Crustacea In Eastern Kansas

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Abstract

Twenty-nine species of Crustacea, exclusive of the crayfishes, are reported from temporary and permanent bodies of water within a 2½ mile radius of Lawrence, Douglas County, in eastern Kansas, where the topography is characterized by low, rocky hills, dissected by small temporary or permanent streams, well-drained slopes, and broad, poorly-drained floodplains. Trees such as oaks, hickorys, black walnut, elms, locust, cottonwood and others cover the hills while the slopes and floodplains generally support a cover of mixed grasses and herbs. The unevenly distributed annual rainfall varies between 35 and 45 inches, the greater part of which occurs in the spring and fall. Summers are frequently hot and dry.

Small pools in roadside ditches, along railroad fills, in drainage canals in floodplains and in pastures and woodlands are of frequent occurrence; these pools are richly supplied with vegetation which makes excellent culture media for small crustacean animals.

The following species, listed by orders, were found living in eastern Kansas; those names marked with an asterisk are new records for the state. Anostraca: *Streptocephalus texanus, *Streptocephalus sealii, Thamnocephalus platyurus, *Eubranchipus serratus;* Conchostraca: **Caenestheriella belfragei;* Cladocera: **Daphnia pulex, *Daphnia longispina, *Scapholeberis mucronata, *Simocephalus vetulus, *Simocephalus serrulatus, *Ceriodaphnia reticulata, *Moina rectirostris, *Bosmina longirostris, *Chydorus sphaericus, *Kurzia latissima, *Leydigia quadrangularis, *Pleuroxus denticulatus;* Podocopa (subclass Ostracoda) : **Cypridopsis vidua, *Physocpria pustulosa;* Eucopepoda (subclass Copepoda) : *Diaptomus clavipes, *Cyclops bicuspidatus thomasi, *Cyclops vernalis, *Eucyclops agilis, *Attheyella illinoisensis, *Microcyclops varicans, *Macrocyclops albidus;* Isopoda: **Mancasellus ? sp., Caecidotea tridentata, *Armadillidium vulgare;* Amphipoda: **Hyalella knickerbockeri.*

Introduction

The twenty-nine kinds of Crustacea, exclusive of the crayfishes, here reported from eastern Kansas are from an area where the topography is characterized by low, rocky hills dissected by small temporary or permanent streams, well-drained slopes, and broad, poorly-drained floodplains. Oaks,

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hickorys, maples, black walnut, elms, locust, cottonwood and other trees cover many of the hills, while the slopes and floodplains generally support a cover of mixed grasses and herbs. The annual rainfall varies between 35 inches and 45 inches, but precipitation is not evenly distributed throughout the year. The greater part of the total annual precipitation occurs in the spring and fall; the summers are frequently hot and dry.

Under these conditions, small pools in roadside ditches, along railroad fills, in drainage canals in floodplains, and in pastures or woodlands, are of frequent occurrence, although many are ephemeral, and may disappear during the greater part of the year. Since vegetation grows abundantly in these pools during relatively dry periods, the plant material provides an ideal culture medium for bacteria, protozoa, algae, and other planktonic organisms when the pools fill with water in periods of rainfall (plate I).

We are indebted to the following specialists for their kindness in verifying identifications of Crustacea found in eastern Kansas: Dr. John L. Brooks, Dr. Ralph W. Dexter, Mr. Melville Hatch, Dr. C. Clayton Hoff, Dr. Leslie Hubricht, Dr. J. G. Mackin, Dr. Willard G. Van Name and Dr. Harry C. Yeatman.

The earliest reports of microcrustacea in Kansas date as far back as the early 80's of the last century. At that time Packard (1883) published, as a part of Hayden's twelfth report of the United States geographic and geological survey of the territories, a monograph of the phyllopods of North America. Packard (1883: 295) states, "The Phyllopod Crustacea are especially characteristic of the western plains of our Territories, where the most striking and typical forms abound, one entire family (Apodidae) not occurring east of the western edge of the Mississippi Valley, while the most bizarre member of the entire group, the *Thamnocephalus,* lives in pools on the plains of Kansas". Packard obtained specimens of the following phyllopods from Dr. L. Watson of Ellis, Kansas: *"Lynceus brevifrons, L. mucronatus, Leptestheria compleximanus, Eulimnadia texanus, Apus aequalis, A. lucasanus, A. obtusus, Streptocephalus texanus* and *Thamnocephalus platyurus. Cyzicus mexicana, Eulimnadia texanus* and *Branchinecta lindahli"* were obtained from Professor Joshua Lindahl, Fort Wallace, Kansas. Hungerford (1922: 175-181) reported a new species of *Caecidotea* in eastern Kansas. Underwood (1886: 325) sensing the need for correlation of the scattered literature on the subject of the freshwater Crustacea of America, made an index of the described species of Crustacea of America, north of Mexico. Kansas was credited with eleven species of phyllopods, all of which had been reported by Packard


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(1883) as having been received from Dr. L. Watson and Professor Joshua Lindahl.

For the most part, materials used in this study were collected from temporary and permanent bodies of water within a radius of two and one-half miles from Lawrence, Douglas County, in eastern Kansas. Within the period of February 1947 to May 1948, some thirty bodies of water, mostly temporary in nature, were studied. During the vernal and autumnal seasons weekly to semi-weekly visits were made to these pools and Crustacea taken from them.

Tools used in making collections and recording data were an ordinary dip net, a pond-life dip net of silk bolting cloth and plankton towing net of the same material, a Birge cone net, minnow seine, water dipper, two ounce vials, collecting jars and two and one-half gallon galvanized bucket, hand magnifying glass, centrigrade thermometer, camera, notebook and 5" by 8" cards. The dip nets and towing net were used for collecting the smaller form. and the minnow seine for collecting large forms such as *Thamnocephalus.* A two ounce vial was attached to the plankton towing net and when filled with organisms after several sweeps of the net through the water, was removed and capped with a screw top. The collecting jars were one or two quart sizes and were used for transporting collected specimens from the field to the laboratory.

Specimens brought into the laboratory were examined, recorded and

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PLATE I

Fig. 1. Potter's lake on University of Kansas campus 6 feet deep; open water surrounded by ice and snow, January, 1948; Daphnia pulex, Simocephalus vetulus, S. serrulatus, Scapholeberis mucronata, Bosmina longirostris, Chydorus sphaericus, Cyclops vernalis, hyalella knickerbockeri common inhabitants.

Fig. 2. A railroad fill ditch 2½ miles SE of Lawrence, Kansas; 2 feet deep, May, 1948 Eubranchipus serratus, Daphnia pulex, Cyclops vernalis, C. bicuspidatus thomasi, Eucyclops agilis, Mancasellus ? sp. common inhabitants.

Fig. 3. A drainage ditch 2¼ miles NE of Lawrence, Kansas; 6 feet deep May, 1948; Streptocephalus texanus, S. seam, Thamnocephalus platyurus, Eubranchipus serratus, Caenestheriella belfragei, Daphnia pulex, Diaptomus clavipes common inhabitants.

Fig. 4. A railroad fill ditch 2 miles north of Lawrence, Kansas; **4** feet deep; May, 1948; Daphnia pulex, Scapholeberis mucronata, Cyclops vernalis, Eucyclops agilis common inhabitants.

Fig. 5. Roadside ditch 2½ miles SE of Lawrence, Kansas, dry from June, 1947 to September, 1947, same as fig. 6.

Fig. 6. Roadside ditch 24 miles SE of Lawrence, Kansas, 30 inches deep, May, 1948; Streptocephatus sealii, Caenestheriella belfragei, Eubranchitus serratus, Daphnia pulex, Ceriodaphnia reticulata, Cyclops vernalis, C. bicuspidatus thomasi, Eucyclops agilis, Diaptomus clavipes, Cyridopsis vidua, Physocypria pustulosa, Mancasellus ? sp common inhabitants.

Fig. 7. An oxbow lake 2¼ miles NE Lawrence, Kansas; 12 inches deep, May, 1948; Daphnia pulex, Ceriodaphnia reticulata, Scapholeberis mucronata, Cyclops vernalis, Simocephalus serrulatus common inhabitants.

Fig. 8. A pasture pool 14 miles NW of the University of Kansas campus; 4 feet deep, October, 1947; Daphnia pulex, Simocephalus vetulus, Cyclops vernalis, Eucyclops agilis common inhabitants.

cultures were established until such time as specimens could be preserved in alcohol or mounted. Specimens were killed and fixed in 70 to 95 per cent alcohol in equal parts of water and preserved in 95 per cent alcohol. During the late fall and winter of 1947-48 pure cultures of cladocerans, copepods and ostracods were maintained in the laboratory for observation. Samples of water from which the specimens were secured were brought into the laboratory and the hydrogen ion concentration was determined with the aid of a Coleman potentiometer.

Photographs were taken of the various localities from which collections were made and date of collection, temperature of water, pH of water, character of the pool and its bottom, type of pool, and condition of water in it (whether clear, turbid, low or high, drying-up or flooded) were noted on the back of 5" by 8" cards to which the pictures were attached.

Small animals, and parts of taxonomic importance, from larger animals were stained in acid fuchsin and mounted in polyvinyl alcohol.

The life cycle of some members of the order Anostraca is little known because of the sporadic nature of their occurrence in temporary pools. Effort was made to correct this deficiency by taking eggs deposited by gravid females in laboratory aquaria, together with dead bodies of gravid females, and placing this material in a permanent pond on the University of Kansas campus. Also soil and water from the pools where Anostraca had been found were placed in laboratory aquaria and seeded with eggs. To date no Anostraca have appeared in laboratory aquaria nor in the campus pool. However, this result is not unexpected since records indicate that these animals may appear in a pond one year and fail to reappear for several years there after.

