



# Papers on the Crustacea of the Fresh Waters of Minnesota.

BY C. L. HERRICK.

- I. *Cyclopidæ of Minnesota with notes on other Copepoda.*
- II. *Notes on some Minnesota Cladocera.*
- III. *On Notodromas and Cambarus.*

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## I CYCLOPIDÆ OF MINNESOTA, with notes on other Copepods.

## CALANIDÆ.

It seems that recent authors have sufficient ground for uniting the families *Calanidæ* and *Pontellidæ* under the single name; the value of these terms as subfamily names even may be questioned.

The family is represented in our limits by two genera and by three, or doubtfully more species.

The fifth pair of feet furnishes, by its modifications, the best criteria for distinguishing genera and species.

## Genus DIAPTOMUS, Westwood.

Body elongated, compressed; head distinct from the thorax, anterior antennæ 25-jointed, those of the male geniculate on the right side; posterior antennæ and mouth parts as in *Calanus*: inner branches of all the swimming feet three-jointed except the first, which is two-jointed; fifth foot consisting of two unequal branches, prehensile; abdomen of male with five-joints, of female three-jointed.

## DIAPTOMUS CASTOR.

(Plate I, figs. 1-7, Plate II, figs. 1-2, 16.)

*Bibliography.*

- Monoculus castor, *Jurine*.  
 Cyclops castor, *Desmarest*, *Baird*, Mag. Zool. and Bot.  
 Cyclops cæruleus, *Muller*, *Latreille*, *Bosc*.  
 Monoculus cæruleus, *Fabricius*, *Manuel*, *Gmelin*.  
 Cyclops lacinulatus, *Muller*, *Ramdohr*, *Latreille*, *Bosc*, *Baird*, Trans.  
 Beow. club.  
 Monoculus lacinulatus, *Manuel*, *Gmelin*.  
 Cyclops rubens, *Muller*, *Latreille*, *Bosc*, *Baird*.  
 Diaptomus castor, *Westwood*, *Baird*, *Baker*.  
 Cyclopsina castor, *M. Edwards*, *Baird*, *Claus*.  
 Glaucæ rubens, *Koch*, Deutschlands Crust.  
 Glaucæ cærulea, *Koch*, " "  
 Diaptomus castor, *Baird*, Brit. Entom.  
     *Claus*, Die Freilebenden Copepoden.  
     *Lilljeborg*, De Crust, ex ord. trib.  
     *Lubbock*, Trans. Linn. Soc.  
 westwoodii, *Lubbock*, " " "  
 castor, *Fric*, Die Krustenthierie Böhmens.  
 castor, *Brady*, Brit. Copepoda.

The above bibliography is complete only up to a comparatively recent date; many notices may be found in recent literature.

The species which, after careful study, has been considered identical with the European *D. castor* is that described previously as *D. longicornis* with the remark that it might prove too near *D. castor*. *D. sanguineus*, Forbes, seems to be the same thing nearly. If the amount of variability admitted by Brady to prevail is allowable I see no reason for separating this species. It is very variable as to size and coloration, and even in the configuration of some of the parts, as antennæ, etc., a certain amount of latitude is to be given; (See plates of Claus, Zur Anatomie und Entwicklungs-geschichte der Copepoden Arch. f. Naturg. XXIV Jahrg., B I.)  $\frac{1^4}{100}$  -  $\frac{1^8}{100}$ ; cm. in length. The following points are variable:—length of caudal stylets, structure and thickness of male geniculating antenna, size of claw of fifth male foot and spinous armature of feet. How far such variations may extend and how much they are dependent on peculiarities of habitat, etc., farther study must demonstrate. Some interesting facts meanwhile are suggestive. A second and gigantic form which may be known as

### *Diaptomus giganteus*.

(Plate II, figs. 3-11-15.)

with the reservation that it is doubtfully of more than varietal value, was found under such circumstances as to suggest that it might be only a curiously magnified condition of *D. castor*. It is known to occur only in a small marshy pool of about two square rods extent and which annually dries up nearly completely. A few yards away is a second pool of a somewhat greater size and which less frequently dries up in summer. These two pools within the memory of the writer were united, but in the gradual dessication which has been observed in all Minnesota, they have been isolated. The former pool in June was found to contain *mature* males and females of the *D. giganteus* only, few other copepods being present, while the other pool contained *all stages* of the common *D. castor*. There are no neighboring waters, the nearest being half a mile, and that (L. of Isles) has only *D. castor*.

The smaller pool soon completely dried up so that this form was, for the time, exterminated. The conclusion seems almost resistless that the stagnation incident to evaporation produced circumstances favorable to the development of this enlarged form. At any rate it is an interesting fact in local distribution

This variety is  $\frac{3}{10}$  cm. long or more, and is much the largest fresh

water copepod known to me; it is a deep red in color and very compactly framed. Although so much larger than *D. castor*, it is almost impossible to find any structural differences. The male fifth foot differs somewhat, but mainly in the enlargement of one part at the expense of the others. The thorns on the feet are strongly pectinate and the larger ones bear short spines instead of bristles.

*Diaptomus armatus*, sp. n.

(See accompanying cut.)

A second form is imperfectly known, but presents some clearly marked distinctions which may have specific value.

Length about as *D. castor*; body slender; antennæ reaching base of abdomen only; female differing otherwise but little from *D. castor* (?); male considerably smaller; caudal stylets narrow; antennæ peculiar, shorter than the body; thickened portion of the geniculate antenna short; two last joints very short; one preceding the second long, bearing a hook at end; fifth foot with a very long claw to longer ramus (nearly as long as the ramus itself) with a tooth on the inner margin near the base, not perfectly arcuate, reaching, when extended, to end of caudal setæ.

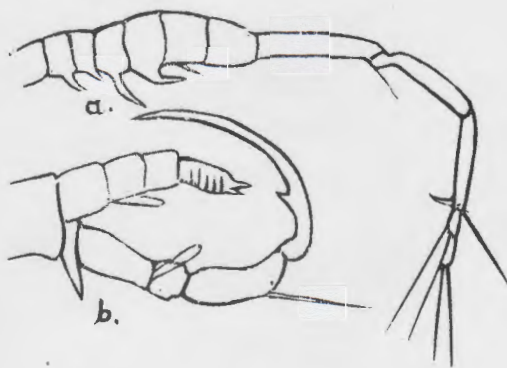


Fig. 1.

*Diaptomus armatus*.

a. part of male antenna. b. fifth foot of male.

Genus POTOMOICHETOR,\* Gen. nov.

Cephalothorax six-jointed as in *Diaptomus*, but with the distal segment more evident; abdomen, in the male, five-jointed, in the female

\*River inhabitant.

*four-jointed*; antennæ *twenty-four* jointed, the right geniculated as in *Centropages* (= *Ichthyophorbia*); first pair of feet with the rami *both three-jointed*, like the following; feet of the fifth pair, in the female, like the preceding, but with a spine of the joint preceding the terminal one enlarged and divaricated somewhat as in *Centropages*; in the male, the right with a two-jointed outer ramus, the terminal joint of which is spined and bears near its base a blunt expression of its inner margin; outer ramus of left foot three-jointed, armed with unequal spines; inner branches smaller, similar, three-jointed; the terminal joint bearing curved spines; ovary and testes as in *Diaptomus*, with which the mouth parts agree in the main; eyes medium, confluent; no lower or secondary eye-spots.

POTOMOICHETOR FUCOSUS, sp. nov.

(Plate II, Figs. 12-14. Plate III, Figs. 1-8, 13-14.)

Rather slender, and in size, as well as general appearance, resembling the smaller forms of *Diaptomus castor*; antennæ rather stout, reaching but little beyond the feet, appendaged as in *D. castor*, in the male strongly geniculated, but somewhat variously so; the six joints preceding the terminal four are thickened; those preceding the joint or hinge are arcuate on the distal margins; the secondary antennæ are about as in *Diaptomus*; mandibular palp two-branched; the outer three-jointed, the inner two-jointed; the terminal joint of the shorter branch bearing seven setæ, of the other four, the proximal joint of the former with three stout spines; the maxillæ nearly like *Diaptomus*; the processes have respectively the following numbers of setæ: the basal plate eight, the small process at base of posterior branchial appendage one, the appendage itself twelve, terminal portion three groups, first containing nine, the second three and the third four or five, the upper of the anterior processes two and the lower three; fifth feet nearly like the others in size; the right in the male having the outer branch but two-jointed by the coalescence of the two outer to form an arcuate and deformed appendage armed at the end with three stout equal spines; corresponding branch of left foot three-jointed; the terminal joint bearing three unequal spines, each of the preceding but one; inner branches similar, three-jointed; terminal joint being short and armed with three short lanceolate setæ and three longer ones, two of which are curved so as to be slightly prehensile; fifth foot of female with both rami three-jointed; inner ramus much smaller; antepenult

segment of the outer ramus extending into a large lanceolate process; ova sac long-ellipsoidal reaching to nearly the end of caudal setæ.

This species prefers running water or estuaries of streams. Crow river, Meeker county, and a brook between Minneapolis and St. Paul.

#### NOTE ON CANTHOCAMPUS.

Claus says (*Freilebenden Copepoden*, p 121) that he could not find the coiled "shell gland" in *Canthocampus*, though it is described by Leydig. I have found it in a European species, (*C. minutus?*) and think it constant. *Canthocampus* also has a singular area of nervous hairs upon the forehead, and in the same situation, pits which seem rudimentary eye-spots and sometimes appear to be pigmented. The pentagonal area mentioned is bounded by a raised line.

#### CYCLOPIDÆ

Contains five genera, viz.: *Thorellia*, *Cyclops*, *Oithona*, *Lophophorus* and *Cyclopina*; passing, by the genera *Misophria* and *Pseudocyclops*, into the *Calanidæ* or marine copepods. The affinities of these little studied genera need further study, as they are very interesting, the question being still open in how far the cyclopoid forms are altered by adaptation to saline habitat, if such an adaptation takes place at all.

The following is Brady's definition:

Cephalothorax ovate and usually much more robust than the abdomen; anterior antennæ seldom longer than the cephalothorax, those of the male alike on both sides and modified for the purpose of clasping; posterior antennæ branched (i. e. palpus wanting); palps of mandibles and maxillæ usually well-developed; foot-jaws mostly less developed than in *Calanidæ*; first four pairs of feet as in *Calanidæ*, fifth pair rudimentary, alike in both sexes, and usually one-jointed; ovisacs two.

