

# THE FRESH-WATER AMPHIPODA OF NORTH AMERICA.

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All the species of Amphipoda known to occur in the fresh waters of North America were described by Prof. Sidney I. Smith in his report on the Crustacea of the Fresh Waters of the United States, published in 1874. Previous to that report practically no work had been done on the fresh-water forms belonging to this group. Since then many new species have been described, and the present paper is intended to include descriptions of all of the species of Amphipoda now known to occur in the fresh waters of North America. Only two species are here described for the first time, but as I have had the opportunity of examining specimens—in some cases the types—of most of the known forms, it was thought best to redescribe and figure them.

The genera and also the species, in several instances, were in a state of confusion; consequently an extensive synonymy of each species described has been included. A bibliography has also been added which lists the principal papers dealing with the amphipod fauna of the region covered by this paper.

I am greatly indebted to Dr. S. J. Holmes, of the University of Wisconsin, under whose direction this work was conducted, for many courtesies received during the preparation of this paper. My thanks are due also to Prof. S. A. Forbes for the loan of a large collection of material from the Illinois State laboratory of natural history. A large number of specimens were obtained from the United States National Museum, and the valuable aid thus received is gratefully acknowledged.

## KEY TO FAMILIES AND GENERA.

- A. First antennæ with secondary flagellum; fifth pereopods shorter than preceding; two rami of third uropods nearly equal; second gnathopods smaller than first ..... *LYSIANASSIDE.* *Pontoporeia*, p. 26.
- AA. First antennæ with secondary flagellum; fifth pereopods longer than the preceding; second gnathopods generally larger than the first ..... *GAMMARIDE*
- B. Telson cleft; uropods biramous.
- C. Inner ramus rudimentary; telson cleft not more than three-fourths distance to base.

- D. Outer ramus of third uropods uniaarticulate.....*Eucrangonyx*, p. 29  
 DD. Outer ramus of third uropods biarticulate.....*Niphargus*, p. 36  
 CC. Inner ramus not rudimentary, one-half to three-fourths as long as outer, which is biarticulate; telson cleft to the base, or nearly so.....*Gammurus*, p. 38  
 BB. Telson entire.  
 C. Third uropods with rami.  
 D. Third uropods uniramous; telson short and broad.....*Crangonyx*, p. 49  
 DD. Third uropods biramous. Inner ramus rudimentary, outer uniaarticulate; last two segments of urosome coalescent.....*Stygonectes*, p. 51  
 CC. Third uropods without rami.....*Apocrangonyx*, p. 53  
 AAA. First antennæ without secondary flagellum; telson entire, short and broad; third uropods uniramous.....ORCHESTIIDÆ; *Hyalella*, p. 54

### Family LYSIANASSIDÆ.

Only two species, *Pontoporeia hoyi* Smith, and *Pontoporeia filicornis* Smith, have been described as belonging to this family. I have not had specimens of either, but will quote Professor Smith's descriptions of them.

#### Genus PONTOPOREIA Krøyer.

##### KEY TO SPECIES.

- A. Antennæ not reaching to the posterior end of the abdomen; outer ramus of third uropods not more than twice as long as the peduncle.....*P. hoyi*, p. 26  
 AA. Antennæ extending to or beyond the tip of the abdomen; outer ramus of the third uropods more than twice as long as the peduncle.....*P. filicornis*, p. 28

#### PONTOPOREIA HOYI Smith.

*Gammurus brevistylis* STIMPSON, MSS. (female).

*Pontoporeia affinis* SMITH, Am. Jour. Sci., 3rd. ser., II, 1871, p. 453; Prelim. Rep. on Dredgings in Lake Superior, 1871, p. 1022.

*Pontoporeia hoyi* SMITH, Rep. U. S. Fish Com., 1872-73, (1874) p. 647, pl. 11, fig. 5.

Professor Smith's description follows:

On first examining specimens of this species, obtained in Lake Superior in 1871, I regarded them as specifically identical with the *Pontoporeia affinis* of the Scandinavian lakes and the Baltic. A subsequent and more minute comparison has, however, revealed some differences, which are apparently constant. In the form and proportions of the segments of the thorax and abdomen, in the size and form of the eyes, in the minute details of antennule, antennæ, and mouth appendages, I can detect no differences by which it would be possible to distinguish specimens taken in Lake Superior from those sent from Lake Wetter, or from the beautiful figures of the Scandinavian species given by Sars.<sup>a</sup> In the first pair of legs, however, the propodus in the American species is proportionately a very little shorter than in the European, and the palmary margin is less oblique—that is, it is not so nearly parallel with the posterior margin; the posterior margin is somewhat shorter, and furnished with fewer hairs; and there are usually two small and slender spines on the palmary margin near the tip of the closed dactylus, while in the European species there are no real spines upon the palmary margin, but only slender setiform hairs. In both the European and American species, there is a very thin and narrow lamellar edge,

<sup>a</sup> Histoire Naturelle des Crustacés d'Eau Douce de Norvège, 1867, p. 82, pl. VII, figs. 10-25; pl. VIII, figs. 1-5.

extending nearly the whole length of the palmary margin. The dactylus is apparently a little longer and more slender in the European species. The obliquity of the palmary margin, and its armature near the posterior angle, seem to be always characteristic of the American species. In the young specimens, however, there is often but one spine, while in larger ones there are often three. In the third and fourth pairs of legs of the American species the dactylus is usually armed on the inside, a little way from the tip, with two setiform hairs, while in the European species there is only one. Some young specimens of the American species, however, agree with the European in having but one hair upon the dactylus, while large ones often have three, and in the full-grown male from Lake Michigan, mentioned farther on, there are even four.

The most remarkable differences are in the peculiar, elongated, papilliform appendages upon the sternal portion of the thoracic segments. In the European species, Dr. G. O. Sars describes and figures an elongated and slender process depending from the middle of the sternum of several of the thoracic segments; and in the single specimen which I have examined, there are three of these processes, one each on the second, third, and fourth segments. Dr. Sars, who has studied the living animals very carefully, does not suggest what may be the use of the appendages, or whether they ever vary in number or position in different specimens. In specimens from Lake Superior there are usually seven of these appendages, one upon the second and

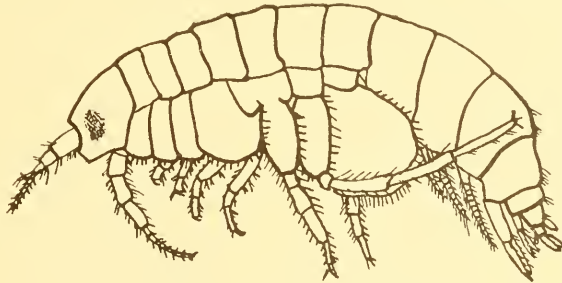


FIG. 1.—PONTOPOREIA HOYI. (After Smith.)

two each upon the third, fourth, and fifth segments. In form and size, these appendages do not differ, except that in alcoholic specimens they seem to be a little longer in the American species. In some specimens of the American species, the appendage upon the second segment is wholly wanting, and in two specimens examined carefully there was only a single median one upon the third segment. In the absence of all knowledge of the nature and use of these appendages, it seems useless to speculate on their importance as distinctive characters. In a species of *Pontoporeia* from the Gulf of St. Lawrence, which I suppose to be the *P. affinis* of Kroyer, there are no such appendages on any of the thoracic segments. This fact, together with the variation noticed in the specimens from Lake Superior, would seem to indicate that these appendages are not of so much importance as might at first be supposed.

This species was found in great abundance in the dredgings in Lake Superior in 1871, and occurred in every haul from 4 to 169 fathoms. It was also dredged by Mr. J. W. Milner in Lake Superior in 1872, in 60 fathoms off Outer Island. It is common in the stomach of the whitefish from Lakes Superior and Michigan, and probably also from the lower lakes. All the specimens dredged in Lake Superior were taken in August and the early part of September, and none of the females were carrying eggs during that time. Females carrying eggs were dredged by Dr. Stimpson, in Lake Michigan, in 40 to 60 fathoms, off Racine, Wis., June 24, 1876, and with them the adult male form with long antennule and antennæ. This peculiar

form of the adult male, corresponding perfectly with the same form of the European species figured and described by Dr. Sars, I have not been able to find among the numerous specimens from Lake Superior. A single specimen of this form of the male was, however, sent to me by Dr. Stimpson under the manuscript name of *Gammarus Hoigi*, while two specimens of the female were sent as *Gammarus brevistylis*. These are undoubtedly the same as the *Gammarus Hoigi* and *brevistylis* mentioned, without description, by Dr. P. R. Hoy. <sup>a</sup>

#### PONTOPOREIA FILICORNIS Smith.

*Gammarus filicornis* STIMPSON, MSS.

*Pontoporeia filicornis* SMITH, Rep. U. S. Fish Com., 1872-73 (1874), p. 649.

Professor Smith's description follows:

*Male*.—Outline of the head very much as in *P. affinis*. Eyes about as large as in that species, slightly elongated, black. Peduncle of the antennula reaching nearly to the distal end of the penultimate segment of the peduncle of the antenna, about as long as the head and the first segment of the thorax together; first segment large and thickened; second half as long as the first; third slightly more than half as long as the second. Flagellum greatly elongated and very slender, reaching nearly to the tip of the abdomen, and composed of thirty-three segments, of which the proximal are longer than broad, while they increase in length distally, until, near the tip, they are many times longer than broad, and exceedingly slender. The upper side of the flagellum is nearly naked, only the alternate segments being furnished with two minute setæ near the distal extremity, while the under side of each segment is armed distally with minute setæ, and most of the segments with one or several clavate (olfactory) papillæ, and many of the segments have in addition a peculiar transparent, shallow, bell-shaped appendage, raised on a very slender peduncle. Secondary flagellum reaching to the fourth segment of the primary, and composed of four segments, of which the terminal one is very short. Penultimate segment of the peduncle of the antenna about as long as the first segment of the peduncle of the antennula; ultimate segment slightly shorter; penultimate and antepenultimate segments furnished with long, plumose hairs below and several fascicles of short, setiform hairs above. Flagellum much longer than the flagellum of the antennula, very slender, and composed of about fifty very elongated and somewhat flattened segments, which have about the same proportions as in the flagellum of the antennula, and are furnished with the same kinds of appendages.

Epimera of almost exactly the same proportions and form as in *P. affinis*, and the first four margined with plumose hairs in the same way. First pair of legs very nearly like those of *P. affinis*; the palmary margin even slightly more longitudinal than in that species, continuous with the posterior margin, and armed with two small obtuse spines near the tip of the closed dactylus in addition to the setiform hairs. Second pair of legs of the same form as in *P. affinis*, except that the palmary margin is slightly concave and a little oblique in a proximal direction; the posterior margin furnished with fascicles of setiform hairs, as in that species, and armed close to the palmary margin with three or four small obtuse spines. Third and fourth pairs of legs like those of *P. affinis*, except that the dactyli have each three setiform hairs near the tip, being in this as in several other respects nearer *P. Hoigi*. Fifth and sixth pairs of legs almost exactly as in *P. affinis*, except the posterior margin of the propodus in the sixth pair is armed with three pairs of small spines. Seventh pair of legs having a few small spines on the propodus, but otherwise as in *P. affinis*.

