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THREE NEW CRAYFISHES (*CAMBARUS*) FROM
PUEBLA AND MISSOURI

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ONE of the new species described below, *Cambarus contrerasi*, was obtained in the state of Puebla, Mexico, during the course of a zoological expedition conducted by Dr. Myron Gordon and the writer in the late spring of 1930. The other two new species, *Cambarus hubbsi* and *Cambarus peruncus*, were obtained by E. B. Williamson and the writer during a zoological expedition in the Missouri Ozark Mountains in the summer of 1930.

Cambarus (Cambarus) contrerasi, new species

Figs. 1-6

Male form I. Antennae short, length scarcely exceeding carapace. Antennal scale (Fig. 4) broad, widest anteriorly. Terminal setae nearly half as long as antennal scale. Terminal spine short. Rostrum about one-fourth total length of cephalothorax, slightly excavate above with a faint median carina on anterior half. Margins entirely raised, gently curved near apex to form acumen, lateral spines of rostrum absent. Postorbital ridges terminating bluntly. Cephalic groove interrupted on the sides. Branchiostegal spines pres-

ent, lateral spines of cephalothorax absent. Areola narrow, less than 1 mm. in width in specimen 54.6 mm. long. Cephalothorax evenly rounded, punctate, laterally granulate toward anterior margin. Chelae moderately broad, scabrous, with scale-like tubercles increasing in number and size along inner margin of palm. Fingers ribbed above, immovable one with tubercle near base on margin opposed to dactylus. Carpus three-fourths as long as merus, with spine on inner margin and with several below. Merus with one spine and several small tubercles above, and with biserial rows of spines below. Ischiopodite of third and fourth walking legs with hooks (Fig. 6). Coxopodites of third, fourth, and fifth walking legs with protuberances, that of the fourth the largest and hook-shaped. First abdominal appendages (Fig. 3) reaching nearly to coxopodites of first walking legs. Apex of male appendage (Figs. 1-2) with an anterior crescentic horny wall, and with a triangular tooth nearly as high as the anterior crescentic wall lying in its cavity. Inner margin of outer part with a small elevation and a blunt tooth posterior to the crescentic wall. Inner part of appendage soft, not exceeding outer part, terminating in a moderately acute spine.

Male form II. Hooks on ischiopodites of third and fourth walking legs reduced in size. Tubercles on coxopodites of third, fourth, and fifth walking legs present but reduced. First abdominal appendage (Fig. 5) with apical crescentic wall thicker than in Form I. Inner margin of outer part with a rounded tubercle. Inner part of appendage terminating bluntly.

Female. Unknown.

Color. Greenish brown, with orange chelipeds.

Sex	Measurements in mm.			Anterior width in cephalothorax
	Abdomen	Anterior cephalothorax	Posterior cephalothorax	
Male I	27.2	17.4	10.0	3.5
Male II	27.0	18.0	9.4	3.7

The measurement of the anterior width in the cephalothorax is the number of times the distance between the peduncles of the antennal scales is contained in the length of the cephalothorax.

Type locality. Tributary of the Rio Cazones near Agua Fria, 12 miles south of Miahuapan, State of Puebla, Mexico. This collection was made near the road which extends from Miahuapan to Villa Juarez by Myron Gordon, Richard Ostos, and the writer on May 11, 1930. This small stream flowed slowly through a rather low jungle. The water was clear and quite cool. Algae were very abundant on the rocks which protruded above the mud and gravel bottom. In addition to the two specimens of crayfish, we obtained here several specimens of the shrimp *Macrobrachium olfersii*.

The male type (Form I) is deposited in the crustacean collection of the University of Michigan Museum of Zoology as Cat. No. 53262. The male paratype (Form II) has been deposited in the United States National Museum.

This species is named for the eminent carcinologist, Professor Francisco Contreras, Jefe del Museo Nacional de Historia Natural, Mexico, Distrito Federal.