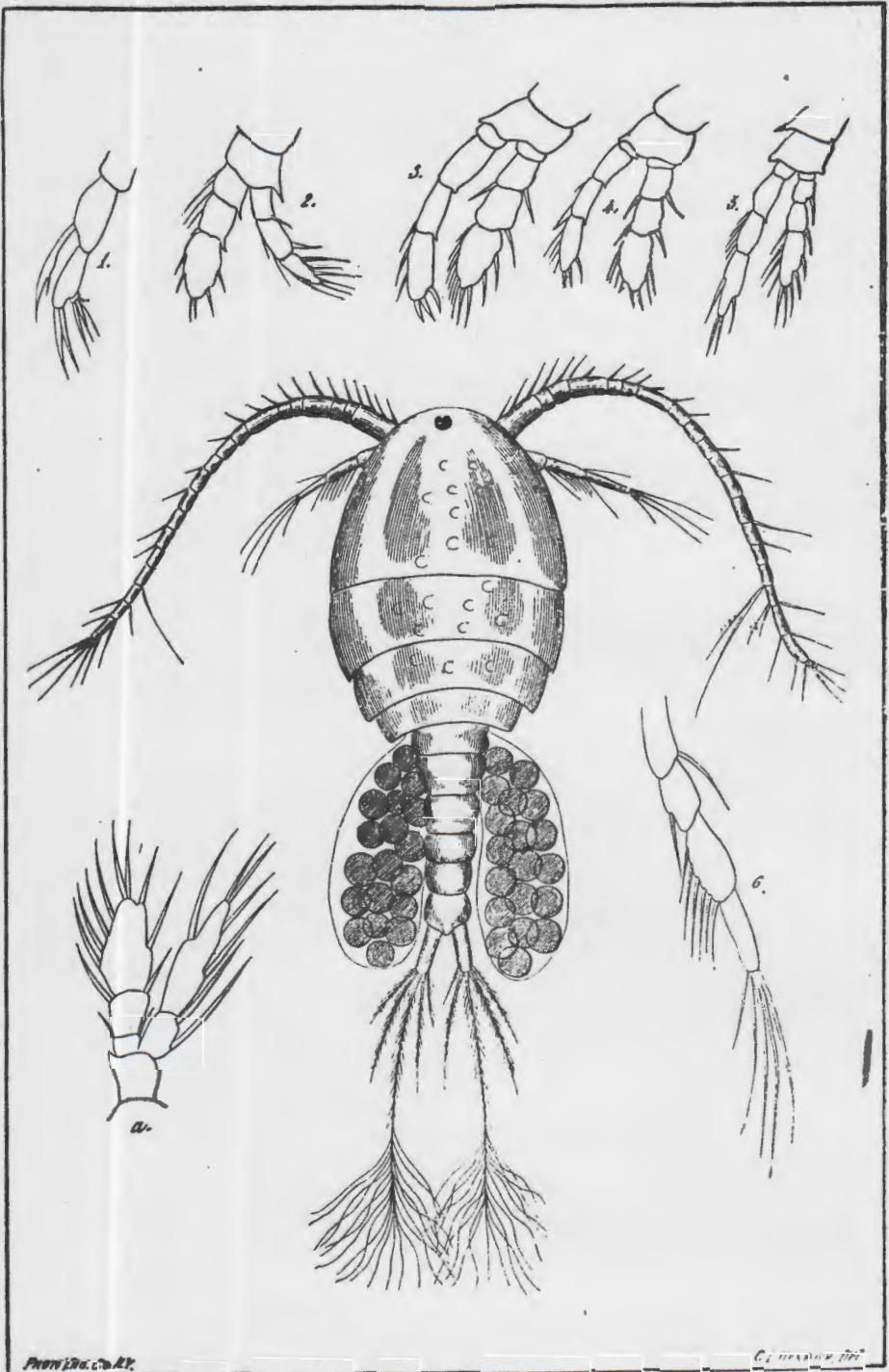


Fig. 2.

Unicomplicated caudal setae.

## Genus CYCLOPS.

Brady well says of this genus: "As regards discrimination of species it is, perhaps, the most difficult and puzzling of all the Copepoda." He also states that "the only safe rule in this state of things is to accept no specimens as types which do not show amongst them ova-bearing females." It is necessary, however, to limit the matter more closely, as will be shown farther on, for not only do immature females become fruitful even while the antennæ are yet incompletely developed, but the species are subject to a sort of dimorphism which it is interesting to parallelize with that in the males of *Cumburus*. The species are all fresh-water, so far as it is at present known, though it may be that salt-water forms exist under other names.

The characters of the family with some limitations apply to the genus.

The following species are probably but few of those which occur even in Minnesota, but they are so clearly defined, for the most part, as to be unmistakable and their description it is hoped will form a foundation upon which to lay later study.—Observations extend over a term of about four years.

*Species with seventeen-jointed Antennæ.*

## CYCLOPS TENUICORNIS, Claus.

*Bibliography.*

Plate VI, figs. 1-11, 20. Plate V, fig. 14.

*Cyclops tenuicornis*, Claus, Das Genus Cyclops.

Die Frei-lebenden Copepoden.

Sars, Oversigt af de Indenlandske.

Ferskvands Copepoder.

Uljanin, Reise in Turkestan.

Brady, British Copepoda.

*Cyclops signatus*, Koch, Deutschlands Crust.

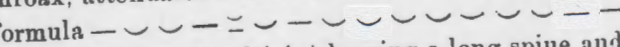
G. O. Sars. Uljanin. Brady.

*Cyclops coronatus*, Claus. Fric.

We feel confident that the two forms distinguished by Claus as *C. coronatus* (= *signatus*) and *C. tenuicornis* should be united, as the only distinction which is at all reliable, is the knife-like serrated ridge on the last joint of the antennæ. The last joints are frequently longer in *tenuicornis* form, as are the stylets in *coronatus*, but this varies. In the



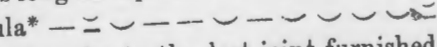
same gathering (for in so far as we have observed they occur together where circumstances permit a full development,) the *coronatus*-form is larger and carries more numerous eggs. No young with the serrated antennæ have been seen, though searched for diligently. On the other hand young forms of *tenuicornis* abound, and we have seen females with incompletely grown antennæ with egg-sacs. In view of these and similar facts, we feel justified in considering *coronatus* probably a post-*imago* of *tenuicornis*.

Cephalothorax broad; abdomen rather slender; antennæ reaching about to base of throat, attenuated at the end; terminal joint with a knife-like ridge; formula —  —; fifth foot composed of a long basal joint bearing a long spine and a terminal three-spined division; caudal stylets over twice as long as last abdominal segment; setæ all nearly terminal, inner one much longer than usual, length  $\frac{25}{100}$  cm.

Common in America, England and continental Europe.

#### CYCLOPS ATER, n. sp.

(Plate III, figs. 9-12.)

Length about  $\frac{21}{100}$  cm; antennæ as long as cephalothorax,  $\frac{12}{100}$  cm., slender and gradually tapering; formula\* —  —; terminal joints rather short; the last joint furnished with a knife-like ridge as in *tenuicornis*; second antennæ much as in *tenuicornis*; maxillipeds rather large; fifth foot one-jointed, armed with three subequal spines; abdomen rather short, last segment very short; stylets somewhat elongated; setæ rather short, lateral seta near the end; eggs pale; color deep blue or gray.

This beautiful and very distinct species is found in "Mud Lake" in Hennepin county, with *Cyclops signatus*. The large very dark cephalothorax and shortened abdomen make it conspicuous. The one-jointed fifth foot, shape of the operculum vulvæ in connection with the shortened joints of antennæ and characters of the caudal stylets, make the species sufficiently distinct from any other.

#### CYCLOPS INGENS, sp. nov.

(Plate IV, figs. 1-8.)

A large species perhaps too near *C. gigas*, or *C. brevicornis* Claus, but differing from the former as to the length of antennæ and stylets

\*NOTE. The accent marks are used to signify that joints represented by them (counting from base) are either long —, short  $\smile$ , medium  $\simeq$ .

and in not having the distal margins spined (except in some cases?) and from the latter in size and arrangement of caudal setæ.

Thorax large; abdomen rather slender; stylets rather slender with the lateral seta well towards the end; second and third setæ alone long, weakly pectinate; last joint but one of abdomen sometimes toothed along the distal, under margin; maxillipeds as in *C. gigas*; jaws with large teeth; antennæ very short not reaching to the base of the first cephalothoracic segment; formula —  $\bar{\bar{}} \cup$  —  $\bar{\bar{}} \cup$  —  $\cup \cup \cup$   $\cup \cup \cup \cup \bar{\bar{}} \bar{\bar{}}$ ; fifth foot two-jointed, the proximal joint very broad with a strong spine, second joint cylindrical with a long seta and a very short spine near the end; operculum vulvæ somewhat heart-shaped; egg sacs oval-elongated, reaching beyond the end of abdomen; length  $\frac{4}{10}$  cm. including stylets and setæ.

This is one of the largest and finest as well as rarest of our forms and loves, as it appears, lakes having outlets.

*Small forms with seventeen-jointed Antennæ.*

CYCLOPS NAVUS, sp. nov.

(Plate V, figs. 6-13-15-17.)

Closely related to *Cyclops pulchellus*, Koch, and to *Cyclops strenuus*, Fischer.

Rather slender; abdomen long; stylets about three times as long as last segment of abdomen; lateral seta rather stout; outer and inner terminal setæ minute; middle ones of moderate length; antennæ short, reaching barely to or but little beyond the end of first segment; formula —  $\bar{\bar{}} \cup$  —  $\bar{\bar{}} \cup$  —  $\cup \cup \cup \cup \cup \cup \cup \cup \bar{\bar{}} \bar{\bar{}} \bar{\bar{}}$ ; fifth feet two-jointed, terminal joint large, with two considerable spines; operculum vulvæ of peculiar shape; length  $\frac{11}{10}$  cm. excluding setæ.

Quite abundant and perhaps passing into the following.

CYCLOPS PARCUS, sp. nov.

(Plate VI, figs 12-15.)

Almost exactly like the last but not yet found in the same waters. Distinguished by the broad and short basal joint of the fifth foot which extends into a process carrying a spine, the slender second joint with a single long spine and a short thorn, and by the oval shape of the operculum vulvæ.

The caudal setæ are naked for about a third of their length. These distinctions seem constant.

*Section with twelve-jointed Antennæ.*

CYCLOPS SERRULATUS, Fischer.

(Plate V, figs. 1-5, Plate VII, fig. 10.)

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*Cyclops serrulatus*, Fischer Bulletin de la Soc. Imp. etc. Moscou.

Lilljeborg, De crust ex ord. trib.

Claus, Das genus Cyclops.

Sars, Oversigt Ferskvands Copepoder.

Frei-lebenden Copepoden.

Fric, Die Krusten thiere Böhmens.

Uljanin, Reise in Turkestan.

Brady, British Copepoda.

? *Cyclops minutus*, Claus, loc. cit. (young.)

? *Cyclops macrurus*, Sars, loc. cit.

? *Cyclops spinulosus*, Claus, loc. cit.

*Typical Form.*

Cephalothorax oval, compact; abdomen slender and short, suddenly enlarged previous to its union with the thorax; antennæ slender, reaching nearly, but not quite to the last thoracic segment; the last three joints are attenuated and furnish the most evident character of the species; formula  $\text{---} \text{---} \text{---} \text{---} \text{---} \text{---} \text{---} \text{---} \text{---}$ ; during life the antennæ tend to assume the form of a rude Z, the proximal four joints forming the base; antennules small, reaching about to the sixth joint of antennæ; jaws small with large teeth; the single segment of the fifth foot with three equal spines; egg sacs oval, as long as the abdomen; eggs few, dark; caudal stylets very long and slender, spined along the outer margin; lateral setæ small and approximated to the upper one; outer terminal seta short, spine-like, in life set nearly at right angles to the others, spined or beaded on one margin and bristled on the other; the next seta is as long as the abdomen, being somewhat exceeded by the following one; inner seta insignificant; upper seta very small; length less than  $\frac{1}{10}$  cm.

A larger form occurs with an elongated body and abdomen and with extremely attenuated antennæ and caudal stylets, but it is not a va.

riety induced by alpine habitat as suggested by Brady, occurring as a "post imago" form with the ordinary type. Claus' description of *Cyclops spinulosus* suggests that this form may be the basis of his species though the form of the male antenna is different from any yet seen. *Cyclops minutus*, Claus, is most certainly the young of some Cyclops, as is indicated both by the description and figures in *Die Freilebenden Copepoden*. Though placed among the twelve-jointed forms the antennæ are eleven-jointed. The fact that the females may have had egg sacs is no proof of their maturity as I have seen undoubted larval forms of *serullatus* with the sacs. Moreover *two-jointed branches of swimming feet* is a larval character. This is a cosmopolitan and very abundant species, occurring in almost all pools and lakes about Minneapolis. The form and structure of the stylets, antennæ and feet make it an easily recognized species.

CYCLOPS FLUVIATILIS, sp. nov.

(Plate VII, figs. 1-9.)

