

FIGURE 1. DIAGRAM OF A CRAYFISH

ABD., abdomen; AN., antennule; ANT., antenna; ARE., areola; A.S., antennal scale; B., basipodite; C., carpopodite (carpus); CAR., carapace; C.G., cephalic groove; CO., coxopodite; D., dactylopodite; EYE, eye; HO., hook; I., ischiopodite (ischium); I. UR., inner ramus of uropod; L.S., lateral spine; M., meropodite (merus); MAX., third maxilliped; O. UR., outer ramus of uropod; P., propodite (propodus); P. R., postorbital ridge; RO., rostrum; S. O., sexual organ; SW., swimmeret; TEL., telson; 1, 2, 3, 4, 5, walking legs.

# THE DECAPOD CRUSTACEANS OF OKLAHOMA\*

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## I. INTRODUCTION

The decapod crustacean fauna of Oklahoma has been but slightly known. Only a few specimens have been obtained previously by systematists and no attempt has ever been made to compile a list for the State. It is therefore highly fortunate that, through the efforts of the University of Oklahoma Biological Survey, an excellent collection has lately been secured. The following key, descriptions, and notes on habitat and distribution of the various species are based largely upon this collection. In addition many specimens of decapod crustaceans from Oklahoma, collected by a University of Michigan expedition in 1931, have been available for study. Professor J. G. Mackin has very kindly provided several records of Oklahoma decapods. Several Oklahoma crayfish in the Carnegie Museum have also been examined. It is the authors' hope that new explorations may soon supplement this work. Recently Mr. E. B. Webster of Shawnee has given to the museum a fine collection from Potawatomic County.

Two families of decapods occur within the boundaries of Oklahoma. The fresh-water shrimp, *Palaemonetes exilipes*, represents the Palaemonidae, an essentially marine group, and the species of crayfish (*Cambarus* as now defined) represent the other family, the purely fresh-water Astacidae. Ten species of *Cambarus* are now known to occur in Oklahoma. One other species, *setosus*, known from surrounding regions, may possibly be found within the boundaries of the State. These are listed and described in the present paper.

Due to unavoidable delay in publication not all localities for each species are shown on the maps. The lists of station numbers however are complete to date.

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\*Contribution from the Zoological Laboratory of the University of Oklahoma, Second Series, No. 119.

## II. KEY

## FAMILY ASTACIDAE

The key which follows is based upon adult male characters. If adult males of the first form are available, the species should be easily ascertained. First form males can be immediately distinguished by the horny color of the outer tip of the sexual organ. The terminology used in the key is explained by figures (Figs. 1-13) and by a glossary.

## KEY TO THE SPECIES OF CRAYFISH KNOWN TO OCCUR OR PROBABLY OCCURRING IN OKLAHOMA

- 1a. Areola obliterated, linear.
- 2a. Rostrum without lateral spines.
- 3a. Sexual appendage with two terminal protuberances, set at right angles to main shaft. (Fig. 2.)  
*Cambarus diogenes* Girard 1852
- 3b. Sexual appendage ending in four short spines or protuberances. (Fig. 3.)  
*Cambarus gracilis* Bundy 1876
- 2b. Rostrum with lateral spines.
- 4a. Sexual appendage with two terminal spines reaching to base of second walking leg. Length of appendage greater than length of posterior section of carapace. (Fig. 4.)  
*Cambarus longimanus* Faxon 1898
- 4b. Sexual appendage with two terminal spines reaching to base of third walking leg. Length of appendage less than length of posterior section of cephalothorax. (Fig. 5.)  
*Cambarus difficilis* Faxon 1898
- 1b. Areola not obliterated.
- 5a. Eyes absent. (Fig. 6.)  
*Cambarus setosus* Faxon 1898
- 5b. Eyes present.
- 6a. Sexual appendage with two long tapering tips either straight or gently curving. (See also items 6b and 6c below.)
- 7a. Movable finger with deep incision at base on inner side. Sexual appendage with tips recurved nearly at right angles to basal part. Antennal scale with inner margin not uniformly rounded. (Figs. 7 and 8.)  
*Cambarus immunis* Hagen 1870
- 7b. Movable finger without deep incision at base. Sexual appendage with tips gently curving or straight. Antennal scale evenly rounded along inner margin.

- 8a. Both tips of sexual appendage straight. Rostrum with faint median elevation (carina) above. Fingers with black rings near apex. (Fig. 9.)

*Cambarus neglectus* Faxon 1885

- 8b. Both tips of sexual appendage gently curving posteriorly. Rostrum without elevation above. Fingers without black rings. (Fig. 10.)

*Cambarus nais* Faxon 1885

- 6b. Sexual appendage with four short terminal teeth or protuberances on a stout shaft. (See also item 6c below.)

- 9a. Apex of shaft of sexual appendage with conspicuous tufts of setae; all terminal teeth acute. (Fig. 11.)

*Cambarus blandingii acutus* Girard 1852

- 9b. Apex of sexual appendage without tufts of setae; teeth not all acute, one flattened and semi-circular. (Fig. 12.)

*Cambarus simulans* Faxon 1884

- 6c. Sexual appendage with one long tip (which crosses the long tip of the opposite appendage) and one very short tip situated on inner side at mid-length of long tip. (Fig. 13.)

*Cambarus clypeatus* Hay 1899

The above key for the reader's convenience is not based upon the natural relationships of the various species. If such arrangement were attempted the following groupings would prevail. Two of the subgenera here used might well be considered genera. Such a treatment, however, falls outside the scope of the present paper.

#### SUBGENUS *Faxonius*

1. *Cambarus neglectus*.
2. *Cambarus nais*.
3. *Cambarus immunis*.
4. *Cambarus longimanus*.
5. *Cambarus difficilis*.
6. *Cambarus clypeatus*.

#### SUBGENUS *Cambarus*

7. *Cambarus diogenes*.
8. *Cambarus setosus*.

#### SUBGENUS *Ortmannicus* (as now defined)

9. *Cambarus blandingii acutus*.
10. *Cambarus simulans*.
11. *Cambarus gracilis*.

The various species will be considered in their natural order as listed above.

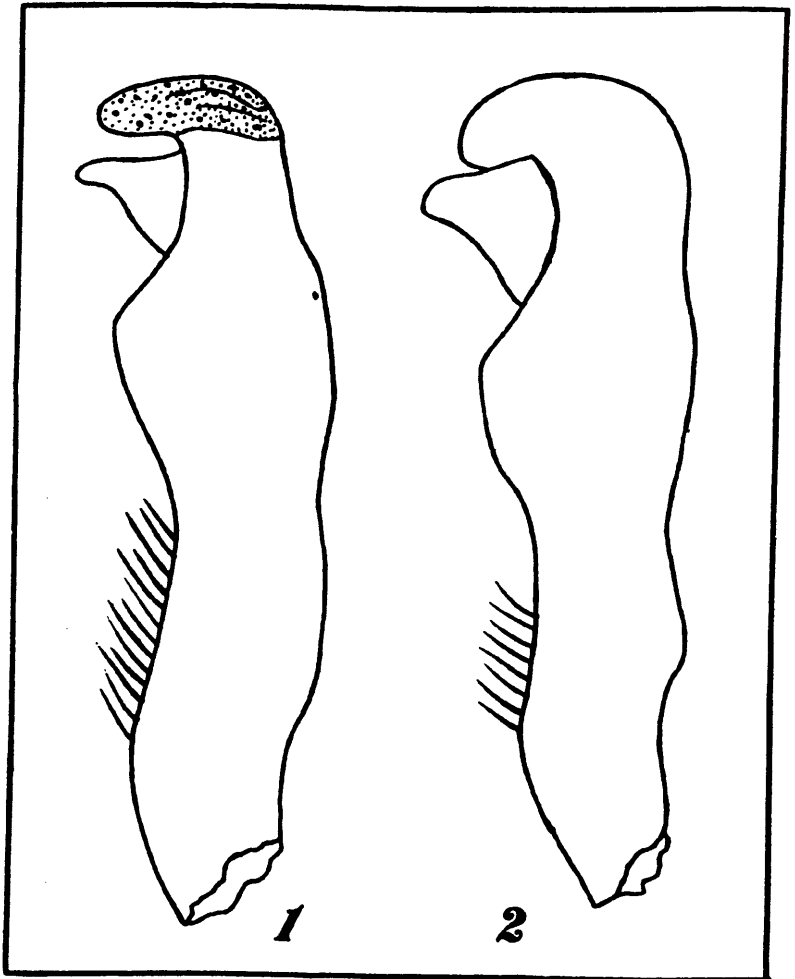


FIGURE 2. *CAMBARUS DIOGENES*.

1. First-form male sexual appendage.
2. Second-form male sexual appendage.

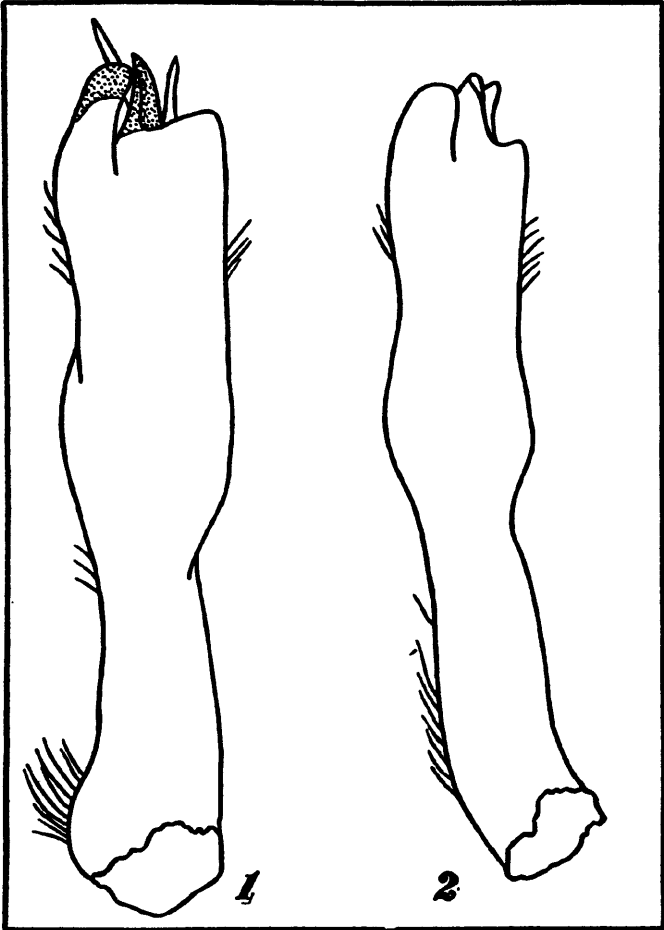


FIGURE 3. *CAMBARUS GRACILIS*.

- 1. First-form male sexual appendage.
- 2. Second-form male sexual appendage.