Check List of Microcrustacea In Eastern Kansas

Superclass: Crustacea Pennant
- Class: Eucrustacea Kingsley
  - Subclass: Branchiopoda Lamarck
    - Order: Anostraca Sars
      - Family: Streptocephalidae Daday
        - *Streptocephalus texanus* Packard
        - *Streptocephalus seali* Ryder
      - Family: Chirocephalidae Prevost
        - *Thamnocephalus platyurus* Packard
        - *Eurbranchipus serratus* Forbes
    - Order: Conchostraca Sars
      - Family: Caenestheriidae Daday
        - *Caenestheriella belfragei* (Packard)
    - Order: Cladocera Latreille
      - Suborder: Calyptomera Sars
        - Family: Daphnidae Straus
          - *Daphnia pulex* (deGeer)
          - *Daphnia longispina* (O. F. Muller)
          - *Scapholeberis mucronata* (O. F. Muller)
          - *Simocephalus vetulus* (O. F. Muller)
          - *Simocephalus serrulatus* (Koch)

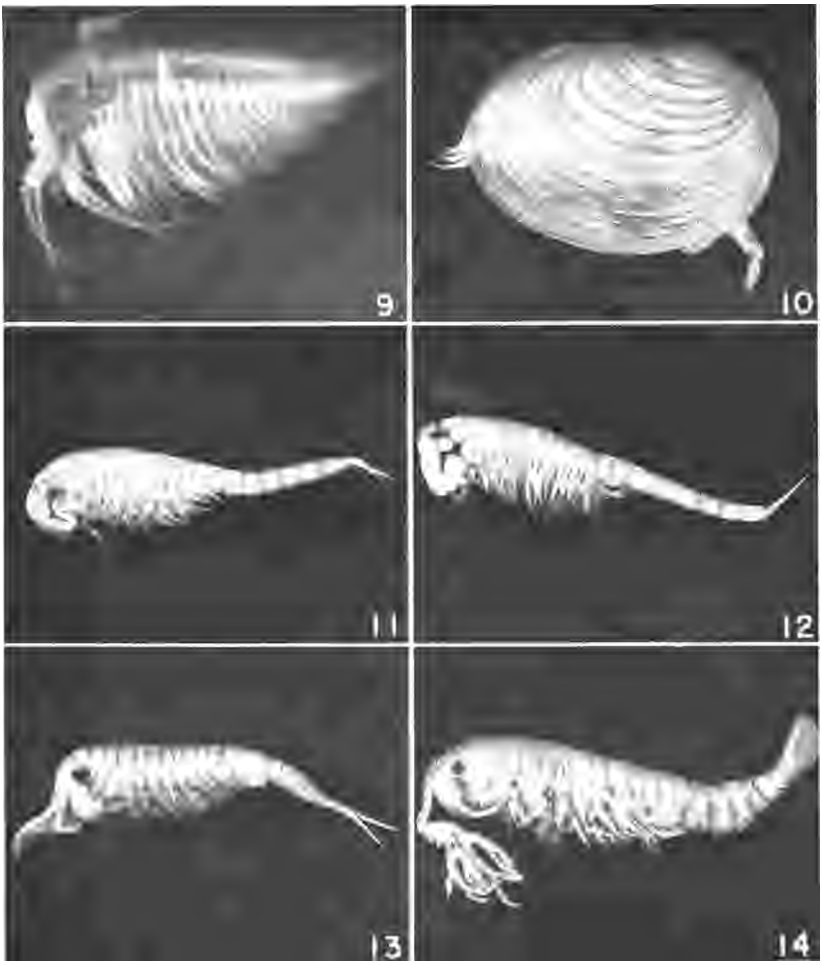


PLATE II

Fig. 9. Caenestheriella belfragei, adult ♂ x 6, shell removed, collected in drainage ditch 2¼ miles NE Lawrence, Kansas, October, 1947.

Fig. 10. Caenestheriella belfragei, adult ♀, x 6, enclosed in bivalve shell, collected in drainage ditch, 2¼ miles NE Lawrence, Kansas, October, 1947.

Fig. 11. Streptocephalus texanus, adult ♂ x 2, taken from drainage ditch 21/4 miles NE Lawrence, Kansas, October, 1947.

Fig. 12. Streptocephalus sealii, adult ♂ x 2, taken from drainage ditch 2¼ miles NE Lawrence, Kansas, October, 1947.

Fig. 13. Eubranchipus serratus, adult d x 2¼, taken from drainage ditch 2¼ miles NE Lawrence, Kansas, March, 1948.

Fig. 14. Thamnocephalus platyurus, adult ♂ x 11, taken from drainage ditch 21/4 miles NE Lawrence, Kansas, October, 1947.
Magnifications are approximate

Ceriodaphnia reticulata (Jurine)
Moina rectirostris (O. F. Muller)
Family: Bosminidae Sars
Bosmina longirostris (O. F. Muller)
Family: Chydoridae Stebbing
Chydorus sphaericus (O. E. Muller)
Pleuroxus denticulatus Birge
Leydigia quadrangularis (Leydig)
Kurzia latissima (Kurz)
Subclass: Ostracoda Latreille
Order: Podocopa Sars
Family: Cypridae Sars
Cypridopsis vidua (O. F. Muller)
Physocypria pustulosa (Sharpe)
Subclass: Copepoda Latreille
Order: Eucopepoda Claus
Suborder: Calanoida Dana
Family: Diaptomidae Westwood
Diaptomus clavipes Schacht
Suborder: Cyclopoida Burmeister
Family: Cyclopidae O. F. Muller
Cyclops bicuspidatus thomasi Forbes
Cyclops vernalis Fischer
Eucyclops agilis (Koch)
**Microcyclops varicans* (G. O. Sars)
**Macrocyclops albidus* (Jurine)
Suborder: Harpacticoida Sars
Family: Canthocamptidae Westwood
Attheyella illinoisensia (Forbes)
Subclass: Malacostraca Latreille
Subclass: Malacostraca Latreille
Series: Eumalacostraca Brobben
Division: Pericarida Calman
Order: Isopoda Latreille
Suborder: Asellota Latreille
Family: Asellidae Sars
Mancasellus ? sp
Suborder: Oniscoidea Budde-Lund
Family: Armadillidiidae Budde-Lund
Armadillidium vulgare (Latreille)
Order: Amphipoda Latreille
Suborder: Gammaridea Dana
Family: Taliteridae Latreille
Hyalella knickerbockeri (Bate)

Annotated List of Species

Streptocephalus texanus Packard

Plate II, Fig. 11

Streptocephalus texanus Packard, Amer. Journ. Sci., ser. 3, 2: 111. August 21, 1871.

Recognition characters: Short laminate frontal appendage present, with slight fissure at distal end suggesting lobosity; eyes stalked; median, single ocellus present on anterodorsal border of head; first antenna filiform,

• Collected by Mr. Arthur L. Duell, May 1, 1948.

arising from dorsolateral angle of head immediately anterior to stalked eye, approximately 3 mm. in length; second antenna or clasper in male large, tortuous and three-segmented; basal segment cylindrical with lateral antenniform appendage arising at junction with second segment which is long and recurved; third segment enlarged and convoluted at junction with second segment, bifurcate, forming a scissors; shorter inner blade or branch of scissors with two unequal teeth on proximal anterior margin; proximal tooth approximately one-third as broad as distal tooth, and varying in shape from bluntly rounded to slightly pointed; distal tooth large and shaped like a plow-share; immediately distal to point of large tooth inner blade constricts, turns downward, enlarges again, terminating acutely; anterior to terminal apex of blade enlarged distal portion bears a lateral protuberance; outer blade or branch having thick base from which two processes issue: shorter, outermost digitiform; longer, innermost long, slender and curved, resembling blade of a scythe; second antenna of female flat and plate-like with short, pointed tip at apex; cercopods of both sexes uniformly setose along entire margins and colored- brilliant red; penal organ long and retractile; *egg* sac long and conical, extending from attachment on first abdominal segment to about seventh abdominal segment, usually light blue to deep blue or rust in color. Creaser (1930b: 9) has proposed the common name, "The Smooth-tailed Fairy Shrimp", for this species.

Local occurrence and ecology: Collections of *S. texanus* were taken from a freshly dug drainage ditch approximately two and one-quarter miles northeast of Lawrence, Kansas, at intervals from October 9 to November 12, 1947. The drainage ditch in which these Crustacea lived lies in an old river bottom area which is flooded by spring and fall rains. The ditch, when completely filled, is approximately six feet deep and 25 feet wide and extends about one-half mile across a field which is under cultivation (fig. 3). The ditch has a soft clay bottom and is devoid of bottom growing vegetation. There was no growth around the borders of the ditch at the time collections were made since the area was being prepared for cultivation. Because of the recent excavation of the ditch and the lack of vegetation growing on the bottom, the water was very turbid. During the collection period the temperature of the water ranged from 34 degrees C. in October to 8 degrees C. on November 9 and 12. The hydrogen ion concentration of the water remained around pH 7.9 for the entire collection period. Packard (1883: 347) noted that he had received immature examples of *S. texanus* from Dr. L. Watson who had collected them from a "prairie pond" in Ellis, Kansas, in the vernal season of 1877 and later during the same season in Wallace, Kansas. No

examples of this species have been collected in the vernal season in eastern Kansas.

Authors have listed the habitats of the species as "prairie ponds", "cattle holes", buffalo wallows", and "tanks" or "pot holes". Jewell (1927: 295) reports *S. texanus* to have hatched from mud taken from a "buffalo wallow" in the sand dune area of Stafford County, central Kansas. Creaser (1930b: 8, 9) reports this species from Santana, south-western Kansas. Little is known about the life history of the Streptocephalidae. However, they are known to appear suddenly in temporary bodies of water and are capable of reaching maturity within 14 days or less.

According to Creaser (1930b: 5, 7) *texanus* has been reported from the neighboring states of Colorado, Oklahoma, Texas and farther west in Utah. Creaser (1930b: 8, 9) also states that the range of the species is more or less limited to south-western United States.

Streptocephalus sealii Ryder
Plate II, Fig. 12.

Streptocephalus sealii Ryder, Proc. Acad. Nat. Sci. Philadelphia, pp. 200-202, 1879.

Recognition characters: Laminate frontal appendage longer than in *S. texanus,* distal end entire with no suggestion of lobosity; eyes stalked; median, single ocellus present on anterodorsal border of head; first antenna filiform, approximately 3 mm. in length, arising from dorsolateral angle of head immediately anterior to stalked eye; second antenna or clasper in male large and not so tortuous as in *S. texanus,* three-segmented; basal segment long and cylindrical with long antenniform appendage arising from outer proximal border where basal segment joins second segment, which is moderately recurved, but shorter than basal segment; third segment greatly swollen at junction with second segment, bifurcate, forming a scissors; shorter inner blade or branch of scissors bearing two teeth, about equal in length, on proximal anterior margin; proximal tooth broadly conical, distal tooth about half as broad at base as proximal tooth; distal to second tooth, blade is slightly enlarged, hyaline, curved downward and terminates in a sharp point; outer blade or branch of scissors possessing a hollowed basal portion into which the two teeth of inner segment fit; outer blade also bears a short anterolateral protuberance, a posterolateral digitiform process, and a long, slender, slightly curved distal process which terminates acutely; second antenna of female ellipsoidal, longer than wide, pointed at apex; frontal appendage absent in female; cercopods of male stout, bowed, and fringed with long setae on proximal one-half of margins, distal one-half of margins bearing

sharp spines on inner and dorsal margins; cercopods of female uniformly setose along margins; cercopods of both sexes colored brilliant red; penal organ long and retractile; ovisac long and conical, reaching slightly beyond base of seventh abdominal segment, deep blue or pale green in color. Creaser (1930b: 9) has proposed the common name, "The Spiny-tailed Fairy Shrimp", for *S. sealii.*

Local occurrence and ecology: S. sealii has not been previously reported for Kansas, but the following collections of it have been made in eastern Kansas: October 9, and 10, 1947, four fully formed adults, two males and two females, were taken from a roadside ditch two and one-half miles southeast of Lawrence, Kansas, (fig. 6). October 30 and November 5, 1947, many fully formed adults of both sexes were collected from a drainage ditch two and one-quarter miles northeast of Lawrence, Kansas. The roadside ditch from which *S. sealii* was first collected in eastern Kansas was dry from June *7,* to September 12, 1947 (fig. 5). Heavy rains on September 12 and 21 partly filled the ditch which was seined September 29 and 30 for crayfish, but no individuals of *S. sealii* were taken. On October 3, the ditch was worked rather thoroughly with a dip net without finding the species. On October 30, and November 5, 1947 fifty specimens of *S. sealii* were collected together with numerous specimens of *S. texanus* from the drainage ditch northeast of Lawrence. Several hundred specimens of *texanus* were taken from this ditch on several occasions before *sealii* suddenly appeared. Individuals of *sealii* collected from the ditch were larger than individuals of *texanus,* but were not so numerous. The sudden appearance of adult male and female *S. sealii* in pools in eastern Kansas on the above mentioned dates attests to the sporadic nature of the appearance of this fairy shrimp. Also, the sudden appearance of adults in ponds two to three weeks after vernal and autumnal rains seems to be characteristic of the species according to other authors. Because of the sporadic occurrence of this species little is known of its ecology or life history.

