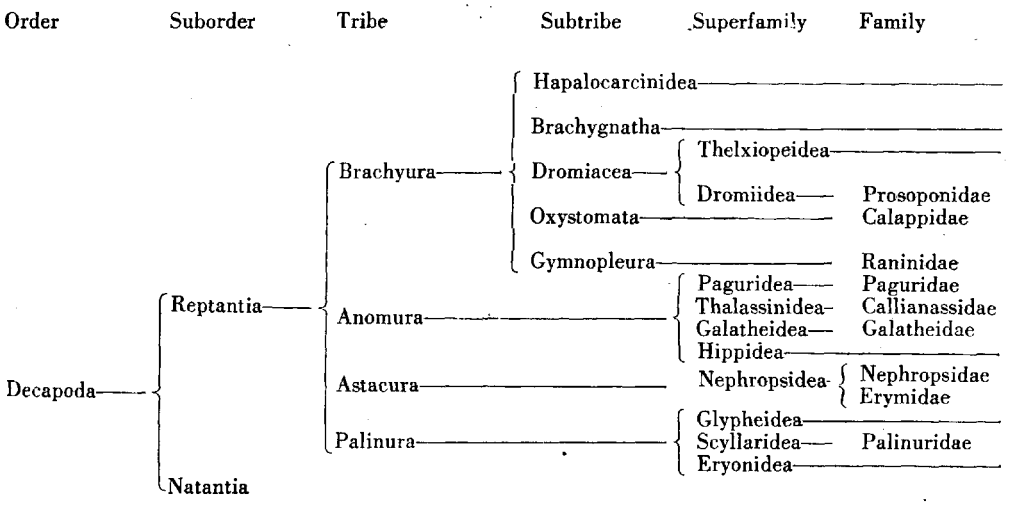


Fig. 2. The protection of the eye in a Palinuran crustacean, the fossil spiny lobster *Astacodes maxwelli* Stenzel, ⅔ of natural size.

Note the rudimentary nature of the rostrum (r) and the prominence of the spines (α) and (γ). For explanation, see text figure 1.

SCHEME OF CLASSIFICATION OF THE DECAPOD CRUSTACEANS



This scheme is not a complete classification scheme. Its intent is to show merely the relationships of the groups treated in the text. Only those families are shown which are represented by fossils treated in this report. The superfamilies are also incomplete, only those being shown which are needed for the understanding of the scheme. The subtribes and tribes of the suborder Reptantia are fully represented above.

STRATIGRAPHIC DISTRIBUTION

Genera →	Linuparus	Astacodes	Enoploclytia	Homarus	"Nephrops"	Galathea	Upogebia	Pagurus	Notopocorystes	Necrocarcinus	Cenomanocarcinus	Rathbunopon
Post-Cretaceous												
Maestrichtian												
Campanian			E. kimzeyi									
Santonian		A. maxwelli	E. sp.	H. blossomanus								
Coniacian			E. triglypta									
Turonian	L. grimmeri L. watkinsi	A. davisi		H. brittonestris H. davisi			Urhacheochir		N. dichrous	N.? ovalis	C. van-straeleni	
Cenomanian												R.? polyakron
Albian — upper	L. adkinsi	?A. wenoensis	E. walkeri E. wintoni	H. farrantensis H. dentonensis	N. americanus	G. cretacea G.? limonifica			N. parvus N. punctatus	N. graysonensis N. moseleyi N. rentroae N. texensis	C. oklahomensis C. armatus	
Albian — middle				H. travisensis				P. travisensis				
Albian — lower								P. banderensis				
Aptian												
Barremian												
Hauterivian												
Valanginian												

Note: Distribution in Texas as it is known at present is shown by solid black vertical columns; outside of Texas by white vertical columns.

Tribe PALINURA Borradaile

Superfamily SCYLLARIDEA Stebbing

Family PALINURIDAE Gray

Genus LINUPARUS A. W. White, 1847

List of Crustacea in the British Museum, p. 70.[2]
Genotype.—*Linuparus trigonus* (De Haan) living, coasts of Japan.

LINUPARUS GRIMMERI Stenzel, n.sp.

Pl. 34, figs. 1–4; Pl. 35, figs. 1, 5, 6; Pl. 45, fig. 3; text fig. 3

Linuparus grimmeri Stenzel *in* Dallas Petroleum Geologists, Geology of Dallas County, Texas, p. 35, fig. 7, 1941.

Description.—Cephalothorax elongate-rectangular in outline, about twice as long as wide; greatest width of carapace in the vicinity of the postcervical grooves (c). Carapace only very gently convex from front to back. Length of the supra-orbital spines (α) is 1/12 the carapace length; there is neither a rostrum nor an accessory spine in the intervening sinus, and the sinus is broad V-shaped with a rounded end. To either side of the supra-orbital spines the front is very nearly straight and defined by an edge, which carries a row of fine tubercles with hair-pits and which slopes downward and outward to the antennar spine (γ). This stout spine has a triangular base and points forward, outward, and upward. The lateral carapace margins are defined anterior to the postcervical grooves by the antennar keel carrying about 6 spines and 1 or 2 spinules. The first of these spines is the antennar one at the fronto-lateral corner; this is also the strongest spine of the keel. The other spines are small. The keel is sigmoid in outline as seen from above, ends abruptly at the postcervical groove, and is not continued behind that groove. Posterior to the groove the lateral margin is at first defined by a short, finely tuberculated, inclined keel nearly parallel with the outer end of the groove. This keel flattens out in posterior direction into the vertical side

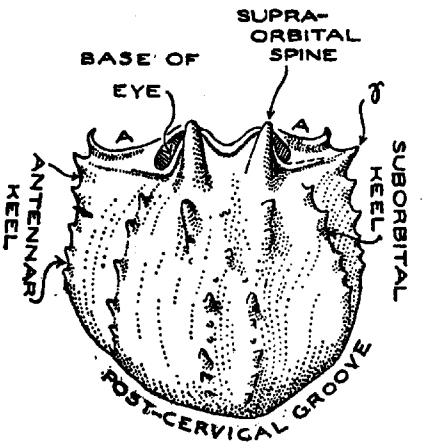


Fig. 3. *Linuparus grimmeri* Stenzel, x2, restored; carapace anterior to the postcervical grooves. A, position of antenna.

wall of the carapace. The posterior carapace margin is highly arched transversely and concave as seen from above; it has a marginal groove (m) and an elevated rim.

Surface of carapace is divided into a shorter anterior and longer posterior portion by the pair of deep and broad, V-shaped postcervical grooves, which are united in the middle by a short, broad, and shallow, transverse groove. The anterior portion of the carapace has 9 spinous keels. Two of these keels, the antennar keels, begin with the fronto-lateral spine and have been described above. Another pair, the supra-orbital keel pair, begins at the supra-orbital spines and extends in a very slight curve almost halfway to the postcervical grooves. Each supra-orbital keel carries the forward pointing supra-orbital spine, behind which is a smooth place; at the end are a forward-pointing spine and a small spinule. Between the supra-orbital and the antennar keel lies the sub-orbital keel (β). The two sub-orbital keels are gently curved, spreading to the posterior, and in line with the keel pair posterior of the postcervical grooves. They start very near the base of the supra-orbital spine and carry 5 to 6 small spines, of which the first and last ones are smaller than those in the mid-portion of the keel. In the midline and near the front is a short, obscure keel with only one small spine (μ). A fourth keel pair outlines

[2]For a discussion of nomenclatorial questions involving this genus see: Woodward, Henry, Further notes on podophthalmous crustaceans from the Upper Cretaceous formation of British Columbia, etc.: Geol. Mag., new ser., dec. 4, vol. 7, p. 394, 1900.

Woods, Henry, A monograph of the fossil macrurous Crustacea of England, pt. 2: Palaeontograph. Soc., vol. 77, pp. 26–27, 1925.

an oval area lying in the midline just in front of the postcervical grooves. Each keel carries 2 small spines and some spinules.

The portion of the carapace posterior to the postcervical grooves has 3 keels, one in midline and the pair at the lateral margins. The median keel has about 9 small spines and in some specimens one spinule just in front of the marginal groove (m). There is an additional small spine on the raised rim of the posterior margin. The paired keels carry each about 20 small, forward-pointing spines. The mid-portion of the carapace is roof-shaped; the two halves make an obtuse angle of 150° at the midline; the side walls are gently convex, slope down with a slight divergence from the outer keels, and are edged with a raised margin at the bottom. The surface of the carapace is covered with tiny spinules pointing forward and upward.

The abdomen has 3 spinous, longitudinal keels in line with the 3 keels of the posterior portion of the carapace. Each of the lateral keels is represented by 2 spines on each abdominal somite except on the first, which does not have any. The posterior of these two lateral spines is always the smaller; it may even be absent. The median keel is represented by one central, laterally compressed spine on the first somite, by two laterally compressed spines on the second, third, fourth, and fifth somites. On the sixth somite there are along the midline two parallel keels about 1 mm. apart, each carrying 4 spinules. The telson carries 2 spinules about 1 mm. apart.

Sternum narrow-triangular in outline, with a very low, broad tubercle on the anterior tip. Each sternite is separated from its successor by a pair of lateral, oblique incisions. The lateral edges of each sternite except the last are turned up and appear in outline concavely divergent toward the posterior. This upturned edge is surmounted in all sternites except the last by a tubercle, which is situated near or at the middle of the edge. The anterior and posterior corners of this upturned edge are drawn out into tubercle-like points. The fifth sternite has two small transverse tubercles transversely arranged near its center.

Antennae much longer than the carapace. Of the peduncular joints 3 are visible; they are spinous. The flagellum is slender and cylindrical, but with a longitudinal groove on its upper surface. Each flagellar segment has a row of hair-pits encircling its anterior margin.

Dimensions.—Syntype 1, length of carapace, 23.7 mm., width, 12.0 mm.; syntype 2, length of carapace, 30.7 mm., width, 15.5+ mm.; syntype 3, width of carapace from one antennar spine to the other, 28.3 mm.; syntype 4, width of carapace (crushed), 20.2 mm., length of carapace, 38.8 mm.

Remarks.—This species is found at the same locality as *Linuparus watkinsi* Stenzel. Therefore, the differences between the two species need to be emphasized.

Linuparus grimmeri Stenzel is slenderer than *L. watkinsi* Stenzel. The proportions of length of carapace to the distance between the paired lateral keels is as follows:

L. grimmeri Stenzel	2.33 to 1
L. watkinsi Stenzel	2.07 to 1

The front of *L. grimmeri* Stenzel has simple supra-orbital spines without accessory spines in the sinus intervening between the two spines, and the sinus is broad V-shaped with a rounded end. The front of *L. watkinsi* Stenzel has supra-orbital spines with accessory spines in the intervening sinus, and the sinus is U-shaped.

All spines of *L. grimmeri* Stenzel are weaker and smaller than the corresponding ones in the other species. However, some of the keels have more spines on *L. grimmeri* Stenzel than on the other species; this is particularly true of the 3 keels of the carapace posterior of the postcervical grooves. Granulation and tuberculation of the carapace surface is less rough in *L. grimmeri* Stenzel than in the other species. The two species may be distinguished at a glance by the greater roughness of *Linuparus watkinsi* Stenzel.

The species is named in honor of Mr. R. A. Grimmer of Dallas, who kindly donated syntype 1. Ten of the types were collected by Mr. W. T. Watkins and one by Mr. Forrest Kirkland of Dallas.

Type data.—Fourteen syntypes, Bureau of Economic Geology, The University of Texas, Austin, Texas.

Type locality.—California Crossing, north-facing bluff on right bank of Elm Fork of Trinity River upstream from and at Chicago, Rock Island & Pacific Railroad bridge, in southwest corner of Joshua McCants survey, on O'Connor dairy land, about 10 miles northwest of Dallas, Dallas County, Texas.

This locality appears to be the same as locality No. 16 of Moreman.[3] According to Moreman this was the site of Horton's Mill, where many of Hyatt's[4] Cretaceous ammonites were collected.

Geologic horizon.—Britton formation of Eagle Ford group, Gulf series, Cretaceous (lower Turonian or Salmurian).

At California Crossing the following fossils are found:

Chordata—Vertebrata:
- Teleost fin bones and vertebrae

Arthropoda—Crustacea:
- Linuparus grimmeri Stenzel
- Lin. watkinsi Stenzel
- Astacodes davisi Stenzel
- Homarus brittonestris Stenzel
- Homarus davisi Stenzel
- Upogebia rhacheochir Stenzel
- Notopocorystes dichrous Stenzel
- Cenomanocarcinus vanstraeleni Stenzel

Mollusca—Cephalopoda:
- Baculites gracilis Shumard
- Scaphites sp.
- Worthoceras vermiculus (Shumard)
- Neocardioceras septem-seriatum (Cragin)
- Eucalycoceras sp.
- Metoicoceras whitei Hyatt
- Proplacenticeras sp.
- Allocrioceras annulatum (Shumard)

Mollusca—Gastropoda:
- Naticoid indet.
- Cerithiid indet.

Mollusca—Pelecypoda:
- Inoceramus fragilis Hall & Meek

Echinodermata—Echinoidea:
- Echinoid indet.

Echinodermata—Ophiuroidea:
- Ophiuroid undescribed

LINUPARUS WATKINSI Stenzel, n.sp.

Pl. 34, figs. 5–8; Pl. 45, figs. 1, 2; text fig. 4.

Linuparus watkinsi Stenzel *in* Dallas Petroleum Geologists, Geology of Dallas County, Texas, p. 36, fig. 8, 1941.

[3]Moreman, W. L., Paleontology of the Eagle Ford group of north and central Texas: Jour. Paleontology, vol. 16, no. 2, p. 197, 1942.

[4]Hyatt, Alpheus, Pseudoceratites of the Cretaceous: U. S. Geol. Survey Mon. 44, 1903.