Lateral margins of the first, second, and third segments of the abdomen with the angles rounded; lateral margin of the third segment furnished with a line of several submarginal, plumose setæ near the anterior angle, and behind them armed with five large and acute spines directed backward, of which four are in pairs near the middle of

<sup>a</sup>Deep Water Fauna of Lake Michigan, Trans. Wis. Acad. Sci., 1870-72, p. 98-101.

the margin, and one alone near the posterior angle; the posterior edges of the lateral expansions of all three of the segments furnished with a few, widely separated, plumose hairs. Peduncles of the first and second pairs of caudal stylets reaching to about the same point, a little beyond the extremity of the sixth segment of the abdomen; the outer rami slightly longer than the inner, and those of the second pair of stylets only a little shorter than those of the first. Rami of the posterior caudal stylets longer than in *P. affinis*; the outer ramus rather more than twice as long as the peduncle, narrow, and tapering to an obtuse tip, both edges furnished with long plumose hairs, and the outer edge with a sharp spine at the base of each hair. Telson slightly longer than broad, cleft half-way to the base, and each lobe tipped with two short spinules and a plumose seta. There are two of the peculiar papilliform appendages on the sternum of the third, fourth, and fifth segments of the thorax, as in *P. Hoyi*, but apparently none upon the second.

\* Length from the front of the head to the tip of the telson, 6 mm.

Of this species, I have seen but a single specimen, which was dredged with the last species in Lake Michigan in 40 to 60 fathoms, off Racine, by Dr. Stimpson, from whom it was received under the manuscript name of *Gammarus filicornis*.

This species differs remarkably from all the heretofore-known species of *Pontoporeira*, in the excessive elongation of the flagella of the antennulæ and antennæ, a character which might be regarded by some naturalists as of generic value. The very close agreement with *P. affinis* and *Hoyi* in all other parts of the animal, however, seems to indicate a very close affinity with those species, especially the latter; and as this one peculiarity is very likely only a sexual character of the old males of the species, I retain the species in the genus. The mouth-appendages seem to agree perfectly with those of the species just mentioned. The singular armature of the lateral margins of the third segment of the abdomen is not peculiar to this species, but is almost exactly repeated in *P. affinis*, *P. Hoyi*, and the marine species, already mentioned, from the Gulf of St. Lawrence, and is probably common to the genus, although it seems to have been overlooked till now.

### Family GAMMARIDÆ.

#### Genus EUCRANGONYX Stebbing.

##### KEY TO SPECIES.

- A. Telson about as long as peduncle of third uropods, not deeply cleft, third uropods short.
- B. Outer ramus of third uropods about twice the length of peduncle; inner ramus very small, telson cleft one-third distance to base.
  - C. Eyes small, elongated, with black pigment ..... *E. gracilis*, p. 32
  - CC. Eyes small without black pigment ..... *E. packardii*, p. 35
- BB. Outer ramus of third uropods shorter than peduncle; inner ramus absent, peduncle produced distally on the inner side into a short, blunt process; telson cleft three-fourths distance to base..... *E. bifurcus*, p. 33
- AA. Telson in the male elongated, equaling from one-fourth to one-third length of body, rounded distally; telson in female short, with a slight emargination; third uropods with short outer ramus and rudimentary inner ramus,
  - E. mucronatus*, p. 29

#### EUCRANGONYX MUCRONATUS (Forbes).

*Crangonyx mucronatus* FORBES, Bull. Ill. State Lab. Nat. Hist., No. 1, 1876, p. 6.—  
 O. P. HAY, Am. Nat., XVI, 1882, p. 241.  
*Eucrangonyx mucronatus* STEBBING, Trans. Linn. Soc. London, 2nd ser., VII,  
 1899, p. 423.  
*Bactrurus mucronatus* W. P. HAY, Proc. U. S. Nat. Mus., XXV, 1902, p. 429.

Blind. Head slightly longer than the first thoracic segment, concave on its anterior margin at the bases of the first antennae and convex between them. First antennae in the male half to two-thirds as long as the body; in the female about half as long as the body; flagellum four or five times as long as the peduncle and consisting in the male of about thirty-five segments, all but the first seven or eight of which are provided with slender olfactory clubs; secondary flagellum slightly longer than the first segment of the primary one (usually shorter in the female) and composed of two segments, the distal one very short. Second antennae only about one-half as long in the first

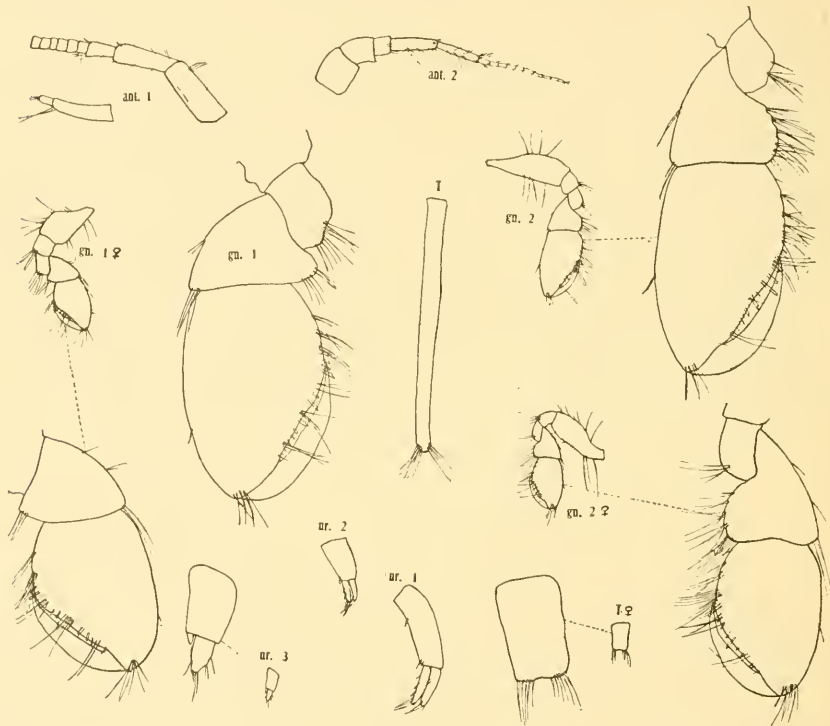


FIG. 2.—*EUCRANGONYX MUCRONATUS*. *ant. 1*, FIRST ANTENNA; *ant. 2*, SECOND ANTENNA; *gn.*, GNATHOPOD; *T*, TELSON; *ur.*, UROPOD; *gn. 1 ♀*, *gn. 2 ♀*, AND *T. ♀* FROM A FEMALE; OTHER FIGURES FROM A MALE.

pair; peduncle extending beyond that of the first pair; the two distal segments elongated, about equal in length; flagellum slightly shorter than the peduncle and composed of about ten segments.

In the male the carpus of the first gnathopods is broadly triangular, fully as broad as the propodus; propodus about two-thirds as broad as long; anterior and posterior margins only slightly convex, the posterior furnished with three small fascicles of long hairs; palm very oblique, slightly concave at the center, with a broad lamellar edge, furnished with two or three fascicles of long hairs, and about ten notched

spines, with usually two large spines near the center and three at the tip of the closed dactyl; dactyl strongly curved, slightly longer than the palm. First gnathopods of the female with the propodus smaller, shorter, and broader distally than in the male.

In the second gnathopods the carpus is slightly longer than broad; much larger than in the first pair; propodus not much larger than in the first pair and not so broad; the posterior and anterior margins only very slightly convex, the posterior furnished with more hairs than in the first pair; palm longer than in the first pair, similarly armed, but having a few more spines; dactyl strongly curved, as long as the palm. Propodus of the second gnathopods in the female not so much elongated as in the male, but similarly armed.

Coxal plates of the three posterior pereopods oval, not large, with both margins serrated.

Abdominal segments rounded dorsally; the lateral margins and all the angles broadly rounded.

The first pair of uropods extend beyond the second pair, which extend beyond the third; second pair not longer than the peduncle of the first; third pair short, not quite so long as the peduncle of the second pair; outer ramus ovate, truncate, about half the length of the peduncle, provided distally and laterally with a few hairs; inner ramus rudimentary, unarmed, about one-third or one-fourth as long as the outer ramus.

Telson in the male cylindrical, very much elongated, equaling from one-fourth to one-third the length of the body, rounded distally, and furnished with two clusters of long hairs. In the female the telson is short, projecting beyond the tips of the third uropods, having a very slight emargination, on either side of which there is a cluster of long, stout hairs.

Length, 10–15 mm.

Collected in old wells at Irvington, Indiana; Champaign and Normal, Illinois.

The telson in the female of this species is somewhat incised posteriorly, but less than is usual in this genus; in the male the telson is entire and greatly elongated, a feature which does not accord with the definition of the genus as originally given by Stebbing. The other characters of this species, however, are so much like those of the other members of this genus that it seems best to retain it in the genus *Eucrangonyx*, to which it was assigned by Stebbing, rather than to place it in a new genus, *Bactrurus*, as proposed by Hay.

## EUCRANGONYX GRACILIS (Smith).

*Crangonyx gracilis* SMITH, Am. Jour. Sci., 3d ser., II, 1871, p. 453; Prelim. Report on Dredgings in Lake Superior, 1871, p. 1022; Rep. U. S. Fish Com., 1872-73, (1874) p. 654.—FORBES, Bull. Ill. State Lab. Nat. Hist., No. 1, 1876, p. 6.—O. P. HAY, Am. Nat., XVI, 1882, p. 241.—W. P. HAY, Proc. U. S. Nat. Mus., XXV, 1902, p. 429.

*Eucrangonyx gracilis* STEBBING, Trans. Linn. Soc. London, 2d ser., VII, 1899, p. 423.

Eyes small, elongated. First antennæ slightly more than half as long as the body; peduncle with the first segment shorter than the second, which is about twice as long as the third; flagellum twice as long as the peduncle and consisting of about thirty segments; secondary flagellum about equal in length to the first segment of the primary

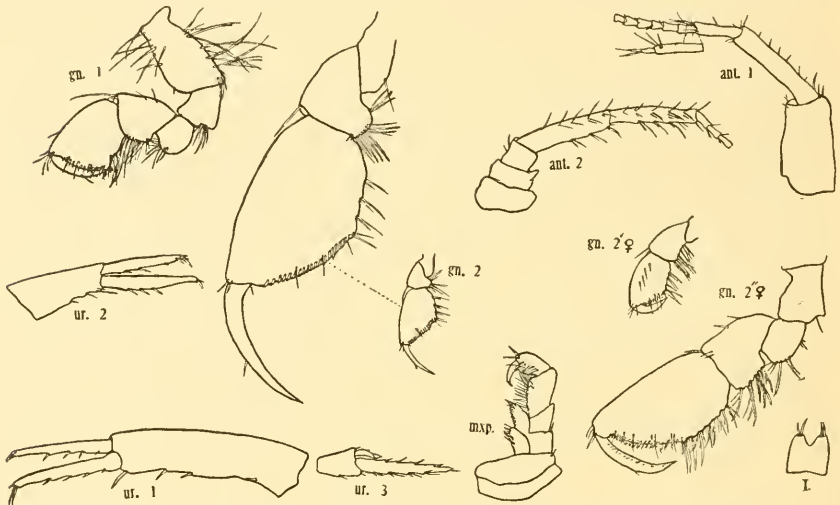


FIG. 3.—EUCRANGONYX GRACILIS, ANN ARBOR, MICHIGAN. *msp.*, MAXILLIPED; FOR OTHER INSCRIPTIONS TO THIS AND SUCCEEDING FIGURES SEE FIG. 2. *gn.* 2'♀, SECOND GNATHOPOD OF A SMALL FEMALE; *gn.* 2''♀, SECOND GNATHOPOD OF A LARGE FEMALE. MAXILLIPED DRAWN TO A LARGER SCALE THAN THE OTHER PARTS.

one, composed of two segments, the terminal one slender and very short. Second antennæ half as long as the first pair; ultimate and penultimate segments of the peduncle nearly equal; flagellum somewhat shorter than the peduncle and composed of eight to ten segments.