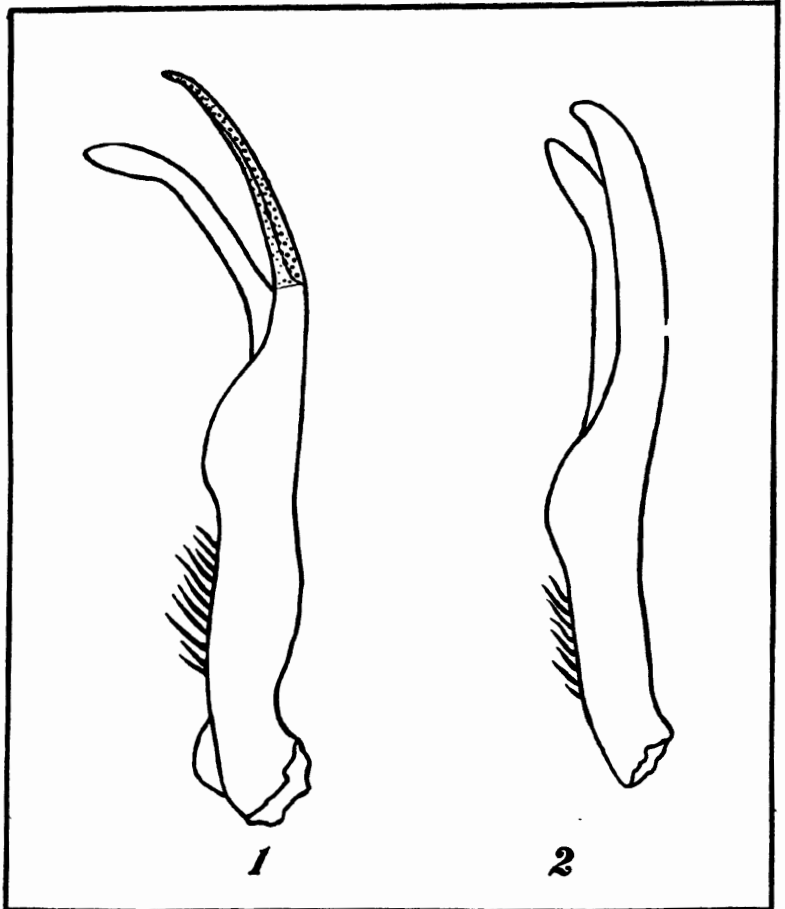


FIGURE 4. *CAMBARUS LONGIMANUS*.

1. First-form male sexual appendage.
2. Second-form male sexual appendage.

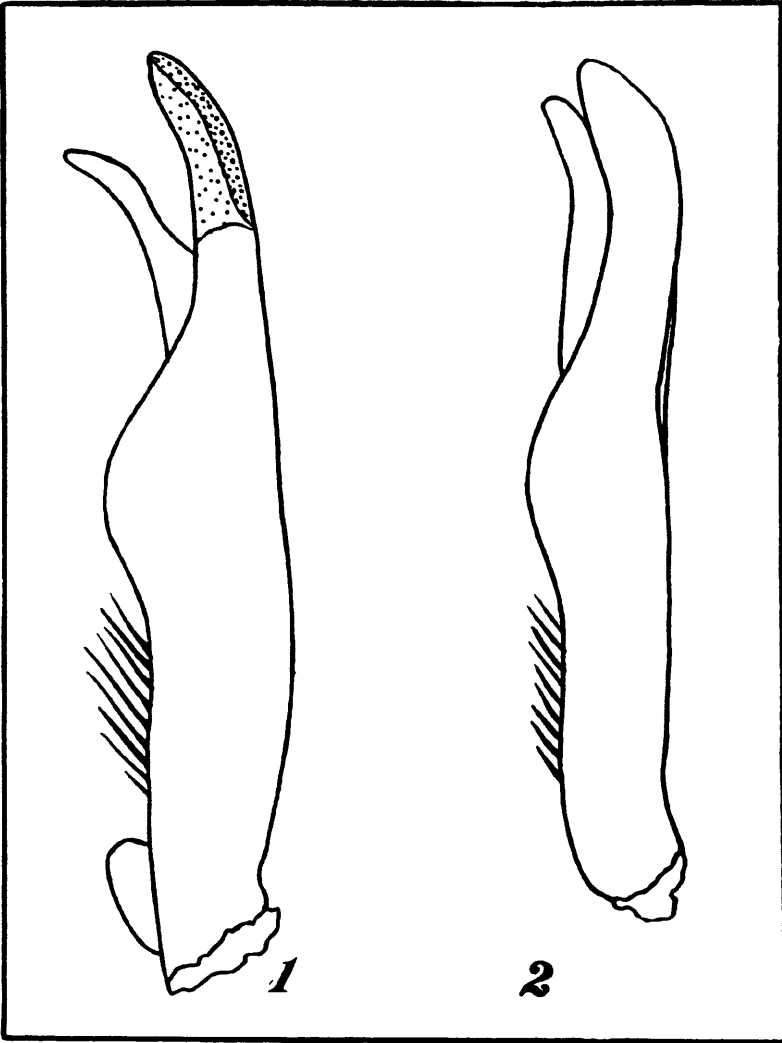


FIGURE 5. *CAMBARUS DIFFICILIS*.

1. First-form male sexual appendage.
2. Second-form male sexual appendage.



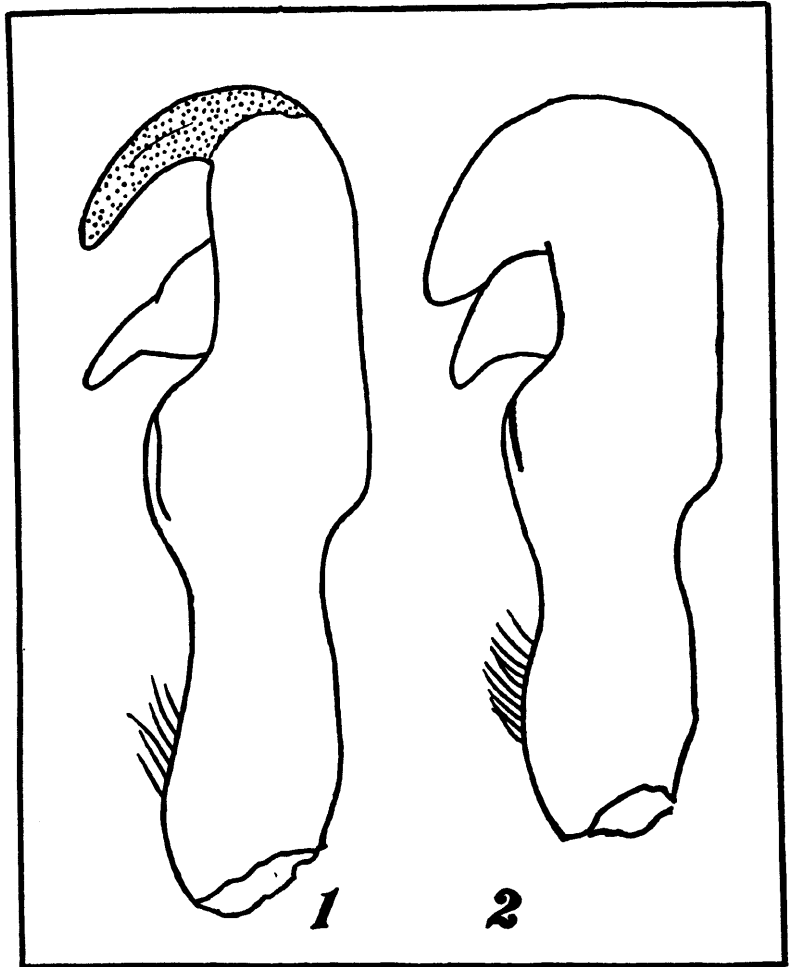


FIGURE 6. *CAMBARUS SETOSUS*.

1. First-form male sexual appendage.
2. Second-form male sexual appendage.

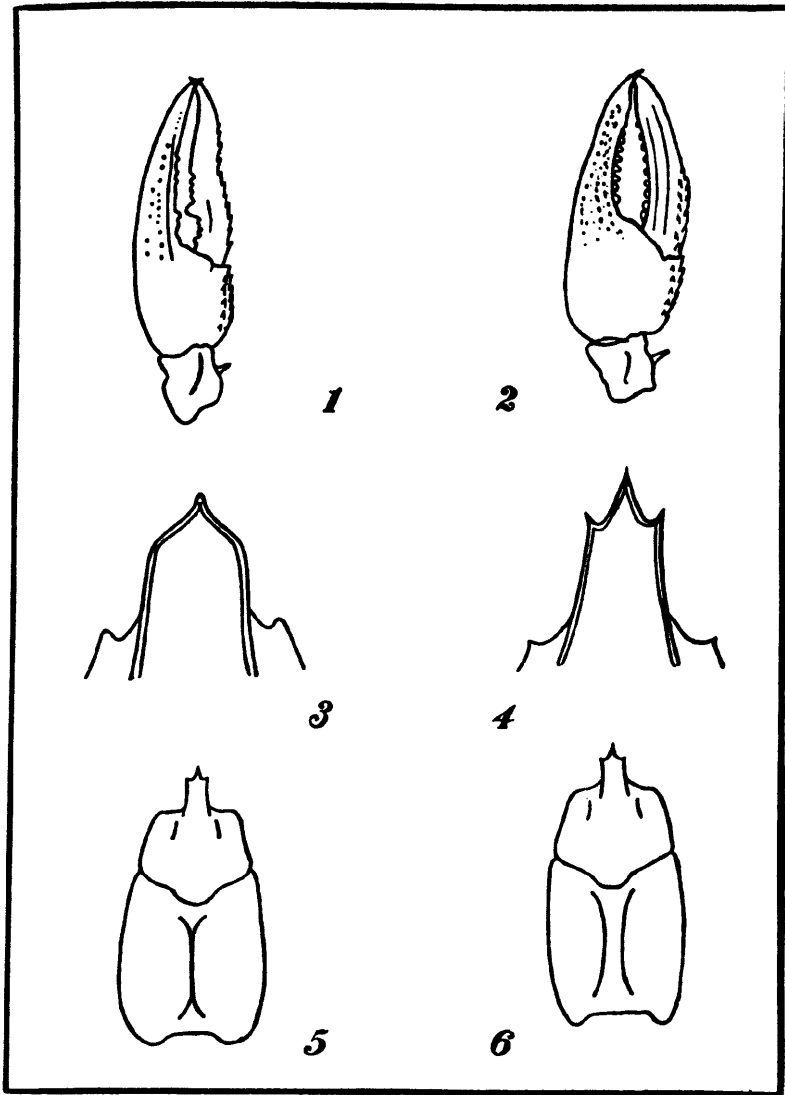


FIGURE 7. CRAYFISH PARTS ILLUSTRATING SYSTEMATIC CHARACTERS.

1. Chela of *C. immunis* showing incision at base of movable finger.
2. Chela without incision at base of movable finger.
3. Rostrum without lateral teeth.
4. Rostrum with lateral teeth.
5. Carapace showing obliterated areola.
6. Carapace showing an areola.