Relationships. The present species is doubtless related to *Cambarus bouvieri* (Ortmann, 1908, pp. 159-166), which was obtained near Uruapan, State of Michoacan, Mexico. These two species are the only ones in the genus possessing a crescentric terminal protuberance on the male copulatory appendage. The differences between these two species may be briefly noted as follows: *C. contrerasi* has tubercles on the coxopodites of the fourth and fifth pereopods which are lacking in *C. bouvieri*. The male copulatory appendage in *C. contrerasi* has a terminal spine on the inner part of the appendage, which is absent in *C. bouvieri*. *C. contrerasi*, moreover, has hooks on the third and fourth pairs of pereopods, while the related species has hooks on only the third pereopods. The hooks on the third pair of pereopods in *C. contrerasi* are greatly reduced.

This species may possibly have affinities with those species which Ortmann (1905, p. 102) differentiates as the *C. alleni* group. The male copulatory appendages in this group are, with the possible exception of *C. alleni*, very different from those found in the species *C. bouvieri* and *C. contrerasi*. The *C. alleni* group is very much in need of a more elaborate study.

Cambarus (*Bartoni*) *hubbsi*, new species

Figs. 7-12

Male form I. Antennae shorter than body. Antennal scale (Fig. 10) exceeding rostrum, truncate with large terminal spine directed slightly outward, inner margin of scale almost parallel with outer throughout its entire length. Eye small, pigment area reduced. Rostrum short, about one-fifth total length of cephalothorax, flat, scarcely excavated, sides convergent, with horny, blunt, lateral and terminal spines. Post-orbital ridges grooved with blunt anterior spine. Cephalic groove not interrupted on the side. Lateral spine of cephalothorax absent. Branchiostegal spine absent. Areola moderately broad, 3 mm. wide in largest specimen, 62.8 mm. long. Cephalothorax ovate, conspicuously flattened above, granulate on the sides, and punctate above except in gastric region; slightly longer than abdomen. Anterior section of cephalothorax one and one-half times as long as posterior section. Chelae moderately broad, swollen, coarsely punctate above and below. Fingers slightly agape, meeting only at the horny tips, opposed edges with rounded tubercles. Carpus with a single spine on median internal margin and a blunt nodule on ventral anterior margin. Merus with dorsal tubercle and a uniserial row of spines below. Usual outer row represented by a single spine. Third walking legs with large hooks. Copulatory appendage (Fig. 9) reaching to base of third walking leg. Outer part of appendage (Figs. 7-8) horny, blade-like, curved, directed outward. Inner part separated from outer part, fleshy, swollen, tapering, and directed slightly downward.

Male form II. Tips of copulatory appendage (Fig. 12) adjacent. Outer tip slightly exceeding the inner (lower) one. Hooks on third walking legs reduced in size.

Female. Annulus ventralis (Fig. 11) broad, posterior margin raised. Sinus curved to right as viewed from ventral side. Fossa shallow, following sinus and extending to anterior margin.

Color. A uniform dark brown.

Sex	Measurements in mm.			Anterior width in cephalothorax*
	Abdomen	Anterior cephalothorax	Posterior cephalothorax	
Male I	29.0	19.8	14.0	3.5
Male II	22.8	14.8	10.2	3.3
Male II	21.8	13.4	9.6	3.4
Female	16.4	10.4	6.2	3.2
Female	17.6	11.8	8.2	3.2
Female	21.2	14.0	9.0	3.3
Female	19.6	12.4	8.0	3.3
Female	15.2	10.0	6.2	3.2
Female	15.0	9.6	5.8	3.2

* For explanation of this measurement see p. 3.

Type locality. Little Creek, tributary to the St. Francis River, one mile northeast of Chloride, Iron County, Missouri. This collection was made by E. B. Williamson and the writer on August 13, 1930.

Distribution. In addition to the type locality this species is known from Ruble Spring Branch, one mile south of Chloride, Iron County, Missouri, and from the James River, one mile south of Galloway, Greene County, Missouri. Faxon (1885, p. 61) lists *C. bartonii* questionably from the Osage River, Missouri. If this locality is correct, the specimens undoubtedly are referable to the present species.

The male type, female allotype, and paratypes are deposited in the crustacean collections of the University of Michigan, Museum of Zoology. The catalogue numbers are: Male type,

Form I, No. 53263 from Little Creek; female allotype, No. 53264 from Ruble Spring Branch; paratypes, No. 53265 from Little Creek; paratypes, No. 53266 from Ruble Spring Branch; and paratype, No. 53267 from James River. Paratypes have also been deposited in the United States National Museum.