Description. — Cephalothorax elongate-rectangular in outline, less than twice as long as wide; greatest width of carapace in the vicinity of the postcervical grooves (c). Carapace only very gently convex from front to back. Front of carapace nearly straight except for the projecting supra-orbital spine pair (α). Length of these spines is 1/8 the carapace length; each spine carries a short, accessory spine halfway down in the intervening sinus; the end of this sinus is U-shaped. To either side of the supra-orbital spine pair, the front is very gently concave or slightly flexuous in outline and defined by a finely tuberculate edge, which slopes downward and outward to the fronto-lateral corner. The front ends in a short, stout, forward and outward-pointing antennar spine (γ) with triangular base located at the extremity. The lateral margins of the

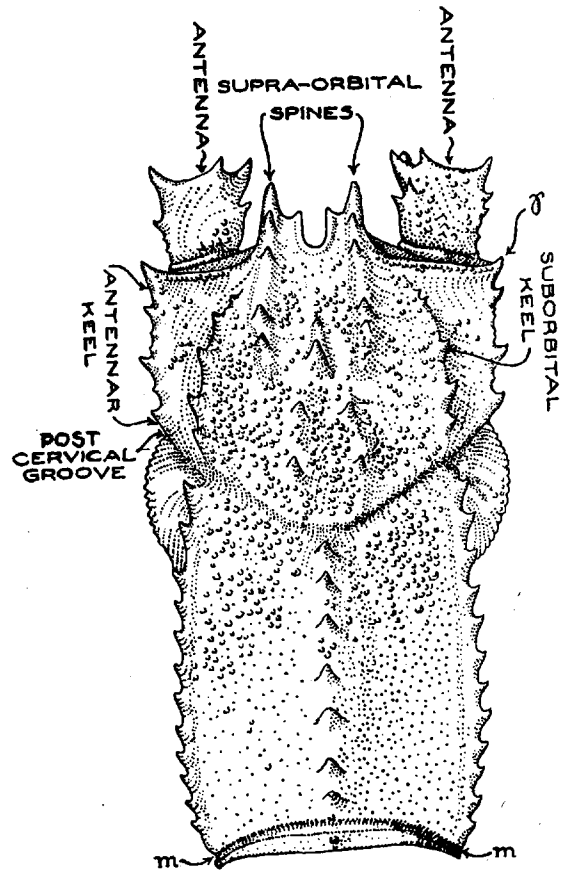


Fig. 4. *Linuparus watkinsi* Stenzel, x2; composite of several specimens: carapace with parts of antennae.

carapace are defined anterior to the postcervical grooves by an antennar keel carrying 4 spines and a few irregular accessory spinules. The first of these spines is the antennar one at the fronto-lateral corner. This keel is gently sigmoid in outline, ends abruptly at the postcervical groove, and is not continued behind that groove. Posterior to the postcervical groove the lateral margin is at first defined by a short, densely tuberculated, inclined keel nearly parallel with the outer end of the groove. This keel flattens out in posterior direction into the vertical side wall of the carapace. Posterior margin of carapace highly arched in transverse direction and slightly concave as seen from above; it has a marginal groove (m) and an elevated rim.

Surface of carapace divided into a shorter anterior and longer posterior portion by the pair of deep and broad, V-shaped postcervical grooves, which are united in the middle. The anterior portion of the carapace has 9 spinous keels. Two of these 9 keels, the antennar keels, begin at the fronto-lateral corner, follow the lateral margin, and have been described above. Another pair, the supra-orbital keels, begins at the supra-orbital spines and extends in a slight curve almost halfway to the postcervical grooves. Each keel of this pair carries two unequal, closely spaced spines and some minor tubercles situated behind a low and smooth portion of the keel. To the front of this smooth portion the keel is a part of the supra-orbital spine; it is spinulous and merges into the tip of the spine. Between this keel pair and those at the lateral carapace margin lies the sub-orbital keel pair (β). These are gently curved, spreading to the posterior, and in line with the lateral keel pair posterior to the postcervical grooves. They start very near the base of the supra-orbital spine and carry 4 to 5 unequal spines, of which the first and last ones are smaller than those in the mid-portion of the keel. In the midline and near the front is a short, indistinct keel (μ) with either one spine or two unequal spines and some minor tubercles. A fourth keel pair outlines an oval area lying in the midline just in front of the grooves. Each keel carries 2 large spines and some minor spines and spinules.

The portion of the carapace posterior to the postcervical grooves has 3 keels, one in midline and the pair at the lateral margins. The median keel has 7 major spines and few accessory minor spines. In line with this keel and separated from it by the posterior marginal groove, there is a spine on the raised posterior margin. The paired keels carry each 12 major spines. The mid-portion of the carapace is roof-shaped; the two halves make an obtuse angle of 125° at the midline; the side walls slope down vertically or converge slightly downward from the outer keels and are edged at the bottom with a raised margin. The surface of the carapace is rough with scattered, tubercular hair sockets directed forward and upward.

Sternum narrow-triangular in outline, with a low, broad tubercle on the anterior tip. Each sternite is separated from its successor by a pair of lateral, oblique incisions. The lateral edges of each sternite except the last are turned up and appear in outline concavely divergent toward the posterior. This upturned edge is ornamented with a row of small tubercles in the first sternite; in the second and third sternites the edge has a small tubercle at the anterior corner and a high, compressed tubercle slightly anterior of the middle of the edge; in the fourth sternite there is, in addition to these two tubercles, a third one at the posterior corner of the edge; the fifth sternite has a high, two-headed tubercle in its center and short, straight, parallel, only slightly upturned lateral edges with a small tubercle at the anterior corner and a few small tubercles following. The posterior margin of the sternum is highly arched in transverse direction and carries a row of tubercles along its rim.

Abdomen has 3 spinous, longitudinal keels in line with the 3 keels of the posterior portion of the carapace. Each of the lateral keels is represented by 2 spines on each abdominal somite, except on the first, which does not have any. The median keel is represented by one central spine on the first and second somites, by two laterally compressed

spines fortified by a few spinules on the third somite, by 4 spines arranged in groups of two on the fourth somite, and by two simple spines on the fifth somite. On the sixth somite there are along the midline two short, parallel keels about 1 mm. apart, each carrying 3 spinules. The pleura of the abdominal somites have serrated edges. The telson carries a spine on the midline near its anterior edge and has parallel sides. The uropods are narrow; their edges are sigmoid in outline.

Dimensions.—Syntype 1, length of carapace with exclusion of the supra-orbital spines, 25.7 mm., width, 14.6 mm.; syntype 2, width of carapace, 21.5 mm., length of sternum, 19.8 mm., greatest width of sternum, 11.9 mm.; syntype 3, width of carapace, 23.5 mm., length of supra-orbital spines, 4.0 mm.; syntype 4, length of carapace with exclusion of the supra-orbital spines, 30.0 mm., width, 18.7 mm.

Remarks.—This species is easily distinguished from most North American Cretaceous species of *Linuparus*. In *L. adkinsi* Rathbun,[5] *L. kleinfelderi* Rathbun,[6] and *L. vancouverensis* (Whiteaves),[7] crowded tubercles cover the keels of the carapace and spines are rare, being restricted to the anterior ends of the keels. *Linuparus watkinsi* Stenzel with its keels spinous throughout is much rougher than these species. However, *L. canadensis* (Whiteaves)[8] is very nearly related to *L. watkinsi* Stenzel. The Canadian species is much larger in size, being about 3 times as large as *L. watkinsi* Stenzel, but has very similar spinous keels. The most readily recognized difference is the arrangement of the spines in the middle of the carapace anterior to the postcervical grooves. According to Whiteaves (p. 88), in *L. canadensis* (Whiteaves) "next to the furrow, and in advance of it, in the median line, there are five tubercles arranged in two convergent rows of two pairs and an odd one, which if connected by lines, would have much the shape of an isosceles triangle, with its base near the furrow." The same spines of *L. watkinsi* Stenzel do not form a true triangle, because the two equal sides are curved with the convexity outward. There are also a few minor accessory spinules in these lines in *L. watkinsi* Stenzel, but not in *L. canadensis* (Whiteaves). The same is true of accessory spines along the supra-orbital keels.

If the ventral carapace surface described by Woodward[9] really belongs to *Linuparus canadensis* (Whiteaves) there are several differences in the tubercles of the two related species. Each sternite of *L.* cf. *canadensis* (Whiteaves) Woodward is ornamented with a pair of rounded, subcentral tubercles, except the first sternite. These tubercles are absent in *L. watkinsi* Stenzel, but there is in their stead a high, double-headed median tubercle on the last sternite.

The species is named in honor of Mr. W. T. Watkins of Dallas who collected three of the types of this species.

Type data.—Six syntypes, Bureau of Economic Geology, The University of Texas, Austin, Texas.

Type locality.—Same as *Linuparus grimmeri* Stenzel.

Geologic horizon.—Same as *Linuparus grimmeri* Stenzel.

Genus ASTACODES Th. Bell, 1863

A monograph of the fossil malacostracous Crustacea of Great Britain, pt. 2, Crustacea of the Gault and Greensand: Palaeontograph. Soc., vol. 14, pp. 30–31.

Genotype.—*Astacodes falcifer* Bell from the Speeton clay (Hauterivian) of England. Genotype by monotypy.

ASTACODES MAXWELLI Stenzel, n.sp.

Pl. 35, figs. 2–4; Pl. 45, figs. 4–6; text figs. 2, 5.

Description. — Cephalothorax elongate in outline, not quite twice as long as wide; greatest width about halfway between the postcervical grooves and the posterior end. Carapace nearly straight from front to back and rounded-rectangular in transverse cross section. Carapace

[5]Rathbun, M. J., Fossil Crustacea of the Atlantic and Gulf Coastal Plain: Geol. Soc. Amer., Spec. Paper 2, p. 37, pl. 10, figs. 4–10, 1935.

[6]*Idem*, pp. 35–36; pl. 8; pl. 9, figs. 1–2; pl. 25.

[7]Woodward, Henry, Further notes on podophthalmous crustaceans from the Upper Cretaceous formation of British Columbia, etc.: Geol. Mag., new ser., dec. 4, vol. 7, pp. 395–396, pl. 15, 1900.

[8]Whiteaves, J. F., Contributions to Canadian paleontology, vol. 1: Geol. Nat. Hist. Survey Canada, pp. 87–88, pl. 11, 1885.

[9]*Op cit.*, pl. 16, fig. 1.

divided by the deep and wide postcervical grooves (c) into a smaller anterior and a larger posterior portion. Front of carapace nearly straight except for a short, narrow, projecting median rostrum. The rostrum is 1/20 of the carapace length. The rostrum is simple; its top surface flat, the sides vertical. To both sides of the rostrum the front rises concavely upward to the supra-orbital spine-ridges (a). These ridges are high, laterally compressed, widely separated, and upward divergent; backward they continue as low, rounded ridges for a short distance and disappear about midway between the front and postcervical furrows; they carry a strong, forward and upward-pointing spine posterior of the laterally compressed, frontal portion; only the bases of these spines are preserved. The gastric region is moderately convex and bears two lines of spinules or spines, which converge forward at an acute angle; their junction is their end and lies in the concave space between the supra-orbital spine-ridges; to the rear the two lines of spinules curve, become parallel, and disappear before reaching the postcervical grooves. The spinous sub-orbital keels (β) start at the front near the supra-orbital spine-ridges, curve with their convexity outward, and continue to the postcervical grooves; the size of these keels and their spines increases gradually to the back so that the anterior portion is a mere row of spinules and the posterior portion a spinous ridge; these ridges are in line with the rounded, obtuse, obsolete, lateral keels of the carapace, which are posterior to the postcervical grooves. A fourth pair of spinous ridges, the antennar keels (γ), is on the anterior portion of the carapace starting at its fronto-lateral corner; the anterior portion of this ridge is a high, laterally compressed two-pronged spine subparallel with and similar to the supra-orbital spine-ridge; to the rear this narrow ridge descends rapidly and forms a low keel, which extends to the groove and carries 3 to 4 spines in a row in front of the groove. Posterior to the groove this keel continues for about one centimeter and carries 2 or 3 spines.

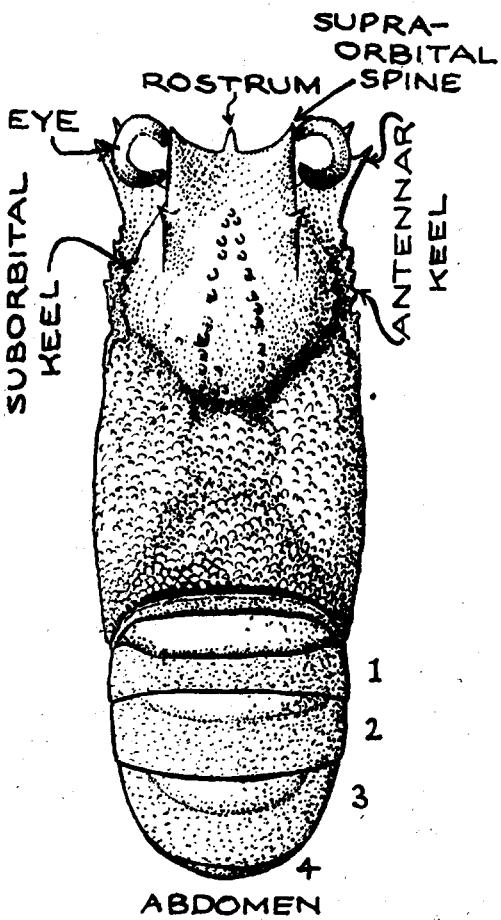


Fig. 5. *Astacodes maxwelli* Stenzel, x1; composite of several specimens.

The mid-portion of the postcervical grooves is transverse; the side portions are at right angles. From the mid-portion there extend backward the sigmoidally curved, shallow, and inconspicuous branchio-cardiac grooves (a), the posterior ends of which are connected by a very shallow transverse depression; a short groove radiates from the posterior end of each branchio-cardiac groove in the direction of the postero-lateral corner of the carapace. A narrow groove starts at each postero-lateral corner of the carapace and curves gently on the side walls of the carapace forward to the ends of the postcervical groove.

The posterior portion of the carapace is gently convex along the midline; toward the sides it is delimited by an obtuse,

rounded, obsolete, longitudinal angulation, which is sharper near the groove than at the posterior margin; the side walls are gently convex and converge slightly downward. The posterior margin is highly arched in transverse direction and concave as seen from above. It is edged by a deep marginal groove (m), which is wider in the middle and narrows down to the sides; this deep and narrow marginal groove continues forward along the ventral margins of the carapace. The posterior portion of the carapace is covered with many forward-pointing, subsquam form tubercles; the anterior portion carries some scattered, forward-pointing spinules.

Abdominal terga convex in transverse direction, flat in longitudinal direction; covered with numerous pits if not decorticated. Ambulatory legs long, slender, oval in cross section.

Dimensions.—Syntype 1, length of carapace, 62.5 mm., width of carapace, 37.0 mm.; syntype 2, length of carapace, 68.0 mm., width of carapace, 40.5 mm.; syntype 3, width of carapace, 33.9 mm.; syntype 4, length of carapace, 61.3 mm., width of carapace, 37.2 mm.

Remarks.—Hitherto the genus *Astacodes* was represented only by its type species, *Ast. falcifer* Bell, which was first mentioned as *Palinurus uncinatus* Phillips[10] in 1835. After 100 years the second and third species of the genus have been discovered. The 100 years attest to the rarity of the material. The second species, *Ast. maxwelli* Stenzel, extends the known stratigraphic range of the genus from the Hauterivian to the Santonian.

Both species are remarkably alike in many respects. The differences seem to be minor. *Astacodes falcifer* Bell has 2 spines in a row behind the supra-orbital spine-ridge; *Ast. maxwelli* Stenzel only one. *Astacodes falcifer* Bell has a double row of tubercles along the midline of the carapace between the postcervical grooves and the posterior margin; in *Ast. maxwelli* Stenzel there is no special arrangement of tubercles along that line. The abdominal terga of *Ast. maxwelli* Stenzel lack a median carina. The Texan species is also more than twice the size of the English.