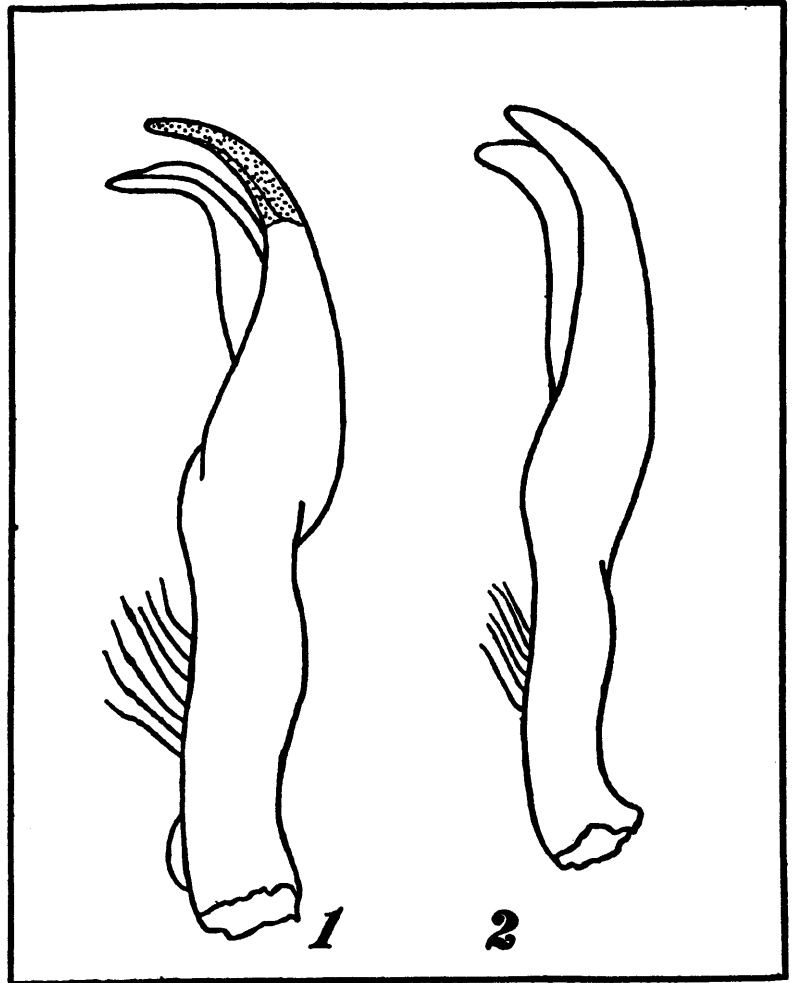


FIGURE 8. *CAMBARUS IMMUNIS*.

1. First-form male sexual appendage.
2. Second-form male sexual appendage.

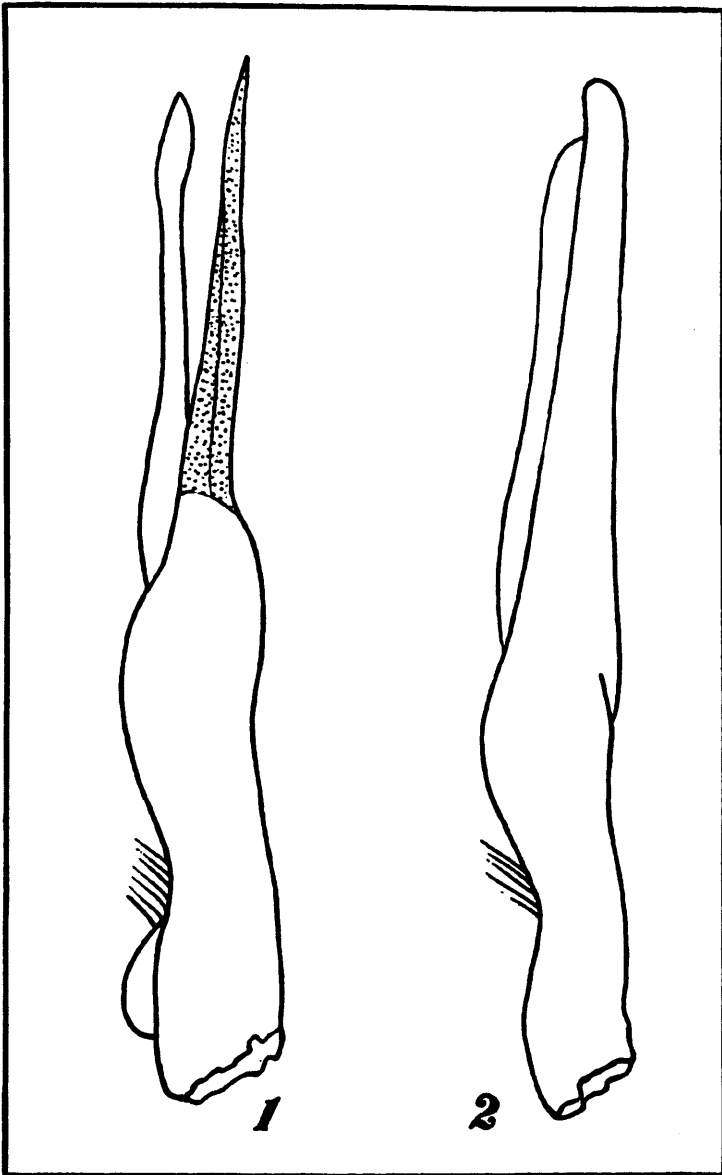


FIGURE 9. *CAMBARUS NEGLECTUS*.

1. First-form male sexual appendage.
2. Second-form male sexual appendage.

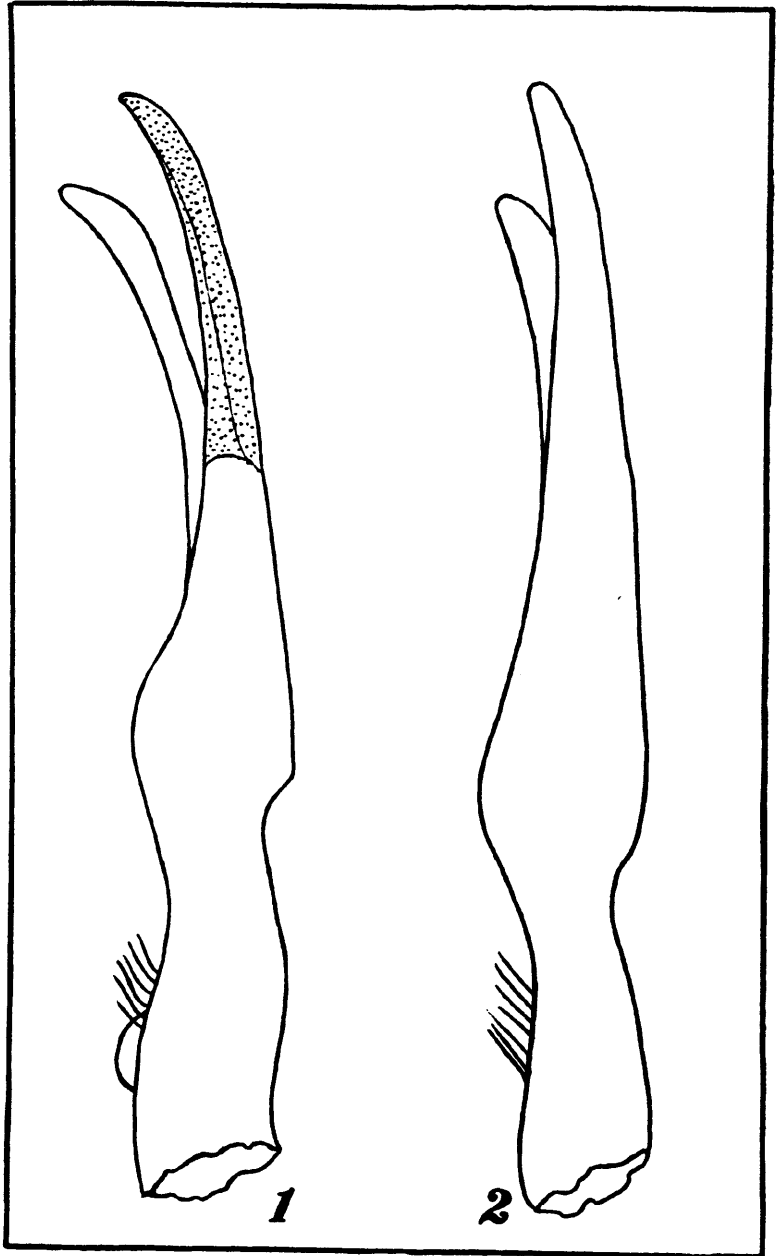


FIGURE 10. *CAMBARUS NAIS*

1. First-form male sexual appendage.
2. Second-form male sexual appendage.

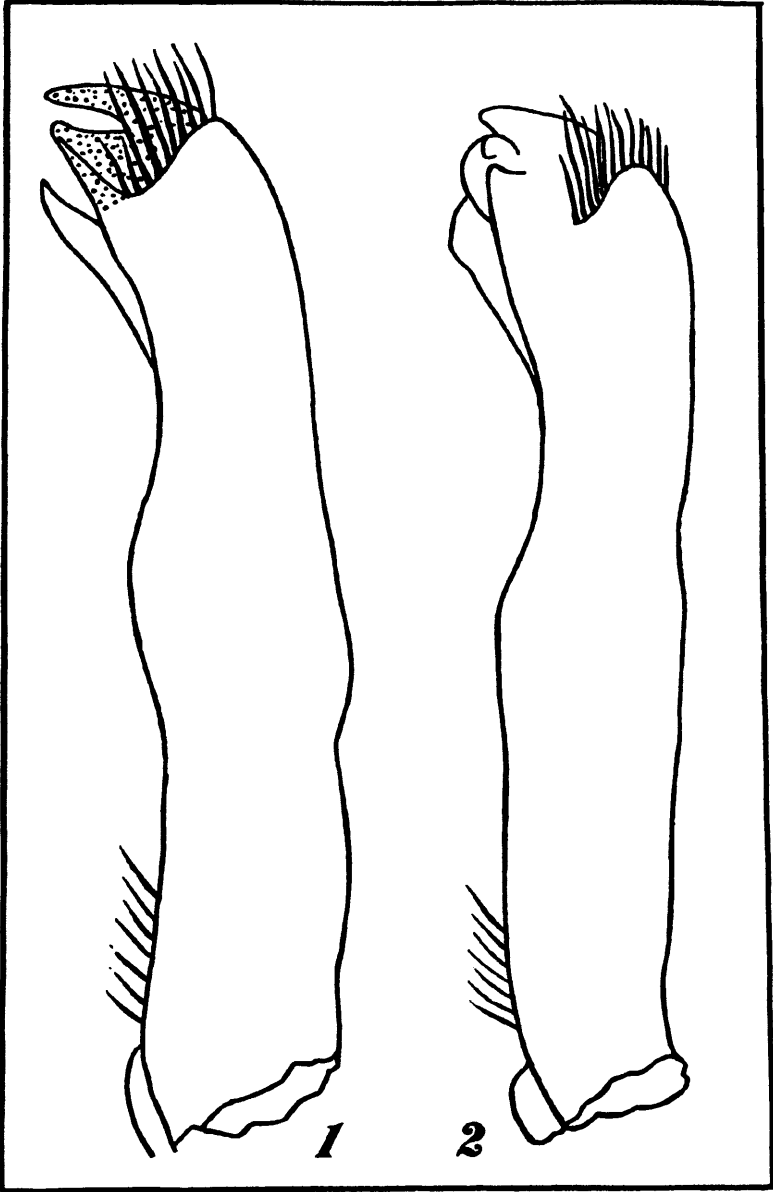


FIGURE 11. *CAMBARUS BLANDINGII ACUTUS*.

- 1. First-form male sexual appendage.
- 2. Second-form male sexual appendage.