This species is named for my friend Dr. Carl L. Hubbs. Six other ichthyologists have had species of *Cambarus* named in their honor. Crayfish are roaming the streams today bearing the names of Hay, Evermann, Putnam, Meek, Girard, and Jordan.

Ecology. My first acquaintance with *C. hubbsi* came quite unexpectedly while collecting with E. B. Williamson on the Ruble Spring Branch, one mile south of Chloride, Missouri. As we approached a pool in the stream bed, but a short distance from the bridge, Mr. Williamson observed some large crayfish which darted under a huge boulder and pile of brush. By dredging around with our hands we managed to dig a hole under the boulder. Repeated dips with a net secured five specimens. The next day in a small stream one mile north-east of Chloride we obtained three more. Still later we obtained a single specimen in the James River near Galloway, Greene County, Missouri. Like many others of the Bartonius group, *C. hubbsi* dredges a burrow under a large rock, or preferably a huge boulder. This species is apparently not very prolific for, although we worked for several hours in each of the various streams where it was found, we obtained only nine specimens.

Relationships. The subgenus Bartonius (Ortmann, 1905, p. 97) contains six other species or subspecies which possess lateral spines on the rostrum. Three of these (*C. hamulatus*, *C. setosus*, and *C. ayersii*) are blind. The three other members (*C. extraneus*, *C. jordani*, and *C. cornutus*) differ from the present species in that each of them possesses lateral spines on the cephalothorax which are lacking in *C. hubbsi*.

In Tennessee, *C. extraneus* inhabits the same general region as the blind species *C. hamulatus*. *C. hubbsi* inhabits the same

general region in Missouri as the blind species, *C. setosus* and *C. ayersii*. The discovery of this species would have interested the late Dr. Ortmann. In 1905 he wrote as follows: "*C. hamulatus* is found in a cave in eastern Tennessee, that is to say, right in the center of origin of the subgenus, while the other one, *C. setosus*, comes from a cave in Jasper County, Missouri (in the Ozark region). This is very remarkable, and very likely indicates, that the center of origin of the subgenus includes the Ozark Mountains. . . . Consequently, we are to regard *C. setosus* as the last remnant of the primitive forms of the subgenus surviving in the western extremity of the original home." Ortmann considered those species having lateral spines on the rostrum as the most primitive members of the subgenus *Bartonius*. The discovery of this new species completely substantiates Dr. Ortmann's view that the original home of this subgenus should include the Ozark region.

***Cambarus (Faxonius) peruncus*, new species**

Figs. 13-17

Male form I. Antennae shorter than body. Antennal scale exceeding rostrum, moderately broad, broadest beyond the middle, terminal spine of medium size. Rostrum moderately long, more than one-fourth total length of cephalothorax, excavated, sides slightly convergent with moderately sharp lateral and terminal spines. Small branchiostegal spine present. Cephalothorax with small lateral spines. Limits of areola poorly defined, about 2 mm. wide in specimen 55 mm. long. Cephalothorax round, polished, punctate except in gastric region, slightly granulate along anterior border. Chelae moderately broad, fingers slightly agape, conspicuously setose, without ribs. Carpus with a spine on anterior internal border and another and larger spine on median internal border. Ventral side of carpus with an anterior spine. Merus with a single spine above before the apex and with biserial row of spines below, the outer row represented by 2 spines and the inner by 5-6 spines. Ischiopodite of third and fourth

walking legs (Fig. 16) with hooks. Copulatory appendages (Figs. 14-15) very long, inner portion reaching to base of first walking legs when the abdomen is flexed. Outer part of appendage slender, tapering, and slightly curved posteriorly. Inner part of appendage shorter than outer, grooved throughout its length on anterior margin. Apex of inner part abruptly widened and recurved.

Male form II. Hooks on third and fourth pereopods reduced in size. Outer part of copulatory appendage (Fig. 13) thicker than in Form I. Inner part adjacent to outer part for most of its length. Inner part grooved on anterior margin at apex.

Variations. One male specimen (Form I) has hooks on the second, third, and fourth pairs of walking legs.

Female. Chelae smaller with fingers less agape than in male. Annulus ventralis (Fig. 17) with posterior margin elevated and produced posteriorly. Sinus irregularly curved on posterior margin, then abruptly turned to the left as viewed from ventral side. Fossa moderately shallow, extending almost to the depressed anterior margin of annulus.

