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A NEW CRAYFISH OF THE GENUS *CAMBARUS* FROM TENNESSEE WITH AN EMENDED DEFINITION OF THE GENUS (DECAPODA, ASTACIDAE)

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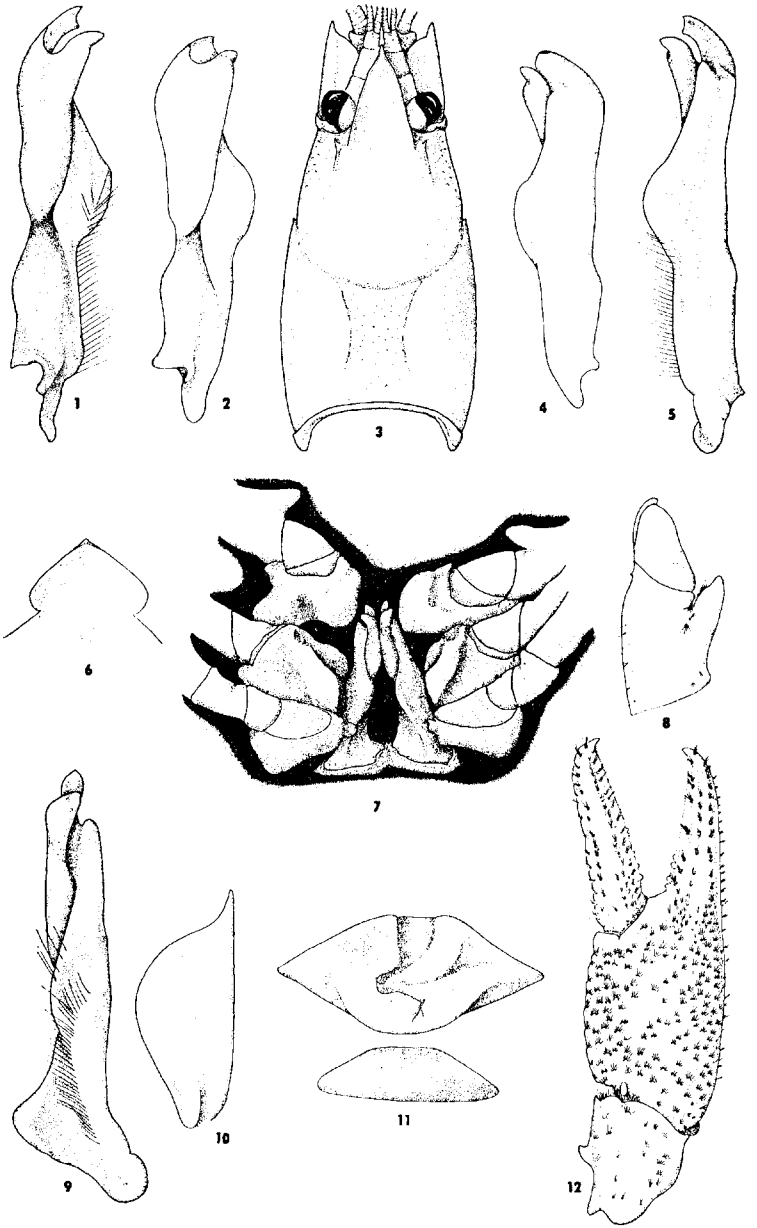
The species described herein first came to my attention in 1951 when John W. Parsons of the Tennessee Game and Fish Commission sent several lots of crayfishes to me that had been obtained from the watershed of the Caney Fork of the Cumberland River and Emory River. Among the specimens was a single female of a new form which had been collected from the Caney Fork proper on 4 August 1951. Attempts to secure additional specimens at that time were unsuccessful, and not until 22 July 1961, was the species seen again when Perry C. Holt obtained six specimens, including three second form males, from the Caney Fork at Pleasant Hill, Cumberland County.

With the acquisition of the males, the possible phylogenetic significance of the species became evident; however, it seemed unwise to describe it without having a first form male available.

On a collecting trip into the southeastern United States in April 1962, Joseph F. Fitzpatrick, Jr., and I obtained a series of 26 specimens, including 10 first form males.

The inclusion of this unique crayfish in the genus *Cambarus* requires a modification in the definition of the genus as proposed by Hobbs (1942:354). This definition began as follows: "First pleopod of first form male terminating in two distinct parts; both short and usually heavy and tapering to a point. Both terminal elements are bent caudad and usually at about a 90 degree angle to the main shaft of the appendage . . . ." In the new species, the pleopod terminates in three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distinct parts, the disposition of only one of which approaches a 90 degree angle to the main shaft of the appendage.