The habitat of *S. sealii* is generally reported by authors to be similar to that of *S. texanus.* Creaser (1930b: 8) states, "It is noteworthy that at the present time *S. sealii* and *S. texanus* have not been found together in the same ponds, although the ranges of the two species overlap. It is possible that some ecological or chemical factor of the environment is responsible for this segregation".

General distribution: Widely distributed in America; Creaser (1930b: 8) reports occurrences of the species as far north as Alberta, Canada, south to Mississippi and Alabama, west to Arizona and east to New Jersey. Reports have been made from neighboring states of Colorado (Dodds,

1915: 97-98). Oklahoma (Mackin, 1938: 45) and Texas (Resta, 1921: 96-98) Creaser (1930b: 5, 6) indicates that Packard's *Streptocephalus floridanus,* collected from St. John's River Florida; Dodd's *Streptocephalus coloradensis* collected at Fort Collins, Colorado; and Pesta's *Streptocephalus americanus,* collected from Dallas, Texas, are in reality synonyms of *S. sealii.*

March 30, 1948, Mr. Jerry A. Palmer brought into the laboratory examples of *S. sealii* measuring 42 to 45 mm. in length. These large individuals were collected in a pasture basin near Joaquin, Shelby County, Texas, March 28, 1948. According to Palmer, water in this basin is low, only a few inches in depth, at some seasons of the year, but the basin is never dry.

Thamnocephalus platyurus Packard

Plate II, Fig. 14.

Thamnocephalus platyurus Packard, Bull. U. S. Geol. and Geogr. Survey Territories, iii, 1: 175. April 9, 1877.

Recognition characters: Frontal appendage of male well developed, cylindrical, arising from anterior margin of head, greatly branched and thickly spinose on secondary branches; first antenna of both sexes slender, of moderate length; second antenna or clasper of male composed of two segments; basal segment short and thick with short spine on medial lateral border and an elongate hyaline process on inner border; second segment or clasping organ long, curved, simple, subconical, saber-like and chitinous; second antenna of female extremely long, flat and oar-like, extending over one-half length of body; penal organ long and retractile; ovisac long, conical and blue-green in color; oviducts colored robin's *egg* blue; cercopods of both sexes confluent.

Local occurrence and ecology: The first specimen of *T. platyurus,* a male, was collected from a recently excavated drainage ditch approximately two and one-quarter miles northeast of Lawrence, Kansas, October 27, 1947. This specimen measured 45 mm. in length. On October 29, 1947, the ditch was seined with a minnow seine and 11 additional specimens taken, four of which were females. The males measured from 45 to 47 mm., while the females were without exception 50 mm. long. The females are very strikingly colored; the tail is scarlet, ovisacs light green, oviducts robin's egg blue, swimming feet very pale green and the oar-like second antennae and remainder of body white. *Streptocephalus texanus* had been taken from this ditch on several previous occasions before the first collection of *T. platyurus* was made. Packard (1883: 354-355) gives an interesting account of the first collections of this species by Dr.

L. Watson at Ellis, Kansas, 1874. It is worthy of note that *T. platyurus* was originally found in a pool with *Streptocephalus texanus.* Packard (1883: 335) suggests that the habitat of *T. platyurus* is different from that of most other fairy shrimps in that it is not found in "Buffalo wallows" or upland pools. It is impossible now to reject or confirm this suggestion, since the species has been collected only twice in eastern Kansas. The life history of the species is little known. Individuals reaching maturity live for only a short time—possibly only a few days. The full cycle has not been observed in nature and the animals have not been cultured in the laboratory.

General distribution: The range of *T. platyurus* is apparently confined to central and southwestern United States and Mexico. Creaser (1935: 376) lists *platyurus* from Texas, Oklahoma, Kansas, Colorado, Arizona, U. S. A., and San Luis Potosi in Mexico.

Eubranchipus serratus Forbes

Plate II, Fig. 13

Eubranchipus serratus Forbes, Bull. Illinois State Lab. Nat. Hist. 1: 13. October 16, 1876.

Recognition characters: Frontal appendage of male arising from base of second antenna or clasper, laminate and asymmetrical, forming a broad sigmoid curve; proximal half of outer margin of appendage equipped with long spinose processes, distal half of outer margin possessing short, knob-like processes; inner border of appendage equipped with short, spinose processes of nearly uniform size; first antenna short and filiform, arising from anterolateral border of head, immediately in front of stalked eyes. Second antenna or clasper of male biarticulate; basal segment stout and elongate, second segment of moderate length, bowed, broader at proximal union with basal segment than at distal end, outer lateral surface hollowed; seen in profile, distal end of segment resembling a small slipper, inner proximal border armed with blunt, irregular process half as long as segment; second antenna of female irregularly ovoid, apex pointed; cercopods of both sexes uniformly setose along margins, colored red or amber; penal organ retractile, bearing spine on terminal end; ovisac irregularly rounded, colored rust or blue-green; swimming appendages of male and female variable in color, some pale blue, others rust. colored or colorless.

Local occurrence and ecology: E. serratus has not previously been reported for Kansas, but occurs in eastern Kansas under a wide variety of field conditions. Depth, temperature, hydrogen ion concentration and turbidity of water seem to exercise little effect on these animals. Examples

of the species have been taken from pasture pools containing only a few inches of water; from ditches along roadsides and railroad fills containing from one to four feet of water; and from a drainage ditch where the water was approximately six feet deep. *E.* serratus has been taken from water ranging in temperature from 4 degrees C. to 23 degrees C. However, it has been observed that individuals swimming about in the warmer waters tend to congregate near the shady areas of a pool. *E.* serratus occurs in pools in eastern Kansas as early as February 15 and as late as May 12. Adults have been taken from pools covered with sheets of floating ice-resulting from late winter and early spring thaws. On February 16, 1948, in a flooded field adjoining a deep drainage ditch two and one-quarter miles northeast of Lawrence, Kansas, thousands of dead bodies of fully mature male and female *E.* serratus were found lying in furrows in the earth about 12 inches deep under water on which ice floated. Apparently large numbers of *E.* serratus hatched in the furrows in January or early February and were unable to reach the surface where they could get sufficient quantities of oxygen because of the depth of the ice that covered the field from January 1, 1948 until February 12, 1948. Consequently, they died where they hatched and reached maturity. The bodies seemed to be well preserved but when handled broke up easily.

E. serratus may occur in water ranging in pH from 6.93 to *7.6.* It thrives best in clear pools with weedy bottoms but is able to live in turbid water. Generally speaking, fairy shrimps thrive best in clear pools containing considerable vegetation.

There is considerable size variation in the species. Apparently local conditions are important factors in the size variation of *E.* serratus in pools in eastern Kansas. In some pools specimens collected in the spring of 1947 were larger than individuals taken from the same pools in the spring of 1948 and conversely, specimens taken from other pools in 1947 were substantially smaller than individuals taken from the same pools in 1948. Fully formed adults measuring a maximum of 20 mm in length have been from pools, whereas in other pools the length ranged from 10 to 35 mm.

Hay and Hay (1889: 91-95) concluded that eggs of *Eubranchipus* must be dried before hatching will take place. Creaser (1931: 267-268) suggests that drying may be necessary in some cases but not in all. Avery (1939:356) reports hatching *E.* vernalis eggs which were kept moist, while *eggs* permitted to dry failed to hatch. Dexter and Ferguson (1943: 211) observed that *E.* vernalis eggs which were kept at room temperature for several months and then placed in pond water failed to hatch.

General distribution: E. serratus has been reported from Oklahoma

(Mackin, 1938: 46); Illinois, Nebraska, Missouri (Creaser, 1935: 374); Ohio (Dexter and Ferguson, 1943: 210-222).

Caenestheriella belfragei (Packard)

Plate II, Figs. 9, 10.

Estheria belfragei Packard, Amer. Journ. Sci. ser. 3, 2: 112. August, 1871.

Caenestheriella belfragei, Daday, Ann. Sci. Nat. Zool. Paris, ser. 9. 20: 108-116. 1915.

Recognition characters: Dorsal and posterior margins of valves, seen from the side, forming a distinct angle; seen from above or below, broadly fusiform; greatest width near anterior end across umbones; valves with 23 to 26 growth lines edged with fine setae; surface of valves punctate; dorsal border of last 18 trunk segments, exclusive of telson, armed with hairs and spines increasing in size posteriorly; 19 to 25 teeth of unequal size on dorsal margin of telson; superior ramus of second antenna composed of 15 to 16 segments; inferior ramus 16 to 17 segments; third pair of feet on male and first pair of feet on female with distinct endopodital palp; apical border of second pair of feet of male armed with long, thin setae on side near base of apical claw; ninth and tenth pairs of feet of female equipped with distinct endopodital palps.

Local occurrence and ecology: C. *belfragei* has not been previously reported for Kansas, but examples of it were taken from a recently excavated drainage ditch two and one-quarter miles northeast of Lawrence, Kansas, October 29, 1947 and in a roadside ditch two and one-half miles southeast of Lawrence, Kansas, October 10, 1947, February 20, March 17 and 20, 1948. *C. belfragei* is a bottom dweller for the most part, occasionally swimming rapidly up to the surface of the water and just as rapidly sinking to the bottom. Specimens observed in the laboratory attacked and devoured smaller crustaceans such as Cyclops, *Diaptomus*, Daphnia and *cypridopsis*. Excreta from the digestive tract suggests that diatoms and other micro-plankton also form a part of the diet. Temperature and pH of water seem to have little effect upon the presence of *C. belfragei* in pools in eastern Kansas. Examples have been taken from water ranging in temperature from 5 to 35 degrees C., and from pH 6.8 to pH 7.9. Fewer specimens were collected in the colder, slightly acid vernal waters than in the warmer, alkaline autumnal waters.