Color. Brown with mottlings or spots of a darker brown on chelae, abdomen, and cephalothorax.

Sex	Measurements in mm.			Anterior width in cephalothorax*
	Abdomen	Anterior cephalothorax	Posterior cephalothorax	
Male I	30.6	18.4	9.8	3.4
Male I	27.0	16.8	8.4	3.4
Male I	25.4	15.8	8.8	3.3
Male I	26.0	16.0	9.0	3.4
Male I	25.6	16.2	9.0	3.3
Male II	24.0	15.4	7.6	3.2
Female	28.0	15.8	8.6	3.3
Female	24.6	15.0	8.0	3.4
Female	27.8	16.6	8.2	3.2
Female	31.2	18.4	10.0	3.5
Female	23.4	14.6	7.2	3.3

* For explanation of this measurement see p. 3.

Type locality. Little Creek, tributary to the St. Francis River, one mile northeast of Chloride, Iron County, Missouri. This collection was made by E. B. Williamson and the writer on August 13, 1930.

Distribution. In addition to the type locality this species was taken in Ruble Spring Branch, one mile south of Chloride, Iron County, Missouri. This stream is also a tributary to the St. Francis River.

The type, allotype, and paratypes are deposited in the crustacean collections of the University of Michigan, Museum of Zoology. The catalogue numbers are as follows: Type male, Form I, No. 53268 from Little Creek; allotype female, No. 53269 from Little Creek; paratypes, No. 53270 from Little Creek; paratypes, No. 53271 from Ruble Spring Branch. Paratypes have also been deposited in the United States National Museum.

Ecology. This species was found lurking under small rocks. *C. hubbsi*, *C. virilis*, and *C. diogenes* were obtained in the same stream with *C. peruncus*.

Relationships. The present species is surely related to *Cambarus hylas* Faxon, 1890. This relationship is manifest in body form and coloration, but especially in the bizarre shape of the annulus ventralis, which is nearly identical in the two species. The differences between *C. peruncus* and *C. hylas* are as follows: The new species lacks the ribs or corrugations on the chelae which are present in *C. hylas*. *C. peruncus* has chelae which are less pilose than in the related species.

The sexual appendages of the male are, moreover, noticeably different. The first form male appendage of *C. hylas*, here described for the first time, is as follows: Appendage long, extending to base of first pair of pereopods. Outer part slender, tapering, and slightly recurved at the apex with a slight shoulder on the anterior margin. Inner part soft, shorter than outer part, and slightly flattened near apex, which is very slightly recurved. A fine series of this species is at my

disposal from McKenzie Creek at Piedmont, Wayne County, Missouri. The presence of hooks on the third and fourth walking legs in *C. peruncus* is worthy of more than trivial consideration.

C. peruncus, without question, is a member of the subgenus *Faxonius* as defined by Ortmann (1905, p. 97). The blind cave species, *C. pellucidus*, assigned by Ortmann (1905, p. 111) to the subgenus *Faxonius*, also has hooks on the third and fourth walking legs. Ortmann argues that this condition must have arisen independently since the other members of *Faxonius*, without exception save for the present species, have only the third pair of legs bearing hooks. Faxon (1914, p. 415) lists *C. pellucidus* under the subgenus *Cambarus*. In any event we now have evidence with the discovery of *C. peruncus* of an independent acquisition (or a primitive retention of two pairs of hooks within the subgenus *Faxonius*.)

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- . 1890. Notes on North American Crayfishes, Family Astacidae. Proc. U. S. Nat. Mus. 12: 619-634.
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- ORTMANN, A. E. 1905. The Mutual Affinities of the Species of the Genus *Cambarus* and their Dispersal over the United States. Proc. Amer. Philos. Soc. 44: 91-136, 1 pl.
- . 1908. Une Écrivisse Nouvelle du Mexique *Cambarus (Cambarus) bowvieri* nov. sp. Ann. Sci. Nat. 9: 7, 159-166.

EXPLANATION OF PLATES

All figures drawn with the aid of a camera lucida. The stippled areas of the first form male copulatory appendages represent the extent of the corneaceous part of the tip.