A very small and distinct species of the section with 12-jointed antennæ was found in an estuary of the Mississippi river, (also later in L. Minnetonka) with the following characters:—

Body elongated; thorax very long; abdomen slender; stylets about as long or longer than last abdominal segment; setæ all very short, not pectinate; lateral and dorsal setæ very small; outer one spine-like, short and stout, two middle short, inner one very small and inconspicuous; antennæ reaching nearly to the base of abdomen; formula, — 2 — — — — — — — — — —; the three joints following the six basal are much elongated while the terminal ones are but moderately so, a character which is peculiar to this species; terminal segment slightly but evidently hinged, and together with pair preceding somewhat curved; feet with the terminal spines strongly toothed; fifth foot very small, one-jointed, bearing three small setæ; operculum vulvæ heart-shaped; egg sacs subquadrangular; eggs large; abdomen in the young much elongated: color deep indigo, length  $1\frac{1}{10}$  cm.

CYCLOPS ADOLESCENS, sp. nov.

(Plate VI, figs. 16-20.)

The form figured under the above name seems closely allied to *C. affinis*, Sars, from which it differs chiefly in the arrangement of the joints of antennæ.

The body passes without marked transition into the abdomen which is abnormally shortened; caudal stylets very short as is the last segment of the abdomen; setæ exactly as in *C. parvus* with which it was found; antennæ eleven-jointed; formula — ◡ — ◡ ◡ — — ◡ — —; a semi-circular series of spines upon the basal joint; fifth foot obsolescent, the three spines appearing to spring directly from the last thoracic segment which also bears a series of teeth; egg-sac reaching to base of abdomen, with rather numerous eggs; feet heavily spined on one margin; length  $1\frac{1}{10}$  cm., male  $1\frac{0}{100}$  cm.

This species, together with all others of this sort with eleven-jointed antennæ, is perhaps but an immature and abnormally modified form of some of the common species. If this be true the rarity of these nominal species is explained. *C. minutus*, Claus, is certainly but a larval form, as is shown by the two-jointed branches of swimming feet.

*Section with 8-jointed Antennæ.*

• CYCLOPS CRASSICORNIS, Müller.

(Plate IV, figs. 9-14.)

*Bibliography.*

Cyclops crassicornis, *Müller*, Entomostraca.

*Sars*, Oversigt Ferskvands Copepoder.

*Uljanin*, Reise in Turkestan.

*Brady*, British Copepoda.

pauper, *Fric*, Die Krustenthierc Böhemens.

? magniceps, *Lilljeborg*, De crustaceis ex ordinibus tribus, etc.

A small species characterized by its small size and the eight-jointed antennæ; body depressed and passing gradually into the rather uniform abdomen; first cephalothoracic joint large; abdomen rather slender; stylets of moderate length, spined along the outer margin somewhat as in *C. serrulatus*; outer seta lance-shaped, short; the next one as long as stylets and last two segments; the following one nearly twice as long; inner one very small; last joint of abdomen spined; the preceding one fringed on distal margin with weak setæ; antennæ short, not reaching the base of first segment; formula — — — — ◡ ◡ ◡ — —; the basal joint with a semi-circular set of fine bristles, and with the following is furnished with pectinate setæ; second antennæ short; terminal joint short, with two curved, strong spines and other weaker ones; fifth feet small one-jointed with three unequal spines, bordered

above by a spined plate of the last thoracic segment; length about  $\frac{11}{100}$  cm. excluding setæ.

This species appears not to be very abundant, or at least from its small size it is not often encountered. A few particulars distinguish these western forms from the description given by Brady, among them being the spinous armature of the stylets, the bristles on the penultimate segment of the abdomen, pectinate bristles of the fifth feet, and the greater length of the abdomen, yet I see no reason for separating them. I have not seen the male and can not be sure that there is no further development, but the fact that the feet in this form are three-jointed, and its peculiar characters, clearly distinguish the species from any other known to me.

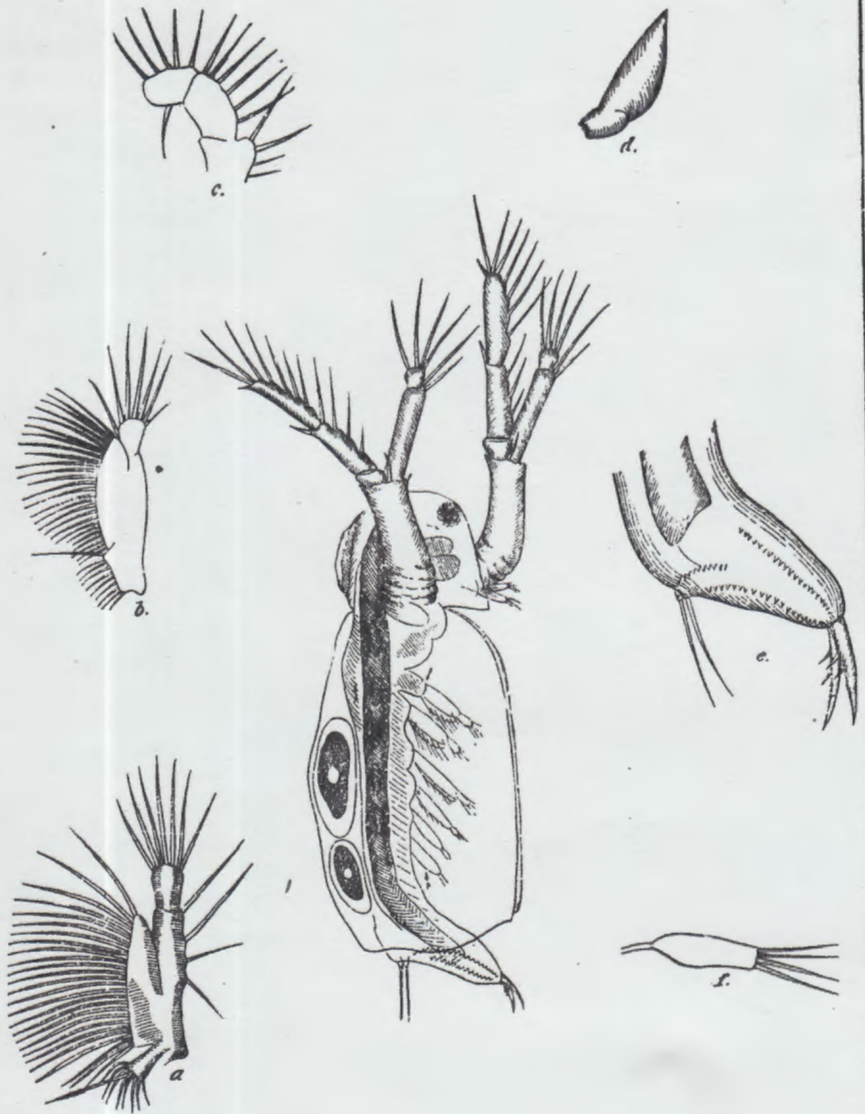


Fig. 3, *Sida crystallina*.

## II. NOTES ON SOME MINNESOTA CLADOCERA.

## Tribe I CTENOPODA.

## SIDIDÆ.

Antennæ of second pair with unequal rami, superior larger; last joints compressed and setose; intestine simple.

Of this family two species are certainly identified in America, both of which are abundant in certain favorable locations at the proper seasons. No species of the *Holopedidæ* are known to occur here.

## Genus SIDA Straus.

Superior ramus of second antennæ three-jointed; posterior margin of post-abdomen with numerous spines (20-30.)

## SIDA CRYSTALLINA, Müller.

(Fig. 3.)

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*Daphnia crystallina*, Latreille. Bosc.  
*Sida crystallina*, Straus, Mém. Mus. Hist. Nat.  
*Sida crystallina*, M. Edwards, Hist. Nat. Crust.  
*Monoculus crystallinus*, Gmelin. Manuel. Fabricius.  
*Monoculus elongatus* De Geer, Mém. servir Hist. Ins.  
*Sida crystallina*, Lievin, Branch. d. Danziger Geg.  
     Baird, Brit. Entom.  
     Lilljeborg, De crust. ex ord. trib.  
     Fischer.  
     Schödler, Die Branch. d. Umg. v Berlin.  
         Neue. Beitr.  
     Leydig, Naturg. d. Daph.  
     Sars, Norges Ferskv—Krebsdyr.  
     *elongata* Sars   "   "   "  
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     Weismann.



I note this cosmopolitan species, of which a nearly complete bibliography is given above, simply to mention that I have recently found for the first time specimens of *Sida* reaching the size mentioned by P. E. Müller ( $\frac{3.0}{1.00}$  cm.)

In smaller pools, when present our *Sida* is much (often  $\frac{1}{2}$ ) smaller, and only in L. Minnetonka does the species attain its ultimate development.

Genus DAPHNELLA.

Superior ramus of second antennæ apparently 2-jointed, narrow; post-abdomen destitute of spines.

DAPHNELLA BRACHYURA Lievin.

(Plate VII, 11-16)

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*Daphnella wingii*, Baird, Brit. Entom.

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*Daphnella brandtiana*, Sars, Norges Ferskv.—Krebsdyr.

*Daphnella brachyura*, P. E. Müller, Danmark's Cladocera.

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*Sida brachyura*, Pavesi, Nuova serie di ricerche della fauna pelagica nei laghi italiani, (L. Trasimens.)

(Compare also *D. expinosa*, Birge, Notes on Cladocera p. 3.)

The species of *Daphnella* found about Minneapolis, occasionally abundant, seems not to differ in any important character from European types of *D. brachyura* although I formerly regarded it as distinct (*D. winchelli*.)

Head less than one-half the body (about  $\frac{27}{100}$  cm. while body is  $\frac{60}{100}$  cm. long); eye about  $\frac{1}{4}$  head; antennæ when reflexed extend a little beyond  $\frac{2}{3}$  the length of body. Male  $\frac{7}{100}$  cm. long; antennæ reflexed reaching base of shell; anterior antennæ extremely long; copulating organs reaching nearly to end of claws. Having carefully compared our specimens with the description and figures given by Birge for his *D. expinosa*, the evidence seems to indicate not only that they are identical but both are really *D. brachyura*. The distinctive characters of *D. expinosa* are a greater indentation between head and body, absence of caudal teeth, greater length of male appendages, and the opening of the vasa deferentia in the "instep" of these appendages.

The absence of teeth upon the post-abdomen is of even generic importance according to Sars, who gives it in his synopsis of genera as typical for *Daphnella*. In our specimens the claws are at least pectinate if not serrate, while the appendages of the male reach generally nearly to the middle of the claws. The relative length of these appendages and the antennæ of male is variable.

## Tribe II, ANOMPODA.

### DAPHNIDÆ.

Rami of antennæ 3 and 4-jointed; feet of five pairs; intestine with anterior cæca not convolute.

#### GENUS MOINA, Baird.

A transition between *Sidida* and *Daphnida* is made through this genus.

Head separated from the body by a depression; macula nigra absent; antennæ of female large, movable, of male very long, curved; first foot of male with strong hook; valves short, truncate behind.

#### MOINA BRACHIATA.

We believe with P. E. Müller that this and *M. rectirostris* are identical. The most complete discussion of the merits of the three species (the above and *M. paradoxa*) is found in Weismann's paper, *Ueber einige neue oder unvollkommen gekannte Daphniden*, Grüber and Weismann, 1877, which see for bibliography and elaborate, not to say labored, distinctions. This species is not common, but when found (in muddy pools in late summer) frequently appears in great numbers. For embryology see *Grobber*, *Entwicklungsgeschichte der Moina rectirostris*.

#### GENUS DAPHNIA.

This genus as limited by Müller is well distinguished from the remaining genera of the family--*Simocephalus*, *Scapholeberis*, *Ceriodaphnia* and *Moina*.