General distribution: C. *belfragei* was first collected by G. W. Belfrage in the month of April, at Waco, Texas, and was reported by Packard (1871: 112-113). Mackin (1938: 47) reports the species for Oklahoma. A. Byron Leonard and Austin B. Williams collected examples of the species from roadside ditches in McPherson County, Kansas. and

from a pasture pool in Marion County, Kansas, in April, 1947. The geographical range of the species is unknown.

KEY TO GENERA AND SPECIES OF DAPHNIDAE IN EASTERN KANSAS

1. Rostrum present ---------- 2
   Rostrum wanting ---------- 9
2. No cervical sinus; carapace transparent ---------- 3
   Cervical sinus present; carapace opaque ---------- 5
3. Valves reticulated, oval to ellipsoidal, dorsoposterior ----------
   margin terminating in long spine ---------- Genus *Daphnia* 4
4. Post-abdominal claw with pecten ---------- *Daphnia pulex*
   Post-abdominal claw without pecten ---------- *Daphnia longispina*
5. Posterior and ventral margins of carapace straight, the latter terminating in
   short spine ---------- Genus *Scapholeberis* 6
   Posterior and ventral margins not straight ---------- 7
6. Head and ventral margin of carapace dark brown to black ----------
   ---------- *Scapholeberis mucronata*
7. Dorsoposterior margin of carapace terminating in bluntly rounded spine ---
   ---------- Genus *Simocephalus* 8
8. Vertex rounded, ocellus elongated ---------- *Simocephalus vetulus*
   Vertex pointed, armed with spines; ocellus rhomboidal ----------
   ---------- *Simocephalus serrulatus*
9. Head small and depressed; antennules short; valves reticulated; post-abdominal
   claw pectinate ---------- *Ceriodaphnia reticulata*
   Head large and not greatly depressed; antennules long; valves smooth,
   ephippium reticulated around edges ---------- *Moina rectirostris*

Daphnia pulex (de Geer)

Plate **III,** Fig. 15.

Daphnia pulex de Geer, memoires pour servir a' l' Histoires des Insectes 7:950, 1778.

Recognition characters: Body heavy and transparent, armed with long posterior spine; antennules small and hidden, except for setae, which may extend beyond tip of rostrum; post-abdomen large, anus terminal; 12 or fewer anal spines; post-abdominal claw with pecten.

Local occurrence and ecology: Common in eastern Kansas, especially in spring and fall; apparently absent from open water in summer and in winter, although a laboratory culture carried on reproduction throughout **the year.** *D. pulex* is probably the most common and abundant crustacean in pools, ponds, streams and ditches in eastern Kansas. Shortly after the first spring and fall rains this animal may be collected in large numbers from almost any puddle or larger body of water. Although *D. pulex* has not been taken from pools in summer and winter, it is able to survive in water ranging in temperature from 5 to 27 degrees C., and in pH from 6.9 to 7.4. The foliaceous feet of *pulex* are in constant motion straining micro-organisms and debris from the water. Some of this plankton is engested and some rejected.

General distribution: Very commonly and widely distributed in America and Europe (Blake, 1935: 384) ; Birge (1918: 695) also indicates

a wide distribution for this species; Hoff (1943: 84) states that *pulex* is not common in Reelfoot Lake, Tennessee, but admits that his collections might have been made during a period of seasonal population decline.

Daphnia longispina (0. F. Muller)

Plate III, Fig. 16.

Daphnia longispina, Müller, Entomostraca, seu Insecta Testacea in aquis Daniae et Norvegiae reperta, p. 199. Lipsiae. 1785.

Recognition characters: Body heavy and transparent, armed with a long posterior spine; antennules small and hidden; head large. and variable in shape from bluntly rounded to elongate, frequently terminating in a point; post-abdomen large, anus terminal; 9 to 14 anal spines; post-abdominal claw without pecten.

Local occurrence and ecology: D. longispina has not been reported previously for Kansas, but it occurs in the open water of large artificial lakes in eastern Kansas. The first examples of *D. longispina* taken in eastern Kansas were collected from Lone Star Lake, approximately 12 miles southwest of Lawrence, Kansas. Lone Star lake is as much as 45 feet deep and covers an area of 195 acres. Little is known about the ecology of *longispina* in Lone Star lake since only two collections of it have been made. However, a Birge cone net dragged behind a rowboat for from 150 to 500 yards collected large numbers of *D. longispina,* suggesting that during the month of April at least the species is very abundant in the lake. Contents of the intestines of dead individuals showed a predominance of diatoms and Protozoa.

General distribution: Found in open water of lakes in all regions of the United States and Europe (Birge, 1918: 696, 697).

Scapholeberis mucronata (0. F. Muller)

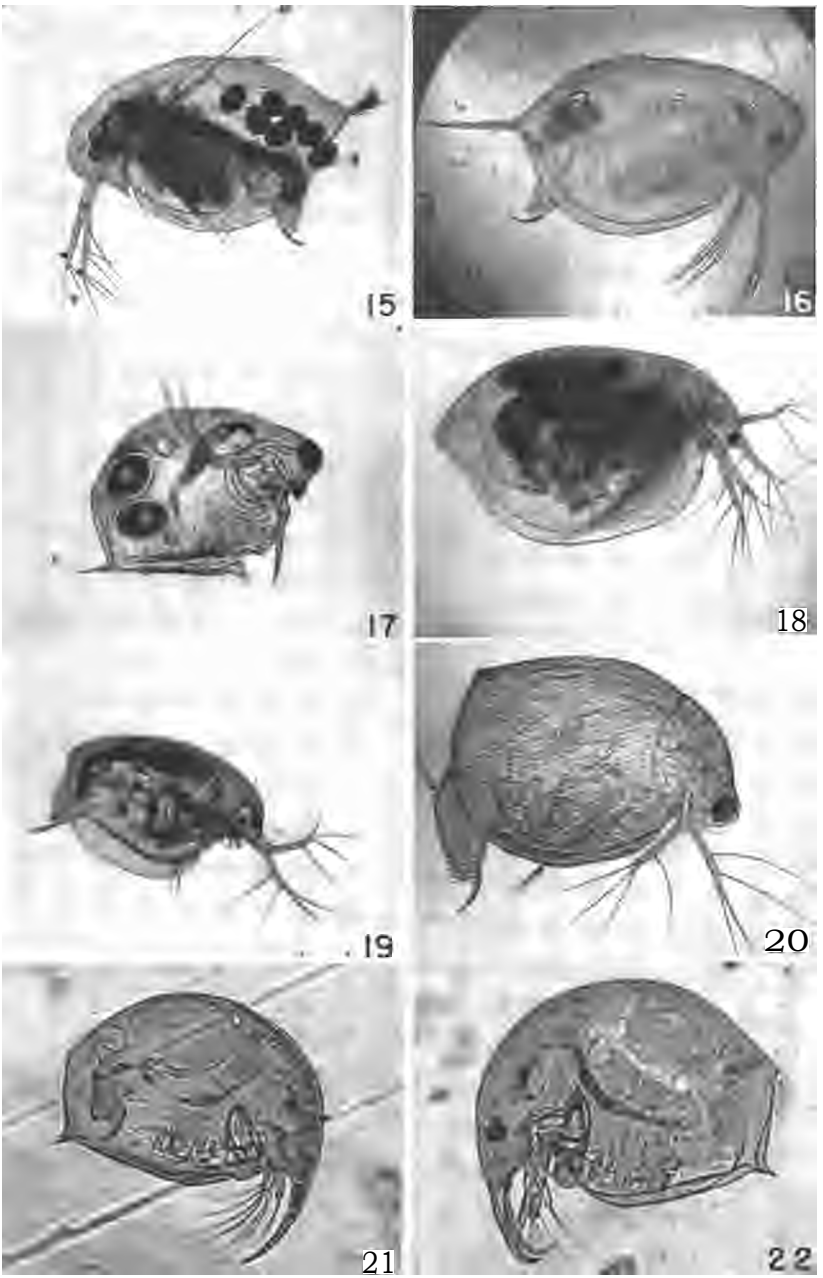
Plate III, Fig. 17.

Daphne mucronata Muller, Zool. Dan. Prod. No. 2404, Entromostraca, p. 94, figs. 6, 7. 1785.

Scapholeberis mucronata, Schodler, Branchiopoden der Umgegend von Berlin, p. 18. 1858.

Recognition characters: Body small, quadrate; head and ventral margins of carapace dark brown to black; ventral margin of carapace setose and extended into a sharp point or spine; post-abdomen short and broad, anus terminal; seven or fewer anal spines; post-abdominal claw denticulate, never pectinate.

Local occurrence and ecology: S. mucronata has not been previously reported for Kansas, but it occurrs commonly in eastern Kansas in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temporary pools in spring and summer, being most abundant in vernal waters. Clear pools are frequently so thickly populated with *S. mucronata* that individuals can easily be seen with the unaided eye. *S. mucronata* seems to prefer the surface of water and is frequently seen swimming on its back with its ventral surface just under the water. *S. mucronata* is a rapid swimmer, darting through the water with quick powerful strokes. Large numbers of individuals have been collected from roadside ditches, pasture pools and oxbow lakes.

General distribution: Common everywhere in Europe and America (Birge, 1918: 699).

Simocephalus vetulus (0. F. Muller)

Plate III, Fig. 18.

Daphne vetula Müller, Zool. Dan. Prod., p. 199. 1776.

Simocephalus vetulus, Schödler, Branchiopoden der Umgegend von Derlin, p. 18. 1858.

Recognition characters: Body transparent, irregularly quadrate, terminating posteriorly in short, bluntly rounded, indistinct spine, located on dorsal half posterior margin; antennules small, not hidden by rostrum; cervical sinus deep; slight concavity on dorsal margin of head just above eye; vertex rounded; ocellus elongated, reaching from base of eye almost to tip of rostrum; post-abdomen large, truncate, anus terminal; anal spines, ten or fewer, increasing in size distally; post-abdominal claw long, not pectinate; length variable, from 1.5 mm. to 2.7 mm.

S. vetulus is often confused with *S. serrulatus* since the two species resemble each other closely and are frequently found together in the same pool.

PLATE HI

Fig. 15. Daphnia pulex, adult x 30, taken from roadside ditch 2½ miles SE Lawrence, Kansas, March, 1948.