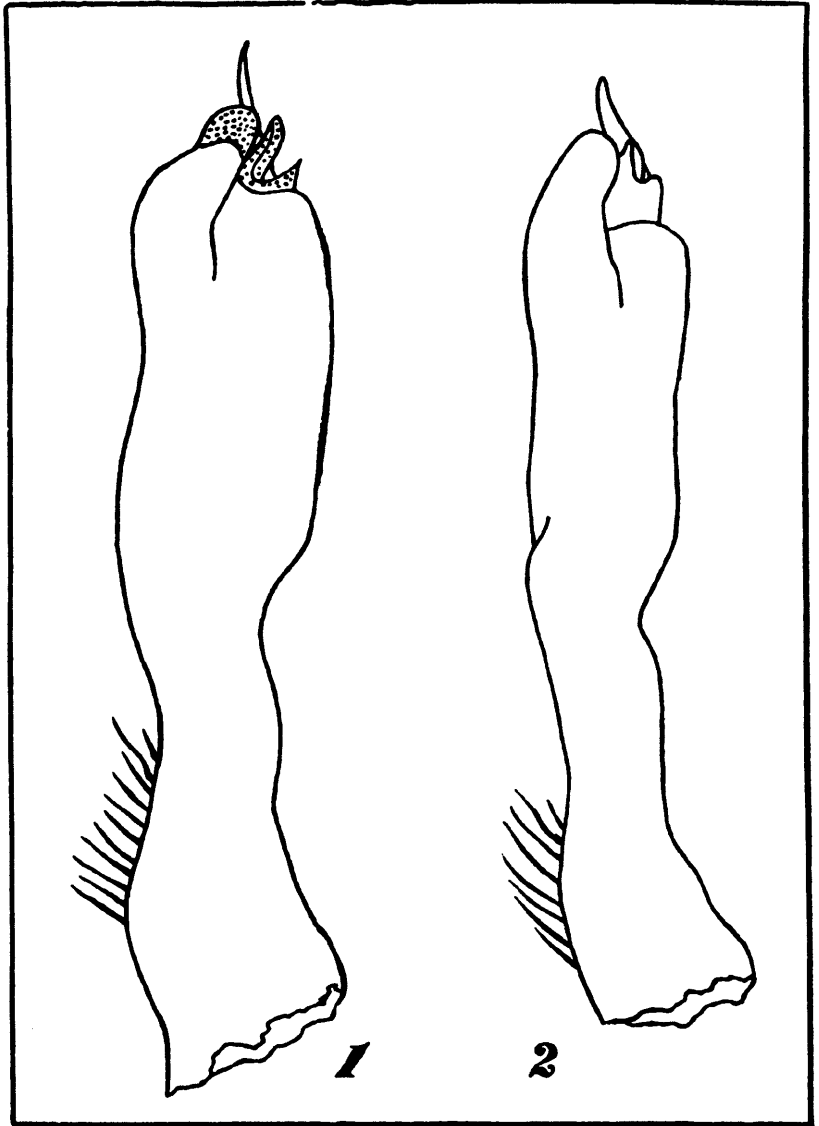


FIGURE 12. *CAMBARUS SIMULANS*.

1. First-form male sexual appendage.
2. Second-form male sexual appendage.

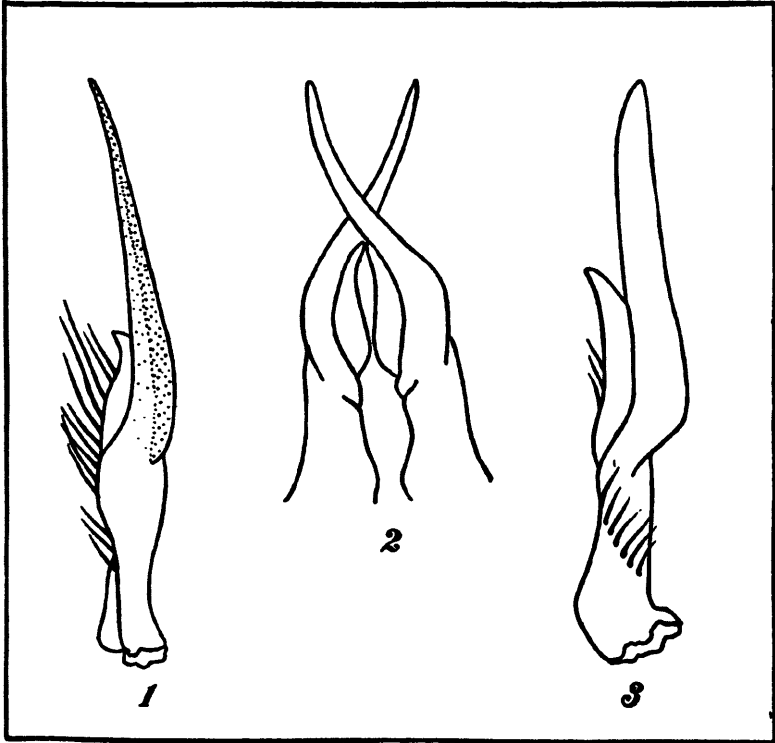


FIGURE 13. *CAMBARUS CLYPEATUS*.

1. First-form male sexual appendage.
2. Position of two parts of sexual appendage.
3. Second-form male sexual appendage.



### III. DESCRIPTONS OF COLLECTING STATIONS

The following brief descriptions of collecting stations are those from which specimens were taken by the field parties of the University of Oklahoma Biological Survey, during the summers of the years 1926 through 1932. In addition other localities are listed, some from other museum collections and a few from the literature. All collections are in the Museum of Zoology of the University of Oklahoma or at the Museum of Zoology of the University of Michigan, except those from localities the station numbers of which are marked with an asterisk. The collections so marked are at the institutions mentioned in the locality description except in a few cases in which records have been taken from the literature.

For convenience the stations are listed in groups under the major river systems:—I. Red River system:—IA. Red River system proper and IB. Washita River system (of Red River); II. Arkansas River system:—IIA. South Canadian River system, IIB. North Canadian River system, IIC. Cimarron River system, IID. Arkansas River system proper, IIE. Illinois River system, IIF. Neosho River system, IIG. Verdigris River system, and IIH. Poteau River system. The station descriptions will be found under these section headings.

#### I. RED RIVER SYSTEM

##### IA. RED RIVER

Station 1:—Tributary of Kiamichi River, Goodland, Choctaw County, Choctaw Nation.

Station 2:—Walnut Creek (of Kiamichi River), 1 mile southwest of Albion, Pushmataha County, June 19, 1931. This small tributary of the Kiamichi River was from 3 to 4 feet wide, from 3 inches to 1 foot deep, and had pools up to 30 feet wide and from 4 to 6 inches deep. The very clear water flowed with a fairly swift current over a bottom of gravel and small rocks, between gravel banks from 4 to 6 feet high. No vegetation was present in the stream. The temperature was 33°C., and the pH 7.2.

Station 3:—Rock Creek (of Kiamichi River), 1 mile southwest of Talihina, LeFlore County, June 19, 1931. This stream was about 30 feet wide, and six feet at its greatest depth. Some *Nymphaea* was present in the water, which was slightly muddy. Willows, birches, oaks, and elms were growing on the banks, which were from 10 to 15 feet high. The temperature was 28°C., and the pH 6.6.

Station 4:—Buffalo Creek (of Kiamichi River), 5 miles northwest of Tuskahoma, Latimer County, June 18, 1931. This small stream from 6 to 15 feet wide had alternating riffles and pools; most of the pools were small, although a few pools (50 feet by 300 feet) were "backed up" from the main stream. The specimens were taken from pools only. The temperature was 29°C., and the pH 6.8.

Station 5:—A small tributary of Jackfork (of Kiamichi River), 6 miles east of Weathers, Latimer County, June 19, 1931. The collection was made from a pool 20 feet by 50 feet with abundant vegetation (some of which was enclosed with the specimens). The temperature was 29°C., and the pH 6.0.

Station 6:—North Fork (of Jackfork of Kiamichi River), 4 miles east of Weathers, Pittsburg County, June 19, 1931. This stream with alternating riffles (10 to 20 feet wide) and deeper pools had gravel and mud banks from 10 to 20 feet high, covered with birch, sycamore, red oak, maple, and willow. *Dianthera americana* was growing in the riffles, which were 6 inches deep and had a bottom of small boulders. The temperature was 29°C., and the pH 6.8.

Station 7:—Olney, (of Boggy Creek), Coal County, July 18, 1912.

Station 8:—Connorville, (of Blue River), Johnston County.

Station 9:—Beaver Creek, 8 miles east of Walters, Cotton County, July 19, 1932. This small stream about 15 feet wide flowed rapidly through plains country over a bottom of hard mud; the water was muddy (gray); along the banks were very large cottonwoods and also a thick undergrowth of small trees and bushes.

Station 10:—Mt. Scott, (of Cache Creek), Comanche County.

Station 11:—Medicine Bluff Creek (of Cache Creek), 10 miles north of Cache, Wichita National Forest, Comanche County, June 16, 1932. The creek at this station was from 4 to 10 feet wide and from 1 to 5 feet deep; larger rocks in the gravel bottom caused the water to run in small riffles; there were overhanging trees and grasses on the banks.

Station 12:—Tributary of Medicine Bluff Creek (of Cache Creek), 14 miles north-by-west of Cache (section 14W), Comanche County, June 22, 1928. This slow-moving stream with low banks and a bottom of sand and mud was about 18 inches deep; on this date the water was full of duckweed; the banks were thickly covered with sedges and grass. The temperature was 81.5°F., and the pH 8.2.

Station 13:—Jimmy Creek (tributary of Medicine Bluff Creek of Cache Creek), 1.3 miles northwest of Mt. Sheridan store (section 16W), Comanche County, June 22, 1928. At this station the banks of the stream were low and gravelly; the current was swift. The water was somewhat muddy; its temperature was 68.5°F., and the pH 7.9.

Station 14:—West Cache Creek (of Cache Creek), near Camp Boulder, Wichita National Forest, Comanche County, June 7 to 12, 1926, and June 16, 1932. This was a very clear stream, without taste; vegetation was absent, except for filamentous green algae. The bottom was clean, and of sand, gravel and granite rock; the shore was wooded, or gravelly or rocky. The width was 5 to 30 feet and the depth 6 inches to 3 feet (28 feet in one hole); the current was swift between pools. The temperature was from 82° to 84°F., and the pH 7.6.

Station 15:—Cut-off slough of Otter Creek (of North Fork of Red Run) 8½ miles southwest of Snyder, Kiowa-Tillman County line, June 28, 1928. This was a typical cut-off slough, with very low banks of mud, covered with many different weeds and grasses. The water was very muddy, and filled with brush. The temperature was 101°F., and the pH 8.0.

Station 16:—Otter Creek (of North Fork of Red Run), 1 mile east of Mountain Park, Kiowa County, June 28, 1928. This stream of muddy water was from 6 inches to 4 feet deep, barely moving over a bottom in some places sandy, in others muddy. The high banks were covered with grasses and sedges near the water. The temperature was 82°F., and the pH 8.0.

Station 17:—Elm Fork, 4 miles north of Mangum, Greer County, June 21, 1926. The water was fairly clear, but distinctly salty to the taste; there was very little vegetation; the stream had a sand and sand-mud bottom. Collections were made from running water as well as from cut-off pools.

Station 18:—North Fork, 5 miles south of Carter, Beckham County, June 22, 1932.

Station 19:—Mud-hole just south of North Fork, 7 miles south of Carter, Beckham County, June 22, 1932. This old cut-off was about 15 feet wide and 100 feet long, and about 10 inches deep; the water was very foul and the bottom of slimy mud; grasses and sedges were growing around the edges, but there were no trees.

Station 20:—North Fork, near Sayre, Beckham County, June 24, 1926. The water was quite clear and shallow; there was a noticeable current.