The species is named in honor of Mr. J. B. Maxwell of Roxton and of Mr. Carlisle Maxwell of San Antonio. It is through the efforts of these gentlemen that much of the material was secured for scientific study.[11]

Type data.—Thirteen syntypes, Bureau of Economic Geology, The University of Texas, and the Texas Memorial Museum, Austin, Texas. One of the specimens is a loan from Mr. Carlisle Maxwell of San Antonio, Texas.

Type locality.—Quarries on east side of State highway No. 188 (Roxton-High road) extending from the vicinity of Arkansas Church, 2.1 miles, to 1.1 miles north of the railway depot in Roxton, southwestern Lamar County, Texas.

Geologic horizon.—The specimens occur in concretionary portions of the rock. The concretions are formed around the fossil lobsters and teleost fishes and are bright red-maroon on outside and buff inside. The rock is a granular, cross-bedded, slightly glauconitic, oölitic limestone, which R. T. Hill called the Roxton beds.[12] These beds are the top portion of the Gober[13] chalk tongue of the Austin chalk, Gulf series, Cretaceous. The age of the beds is Santonian.

ASTACODES DAVISI Stenzel, n.sp.

Pl. 36

Description. — Cephalothorax elongate in outline, a little more than twice as long as wide; greatest width about halfway between the postcervical grooves and the posterior end. Carapace apparently nearly straight from front to back and rounded-rectangular in transverse section. Carapace divided by the deep and wide postcervical grooves (c) into a smaller anterior and a larger posterior portion. Front

[10]Phillips, J., Illustrations of the geology of Yorkshire; or, A description of the strata and organic remains of the Yorkshire Coast, 2d ed., pt. 1, p. 170, 1835.

[11]Assistance in the collection and preparation of these materials was furnished by the personnel of Work Projects Administration Official Project No. 665-66-3-233.

[12]Hill, R. T., Geography and geology of the Black and Grand Prairies, Texas: U. S. Geol. Survey, 21st Ann. Rept., pt. 7, pp. 114, 340, 1901.

[13]Stephenson, L. W., Notes on the stratigraphy of the Upper Cretaceous formation of Texas and Arkansas: Bull. Amer. Assoc. Petr. Geol., vol. 11, p. 8, 1927.

of carapace nearly straight except for a short, narrow, projecting median rostrum. The rostrum is 1/20 of the carapace length. It is simple; the top surface is arched. To both sides of the rostrum the front rises concavely upward to the supra-orbital spine-ridges (α). These ridges are high, laterally compressed, widely separated, and upward divergent; backward they continue for a short distance carrying two spines, of which the posterior one is the smaller; the ridges disappear posterior to the latter spine about halfway between the front and the postcervical furrows. The gastric region is moderately convex and bears two lines of small spines, which converge forward at an acute angle; at their junction near the base of the rostrum there is a small, compressed spine and a spinule anterior to that; to the rear the two lines become parallel; each line has 4 laterally compressed, small spines and one spinule in the following sequence from front to back: spinule-interval-spine-interval-spine-long interval-spine-short interval-spine-postcervical groove. These two lines are continued posterior of the postcervical grooves, where the two lines converge again. Each line carries about 4 laterally compressed, subsquamiform tubercles, which are a little larger than those covering the remainder of the carapace. The sub-orbital lines (β) of spines start at the front near the supra-orbital spine-ridges, curve with their convexity outward to the postcervical grooves; the size of the spines increases gradually to the back; there are 4 small, forward-pointing spines in each line. These lines are in line with the rounded, obtuse, obsolete lateral keels of the carapace, which are posterior to the postcervical grooves. A fourth pair of spinous ridges, the antennar keels (γ), is on the anterior portion of the carapace starting at its fronto-lateral corner; each of these ridges carries 4 laterally compressed spines, which decrease in size to the posterior.

The mid-portion of the postcervical grooves is short and transverse; the side portions are curved sigmoidally.

The posterior portion of the carapace is gently convex along the midline; toward the sides it is delimited by an obtuse, rounded, obsolete, longitudinal angulation; the side walls are gently convex. The posterior margin is highly arched in transverse direction and concave as seen from above. It is edged by a deep marginal groove (m), which is wider in the middle and narrows down to the sides. The posterior portion of the carapace is completely covered with many forward-pointing, subsquamiform tubercles. The anterior portion carries many scattered spinules.

Abdominal terga convex in transverse direction, flat in longitudinal direction; each tergum has several either shallow or sharp transverse grooves; some parts of each tergum are punctate while others are finely tuberculate. A narrow, small median keel is present in terga 2 to 4. Each margin of a pleurum is lobulated and has a spine and several succeeding spinules. The telson has many fine, backward-pointing spinules. The uropods are smooth.

Dimensions.—Holotype, length of carapace exclusive of rostrum, 51 mm., length of rostrum, 2.5 mm., width of carapace, 23 mm.

Remarks.—This species is readily distinguished from *Astacodes falcifer* Bell by the different arrangement of spinules along the midline of the carapace. In other respects *Ast. davisi* Stenzel has closer relationship to *Ast. falcifer* Bell than *Ast. maxwelli* Stenzel.

The species is named in honor of Mr. Eugene Elmer Davis of Dallas, Texas, who collected the fine holotype specimen and kindly put it at the writer's disposal for description. The paratype was collected by the late Mr. Forrest Kirkland of Dallas.

Type data.—Holotype and paratype, the latter a portion of an abdomen, Bureau of Economic Geology, The University of Texas, Austin, Texas.

Type locality.—Same as *Linuparus grimmeri* Stenzel.

Geologic horizon.—Same as *Linuparus grimmeri* Stenzel.

Tribe ASTACURA Borradaile

Superfamily NEPHROPSIDEA Alcock

Family ERYMIDAE Van Straelen

Genus ENOPLOCLYTIA F. McCoy, 1849

On the classification of some British fossil Crustacea, with notices of new forms in the University collection at Cambridge: Annals and Mag. Nat. Hist., ser. 2, vol. 4, p. 330.

Genotype.—*Enoploclytia leachii* (Mantell) from the Chalk (Turonian to Campanian) of England.

According to Woods[14] the genera *Palaeastacus* T. Bell 1850 (Bell, Th., Notes on the Crustacea of the Chalk formation, *in* Dixon, F., Geology and fossils of the Tertiary and Cretaceous formations of Sussex, p. 344, London, 1850; genotype *Palaeastacus dixoni* Bell *in* Dixon, p. 344, pl. 38, figs. 1–4, from the Lower Chalk (Cenomanian) of England) and *Phlyctisoma* T. Bell 1863 (Bell, Th., A monograph of the fossil malacostracous Crustacea of Great Britain, pt. 2: Palaeontograph. Soc., vol. 14, p. 34, 1863; genotype *Phlyctisoma tuberculatum* Bell, *ibid.*, p. 35, pl. 11, figs. 1–8, from the Cambridge greensand (Upper Albian) of England) do not differ in any essential respect from the genus *Enoploclytia*. The two former genera are, therefore, later synonyms of the latter genus, which takes precedence over them by reason of priority. It is obvious that Wood's conclusion must be respected, because he had available for his study materials comprising the genotype species of all three genera.

The North American species of *Enoploclytia* are in confusion. This confusion is due to wrong generic assignments and to the lack or neglect of stratigraphic information. The writer has attempted to eliminate some of the existing confusion and gives below a summary of all species of the genus reported from the United States of America:

Tertiary species of Enoploclytia:

(?) Enoploclytia selmaensis (Rathbun)
Paleocene, Alabama

Enoploclytia tumimanus (Rathbun)
Paleocene, Alabama

Cretaceous species of Enoploclytia:

Enoploclytia kimzeyi (Rathbun)
Campanian, Texas

Enoploclytia sp. Stenzel
Santonian, Texas

Enoploclytia triglypta Stenzel
Coniacian, Texas

Enoploclytia walkeri (Whitfield)
Upper Albian, Texas

Enoploclytia wintoni Stenzel
Upper Albian, Texas

Species which have been referred to Enoploclytia but are of doubtful generic position or validity:

"Enoploclytia" sculpta Rathbun
Maestrichtian, Tennessee

"Enoploclytia" wenoensis Rathbun
Upper Albian, Texas

Enoploclytia(?) sp. Rathbun
Campanian or Maestrichtian, Mississippi

ENOPLOCLYTIA KIMZEYI (Rathbun)

Palaeastacus kimzeyi Rathbun, M. J., Fossil Crustacea of the Atlantic and Gulf Coastal Plain: Geol. Soc. Amer., Spec. Paper 2, pp. 23–24; pl. 2, figs. 15–21, 1935.

Remarks.—This *Enoploclytia* has the postcervical groove (c) extending far down and joining the anterior branch of the hepatic groove (b_1) just behind the eminence omega.

Type data.—Holotype, No. 73797, and paratypes, No. 73841, U. S. National Museum, Washington, D.C.

Type locality.—About 3 miles southwest of Farmersville, Collin County, Texas; holotype, A. H. Kimzey collector, 1926, and paratypes, L. W. Stephenson collector, 1927, Coll. No. 13784.

Geologic horizon.—Base of Wolfe City sand of Taylor group, Gulf series, Upper Cretaceous (Campanian).

ENOPLOCLYTIA sp. Stenzel, n.sp.

Pl. 37, figs. 4–6

Description.—This species is mentioned only because it occurs with *Astacodes maxwelli* Stenzel. The material available consists of the dorsal part of a partly pressure-deformed carapace, a cheliped, and parts of the ambulatory legs.

Carapace traversed by deep grooves. Cervical groove (e-e_1) is the deepest and sharpest, begins at midline of carapace, and descends nearly in a straight line steeply forward. Groove (d) is broad and

[14]Woods, Henry, A monograph of the fossil macrurous Crustacea of England, pt. 6: Palaeontograph. Soc., vol. 82, pp. 81–86, 1930.

shallow and extends for only a short distance forward from the cervical groove. Postcervical groove (c) composed of two parts. It begins broad, shallow, and winding near the midline, then continues more sharply incised obliquely forward and downward, and ends not far from groove (e-e_1). Postcervical groove (c) is joined from below by the deeply incised hepatic groove (b_1). Branchio-cardiac groove (a) begins at the midline of the carapace immediately posterior to the postcervical groove (c) and descends obliquely and shallows out at about the middle of the side. Marginal groove (m) deep and sigmoidally curved at the posterior carapace margin.

Spiniform tubercles are present anterior to the grooves (a). Posterior to these grooves the carapace carries only slightly raised hair-pits.

Manus elongate, tumid-oval in cross section, with many hair-pits and few blunt tubercles or spines. Carpus with a few prominent spines and many hair-pits. Merus of cheliped with many hair-pits and a few spines; these are particularly concentrated at the distal margin; the two most prominent spines are at the two hinge points.

Dimensions.—Length of carapace without rostrum, 9 cm.; height of manus, 1.8 cm.

Type data.—Monotype, Bureau of Economic Geology, The University of Texas, Austin, Texas.

Type locality.—Same as *Astacodes maxwelli* Stenzel.

Geologic horizon.—Same as *Astacodes maxwelli* Stenzel.

ENOPLOCLYTIA TRIGLYPTA Stenzel, n.sp.

Pl. 37, figs. 1–3; text figs. 6, 7

Description.—Carapace traversed by deep and sharp grooves. Cervical groove (e-e_1) slightly convex to the anterior, winding near the midline of the carapace; side walls of the cervical groove unequal in slope, anterior side wall gently sloping, posterior side wall very steep, in some places even vertical. Postcervical groove (c) sigmoid in outline, deep and steep-sided near the midline but shallowing and disappearing laterally. Branchio-cardiac groove (a) nearly parallel to the postcervical groove and undulating in outline, deep and steep-sided throughout its course, but widening toward the hepatic groove. Hepatic groove (b_1) very broad and shallow, concave toward the midline, but with an abrupt turn around the swelling omega. Antennar groove (b) concave toward the midline, broadening and shallowing in anterior direction. Inferior groove (i) concave toward the anterior, broad and deep, its anterior side wall less steep than its posterior one.

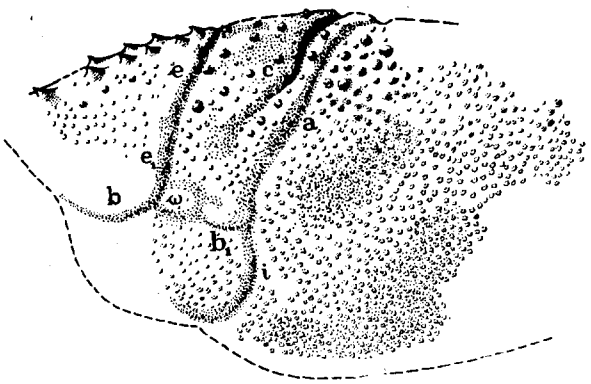


Fig. 6. *Enoploclytia triglypta* Stenzel, x1; left side of incomplete carapace.

The front is to the left, the dorsum at the top of the figure. Abbreviations of grooves: a, branchio-cardiac; b, antennar; b_1, hepatic; c, postcervical; e-e_1, cervical; i, inferior; ω, eminence omega.

Swelling omega (ω) distinct and elongate in shape. Carapace covered with regularly spaced, spiniform tubercles, each of which has a hair-pit on the anterior slope just below the tip. These spiniform tubercles are coarser toward the midline of the carapace than toward the lateral margins. The area above the groove (b_1) is nearly devoid of such tubercles. Three oblique rows of spines are in the space between the cervical and postcervical grooves on each side of the carapace. Three longitudinal rows of spines are anterior to the cervical groove on each side of the carapace. The pair of spine rows which is along the midline of the carapace seems to be continuous nearly to the posterior margin of the carapace.

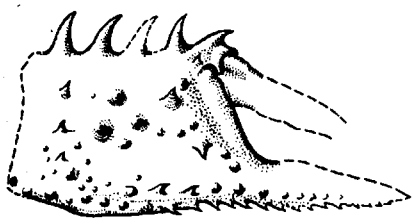


Fig. 7. *Enoploclytia triglypta* Stenzel, x1; incomplete manus.

Manus short and stout, but longer than high; upper margin with 4 or 5 curved strong spines; lower margin with many smaller spines; outer surface with scattered spines of intermediate size. Attached finger incompletely preserved, but apparently not longer than the manus.

Dimensions. — Syntype 1, preserved length of carapace, 7.8 cm., preserved height of carapace, 5.0 cm.; syntype 2, preserved height of carapace, 6.2 cm.; syntype 3, length of manus, 2.9 cm., height of manus, 2.2 cm.

Remarks.—This species is represented by fragments of the carapace and a manus. The fragments are insufficient for a complete and comprehensive description of the species, but they are sufficient to characterize the species and to distinguish it from other species of the genus.

Among the English species of the genus, *Enoploclytia dixoni* (Bell)[15] seems strikingly similar to *En. triglypta* Stenzel in the outline of the grooves and rows of spines on the carapace. However, that English species is much smaller in size than the Texan species. One might be tempted to place the Texan material with the English species were it not for the large geographic separation of the two species.