Carpus of the first gnathopods in the male about as broad as long; the posterior margin produced but slightly and furnished with long plumose hairs; propodus almost quadrate in outline, a little longer than broad; palm convex, slightly oblique, and armed on each side with from ten to fifteen notched spines, which are equidistant from each other except at the posterior angle, where about five are crowded together; each spine is furnished with a hair a short distance from the tip; the posterior margin slightly concave, with a few long hairs;



daetyl stout, slightly curved, extending to the posterior margin of the palm.

Carpus of the second gnathopods in the male like that of the first pair; propodus more elongated than in the first pair, broadened distally; palm oblique, somewhat arcuate, armed with fifteen or more spines similar to those of the first pair, but not crowded into a group at the posterior angle; posterior margin of hand with five or six groups of hairs; daetyl strongly curved, as long as the palm. In the female the propodus of the second gnathopods is proportionally more elongated than in the male and does not increase in breadth distally.

Third, fourth, and fifth pereopods with the coxal plates serrate, and with small spines on both margins.

Postero-lateral angles of the first three segments of the abdomen produced, terminating in a small tooth.

First pair of uropods projecting backward beyond the second and third pairs, two rami equal and about two-thirds as long as the peduncle; second pair with rami equal, and equal in length to the peduncle; third pair short, reaching to the tip of the second pair, peduncle short; outer ramus about twice the length of the peduncle, inner ramus very small, slender, shorter than the peduncle, usually without spines or hairs. Telson slightly shorter than the peduncle of the third uropods; about as broad as long, cleft about one-third the distance to the base with two or three spines on the truncate extremities of the lobes.

The specimens of this species differ greatly in size, varying in mature specimens from 7–18 mm., but the larger ones agree in all essential features with the smaller.

*Distribution.*—Providence, Rhode Island; Ann Arbor and Isle Royal, Michigan; Lake Huron; Lake Superior; Portage, Wisconsin; Champaign, Illinois; Irvington, Indiana; Delaware, Ohio; Nashville, Tennessee.

This species can not belong to the genus *Cranzonyx* to which it was assigned by Smith. That genus as generally defined has the third uropods uniramous and the telson entire. The new genus *Eucranonyx*, in which this species has been placed by Stebbing, is like *Cranzonyx* in general, but with a small inner ramus to the third uropods and with the telson emarginate.

#### EUCRANGONYX BIFURCUS (O. P. Hay).

*Cranzonyx bifurcus* O. P. HAY, Am. Nat., XVI, 1882, pp. 145–146.

Eyes oval, large, about twice as large as those of *Eucranonyx gracilis* which this species resembles. First antennæ not quite half the length of the body; third segment of the peduncle two-thirds as long as the first or second segments, which are nearly equal; flagellum

composed of about twenty-five elongated segments; secondary flagellum slightly shorter than the first segment of the primary flagellum, consisting of two segments, the distal one short; entire antennæ furnished with comparatively few short hairs. Second antennæ slightly more than half as long as the first pair; two distal segments of the peduncle elongated, nearly equal in length, the third segment short; flagellum not so long as the two distal segments of the peduncle, composed of about six elongated segments; antennæ furnished with a few hairs and a number of large olfactory clubs.

Carpus of the first gnathopods in the male short and broadly triangular, nearly as broad as the propodus; propodus slightly longer than

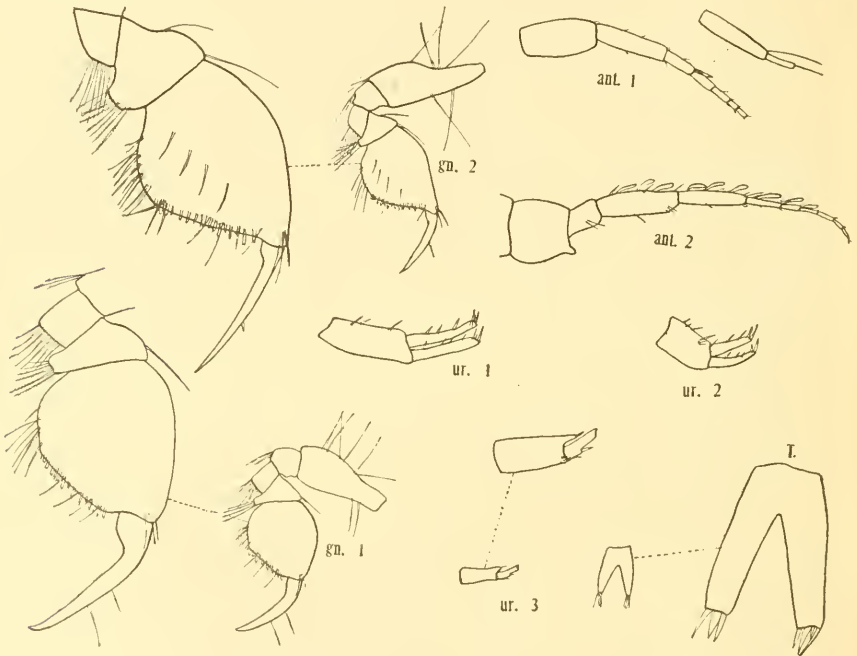


FIG. 4.—*EUCRANGONYX BIFURCUS*, MALE. MACON, MISSISSIPPI.

broad; lateral margins convex, the posterior provided with four or five small fascicles of hairs; palm oblique, armed on each side with about twelve spines and a few hairs; dactyl strongly bent near the base, as long as the palm. Second gnathopods with the carpus and propodus very similar to those of the first pair, but more elongated; the palm more oblique, armed with about fifteen notched spines; posterior margins furnished with six small fascicles of hairs.

Last three pairs of pereopods with the coxal plates oval, both margins serrate and armed with small spines.

Abdominal segments rounded dorsally; postero-lateral angles of the first three segments produced backward into a tooth.

First uropods projecting backward beyond the second pair, and the second beyond the third; third pair consisting of a peduncle and a single small ramus; peduncle more than twice as long as broad, furnished with a few spines, and produced distally on the inner side into a short, blunt process furnished at the tip with a small spine; ramus about two-thirds the length of the peduncle, provided with a few spines. Telson cleft three-fourths the distance to the base, projecting beyond the third uropods, lobes diverging toward the tip, each armed distally with three or four spines.

Length, 9 mm.

*Type locality*.—Macon, Mississippi.

This species differs from the other members of the genus *Eucrangonyx* in the absence of the rudimentary inner ramus of the third uropods. In all other characters, however, it so closely resembles the species of this genus that it seems best to retain it in *Eucrangonyx* rather than to place it in a new genus.

#### EUCRANGONYX PACKARDII (Smith).

*Crangonyx packardii* SMITH, Mem. Nat. Acad. Sci., IV, 1888, pp. 34-36, pl. v, figs. 1-11.

The following description, with figures, is taken from Memoirs National Academy of Sciences, where the species is described by Prof. S. I. Smith as *Crangonyx packardii*.

This species is so closely allied to *Crangonyx gracilis* that it might readily be mistaken for it were it not for the peculiar structure of the eyes. The eyes of *C. gracilis* are composed of a few facets, and are abundantly supplied with black pigment. In all the specimens of *C. packardii* which I have seen the eyes are observable with difficulty, the black pigment being wholly wanting. The specimens received at first were very badly preserved, and I thought the absence of the pigment might be due to this fact; but subsequent examination of more perfect specimens shows that this can not be the case, and that the eyes are in life undoubtedly wholly without black pigment. The eyes are scarcely, if at all, observable in the ordinary alcoholic specimens, but when rendered translucent by immersion in glycerin the structure of the facets is distinctly observable, as shown in fig. 5. As observed by Doctor Packard, the flagella of the antennule of *C. gracilis* are a little shorter, and usually contain four or five segments less than *C. gracilis*, but this is an uncertain character, and some specimens of *C. gracilis* from Lake Superior actually have only one or more segments than the subterranean species. In the antennae there are no constant differences. There are some very slight differences in the first and second pairs of legs; especially in the females, but not greater than usually exist in the individuals of a single species in allied genera, and any large series of specimens would undoubtedly show all the intermediate forms. In the third to the seventh pair of legs there is a constant difference in all the specimens examined, the spines being more numerous, longer, and more slender in *C. gracilis*. The spines upon the first and second caudal stylets are a little shorter and more obtuse in *C. packardii* than they usually are in *C. gracilis*; otherwise there is no difference in the caudal stylets and telson.

These differences are all such as very naturally lead to the supposition that this subterranean form has been derived from the *C. gracilis* at no very remote period,

although this supposition may well be held in reserve until we have a more complete series of the subterranean species for comparison. *C. gracilis* occurs as far south as Grand Rapids, Michigan, whence we have received specimens from Mr. N. Coleman, and it very likely occurs in the same region as *C. packardii*.

The figures are all from Professor Packard's original specimens, collected from wells in Orleans, Indiana, by Dr. Moses Elrod. Only one of these has the body entire; this is a female, 5.5 mm. long, and from which figs. 5 to 8 were made. A

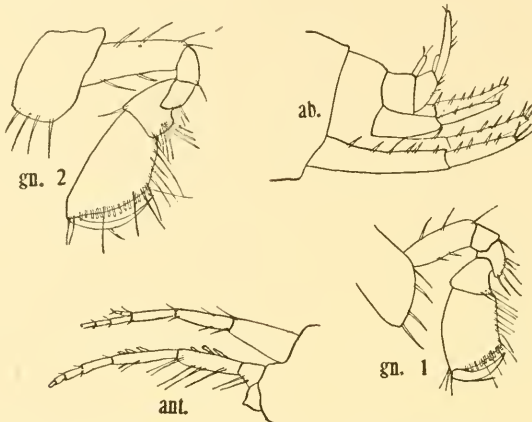


FIG. 5.—*EUCRANGONYX PACKARDII*. (After Smith.) *ab.*, TERMINAL PORTION OF THE ABDOMEN WITH THE UROPODA.

large specimen, a female about 7.5 mm. long, unfortunately wanting most of the antennule and antennæ, collected from a well at New Albany, Indiana, by Dr. John Sloan, was sent to Doctor Packard for examination.

### Genus *NIPHARGUS* W. P. Hay.

#### *NIPHARGUS ANTENNATUS* (Packard).

*Crangonyx antennatus* PACKARD, *Am. Nat.*, XV, 1881, p. 880.

*Eucrangonyx antennatus* STEBBING, *Trans. Linn. Soc. London*, 2d ser., VII, 1899, p. 423.

*Niphargus antennatus* W. P. HAY, *Proc. U. S. Nat. Mus.*, XXV, 1902, p. 429.

Eyes composed of a few slightly pigmented facets or wanting altogether, when present of no definite shape. First antennæ more than half as long as the body; first and second segments of the peduncle nearly equal in length, slightly longer than the third; flagellum about three times as long as the peduncle, composed of about twenty-five segments in the female; the number of segments in the flagellum varies in the two sexes according to Hay's description, there being more in the female than in the male; secondary flagellum longer than the basal segment of the primary one, composed of two segments, the distal one very short; each segment furnished distally with a few long hairs. Second antennæ not half so long as the first pair; flagellum short; not greatly exceeding the third segment of the peduncle and composed of about eight segments.