Only one other member of the genus, *Cambarus obeyensis* Hobbs and Shoup (1947: 138), possesses a pleopod approaching that of this species. In a discussion of the relationships of *C. obeyensis*, those authors stated, "The structure of the first pleopod of the male is somewhat unusual in that although all other known members of the genus have both terminal elements bent at least to a right angle from the main shaft of the appendage, in *C. obeyensis* the central projection has assumed a position somewhat intermediate between that found in the typical Cambarids and in some of the members of the Limosus Section of the genus *Orconectes*. . . . ." (loc. cit., p. 141). In order adequately to accommodate these two species in the generic diagnosis, the following is proposed.

GENUS *CAMBARUS* ERICHSON 1846: 88

Diagnosis: First pleopod of first form male symmetrical and terminating in two or three distinct parts, usually only two (mesial process and central projection) bent caudally or caudolaterally with principal axes of shaft and each ramus forming angles of approximately 90 degrees; if mesial process and central projection directed at angles of less than 90 degrees to main shaft, central projection never comprising more than ⅛ of total length of appendage or bent at angle of less than 45 degrees; central projection corneous and flattened laterally; mesial process mostly non-corneous, frequently inflated; caudal process, when present, forming knob-like prominence at caudolateral base of central projection. Hooks present on ischiopodites of third pereiopods only except in *Cambarus dissitus* Penn (1955: 73) in which also present on those of fourth pereiopods. Opposable margins of ischiopodites of third maxillipeds with teeth.

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PLATE I. *Cambarus pristinus*, sp. nov. 1, Mesial view of first pleopod of holotype; 2, Mesial view of first pleopod of morphotype; 3, Dorsal view of carapace of holotype; 4, Lateral view of first pleopod of morphotype; 5, Lateral view of first pleopod of holotype; 6, Epistome of holotype; 7, Bases of third, fourth, and fifth pereiopods and first pleopods of holotype; 8, Basipodite and ischiopodite of third pereiopod of holotype; 9, Caudal view of first pleopod of holotype; 10, Antennal scale of holotype; 11, Annulus ventralis of allotype; 12, Distal podomeres of cheliped of holotype.

Cambarus pristinus,[1] new species

Diagnosis: Pigmented; eyes of normal size and with pigment; rostrum widest at base, margins tapering, and tip reaching slightly beyond penultimate segment of base of antennule, marginal spines or tubercles lacking; postorbital ridges not prominent but terminating cephalically in spines or acute tubercles; areola conspicuously broad (1.8–2.3 times longer than wide, with 6 to 9 shallow punctations across narrowest part); lateral surfaces of carapace provided with spine on each side; chela of first form male 2.6–2.9 times longer than greatest width, dorsal surface studded with squamous setiferous tubercles. Simple hooks present on ischiopodites of third pereiopods only. First pleopod of first form male reaching base of third pereiopod when abdomen is flexed and terminating in three parts; mesial process thumblike, non-corneous, and directed caudolaterally at angle of 80 to 85 degrees to main shaft of appendage; central projection blade-like, concave distally, corneous, and directed caudolaterally at angle of approximately 50 degrees to main shaft; caudal element knoblike, non-corneous, and situated at caudolateral base of central projection. Annulus ventralis as figured (Fig. 10).

Holotype male, Form I: Pigmented, eyes normal. Body subcylindrical. Abdomen narrower than thorax (11.4 and 12.5 mm in widest parts, respectively). Carapace wider than deep in region of caudodorsal margin of cervical groove (12.3 and 10.0 mm); carapace widest slightly cephalic to midlength of areola.

Areola (Fig. 3) broad, 2.14 times longer than wide, with 7 or 8 punctations across narrowest part. Cephalic section of carapace 2.1 times longer than areola; length of areola 31.9 percent of entire length of carapace. Rostrum with non-thickened, slightly elevated convergent margins continuing uninterrupted almost to apex; long acumen not distinctly delimited at base, terminating apically in corneous upturned tubercle reaching slightly beyond base of distal podomere of peduncle of antennule; upper surface plane apically and slightly concave caudally with shallow fovea at base and with scattered punctations; row of setiferous punctations mesial and lateral to elevated margins, lateral row terminating cephalically at base of acumen, mesial row continuing onto acumen. Subrostral ridges poorly developed and evident in dorsal aspect for only short distance at base of rostrum. Postorbital ridges moderately well developed, each with shallow, setiferous, dorsolateral groove and terminating cephalically in corneous spiniform tubercle. Suborbital angle well defined and acute. Branchiostegal spine moderately well developed and acute. Surface of carapace punctate dorsally and granulate laterally, prominent *cervical spine* (name here proposed to replace *lateral spine*[2]) present on lateral surface just posterior to cervical groove.

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[1] Pristinus, L.—early, primitive; so named because of the assumed primitive characters possessed by this species.