For a discussion of the differences among *En. triglypta* Stenzel and some North American Cretaceous species of the genus, see the remarks under *En. walkeri* (Whitfield).

The specific name *triglypta* is derived from the Greek τρι, "three," and γλυπτος, "carved" or "grooved," and refers to the three prominent grooves of the carapace of this species.

Type data.—Three syntypes consisting of a fragment of the right side of the carapace (syntype 1), fragments of both sides of the carapace (syntype 2), and a chela (syntype 3), Bureau of Economic Geology, The University of Texas, Austin, Texas.

Type locality.—Rock pit on south side of an east-west road, by road 4.66 miles southeast of Savoy, Fannin County, Texas. Material was collected under supervision of Mr. Lloyd J. Ryman.[16]

Geologic horizon.—Chalk of Ector tongue of the Austin chalk, Gulf series, Cretaceous (Coniacian).

ENOPLOCLYTIA WALKERI (Whitfield)

Pls. 38, 39; text figs. 8, 9

Paramithrax? walkeri Whitfield, R. P., *in* White, C. A., Contributions to invertebrate paleontology, No. 2, Cretaceous fossils of the western states and territories: U.S. Geol. and Geog. Survey Terr. 12th Ann. Rept., pt. 1, sect. 1, pp. 37–38; pl. 16, fig. 1a-c; pl. 17, fig. 1a, 1880.

Merrill, G. P., Catalogue of the type and figured specimens of fossils, minerals, rocks, and ores: U.S. Nat. Mus. Bull. 53, pt. 1, p. 484, 1905.

Adkins, W. S., Handbook of Texas Cretaceous fossils: Univ. Texas Bull. 2838, p. 83, 1928.

Palaeastacus walkeri? Rathbun, M. J., Fossil Crustacea of the Atlantic and Gulf Coastal Plain: Geol. Soc. Amer., Spec. Paper 2, pp. 21–23; text fig. 1; pl. 3, figs. 7–9; pl. 4, figs. 1, 2; pl. 5, fig. 4. Not pl. 5, figs. 1–3, 1935.

Original description.—This species is represented only by the claw and part of the penultimate joint of the right anterior limb. The specimen is of a short, rather compact and robust form, and somewhat triangular in transverse section. The length of the hand, from its articulation with the preceding joint to the base of the fixed mandible, bears the proportion to the height and thickness that seven does to five and four; the latter measurement being exclusive of the nodes. The mandibles, both fixed and movable, are distinctly round, without any flattening or carination; are gently and nearly equally curved throughout their length, and the articulating processes strong and robust. The hand is somewhat flattened on the inside and angular on the outer surface; the angulation being rather below the middle of the height, giving it the triangular form. The next preceding joint is only preserved in part; it is strong, obliquely ovate

[15]Woods, Henry, A monograph of the fossil macrurous Crustacea of England, pt. 6: Palaeontograph. Soc., vol. 82, pp. 83–85; pl. 23, figs. 9–12; pl. 24, figs. 1–3, 1930.

[16]Assistance in the collection and preparation of these materials was furnished by the personnel of Work Projects Administration Official Project No. 665-66-3-233.

in form, and provided with a large flattened basal projection near the inferior articulation.

Surface of the specimen, with the exception of the inner face of the mandible, marked by numerous strong spine-like nodes or tubercles, which have probably been spines on the surface of the shell (the specimen being an internal cast). These nodes are arranged in longitudinal lines on the outside of the claw, and partly so on the inside; but on the latter there is also a line of large nodes extending obliquely downward from the upper edge, parallel to the margin of the socket of the movable mandible, and at a short distance from it, and continuing upon the mandible. The preceding joint is also marked by lines of strong nodes; a double transverse line on the inside parallel to the anterior margin, but divided from it by a broad, rounded channel, and a single line of stronger nodes on the outside. The flattened area forming the basal projection of the joint is also bordered by nodes.

The specimen, being an internal cast only, does not furnish the exact features of the shell itself, and as there is only a part of the limb known it is difficult to determine the generic characters in a satisfactory manner. There would appear to be but little reason to doubt, from its spiny character and the round claws, its relations to the group commonly called spider-crabs. Still there are some features which seem to differ from those of the generality of the species of that group, and it is therefore with some hesitation that I have referred it to the family Maiadae, and still more doubtfully to the genus *Paramithrax;* but I am not able to find any genus of strictly fossil crustaceans to which it seems so nearly allied. The specimen is of interest on account of its large size, and

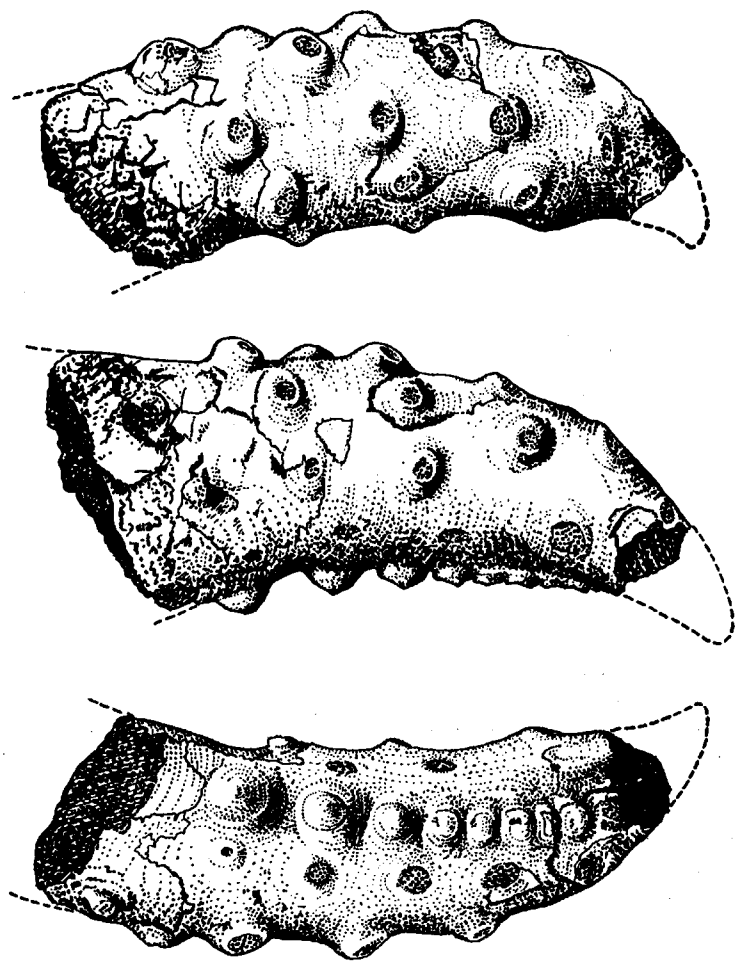


Fig. 8. *Enoploclytia walkeri* (Whitfield), x2; three views of the left movable finger. The view at the bottom shows the occludent surface. The view at the middle shows the inner surface. The view at the top shows the top surface of the finger.

also as being the first of this group of crustaceans yet recognized from the Cretaceous formations of this country.

Locality and formation.—The specimen here described and figured was obtained from the Cretaceous rocks near San Antonio, Texas, by Mrs. N. S. Walker, of that place, and in honor of whom the specific name is given.

Revised description.—Whitfield's original description was based upon a manus and part of the attached carpus. This specimen was an internal mold with all the original exoskeleton missing. Such steinkerne are not very reliable for description in this group of animals, because usually the exoskeleton of their chelae is not only very thick but also of uneven thickness. Nevertheless, such preservation is the usual one in these fossils and is useful for the recognition of the species.

The writer has before him 4 manus from the Fort Worth region. They are so similar to the monotype that it seems obvious that they belong to the same species. One of the manus is a steinkern as the monotype; another has much of the exoskeleton preserved. Even that specimen has the surface so corroded that there is not much to add to Whitfield's original description. However, two important additions to his description and figures of the monotype must be made. First, the exoskeleton of the manus is thick; in some places it is nearly 2 mm. thick. This makes the manus as a whole plumper and heavier looking than the type steinkern. Second, the tubercles of the steinkern look entirely different from the completely preserved tubercles. The completely preserved tubercles are stout cones with a base which is circular or slightly elongate in the direction of the longitudinal axis of the hand. The height of the cones is about one-half their basal diameter. On the distal slope the cones have a slight swelling, which carries many small pits in a sieve-like arrangement. These pits are presumably hair-pits.

In this connection the most interesting specimen is a very well preserved dactylus of the left chela (see text fig. 8). This finger has many tubercles with sieve-like hair-pits. These tubercles are large on the upper and outer surface, but small on the inner surface of the dactylus and near the occludent teeth. All tubercles point distally, that is, forward and outward. They are more nearly ring-wall-shaped than conical and have again the sieve-like arrangement of the hair-pits. The occludent teeth are conical to hemispherical, worn by use at the top. The proximal ones are separate, but the distal ones are crowded so that there is only a tight cleft between adjoining tubercles. The specimen has 9 occludent teeth; but, of course, it is not a complete dactylus. The tubercles with the hair-pits and the shape of the dactylus are somewhat similar to a stalk of a compound coral.

One of the four manus from the Fort Worth region is a part of a complete right cheliped. This cheliped was found by Mr. W. T. Watkins.

The carpus is short and triangular in outline as seen from the outside. The outside surface has about 19 spines. One row of these spines parallels the manus-carpus joint and has a prominent spine at each end of the row, producing a sharp projection at the top and the bottom of the carpus. The inside surface of the carpus has only a few spines.

The merus is long and compressed. The proportion of length to thickness to height is 4:1:2. The thickness decreases from the distal to the proximal end, which is about 1/3 of the thickness of the former. The upper margin of the merus is a thin crest with about 8 large, compressed spines. The lower margin is broader and has several rows of small spines. The inside surface of the merus is smooth; it fits probably against the body of the animal.

In order that this species may be known less incompletely there is given below a description of a carapace from the Fort Worth region. This carapace was found resting on its side in the limestone and is compressed laterally by the load of the sediments. This carapace was described previously by M. J. Rathbun (Pl. 4). However, additional preparation has made clearer some of the features of this carapace.

Carapace very large, entire except for the rostrum. Carapace traversed by deep and sharp grooves. Cervical groove (e-e_1) slightly convex to the anterior,

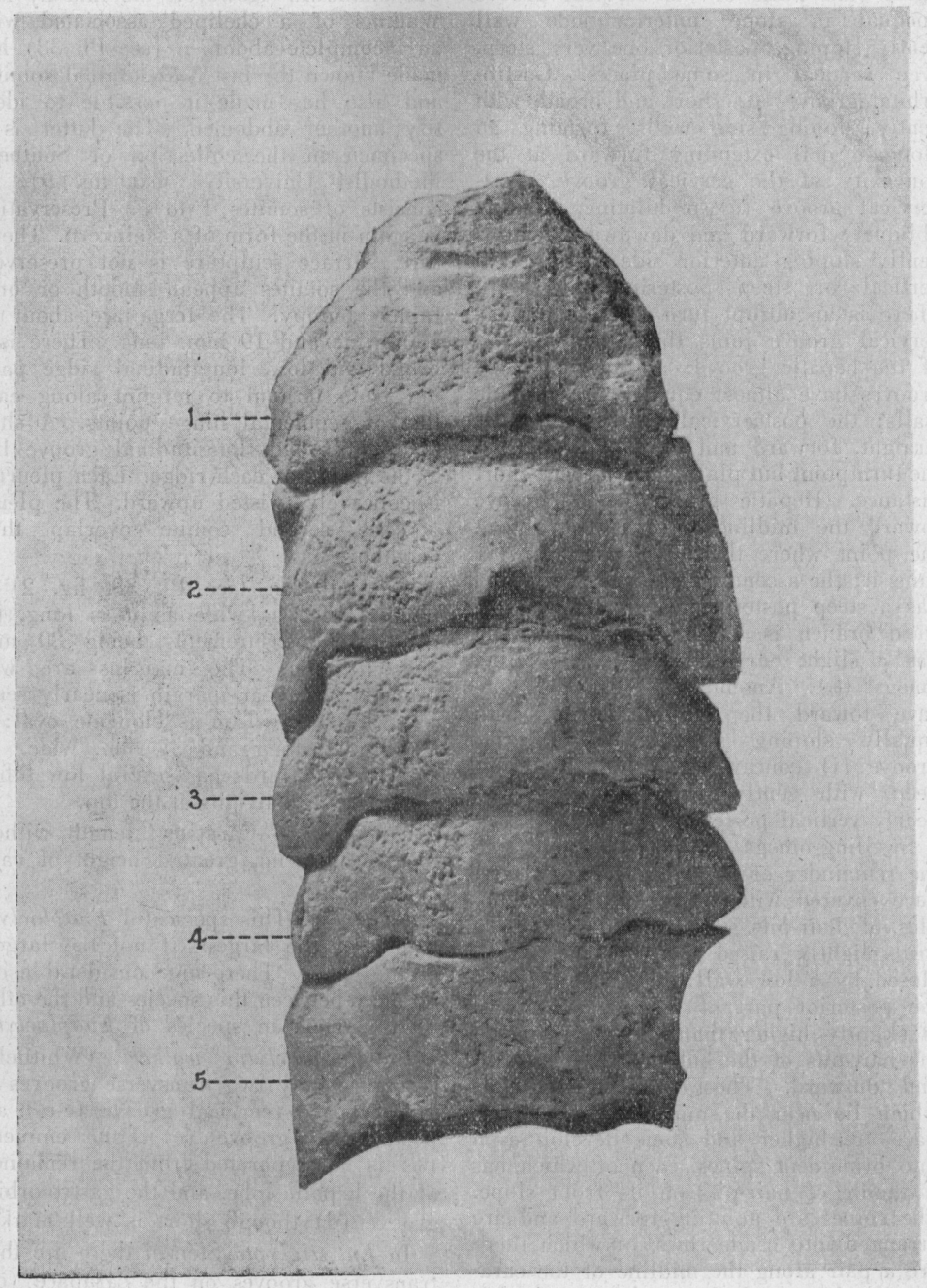


Fig. 9. *Enoploclytia walkeri* (Whitfield), x1; dorsal view of a decorticated abdomen. Collection of Southern Methodist University.

winding near the midline of the carapace; side walls of the cervical groove unequal in slope, anterior side wall gently sloping, posterior one very steep, even vertical in some places. Gastro-orbital groove (d) short and broad, with gently sloping side walls, forming an elongate dell extending forward at the convexity of the cervical groove. Postcervical groove (c) undulating, running obliquely forward and downward, with a gently sloping anterior side wall and a vertical or steep posterior side wall. There is an abrupt turn where the postcervical groove joins the ascending end of the hepatic groove; at that place the grooves have almost equally sloping side walls; the postcervical groove continues straight, forward and downward, beyond the turn point but plays out in a very short distance. Hepatic groove (b_1) concave toward the midline, turning sharply at the point where the inferior groove (i) joins it; the ascending branch is deep and has a steep posterior side wall; the forward branch is broad and shallow and has a slight curve around the swelling omega (ω). Antennar groove (b) concave toward the midline, deep, with equally sloping side walls. Inferior groove (i) concave toward the anterior, deep, with gently sloping anterior and nearly vertical posterior side wall.