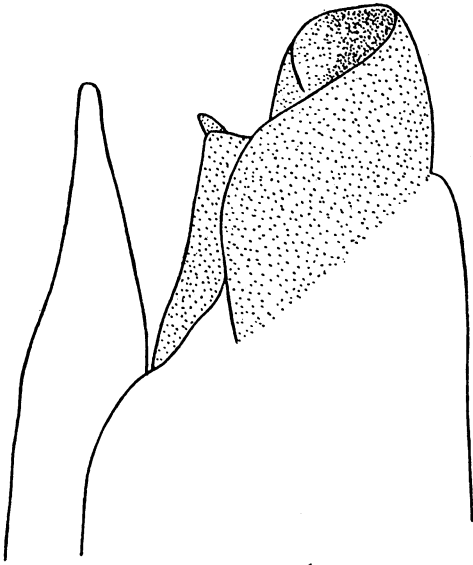


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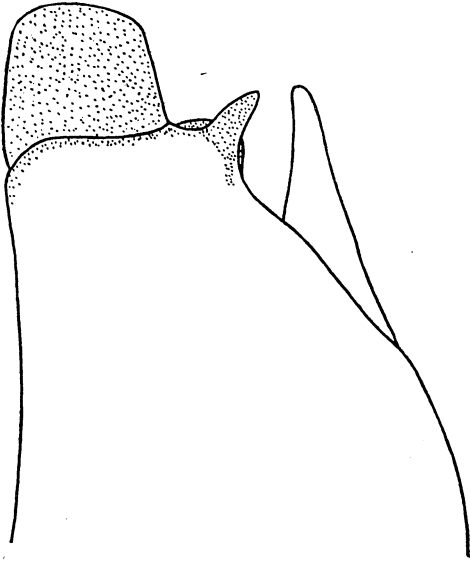
PLATE I

Cambarus contrerasi

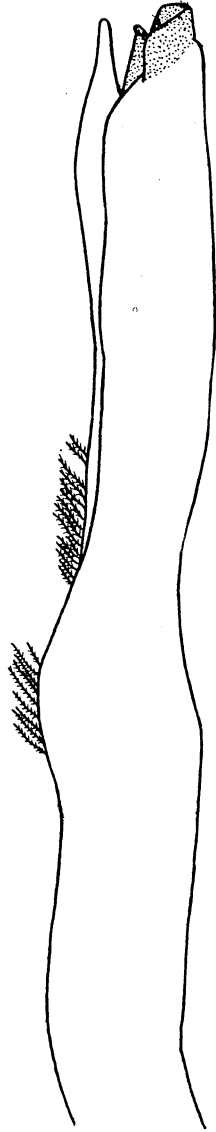
- Fig. 1. Outer lateral view of apex of first form male copulatory appendage.
- Fig. 2. Inner lateral view of apex of first form male copulatory appendage.
- Fig. 3. Outer lateral view of first form male copulatory appendage.



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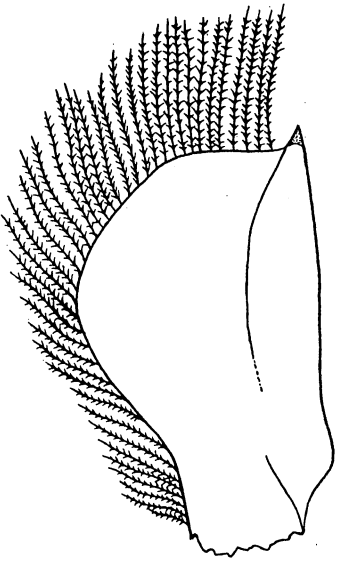
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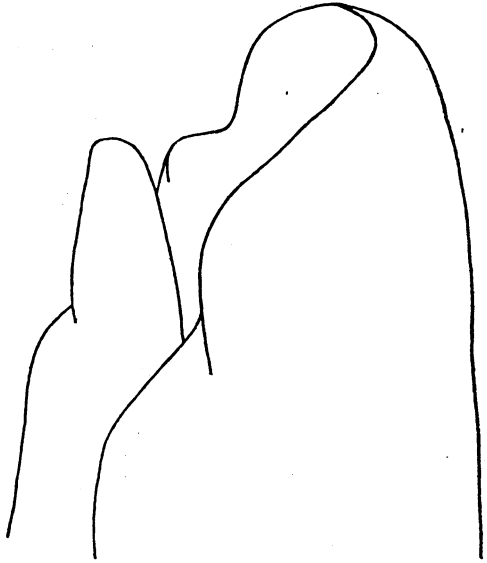
PLATE II