In the female the first gnathopods have the carpus short, triangular, as broad as the propodus; propodus less than twice as long as broad; anterior margin slightly convex; posterior margin straight or nearly so, furnished with a few fascicles of long hairs; palm slightly oblique and convex, furnished on each side with a few hairs, six or eight short notched spines, and one long stout spine at the tip of the closed dactyl; dactyl stout and curved. In the male, from Hay's description, the propodus is larger, stouter, and more strongly armed than in the female.

Propodus of the second gnathopods of the female elongated, twice as long as broad, narrowed distally; lateral margins slightly convex, the posterior one furnished with a few fascicles of long hairs; palm

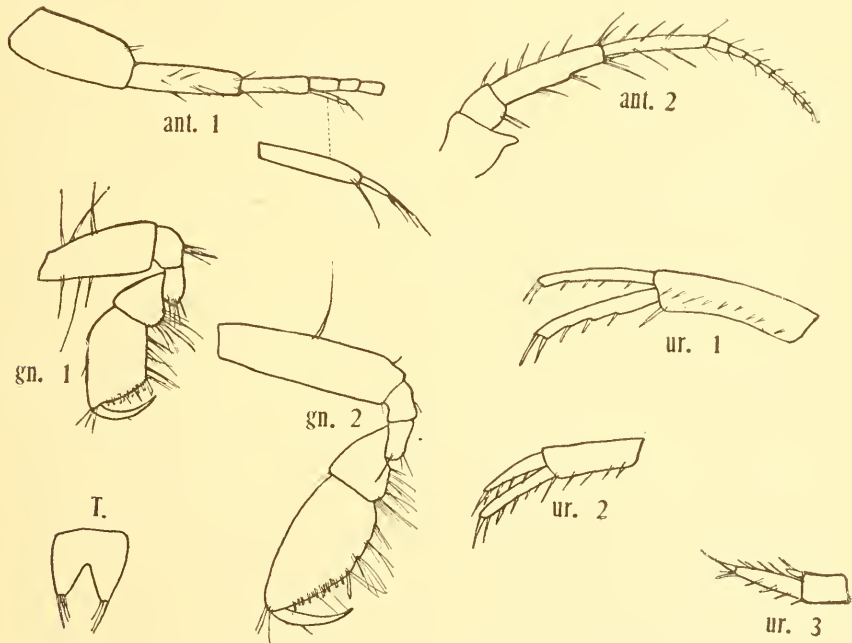


FIG. 6.—*NIPHARGUS ANTENNATUS*, FEMALE. NICKAJACK CAVE, SHELLMOUND, TENNESSEE.

oblique, convex, armed as in the first pair, but with more numerous spines. In the male, according to Hay's description, the second gnathopods are larger than in the female and have the propodus proportionally more developed.

The abdominal segments are rounded above and without spines.

The uropods project backward about an equal distance; the terminal pair are slightly longer than the peduncle of the second pair, with the outer ramus well developed, composed of two segments, the terminal one very short, and armed distally with a few spines, the first segment furnished on both margins with four or five spines; inner ramus short, rudimentary, and furnished with a few hairs at the tip.

Telson emarginate, the emargination reaching to the middle or nearly to the base; each lobe furnished at the truncate tip with three or four stout spines.

Length 10 mm.

This species has been collected at various places within Nickajack Cave, Shellmound, Tennessee.

The genus *Niphargus*, to which this species has been assigned by Hay, differs from *Crangonyx* in the telson, which in the latter genus is entire and in the former divided, and in the third uropods, which in *Crangonyx* are uniramous and in *Niphargus* biramous with the outer ramus biarticulate. It differs from *Eucrangonyx*, in which genus it has been placed by Stebbing, in the outer ramus of the third uropods, which in *Eucrangonyx* is unarticulate and in *Niphargus* biarticulate.

### Genus GAMMARUS Fabricius.

#### KEY TO SPECIES.

- A. Telson cleft to the base.
- B. Eyes present.
- C. Third uropods with basal segment of outer ramus elongated, terminal segment short, styliform; inner ramus half or more than half as long as the outer; both rami furnished with long plumose hairs.
- D. Inner ramus of third uropods at least three-fourths as long as the outer; nearly as broad as the basal portion of the outer ramus.
- E. Terminal segment of outer ramus of third uropods with long plumose hairs on lateral margin; secondary flagellum composed of two to four segments..... *G. limnicus*, p. 42
- EE. Terminal segment of outer ramus of third uropods without long plumose hairs on the lateral margins; secondary flagellum composed of five or six segments..... *G. fasciatus*, p. 40
- DD. Inner ramus of third uropods only slightly more than half as long as outer ramus; much more slender than the basal portion of the outer.....  
*G. propinquus*, p. 46
- CC. Third uropods with the basal segment of the outer ramus elongated, with fascicles of a few long hairs on lateral margins; terminal segment short; inner ramus rudimentary, shorter than the peduncle... *G. ramellus*, p. 38
- BB. Eyes absent..... *G. caecus*, p. 47
- AA. Telson not cleft to the base..... *G. purpurascens*, p. 45

### GAMMARUS RAMELLUS, new species.

Eyes small, reniform; their distance apart more than twice their diameter. First antennæ not quite half so long as the body; first and second segments of the peduncle about equal and nearly twice as long as the third; flagellum composed of twenty to twenty-five segments; secondary flagellum slightly exceeding the terminal segment of the peduncle in length and consisting of three or four segments. Second antennæ more than half as long as the first pair; peduncle longer than in the preceding pair; flagellum composed of eight to twelve segments.

First gnathopods of the male with the carpus triangular, as broad as long; propodus slightly longer than broad; lateral margins convex;

the posterior one furnished with three or four small fascicles of hairs; palm oblique, with two emarginations, and furnished with a few long hairs and a group of six or eight spines at the posterior angle; dactyl strongly curved, as long as the palm.

Carpus in the second gnathopods more elongated than in the first pair; propodus oblong; lateral margins only slightly curved, the posterior one furnished with six or seven fascicles of long hairs; palm less oblique than in the first pair, furnished with a row of long hairs at the base of the lamellar edge and six or seven spines at the rounded posterior angle; dactyl not so strongly curved as in the first pair, longer than the palm.

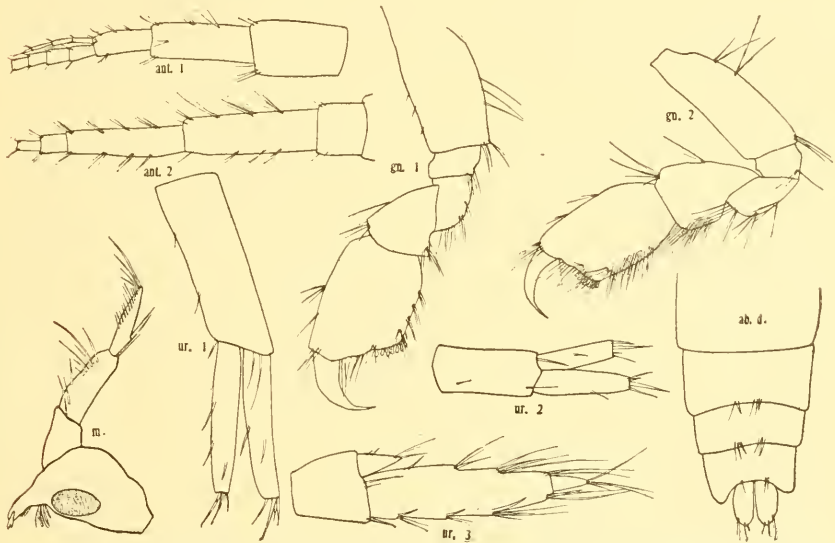


FIG. 7.—GAMMARUS RAMELLUS, MALE. POINT ARENA, CALIFORNIA. *m.*, MANDIBLE, DRAWN TO A LARGER SCALE THAN THE OTHER PARTS; *ab. d.*, DORSAL SID OF THE LAST SEGMENTS OF THE ABDOMEN.

Coxal plates of the last three pereopods with the posterior margins serrated and furnished with short spines.

Postero-lateral angles of the first three abdominal segments produced but little and terminating in a small spine. The last three or four abdominal segments are furnished dorsally on each side with a fascicle of two or three spines and a few short hairs.

First uropods projecting backward slightly beyond the peduncle of the third pair; third pair with the peduncle short, as broad as long, armed distally with a few hairs; outer ramus elongated, biarticulate, the basal segment long, tapering distally, armed laterally with fascicles of a few long hairs and one or two large spines; terminal segment very short, tapering distally and terminating in a tuft of long hairs; inner ramus rudimentary, slightly more than half as long as the

peduncle, furnished at the tip with a spine and a few hairs, and a few short hairs on the inner margin.

Telson cleft to the base, the lobes rounded distally and furnished with a few hairs and a few small spines.

Length, 10 mm.

*Type locality*.—Point Arena, California. Specimens from Portland, Oregon, were also examined. These were larger and stouter than those from California.

*Type*.—Cat. No. 32841, U.S.N.M.

#### GAMMARUS FASCIATUS Say.

*Gammarus fasciatus* SAY, Jour. Acad. Nat. Sci. Phila., I, 1817, p. 374.—DE KAY, Zool. of New York, VI, 1844, p. 37.—BATE, Cat. Amphipodous Crustacea British Mus., 1862, p. 210, pl. XXXVII, fig. 6.—SMITH, Rep. U. S. Fish Com., 1872-73 (1874), p. 653.—FORBES, Bull. Ill. State Lab. Nat. Hist., No. 1, 1876, p. 6.

Eyes reniform; their distance apart slightly exceeding their diameter. First antennæ with the first and second segments nearly equal in length and twice as long as the third; flagellum twice as long as the peduncle and composed of about thirty segments; secondary flagellum as long as the second segment of the peduncle and consisting of five or six segments. Second antennæ about two-thirds the length of the first; peduncle exceeding that of the first pair, with the two distal segments elongated and nearly equal; flagellum slightly shorter than the peduncle and composed of about fifteen segments.

In the male the carpus of the first gnathopods is triangular, slightly longer than broad; propodus not quite twice as long as broad, much narrowed distally; palm slightly concave, very oblique, continuous with the posterior margin, with a narrow lamellar edge, armed with a few long hairs, near the middle of the inner side with a stout spine, at the base of which there is a fascicle of long hairs, and three or four smaller spines near the tips of the closed dactyl; posterior margin with four or five fascicles of long hairs; dactyl strongly curved and half as long as the propodus. Propodus of the female much smaller than that of the male, only slightly narrowed distally; palm not so oblique as in the male, furnished with a few long hairs and a few spines at the tip of the closed dactyl, but without a spine at the middle of the palm.

Propodus of the second gnathopods in the male as long as in the first pair, broadest distally; lateral margins nearly parallel; the posterior margin furnished with numerous fascicles of hairs; palm oblique, but not so much so as in the first pair, concave in the middle, armed with a few short hairs at the base of the broad lamellar edge, a stout median spine, and three or four smaller ones at the tip of the closed dactyl; dactyl not so strongly armed as in the first pair, as long as



the palm. Second gnathopods in the female much smaller than in the male; carpus elongated, as broad as the propodus; propodus narrow, twice as long as broad; lateral margins parallel; palm straight, transverse, without a lamellar edge and devoid of a median tooth.

Coxal plates of the last three pereopods with the posterior margin serrate.