Swelling omega (ω) not separated from the remainder of the hepatic lobe. Carapace covered with regularly spaced bundles of hair-pits. Each bundle is on a low, slightly raised pedestal and is enclosed by a low wall; in some instances the posterior part of the enclosing wall is slightly higher than the anterior and the hair-pits of the bundle point forward and outward. Those of the pedestals which lie near the midline of the carapace are higher and some develop even into prominent spines, each of which has a bundle of hair-pits on its front slope. The spines are pointing forward and are arranged into crude rows, of which there are a pair along the midline of the carapace and several diagonal ones farther away from the midline. Posterior margin of carapace with a smooth, deep marginal groove (m) and a smooth, angulated edge, sigmoid in outline to both sides of the midline.

Hitherto the abdomen of this species was unknown. However, the find by Mr. Watkins of a cheliped associated with an incomplete abdomen (see Pl. 38) has made known the last 3 abdominal somites and also has made it possible to identify another abdomen. The latter is a specimen in the collection of Southern Methodist University (text fig. 9). It consists of somites 1 to 5. Preservation is again in the form of a steinkern. Therefore, surface sculpture is not preserved, and the somites appear smooth or only faintly bumpy. The terga are about 44 mm. wide and 19 mm. long. There is a broad and low, longitudinal ridge passing from tergum to tergum along each line of segmental hinge points. A shallow and broad, longitudinal groove lies to the inside of each ridge. Each pleurum is concavely twisted upward. The pleura of the second somite overlap their neighbors.

The tail fan (see Pl. 38, fig. 2) is almost twice as wide as it is long, the respective measurements being 80 mm. and 46 mm. The margins are well rounded; the rear margin is nearly semicircular. The telson is elongate oval; it is 46 mm. long and 37 mm. wide. Its anterior two-thirds has several low tubercles carrying hair-pits at the top.

Dimensions.—Carapace, length without rostrum, 17 cm., greatest height of carapace, 9 cm.

Remarks.—This species of *Enoploclytia* is one of the largest, if not the largest, of the genus. There are considerable differences between this species and the other North American species of *Enoploclytia.*

In *Enoploclytia walkeri* (Whitfield) there are only two transverse grooves on the carapace (cervical groove (e-e_1) and postcervical groove (c)), the eminence (ω) is not separated from the remainder of the hepatic lobe, and the gastro-orbital groove (d) though short is well marked.

In *En. triglypta* Stenzel there are three transverse grooves on the carapace (cervical groove (e-e_1), postcervical groove (c), and branchio-cardiac groove (a)), the eminence (ω) is separated from the hepatic lobe, and there is only the barest indication of a gastro-orbital groove (d)

as a very slight shallowing of the anterior side wall of the cervical groove.

In *En. kimzeyi* (Rathbun) there are three transverse grooves on the carapace as in *En. triglypta* Stenzel, but the post-cervical groove (c) extends all the way down to the hepatic groove (b_1).

It may be noted, incidentally, that Whitfield named the species for Mrs. N. S. Walker. Correct naming should have required *walkerae* for the specific name.

Type data.—The whereabouts of Whitfield's type is unknown. A plaster cast of his type, Cat. No. 8360, is at the U.S. National Museum, Washington, D.C.

The carapace, dactylus (text fig. 8), right cheliped, and telson are at the Bureau of Economic Geology, The University of Texas, Austin, Texas.

The abdomen (text fig. 9) is in the collection of Southern Methodist University at Dallas, Texas.

Type locality.—"Near San Antonio," according to Whitfield. No additional material from the vicinity of that town has come to the writer's attention. The exact location of the type locality remains unknown.

Most of the additional material came from the Forth Worth region. The carapace described above (Pl. 39) came from a small waterfall at crossing of Houston & Texas Central and International & Great Northern Railroad tracks in Sycamore Creek valley, 2½ miles south-southeast of Fort Worth, Tarrant County, Texas. Bureau of Economic Geology Coll. No. 201, W. S. Adkins collector, 1919.

The dactylus described above (text fig. 8) was collected by Mrs. J. H. Renfro in the northeast corner of Alta Vista dairy farm land, on the east side of the road, about 6 miles north of Fort Worth, Tarrant County, Texas.

The right cheliped and the telson described and figured here (Pl. 38) were collected by Mr. W. T. Watkins on Toland's farm, 4 miles west of Argyle, Denton County, Texas.

The large abdomen (text fig. 9) in the collection of Southern Methodist University at Dallas, Texas, bears the label: "No. L23, Fort Worth limestone, towards Trinity from Tandy's Lake, Tarrant County, Texas." The specimen was loaned to the writer by Dean Ellis W. Shuler. The writer wishes to express his thanks for the loan.

Geologic horizon.—The geologic horizon of Whitfield's type is unknown. Cretaceous rocks exposed near San Antonio range from the Travis Peak formation, Comanche series, Lower Cretaceous (Aptian), to the Navarro formation, Gulf series, Upper Cretaceous (Maestrichtian). However, all additional material of this species has come only from the Georgetown limestone, Comanche series, Lower Cretaceous (upper Albian), or its stratigraphic equivalents. Therefore, it is probable that Whitfield's type came from the Georgetown limestone.

The material from the vicinity of Fort Worth except the large abdomen (text fig. 9) came from the limestone ledges in the basal part of the Weno formation, Washita group, Lower Cretaceous (upper Albian).

The large abdomen from the Southern Methodist University collection came from the Fort Worth limestone.

A specimen consisting of the merus, carpus, and manus of the left cheliped and figured on Plate 5, figure 4, by Rathbun came from the Fort Worth limestone equivalent of the Georgetown limestone (upper Albian) from the cliffs along the Georgetown-Belton road, 1 mile north of Georgetown, Williamson County, Texas.

The manus figured by Rathbun on Plate 5, figures 1–3, came from the Buda limestone, but the specimen does not belong to this species.

ENOPLOCLYTIA WINTONI Stenzel, n.sp.

Pl. 43, figs. 1, 2

Description.—Left and right manus equal in size and shape. Manus elongate and devoid of any ridges or keels; the proportion of length to width to thickness is about 7:4:3. Inner margin broadly rounded in cross section throughout its entire length, outer margin broadly rounded at the proximal end, but narrowing down toward the fixed finger. Upper surface gently convex in longitudinal direction, strongly and evenly convex in transverse direction so that the greatest inflation is along the middle.

Lower surface strongly convex in longitudinal direction at the proximal end but only gently convex toward the distal end, strongly and unevenly convex in transverse direction so that the greatest inflation occurs at the outer third of the surface and near the proximal end. Inner surface as a whole slightly more tumid than the outer. Both surfaces are covered with many spines and spinules, which are larger toward the inner than toward the outer margin. However, the spinules of the upper surface are larger than those of the lower surface, whereas the spines are of equal size on both surfaces. Only the bases of the spines are preserved. The joint which carries the movable finger is encircled by a raised rim and an adjoining deep and smooth groove. The rim carries some spines.

The fingers are straight, long, and slender; circular in cross section. The fixed finger has spines like the palm but they are restricted to the proximal end. The movable finger has a large spine near the proximal end. The occludent sides of the finger carry many, equal, vertical, spine-like teeth of 3 to 4 mm. length.

Dimensions.—Right manus, length, 39.2 mm., width, 22.3 mm., thickness, 16.3 mm.; preserved length of fixed finger, 47.2 mm.

Remarks.—The two manus are embedded in matrix in parallel position at one-half centimeter distance. Therefore, it is certain that they belong to the same individual. The material was found by Mr. Norman E. Nelson of Fort Worth.

This species is similar to *Enoploclytia tumimanus* Rathbun from the Paleocene of Alabama. However, *En. tumimanus* Rathbun has a more inflated manus with fewer spines. As far as they are known, the other Cretaceous Enoploclytias of North America have a manus of entirely different shape, except for the incompletely known *Enoploclytia* sp. Stenzel from the much younger Roxton beds.

Type data.—Monotype consisting of the two manus, Coll. No. N302, Geology Department, Texas Christian University, Fort Worth, Texas.

Type locality.—Near Crowley, Tarrant County, Texas.

Geologic horizon. — Weno limestone, Washita group, Comanche series, Lower Cretaceous (upper Albian).

"ENOPLOCLYTIA" SCULPTA Rathbun

Enoploclytia sculpta Rathbun, M.J., *in* Wade, Bruce, The fauna of the Ripley formation on Coon Creek, Tennessee: U.S.Geol. Survey Prof. Paper 137, pp. 187–188; pl. 66, figs. 1–5, 1926.

Rathbun, M. J., Fossil Crustacea of the Atlantic and Gulf Coastal Plain: Geol. Soc. Amer., Spec. Paper 2, p. 18, 1935.

Remarks.—This species has punctate abdominal terga free of major spines. The remainder of the animal is not well known. The lack of strong spines on the abdomen makes it highly improbable that this is a species of the genus *Enoploclytia*, because this genus is characterized by strong spines on the abdomen and carapace. The species should be listed as *Macruran genus, indet.* at present.

Type data.—Monotype, No. 73119, U. S. National Museum, Washington, D.C.

Type locality.—Dave Weeks' place on Coon Creek, in northeast part of McNairy County, Tennessee, 3½ miles south of Enville and 7½ miles north of Adamsville; Bruce Wade collector.

Geologic horizon.—Coon Creek tongue of Ripley formation, Gulf series, Upper Cretaceous (Maestrichtian).

"ENOPLOCLYTIA" WENOENSIS Rathbun

Enoploclytia wenoensis Rathbun, M. J., Fossil Crustacea of the Atlantic and Gulf Coastal Plain: Geol. Soc. Amer., Spec. Paper 2, p. 20; pl. 6, figs. 7, 8, 1935.

Remarks. — This species has smooth, punctate abdominal terga free of spines. The posterior part of the carapace, the only part that is known, is covered with small, subsquamiform tubercles and lacks any keels or spines. This is certainly not an *Enoploclytia;* presumably it is an *Astacodes.* However, new and additional material is needed to identify the genus.

Type data.—Monotype, Bureau of Economic Geology, The University of Texas, Austin, Texas.

Type locality.—Brickyard pits, 1¾ miles southeast of Gainesville, Cooke County, Texas. Bureau of Economic Geology Coll. No. 191.

Geologic horizon.—Weno formation, Washita group, Comanche series, Lower Cretaceous (upper Albian).

ENOPLOCLYTIA (?) sp. Rathbun

Enoploclytia (?) Rathbun, M.J., Fossil Crustacea of the Atlantic and Gulf Coastal Plain: Geol. Soc. Amer., Spec. Paper 2, p. 20; pl. 2, fig. 6, 1935.

Remarks.—An unidentifiable fragment.

Type data.—Monotype, No. 73842, U. S. National Museum, Washington, D.C.

Type locality.—Cut of Southern Railroad, 3 miles southeast of Corinth, Alcorn County, Mississippi; L. W. Stephenson collector (6469).

Geologic horizon.—Base of Selma chalk just above the Coffee sand, Gulf series, Upper Cretaceous (Campanian).[17]

(?) ENOPLOCLYTIA SELMAENSIS (Rathbun)

Palaestacus selmaensis Rathbun, M. J., Fossil Crustacea of the Atlantic and Gulf Coastal Plain: Geol. Soc. Amer., Spec. Paper 2, p. 24; pl. 2, fig. 14, 1935.

Remarks.—This species is a part of the collections made by L. C. Johnson in 1883 in Alabama. These collections contained also *Enoploclytia tumimanus* Rathbun and other Paleocene Midway crustaceans. They were wrongly regarded by Rathbun to be Upper Cretaceous Selma chalk fossils.

It is to be regretted that this material was named *selmaensis*, because it does not originate from the Selma chalk.

The holotype, a left wrist fragment, is the only figured specimen. The descriptions and figure are insufficient to characterize the species. The writer is not convinced that it is a valid species or that it belongs to this genus.

Type data.—Holotype, No. 73848, and paratypes, Nos. 73849 and 73840, U. S. National Museum, Washington, D.C.

Type locality.—Holotype: Prairie Creek and Allenton, Wilcox County, Alabama, collection No. 281.

Paratypes: Prairie Creek and Pine Barren section, Wilcox County, Alabama, collection No. 284, and Prairie Creek, Wilcox County, Alabama, collection No. 264.

Geologic horizon.—Suçarnoochee shale, Midway group, Paleocene.

ENOPLOCLYTIA TUMIMANUS Rathbun

Enoploclytia tumimanus Rathbun, M. J., Fossil Crustacea of the Atlantic and Gulf Coastal Plain: Geol. Soc. Amer., Spec. Paper 2, pp. 4, 8, 18–20, pl. 1, figs. 1–12; pl. 2, figs. 1–5, 1935.

Remarks. — Rathbun described this species as coming from the Selma chalk, Gulf series, Upper Cretaceous. However, the type localities in Alabama cited by Rathbun are not in the Selma chalk but in the Paleocene Midway group. The species is common in the Midway group of the vicinity of the type locality, where the writer has collected many specimens.

Type data.—Holotype, No. 73799, and paratypes, U. S. National Museum, Washington, D.C.

Type locality.—Vicinity of Prairie Creek, Allenton, and Pine Barren section at stations 264, 281, and 284, Wilcox County, Alabama; L. C. Johnson collector. An original label for 284 gives "scattered shells and fragments picked up on prairies," sections 32 and 34, Township 12, Range 10, April 25, 1883. Rathbun's holotype specimen belongs in this latter lot.

Geologic horizon.—Sucarnoochee shale, Midway group, Paleocene.

The following crustaceans occur with this *Enoploclytia* in the Sucarnoochee shale of the type locality:

Homarus johnsoni (Rathbun)
Linuparus wilcoxensis Rathbun
Dromilites americana Rathbun
Symethis johnsoni Rathbun
Xanthilites alabamensis Rathbun

Family NEPHROSIDAE Stebbing

Genus HOMARUS H. Milne-Edwards, 1837

Histoire naturelle des crustacés, vol. 2, p. 333.

Genotype.—*Homarus vulgaris* H. Milne-Edwards, living.

HOMARUS TRAVISENSIS Stenzel, n.sp.

Pl. 41, figs. 14–16; text fig. 10

Description.—Monotype is the manus of the right cheliped with the fingers missing. Manus not quite twice as long

[17]Stephenson, L. W., and Monroe, W. H., The Upper Cretaceous deposits: Mississippi State Geol. Survey, Bull. 40, p. 110, 1940.

as wide and compressed-oval in cross section. Lower surface has its greatest convexity along a line lying about 1/3 of the palm width up from the outer margin and is slightly more swollen than the upper surface; greatest convexity of upper surface along a line lying about 2/3 of the palm width above the outer margin and thus diagonally opposite to the greatest convexity on lower surface. Outer margin narrowly rounded in cross section and curved in outline; the proximal 1/3 descends rapidly downward away from the manus-carpus joint; the distal 2/3 diverges only a little from parallelism with the inner margin. Inner margin sharp and narrow in cross section and nearly straight in outline.