[2] The designation, "lateral spine," has been used carelessly in the past to apply to the cervical spine and the marginal spine of the rostrum, and in some species (viz. *O. limosus*, *O. pellucidus*) to the many spines on the lateral surface of the

Abdomen longer than carapace (27.5 and 23.5 mm). Cephalic section of telson with two spines in each caudolateral corner.

Epistome (Fig. 6) broader than long, broadly rounded with short cephalomedian projection. Antennule of usual form with spine on lower surface of basal segment slightly distal to midlength. Antennae broken but probably extending caudad to second or third abdominal segment. Antennal scale (Fig. 11) 2.4 times longer than broad with greatest width slightly distal to midlength; mesial margin of lamellar portion evenly rounded; outer heavier portion terminating in strong spine.

Right chela (Fig. 12) elongate, subovate in cross section, and with palm only slightly inflated; palm studded with squamous, setiferous tubercles extending along upper and lower proximolateral surfaces of immovable finger; inner margin of palm with row of 10 tubercles, other slightly smaller ones irregularly arranged dorsolateral to this row; dorsal proximal articular tubercle conspicuous and more elevated distally than in most crayfishes; upper articular tubercle at base of dactyl not so conspicuous. Opposable margin of immovable finger with 4 tubercles along basal third, with crowded denticles along distal two-thirds; upper surface with median longitudinal ridge flanked by deep setiferous punctations; lateral margin costate with single row of similar punctations; lower surface similar to upper one but punctations lateral to ridge much shallower. Opposable margin of dactyl with row of 4 tubercles along proximal half and crowded denticles along distal half; upper and lower surfaces similar to those of immovable finger; mesial surface with row of squamous, setiferous tubercles becoming progressively smaller and more adpressed distally.

Carpus distinctly longer than broad (5.8 and 3.2 mm) with shallow oblique furrow on upper surface; upper surface mostly punctate but with few squamous tubercles and prominent spiniform tubercle on mesiodistal margin; mesial surface punctate proximally and tuberculate distally with very large tubercle near distal margin; lower surface with only two prominent tubercles, distolateral spiniform one and broad submedian distal one.

Dorsal surface of merus with a single anteapical acute tubercle; lateral and mesial surfaces with widely scattered tubercles; laterodistal and mesiodistal articular knobs with corneous acute tubercles; lower surface with mesial row of 8 tubercles and lateral one of 4, tubercles in both rows progressively more spiniform distally. Ischium with ventral margin irregular and with one very small tubercle; otherwise punctate.

Hooks (Figs. 7, 8) on ischia of third pereiopods only; hooks simple and projecting proximally beyond distal margin of basis. Caudomesial surfaces of coxae of fourth pereiopods (Fig. 7) with unusually prominent tuberosities bearing densely setiferous excavations cephalomesially.

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carapace not in the cervical cluster. This proposal should result in a more exact and less ambiguous terminology.

First pleopods (Figs. 1, 5, 7, 9) symmetrical and extending cephalad to coxae of third pereiopods when abdomen is flexed. See diagnosis for description.

Allotypic female: Excluding secondary sexual characters, differing from holotype in following respects: most tubercles more acute and most spines longer; opposable margin of dactyl with 5 tubercles in proximal half and another at proximal end of distal two-fifths of finger; opposable margin of immovable finger also with 6 tubercles, the distalmost slightly more distal than corresponding tubercle on dactyl; opposable margins of both fingers with single row of minute denticles between and distal to tubercles; mesiodistal articular knob of merus with spine or tubercle, lower surface with mesial row of 10 and lateral one of 5 tubercles.

Annulus ventralis (Fig. 10) slightly movable, more than twice as broad as long; cephalomedian trough, flanked by longitudinal ridges, narrowing near midlength with caudal portion directed caudodextrally and joining cephalic arm of tilted S-shaped sinus; cephalic curve of sinus extending caudodextrally and caudal one directed cephalosinistrally with slightly more than cephalic half of sinus lying dextral to median line and slightly more than caudal half situated in caudal half of annulus; caudal third of annulus produced caudally into broad, rounded, ventrally flattened lobe. Sternal sclerite immediately caudal to annulus more than three times broader than long. (See *Measurements*).

Morphotypic male, Form II: Differs from holotype in following respects: spines and tubercles more nearly like those in allotype in size and shape; opposable margin of dactyl with 3 tubercles in proximal one-fourth of finger and an additional one situated somewhat lower than three just mentioned immediately proximal to midlength of finger; opposable margin of immovable finger similar to that of dactyl but with 4 tubercles in proximal group; mesiodistal articular knob of merus without spine or tubercle, lower surface with mesial row of 5 tubercles; only 2 in position of lateral row in holotype and allotype; hook on ischiopodite of third pereiopod strong and reaching level of distal end of basipodite; prominence on coxopodite of fourth pereiopod only slightly less well developed than in holotype. (See Measurements).