The infero-posterior angles of the second and third abdominal segments are slightly produced, forming less than a right angle. The fourth, fifth, and sixth segments are slightly angulated dorsally, each

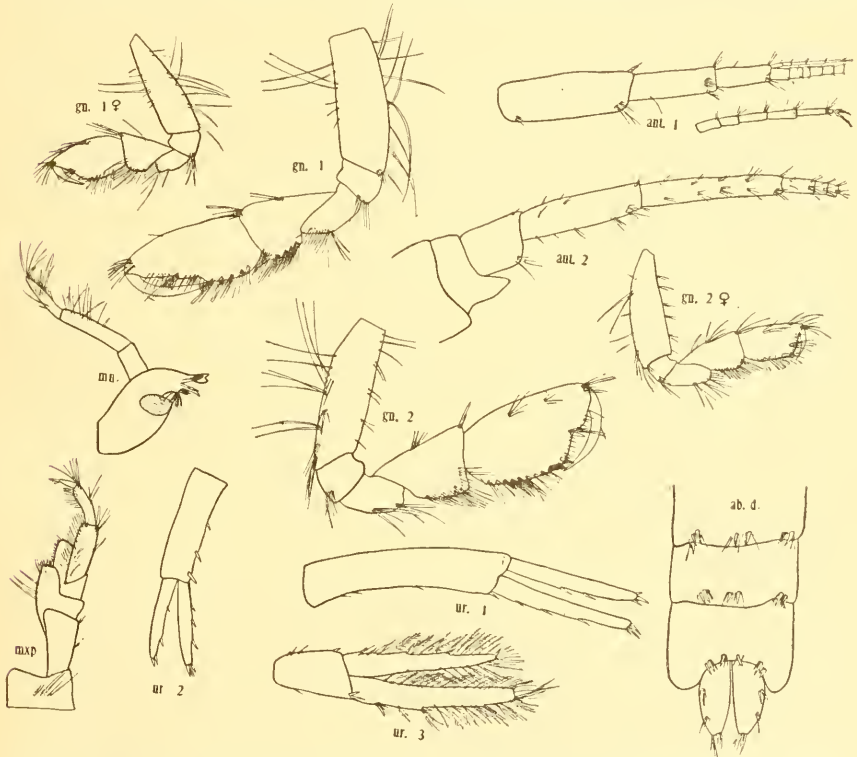


FIG. 8.—GAMMARUS FASCIATUS. *gn. 1 ♀*, *gn. 2 ♀*, FIRST AND SECOND GNATHOPODS OF A FEMALE, OTHER FIGURES FROM A MALE; *ma.*, MANDIBLE, AND *m.p.*, MAXILLIPED, DRAWN TO A LARGER SCALE THAN THE OTHER PARTS; *ab. d.*, DORSAL SIDE OF THE TERMINAL PART OF THE ABDOMEN.

bearing three fascicles of well-developed spines, the median one of which on the fourth and fifth segments is raised on a distinct protuberance.

First uropods exceeding the second pair in length and projecting backward slightly beyond the peduncle of the terminal pair; outer ramus of the terminal pair composed of two segments, the first segment elongated, furnished on both margins with many long plumose hairs and on the outer margin with several small obtuse spines; the distal segment very short, styliform, and furnished at the tip with several hairs, but having no hairs on the lateral margins; inner ramus

not quite so long as the first segment of the outer ramus, armed with a few spines on the inner margin and numerous long plumose hairs on both margins.

Telson cleft to the base, the lobes furnished distally with two or three spines and a few hairs.

Length, 10–15 mm.

*Distribution.*—Hudson River and Niagara Falls, New York; Ann Arbor, Michigan; Lake Superior; Delavan and Lake Geneva, Wisconsin; Havana, Illinois; Burlington, Iowa; Redfoot Lake, Tennessee; Brookside, West Virginia; Washington, District of Columbia; St. Johns River, Florida.

#### GAMMARUS LIMNÆUS Smith.

*Gammarus lacustris* SMITH, Amer. Jour. Sci., 3d ser., II, 1871, p. 453; Prel. Rept. on Dredgings in Lake Superior, 1871, p. 1023.

*Gammarus limnæus* SMITH, 7th Rept. U. S. Geol. Survey, 1874, p. 609; Rept. U. S. Fish Com., 1872–73, p. 651, 1874.

*Gammarus robustus* SMITH, 7th Rept. U. S. Geol. Survey, 1875, p. 610.

Eyes small, slightly elongated. First antennæ about as long as the thorax; first and second segments of the peduncle nearly equal, twice as long as the third; flagellum composed of about thirty elongated segments, which are furnished with few hairs; secondary flagellum composed of two to four segments, of which the terminal one is short. Second antennæ slightly shorter than the first; peduncle exceeding that of the first pair with the two distal segments nearly equal in length; flagellum shorter than or nearly equal to the peduncle, consisting of about twelve segments.

First gnathopods of the male with the carpus broadly triangular, as broad as the propodus; propodus a little less than twice as long as broad, much narrowed distally; palm very oblique, continuous with the posterior margin, and having a lamellar edge furnished with a few long hairs, and two long obtuse spines near the middle, and three or four smaller spines on each side near the posterior angle; dactyl strongly curved and about one-half as long as the propodus; lateral margins convex, the posterior one furnished with a few long hairs and several short, obtuse spines. In the female the propodus is considerably smaller and proportionally shorter than in the male; palm oblique, with a narrow lamellar edge continuous with the posterior margin, furnished with a few long hairs, and several spines on each side of the tip of the closed dactyl; posterior margin furnished with several short spines, and numerous long hairs arranged in several fascicles.

Carpus of the second gnathopods in the male slightly longer than in the first pair; propodus as long as in the first pair, slightly broadest distally; lateral margins nearly parallel, posterior one furnished with five or six fascicles of long hairs; palm slightly oblique, concave at the

middle, with a broader lamellar edge than in the first pair; armed with a long, obtuse spine and a fascicle of long hairs at the center, two or three small spines at the posterior angle, and a row of short hairs at the base of the lamellar edge. In the female the carpus and propodus are much smaller than in the male and proportionally more elongated; carpus fully as broad as the propodus; propodus twice as long as broad, palm straight, nearly transverse, without the median spine.

Posterior margin of the coxal plates of the last three pereopods serrate.

Fourth and fifth abdominal segments rounded above, each bearing three fascicles of small spines; the sixth segment with two lateral

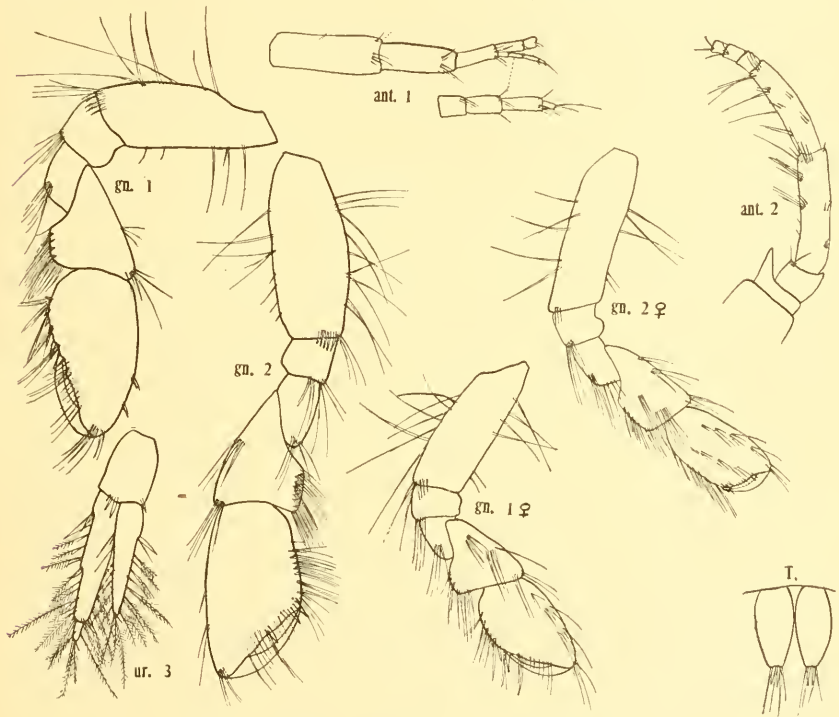


FIG. 9.—GAMMARUS LIMNEUS. ANN ARBOR, MICHIGAN.

fascicles and two or three short median hairs. Infero-posterior angle of the first abdominal segment rounded, in the second and third produced posteriorly and forming an acute angle.

First pair of uropods exceeding the second pair in length and extending slightly beyond the peduncle of the third pair. Outer ramus of the terminal pair narrow, the basal segment furnished on both margins with many long plumose hairs, and on the outer margin with a few short spines; terminal segment short, styliform, lateral margins as well as tip furnished with long plumose hairs; inner ramus slightly shorter than the basal portion of the outer, with both

margins furnished with long plumose hairs and the inner with a few spines.

Telson cleft to the base, each division furnished with three or four short spines and several long hairs.

Length, 15 mm.

Aroostook County, Maine; Caledonia, New York; Marquette, Ann Arbor, and Isle Royal, Michigan; dredged in Lake Superior; Fort Wingate, New Mexico; Wahsatch Mountains; Shoshone Falls, Idaho; Salt Lake City, Utah; Flat Head Lake, Montana; Yellowstone National Park.

This species closely resembles *Gammarus fasciatus*, from which it can be distinguished most easily by the presence of long plumose-hairs on the lateral margins of the terminal segment of the outer ramus of the third uropods. The other characters in which these two species differ can be appreciated only by a careful comparison of specimens of the two species. The antennæ in *Gammarus limnæus* are furnished with fewer hairs than in *Gammarus fasciatus* and the secondary flagellum consists of two to four segments (in *Gammarus fasciatus* five or six). The propodus of the first gnathopods of the male of *Gammarus limnæus* is broader at the proximal end than in *Gammarus fasciatus*; the lateral margins are more convex, and the posterior margin is furnished with spines, which, if present in *Gammarus fasciatus*, are very small. In the female the propodus of the first gnathopods of *Gammarus limnæus* is much narrower distally and the palm is more oblique than in the other species. In *Gammarus limnæus* the spines on the abdominal segments are smaller and the median ones are not raised on distinct protuberances as they are in *Gammarus fasciatus*.

After a careful comparison of the description and figures of *Gammarus limnæus* Smith and *Gammarus robustus* Smith I have concluded that they are the same species. The two species correspond in all characters except the gnathopods, and the differences which are there pointed out are not sufficiently marked to justify distinguishing the two forms as separate species. In *Gammarus limnæus* the propodus of the first gnathopods is longer in proportion to the width, the palm is more oblique, and the posterior margin is armed with more spines than in *Gammarus robustus*. In the second gnathopods the propodus of *Gammarus limnæus* is longer than in *Gammarus robustus*. These are differences which appear in specimens of different sizes. From the lengths of the two species which Smith gives (*Gammarus limnæus* 15-20 mm. and *Gammarus robustus* 10-15 mm.) he evidently examined larger specimens of *Gammarus limnæus* than of *Gammarus robustus*, which fact would account for the differences in the gnathopods which he found.

## GAMMARUS PURPURASCENS W. P. Hay.

*Gammarus purpurascens* W. P. HAY, Proc. U. S. Nat. Mus., XXV, 1902, p. 433.