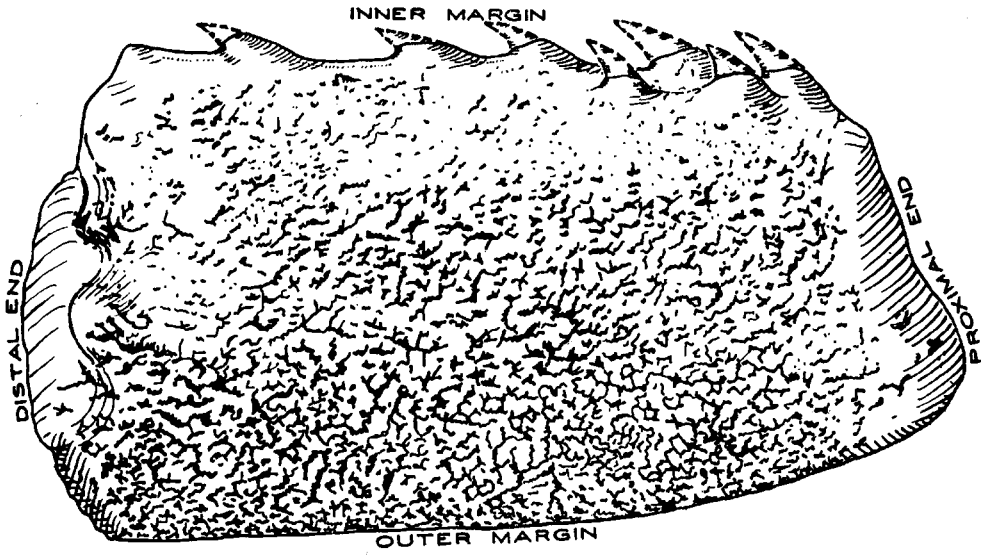


Fig. 10. *Homarus travisensis* Stenzel, x6; lower surface of right manus; monotype.

Upper and lower surfaces finely wrinkled and granulated. A small and low boss between the bases of the 2 fingers at the distal end of the lower surface. Outer margin smoother than either surface; inner margin with 7 broken spines, which point distally and upward. Of the 7 spines 5 lie in a row on the crest of the margin and two lie in a parallel row at the proximal end a little below the crest on the lower surface of the manus.

Dimensions.—Length, 20.7 mm.; width at distal end, 10.8 mm.; thickness, 5.7 mm.

Remarks.—The genus *Homarus* H. Milne-Edwards is rich in species. Over 50 fossil species have been named and described. The stratigraphic range of the genus is from the Valanginian to the present.[18] Its palaeogeographic distribution is nearly world-wide; it has been found in the fossil state in Patagonia and North America including Greenland, from England to southern Russia, in Australia, West Africa, and southern India.

In the United States east of the Rockies it is represented by eleven fossil species[19] ranging geographically from New Jersey to Texas, chiefly in the Atlantic and Gulf Coastal Plain. With the exception of one species all fossil North American *Homarus* are from the Cretaceous. Those from the Lower Cretaceous are *Homarus dentonensis* (Rathbun) and *Homarus tarrantensis* (Rathbun). Of these two, *H. tarrantensis* (Rathbun) is based on an abdomen and cannot be compared with the new species. *Homarus dentonensis* (Rathbun) has a palm one-half the size of

[18]Glaessner, M. F., Crustacea decapoda: Fossilium Catalogus, I, pt. 41, 1929.

Woods, Henry, A monograph of the fossil macrurous Crustacea of England, pt. 6: Palaeontograph. Soc., vol. 82, pp. 86–88, 1930.

[19]Rathbun, M. J., Fossil Crustacea of the Atlantic and Gulf Coastal Plain: Geol. Soc. Amer., Spec. Paper 2, 1935.

H. travisensis Stenzel. In cross section the palm of *H. dentonensis* (Rathbun) is more tumid; the inner margin is narrowly rounded and not sharp as in *H. travisensis* Stenzel. However, the placing of the spines on the inner margin is somewhat similar in both species.

Type data.—Monotype, Bureau of Economic Geology, The University of Texas, Austin, Texas.

Type locality.—Old road metal pit on southwest side of Austin—Bull Creek—Anderson Mill road, on divide between Dry Creek and Shoal Creek drainage, about 8000 feet northeast of Mount Bonnell in airline distance, Travis County, Texas.

The specimen was collected and generously donated by Mr. Ralph H. King and Mr. George Harris.

Geologic horizon.—Yellow clay marl of Walnut formation, Fredericksburg group, Comanche series, Cretaceous (middle Albian). The specimen was found within a few feet of the base of the Fredericksburg group. Collected with it was an ammonite of the genus *Engonoceras.*

HOMARUS BRITTONESTRIS Stenzel, n.sp.

Pl. 40, figs. 1–7; text fig. 11

Homarus brittonestris Stenzel *in* Dallas Petroleum Geologists, Geology of Dallas County, Texas, p. 37, fig. 9, 1941.

Description.—Animal small; fossil remains strongly compressed laterally by the settling of the enclosing sediment.

Carapace measured along the midline and with the rostrum excluded is slightly longer than the first 4 abdominal somites. Rostrum long and slender, about one-half the length of the remainder of the carapace. The rostrum is channeled on top; the margins of the rostrum are raised into narrow crests (ρ), which carry slightly curved and forward, upward, and outward-pointing spines. These spines alternate in position on the two crests; there are 3 spines on each side; they occupy the frontal half of the crests; the posterior half of the crests is free of spines. The tip of the rostrum is a sharp spine of similar appearance. Where the margins of the rostrum turn out and merge into the margin of the orbit, they leave the crests, which continue as narrow ridges on the gastric region. These

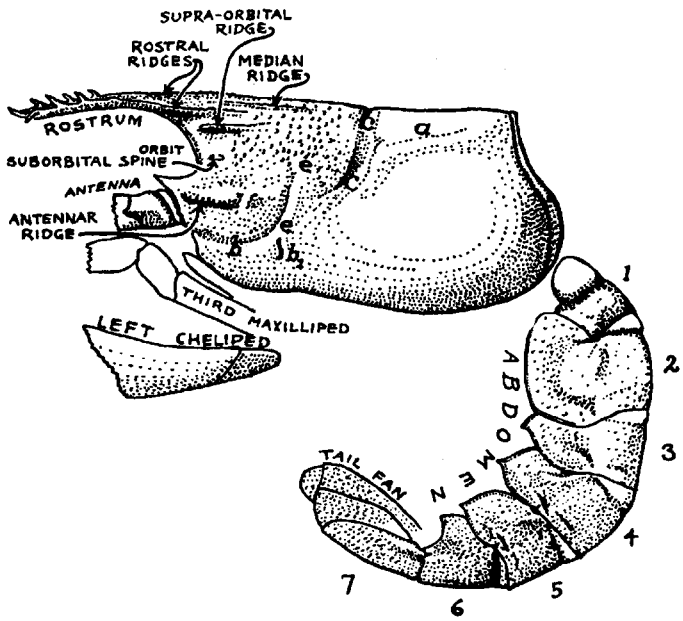


Fig. 11. *Homarus brittonestris* Stenzel, x2; composite of several specimens.

rostral ridges (ρ) diverge to the posterior at a very acute angle and play out in the frontal third of the gastric region. As these rostral ridges diverge they make room for a median ridge (μ), which is short and ends in the middle of the gastric region. Another pair of ridges is supra-orbital in position. These ridges begin abruptly with a spine about 1 or 2 mm. from the orbital margin, diverge to the posterior in the same way as the rostral ridges, and extend to the posterior only a short distance beyond the end of the rostral ridges. These 5 ridges, namely, the median one, the rostral pair, and the supra-orbital pair, are evenly spaced. There is a sub-orbital spine about 1 or 2 mm. from the orbital margin, but it is small and stands by itself. Opposite to the antenna there is a ridge, which begins abruptly with a forward-pointing spine placed next to the carapace margin. This antennar ridge is short and flattens out before reaching a spine, which is in line with it. The post-antennar spine is small and stands by itself.

The postcervical groove (c) is broad and deep, shallows and disappears laterally. The branchio-cardiac groove (a) begins as a slight notch in the posterior wall of groove (c), continues as a shallow groove obliquely to the posterior, and disappears without reaching the posterior carapace margin; the branchio-cardiac groove is emphasized by a low ridge adjoining it to the outside. The cervical groove (e) is deep and narrow. The grooves (b) and (b_1) originate from (e); the hepatic groove (b_1) is short and narrow; it ends in an abrupt short hook. The antennar groove (b) is deep and narrow at first, but shallows to the anterior; it turns in a broad curve forward and continues straight forward to the carapace margin.

The posterior margin of the carapace has a groove and raised rim. This rim is narrower at the midline than at the lateral extremities. The carapace is covered with tubercles, which are larger over the gastric region, and largest on top of the 5 ridges in the vicinity of the rostrum.

The abdomen has an obscure, low and broad ridge separating the pleura from the terga. The pleurum of the second abdominal somite is broad, its anterior margin is narrowly rounded; its posterior margin is broadly rounded; its extremity is gently curved. This pleurum overlaps the first pleurum completely and the third one partially. The pleura of the third, fourth, and fifth abdominal somites have arcuate margins meeting in a backward-pointing sharp angle. The pleurum of the sixth abdominal somite is pointed; its anterior margin is arcuate; its posterior margin is emarginate for insertion of the uropods. Tail fan without ridges. Telson with a longitudinal groove on either side parallel to the outer margins.

Parts of the cheliped are preserved in some specimens, but nearly all are too fragmentary for description. Only one right cheliped manus is well enough preserved to furnish a basis for description (see Pl. 40, figs. 5–7). Manus twice as long as wide and oval in cross section. Lower surface has its greatest convexity along the middle and is more convex than the upper; greatest convexity of the upper surface slightly below the middle. The manus is therefore distorted-oval in in cross section. The two margins diverge distally at an angle of 13°. Outer margin straight to faintly curved in outline and sharp-edged; the edge carries many small tubercles in a row on the crest and is turned up toward the upper surface, from which it is separated by a thin groove with very many fine hair-pits. Inner margin is straight and has two rows of fine spines delimiting a narrow, flat area. The upper one of these two rows has 5 spines and 7 spinules; the other row has 4 spines and 5 spinules. All spines and spinules point upward and forward. Both surfaces of the manus have many uniformly scattered tubercles, which are larger toward the inner margin on both surfaces and larger on the upper surface than on the inner one.

Dimensions.—Syntype 1, length of carapace exclusive of rostrum, 21.8 mm.; syntype 2, length of abdomen from second to sixth somite inclusive measured along the midline, 45 mm.; syntype 3, length of carapace exclusive of rostrum, 22 mm., length of entire abdomen measured along midline, 44 mm.

Remarks.—Eleven species of *Homarus* have been described from the Cretaceous of the United States east of the Rockies. However, among these 11 species the carapace or abdomen is known from only 4 species.

Homarus tarrantensis (Rathbun)[20] has much stronger longitudinal ridges on the abdomen separating the pleura from the terga, and its tail fan has longitudinal, radiating ridges. *Homarus brittonestris* Stenzel has very weak longitudinal ridges on the abdomen and no ridges on the tail fan.

Homarus dentonensis (Rathbun)[21] has a pleurum of the second abdominal somite with a clearly visible rectangular corner at the point where the outer and the posterior margins of the pleurum meet. The same point is present in *H. brittonestris* Stenzel, but it is very obscure, because it is rounded and the angle at which the two margins meet at this point is obtuse. The carapace of *H. dentonensis* (Rathbun) is too imperfect to permit comparisons.

Homarus tennesseensis (Rathbun)[22] has 3 distinct spines in a row occupying the position of the antennar ridge and hepatic spine of *H. brittonestris* Stenzel. There are also two spines apparently occupying the same position as the lone suborbital spine of *H. brittonestris* Stenzel. The pleura of the second and third abdominal somites of *H. tennesseensis* (Rathbun) are sculptured with a conspicuous submarginal groove; such grooves are missing or only very weakly developed on the pleura of *H. brittonestris* Stenzel.

Homarus mcnairyensis (Rathbun)[23] has a median ridge and two marginal ridges extending the entire length of the rostrum; in *H. brittonestris* Stenzel, the median ridge does not enter the rostrum, but stops posterior to the base of the rostrum. However, the 5 ridges in the vicinity of the rostrum are very similar in both species.

The species name is derived from the Britton member of the Eagle Ford formation. The Latin ending *estris* means "pertaining to."

Type data.—Nine syntypes, Bureau of Economic Geology, The University of Texas, Austin, Texas.

Type locality.—Same as *Linuparus grimmeri* Stenzel.

Geologic horizon.—Same as *Linuparus grimmeri* Stenzel.

HOMARUS DAVISI Stenzel, n.sp.

Pl. 40, fig. 8

Description.—Monotype consists of a carapace with 4 abdominal segments largely pressure-deformed.

Carapace measured along the midline and with the rostrum excluded is about 1½ times as long as the first 4 abdominal somites. Rostrum preserved only at its posterior. There it is channeled on top; the margins are raised into round-topped ridges, which carry forward and upward-pointing spines. There are 2 of these spines on the preserved part of each rostral ridge. The rostral ridges (ρ) diverge to the posterior at a very acute angle and play out gradually in the frontal quarter of the gastric region. The orbits are encircled by a fine, thin, raised rim. This rim is smooth except where it runs forward on the side of the rostrum; it bears two spinules on the preserved part of the rostrum. The median ridge (μ) begins where the rostral ridges disappear; it is higher at its anterior and gradually fades out to the posterior; it ends at the posterior quarter of the gastric region. The median ridge is low and inconspicuous throughout; it carries 3 pairs of small spines; the spines of each pair are about 1 millimeter apart; the spacing of the pairs on the ridge is uneven; the first 2 pairs are close together near the front of the ridge. The supraorbital ridges (α) begin in the corner formed by the rostral ridge (ρ) and thin, raised rim of the orbit and rise rapidly

[20]Rathbun, M. J., Fossil Crustacea of the Atlantic and Gulf Coastal Plain: Geol. Soc. Amer., Spec. Paper 2, p. 27; pl. 6, fig. 20, 1935.
Described as *Hoploparia.*

[21]Rathbun, M. J., *op. cit.*, p. 26; pl. 2, figs. 7–13, 1935. Described as *Hoploparia.*

[22]Wade, Bruce, The fauna of the Ripley formation on Coon Creek, Tennessee: U. S. Geol. Survey Prof. Paper 137, pp. 186–187; pl. 64; pl. 65, figs. 1, 3, 6, 1926. Described as *Hoploparia.*

[23]Wade, Bruce, *op. cit.*, p. 187; pl. 65, figs. 2, 4, 5, 7, 8, 1926.
Described as *Hoploparia.*

to their first and most conspicuous spine, which is about 3½ millimeters from the orbital rim. These supra-orbital ridges diverge to the posterior only in that portion which is anterior to their first spine; to the posterior of that spine they are nearly parallel; they extend to the posterior only as far as the median ridge (μ) does; there are 3 spines on each supra-orbital ridge; the two posterior spines are small. These 5 ridges, namely, the median one (μ), the rostral pair (ρ), and the supra-orbital pair (α), are unevenly spaced; the distance between the rostral and supra-orbital ridges is smaller than the distance from the median to the rostral ridge. No suborbital spine or ridge is present. The antennar ridge begins opposite the antenna and extends continuously to the fork of the cervical (e), antennar (b), and hepatic (b_1) grooves; it carries at least 4 spines evenly spaced. In addition to these ridges and spines there are scattered, small, forward-pointing spines in the space between the end of the supra-orbital ridge and the cervical and postcervical grooves. The posterior border of the cervical groove (e) is surmounted by 4 equal, forward-pointing spines on each side of the carapace. The superior border of the hepatic groove (b_1) is studded with 5 spines, which decrease in size to the posterior. The inferior border of the antennar groove (b) is studded with a row of about 7 forward-pointing spines, of which those in the middle of the row are the largest. There are scattered spinules to the inferior of this row on the carapace. The remainder of the carapace, that is, the portion posterior of the transverse grooves, is devoid of spinules, spines, or ridges; but is covered like all the carapace with very many, uniformly distributed, forward-pointing hair-pits. The posterior border of the carapace has a groove and a thin, smooth, raised margin.