As remarked by Birge, this is not the typical representative of the

group but is a very divergent member of it, worthy, probably, of forming a distinct section or sub-family. The most remarkable feature is one which appears in a comparatively early embryonic period and, in some cases, nearly disappears in later life. This is the development of a long spine from the dorsal, posterior end of the shell. This is the real diagnostic test and has not yet been incorporated into the definition of the genus. The occurrence of a crista is more variable apparently, but may be of some importance.

The following is suggested as a revision of the diagnosis:

Shell more or less oval or sub-quadrate and reticulate; head rounded anteriorly, but sometimes with a crest, prolonged below into a beak which is truncate posteriorly and bears the antennæ near the apex; upper dorsal corner of shell in young of both sexes and mature males prolonged into a long spine; the macula nigra is present but not always pigmented; the post-abdomen spined behind; opening of rectum at the end.

*The female* with two age-forms (heterogenetic and dimorphic); the second form frequently scarcely spined; antennæ small, not movable, furnished with sense-hairs; ephippium with two ova, separable from remainder of shell along the latero-median suture; the brood-cavity closed by more than two unequal processes of the abdomen.

*Male* with long movable (almost two-jointed) antennæ furnished with prehensile stylus; first foot bearing a curved claw; swimming antennæ very long; vas deferens opening at the end of post-abdomen. Embryo with second antennæ palpate; a curved appendage to shell which becomes the spine of adult.

#### DAPHNIA PULEX.

This species is mentioned here simply to remark concerning *D. pulex*, var *denticulata* of Birge, (Notes on Cladocera, p. 11, plate I, fig. 11,) that the European as well as all the American specimens of *D. pulex*, have a fine series of spines on the claws of the post-abdomen. A glance at Tafel XII, fig. 39, of the Zeitschrift für Wiss. Zoöl. Bd. XXXIII, with Weismann's plate of the end of the abdomen of this species, is sufficient evidence of this fact, though as the animal is a male and quite young, the spines are less evident; moreover the number of caudal teeth is known to be variable with age. Some other peculiarity must be found to give this varietal distinction validity.

## DAPHNIA sp?

(Plate X, figs. 15-16).

From a cold marsh a gathering in June, 1882, contained several females like that represented by fig. 16. They were far from being abundant, however, and the pool contained no other *Daphnia* showing that it was unfavorable to the growth of these animals.

These females differ from *D. pulex* chiefly in their small size, ( $\frac{14}{100}$  cm.) being the smallest *Daphnia* seen with an evidently mature appearance. The caudal spine is sickle-shaped; post-abdomen as in *pulex*; antennæ short; the animal beautifully clear and variegated by the brilliant contents of ovary, eggs and intestine. I hesitate to regard it as a distinct species.

Figure 15 represents a single specimen of *Daphnia* found with the above which was somewhat injured during its moult. This resembles *D. apicata*, Kurz, and *D. pellucida*, Müller, and is perhaps the male of the species represented by fig. 16. Our knowledge of the variations induced by environment is yet too meager to draw up definitions of species with certainty from a single gathering, but these forms are peculiarly interesting.

See also the accompanying figure, (fig. 4,). These forms merit closer study.

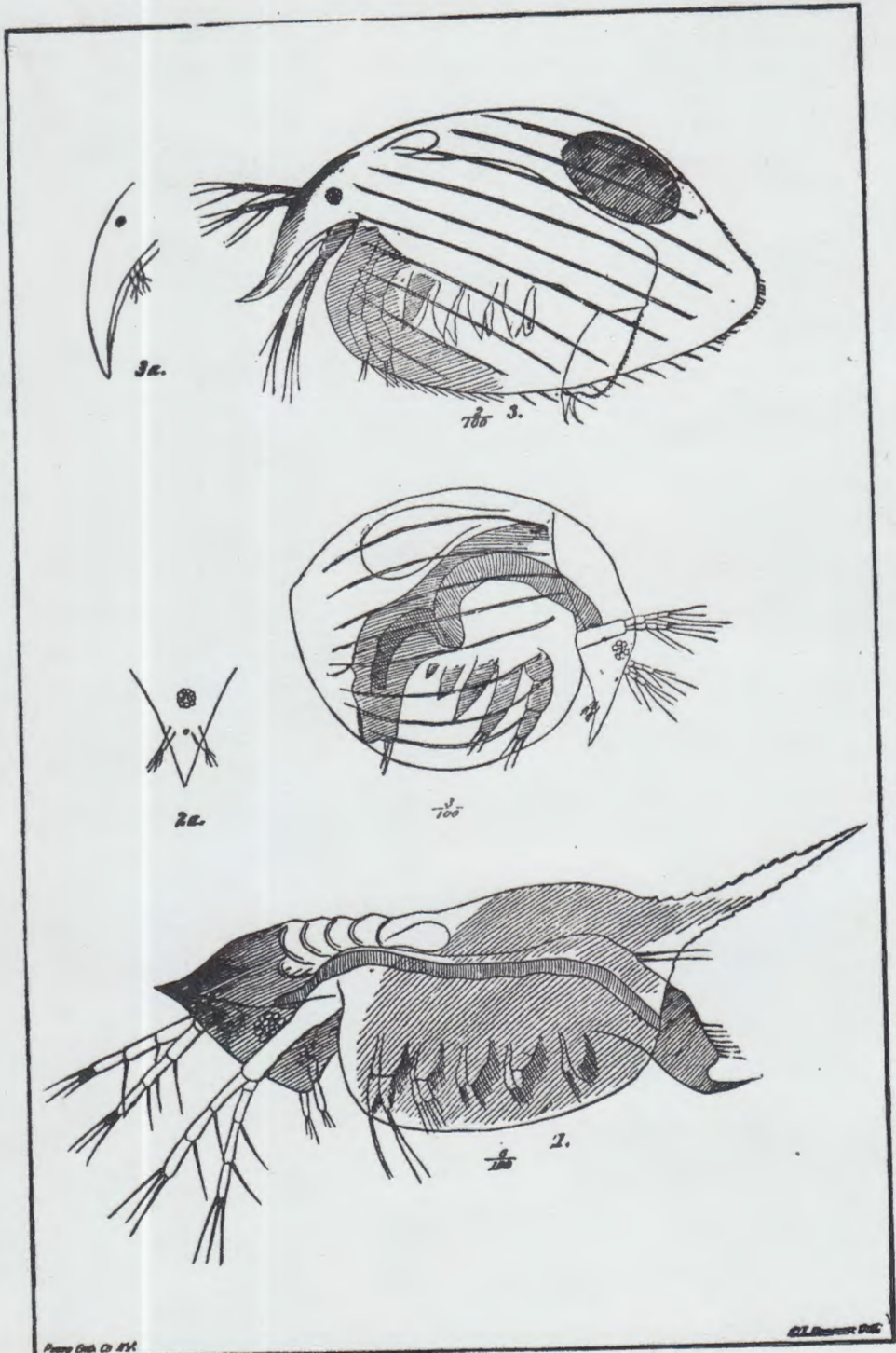


Fig. 4. *Daphnia longispina* (numbered 1) etc.

## SCAPHOLEBERIS, Schödler.

In a former paper *S. mucronata* was reported from this locality with the remark that only the unhorned variety seems to occur here. A rather diligent search has failed to find var. *fronte cornuto*, though our waters have been carefully searched at intervals for several years and at different seasons. Birge quotes only this variety. However, the species is not common and the other form may yet be discovered. See Fig. 5.

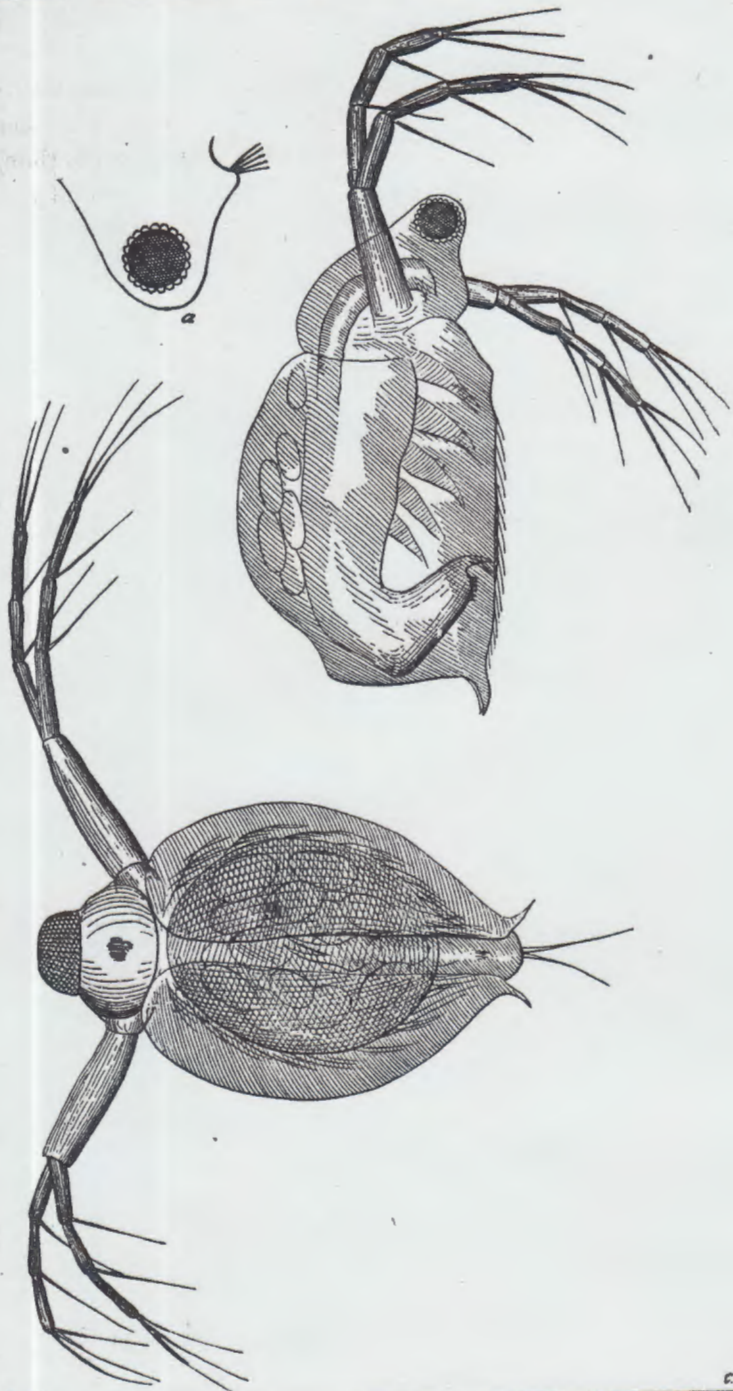


Fig. 5. *Scapholeberis mucronata*.

A second variety or species has been found which differs somewhat from typical *mucronata*, but does not appear to be *nasuta* of Birge. Is not the latter a variety simply?

SCAPHOLEBERIS ARMATA var. ? nov.

Length  $\frac{7}{100} - \frac{8}{100}$  cm.; much as *S. mucronata* in form; but the spines are greatly elongated in old as well as young individuals; and in individuals having winter as well as summer eggs, though the winter form seems to have longer spines which are nearly equal in some cases to the height. Antennæ are short and transparent. The head is separated from the body by a marked depression; but is curved forward so that the beak lies generally between the valves. The antennules are of medium size. Nowhere reticulate (?) nor tuberculate. The shell is marked by impressed lines, especially anteriorly and below. The lower margin is straight and beaded anteriorly, but toward the base of the *mucro* are several long bristles which stop abruptly and are followed by a few very weak hairs. The post-abdomen has three teeth at the base of the claws, which are smooth.