Fig. 16. Daphnia longispina, adult x 36, collected from open water of Lone Star Lake 12 miles SW Lawrence, Kansas, April, 1948.

Fig. 17. Scapholeberis mucronata, adult x 38, taken from Potter's lake, University of Kansas campus, May, 1948.

Fig. 18. Simocephalus vetulus, adult x 22, taken from Potter's Lake, University of Kansas campus, April, 1948.

Fig. 19. Simocephalus serrulatus, adult x 30, from laboratory culture, April, 1948.

Fig. 20. Ceriodaphnia reticulata, adult x 41, from oxbow lake 2¼ miles NE Lawrence, Kansas, April, 1948.

Fig. 21. Bosmina longirostris, adult x 75, taken from open water of Potter's lake, University of Kansas campus, April, 1948.

Fig. 22. Bosmina longirostris, adult x 85, taken from open water of Potter's lake, University of Kansas campus, April, 1948.
Magnifications are approximate.

Simocephalus serrulatus (Koch)

Plate III, Fig. 19.

Daphnia serrulata Koch, Deutschlands Crustaceen, heft 35, taf. 14, Regenburg. 1841.

Simocephalus serrulatus, Leydig, Naturgeschichte der Daphniden, p. 165. Tubingen. 1860.

Recognition characters: Body transparent, distinctly quadrate, terminating posteriorly in short, bluntly rounded spine, located on dorsal half of posterior margin; antennules small, not hidden by rostrum; cervical sinus deep; slight concavity on dorsal margin of head just above eye; vertex pointed, armed with short spines; ocellus rhomboidal to triangular, rarely if ever elongated; post-abdomen large, truncate, anus terminal; 8 to 12 anal spines, increasing in size distally; post-abdominal claw long and unarmed; length variable, from 1.75 mm. to 3.0 mm.

Local occurrence and ecology: Since the two species of *Simocephalus* are found in eastern Kansas under the same conditions they will be discussed together. Neither of the species has been reported previously for Kansas, but both commonly occur in temporary pools in eastern Kansas in spring and fall. Both species appear to be sporadic in occurrence, suddenly appearing in a pool and remaining in great abundance for a week or two then disappearing as suddenly as they appeared. Similar occurrences have been observed in laboratory aquaria. These animals seem to survive equally well in slightly acid or alkaline water and are not greatly affected by temperature. Their food consists largely of diatoms and other micro-organisms.

General distribution: Common in Europe and America; Birge (1918: 689, 699) lists both species of *Simocephalus* as common everywhere in weedy water. Hoff (1943: 89) states that the two species have in general the same local distribution and habitat range, but that *S. serrulatus* occurs in a slightly higher percentage of collections than *S. vetulus.*

Ceriodaphnia reticulata (Jurine)

Plate III, Fig. 20.

Mon oculus reticulatus Jurine, Histoire des Monocles qui se trouvent aux environs de Geneve, 14: 139, figs. 3, 4. 1820.

Ceriodaphnia reticulata, Dana, Crustacea, in United States Exploring Expedition, during the years 1838-1842, under the Command of Charles Wilkes, U.S.N., 13: 1630. 1852.

Recognition characters: Carapace distinctly rounded, reticulated; valves joined below ventral half of posterior margin, forming slight angle; antennules short, provided with median sensory hair; cervical sinus deep;

head long with prominent fornices; ocellus small; post-abdomen short and broad, anus terminal; 7 to 10 anal spines; post-abdominal claw pectinate proximally and denticulate distally.

Local occurrence and ecology: Common in vernal and autumnal temporary pools in eastern Kansas, but not previously reported for Kansas. C. reticulata frequently occurs in pools with Scapholeberis *mucronata*. C. reticulata is transparent and not readily detected with the unaided eye, but is as abundant in pools as the more easily seen *mucronata*. Unlike mucronata, reticulata prefers deeper water in which it moves about with slow, short strokes of the antennae. *C.* reticulata tends to congregate in large numbers around vegetation near the shoreline.

General distribution: Europe; eastern and central America (Blake, 1935: 385).

Moina rectirostris (Muller)

Daphnia rectirostris, Müller, Entomostraca, p.92, t.12, figs.1,2, 1785.

Moina *rectirostris*, Baird, British Entomostraca, p.101, t. xi. figs.1,2, 1850.

Recognition characters: Carapace well rounded, distinctly separated from head by deep cervical sinus; rostrum and ocellus absent; post-abdomen; anal spines seven to 11, the more distal spines bidentate; post-abdominal claw pectinate; the broad sac may become so distended with eggs or young as to appear to be a separate structure from the rest of the carapace.

Local occurrence and ecology: Not previously reported for the state; M. rectirostris was collected from a drainage ditch under a railroad trestle approximately two and one-half miles southeast of Lawrence, Kansas, from August 3 to 15, 1947, in water with a temperature range from 28 to 32 degrees C., and a hydrogen ion concentration of 6.9. Individuals were so abundant in the shallow parts of the ditch as to be easily visible to the unaided eye. The ecology of this species has not been thoroughly studied.

General distribution: Widely distributed in Europe and America in muddy pools (Birge, 1918: 705).

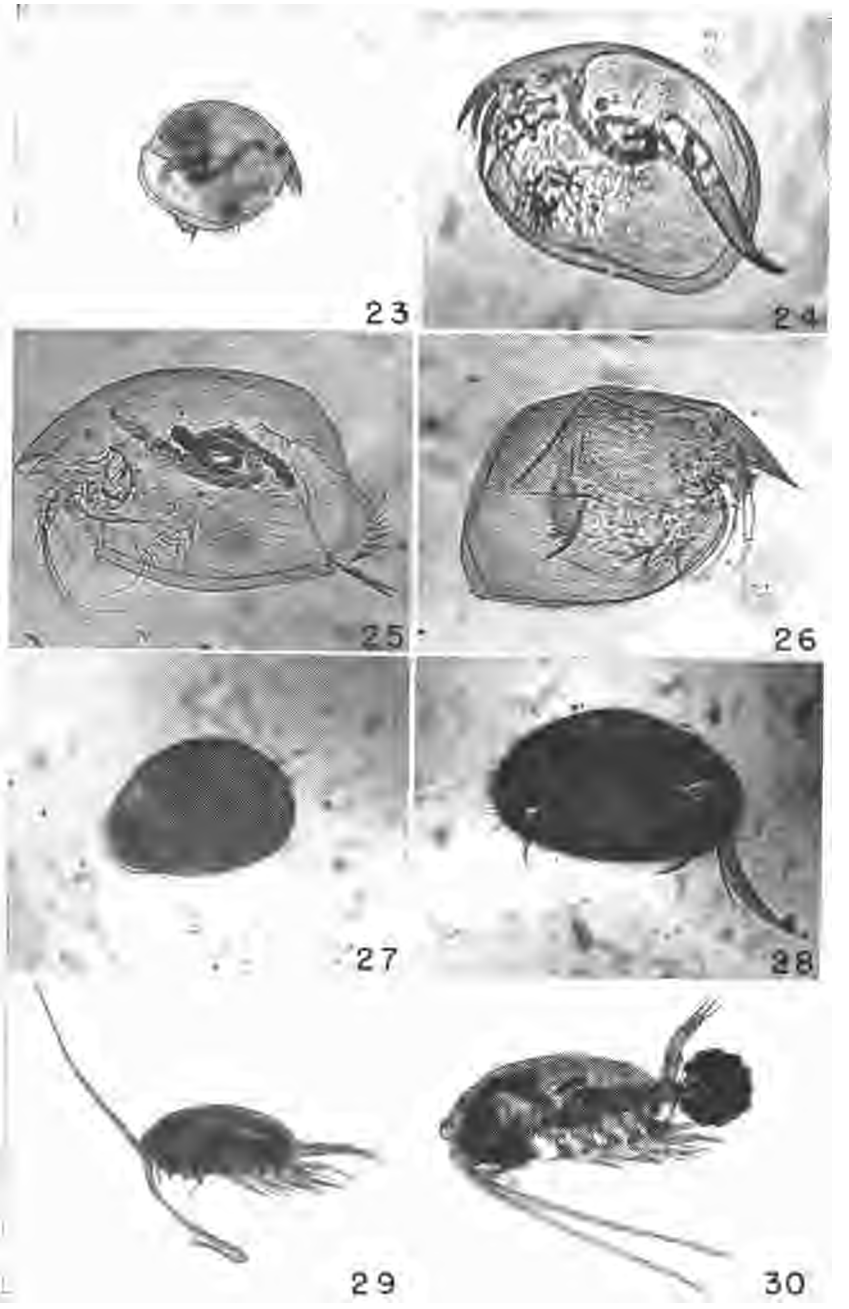
Bosmina longirostris (0. F. Muller)

Plate III, Figs. 21, 22.

Lynceus longirostris Müller, Entomostract, 10: 76, figs. 7, 8. 1785.

Bosmina longirostris, Baird, British Entomostraca, 15: 105, fig. 3. 1850.

Recognition characters: Carapace small, strongly arched dorsally; antennules variable in shape, curved or recurved; posteroventral spine short; post- abdomen divided by anal opening, truncate; post-abdominal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claw bearing two series of spinules, basal spinules increasing in length distally becoming very fine denticles at tip of claw.

Local occurrence and ecology: Not previously reported for Kansas; ***B. longirostris*** has been taken from the open water of a small pond on the University of Kansas campus, but not from the weedy shoreline area. *B. longirostris* swims in large groups on the surface of the water. Water samples collected in a Birge cone net may have a film of *B. longirostris* on the surface of the water in the vial. *B. longirostris'* swimming movements are sluggish, consisting of short strokes of the antennae. Individuals caught in the surface film cling together in groups, sometimes end-to-end in long chains. In a water sample they are easily detected since they are most often held on the surface of the water by surface tension. This species nas been collected in April in eastern Kansas. Its ecology has not been carefully studied. However, its food appears to be floating debris and planktonic microorganisms.

General distribution: Common in Europe and America; Birge (1918: 706) states that *B. longirostris* is very common in open waters of lakes and in weedy margins of pools and marshes. Hoff (1943: 92) reports that the species was found widespread in Reelfoot Lake, Tennessee, most abundantly in early summer, and more often than not associated with vegetation.