The grooves of the carapace are poorly recognizable on account of the pressure-deformation. The post-cervical groove (c) is deep and short. The branchio-cardiac groove is absent or not recognized. The cervical groove (e) is shallow. The grooves (b) and (b_1) diverge with an obtuse angle. The antennar groove (b) is longer than the hepatic groove (b_1), which is straight and shallows out rapidly.

The abdomen is incomplete; only the first 3 and part of the fourth somite are present. The first somite is very short; at each abdomen-carapace hinge point it overlaps the carapace with a rounded lobe. Only the terga are visible except for parts of the left pleurum of the second somite. This pleurum appears to have the usual broad, rounded outline overlapping its neighbors. The terga are smooth and punctate with many tiny pits.

Dimensions.—Monotype, length of carapace exclusive of rostrum, 44 mm.

Remarks.—This species is found at the same locality as *Homarus brittonestris* Stenzel. Therefore, the differences between the two species need to be emphasized. *Homarus davisi* Stenzel is about twice as large as *H. brittonestris* Stenzel; also the former lacks the suborbital spine, which is present in the latter. The anterior portion of the carapace of *H. davisi* Stenzel has many more spines than *H. brittonestris* Stenzel, so that it can be separated from the smaller species readily by the greater roughness of that part of the carapace. In detail there are numerous differences between the two species in the extent and the spines of the various ridges of the carapace. These differences cannot be explained by assuming merely an age difference.

The species is named in honor of Mr. Eugene Elmer Davis of Dallas, the collector of the monotype.

Type data.—Monotype, Bureau of Economic Geology, The University of Texas, Austin, Texas.

Type locality.—Same as *Linuparus grimmeri* Stenzel.

Geologic horizon.—Same as *Linuparus grimmeri* Stenzel.

Genus NEPHROPS W. E. Leach, 1816

Encyclopaedia Britannica [Suppl. to ed. 4–6], i, 2, p. 420.

Genotype.—*Nephrops norvegicus* (Linné), living, south coast of Iceland, west coasts of Europe and western Mediterranean.

The species described below does not belong to the genus *Nephrops;* compare under "Remarks" below.

"NEPHROPS" AMERICANUS Rathbun

Pl. 41, figs. 1–6

Nephrops americanus Rathbun, M. J., Fossil Crustacea of the Atlantic and Gulf Coastal Plain: Geol. Soc. Amer., Spec. Paper 2, pp. 28–29; pl. 5, figs. 6–9, 1935.

Description.—Propodus squarish in outline and compressed. Upper margin nearly straight, apparently narrowly rounded in cross section, although all specimens at hand are crushed along that margin. Lower margin very slightly sigmoid in outline and slightly divergent from the upper margin, narrowly rounded in cross section; sharply set off from the outer surface of the propodus by a narrow groove, which is overhung by a row of elongate, squamiform hair-pit tubercles. Outer and inner surface of propodus gently convex in longitudinal, more so in transverse direction. Both surfaces have many transversely elongate, distally pointing tubercles, which have oval to semilunar to 8-shaped pits at their tips. It is not certain whether these pits are hair-pits or merely the worn tips of the tubercles. The same applies to the row of squamiform tubercles along the lower margin. There are many more tubercles on the outer than on the inner surface of the propodus, but the tubercles of the inner surface are larger. The inner surface has at its lower margin two rows of tubercles above and parallel to the row along the lower margin. Of these two rows the one nearer the margin has more but weaker tubercles than the other. Near the base of the fixed finger and at the interdigital sinus the inner surface of the propodus and the proximal end of the fixed finger are devoid of tubercles, but have instead many round to elongate-oval depressions. Some of the depressions are tiny: others are larger but nevertheless small in size. The bottom of each depression is perforated like a sieve by many fine hair-pits. Such hair-pit depressions are absent from the outer surface. A small, sharply raised, round lobe covers the hinge point of the movable finger on either side. Below this hinge point at the joint the distal edge of the propodus carries a slightly protruding, swollen area covered with about 10 to 12 small, round tubercles with pits at their tips. This feature is on both sides of the manus.

The fixed finger is short, stout, curved inward and upward. The three rows of tubercles on or near the lower margin of the propodus continue on the fixed finger for 2/3 of its length. A deep groove develops between the two lower and the upper of these three rows, so that the two lower rows are on a rounded, longitudinal ridge at the lower margin and the third row is on a rounded ridge on the inner surface of the fixed finger. A similar, third, rounded ridge is on the outer surface of the fixed finger just below the occludent teeth. However, this ridge carries only 2 or 3 pit-tubercles. The outer surface is concave between this ridge and the lower margin. A few pit-tubercles are on this concave part. From the interdigital sinus an angulation extends up along the fixed finger. This angulation is rectangular near the sinus but broadens distally. There are 3 to 4 pit-tubercles on the angulation near the root of the finger. The area between this angulation and the occludent teeth is concave and has many hair-pit depressions on its proximal half. The occludent teeth are along the narrow upper margin and are about 17 in number and small, rounded, and equal in size, except the most proximal one, which is slightly larger.

The movable finger is curved downward and inward and overlaps the fixed finger so that its tip is outside of the fixed finger tip. There are three parallel, rounded, longitudinal ridges separated by narrower, deep grooves; but toward the tip the two grooves disappear and the ridges join. One ridge is median, at the upper margin of the fixed finger. The other two ridges are to either side, each originating at the hinge point on either side of the propodus—finger joint. The areas between these ridges and the occludent margin of the finger are concave and carry hair-pit depressions like those of the propodus; the concave area on the inner surface is long and extends nearly up to the tip of the finger; the concave area on the outer surface is only half as long. Occludent teeth of movable finger like those of the fixed one.

Dimensions.—Left manus (Pl. 41, fig. 5), length, 15.6 mm., height at distal end, 13.4 mm., thickness (crushed, therefore too small), 6 mm.; left manus (figs. 3, 4), height at distal end, 10.4 mm., thickness, 6.5 mm.

Remarks.—This species was described by Rathbun from 3 separate fingers. Because the fingers were not connected to a manus, Rathbun misunderstood the material and described the fixed as the movable finger and vice versa. The material at hand is more complete and allows the correction of the fingers. In addition the nature of the propodus is such that it is clear that the species does not belong in the genus *Nephrops*. The lobster *Nephrops* has a greatly elongate propodus of nearly four-sided cross section, due to the fact that there are strong median keels on the surfaces of the propodus in addition to the two strong keels along the margins. *"Nephrops" americanus* Rathbun has no such propodus. The generic position of *"Nephrops" americanus* Rathbun remains dubious until additional material is discovered.

Type data.—Two figured syntypes of Rathbun are at the Bureau of Economic Geology, The University of Texas, Austin, Texas. The third. unfigured syntype of Rathbun is at the U. S. National Museum, Washington, D.C.

Type locality.—One-half mile south of Baptist Seminary, 4 miles southwest of Fort Worth, Tarrant County, Texas; W. S. Adkins and W. M. Winton collectors.

The species occurs at many other localities in the vicinity of Fort Worth, and the collections of Texas Christian University, brought together by W. M. Winton and Gayle Scott, contain numerous specimens from that area. The following are the localities of the specimens figured in the present paper:

High bluff opposite Cobb brick plant, 100 yards north of the Houston & Texas Central Railroad bridge on Sycamore Creek between Mansfield road and crossroad going east from Katy Lake; south-southeast of the center of Fort Worth, Tarrant County, Texas (collection numbers M541, G850, Texas Christian University). Dr. Gayle Scott, collector; see Plate 41, figure 6.

Watauga; gullies in pasture about 0.1 mile east and within sight of U. S. highway No. 377, Fort Worth–Denton road, opposite a Texas & Pacific Railroad trestle and 0.2 mile north of Watauga schoolhouse, northern Tarrant County, Texas (Bureau of Economic Geology locality No. 219–T–3). Mr. J. H. Renfro, collector; see Plate 41, figures 3–5.

Watauga; slopes at the head of a short, right tributary to a wide, flat-bottomed branch which is a left tributary of Big Fossil Creek; 0.51 mile east of U. S. highway No. 377 or 0.40 mile east and 0.08 mile north of Watauga schoolhouse, northern Tarrant County, Texas (Bureau of Economic Geology locality No. 219–T–4). Mrs. J. H. Renfro, collector; see Plate 41, figures 1, 2.

Geologic horizon.—Rathbun's type material came from the Pawpaw shale, Washita group, Comanche series, Cretaceous (upper Albian). Additional material came chiefly from the Pawpaw shale, but one specimen came from the Denton formation, Washita group, Comanche series, Cretaceous (upper Albian). The fossil seems most abundant in the Pawpaw shale.

Tribe ANOMURA Milne-Edwards

Superfamily GALATHEIDEA Henderson

Family GALATHEIDAE Dana

Genus GALATHEA Fabricius, 1793

Entomologia systematica emendata et aucta, vol. 2, p. 471.

Genotype.—*Galathea strigosa* (Linné), living.

GALATHEA CRETACEA Stenzel, n.sp.

Pl. 43, fig. 3

Description.—Carapace small, elongate rectangular in outline; the length to width proportion is 6 to 5. Carapace depressed, nearly straight along midline, but convex from side to side. Rostrum 1/3 to ½ the length of the carapace, elongate triangular in outline with the sides concave in outline and the broad base as wide as the length of the rostrum. dorso-ventrally strongly compressed, and thin; dorsally with a broad, V-shaped median groove, ventrally with a corresponding V-shaped keel; dorsal surface of rostrum with many short, arcuate rugae to each

side of the median groove. Some of these rugae produce small denticles at the margins of the rostrum. Greatest width of the carapace at the posterior quarter; lateral margins slightly convergent to the anterior of the greatest width, to the posterior rapidly curving inward. Posterior margin concave as seen from above. Cervical, antennar, and hepatic grooves smooth and deep. Cervical groove curved, antennar groove sinuous, hepatic groove nearly straight. Hepatic groove meets the lateral margin at a right angle. The median groove of the rostrum extends backward in a pair of short and shallow gastro-orbital grooves, which enclose an acute angle. Entire carapace covered with transverse rugae, some of which are short while others are long enough to extend across the entire width of the carapace or at least from groove to groove. There are 7 precervical entire rugae; of these 2 abut against the cervical groove and 5 against the antennar grooves; two entire precervical rugae are cut by the gastro-orbital grooves; there are 5 rugae between the hepatic and the antennar grooves; of the postcervical rugae only the last 3 reach across the entire width of the carapace; those anterior to the last three rugae are arranged in three tiers, one of which is median or cardiac; the other two are lateral or branchial in position. There are 4 rugae in the cardiac tier and 5 in the branchial tiers; the ends of the cardiac rugae are not in line with the branchial rugae. All rugae have a row of innumerable and very fine pits along their crest. The rugae which lie anterior to the greatest width of the carapace and which reach the lateral carapace margins produce spinules at the margins. Six spinules are posterior to the hepatic groove, 5 spinules are between the hepatic and antennar groove, about 3 spinules are anterior to the antennar groove.

The first 3 abdominal segments are visible; they are simple, transversely grooved. The abdomen is curved under the carapace.

The small, pyritized nodule containing the monotype specimen shows also traces of the legs.

Dimensions.—Length of specimen, 9.9 mm.; length of rostrum, 2.5 mm.; length of carapace without rostrum, 6.0 mm.; width of carapace, 5.1 mm.

Remarks.—This is the first fossil species of the genus described from North America. It is also the oldest known *Galathea.* The next one in age is *Galathea ubaghsi* Pelseneer[24] from the upper Senonian of Limburg. The specimen is a pyrite micromorph. The specimen was collected by Mrs. J. H. Renfro of Fort Worth, Texas.

Type data.—Monotype, Bureau of Economic Geology, The University of Texas, Austin, Texas.

Type locality.—Watauga; gullies in pasture about 0.1 mile east and within sight of U. S. highway No. 377 (Fort Worth–Denton road), opposite a Texas & Pacific Railroad trestle, and 0.2 mile north of Watauga schoolhouse, northern Tarrant County, Texas (Bureau of Economic Geology locality No. 219–T–3).

Geologic horizon. — Pawpaw shale, Washita group, Comanche series, Cretaceous (upper Albian).

GALATHEA (?) LIMONITICA Stenzel, n.sp.

Pl. 43, fig. 4

Description.—Carapace small, incompletely preserved, its length presumably 4/3 of its width. Carapace depressed, nearly straight along midline, but convex from side to side. Rostrum not preserved. Cervical, antennar, and hepatic grooves smooth and deep. Cervical groove curved; antennar groove straight; hepatic groove slightly curved with the concave side to the anterior. The antennar groove gives off two short grooves at one point; one of these extends to the frontal margin, the other to the lateral margin of the carapace. The mesogastric area is delimited by a pair of smooth gastro-orbital grooves. In front just behind the base of the rostrum this groove pair is united, making a single groove of less than 1 millimeter length; to the posterior they separate at an acute angle and then turn to run parallel for about 1 millimeter, thus enclosing the extremely

[24]Pelseneer, P., Notice sur les crustacés décapodes du Maestrichtien du Limburg: Mus. royal Histoire nat. Belgique Bull., vol. 4, p. 166, fig. 5, 1886.

narrow anterior extension of the mesogastric area; then they spread broadly asunder and extend to the point where the cervical, antennar, and hepatic grooves meet. This groove pair which delimits the mesogastric region to the anterior and at the sides is less deep than the other grooves of the carapace. A faint median keel extends from the tip of the mesogastric area back to the middle of that area. Entire carapace covered with transverse rugae, some of which are short while others are long enough to extend from one groove to its counterpart. There are 5 very short transverse rugae in the very narrow anterior extension of the mesogastric area; six long and one short rugae cross the remainder of the mesogastric area; of these the two posterior ones abut with their ends against the cervical groove; protogastric area with 5 transverse rugae, which are anterior, and 6 oblique rugae, which are posterior; hepatic area with short, irregular rugae. The postcervical rugae are arranged in 3 tiers, one of which is median or cardiac and the other two are lateral or branchial in position. Cardiac tier with 5 long anterior rugae and 2 short posterior ones; lateral tiers incompletely preserved. The cardiac tier is delimited to the posterior by a curved, V-shaped groove pair, which is only partly preserved. Posterior to this groove pair there were some more rugae, but these are preserved only in a small piece.