Eyes large, reniform; larger than in *Gammarus limnaeus* Smith, which species *Gammarus purpurascens* resembles. First antennae longer than in *Gammarus limnaeus*, about half the length of the body; first and second segments of the peduncle nearly equal in length; third segment about half as long as the second; flagellum composed of twenty-five to thirty segments; secondary flagellum consisting of four

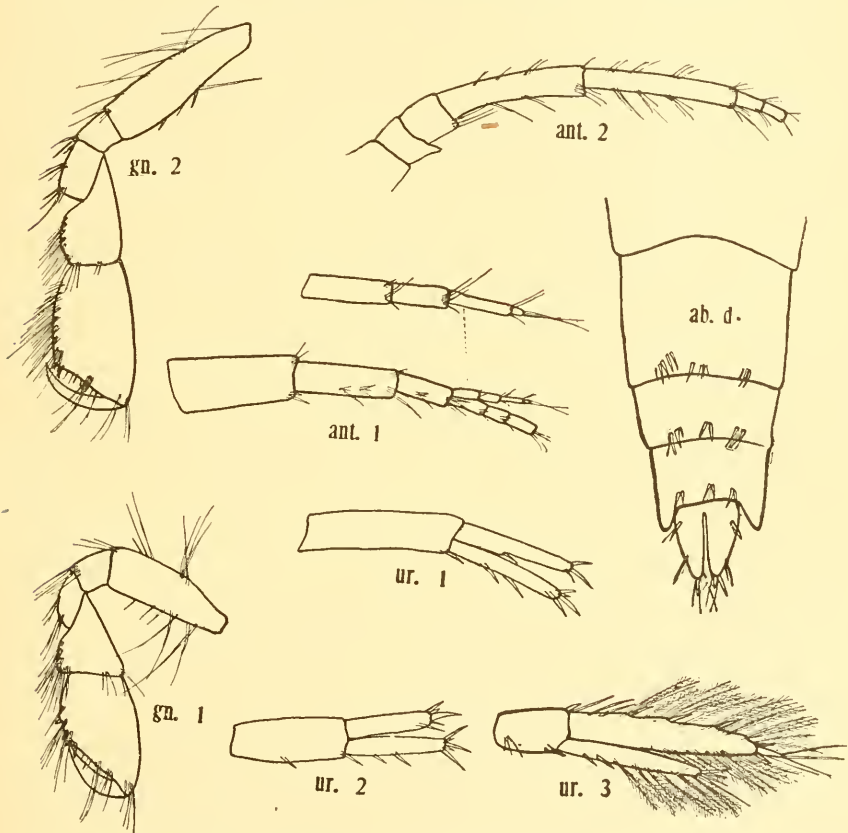


FIG. 10.—GAMMARUS PURPURASCENS, MALE. NICKAJACK CAVE. *ab. d.*, DORSAL SIDE OF THE TERMINAL SEGMENTS OF THE ABDOMEN.

segments, the distal one very short and tapering. Second antennae slightly more than half as long as the first pair; peduncle exceeding that of the first pair in length, the two distal segments elongated, nearly equal; flagellum slightly shorter than the peduncle, composed of about ten segments, each of which bears a small olfactory club.

First gnathopods of the male with the carpus broadly triangular, nearly as broad as the propodus; propodus broad, narrowed distally;

palm very oblique, continuous with the posterior margin and furnished with a few short hairs on each side, a fascicle of long ones at the center, and a few spines at the tip of the closed dactyl; the posterior and anterior margins of the propodus convex, the posterior one provided with a few fascicles of long hairs and one or two small spines near the palm; dactyl strongly curved, half as long as the propodus.

Second gnathopods with the propodus rectangular, more than half as broad as long; lateral margins only slightly convex, the posterior with about eight fascicles of long hairs; palm oblique, furnished as in the first pair except that no spines extend upon the posterior margin; dactyl not so strongly curved as in the first pair, extending slightly beyond the palm.

Basal plates of the third, fourth, and fifth pereopods narrow, broadest proximally, with margins serrate and furnished with a few spines.

Three posterior segments of the abdomen rounded dorsally, each furnished with three small fascicles of spines; the spines of the median fascicles smaller than those of the lateral ones.

First pair of uropods slightly exceeding the second pair in length, projecting somewhat beyond the peduncle of the third; third pair with a short peduncle only slightly longer than broad; the outer ramus consisting of two segments, the basal one long and narrow with four or five spines on the outer margin and many long plumose hairs; terminal segment very short, styliform, and furnished distally with a few long hairs; inner ramus about three-fourths as long as the basal portion of the outer, with many long plumose hairs and usually a few spines on the inner margin. Telson divided almost to the base, with a spine and a few hairs on the outer margin, and three or four spines and a few short hairs distally.

Length, 10 mm.

The type specimens of this species were collected at the mouth of Nickajack Cave, Shellmound, Tennessee. Specimens of a smaller size have also been found in a spring at Rossville, Georgia.

#### GAMMARUS PROPINQUUS W. P. Hay.

*Gammarus propinquus* W. P. Hay, Proc. U. S. Nat. Mus., XXV, 1902, p. 224.

This species is very similar to *Gammarus fasciatus* Say, but differs from it in the following characters: The secondary flagellum consists of from two to five segments; in *Gammarus fasciatus* from five to six. The palm of the first gnathopods of the male in *G. fasciatus* is more irregular and more concave. In the second gnathopods it is more concave and slightly more oblique than in *Gammarus propinquus*. The best distinguishing characteristic, however, is in the third uropods, the inner ramus of which in *Gammarus propinquus* is much more slender than the outer and half or only slightly more than half as long.

In *Gammarus fasciatus* the inner ramus is only slightly narrower than the outer and at least three-fourths as long.

Length, 10–15 mm.

Specimens of this species have been collected in several localities in regions about Mammoth Cave, Kentucky, the type coming from a

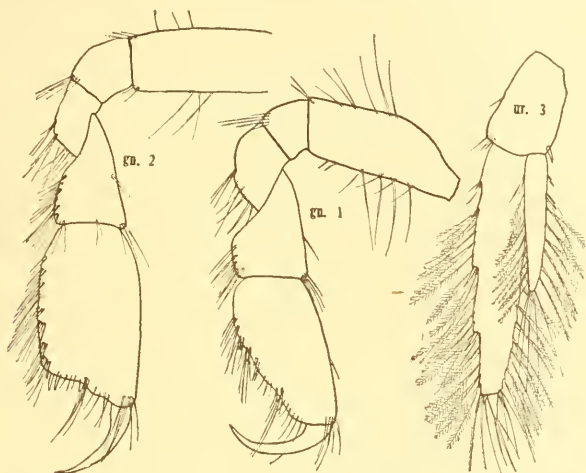


FIG. 11.—*GAMMARUS PROPINQUUS*, MALE. MAMMOTH CAVE, KENTUCKY.

spring about 2 miles north of this cave; collected also in springs in the Ozark Mountains, Missouri, and in West Virginia.

#### *GAMMARUS CÆCUS*, new species.

Eyes absent. First antennæ more than half as long as the body; second segment of the peduncle slightly longer than the first and about three times as long as the third; flagellum composed of twenty to thirty elongated segments, each bearing a few short hairs at the distal end; secondary flagellum reaching slightly beyond the third segment of the primary flagellum, composed of four segments, the distal one short and furnished with long hairs.

Second antennæ are about two-thirds as long as the first pair with the peduncle extending far beyond that of the first pair; ultimate segment of the peduncle only slightly longer than penultimate which is greatly elongated and about equal in length to the antepenultimate; flagellum composed of about twelve segments, which are shorter than those of the first antennæ and furnished with more hairs.

The carpus of the first gnathopods of the male is triangular and elongated with the anterior margin furnished with a few long hairs and numerous short ones; propodus narrower than the carpus, twice as long as broad, with the anterior margin concave, armed sometimes with a fascicle of hairs, the posterior margin convex, and the palm

almost straight, slightly convex, and armed with four or five spines and a few short hairs; dactyl as long as the palm and fitting it closely.

Second gnathopods with a carpus broader than in the first pair but similarly armed; propodus not so broad as the carpus, about twice as long as broad and larger than in the first gnathopods; posterior margin almost straight; anterior margin slightly convex and usually furnished with one or two fascicles of hairs; palm very oblique, slightly concave at the center, armed with five or six spines at the tip of the closed dactyl, and one or two spines and a few short hairs on the margin; dactyl strongly curved, as long as the palm.

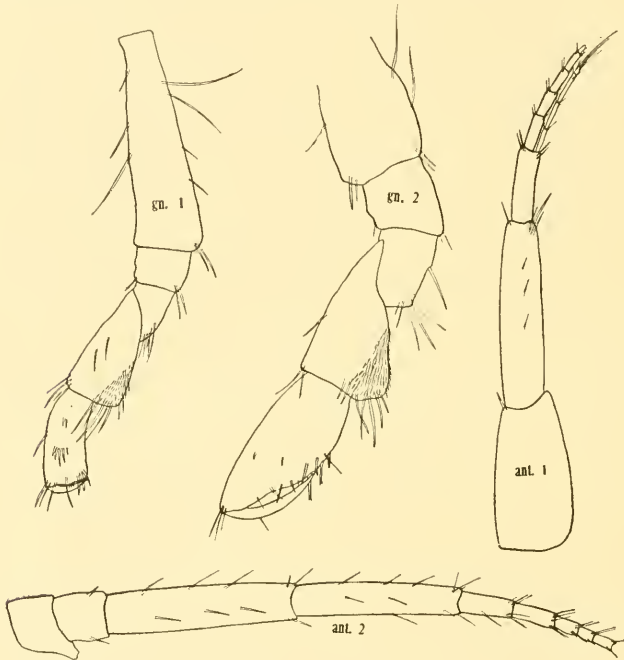


FIG. 12.—*GAMMARUS CECUS*, MALE. MODESTA CAVE, NEAR CAÑAS, CUBA.

Both margins of the coxal plates of the third, fourth, and fifth pereopods are serrate and furnished with spines, those on the anterior margin being smaller than those on the posterior.

Postero-lateral angles of the third and fourth abdominal segments are produced backward and end in a blunt tooth. The last two or three abdominal segments are furnished dorsally with a few short spines.

The first uropods project slightly beyond the second pair. In both pairs the rami are about equal in length and slightly longer than the peduncle. The third uropods were broken off in the few specimens which I had for examination. Telson cleft to the base, armed distally with a few short spines.



Length, 10 mm.

Collected by Dr. C. H. Eigenmann among the roots of a tree, Modesta Cave, near Cañas, Cuba.

*Type*.—Cat. No. 32689, U.S.N.M.

### Genus CRANGONYX Bate.

#### KEY TO SPECIES.

- A. Telson nearly as broad as long, with a slight emargination distally; second uropods with rami equal..... *C. vitreus*, p. 49.  
 A A. Telson entire, two-thirds as broad as long; rami of second uropods unequal, the outer ramus about half as long as the inner..... *C. tenuis*, p. 50.

### CRANGONYX VITREUS (Cope).

*Stygobromus vitreus* COPE, Amer. Nat., VI, 1872, p. 422; 3rd and 4th Annual Repts. of Geol. Survey of Indiana, 1872, p. 181.

*Crangonyx vitreus* PACKARD, 5th Annual Rept. Peabody Academy of Science, Salem, 1873, p. 95.—SMITH, Rept. U. S. Fish Com., 1872-73 (1874), p. 656; Amer. Jour. Sci., 3rd series, IX, 1875, p. 476.

Blind. First antennæ more than half as long as the body; the three segments of the peduncle nearly equal in length; flagellum composed of about fifteen segments; secondary flagellum reaching beyond the first segment of the primary one, consisting of two segments. Second antennæ slightly less than half as long as the first pair; peduncle extending beyond that of the first pair with the two distal segments elongated and nearly equal; flagellum very short, scarcely exceeding the distal segment of the peduncle in length and composed of six segments.