Cambarus contrerasi

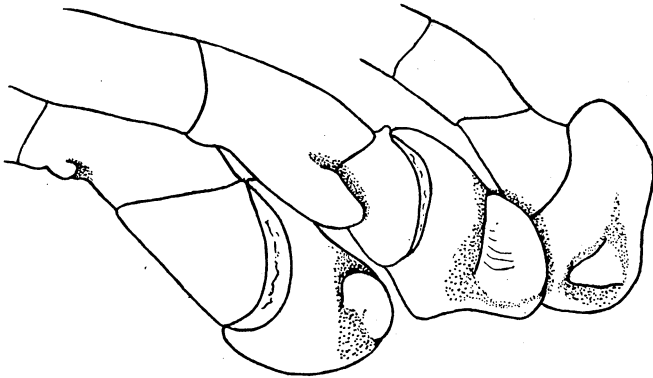
- Fig. 4. Antennal scale.
- Fig. 5. Outer lateral view of apex of second form male copulatory appendage.
- FIG. 6. Basal segments of third, fourth, and fifth pereopods of male.



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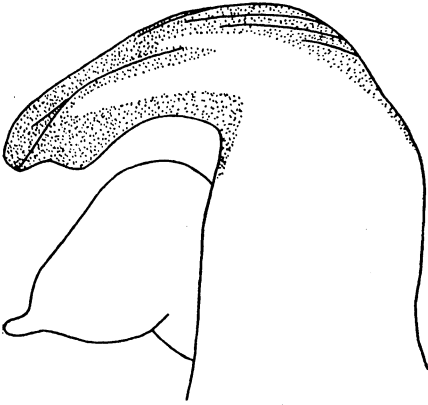
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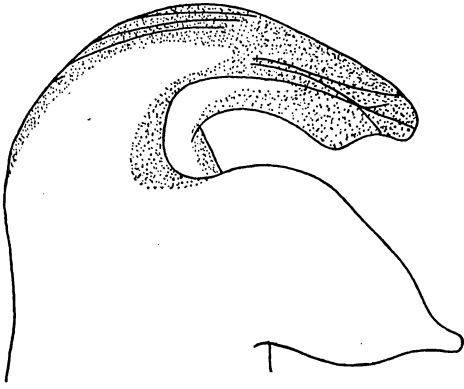
PLATE III

Cambarus hubbsi

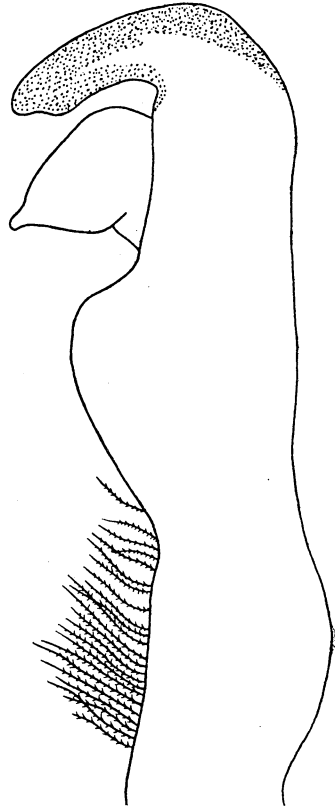
- Fig. 7. Outer lateral view of apex of first form male copulatory appendage.
- Fig. 8. Inner lateral view of apex of first form male copulatory appendage.
- Fig. 9. Outer lateral view of first form male copulatory appendage.