Dimensions.—Length of carapace without rostrum, 6.8 mm.; width of carapace, about 6 mm.

Remarks.—For exact generic determination it is necessary that the rostrum of this species be found, because the two genera *Galathea* Fabricius and *Munida* Leach[25] are distinguished by the shape of the rostrum. The rostrum of *Galathea* is depressed, whereas the rostrum of *Munida* is compressed in shape.

Galathea(?) limonitica Stenzel differs in many surface markings from *Galathea cretacea* Stenzel. The former has many more grooves on the carapace than the latter. *Galathea(?) limonitica* Stenzel is a limonitized pyrite micromorph.

Type data.—Monotype, Bureau of Economic Geology, The University of Texas, Austin, Texas.

Type locality.—South of Fort Worth, Tarrant County, Texas. Collected by Mr. Norman E. Nelson, Coll. No. N301, Texas Christian University, Fort Worth, Texas.

Geologic horizon.—Pawpaw shale, Washita group, Comanche series, Cretaceous (upper Albian).

Superfamily THALAESSINIDEA Dana

Family CALLIANASSIDAE Bate

Genus UPOGEBIA W. E. Leach, 1814

Edinburgh Encyclopaedia, vol. 7, p. 400.
Genotype.—*Upogebia stellata* (Montagu).

UPOGEBIA RHACHEOCHIR Stenzel, n.sp.

Pl. 42; text fig. 12

Upogebia rhacheochir Stenzel *in* Dallas Petroleum Geologists, Geology of Dallas County, Texas, p. 38, fig. 11, 1941.

Description.—Carapace too poorly preserved for description. First abdominal somite is the smallest of all seven; its anterior margin is one-half the width of its posterior margin; the center is occupied by a large, elongate boss behind the groove which delimits the carapace-abdomen joint; a pair of hair-pits is just behind that groove spaced far apart; a line of four hair-pits is on the posterior slope of the central boss; a line of about 8 crowded hair-pits is on a low ridge, which separates the tergum from the pleura; the pleura are simple and narrow. The second abdominal tergum is large and squarish in outline; its smooth, shiny surface is interrupted by 4 pairs of widely separated hair-pits; the anterior pair is near the middle, the 2 posterior pairs are at the posterior edge, the 4 pits on either side are not in line; the low, smooth ridge separating the tergum from the pleura is sigmoid; the pleura are triangular with their greatest width at the posterior, the point is narrowly rounded; an oblique line of crowded hair-pits begins at the posterior edge and separates the rounded point from the remainder of the pleurum. The third abdominal tergum is rectangular, broader

[25]Leach, W. E., Malacostraca Podophthalma Britanniae, explanation of pl. 29, 1815. Genotype, *Munida bamffia* (Pennant).

than long, and smaller than the second; a curved, well-defined ridge with a shallow, adjoining groove above separates the tergum from the pleura; tergum with 8 pairs of hair-pits, some of which are on either side parallel to and just above the groove; two pairs of slanting hair-pits are at the posterior margin of the tergum; an oblique line of crowded hair-pits runs forward and outward from the middle of the ridge which separates tergum from pleurum; behind this line there are on the pleurum a few scattered pits near this ridge; a hair-pit is near the anterior end of this ridge. The fourth tergum is smaller than but similar to the third; there are 4 evenly spaced rows of hair-pits; the outer rows each with 4 pits are near the lateral groove of the tergum; the inner rows each with 5 pits are slightly convergent; the lateral groove and ridge of the tergum are well defined; the pleura are similar to those of the third somite, but the line of crowded hair-pits is more anterior in position and runs outward and backward; scattered hair-pits are on the pleurum behind this line. The fifth tergum is almost the same size as the fourth; it has a line of 6 hair-pits in the lateral groove; this groove and its accompanying ridge are less distinct; the pleura are evenly rounded at the margin and are almost semicircular; the oblique line of crowded hair-pits is far to the anterior and runs outward and backward; scattered hair-pits occupy the middle of the pleurum behind that line. The sixth abdominal tergum is larger and elongate rectangular; 3 curved lines of crowded hair-pits are on each side running up on the tergum from its posterior corner; the last pair of lines almost meets in the middle; there are 5 pairs of hair-pits on the tergum; the first 4 pits are near the anterior margin of the tergum; the two inner ones of these and 2 additional pairs form a pair of lines of unevenly spaced pits; another widely spaced pair is near the posterior margin; the lateral margins of this somite are curled down forming rudimentary pleura; the lateral edges have narrow rims. The tail is well developed; the telson has parallel sides and is ovally rounded at the end; a small, median boss with several hair-pits at its top is near the anterior edge; a pair of slightly divergent rows of hair-pits is on the posterior half of the telson; a curved, transverse row of widely spaced pits is at the anterior edge of the telson and extends through the boss; the outer uropod fin has 2 radiating ridges, of which only one extends to the margin; on one specimen there is a row of setae along the inner margin of this fin; the inner uropod fin has one ridge running near its inner margin and accompanied by a row of widely spaced hair-pits.

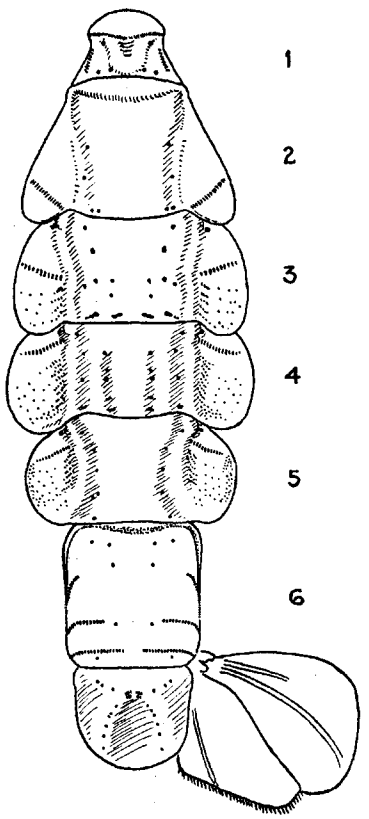


Fig. 12. *Upogebia rhacheochir* Stenzel, x3; composite of several specimens; abdomen.

The chelae of the first legs are equal in size and elongate. Carpus short, less than one-half the length of the manus; greatest thickness about 3/4 of its height; height equal to the length; surface polished; upper margin narrowly rounded; lower margin broadly rounded and with a shallow transverse constriction near the carpus joint; upper margin ends distally

in an inconspicuous, well-rounded point; spines are absent. Manus elongate; its length twice its height; height slightly increasing distally; its greatest thickness 3/5 of its height; upper margin narrowly rounded and with 3 unevenly spaced hair-pits in a row on its crest; toward the outer surface the upper margin is delimited by a narrow rim; the upper margin and this rim are straight except at the proximal end, where they curve rapidly down to the manus-carpus joint; a similar rim delimits the outer surface below and extends to the tip of the pollux; the lower margin of the manus is so nearly flat that it forms something of a narrow lower surface; this lower surface curves narrowly into the inner surface forming a rounded longitudinal edge, which extends to the tip of the pollux, but flattens there; along this rounded edge on the lower surface there is a line of about 7 hair-pits, which are wider spaced at the proximal end; the outer surface is at its lower distal part twisted inward to the pollux, which is curving forward and inward; aside from this twist the outer surface is gently convex, but at its upper third there is a very slight longitudinal dell, which is more conspicuous distally and flattens out near the middle; the inner surface is slightly more tumid than the outer; near its upper margin are two pits in a row, one near the middle, the other at the anterior quarter; the lower surface is very slightly convex in transverse direction and twisted in longitudinal direction, its slant being downward and outward at the distal end. The point of the pollux is bruised in the best specimen (see Pl. 42, figs. 7–10) but can not have added much to its length, which is 1/5 of that of the manus; the pollux is twisted inward so that it points inward and forward; its outline is short triangular; its outer surface is slightly concave; its inner surface is tumid; its lower surface is gently convex; the occludent margin may have had a low proximal tooth.

The manus of a smaller specimen (female?, Pl. 42, figs. 11–14) differs in the following features: the outer surface is more tumid, the dell is not developed, and the twist toward the pollux is slighter; the inner surface is also more tumid; the lower surface is slightly more convex and the distal twist is absent; the rims delimiting the outer surface above and below are less sharp; there is only one hair-pit on the upper margin; it is in the middle; the pollux is only slightly curved inward, slenderer, and longer; its length is about 1/3 of that of the manus.

Dimensions.—Syntype 1, length of entire abdomen, 40 mm., length of telson, 5.5 mm., length of outer tail fin, 8.3 mm.; syntype 2, length of abdomen exclusive of first segment, 37 mm., length of telson, 6 mm., length of outer tail fin, 8 mm.; syntype 5, length of entire abdomen, 41 mm., length of manus, 9.7 mm.; syntype 6, length of abdomen exclusive of telson, 33 mm., length of manus, 10 mm., height at distal end, 5.3 mm., thickness of manus, 3.1 mm.; syntype 7, length of abdomen exclusive of telson, 27 mm., length of manus, 7.4 mm., height at distal end, 3.2 mm., thickness, 2.2 mm.

Remarks.—The characteristics of the genus *Upogebia* as distinguished from those of *Callianassa*[26] are as follows: first pair of legs subequal and subchelate, remaining pairs simple; eye stalks cylindrical, cornea terminal; rostrum short, stout, and tridentate. Of these characteristics only those concerning the first pair of legs can be used in this case, because the other generically characteristic portions of the animal are not preserved. Several of the types had the first leg pair preserved side by side and in place with reference to the abdomen. In these type specimens the chelae are equal in size. The large manus described herein also shows that the pollux is very short and curved off, making the manus subchelate. In *Callianassa* the chelae of the first leg pair are very unequal in size and the pollux is well developed.

The genus *Upogebia* is not well represented by fossils; there are only 5 fossil species known. Three of these have been described from North America. *Upogebia midwayensis* Rathbun[27] from the Midway

[26] *Callianassa* W. E. Leach 1814, Edinburgh Encyclopaedia, vol. 7, p. 400; genotype, *Callianassa subterranea* (Montagu).

[27] Rathbun, M. J., Fossil Crustacea of the Atlantic and Gulf Coastal Plain: Geol. Soc. Amer., Spec. Paper 2, pp. 66–67; pl. 16, figs. 1, 2, 1935.

group of Alabama unfortunately is figured only very poorly, but the description indicates a subquadrilateral furrow on the pleura of the fourth and fifth abdominal somites. Such furrows are apparently not present on the new species.

Upogebia eocenica Rathbun[28] from the Eocene of Washington has an entirely different manus than *Up. rhacheochir* Stenzel. There are also considerable differences in the abdomen of the two species.

Callianassa gamma Rathbun[29] from the Paleocene Sucarnoochee shale of Alabama, which is based on a single manus, is so similar to the manus of *Upogebia rhacheochir* Stenzel that one can not escape the conclusion that the two species are congeneric. Also, comparison with the more plentiful material of *Upogebia rhacheochir* Stenzel indicates that the described manus of *Upogebia gamma* (Rathbun) is the right and not the left manus, as given by Rathbun. Several specimens of *Upogebia rhacheochir* Stenzel are available which have the two hands preserved side by side in parallel position. Such specimens allow correct interpretation of the position of the manus.

The species name is derived from the Greek nouns ραχις, "ridge," and χειρ, "hand," and refers to sharp rims delimiting the outer surface of the hand above and below.

Type data. — Twenty-two syntypes, Bureau of Economic Geology, The University of Texas, Austin, Texas.

Type locality.—Same as *Linuparus grimmeri* Stenzel.

Geologic horizon.—Same as *Linuparus grimmeri* Stenzel.

[28]Rathbun, M. J., The fossil stalkeyed Crustacea of the Pacific slope of North America: U. S. Nat. Mus. Bull. 143, pp. 124-125; pl. 29, figs. 1-2; pl. 30, 1926.

[29]Rathbun, M. J., Fossil Crustacea of the Atlantic and Gulf Coastal Plain: Geol. Soc. Amer., Spec. Paper 2, pp. 68-69; pl. 17, figs. 7-10, June 25, 1935. Name preoccupied by *Callianassa gamma* Stenzel (Stenzel, H. B., Middle Eocene and Oligocene decapod crustaceans from Texas, Louisiana, and Mississippi: Amer. Midland Naturalist, vol. 16, pp. 393-394; pl. 15, figs. 5-6, May 27, 1935).

Superfamily PAGURIDEA Dana

Family PAGURIDAE Boas

Genus PAGURUS Fabricius, 1775

Syst. Entom., p. 410.

Genotype.—*Pagurus bernhardus* Linné.

PAGURUS BANDERENSIS Rathbun

Pl. 45, figs. 7–15

Pagurus banderensis Rathbun, M. J., Fossil Crustacea of the Atlantic and Gulf Coastal Plain: Geol. Soc. Amer., Spec. Paper 2, p. 39, pl. 9, figs. 7–8, 1935.

Original description.—The distal portion of a right chela showing fingers and adjacent palm. Surface for the most part covered with large pointed granules not contiguous and directed obliquely distad; on the inner surface the longitudinal furrow on immovable finger is smooth, also that part of palm not bordering the fingers. Lower margin of specimen concave except near tip of finger where it is slightly ascending. Fingers gaping at base. Immobile finger half as high at base as it is long and of uniform height to its middle; outer surface as well as inner with a shallow longitudinal furrow; prehensile edge with about eight lobiform teeth, the largest one at the bend in the outline; tip blunt. Dactylus closed within fixed finger, equally high at base gradually diministing, upper line arcuate, outer surface with a narrow furrow on which granules are scanty, prehensile edge concave and furnished with small tubercles; tip lacking, but did not reach end of fixed finger. Palm vertical at base of dactyl, swollen outwardly along the gape and the fixed finger as far as the bend; upper margin lacking.

Revised description.—Thanks to the efforts of W. T. Watkins there is available not only the distal portion of a right chela but several entire right chelae, several left manus, and part of an ambulatory leg.

Right manus about as long as high, compressed-oval in cross section. Outer surface more convex in transverse than in longitudinal direction. Inner surface straight in longitudinal direction except for the proximal half, which is convex; highly convex in transverse direction.