This variety is much like *S. nasuta* of Birge, perhaps, but differs perceptibly in several points. Most conspicuous are the greatly elongated spines and the short antennæ. This variety is about as large as *mucronata* but less than *nasuta*.

## BOSMINIDÆ.

### Genus BOSMINA.

First antennæ many-jointed; intestine straight. Sole genus of the family, and one which Kurz characterizes as "one of the most difficult of the genera of Cladocera."

There are three species known in the United States, two of which are found from the Eastern States to the Mississippi and westward, and are identical with European forms. The third may not prove distinct.

### BOSMINA LONGIROSTRIS.

(Plate X, fig. 2.)

Differs from the following in having the terminal claws not toothed, and from *B. striata* in the shorter antennæ and reticulate shell.



## BOSMINA CORNUTA.

(Plate IX, figs. 3-5.)

$\frac{3}{10}$  cm. long; shell reticulate with hexagonal meshes; antennæ curved backward and outward at the tip; claws with several teeth near the base. In embryonic specimens the antennæ are straight.

## BOSMINA STRIATA, sp. n.

(Plate IX, fig. 1.)

$\frac{3}{10}$  cm. long; shell marked with anastomosing longitudinal striæ; antennæ very long; frontal seta about midway between eye and the sense-hairs of the antennæ: posterior inferior angle of shell spined as in the previous species.

The species resembles *B. maritima* greatly. The members of this genus have been little studied owing to their small size and comparative rarity, and it is even possible that some of the species will prove invalid.

All three of the above species were found in one gathering from Lake Minnetonka. Only one other locality (for *B. longirostris*) is known to me in this State.

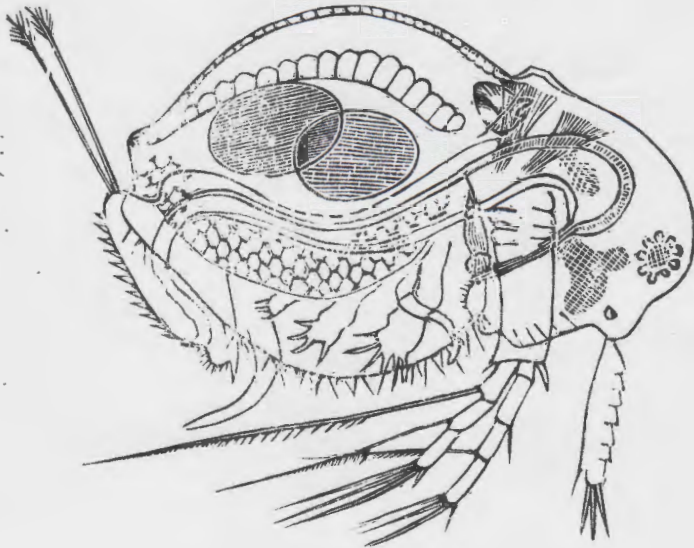
## LYNCODAPHNIDÆ.

## Genus MACROTHRIX.

Aside from *M. roseus* and *M. tenuicornis* (to which, perhaps, *M. agilis* of a previous report may be referred) a single species of macrothroid crustacean was collected at Lake Minnetonka, which is very remarkable. The specimen was apparently somewhat injured in moulting, and it is not possible to tell how much of its peculiar shape may be due to this fact, but some of its characters are sufficient evidence that it constitutes at least a new species.

It resembles in outline *Simocephalus vetulus*; the antennæ are very narrow and curved in a lateral as well as posterior direction; the second or swimming-antennæ are long as in other members of the genus; *macrula nigra* present but small; eye small; post-abdomen short, triangular; claws pectinate; a dorsal sucking-disc is present;

length  $\frac{10}{100}$  cm. For this species, the name *MACROTHRIX PAUPER* is provisionally offered. (Plate VIII, fig. 1.)



(FIG. 6.)

*MACROTHRIX TENUICORNIS*, Kurz.

(FIG. 6.)

The description given by Kurz is very full and agrees very well. The peculiar arrangement of the movable spines at the margin of the valves is characteristic. I have observed that *this species forms an ephippium*. Müller says distinctly of the series of genera including *Macrothrix*, *Drepanothrix*, *Lathonura*, *Bosmina*, *Acantholebris* and *Iliocryptus*, "*Testae abjectae corporis, nullo ephippio, ova hiberna obtegent.*"

*Bosmina* is little related to the *Lyncodaphnidæ* and, however it may be with regard to other species, in *M. tenuicornis* an evident ephippium is formed in much the same way as in *Ceriodaphnia*. In *Daphnia* this egg-cover is produced by an alteration of part of the inner layer of the shell which becomes turgid and secretes a thick coating. The ephippium simply extends over the brood-cavity, being marked off from the rest of the shell by the median suture of the valves. In other *Daphnidæ* and in *Macrothrix* nearly the whole of the valves are thus modified. The shell of *M. tenuicornis* is normally smooth, but in the ephippial female, that portion of the inner layer of the shell

bordering the egg-cavity and a little beyond, is composed of large and very deep cells; the space between the outer and inner layers is much greater than in *Daphnia*.

#### Genus LATHONURA.

Although no species of this genus has been found in Minnesota, it is to be expected that it will eventually be discovered that the cosmopolite *L. rectirostris*, Müll. occurs in our limits. It occurs in Mass. according to Birge. The figures (Plate VIII, figs. 11-12) were drawn from specimens found in Leipzig, Saxony, illustrating a tendency, especially common in the *Lyncodaphindæ*, to abnormal growth of the spinous appendages—in this case the anal setæ.

#### Genus ILIOCRIPTUS.

A genus represented by a single European species. Our form may differ somewhat in some respects from the generic diagnosis, but certainly belongs here. There are no anterior cœca (as indeed there are probably not in the European *I. sordidus* though so stated by Müller,) and no permanent cœcum or dilation of the intestine before the rectum. The marginal spines are straight, long and movable without branches.

#### ILIOCRIPTUS SPINIFER sp. nov.

(Plate VIII, figs. 2-6.)

Short; depth nearly equaling length of body excluding head; rounded behind; free edges of valves beset with slender ciliate spines which are not branched; antennæ exactly as those of *I. sordidus*, as is the post-abdomen, save that the anus seems to be situated higher; ova three or more.

This species occurs in Silver lake, east of Minneapolis. It swims quite well, while of the European species it is said this is not the case. It does, however, frequently load itself with filth so as to be too heavy to swim freely.

## LYNCODAPHNIA, Gen. n.

(Plate IX, figs. 1-3.)

Form much as is species of *Alonella*, etc., truncate behind; superior antennæ like *Macrothrix*, attached movably to the end of a blunt prominence beneath the head; second or swimming antennæ slender; four-jointed ramus with three long setæ at the end of terminal joint where is also a stout spine; joint following the basal joint also with a spine above; middle joint unarmed (?); three-jointed ramus as in *Macrothrix*; the basal segment armed with a much elongated seta; eye relatively small; pigment fleck present; *intestine twice-convoluted*, expanded in front of colon, opening in the "heel" of the post-abdomen; post-abdomen slender, sub-triangular, margined behind with a double series of spines; terminal claws large, straightish and furnished with a long and short spine near the base, also very minutely feathered behind; shell marked alone by the so-called "stuzbalkein;" lower margin with movable spines.

Few more interesting forms have been noticed than this, since it combines the characters which have hitherto been considered as very clearly forming the boundaries of distinct families.

Kurz says, (*Dodekas neuer Cladoceren nebst einer kurzen Uebersicht der Cladocerenfauna Böhmens*, p. 30:) "Keine Cladocerenfamilie bildet eine so streng in sich abgegrenztes natürliches ganze, wie eben die Lynceiden," and this even after recognizing the relationship of *Macrothrix* and *Lithonura* to the Lynceids by placing them in the sub-family *Lyncodaphniæ*. The form for which I propose the name *Lyncodaphnia* is quite as much like such forms as *Alona* and related Lynceids, as any species of the *Lyncodaphniæ*, while at the same time the characters of antennæ and head are almost identical with *Macrothrix*. This furnishes but another example of the fact that possibility of distinguishing families and genera lies alone in the meagerness of our knowledge.

## LYNCODAPHNIA MACROTHROIDES, sp. n.

Form sub-rectangular, greatly elongated; length  $1\frac{2}{10}$  cm., height  $1\frac{5}{10}$  cm. or less; first antennæ long and slightly curved, bordered behind by about ten spines and terminating in two unequal sword-shaped spines and several sense-hairs, about  $1\frac{1}{10}$  cm. long; swimming antennæ very slender as in *Macrothrix*,  $1\frac{0}{10}$  cm. long; head not marked off by a depression from the body, small and extending below into a blunt elevation for attachment of antennæ; labrum rather large; eye

small; macula nigra conspicuous but not large; anterior feet strongly armed with curved spines. The intestine anteriorly is furnished with cœca, is twice convoluted, broadened before entering the rectum and opens a little distance beyond the oval seta in the heel of the post-abdomen; post-abdomen rather slender, toothed behind with a double series of about twelve prominences, becoming distally sharp, strong teeth; terminal claws curved at the end only, pectinate and bearing two unequal but large processes near the base; eggs much like those of *Macrothrix*.

Occurs in Lake Minnetonka, Hennepin Co., Minnesota, rare.

## LYNCEIDÆ.

But few of this large family, furnishing the majority of the Cladocera fauna of any locality and at any time of year, have been carefully studied here. The following are mentioned as of particular interest:

### SUB-FAMILY EURYCERCINÆ.

The single species *Eurycercus lamellatus* which constitutes this sub-family has been mentioned and figured in a previous paper. It is quite abundant and constant.

*Eurycercus* is connected with the true Lynceids by the following genus which has quite as many affinities with *Eurycercus* as any Lynceid. Schödler seems to be the only writer who has laid sufficient stress upon this similarity, though it may not be best to unite the two forms as he did.

### Genus LEYDIGIA, Kurz.

#### LEYDIGIA QUADRANGULARIS, Leydig.

(Plate VIII, 7-8.)

The Minnesota species is referred to *L. quadrangularis* under the belief that there is no specific distinction between that species and *L. acanthocerooides*, Fischer.

Our form does not agree in every particular with the very minute

description of Kurz and does agree very well with what is said of *L. acanthocercoides*. However, Kurz says of the latter species, "Diese Art ist von der vorangehenden (*L. acanthocercoides*) im weiblichen Geschlecht schwierig zu unterscheiden," and immediately adds that the male is unknown to him. In P. E. Müller's time both males were unknown. Müller says of *acanthocercoides*, "ungues caudales inermes," of *quadrangularis*, "ungues caudales dente minuto." Kurz on the other hand says of the former, "der Basaldorn ist kurz," of the latter "die Endklauen haben keinen Basaldorn."

Our species has no spine on the claws, and has a small spine on an eminence on the dorsal part of the abdomen, as well as two ciliated prominences between it and the oval setæ; length  $\frac{1}{10}$  cm.; color red. Silver Lake, east of Minneapolis.

CAMPTOCERCUS MACROURUS.

(Plate X, fig. 9.)

This large species occurs rather sparingly at Lake Minnetonka. It is probably widely distributed in America as well as Europe. It is known in Cambridge, Mass. and Madison, Wis. (Birge).

CAMPTOCERCUS ROTUNDUS, sp. nov.

(Plate VIII, figs. 9-10.)

Short, quadrangular, dorsally nearly uniformly arched; antennæ of first pair long, curved outward, with long terminal bristles; abdomen long, nearly uniform in width; teeth of post-abdomen few, inconspicuous; terminal claw nearly straight; basal spine large; the claw also has a series of spines beginning a little beyond the middle and shortening proximally; length  $\frac{1}{10}$  cm. This resembles *C. rectirostris*, Schödler, a little in outline of body but the head is like *C. macrourus*, except that there is a slight beak directed anteriorly (not shown in the figure); the post-abdomen is much as in *C. macrourus*, but is less heavily spined. In size it is somewhat less than *C. lulljeborgii*, and the shortest species known to me.