Station 21:—Salt Fork, 11.4 miles north of Hollis, Harmon County, June 21 to 24, 1926. The water was clear, tasting a little "slick," but *not* salty; the vegetation was undeveloped, except for a little sedge growth along the banks; the bottom was of sand and mud; most of the pools were cut off; there was generally no current; the depth varied from 1 to 2 feet.

Station 22:—Gypsum Creek, 6½ miles east of Eldorado, Jackson County, June 19, 1932. The stream was from 4 feet to 100 yards wide and from 6 inches to 3 feet deep; the current was slow; the bottom of quicksand; the banks were of sand; the temperature was 25°C.

Station 23:—Sand (or Lebos) Creek, 3 miles south of Eldorado, Jackson County, June 19, 1932. This is the stream which flows through the Eldorado Salt Plains; the maximum width was 3 feet and the greatest depth 1 foot; the bottom was of quicksand; there was a considerable growth of algae in the water; the temperature was 23°C., and the water was very salty.

Station 24:—Sand (or Lebos) Creek, 3 miles east and  $\frac{1}{2}$  mile south of Hollis, Harmon County, June 21, 1926. The water was fairly clear in the shallower parts of the stream, but dark, muddy, and foul-smelling (polluted?) in the deeper nearly stagnant pools; the vegetation was scanty in the shallow water but thick in the pools; the bottom was sandy to muddy; the low but steep banks were of bare mud; the stream was lined with willows and cottonwoods; the current was moderate; the width varied from 4 to 12 feet, and the depth from 6 inches to 2 feet.

Station 25:—Red River, 6 to 9 miles southwest of Hollis, Harmon County, June 16, 1926, and June 20, 1932. The water was red and muddy and a little salty to the taste; the width varied from 20 to 100 feet, the water wandering over a sand bed more than  $\frac{1}{2}$  mile wide; the depth varied from 6 inches to 4 feet. There was no vegetation, except many sedges in pools; the bottom was of quicksand and deep soft mud; the stream was bordered by sandy shores or rocky cliffs; the pools were usually from 15 to 20 feet wide. The temperature was 24°C., and the pH 7.7, in running water after rain.

Station 26:—Buck Creek,  $7\frac{1}{2}$  miles southwest of Hollis, Harmon County; June 20, 1926. The water was clear in the creek, but black and muddy in the cut-off slough; there was practically no vegetation, except a few sedges; in the creek the bottom was mostly of sand, but in the slough it was of black mud 8 inches deep; the width of the creek where the water was flowing was from 2 to 6 feet; the slough was 35 feet by 75 feet. The pH was 7.7.

Station 26A:—Yanubbe Creek, 2 miles north of Broken Bow, McCurtain County, June 19, 1925.

Station 26B:—Tributary of Mountain Fork River, 9 miles east of Broken Bow, McCurtain County, July 7, 1925.

## IB. WASHITA RIVER

Station 27:—Crystal Cave, Sulphur, Murray County, (U. of M.), October, 1930.

Station 28:—Tributary of Saddle Mountain Creek, just east of Saddle Mountain, Comanche County, June 22, 1928. This small sluggish stream of fairly clear water was from 3 to 8 inches deep. The very low, overhanging banks were heavily covered with sedges and grass. The water temperature was 84°F., and the pH 7.4.

Station 29:—Tributary of Saddle Mountain Creek  $\frac{1}{2}$  mile north of Saddle Mountain, Comanche County, June 22, 1928. This clear creek flowed over a bottom of sand or, in some places, mud; the banks were high and steep. The stream was from 6 to 10 feet wide and averaged 18 inches in depth. The temperature was 85°F., and the pH 7.8.

Station 30:—Sugar Creek, 2 miles north and 4.2 miles west of Saddle Mountain, Kiowa County, June 22, 1928. This small stream of clear water flowed over a sandy bottom. At this date its low banks were covered with grass and other vegetation, with some rocks at the margin of the water, the depth of which was from 6 to 12 inches. The temperature was 84.5°F., and the pH 7.8.

Station 31:—Time O' Day Spring Creek (of Sugar Creek), 16 miles northwest of Cache, Wichita National Forest and Game Preserve, Comanche County, June 4, 1928. This clear little creek was fed by the nearby Time O' Day Spring, whence it flowed quite rapidly in a narrow stream 2 inches to 2 feet deep over a gravelly bottom. Occasionally it widened into deeper pools, from one of which all of the crayfish were taken. The temperature of this pool was 83°F., and the pH 7.8.

Station 32:—Time O' Day Spring Creek (of Sugar Creek), 7 miles southeast of Cooperton, Comanche County, June 24, 1932. This spring-fed stream of clear water was from 2 to 6 feet wide; the current was slow; deeper basins with rock bottoms alternated with shallow gravelly riffles.

Station 33:—Hammon, Roger Mills County.

Station 33A:—Underground river in Rock Prairie Mystic Cave, 127 feet below the surface, 6 miles east-southeast of Dougherty, Murray County, June 15, 1924.

## II. ARKANSAS RIVER SYSTEM

### IIA. SOUTH CANADIAN RIVER

Station 34:—McAlester, (of Gaines Creek), Pittsburg County.

Station 35:—Pool at the side of a railroad (during flood connected with Gaines Creek),  $\frac{1}{2}$  mile north of Bache, Pittsburg County, June 14, 1927. This was a small,

very muddy pond about 15 by 30 feet, with willows along one side. The banks were very low and muddy or grassy. The bottom was covered with decaying vegetation, and emergent sedges were very common in the water. The maximum depth was 18 inches.

Station 36:—North Fork (of Gaines Creek), 6 miles south of Wilburton, Latimer County, June 11, 1931. This creek averaged 15 to 25 feet in width; it had alternating riffles (3 to 4 feet deep) and pools (3 to 5 feet deep), with some holes 6 to 7 feet deep. Considerable vegetation was found in the pools; *Nymphaea* was common. The current was slow, except in riffles, and flowed over a bottom of mud with many boulders. The steep banks were from 6 to 10 feet high. Common trees were sycamore, white oak, black gum, and hard maple. The water was not clear. The temperature was 29°C., and the pH 6.8.

Station 37:—Section House Creek (of Gaines Creek), 5 miles southwest of Wilburton, Latimer County, July 5, 1931. (U. of M.)

Station 38:—Walnut Creek, Kainister (?) McClain County.

Station 39:—South Canadian River, 4 miles south of Norman, Cleveland County, July 21, 1926.

Station 40:—South Canadian River, ¾ miles northwest of Taloga, Dewey County, July 12, 1928. At the time of seining, the river was running close to the high east bank, which was covered with thick vegetation of grass and weeds. The water was quite muddy, and without vegetation. The bottom was of mud and sand. The specimens were taken from the main channel. The temperature was 72°F., and the pH 7.5.

## IIB. NORTH CANADIAN RIVER

Station 41:—Muddy Creek (of Deep Fork), near Okemah, Okfuskee County.

Station 42:—North Canadian River, 7 miles south of Weleetka, Hughes County, June 14, 1927. The banks were typical of the North Canadian River—gently sloping mud or sand, with willows scattered along them. The bottom of the stream where the collections were made was composed entirely of soft mud with neither emergent nor submergent vegetation. Most of the specimens were seined from a depth of 3 or 4 feet in flooded pools which slope to a maximum depth of 10 feet. The temperature of this stream averaged 73°F., and the pH was 8.0.

Station 43:—Slough (called locally Horseshoe Lake) of the North Canadian River ¾ miles east of Shawnee, Pottawatomie County, July 27, 1932. The stagnant water in this slough which was filled by recent rains, was green with algae; there was some brush in the water; the mud on the bottom was from 1 to 3 feet deep; the banks were covered with willows which overhung the water.

Station 44:—North Canadian River, 5 miles east and 1 mile north of Woodward, Woodward County, July 13, 1928. Collections were made from the main channel of the river. At the time of seining, the water was fairly clear and running close to the north bank, which was well-covered with grass and fairly steep; the south bank was very gently sloping; both banks were of sand, as was also the river bottom. There was no vegetation at all in the water, which was from 6 inches to 6 feet deep; the deepest parts were near the north bank where the current was quite swift. The river bed was several hundred feet in width, but the width of the stream in this general locality varied from about 20 to 200 feet. The temperature of the water was 80°F., and the pH 7.8.

Station 44A:—Streams and ponds in vicinity of Shawnee, Pottawatomie County, October, 1933. Collected by E. B. Webster.

## IIC. CIMARRON RIVER

Station 45:—Pond (of Barney Creek), 20 miles northwest-by-west of Orienta, Major County, July 16, 1928. This pond of very muddy water, with a mud bottom, was about 75 feet long and 20 feet wide the water varied in depth from 16 to 18 inches. The banks were very low (only 6 to 8 inches), and covered with vegetation in the water of the pond. The temperature of the water was 85°F., and the pH 7.6.

Station 46:—Sleeping Bear Creek (of Sand Creek), about 20 miles southeast of Buffalo, Harper County, July 11, 1926. This was a clear, cool stream from 10 to 15 feet wide and about 1 foot deep.

Station 47:—Cimarron River, 3 miles northwest of Kenton, Cimarron County, July 2 to 7, 1926. The water was very clear; at places where there was a noticeable

current the width was about 6 feet; the depth varied from 4 to 8 inches; the temperature was 82° to 84°F.

Station 48:—Cimarron River, 1½ miles north of Kenton, Cimarron County, July 7, 1926. This was a pond in the channel of the river, which at this point flows only in flood.

### IID. ARKANSAS RIVER

Station 49:—Arkansas River, 5½ miles southwest of Fort Smith, Arkansas, Le Flore County, July 4, 1927. This large river ranging in width from ½ to more than 1 mile wide, was "up" slightly at the time, the water was very muddy and the current quite swift. The entire bed was composed of sand and mud, and the banks proper were from 15 to 25 feet high and of unusually clean yellow sand. On top of these banks was a row of cottonwoods and some willows. Behind these trees Bermuda grass covered the sand. As it was practically impossible to seine the main stream at the time it was visited, all of the specimens were taken in cut-off pools (mainly covering old cotton fields). All of the crayfish were collected within 5 miles of the old Fort Smith. The temperature of the water at the surface of the pools was 86°F., at 5 p. m., and the pH 7.9.

Station 50:—Tulsa, Tulsa County, July 20, 1911.

Station 51:—Tulsa, (Arkansas River?), Tulsa County, July 20, 1911.

Station 52:—Arkansas River, Blackburn, Pawnee County, July 14, 1912. Collector, Dwight Isley.

Station 53:—Arkansas River, 8 miles east of Ponca City, Kay County, July, 1928.

Station 54:—Chikaskia River (of Salt Fork of Arkansas River), Tonkawa, Kay County. (Carnegie Museum).

Station 55:—Stirk Creek (of Salt Fork of Arkansas River), Tonkawa, Kay County. (Carnegie Museum).

Station 56:—Salt Fork of Arkansas River, 7 miles east and 2 miles north of Ingersoll, Alfalfa County, July 11, 1926. The water was exceedingly muddy, the stream 100 to 400 feet wide, the current swift, and the depth from 1 to 3 feet (stream in flood).

Station 56A:—Small streams near Tulsa, Tulsa County.

### III. ILLINOIS RIVER

Station 57:—Tyner Creek, 13½ miles southwest of Westville, Adair County, July 11, 1929. This was a clear stream with a fairly swift current, 6 inches to 3 feet deep, flowing over a gravel bottom obstructed by some brush but no vegetation. The grassy banks were from 3 to 10 feet high.