KEY TO GENERA AND SPECIES OF CHYDORIDAE IN EASTERN KANSAS

1. Body, seen from the side, irregularly spherical ---------- Genus *Chydorus* 2
   Body, seen from the side, elongate or oval, not spherical, ---------- 3
2. Body less than 0.5 mm. in length; post-anal part of post-abdomen nearly square, truncate ---------- *Chydorus sphaericus*
3. Post-abdominal claw with two spines at base; post-abdomen slightly widened at distal end, armed with a cluster of spines Genus *Pleuroxus*
   Post-abdominal claw long and slender, with or without a basal spine; post-abdomen conspicuously enlarged with long spines in groups with small spines, distal group of spines extremely long ---------- Genus *Leydigia* 5

PLATE IV

Fig. 23. Chydorus sphaericus, adult ? x 45, taken from Potter's lake, University of Kansas campus, April, 1948.
Fig. 24. Kurzia latissima, adult x 90, taken from railroad fill ditch 2½ miles SE Lawrence, Kansas, April, 1948.
Fig. 25. Leydigia quadrangularis, adult x 100, from laboratory culture, December, 1947.
Fig. 26. Pleuroxus denticulatus, adult x 95, taken from railroad fill ditch 2½ miles SE Lawrence, Kansas, May, 1948.
Fig. 27. Physocypria pustulosa, adult x 50, collected from Potter's lake, University of Kansas campus, May, 1948.
Fig. 28. Cypridopsis vidua, adult x 70, collected from roadside ditch 2½ miles SE Lawrence, Kansas, May, 1948.
Fig. 29. Diaptomus clavipes, adult ♂ x 20, taken from drainage ditch 21/4 miles NE Lawrence, Kansas, October, 1947.
Fig. 30. Diaptomus clavipes, adult x 30, collected from drainage ditch 21/4 miles NE Lawrence, Kansas, October, 1947.
Magnifications are approximate.

Post-abdominal claw long, straight, with a signal basal spine and a series of small denticles terminating in a larger one about the middle of the claw, very fine teeth thence to apex; post-abdomen long and slender, armed with numerous marginal denticles ---------- Genus *Kurzia* 6

4. Posteroventral margin of carapace armed with three or four teeth ---------- *Pleuroxus denticulatus*
5. Post-abdominal claw with a single basal spine; eye smaller than ocellus ---------- *Leydigia quad rangularis*
6. Post-abdomen with 10 to 12 marginal denticles; length of post-anal part of post-abdomen not less than three times its width --------- *Kurzia latissima.*

Chydorus sphaericus (0. F. Muller)

Plate **IV,** Fig. 23.

Lynceus sphaericus Muller, Schrift. d Berlin Gesellsch. Nat. Fr. 6: 185-192. 1785.

Chydorus sphaericus, Baird, British Entomostraca. p. 126. 1850.

Recognition characters: Body irregularly spherical, nearly quadrate, strongly arched dorsally, tapering sharply postero-ventrally; antennules stout, not extending beyond rostrum; post-abdomen short with eight marginal denticles; post-abdominal claw small; basal spine of claw minute; size, not exceeding 0.5 mm. in length; color light yellow; valves reticulated.

Local occurrence and ecology: Not previously reported for Kansas; *C. sphaericus* occurs commonly in temporary and permanent pools in eastern Kansas in spring. C. *sphaericus is* a rapid swimmer, frequently swimming on its back with short, strong strokes of the antennae. Large numbers of individuals may be taken in a single collection. There *seems* to be little particular habitat preference since this animal has been collected from open water as well as in weedy areas.

General distribution: Found all over the world; *C. sphaericus* is the commonest of all Cladocera (Birge, 1948: 732).

Kurzia latissima (Kurz)

Plate IV, Fig. 24.

Alonopsis latissima, Kurz, Dodekas neur Cladoceren, 40, t. ii, figs. 13-15. 1874.

Recognition characters: Body subquadrate, greatly compressed, dorsally arched; valves crested, marked with longitudinal striations; antennules long and slender, not extending beyond rostrum; post- abdomen long and slender, armed with 10 to 12 marginal denticles, lower angle produced into lobe; post-abdominal claw long, straight, armed with single basal spine and series of small denticles terminating in larger one about middle of claw, very fine teeth thence to apex; length variable, usually not more than 0.5 mm. to 0.7 mm.

Local occurrence and ecology: Not previously reported for Kansas; *K. latissima* has been collected in large numbers in spring and fall in temporary vernal and autumnal pools in eastern Kansas. These pools are usually not overgrown with weeds. Cultures maintained in the laboratory have carried on reproduction sporadically throughout the year. Cultures kept in a refrigerator at 6 degrees C. carried on reproduction about as frequently as those kept at room temperature. Examination of intestinal contents of individuals indicates that diatoms and other micro-organisms make up the diet of *K. latissima.*

General distribution: Found in all regions of the world (Birge, 1918: 718). Hoff (1943: 96) states that this species occurs throughout the summer in Reelfoot Lake, Tennessee, seldom associated with heavy beds of vegetation.

Leydigia quadrangularis (Leydig)

Plate IV, Fig. 25.

Lynceus quadrangularis Leydig, Naturgeschichte der Daphniden (Crustacea Cladocera). pp. IV, 252. Tubingen. 1860.

Leydigia quadrangularis, Kurz, Dodekas neuer Cladoceren, 52, t. fig. 1. 1874.

Recognition characters: Body oval, carapace broader posteriorly than anteriorly, strongly compressed; post-abdomen conspicuously large, armed with clusters of long and short spines along margin, spines greatly elongated distally; single basal spine on long slender post-abdominal claw.

Local occurrence and ecology: *L. quadrangularis* has not been reported previously for Kansas, but has been collected in small numbers in vernal and autumnal pools in eastern Kansas. In water taken from a roadside ditch two and one-half miles southeast of Lawrence, Kansas, November 12, 1947, and kept in the laboratory two specimens of *L. quadrangularis* were observed after about two weeks. In water taken from an oxbow lake two and one-quarter miles northeast of Lawrence, Kansas, March 16, 1948, 25 individuals appeared over a period of two to three weeks. Since these water samples were carefully examined when first brought into the laboratory it may be assumed that eggs present in the samples hatched in the laboratory. The ecology of this species has not been carefully studied.

General distribution: Not common; found singly among weeds in all regions in America (Birge, 1918: 721).

Pleuroxus denticulatus Birge

Plate IV, Fig. 26.

Pleuroxus denticulatus Birge, Wisconsin Acad. Sci. Arts and Ltrs., 4 (for 1876-77) : 96-97, pl. I. fig. 21. 1879.

Recognition characters: Carapace elongated and dorsally arched, posterior margin greatly reduced in length; ventral margin of valves fringed with long setae; posteroventral margin armed with three or four teeth; antennules short, not reaching to base of long straight rostrum; post-abdomen short and broad, armed with marginal denticles only; post-abdominal claw with two basal spines.

Local occurrence and ecology: Not previously reported for Kansas; *P. denticulatus* is common in vernal and autumnal pools and ponds in eastern Kansas. Collections of this animal have been taken from ditches along railroad fills and roadsides. It is most common in weedy pools, frequently occurring in large numbers in water having a wide range of temperature and [illegible].

General distribution: Common everywhere in America in weedy water (Birge, 1918: 728). Hoff (1943: 95) states that *denticulatus* is present throughout the summer in widely separated areas in Reelfoot Lake, Tennessee, being found in largest numbers in samples from *Heteranthera* and pondweed beds.

Cypridopsis Vidua (0. F. Muller)

Plate IV, Fig. 28.

Cypris vidua Müller, Zool. Dan. Prod. No. 2384. 1776.

Cypridopsis vidua, Brady, Monograph on Recent British Ostracoda, Trans. Lin. Soc., 26: 353. 1868.

Recognition characters: Shell well arched, tumid, very setose; erect setae standing out from surface of shell, giving it a hairy appearance; four dark green or black color bands extending from dorsal border of shell almost to ventral margin of shell; single median eye large; a strong swimmer.

Local occurrence and ecology: Not previously reported for Kansas; *C. vidua* occurs abundantly in most ponds, pools and lakes in eastern Kansas, especially in spring; present in summer and fall pools but not in large numbers. *C. vidua* is a bottom feeder, straining micro-organisms from the water as it creeps along. In the laboratory it has been observed to swim rapidly up to the surface of the water in an aquarium then sink slowly to the bottom of the aquarium. It frequently appears in samples of pond water which have been in the laboratory for two or three weeks

although no adults were observed when the sample was originally collected and examined.

General distribution: Type locality, Europe, but common in America. Hoff (1942: 153) states that this species is common throughout the Holartic region and has been reported from the Neotropical region as well. Sharpe (1918: 807) reports that C. *vidua* is very common wherever algae are present.

Physocypria pustulosa (Sharpe)

Plate IV, Fig. 27.

Cypria pustulosa Sharpe, Bull. Illinois Lab. Nat. Hist., 4: 414-482. 1897.

Physocypria pustulosa, Muller, G. W. Ostracoda. Des Tierreich, 31: 434. 1912.

Recognition characters: Shell small, irregularly rounded; right of left valve marked with tubercles or pustules on anterior, ventral or posterior margin; three brown or reddish-brown patches on shell: one on median anterior border of shell, second on dorsal border and third patch on posterior border.