ACROPERUS sp?

(Plate X, fig. 10.)

Resembles *Camptocercus macrourus* greatly. Are these two genera really distinct?

## PLEUROXIS PROCURVUS, Birge.

(Plate X, fig. 6)

Very characteristic. Found in Shady Oak lake, and elsewhere abundant.

## PLEUROXIS UNIDENS, Birge.

A species which agrees best with this is quite abundant. It is, however, always of a deep brownish color, and the beak is long and curved inward; it may be distinct.

A third form of *Pleuroxis*, probably *P. denticulatus*, Birge, is abundant also.

## GRAPTOLEBRIS INERMIS, Birge.

(Plate X, figs. 8, 11-12.)

Resembles *Alona testudinaria* very closely; the antennæ are peculiar; each joint has a median circlet of fine bristles; the upper ramus is terminated by two long setæ, one shorter seta and a stout spine; the joint preceding the terminal one has a stout seta. The description given by Birge is otherwise complete. Lake Minnetonka.

## CREPIDOCERCUS SETIGER, Birge.

This is exceedingly rare, and by reason of its small size, difficult to distinguish. It has been encountered but once in Minnesota. This species is easily recognized when found, and though our specimens differ a little from the figure given by Birge, they are doubtless the same.

## ALONA OBLONGA, P. E. Müller.

The specimens examined differ somewhat from Müller's description. The caudal claw is pectinate; the spine at its base is large and covered with a tuft of hairs; the teeth of post-abdomen are large, emarginate and hairy; otherwise the agreement is very close; length .07 cm. Found in Grass Lake, Richfield.

## TRIBE III ONYCHPODA.

## POLYPHEMIDÆ.

## POLYPHEMUS PEDICULUS.

(Plate IX, figs. 4-6.)

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- Polyphemus pediculus, *Schödler*, Neue Beitr. zur Naturg. d. Cladoceren
- Polyphemus kochii, " " " "
- Polyphemus oculus, " " " "
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I have collected from various sources what I could of the extensive bibliography of this, the sole species of the genus. One of the most characteristic and pleasing figures given is that of Weismann in his article on the "Schmuckfarben der Daphnoiden," though we believe that author in the wrong in the deductions made. Our specimens rarely approach the brilliancy of the plate, and there seems to be a more legitimate way of explaining these secondary colors than by sexual selection. This species is never abundant, nor is it very rare; found in Lake Minnetonka, and the larger lakes with their outlets.

### III On *Notadromas* and *Cambarus*.

## CYPRIDÆ.

This group is one of the most difficult and perhaps least studied. A number of species some of which, perhaps most, are new, occur in Minnesota, and among them is a *Cypris* which exceeds any described form in size. I only mention one genus which is cosmopolitan.

### NOTADROMAS, Lilljeborg.

Carapace differing in male and female; eyes two; antennæ similar to those of *Cypris*, the superior having seven and the inferior six joints; setæ of inferior antennæ reaching beyond the apex of the terminal claws; second pair of jaws without a branched appendage, in the male pediform; abdominal rami rather long.

### NOTADROMAS MONACHUS, Müller.

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*Notodromas monachus*, Lilljeborg, De Crust. ex ord. trib.

Brady, British Ostracoda.

Females of this widely distributed species were collected near Minneapolis, presenting in as far as could be seen no material points of distinction from English types.

## DECAPODA.

But two species of *Cambarus*, *C. virilis*. Hagen, and *C. signifer*, occur in Hennepin county, except, perhaps, in the Mississippi. The following localities for the former species are known in the State: Mississippi river, Minnehaha creek, Bassett's creek, Cedar lake, Lake Minnetonka, Lake Independence, Lake Superior.

It is possible to recognize three age-forms in the males of this species.

A. The immature male (II Form, Hagen). Reaching two to three inches in length, this stage has the chelæ proportionally smaller, and the spinous armature less developed: the first abdominal foot is simply bifid at the end.

B. (Form I of Hagen,) usually over two and one-half inches long; chelæ larger; branches of abdominal foot distinct; inner branch grooved but lance-linear.

C. Very large (four inches); inner branch of abdominal foot spatulate at end; the two rows of tubercles on the inner margin of the "hand" with six or seven in a row instead of five.

Male of Form II, A stage,  $2\frac{1}{2}$  in. long, Chela. 7 in., thumb .49 in.

" " I, B stage,  $2\frac{1}{2}$  in. long, " 1 in., " .6 in.

" " I, C stage, 4 in. long, " 1.8 in., " 1.1 in.

" " II, A stage, 3 in. long, " 1.2 in., " .75 in.

It will be seen from the above that size does not govern the transition from the first to the second form entirely. This differs either in different localities or at different seasons of the year. A large gathering from Cedar lake showed no specimens of the form I, while a similar gathering at Lake Independence contained but one of the form II. A male from Minnehaha creek had rudiments of a third tooth on the carpus of the left claw, thus indicating an approach to Hagen's Var. A.

## CAMBARUS SIGNIFER sp. nov.

(FIG. 7.)

A slender, graceful species of rather marked colors, belonging to the section having a hook on the third pair of legs but not on the fourth. The rostrum is not carinated nor toothed at the apex; acumen moderate, lateral borders curved, moderately excavated. Cephalothorax arched and not depressed above, densely punctate; areola linear; chelæ slender, straight; thumb deeply excavated on the inner margin for the proximal one-third; opposite finger with an impressed groove on the inner but not on the outer margin.

*Male, I Form.* Color reddish-(crimson) brown, not obviously figured; tail lighter; fin chestnut, marked with gray; chelæ bright crimson below there are green markings on the body and legs, and some yellow below.

The hands are rather narrow and straight, while the "thumb" is deeply excavated for one-third its length, and the notch thus formed is armed with three or four teeth; the finger opposite has a tooth half way from the apex, and others near the base; the angle at base of thumb is densely hairy. The penultimate and previous joint of second foot bears a very dense and thick tuft of hairs on the inner margin which is particularly noticeable in living specimens. The antennæ are short about as long as the thorax when reflexed.

The first pair of abdominal feet resemble those of *C. virilis* somewhat, but are stouter and less divided. They are more strongly curved than in *C. propinquus*.

The laminae of antennæ are much as in *C. troglodytes* but wider at the base.

The second form has the two branches of the abdominal foot united almost to the end. The young males have the chelæ greenish-blue and mottled, while the coloration of the body is like the females.

The females have shorter chelæ, and broader abdomen marked with chestnut bars on each segment above.

A male 3.3 in. long was still in form II, while another 3.2 in. long was in the form I. Found by hundreds in a shallow pool known as Grass Lake, in Richfield, Hen. Co.

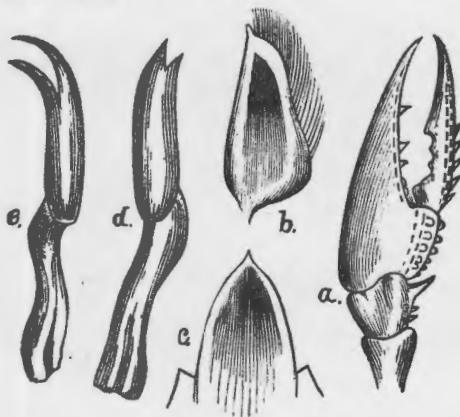


Fig. 7.

*Cambarus signifer.*

a chela. b lamina of antenna. c rostrum. d abdominal foot of form II. e abdominal foot of form I.

## INDEX OF GENERA AND SPECIES.

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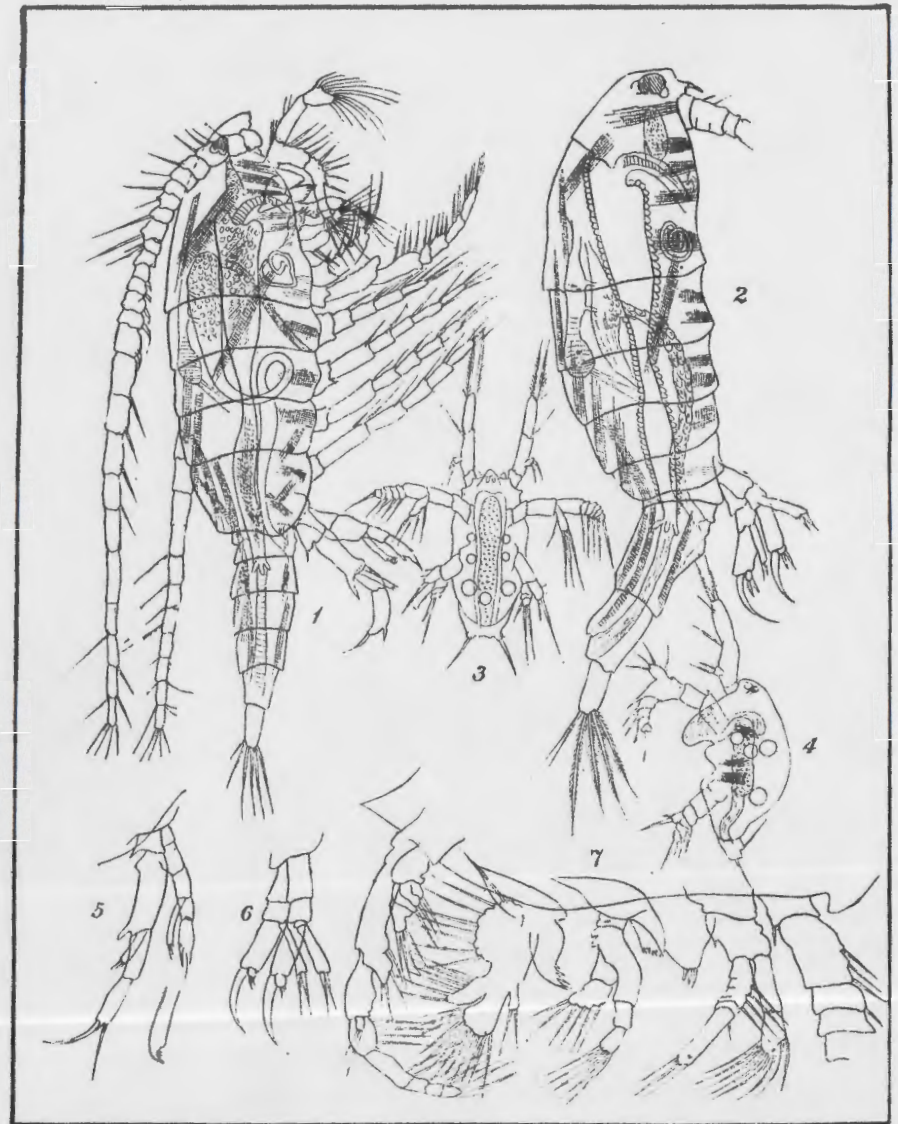
PLATE I.

Geol. & Nat. Hist. Sur. Minn.

PLATE I.

*Diaptomus castor.*

1. Male, antennæ not yet fully developed, showing shell, gland, heart, reproductive, alimentary and muscular systems.
2. Female, antennæ and appendages removed except fifth feet.
- 3 and 4. Nauplius stage.
5. Male foot of fifth pair, (a) "thumb" of larger branch.
6. Female foot of fifth pair.
7. Mouth parts etc.



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PLATE II.

Geol. & Nat. Hist. Sur. Minn.

PLATE II.