Station 58:—Courthouse (or Peach-eater) Creek (of Barren Fork), 9 miles southwest of Westville, Adair County, July 11, 1929. The water of this stream was very clear, from 6 inches to 3 feet deep, and from 8 to 26 feet wide. It flowed swiftly over a clean gravel bottom. There was some brush in the water, but neither submergent nor emergent vegetation. The sloping banks were only 2 to 3 feet high. The temperature of the water was 26°C., and the pH 7.6.

Station 59:—Illinois River, near Tahlequah, Cherokee County, August 21, 1911.

### IIF. NEOSHO RIVER

Station 60:—Fourteen Mile Creek, McBride Switch (McBride), Cherokee County, July 27, 1911.

Station 61:—Wagoner, Wagoner County, August 2, 1911.

Station 62:—Honey Creek, 8 miles south of Grove, Delaware County, July 16, 1929. The water of this stream was clear and flowing fairly swiftly over the gravel bottom. The depth varied from 6 inches to 8 feet, and the width from 10 to 20 feet. Willows were growing in the water. The temperature was 20°C., and the pH 7.8.

Station 63:—Sycamore Creek, 3 miles east of Wyandotte, Ottawa County, July 18, 1929. This was a clear stream varying from 2 inches to 3 feet in depth, and from 6 to 15 feet in width, flowing over a bottom of gravel or mud, between banks 2 to 3 feet high. There was no vegetation in the water. The water temperature was 23°C., and the pH 7.4.

### II. VERDIGRIS RIVER.

Station 65:—Verdigris River, Inola, Rogers County, August 19, 1911.

Station 66:—Hominy Creek, 8 miles west of Skiatook, Osage County, July 16, 1927. The width of this clear stream was from 16 to 50 feet, with shale or sand and mud banks. The water was from 6 inches to 3 feet in depth, clear but with a noticeable film of oil. All vegetation in and near the stream had been killed. Oil was also plainly visible upon all dead tree trunks along the banks. The water was distinctly salty to the taste. Along the stream as far as examined bubbles of natural gas were seen emerging from the clean sand bottom. The pH was 8.2.

Station 67:—Verdigris River, 5 miles west of Claremore, Rogers County, July 15, 1927. This river was from 200 to 300 feet in width with mud banks from 20 to 30 feet high, at an angle of about 45 degrees. This condition was not at all typical, since the stream was "up" several feet.

Station 68:—Verdigris River, Rogers County, August 19, 1911. (Carnegie Museum).

### III. POTEAU RIVER

Station 69:—Poteau River, 4 miles south and 5 miles west of Fort Smith, Arkansas, Le Flore County, July 4, 1927. The Poteau here was a fairly large stream, averaging 150 feet in width. The current of the muddy water was moderate. The banks were 10 to 15 feet in height, nearly perpendicular, and overhung with bushes and trees. All of the specimens were taken within 5 miles of the original Fort Smith. The temperature was found to be 90° F. at the surface at 3 p. m. and the pH 7.5.

Station 70:—Stream 4¼ miles northeast of Wister, Le Flore County, July 7, 1921. (U. of M.)

Station 71:—Wister, Le Flore County, July, 1912.

Station 72:—5 miles east of Fanshawe, Le Flore County, July 7, 1931. (U. of M.)

Station 73:—5½ miles east of Fanshawe, Le Flore County, July 7, 1931. (U. of M.)

Station 74:—Brazil Creek, 3 miles north of Red Oak, Latimer County, June 14, 1927, and June 14, 1931. The stream was composed of alternating pools with very muddy bottoms and riffles of clean gravel. The banks of the stream were either steep mud or gravel. The depth varied from less than 1 foot in the riffles to a maximum of 5 feet in the deeper parts of the pools. In the rapidly flowing parts of the stream no vegetation was noticeable. However, *Nymphæa* was common in the pools and in the many cut-offs. The temperature of this stream was 70°F. at 4 p. m., and the pH 6.9.

Station 75:—Lake Wilson (of Fourche Maline), 4 miles northwest of Wilburton, Latimer County, June 17, 1931. This artificial lake covered 6 or 7 acres, and was as deep as 12 feet in the old channels; its water was quite muddy. The west and northwest sides were marshy; the east side was dammed. Many dead trees (willows, persimmons, and sycamores) were in the water, partially submerged. The bottom was of clay; there were no rocks. This stream through a small tributary is still connected with the Fourche Maline near State Highway 43. The temperature was 28°C., and the pH 6.6.

Station 76:—2 miles west of Wilburton. (of Fourche Maline), Latimer County, July 6, 1931. (U. of M.)

Station 77:—Pond (of Fourche Maline Creek), 2 miles west of Wilburton, Latimer County, July 5, 1931. (U. of M.)

Station 78:—Cunneo Tubby Creek (of Fourche Maline Creek), 2¼ miles north of Wilburton, Latimer County, August 6, 1932.

Station 79:—Cunneo Tubby Creek (of Fourche Maline Creek), 4 miles north-east of Wilburton, Latimer County, July 6, 1931. (U. of M.)

Station 80:—Pools along roadside (of Fourche Maline Creek), 5 miles north of Wilburton, Latimer County, July 4, 1931. (U. of M.)

Station 81:—3½ miles north of Wilburton (of Fourche Maline Creek), Latimer County, July 4, 1931. (U. of M.)

Station 82:—Pond (of Fourche Maline Creek), on college campus, Wilburton, Latimer County, June 17, 1931. The water of this pond covering 2 or 3 acres was muddy and of a maximum depth of 5 feet. Along its edge were found grasses and some sedges. The temperature was 37°C., and the pH 7.6.

Station 83:—Little Fourche Maline Creek (of Fourche Maline Creek), 5½ miles east of Wilburton, Latimer County, June 16, 1931. This rapidly flowing clear stream

was made up of alternating riffles and pools, and averaged in width about 10 feet. The bottom was of gravel and boulders, with some algae growing on the boulders. Many dead leaves and a few logs were present in the stream. The temperature was 24°C., and the pH 6.0.

Station 84:—Fourche Maline Creek, 1½ miles east of Wilburton, Latimer County, June 16, 1931. This was a clear stream flowing slowly except in late summer. The bottom was mainly of rock; the water varied from 2 to 6 feet in depth. The banks were covered with vegetation and were not steep.

Station 85:—Tributary of Fourche Maline Creek, 1½ miles east of Wilburton, Latimer County, June 16, 1931. The depth of the water varied from 1 to 4 feet; the stream was fed mostly by drainage from the mountain sides; most of the water not received in this way was back water from the main stream. The bottom was rocky and the banks were steep; the current when any water was flowing was slow; there was no flow of water during any dry periods of weather.

Station 86:—Bandy Creek (of Fourche Maline Creek), 1 mile south of Wilburton, Latimer County, June 12, 1931. The collection was made in the deeper parts of this small creek. The width at the place of collection was about 15 feet, and the depth from 3 to 4 feet. The water was fairly clear, and the current slow.



FIGURE 14. DISTRIBUTION OF *CAMBARUS NAIS* IN OKLAHOMA



FIGURE 15. DISTRIBUTION OF *CAMBARUS IMMUNIS*, *C. CLYPEATUS*, *C. GRACILIS*, *C. DIFFICILIS*, AND *C. NEGLECTUS* IN OKLAHOMA.

## IV. LIST OF SPECIES

## FAMILY ASTACIDAE

## GENUS CAMBARUS

1. *CAMBARUS NEGLECTUS* Faxon

FIGS. 9, 15, 23.

*Cambarus neglectus* Faxon, Bull. Washburn Col. Lab. Nat. Hist., 1, (4), 1885, p. 142.

STATIONS: 57, 58, 59, 62, 63.

**DIAGNOSTIC CHARACTERS:** Rostrum with faint elevation above. Limits of areola poorly defined. Fingers short, blunt, thick, curved, meeting only at tips, palm deeply pitted. Fingers with conspicuous black ring near apex. Carapace with conspicuous black bars running obliquely along the sides. Spine present on side of carapace. Hooks on third pair of legs in the male.

**COLOR:** This species is one of exceptional beauty. The general body color is yellow. The fingers are tipped with orange and posterior to this is a prominent black ring. The outer margin of the palm and immovable finger has a black streak extending the entire distance. The cephalothorax has two oblique black bands on the posterior section. The dorsal one of these unites above at the posterior margin of the carapace with the band from the opposite side. Each pleura has a black oblique streak on the anterior margin near the point of articulation. This color pattern is a unique and valuable diagnostic character.

**ECOLOGY:** *C. neglectus* lives in streams and rivers in the usual manner under rocks and boulders. It is extremely abundant wherever it occurs and it seemingly prefers those streams and rivers with clear water and a rather strong current.

**RANGE:** This species is found in the White River drainage in Missouri; Neosho and Grand River drainage in Missouri, Kansas and Oklahoma; Republican River drainage in Kansas and Colorado; and the South Platte River drainage in Colorado. Faxon also records this crayfish from the Red River at Arthur, Lamar County, Texas.

**DISTRIBUTION IN OKLAHOMA:** In Oklahoma this crayfish has been taken in Cherokee, Johnston, and Atoka counties. It occurs in the Red River and Arkansas River drainage areas. (Fig. 15.)

2. *CAMBARUS NAIS* Faxon

FIGS. 10, 14, 24.

*Cambarus nais* Faxon, Bull. Washburn Col., 1, (4), 1885, pp. 140-141.*Cambarus pilosus* Hay, Proc. U. S., Nat. Mus. 22, 1899, pp. 121-122.

STATIONS: 7, 12, 28, 30, 47, 52, 54, 55, 60, 61, 64, 65, 66, 67.

**DIAGNOSTIC CHARACTERS:** Rostrum with lateral spines. Areola narrow but distinct. Chelae broad and flattened. Immobile finger usually densely bearded within at base. Horny tip of first-form sexual appendage less than one-half total length of appendage; both tips gently curved in same direction. Hooks present on third pair of walking legs in the male.

**COLOR:** Color usually a greenish-brown in old specimens but greenish in newly-moulted specimens.



**ECOLOGY:** This species has been found in a wide range of ecological habitats. We have taken it in slowly-moving muddy, vegetation-choked waters as well as in clear, swiftly-moving waters.

**RANGE:** The distribution of this much-confused species appears to be the Great Plains area and the Ozark region, west of the Mississippi River. The major drainage areas occupied by this species are those of the Missouri and Arkansas rivers.

**DISTRIBUTION IN OKLAHOMA:** This species occurs in all the major drainage areas in the State except the Canadian River from which we have seen no specimens. (Fig. 14.)

### 3. *CAMBARUS IMMUNIS* Hagen

FIGS. 7, 8, 15, 25.

*Cambarus immunis* Hagen, Ill. Cat. Mus. Comp. Zool., 2, 1870, p. 71.

**STATION:** 41.

**DIAGNOSTIC CHARACTERS:** Rostrum sometimes with, sometimes without lateral spines. Chelae bearded within at base of immovable finger. Movable finger with incision at base. Arcola narrow. Sexual appendage with tips recurved at nearly right angles to the basal part. Annulus ventralis of female with deep median fossa running deeply to the right (ventral view with the head up). Hooks on third pair of walking legs in the male. Carapace with lateral spines.

**COLOR:** Color usually green, occasionally brownish with design on abdomen formed by a lighter color.

**ECOLOGY:** This species prefer slowly-moving streams, ponds, or lakes with muddy bottoms and with an abundance of vegetation. In Michigan, females with eggs have been taken in November and in the early spring as late as April. Some specimens of this species collected at Fargo, North Dakota, on June 6, 1926, included females with eggs.