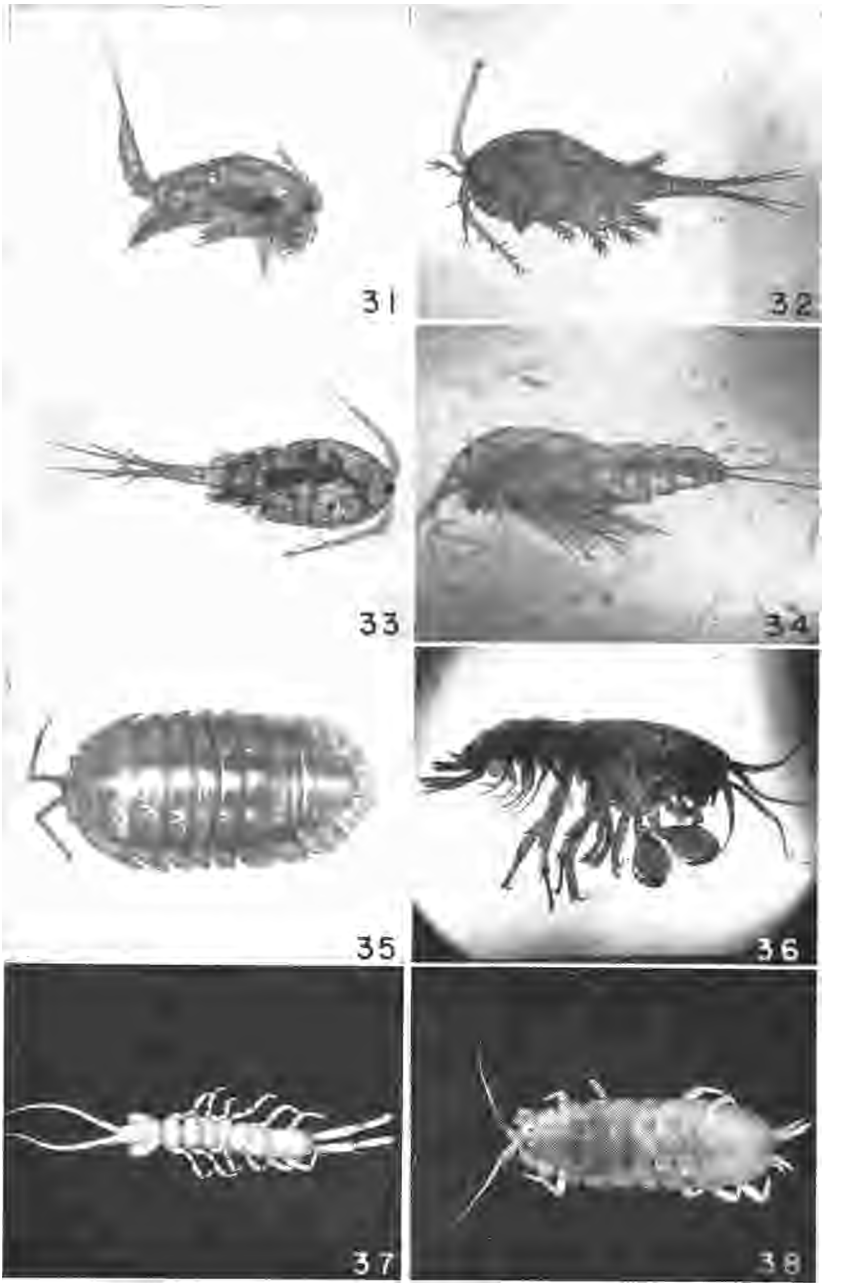
Local occurrence and ecology: Not previously reported for Kansas; *P. pustulosa* is common in eastern Kansas. Samples of water brought into the laboratory from southeastern and western Kansas indicate that the species is also common in those areas of the state. *P. pustulosa* occurs more frequently in pools with thick vegetation although collections of it have been taken from open water. It is most abundant in temporary waters between the months of April and June. A few individuals may be found in the fall. *P. pustulosa* is not predominately a bottom feeder, but has been seen frequently to rest on the bottom of aquaria in the laboratory. *P. pustulosa* has been found in water having a wide range of temperature and pH.

General distribution: Widely distributed in the United States; Hoff (1942: 125) states, "*P. pustulosa* has been reported under the names *P. globula* and *P. pustulosa* by Furtos (1933) from various places in Ohio. Dobbin records it as *Cypria (Physocypria) globula* from Washington and Alaska. It was reported from Illinois by Sharpe (1897) and Kofoid (1908)".

Diaptomus clavipes Schacht

Plate IV, Figs. 29, 30.

Diaptomus clavipes Schact, Bull. Illinois State Lab. Nat. Hist., 5 (for 1897-1901) : 178-181, pl. XXXIV, figs. 1-3; pl. XXXV, figs. 1, 2. 1902.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Recognition characters: Body slender, cephalothorax and abdomen distinctly separated; first antennae with 25 segments; furcal rami short; fifth feet of male asymmetrical, biramous; first basal segment of right fifth foot of male armed with stout hook equal in length to first segment of exopodite; exopod of right fifth foot terminating in long sickle-shaped claw; antepenultimate segment of male right antenna with narrow, lateral hyaline lamella extending only slightly beyond segment if at all; body colored bright red, green or colorless.

Local occurrence and ecology: Note reported previously for Kansas; *D. clavipes* is common in temporary pools during the vernal and autumnal seasons in eastern Kansas. Frequently this animal is so abundant in shallow pools that the water seems to take on the color of their red bodies. It swims about near the surface of the water, engulfing large numbers of micro-organisms; this feeding behavior has also been observed in the laboratory. Debris in the water is usually rejected by quick, forceful movements of the swimming feet.

General distribution: Three known localities: West Okoboji Lake, Iowa; Nebraska, in the vicinity of Lincoln; and Greeley, Colorado (Marsh, 1918: 760).

Cyclops bicuspidatus thomasi (Forbes)

Plate V, Fig. 32.

Cyclops thomasi Forbes, Amer. Nat. 16: 649. August, 1882.

Cyclops bicuspidatus thomasi, Gurney, British Freshwater Copepoda, 3: 29-384. Ray Society London, 120. 1933.

Recognition characters: Body long and slender; first antennae composed of 17 segments; fifth feet of two segments, each with plumose bristle, distal segment also bearing lateral spine; furca and caudal bristles

PLATE V

Fig. 31. Cyclops vernalis, adult ♀ x 30, lateral view, collected from roadside ditch 21 miles SE Lawrence, Kansas, April, 1948.
Fig. 32. Cyclops bicuspidatus thomasi, adult 9 x 35, dorsal view, taken from railroad fill ditch, 21 miles SE Lawrence, Kansas, April, 1948.
Fig. 33. Eucyclops agilis, adult 9 x 33, dorsal view, collected from roadside ditch 21 miles SE Lawrence, Kansas, May, 1948.
Fig. 34. Attheyella illinoisensis, adult e x 40, lateral view, collected from shallow spring-fed stream, one mile NW University of Kansas campus, May, 1948.
Fig. 35. Armadillidium vulgare, adult ♂ x 4.5, taken from rock pile on University of Kansas campus, May, 1947.
Fig. 36. Hyalella knickerbockeri, adult *d* x 13, taken from Potter's lake, University of Kansas campus, April, 1948.
Fig. 37. Caecidotea tridentata, adult *e* x 2, taken from shallow spring-fed pool one mile NW of University of Kansas campus, April, 1948.
Fig. 38. Mancasellus ? sp., adult ♂ x 3, collected from roadside ditch 21 miles SE Lawrence, Kansas, February, 1948.
Magnifications are approximate.
Transmitted June 21, 1948.

very long, small comb and lateral seta on furcal ramus.

Local occurrence and ecology: Not previously reported for Kansas; *C. bicuspidatus thomasi* is common in most bodies of water in eastern Kansas. Depth, temperature and pH of water appear to have little effect upon the presence of *thomasi* in pools since collections of it have been made under a wide variety of conditions. *C. thomasi* swims with quick strokes of the foliaceous swimming feet.

General distribution: Abundant in the Great Lakes and lakes of the northern states; common in certain bodies of water in North Carolina (Yeatman, 1944: 54).

Cyclops vernalis Fischer

Plate V, Fig. 31.

Cyclops vernalis Fischer, Bull. Soc. Nat. Moscou, 26 (1) : 90, 2 pls. 1853.

Recognition characters: Body elongate, slender; never more than two mm. in length, exclusive of furcal setae; posterolateral angles of dorsum of next to last thoracic segment extended outward; posterior margins of abdominal segments usually not serrated, if so, very slightly; furcal rami without hairs; innermost terminal seta of furcal ramus shorter than furcal ramus; first antennae with 17 segments; aesthete at distal end of twelfth segment of fifth foot apical and jointed.

Local occurrence and ecology: Not previously reported for Kansas; *C. vernalis* occurs commonly in most temporary pools and ponds in eastern Kansas in vernal, estival and autumnal seasons, and is especially numerous in vernal and autumnal rain-pools. Samples of water taken from pools in winter usually contain no adult individuals of this species, but after one or more weeks in the laboratory adults have been observed swimming about in the water. It may be assumed that eggs in the water hatched in the laboratory.

General distribution: Widely distributed in America; found from Arctic Alaska to southern Mexico and from the Atlantic to the Pacific Ocean (Yeatman, 1944: 34).

Eucyclops agilis (Koch)

Plate V, Fig. 33.

Cyclops agilis Koch, Deutschlands Crustaceen, 21: 11. 1838.

Recognition characters: First antennae with 12 segments; lateral margin of furcal rami of female bearing row of spines; furcal rami long. The presence of a row of spines on the lateral margin of each furcal ramus on this animal separates it from all other copepods (Hoff, 1944: 23).

Local occurrence and ecology: Not previously reported for Kansas.

E. agilis occurs frequently in shallow pools such as ditches along roadsides and railroad fills in eastern Kansas. It appears in spring, summer and fall, but is most abundant in spring. This animal has not been found during severe winter weather, but it may appear as early as February if the water is not frozen. It apparently reaches its peak of reproduction in May, decreasing in numbers during the summer months when the water in most pools in eastern Kansas has dried-up or is very low.

General distributions "Found everywhere the world over" (Marsh, 1918: 779).

Attheyella illinoisensis (Forbes)

Plate V, Fig. 34.

Canthocamptus illinoisensis Forbes, Bull. Illinois Lab. Nat. Hist. 1 (for 1876-83): 14-15, figs. 23, 26, 27, 31. 1884.

Recognition characters: Body slender and cylindrical, urosome passing insensibly into metasome; first antennae of male composed of seven segments; fourth very short, anterior angle of third produced, the blunt process bearing three long bristles surrounding a slender olfactory club which is as long as the three following segments; penultimate segment of first antenna of male bearing strong spine or slender appressed process at middle of posterior margin; distal segments forming a grasping organ; first antennae of female composed of eight segments; fifth pair of feet, best developed in female, having sub-elliptical basal segment with basal half produced externally into a broad, triangular process bearing second segment on posterior margin; free end of basal segment bearing six large plumose bristles of which inner is longest; second or outer segment of fifth foot ovate, sub-truncate, spined on each margin and bearing four plumose bristles at tip and one at center of outer margin.

Local occurrence and ecology: Not previously reported for the state. *A. illinoisensis* has been found during the spring at two localities in eastern Kansas: a shallow pool near a drainage ditch two and one-quarter miles northeast of Lawrence, Kansas and a very shallow stream fed by a spring about one mile northwest of the west edge of the University of Kansas campus. ***A*** *illinoisensis* apparently is not common in eastern Kansas. Little is known about its ecology in eastern Kansas; however, it is worthy of note that both localities from which ***A.*** *illinoisensis* was taken were shallow pools; in the one instance, running water and the other, standing, but not stagnant water.

General distribution: Found in a pool fed by a slowly running spring in March and April at Normal, Illinois (Forbes, 1876: 16).

Mancasellus ? sp.

Plate V, Fig. 38.

Recognition characters: Body depressed, dark gray in color with splotches of lighter color; head fused with first thoracic segment; eyes sessile; first antennae short, basal portion composed of two segments, flagellum of seven or eight segments; second antenna long, composed of basal portion of four segments and flagellum of numerous proximal ring-like segments and elongate distal segments; mandibles lacking palps, but with a stout chisel-like process on inner margin, and distal portion bearing four to seven teeth; thoracic segments closely articulated, lateral margins fringed with short setae; seven pairs of thoracic appendages, first pair subchelate; propodus of male gnathopod enlarged, bearing three distinct tooth-like processes on the anterior margin; first process small and rounded, second or middle process approximately three times as long as first, third or distal process approximately four times as long as first; uropods terminal, biramous; first and second pleopods of male free; dactyli of last six pairs of thoracic appendages uniungiculate.