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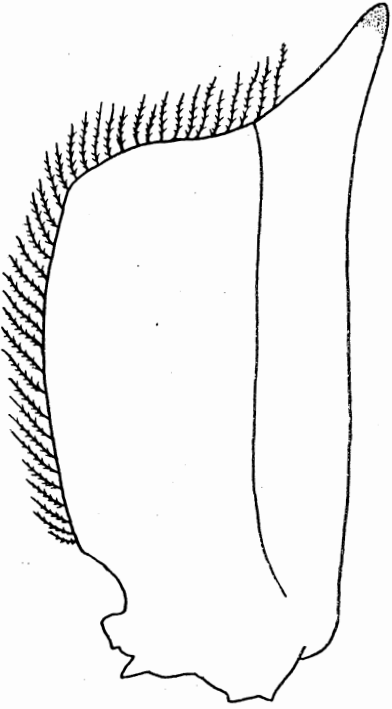
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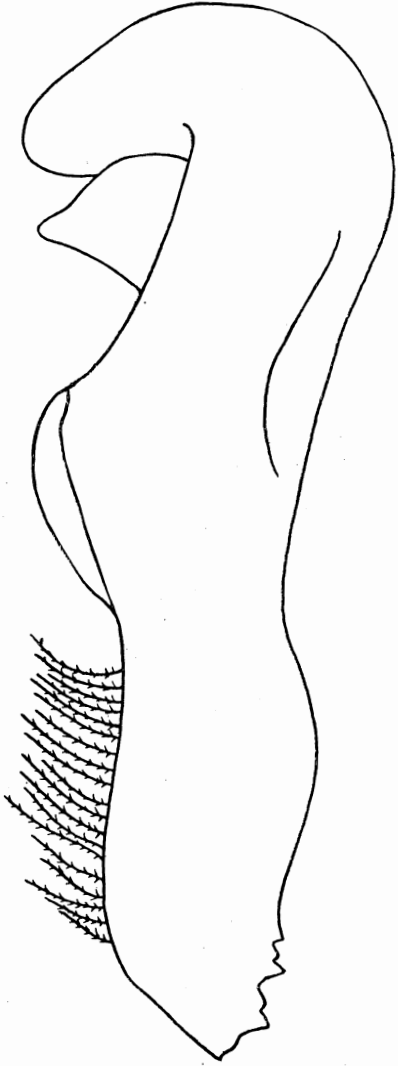
PLATE IV

Cambarus hubbsi

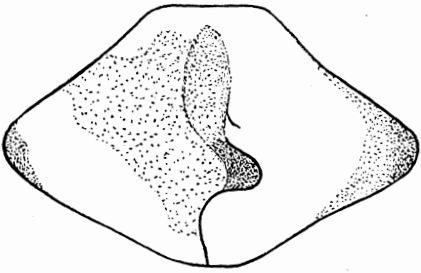
- Fig. 10. Antennal scale.
- Fig. 11. Annulus ventralis.
- Fig. 12. Outer lateral view of second form male copulatory appendage.



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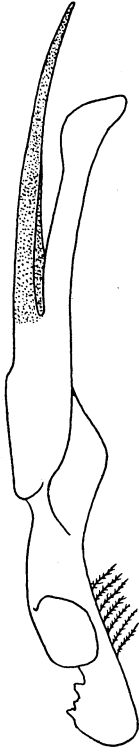
PLATE V

Cambarus peruncus

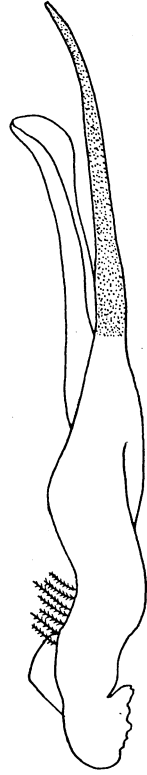
- Fig. 13. Outer lateral view of second form male copulatory appendage.
- Fig. 14. Inner lateral view of first form male copulatory appendage.
- Fig. 15. Outer lateral view of first form male copulatory appendage.
- Fig. 16. Basal segments of third, fourth, and fifth pereopods of male.
- Fig. 17. Annulus ventralis.



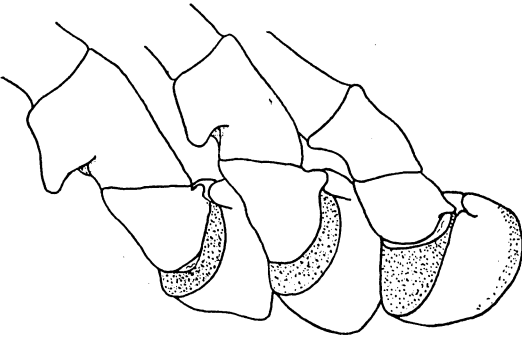
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