**RANGE:** Colorado, Oklahoma, Kansas, Missouri, Nebraska, Iowa, Wyoming, North Dakota, Minnesota, Wisconsin, Illinois, Indiana, Ohio, Michigan, Ontario, New York and Massachusetts.

**DISTRIBUTION IN OKLAHOMA:** Specimens from Oklahoma are known only from "Muddy Creek, near Okemah, Okfuskee County." They were collected January 14, 1928, by Professor J. G. Mackin. (Fig. 15.)

### 4. *CAMBARUS LONGIMANUS* Faxon

FIGS. 4, 16, 26.

*Cambarus palmeri longimanus* Faxon, Proc. U. S. Nat. Mus., 20, 1898, p. 655.  
*Cambarus (Faxonius) palmeri* (in part) Ortmann, Proc. Amer. Philos. Soc., 44, 1905, p. 113.

**STATIONS:** 1, 2, 3, 4, 5, 6, 11, 35, 36, 38, 68, 70, 72, 74, 75, 78, 79, 80, 82, 83, 84, 85, 86, 26A, 56A.

This species exhibits characters in the chelae and sexual appendage which are sufficiently different from those of *palmeri* (a species found in Arkansas and Tennessee) to warrant specific ranking for *longimanus*.

**DIAGNOSTIC CHARACTERS:** Arcola linear (obliterated). Normal chelae exceptionally long (as long as carapace). Rostrum with well-defined terminal and lateral spines. Sexual appendage gently curved, reaching to base of second pair of walking legs when the abdomen is flexed. Hooks on third pair of walking legs in the male. Cephalothorax with lateral

spines. Annulus ventralis rounded; anterior margin depressed, sinus simple and straight, terminating in the small longitudinal, anteriorly situated fossa.

**VARIATION:** Regenerated chelae in all forms with fingers proportionally longer than in normal chelae and with opposed margins meeting throughout the entire length instead of gaping.

**COLOR:** This species is conspicuously colored. The fingers are tipped with orange, preceded by a band of dark blue. The palm is spotted with dark blue in contrast to the olive green color which is the characteristic hue of the cephalothorax and abdomen.

**ECOLOGY:** In the vicinity of Wilburton, Oklahoma, this species was not found in the shallow muddy prairie streams but rather in those streams with flowing water and stony and rocky beds. This crayfish was taken in the usual manner under the rocks. It was also taken from muddy overflow ponds adjacent to the main stream. In a mountain stream near Wister, Oklahoma, we found this species in shallow burrows in the bank of the stream beneath the water.

**RANGE:** This species is known from the Ouachita River drainage in southwestern Arkansas; the Arkansas River drainage in central and western Arkansas and northeastern Oklahoma; and the Red River drainage of Oklahoma, Texas, and Arkansas.

**DISTRIBUTION IN OKLAHOMA:** This crayfish occurs in the Fourche Maline, Verdigris and Kiamichi River systems in the eastern and southeastern section of the State. (Fig. 16.)

5. *CAMBARUS DIFFICILIS* Faxon

FIGS. 5, 15, 27.

*Cambarus difficilis* Faxon, Proc. U. S. Nat. Mus., 20, 1898, p. 656.

STATIONS: 34, 86.

**DIAGNOSTIC CHARACTERS:** Areola linear (obliterated). Chelae shorter than carapace. Sexual appendage reaching to base of third pair of walking legs when abdomen is flexed. Horny tip of first-form sexual appendage flattened at apex; inner tip recurved more than outer tip. Hooks

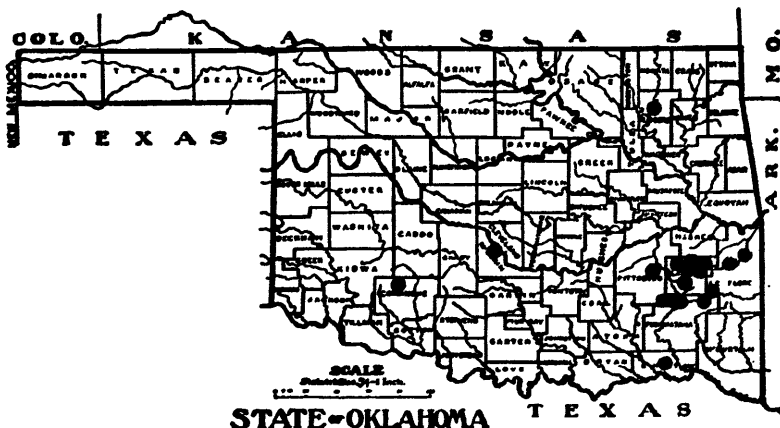


FIGURE 16. DISTRIBUTION OF *CAMBARUS LONGIMANUS* IN OKLAHOMA.

on third pair of walking legs in the male. Annulus ventralis of female with small central fossa (cavity) towards posterior margin.

**ECOLOGY:** The ecological peculiarities of this species are not known.

**RANGE:** This is a local species known only from the Oklahoma records. It apparently occurs only in the Canadian River system.

**DISTRIBUTION IN OKLAHOMA:** Faxon's types were obtained in a creek tributary to the south branch of the Canadian River at McAlester, Pittsburg County, Oklahoma. In addition this species is now known from Bandy Creek, 1 mile south of Wilburton, Latimer County, Oklahoma. (Fig. 15.)

## 6. *CAMBARUS CLYPEATUS* Hay

FIGS. 13, 15, 28.

*Cambarus clypeatus* Hay, Proc. U. S. Nat. Mus., 22, 1899, pp. 122-123.

**DIAGNOSTIC CHARACTERS:** Rostrum without lateral spines. Areola broad. Cephalothorax laterally compressed. Chelae with inflated palm; fingers slender, weak. Sexual appendage with horny outer tip recurved inward and resting across horny tip of appendage of other side; inner tip short and situated at mid-length on inner side of long outer tip. Third pair of walking legs with hooks which are long and pointed in first-form specimens. Annulus ventralis of female subcircular with two tubercles along raised anterior wall which is divided by the fossa; fossa transverse posterior to tubercles.

**COLOR:** In life his species is a dark greenish brown with a darker brown pattern on the abdomen. The abdominal design consists of a median brown line and two lateral ones on the pleurae.

**ECOLOGY:** This species frequents bogs and has also been taken in muddy roadside pools. Doubtless it is a burrower.

**RANGE:** Mississippi, Louisiana, and Oklahoma.

**DISTRIBUTION IN OKLAHOMA:** In the Carnegie Museum there is a single male specimen of this species labelled Wister, Choctaw Nat., Oklahoma. This is now in LeFlore County. (Fig. 15.)

## 7. *CAMBARUS DIOGENES* Girard

FIGS. 2, 29.

*Cambarus diogenes* Girard, Proc. Acad. Nat. Sci. Phila., 6, 1852, p. 88.

*Cambarus obesus* Hagen, Ill. Cat. Mus. Comp. Zool., 3, 1870, p. 81.

**STATION:** 26A.

**DIAGNOSTIC CHARACTERS:** Carapace higher than broad. Chelae broad and stout. Areola linear, obliterated. Rostrum without lateral spines. Hooks on third pair of walking legs in the male. Sexual appendage with two tips curved at right angles to the basal shaft. Cephalothorax without lateral spines. Eye small.

**ECOLOGY:** This crayfish is a burrower and is found in open water only during the breeding season in early spring (in the western part of its range). The burrows are usually built along rivers or streams or in sloughs. Chimneys are frequently built by the crayfish around the entrance of the burrow. The burrows of this crayfish are sometimes used as an abode for other crustaceans. Amphipods, ostracods, and copepods have been found in the pocket containing water at the end of the bur-

row. Female specimens with eggs have been taken in Indiana as early as the middle of April. A female with young was taken in Michigan in June.

RANGE: Wyoming, Colorado, Kansas, Arkansas, Missouri, Iowa, Minnesota, Wisconsin, Illinois, Indiana, Ohio, Michigan, Ontario, New York, Pennsylvania, New Jersey, Maryland, West Virginia, Virginia, North Carolina, Alabama, Mississippi, and Oklahoma.

DISTRIBUTION IN OKLAHOMA: This species is known only from collections from Yanubbe Creek, a tributary of Little River, 2 miles north of Broken Bow, McCurtain County.

#### 8. *CAMBARUS SETOSUS* Faxon

FIGS. 6, 30.

*Cambarus setosus* Faxon, Bull. Mus. Comp. Zool., 17, 1889, p. 237.

DIAGNOSTIC CHARACTERS: Blind. Integument white. Chelae long and narrow. Body depressed. Areola narrow but not obliterated. Fine setae present on abdomen and chelae. First form sexual appendage with tips recurved at an acute angle with main stalk. Antennal scale widest anteriorly.

ECOLOGY: This species lives in subterranean caverns. In Smallen Cave in Christian County, Missouri, it is quite plentiful. Here it can be seen crawling along the bottom in the clear cool pools. When disturbed it darts upward until it reaches the surface, then it swims near the surface to the shore where it may dart into a crevice.

RANGE: This blind crayfish occurs commonly in the caves and subterranean streams in Jasper County, Missouri. We have also taken it in Smallen Cave in Christian County, Missouri. Steele (1902, pp. 18-19) has described another blind crayfish (*Cambarus ayersii*) from Fisher's Cave near Springfield, Missouri. The validity of this latter species remains questionable in view of the great variation in *C. setosus*.

DISTRIBUTION IN OKLAHOMA: Although this species has not been taken in Oklahoma it may occur here in the extreme northeastern part of the State.

#### 9. *CAMBARUS BLANDINGII ACUTUS* Girard

FIGS. 11, 17, 31.

*Cambarus acutus* Girard, Proc. Acad. Nat. Sci. Phila., 6, 1852, p. 91.

*Cambarus blandingii acuta* Faxon, Proc. Amer. Acad. Arts and Sci., 20, 1884, p. 136.

STATION: 1, 2, 4, 34, 37, 38, 42, 43, 44, 49, 50, 51, 67, 69, 71, 73, 74, 76, 81, 82, 84, 26B, 44A, 56A.

DIAGNOSTIC CHARACTERS: Chelae long and subcylindrical with scale-like tubercles above. Areola depressed, smooth, narrow. Carapace granulate. Third and fourth walking legs of male with hooks. Lateral spines of rostrum minute and situated near the terminal spine. Inner part of male sexual appendage terminating in an oblique, outwardly-directed spine. Outer part with three teeth and a row of setae. Annulus ventralis of female broad and bituberculate.

COLOR: This species is frequently a red color which is particularly conspicuous on the abdominal segments. The margins of the rostrum and the granules are often greenish in newly-moulted individuals.

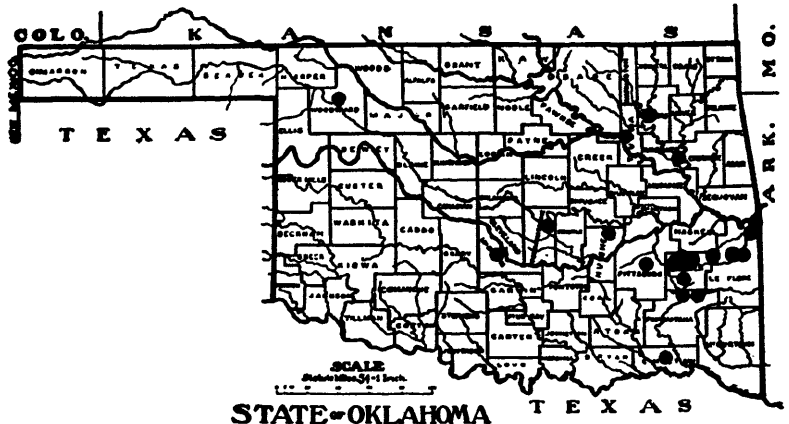


FIGURE 17. DISTRIBUTION OF *CAMBARUS BLANDINGSH ACUTUS* IN OKLAHOMA

**ECOLOGY:** This crayfish frequents stagnant water. Bogs, slowly-moving streams and rivers and ponds are its favorite habitat. Sometimes this crayfish builds a shallow burrow when the water-level falls in the ponds during dry seasons. Females with eggs have been found during March, July and September. This is unusual since ovigerous females usually occur only during some definite season depending on the species.