Local occurrence and ecology: Not previously reported for Kansas. This isopod is found commonly along the borders and on the bottom of most shallow bodies of water in eastern Kansas. It is a bottom feeder, crawling along on blades of grass and other bottom growing vegetation in pools. Large numbers of this animal may be found in groups under decaying vegetation on the bottom of pools and streams. Examples have been collected under a wide variety of conditions. It is very abundant in the spring, disappearing in the summer when pools dry-up and reappearing in the fall shortly after the first fall rains.

General distribution: Unknown. A communication from Dr. Leslie Hubricht (August 9, 1947) states that the genus *Mancasellus* is being revised and that a new generic name will then be available for local examples of this animal.

Caecidotea tridentata Hungerford

Plate V, Fig. 37.

Caecidotea tridentata Hungerford, Kansas Univ. Sci. Bull. 14: 175-181, 1 pl. October, 1922.

Recognition characters: Body long, narrow and chalky white; head large, wider than long but narrower than first thoracic segment; first antennae or antennules composed of basal portion of three segments and flagellum of 12 to 18 segments; second antennae relatively large, consisting of basal portion of six segments and flagellum of numerous closely joined segments; mandibles bearing large flattened palp of three segments and

two chitin-tipped processes, one with chisel-like cutting edge and other equipped with four to seven teeth; thoracic segments loosely articulated, lateral margins fringed with short stout setae; seven pairs of legs on thorax, first pair subchelate; propodus of first foot on male enlarged, with prominent processes on anterior margin, one at base and two near distal end of margin; dactyli of last six pairs of thoracic appendages uniungiculate; telson longer than wide; uropods twice as long as telson and composed of long basal segment and two terminal branches of unequal length.

Local occurrence and ecology: This animal is fairly common in cisterns, wells, springs, and shallow rocky streams in eastern Kansas. Hungerford (1922: 175-181) described this species from a cistern in Lawrence, Kansas and states (p. 178) that specimens in the National Museum, Washington, D. C., were collected in Topeka, Kansas, April 9, May 4, 12, and 29, 1912 and donated by E. A. Popenoe. Specimens of *C. tridenta* were invariably collected under decaying vegetation or rocks in localities where they were found. When the vegetation or rocks under which *tridentata* was hiding were moved, individuals were seen to crawl away in search of new cover. Although eyes are absent in this animal, it seems sensitive to light. Individuals exposed to light in a laboratory aquarium, free from dead vegetation or other materials which might offer protective covering, were observed to crawl rapidly about on the bottom of the aquarium moving the antennae furiously. When leaves or stones were added to the aquarium, these individuals immediately took refuge under them. This behavior might be explained as a tactile response. Hoffman (1933: 31) reports that *C. tridentata* feeds upon insects and Crustacea that fall into and die in water, and that it is often cannibalistic.

General distribution: Unknown.

Armadillidium vulgare (Latreille)

Plate V, Fig. 35.

Armadillo vulgare Latreille, Hist. Crust., 7: 48. 1805.

Armadillidium vulgare, Budde-Lund, Crustacea Isopoda Terrestria per families et genera et species descripta, pp. 1-319. Hauniae. 1885.

Recognition characters: Body oval, depressed, more than twice as long as broad, first antennae rudimentary; second antennae short; uropods terminal, exopod large and lamellar, inner branch narrow and elongate, but not extending beyond extremity of abdomen; body colored dark gray or brown, splotched with lighter colored areas.

Local occurrence and ecology: Not previously reported for Kansas. *A. vulgare* occurs in damp places in the spring and fall. It is found under

rocks and decaying vegetation, in gardens and basements and other situations that afford moisture and shelter. Activity is confined to spring, summer, and fall. In eastern Kansas, apparently *A. vulgare* hibernates about the time of the first frost, reappearing as early as February if the ground thaws. These animals are terrestrial in habit.

General distribution: "Old World origin, but now found throughout much of the world inhabited by civilized man" (Van Name, 1936: 278); "Entire America; cosmopolitan; under stones, in damp places" (Blake, 1935: 443) ; "World wide in distribution" (Richardson, 1905: 666).

Hyalella knickerbockeri (Bate)

Plate V, Fig. 36.

Allorchestes knickerbockeri Bate, Cat. Amphip. Crust. Brit. Mus., p. 36. pl. VI. 1862.

Hyalella knickerbockeri, Smith, Rept. U.S. Fish Comm. 1872-73, p. 645-647, pl. 11. 1874.

Recognition character: Body laterally compressed; first thoracic segment united with head; seven pairs of free thoracic segments all bearing appendages of which first two pairs are subchelate, second pair much larger than first; periopods equipped with gills; last three pairs of pleopods adapted for jumping; posterodorsal margin of first two abdominal segments extended to form spines; first and second antennae long, second considerably longer than first.

Local occurrence and ecology: Not previously reported for Kansas. *H. knickerbockeri* occurs in pools well stocked with *Ceratophyllum.* Collections of *H. knickerbockeri* have been made from a permanent pool on the University of Kansas campus in spring, summer and fall. It is most abundant in the pond in spring in areas where vegetation is abundant. Dead stalks of *Typha* have long straight tubes in which *H. knickerbockeri* may live. This animal is a rapid swimmer, using the last three pairs of pleopods for jumping through the water. It feeds on micro-plankton.

General distribution: "In fresh-water ponds in eastern and central states, where it is one of the two common freshwater amphipods" (Pratt, 1935: 428). According to Ortmann (1918: 843) this species is found in rivers, ponds and lakes from Maine to Florida and California, southward into Central America.

Glossary

Aesthete—sensory hair on the first antenna of copepods.
Anal *spines—spines* bordering the anal opening, if distal to the anal opening, called post-anal spines.
Antenna—(-ae, plural) a jointed appendage of the head.
Antennule—(-s, plural) small antenna.
*Antenniform—*cylindrical, shaped like an antenna.

Antipenultimate—the third from the last segment of an appendage.
Apex—the tip of a process or structure.
Apical—of or pertaining to the apex of a process or structure.
Asymmetrical—without symmetry, the two sides being unlike.
Bidentate—possessing two tooth-like processes.
Bifurcate—divided into two forks or branches.
Biramous—having two rami or branches.
Bivalve—a shell composed of two lateral halves enclosing the body of some crustacea.
Branchial—pertaining to structures used in respiration.
Brood pouch—the dorsal portion of the carapace in the Cladocera; the basket formed by the flat projections of the thoracic legs of the isopods, used for carrying young.
Carapace— a shell-like covering of the anterior portion of the body of a crustacean.
Caudal—pertaining to the post-anal portion.
Cephalothorax—the fused head and thorax or chest region of the copepods.
Cercopods—tails or caudal extensions.
Cervical sin us—a grove between the head and carapace of the Cladocera.
Chelate—forming a pincer.
Cheliform—having the shape of a pincer.
Chitinous—containing chitin, a hard substance which forms the external skeleton of the Crustacea.
Clasper—the second antenna of the male fairy shrimp which is modified for grasping the female in mating.
Compressed—flattened, or reduced in breadth.
Confluent—flowing together.
Conical—cone shaped.
Dactylus—(-i, plural) toe or claw of walking feet of Crustacea.
Denticulate—possessing denticles or tooth-like processes.
Depressed—bent downward or dorsoventrally compressed.
Digitiform—shaped like a digit or finger.
Distal—away from the central axis of the body.
Ellipsoidal—oblong with rounded ends.
Endopodite—the inner branch of the biramous appendages of the Crustacea.
Exopodite—the outer branch of the biramous appendages of the Crustacea.
Filiform—having the shape of a thread or filament.
Foliaceous—leaf-like in shape.
Fornix—(-ces, plural) a supporting ridge over the antenna of some of the Cladocera.
Frontal appendage—an extension from the front of the head or base of the second antennae of the Anostraca.
Furca—(-ae, plural) a fork of the tail; same as cercopod.
Fusiform—spindle shaped.
Geniculate—knee-shaped, or bending like a knee at the joints.
Gnathopod—a modified thoracic appendage used in grasping or holding food.
Hyaline—transparent, glassy in appearance.
Lamella—a thin sheet or plate.
Laminate—plate-like in appearance.
Lobosity—having or appearing to have lobes.
Masticatory—pertaining to the grinding of food.
Metasome—the combined head and thorax segments of the copepods.
Natatory—used in swimming.
Ocellus—a simple immovable eye spot.
Olfactory club—a sensory spine on the antenna of some copepods.
Operculum—a covering or plate as for example, that covering the gills of the aquatic isopods.
Palp—a feeler or sensory organ attached to the jointed appendages.
Peaen—a comb or comb-like structure having processes resembling the teeth of a comb.
Pectinate—comb-like, having a pecten.
Penultimate—the next to the last segment of an appendage.

Periopod—a walking foot, or thoracic appendage.
Pleopod—abdominal appendage used for breathing, locomotion, or carrying eggs.
Plumose—feather-like, resembling a plume.
Podomeres—segments of an appendage.
Post-abdomen—*the* unjointed portion of the abdomen posterior to the swimming feet of the Cladocera.
Post-anal—*distal* to the anal opening.
Prehensile—adapted for grasping or holding.
Propodus—*enlarged* distal segment of the gnathopod.
Proximal—toward the central axis of the body.
Punctate—*covered* or studded with small depressions, pits, spots of color.
Pustule—*an* elevation resembling a pimple or blister.
Quadrate—*four* sided.
Ramus—*(4,* plural) a branch.
Reticulated—*netted,* having the form or appearance of a net-work.
Retractile—*capable* of being withdrawn.
Rostrum—*a* beak or extension of the head.
Sessile—*fixed* or sedentary as for example, eyes without stalks.
Seta—*(-ae,* plural) a small hair-like process.
Setose—possessing setae.
Sigmoid curve—*an* S-shaped curve.
Spatulate—*flattened,* resembling a spatula.
Spinose—possessing spines.
Spinules—small spines.
Subchelate—ultimate segment of an appendage bent back upon the penultimate segment.
Subelliptical—*not* completely elliptical, suggesting ellipticalness.
Telson—*the* last body segment, usually modified.
Triarticulate—*three* jointed.
Trilobed—*having* three lobes.
Truncate—*having* the appearance of being broken off.
Tubercles—*small* rounded elevations resembling pimples, same as pustules.
Tumid—swollen, enlarged.
Ultimate—*the* last segment of an appendage.
Umbo—*(-bone,* plural) an elevation or prominence of a valve of a bivalve shell near the hinge.
Uniramous—*having* one branch.
Uniungiculate—*having* a single terminal claw.
Uropod—*one* of the last pair of pleopods, modified.
Urosome—*the* abdomen and furcae of the copepods.
Vertex—dorsum of the head.

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