Propodus of the first gnathopods in the male slightly longer than broad; lateral margins convex, the posterior margin furnished with a few long hairs arranged in four or five fascicles; palm oblique, convex, armed with four or five groups of long hairs and nine or ten notched spines, one of which at the posterior angle is much longer than the other; dactyl stout. In the second gnathopods the propodus is more elongated and more narrowed distally than in the first pair; palm very oblique, convex, armed as in the first pair but bearing a few more spines.

Both margins of the coxal plates of the last three pairs of pereopods are serrate and armed with small spines.

First and second uropods extending beyond the telson; the third pair projecting only about half way to the tip of the telson; peduncle about as broad as long; the single ramus very small, about one-third as long as the peduncle, slightly longer than broad, and furnished distally with two short hairs. Telson nearly as broad as long, a very slight triangular emargination at the broad distal end, on either side of which are four or five spines.

Length, 5 mm.

Specimens from Mammoth Cave, Kentucky, and Orleans, Indiana.

In this species the telson has a slight emargination, a feature which does not accord with the definition of this genus. The other characters of the species, however, are so much like those of the recognized members of the genus *Crangonyx* that it seems best not to assign it to a new genus. The specimens upon which this description is based were sent to me from the United States National Museum under the name *Crangonyx vitreus* Packard. The specimens agree in the main with Packard's description of this species; however, he has described

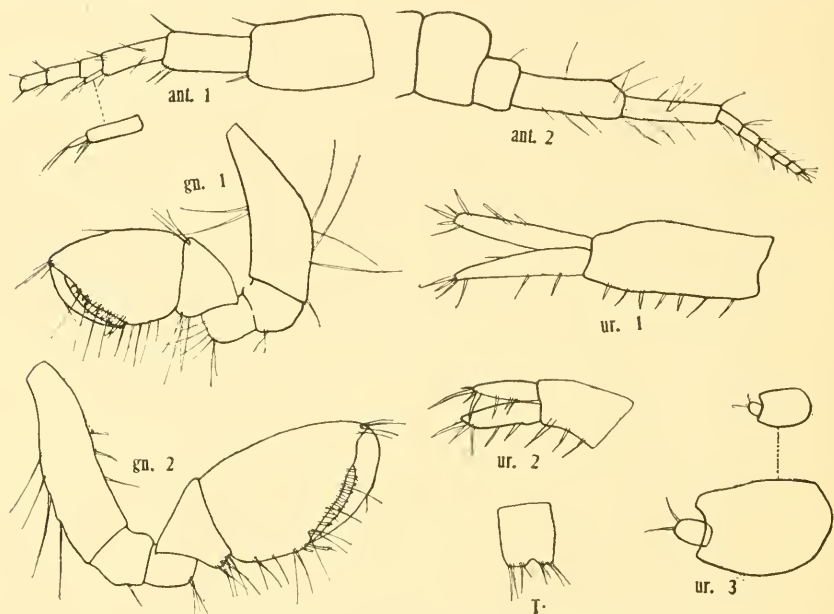


FIG. 13.—CRANGONYX VITREUS, MALE. MAMMOTH CAVE, KENTUCKY.

his specimens so imperfectly that I can not be certain that the specimens which I have described as *C. vitreus* belong to the same species as Packard's. I have followed Packard in quoting *Stygobromus vitreus* Cope, as a synonym of *Crangonyx vitreus* but from Cope's very short description of his specimens it is very doubtful if they belong to the same species or even genus as Packard's *Crangonyx vitreus*.

#### CRANGONYX TENUIS Smith.

*Crangonyx tenuis* SMITH, Rept. U. S. Fish Com., 1872-73 (1874), p. 656.

I have had no specimens of this species for examination, but quote the original description:

A slender, elongated species, with very low epimera, resembling more in form the species of *Niphargus* than the typical species of *Crangonyx*.

Eyes not observable in alcoholic specimens. Secondary flagellum of the antennule very small, composed of two segments, of which the terminal is very short.

First and second pairs of legs differing but little in the two sexes. First pair stouter than the second, and with the palmary margin of the propodus much more oblique; the palmary margin of the propodus of both pairs, and in both sexes, armed on each side with a series of stout, obtuse spines, with a notch and a cilium near the tip.

First three segments of the abdomen longer than the last three of the thorax; fourth, fifth, and sixth together scarcely longer than the third. Caudal stylets all extending to about the same point. First pair with the rami subequal, scarcely half as long as the peduncle. Peduncle in the second pair reaching a little beyond the peduncle of the first pair; the rami very unequal, the outer only half as long as the inner. Posterior pair scarcely as long as the telson; the single terminal segment very small, and tipped with four or five setiform spinules. Telson two-thirds as broad as long, tapering very slightly toward the entire and slightly arcuate posterior margin, which is armed with about ten slender spinules.

In the largest male seen, 13.5 mm. in length (excluding the antennæ), the antennule are about 5 mm. long, the flagellum being twice as long as the peduncle and composed of about twenty-two segments, while the antennæ are stout, fully 6 mm. long, and the flagellum as long as the peduncle, and composed of fifteen segments. All the females and most of the males which I have seen are much smaller, being 6 mm. to 8 mm. in length, and in these the antennule are longer than the antennæ; and the flagellum of the antennule is composed of sixteen to nineteen segments, while that of the antennæ has only eight to ten.

The only specimens which I have seen were found in wells at Middletown, Conn., and were sent to me by Mr. G. Brown Goode.

#### Genus STYGONECTES W. P. Hay.

##### STYGONECTES FLAGELLATUS (Benedict).

*Crangonyx flagellatus* BENEDICT, Proc. U. S. Nat. Mus., XVIII, 1896, p. 616.

*Crangonyx bouersii* ULRICH, Trans. Amer. Microscopical Soc., XXIII, 1902, p. 85, pl. XIV.

*Stygonectes flagellatus* W. P. HAY, Proc. U. S. Nat. Mus., XXV, 1902, p. 429.

This blind species is closely related to *Eucrangonyx mucronatus* (Forbes). It is, however, larger and much stouter. The head, which is slightly longer than the first thoracic segment, is proportionally narrower and more concave at the insertion of the upper antennæ than in *Eucrangonyx mucronatus*.

First antennæ as long as the body; first two segments of the peduncle about equal and three times as long as the third; flagellum composed of forty to sixty segments; secondary flagellum extending slightly beyond the basal segment of the primary one, composed of two segments, the first about four times the length of the second. Second antennæ slightly less than half as long as the first pair; peduncle exceeding that of the first pair in length; two distal segments much elongated and nearly equal; flagellum not quite so long as the peduncle, composed of twelve to eighteen segments.

Propodus of the first gnathopods in the male about two-thirds as broad as long; lateral margins only slightly convex, the posterior

margin furnished with three or four fascicles of spines; palm very oblique, slightly convex, with a narrow lamellar edge furnished on each side with a row of about twenty-four bifurcate spines, two or three of which extend upon the posterior margin; dactyl stout and strongly curved.

In the second gnathopods of the male the propodus is about equal in size to that of the first pair, but with the palm less oblique and the posterior margin correspondingly longer.

First uropods extend to the tips of the second pair, the peduncle slightly longer than the two rami; second uropods about two-thirds

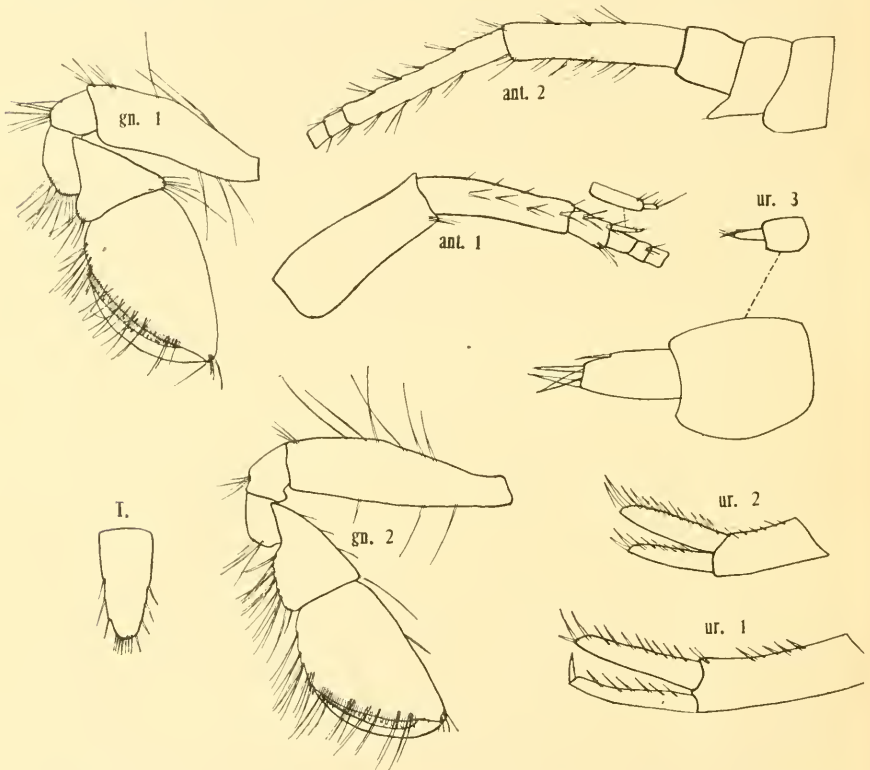


FIG. 14.—*STYGONECTES FLAGELLATUS*, MALE. SAN MARCOS, TEXAS. THE RUDIMENTARY INNER RAMUS OF THE THIRD UROPOD WAS BROKEN IN THE SPECIMEN DRAWN.

as long as the first ones; the first and second pairs reaching far beyond the third pair (in *Eucrangonyx mucronatus* they extend only slightly beyond the tip of the third pair); terminal uropods very small, about two-thirds as long as the peduncle of the second pair; inner ramus rudimentary; the outer one about as long as the peduncle and furnished distally with a few spines. Telson entire, about three times as long as broad at the base, tapering slightly to the distal end, which is subtruncate; furnished with several spines at the tip and four or five spines on the lateral margins.

Length, 13 mm.

Specimens examined from an artesian well San Marcos, Texas, the type locality.

*Crangonyx bowersi* Ulrich is undoubtedly the same species as *Stygonectes flagellatus*. The specific differences which Ulrich points out, together with the rather small size of the single specimen which he examined, indicate that he had an immature specimen. The only differences which he gives are in the number of segments in the antennae and the number of spines on the propodus, which in *Crangonyx bowersi* are less than in *Stygonectes flagellatus*. These are characters which vary with age, there being fewer segments in the antennae and fewer spines on the propodus in the immature forms.

This is the type species of the genus *Stygonectes* to which it was assigned by Prof. W. P. Hay. This genus closely resembles the genus *Crangonyx*, but differs from it in having the last two segments of the urosome coalescent.

Genus APOCRANGONYX Stebbing.

APOCRANGONYX LUCIFUGUS (O. P. Hay).

*Crangonyx lucifugus* O. P. HAY, Am. Nat., XVI, 1882, p. 144.

*Apocrangonyx lucifugus* STEBBING, Trans. Linn. Soc. London, 2d ser., VII, 1899, p. 422.

This species is the type species of the genus *Apocrangonyx* to which it has been assigned by Stebbing. This genus differs from *Crangonyx*, in which the species was placed by Hay, in the rudimentary third uropods which are without rami.