**RANGE:** The exact limits of the range of this subspecies (if it is a true geographical subspecies) cannot be given at this time. It is however now known from Michigan, Ohio, Indiana, Illinois, Wisconsin, Iowa, Missouri, Arkansas, Kansas, Oklahoma, Tennessee and, curiously enough, from the state of Vera Cruz, Mexico.

**DISTRIBUTION IN OKLAHOMA:** This species has been taken in the following drainage areas in Oklahoma: Kiamichi River, Poteau and Fourche Maline Rivers, Canadian River, Arkansas River, and Verdigris River. With the exception of a record from Lucien in Woodward County all the specimens have been obtained in the eastern third of the State. (Fig. 17.)

#### 10. *CAMBARUS SIMULANS* Faxon

FIGS. 12, 18, 32.

*Cambarus simulans* Faxon, Proc. Amer. Acad. Arts and Sci., 20, 1884, p. 112.

*Cambarus gallinus* Cockerell and Porter, Proc. Acad. Nat. Sci. Phila., 1900, p. 434.

**STATIONS:** 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 39, 40, 42, 45, 46, 47, 48, 49, 53, 56, 67, 76, 77, 82, 26A, 33A, 44A.

**DIAGNOSTIC CHARACTERS:** Lateral spines of rostrum minute or wanting. Chelae with scale-like tubercles above. Carapace sparsely granulate on the sides. First-form male sexual appendage with a disk-shaped protuberance and two other spines at apex of outer part and with a slender inner part exceeding the outer horny tips. Hooks on third pair of walking legs in the male. Annulus ventralis of female with raised anterior border.

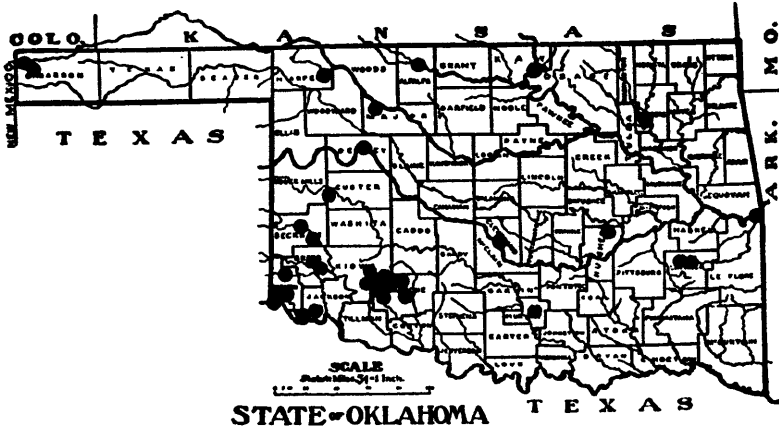


FIGURE 18. DISTRIBUTION OF *CAMBARUS SIMULANS* IN OKLAHOMA.

**ECOLOGY:** This crayfish lives in much the same ecological situations as *C. blandingii acutus*. It seems particularly fond of muddy streams and ponds. When these ponds dry during mid-summer the crayfish resort to burrows. This species is not essentially a burrowing species, however. Females with eggs were found in Oklahoma in early September, 1933. These eggs hatched, September 13, 1933. Young were also found in October in Oklahoma. (Station 44A.)

**RANGE:** Arkansas, Oklahoma, Texas, Kansas, New Mexico, and Colorado.

**DISTRIBUTION IN OKLAHOMA:** This species is the one most frequently encountered in Oklahoma. It has been taken in all the major drainage areas in the State. (Fig. 18.)

### 11. *CAMBARUS GRACILIS* Bundy

FIGS. 3, 15, 33.

*Cambarus gracilis* Bundy, Bull. Ill. State Lab. Nat. Hist. 1, 1876, p. 5.

#### STATION 8.

**DIAGNOSTIC CHARACTERS:** Chelae broad, flattened, fingers curved slightly downward. Rostrum without lateral spines, sides subparallel, suddenly contracted to form short acumen (tip). Carapace higher than broad. Areola obliterated. Abdomen much shorter than cephalothorax and narrow. Inner part of first-form male sexual organ terminating with straight acute spine. Posterior tooth of outer part flattened and disk-shaped. Third walking legs of male with hooks. Annulus ventralis of female movable, with raised anterior margin; the sinus in ventral aspect with the head up, curved to left, terminating at anterior median edge.

**ECOLOGY:** *Cambarus gracilis* is a burrowing species. Its burrows are frequently found long distances from surface water. This crayfish digs burrows sometimes six feet deep before reaching the water level. When it reaches the water level, the crayfish digs an enlarged pocket and here it lives most of the time. During rainy periods and also at night it leaves the burrow for repair or deepening of its home or for feeding. This species

probably also leaves the burrow to breed but this phase of its life is not known. Females with young have been found in October.

RANGE: Oklahoma, Kansas, Missouri, Iowa, Illinois, and Wisconsin.

DISTRIBUTION IN OKLAHOMA: Professor J. G. Mackin has taken this crayfish at Connorville in Johnston County. (Fig. 15.)

#### FAMILY PALAEMONIDAE

First two pairs of legs chelate. Pleura of first abdominal segment overlapped by those of the second. Abdomen with a sharp bend. Rostrum armed with teeth, immovable, long and compressed. Mandibles deeply cleft. Gills developed as phyllobranchiae (gills with two rows of broad flat lamellae).

The members of this family of crustaceans are mostly marine but there are five species found in the fresh waters of the United States.

#### GENUS PALAEMONETES

Both pair of legs approximately the same size. Rostrum with teeth above and usually below. First antennae triflagellate. Second antennae with one flagellum. Mandibles without palp.

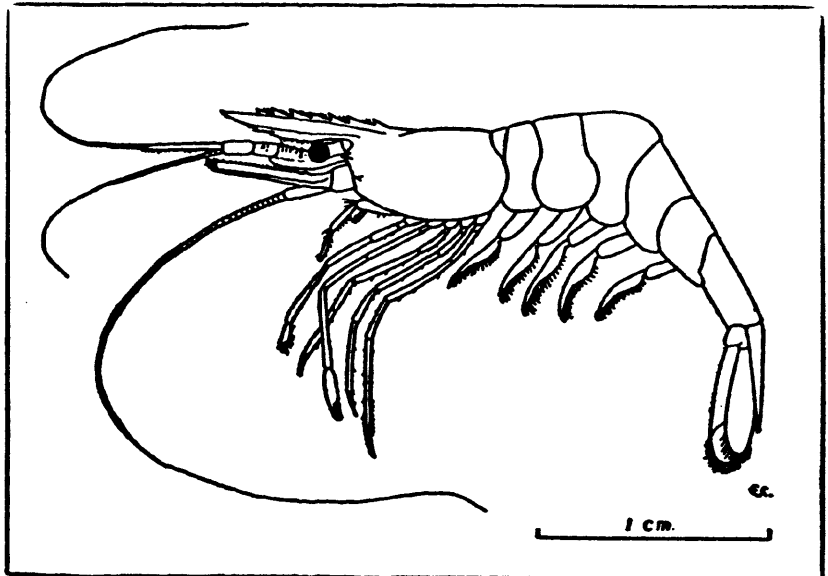


FIGURE 19. *PALAEMONETES EXILIPES*

*PALAEEMONETES EXILIPES* Stimpson

*Palaemonetes exilipes* Stimpson, Ann. Lyc. Nat. Hist. New York, 10, 1871, p. 130.

**DIAGNOSTIC CHARACTERS:** Fifth walking leg exceeding rostrum. Antennae longer than body. Antennules triflagellate, shortest flagellum closely attached to longest and free for but a short distance. Flagellum of antennules with fused part much longer than free part of shortest ramus. Antennal scale reaching to a point even with apex of rostrum. Rostrum long, vertical, armed above with 6 to 8 teeth and below with 1 to 3. Second dorsal tooth of rostrum usually above base of eye stalk. Carapace rounded above, branchiostegal and hepatic spine present. Abdomen abruptly curved at end of third segment.

**COLOR:** In life these shrimp are nearly transparent.

**ECOLOGY:** These shrimp are often very abundant in slowly-moving rivers and streams. In overflow ponds of rivers they frequently are found in great numbers. Oviparous females have been taken in April, June, July, August, and September. The largest females frequently have as many as 50 eggs. These little crustaceans are scavengers and they eat decaying vegetation as well as dead animals.

**RANGE:** Iowa, Wisconsin, Michigan, Ontario, New York, Pennsylvania, Ohio, Indiana, Illinois, Kentucky, Tennessee, Arkansas, Oklahoma, Texas, Nuevo Leon, Louisiana, Mississippi, Alabama, Florida, Georgia, South Carolina, North Carolina, Virginia, District of Columbia, and Maryland.

**DISTRIBUTION IN OKLAHOMA:** Specimens of this shrimp were secured by the University Biological Survey in the Poteau River in Le Flore County on July 4, 1927 (Station 69). The river five miles southwest of Fort Smith, Arkansas, where the collection was made, is characterized as follows: The banks of the river are nearly perpendicular and from ten to fifteen feet high. The river here has a moderate current and average 150 feet in width. The temperature on August 4, 1927, was 90°F., and the pH 7.5. Specimens have also been taken in the Kiamichi River drainage in the southeastern section of Pittsburgh County. Here it was taken on June 19, 1931, in the North Fork of Jackfork, 4 miles east of Weathers (Station 6). One of the specimens obtained here is an oviparous female.

## V. MISCELLANEOUS NOTES ON OKLAHOMA DECAPOD CRUSTACEANS

Faxon in 1890 described *Cambarus dubius* as occurring in the Indian Territory. This record he acknowledged as wrong in his publication of 1914 (p. 396).

At the present time there is reason to believe that the list presented here is not complete. An undescribed species is known to occur in Arkansas and the same drainage area extends for a short distance into Oklahoma. We have also seen a single male specimen of a species not known to us from the vicinity of Guymon in Texas County.



## VI. GLOSSARY

Annulus ventralis.....	An elevation between the fifth pair of walking legs of the female. It is used as a sperm receptacle.
Carina.....	A ridge running lengthwise on the upper surface of the rostrum.
Cephalothorax.....	The solid front part of the animal's body covered by a continuous chitinous shield. The cephalic groove divides it into an anterior and a posterior section. Also called the carapace.
Fossa.....	A cavity, pit, or depression.
Obliterated areola.....	Areola limited to posterior and anterior triangular fields by the fusion of the lines (branchio-cardiac lines) on the cephalothorax.
Pleura.....	The side of an abdominal segment.
Sexual organ.....	The modified first abdominal appendage of the male. Each species has two forms of this organ designated as first and second forms.
Sinus.....	An elongated groove.

## VII. LITERATURE

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