*Diaptomus castor*:

1. End of male antennæ.

2. End of abdomen.

3. Caudal stylet.

4. One pair of feet.

5. Maxilliped.

6. Maxilla.

7. Mandible and palp.

*Diaptomus giganteus*:

8. Antennule.

9. Male fifth foot.

10. Female fifth foot.

11. Spermatic tube.

*Potamoichetor fucosus*:

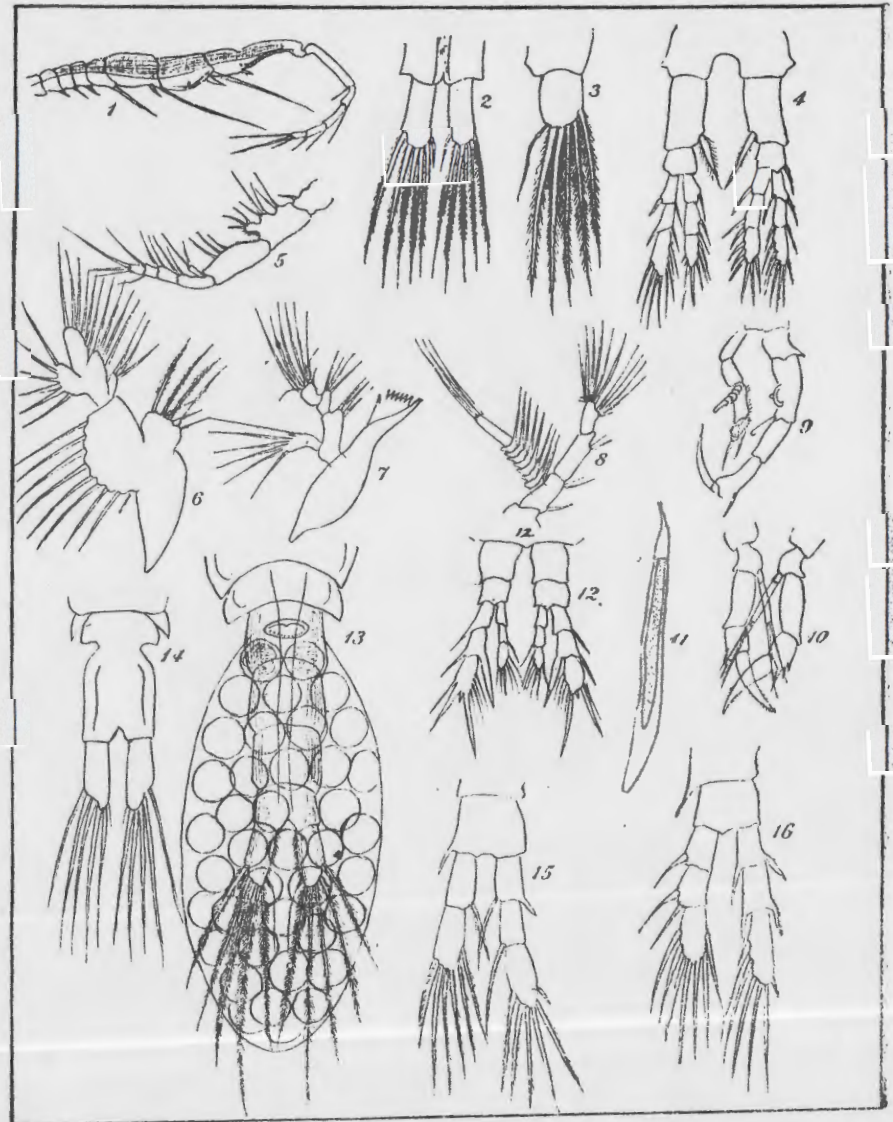
12. Female fifth foot.

13. Female abdomen and egg-sac.

14. Abdomen of young.

15. First foot of *Diaptomus giganteus*, one branch drawn reverse.

16. " " " *castor*, " " "



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PLATE III.

Geol. & Nat. Hist. Sur. Minn.

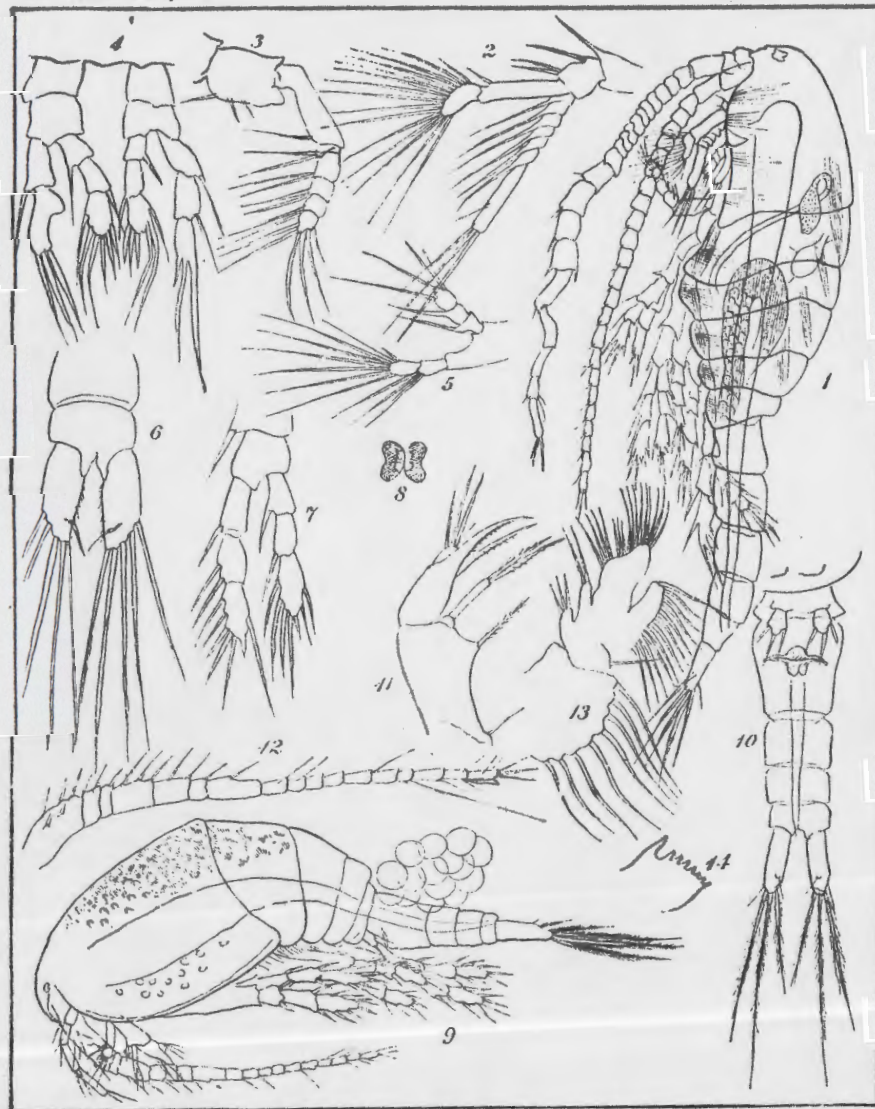
PLATE III.

*Potamoichetor fucosus.*

- 1. Male.
- 2. Antennule.
- 3. Maxilliped.
- 4. Male fifth pair of feet.
- 5. Palp of mandible.
- 6. End of abdomen.
- 7. Feet of first pair.
- 8. Eye.

*Cyclops ater.*

- 9. Female
- 10. Abdomen.
- 11. Maxilliped.
- 12. Antennæ.
- 13. Maxilla of *Potamoichetor fucosus.*
- 14. Mandible of " "





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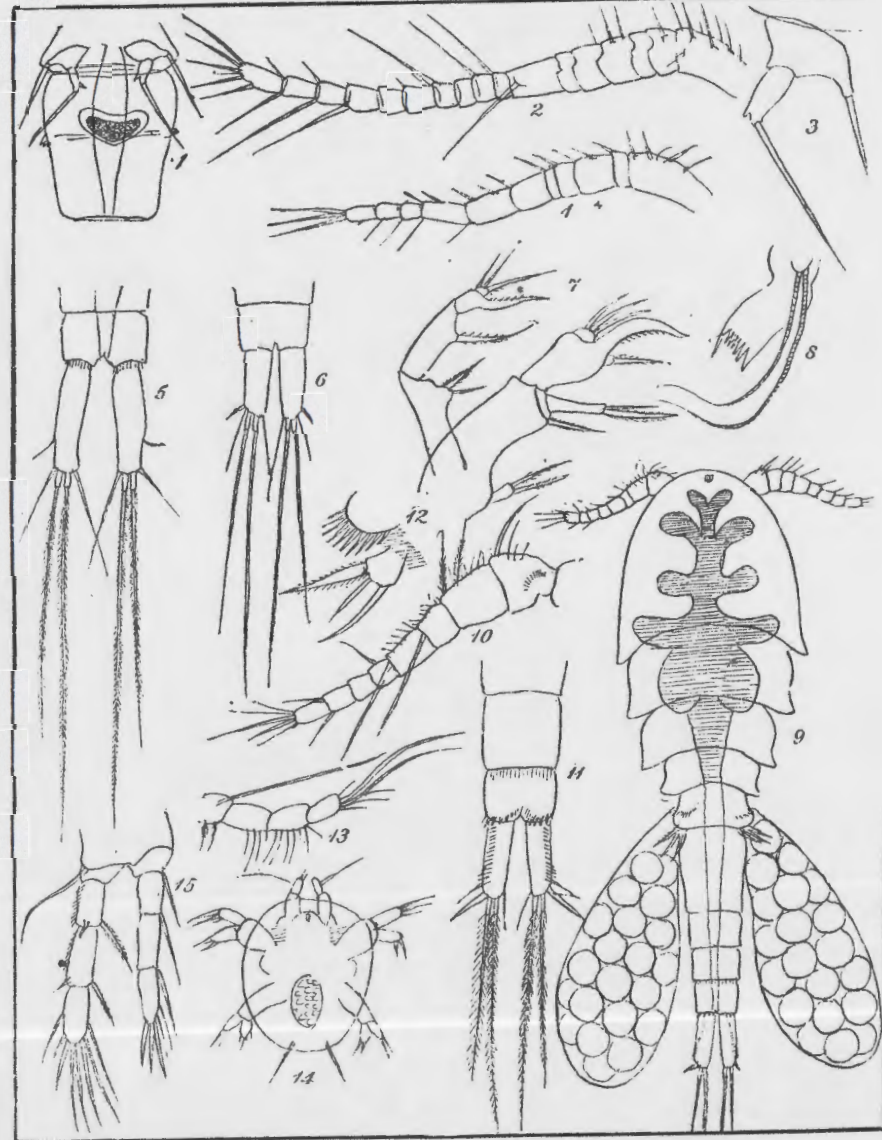
PLATE IV.

Geol. & Nat. Hist. Sur. Minn.

PLATE IV.

*Cyclops ingens.*

- |  |  |
|--|--|
| 1. First segment of abdomen of female. | 5. Stylets of mature female.             |
| 2. Antenna.                            | 6. " young male.                         |
| 3. Fifth foot.                         | 7. Maxilliped.                           |
| 4. Antenna of young male.              | 8. Mandible.                             |
|  | 9. <i>Cyclops crassicornis</i> , Female. |
| 10. Antenna.                           | 13. Second antenna.                      |
| 11. Terminal portion of abdomen.       | 14. Nauplius form.                       |
| 12. Female fifth foot.                 |  |



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PLATE V.

Geol. & Nat. Hist. Sur. Minn.

PLATE V.

*Cyclops serrulatus.*

- |   |                                     |
|---|-------------------------------------|
| 1. Female.  | 4. Antenna of very young.           |
| 2. Antenna of elongated form.                       | 5. Stylet of elongated form.        |
| 3. Stylet of ordinary form.                         |                                     |
|   | 6. <i>Cyclops naevus</i> , antenna. |
| 7. Furca.   | 11. Fifth foot.                     |
| 8. Abdomen of young.                                | 12. Antenna of young.               |
| 9. Abdomen of male.                                 | 13. " male.                         |
| 10. Opening of spermatophore.                       |                                     |
| 14. <i>C. "signatus,"</i> maxilliped.               |                                     |
| 15. <i>C. naevus</i> , swimming foot of first pair. |                                     |
| 16. " " " second pair.                              |                                     |
| 17. Maxillipeds.                                    |                                     |



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PLATE VI.