I have had no specimens of this species for examination, but quote the original description:

This is a small, rather elongated species that was obtained from a well in Abingdon, Knox County, Illinois. As befits its subterranean mode of life, it is blind and of a pale color. In length the largest specimens measure about 6 mm.

*Male*.—Antennule scarcely one-half as long as the body. The third segment of the peduncle two-thirds as long as the second; this two-thirds the length of the first. Flagellum consisting of about fourteen segments. The secondary flagellum very short and with but two segments. Antennae short, only half as long as the antennule. Last two segments of its peduncle elongated. Flagellum consisting of but about five segments, and shorter than the last two segments of the peduncle taken together.

Second pair of legs stouter than the first. Propodite of first pair quadrate, with nearly a right angle between the palmar and posterior margins. Palmar margin on each side of the cutting edge, with a row of about six notched and ciliated spines, one or two of which at the posterior angle are larger than the others. The cutting edge is entire. Dactylopedite as long as the palmar margin, and furnished along the concave edge with a few hairs.

Propodite of the second pair of legs ovate in outline, twice as long as broad. The palmar margin curving gradually into the posterior margin. The cutting edge of the palmar surface uneven, and having near the insertion of the dactyl a square projection. The palmar surface also armed with two rows of notched and ciliated spines, five in the inner row, seven in the outer. Dactyl stout and short.

Two posterior pairs of thoracic legs longest of all and about equal to each other. All the legs are stout and their basal segments squamiform.

Postero-lateral angle of first abdominal segment rounded, of second and third from obtuse angled to right angled.

First pair of caudal stylets extending a little farther back than the second; these exceeding slightly the third. The peduncle of the first pair somewhat curved, with the concavity above, the rami equal and two-thirds as long as the peduncle. The peduncle of the second pair little longer than the outer ramus. Inner ramus nearly twice as long as the outer. Third pair of caudal stylets rudimentary, consisting of but a single segment. This somewhat longer than the telson, broadly ovate, two-thirds as broad as long and furnished at the tip with two short spines.

Telson a little longer than wide, narrowing a little to the truncated tip, which is provided at each postero-lateral angle with a couple of stout spines.

*Female*.—In the female the propodite of the anterior pair of feet resembles closely that of the corresponding foot of the male. The palmar margin of the second propodite is less oblique than in the second foot of the male and does not pass so gradually into the posterior margin. It is also destitute of the jagged edge and the square process of the male foot. There are fewer spines along the margin. One of the spines at the posterior angle is very long and stout.

This species appears to resemble *C. tenuis* Smith, but is evidently different. In that species, as described by Prof. S. I. Smith, the first pair of feet are stouter than the second and have the palmar margin of the propodite much more oblique. The reverse is true of the species I describe. Nor do I understand from the description of *C. tenuis* that the posterior caudal stylets each consist of a single segment. There are some minor differences. From *C. vitreus*, judging from Professor Cope's description in *American Naturalist*, Vol. 6, p. 422, it must differ in the caudal stylets. "Penultimate segment, with a stout limb with two equal styles," is a statement which will not apply to my species, whichever the "penultimate" segment may be.

## Family ORCHESTIIDÆ.

### Genus HYALELLA Smith.

#### HYALELLA KNICKERBOCKERI (Bate).

*Allorchestes knickerbockeri* BATE, Cat. Amphip. Crust. Brit. Mus., 1862, p. 36, pl. vi.

*Hyalella dentata* SMITH, Rep. U. S. Fish Com., 1872-73 (1874), p. 645, pl. II.

*Hyalella inermis* SMITH, 7th Rept. U. S. Geol. Survey of Colorado, 1873 (1875), p. 610.

*Allorchestes dentatus* FAXON, Bull. Mus. Comp. Zool., III, 1876, p. 373, figs. 35, 36.

*Allorchestes dentatus* var. *inermis* FAXON, Bull. Mus. Comp. Zool., III, 1876, p. 373.

*Hyalella inermis* STEBBING, Proc. U. S. Nat. Mus., XXVI, 1903, p. 929.

*Hyalella javoni* STEBBING, Proc. U. S. Nat. Mus., XXVI, 1903, p. 928, pl. LXI.

Eyes round or nearly so; their distance apart slightly greater than their diameter. First antennæ shorter than the second pair; first and second segments of the peduncle about equal in length, slightly longer than the third; flagellum about twice as long as the peduncle and composed of seven to nine segments; second antennæ about half as long as the body; peduncle exceeding that of the first pair with the two distal segments elongated and nearly equal; flagellum usually but little longer than that of the first pair and composed of eight to fifteen segments.

First gnathopods in the male more than half as broad as long; lateral margins strongly curved and furnished with minute spinules; palm transverse, concave at the middle, provided with a few small teeth and short hairs at the posterior angle and a tuft of long stiff hairs at the anterior one; dactyl strongly curved, shorter than the palm. First gnathopods in the female closely resemble those in the male.

Second gnathopods of the male much longer than the first ones; carpus not longer than broad, with a long narrow lobe extending along the posterior margin of the propodus; propodus stout, more than half as broad as long, much broadened distally, especially in the mature

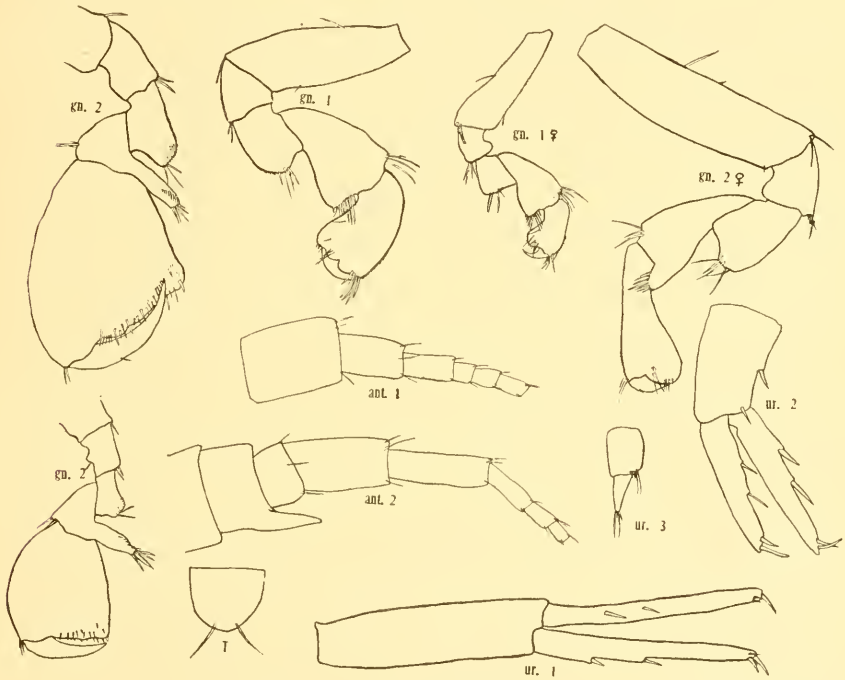


FIG. 15.—HYALELLA KNICKERBOCKERI. ANN ARBOR, MICHIGAN. *gn. 1 ♀*, *gn. 2 ♀*, FIRST AND SECOND GNATHOPODS OF THE FEMALE; OTHER FIGURES OF THE MALE. *gn. 2'*, SECOND GNATHOPOD OF A YOUNG MALE; *gn. 2*, SECOND GNATHOPOD OF A MATURE MALE.

specimens; anterior margin convex; posterior one straight, oblique, and unarmed; palm oblique, the middle portion slightly arenate, with a notch near the middle and one or two slight emarginations at the posterior angle; provided with a submarginal row of spines; palm in immature specimens transverse, emarginations very slight, dactyl not so strongly curved as in the adult. Second gnathopods of the female slender and weak; carpus and propodus elongated and much narrower than those of the male; carpus more than twice as long as broad, posterior projection proportionally not so great as in the male; propodus more than twice as long as broad; palm forming less than a right

angle with the posterior margin, furnished with fewer submarginal spines than in the male; dactyl not strongly curved and fitting the palm closely.

Posterior margins of the coxal plates of the third, fourth, and fifth pereopods serrate.

Postero-lateral angles of the first two abdominal segments slightly produced, forming less than a right angle; the first two or three segments usually produced dorsally, forming a well-marked median posterior tooth.

First uropods almost twice as long as the second pair; third pair very short, not exceeding the basal segment of the second pair in length; peduncle short, nearly as broad as long, furnished distally with a few hairs; the single ramus slender, tapering, about equal in length to the peduncle and provided with a few slender setae at the tip.

Telson short, entire, as broad as long, and furnished distally with a slender seta at each side. Length not exceeding 7 mm.

Abundant throughout the United States. Collected at Caribou, Maine; Cambridge and Quisset Pond, Massachusetts; Ann Arbor, Michigan; Isle Royal, Lake Superior; Wisconsin River, Lake Geneva, Lake Delavan, and Winnebago Lake, Wisconsin; Omaha, Nebraska; Urbana, Pekin, Clifton, Havana, McHenry County, Meredosia Lake, and Lake Michigan, at South Chicago, Illinois; New Philadelphia and Tuscarawas River, Ohio; Piney Branch, District of Columbia; Point Pinellas, Florida; San Marcos, Texas; Lake Merced, Fresno, Los Angeles, West Berkeley, and San Francisco, California; Yellowstone National Park; Volcan Reventado, Costa Rica.

Through the kindness of Dr. S. J. Holmes, who has compared the types of Bate's *Allorchestes knickerbockeri* in the British Museum with specimens of *Hyalella dentata* Smith, I am enabled to state definitely that the latter are of the same species as Bate's types. From Bate's description of *Allorchestes knickerbockeri* in the Catalogue of Amphipodous Crustacea in the British Museum, one can not establish this identity, for some of Bate's statements in this description do not agree with his own specimens, and he has also confused the two sexes in his figures of the gnathopods as well as in his description. Bate's specimens were sent to him by Say under the name *Gammarus minus* Say; but Say evidently misidentified his own species, for the specimens which he sent to Bate, under the name *Gammarus minus* Say, agree in no way with his description of this species. The specimens were then described by Bate as *Allorchestes knickerbockeri*. The specific name *knickerbockeri* has precedence of *dentata*, consequently the name of the species should be *Hyalella knickerbockeri* (Bate).

In some specimens of this species the dorsal spines are absent on the abdominal segments. These nondentate forms were first described by Prof. S. I. Smith, and were given the specific name *inermis*.



After comparing a large number of the dentate and nondentate forms I find they differ only in this one feature, and at present it seems best not to make this difference one of specific value; consequently, I have made *Hyalella incermis* synonymous with *Hyalella knickerbockeri*.

I have also compared Doctor Stebbing's type specimens of *Hyalella faxoni*, from Volcan Reventado, Costa Rica, with a number of specimens of *Hyalella knickerbockeri* and feel convinced that they belong to the same species. The differences which are pointed out by Doctor Stebbing between *Hyalella faxoni* and the nondentate forms of *Hyalella knickerbockeri* are very slight and are differences which are often found upon comparison of a number of specimens of the same species. The principal difference between the two, as pointed out by Doctor Stebbing, is the presence of three setae on the inner plate of the first maxillæ of *Hyalella faxoni* instead of two. I have found specimens, however, from Yellowstone National Park and also from the Isle Royal, Lake Superior, which agree with *Hyalella knickerbockeri* in every detail, but on which I found three setae on the inner plate of the first maxillæ; consequently this distinction between the two forms is not valid.

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