First pleopod (Figs. 2, 4) with all three elements reduced and central projection non-corneous; all disposed approximately as in holotype.

Measurements: As follows (in millimeters):

	Holotype	Allotype	Morphotype
Carapace			
Height	10.0	13.2	11.3
Width	12.5	16.0	13.4
Length	23.5	32.3	29.4
Rostrum			
Width	3.9	5.4	4.4
Length	6.7	8.2	8.3

	Holotype	Allotype	Morphotype
Areola			
Width	3.5	5.2	4.2
Length	7.5	11.0	9.7
Chela			
Length, palm inner margin	7.0	8.7	8.3
Palm width	6.4	8.7	7.4
Length, hand outer margin	17.3	22.7	21.6
Dactyl length	9.4	10.8	10.2

Type-locality: White Oak Creek, a tributary to the Caney Fork of the Cumberland River, 3.9 miles east of the White-Cumberland County line and 0.1 miles south of U. S. Rte. 70S. Here the creek, some 10 to 15 feet wide and 8 to 10 inches deep, is clear and flows with a moderate current over a bed-rock exposure with scattered stones and small gravel deposits. The stream flows through a wooded area with *Quercus* sp., *Acer* sp., and *Kalmia latifolia*. *Cambarus pristinus* shares this stream with two unidentified species of the same genus.

Disposition of types: The holotypic male, form I (no. 115528), the allotypic female (no. 115529), and the morphotypic male, form II (no. 115530) are deposited in the United States National Museum as are the following paratypes: 8 males, form I; 1 male, form II; 16 females; 3 juvenile males; and 1 juvenile female. Paratypes consisting of one male, form I, one female, and one male, form II, are deposited in the Museum of Comparative Zoology.

Range: *Cambarus pristinus* is known from only three localities, all in the drainage of the Caney Fork of the Cumberland River in Cumberland County, Tennessee: the type locality; Caney Fork River just east of Pleasant Hill on U. S. Rte. 70S; and Caney Fork River at Ridgedale bridge, one mile northeast of Clifty. Although extensive collections are not available from this area, it is surprising that among the localities represented *C. pristinus* has not been encountered more often; perhaps its range is as restricted as it seems.

Life history notes: First form males were collected on 19 April 1962, and 7 of the 14 females obtained the same day were carrying eggs.

Relationships: *Cambarus pristinus* has its closest affinities with *Cambarus obeyensis* Hobbs and Shoup which is also an inhabitant of the Cumberland River drainage system. The latter appears to be confined to the headwaters of the East Fork of the Obey River in Cumberland, Fentress, Putnam, and Overton counties, and it is probable that *C. pristinus* is restricted to the Caney Fork. Although the two share a number of features in common, the broad areola, the caudal process on the first pleopod of the male, and the caudomedian prominence of the annulus ventralis of *C. pristinus* distinguish if from *C. obeyensis*, and the presence of a caudal process is unique among members of the genus.

Discussion: *Cambarus pristinus* possesses several characteristics which

are considered to be among the most primitive of the genus. Most prominent among them is the very broad areola which is approximated by only one other species of the genus, *Cambarus extraneus* Hagen (1870:73). Less conspicuous, but perhaps of greater value in assessing relationships, are the number and arrangement of the terminal elements of the first pleopod. In addition to the two elements that are always present in *Cambarus*, there is also a very prominent caudal knob, rudiments of which are evident in a number of species of the genus. The arrangement of the other two elements is as similar to that in many species of *Procambarus, Cambarellus,* and *Orconectes* as to that of other members of the genus *Cambarus*. The chelae are unique among epigean *Cambarus* and resemble those of members of the genus *Procambarus* far more closely than they do those of most members of *Cambarus*.

It does not seem to be a coincidence that these primitive characteristics are encountered in a crayfish inhabiting a stream on the Cumberland Plateau, for as is discussed elsewhere (Hobbs and Barr, in a manuscript submitted for publication) in somewhat greater detail, this area is postulated to have been inhabited by a stock of crayfish that was near the stem-form of both *Orconectes* and *Cambarus*. The extant forms that are believed to have preserved most characteristics of this ancestor are the troglobitic members of the genus *Orconectes* frequenting subterranean waters of the same region. In *Cambarus pristinus,* the postulated primitive features of the first pleopod are as well preserved and only slightly more modified than they are in these troglobitic animals; the caudal knob is even more prominent than it is in them. If our postulates that have been proposed in attempting to reconstruct the origin of the troglobitic *Orconectes* prove tenable, then it is appropriate that the primitive *Cambarus pristinus,* living in the ancestral home, should be considered a relict of the ancestral pro-*Cambarus-Orconectes* stock. A greater number of primitive features is preserved in *C. pristinus* than in any other member of the genus.

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