Geol. & Nat. Hist. Sur. Minn.

PLATE VI.

*Cyclops tenuicornis.*

- 1. Female.
- 2. Mandible
- 3. Maxillæ.
- 4. Stylet.

- 5. Fifth foot.
- 6. Maxillipeds.
- 7. Antennule.

*C. "signatus."*

- 10. Fifth foot.
- 11. Male antenna.

*Cyclops parvus.*

- 8. Abdomen.
- 9. Antenna.

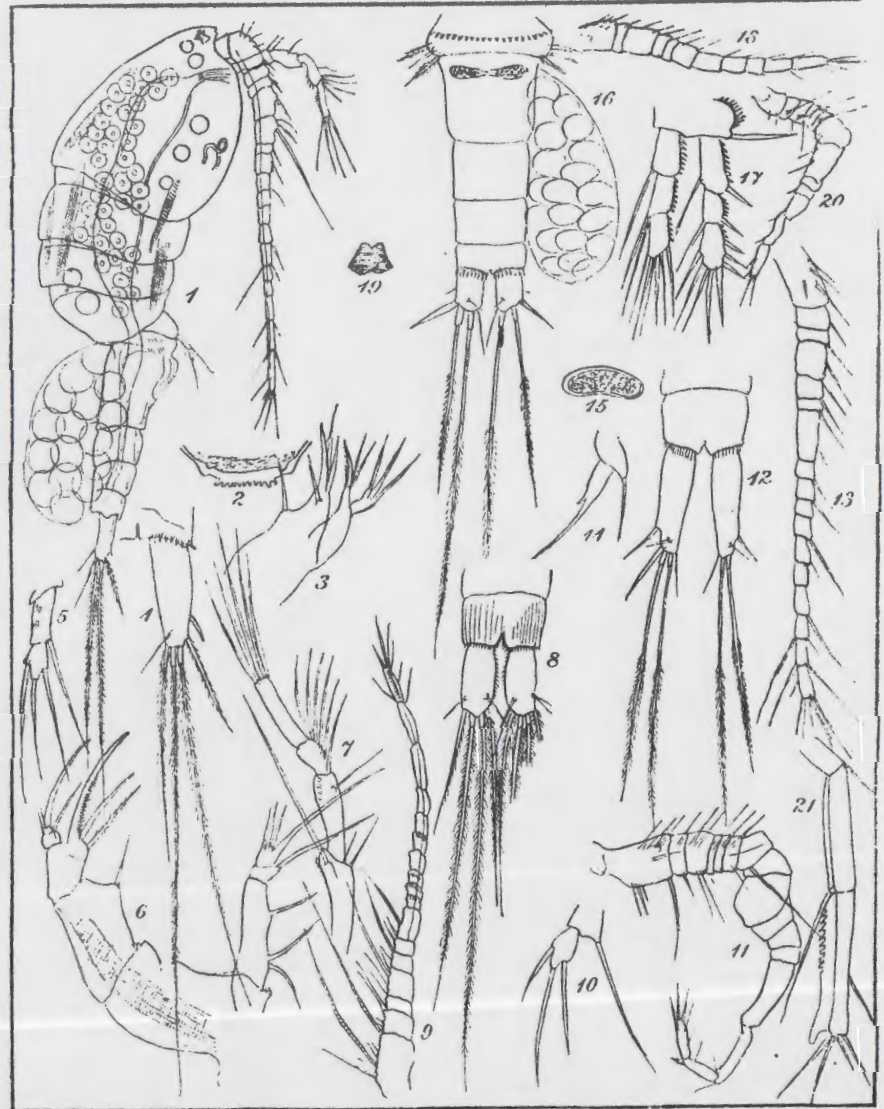
- 12. Abdomen.
- 13. Antenna
- 14. Fifth foot.

*Cyclops adoleosens.*

- 15. Opening of spermatophore.
- 16. Abdomen.
- 17. Foot.
- 18. Female antenna.

- 19. Eye.
- 20. Male antenna.

21. End of antenna of a form of *C. "signatus."*



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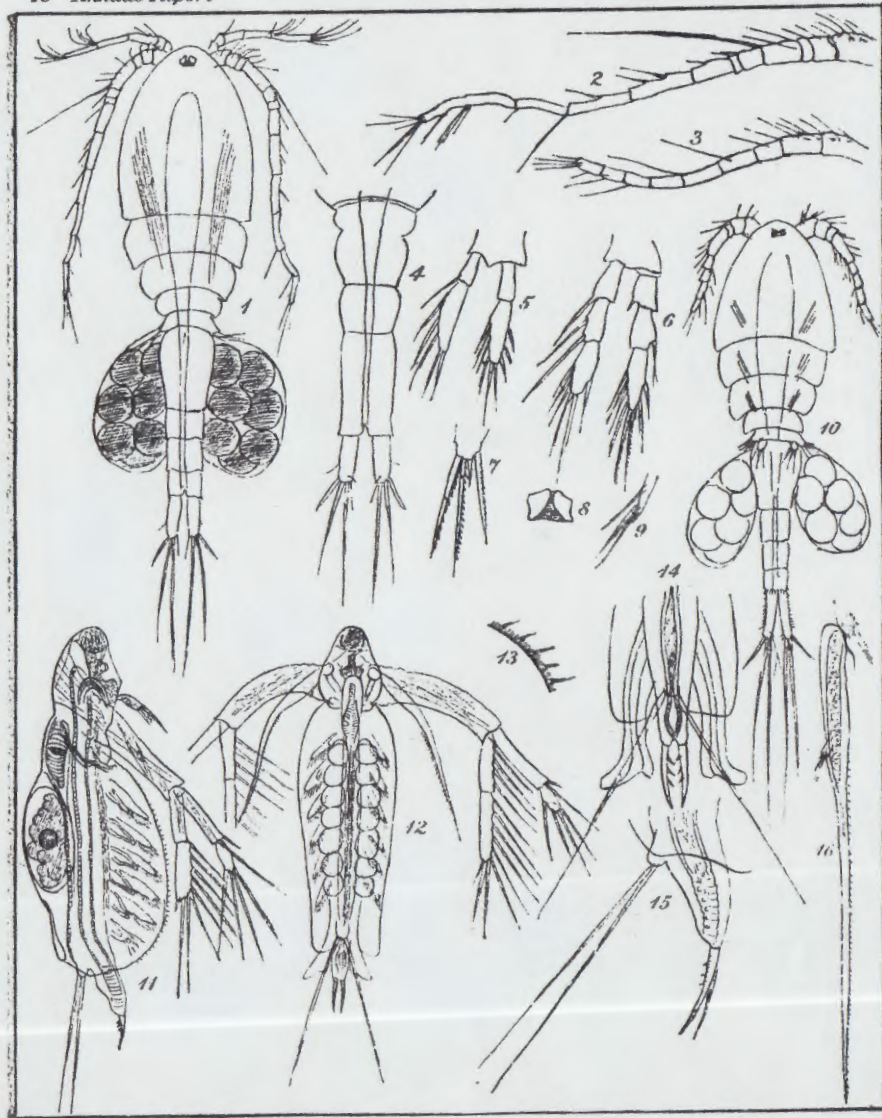
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PLATE VII.

Geol. & Nat. Hist. Sur. Minn.

PLATE VII.

- |  |                                   |                                     |
|--|-----------------------------------|-------------------------------------|
| 3. Antenna of young.                     | 1-9. <i>Cyclops fluviatilis</i> . | 10. Young of <i>C. serrulatus</i> . |
| 11. <i>Daphnella brachyura</i> , female. | 4. Abdomen of young.              | 14. End of male abdomen.            |
| 12. " " male.                            | 5. End of male abdomen.           | 15. End of female abdomen.          |
| 13. Part of edge of valves.              | 6. Antenna of young.              | 16. Antenna of male.                |



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PLATE VIII.

Geol. & Nat. Hist. Sur. :

PLATE VIII.

1. *Macrothrix pauper*,  
2-6. *Ilicryptus spinifer*.  
7-8. *Leydigia quadrangularis*

- 9-10. *Camptocercus rotundus*.  
11-12. *Lathonura rectirostris*.



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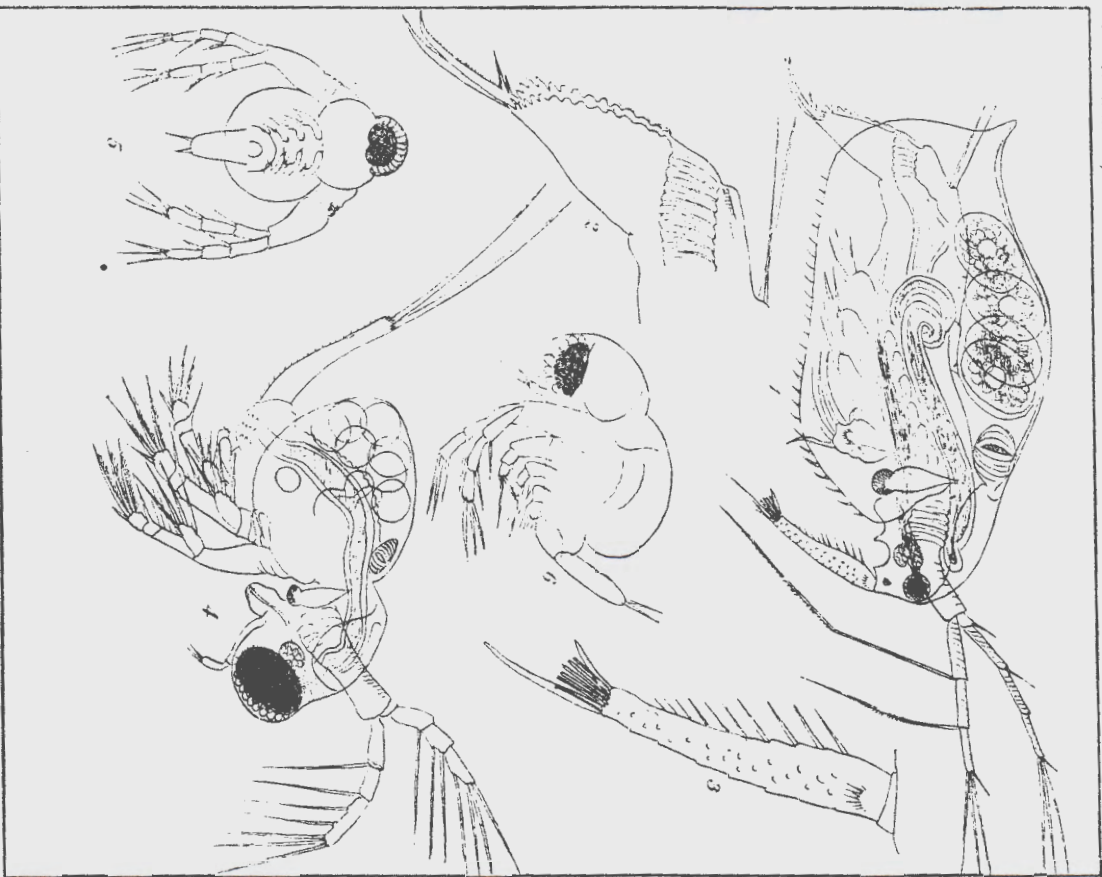
PLATE IX.

Geol. & Nat. Hist. Surv. Minn.

PLATE IX.

1-3. *Lymnædaphnia macrobrachia*.

4-6. *Polyphemus peticularis*.



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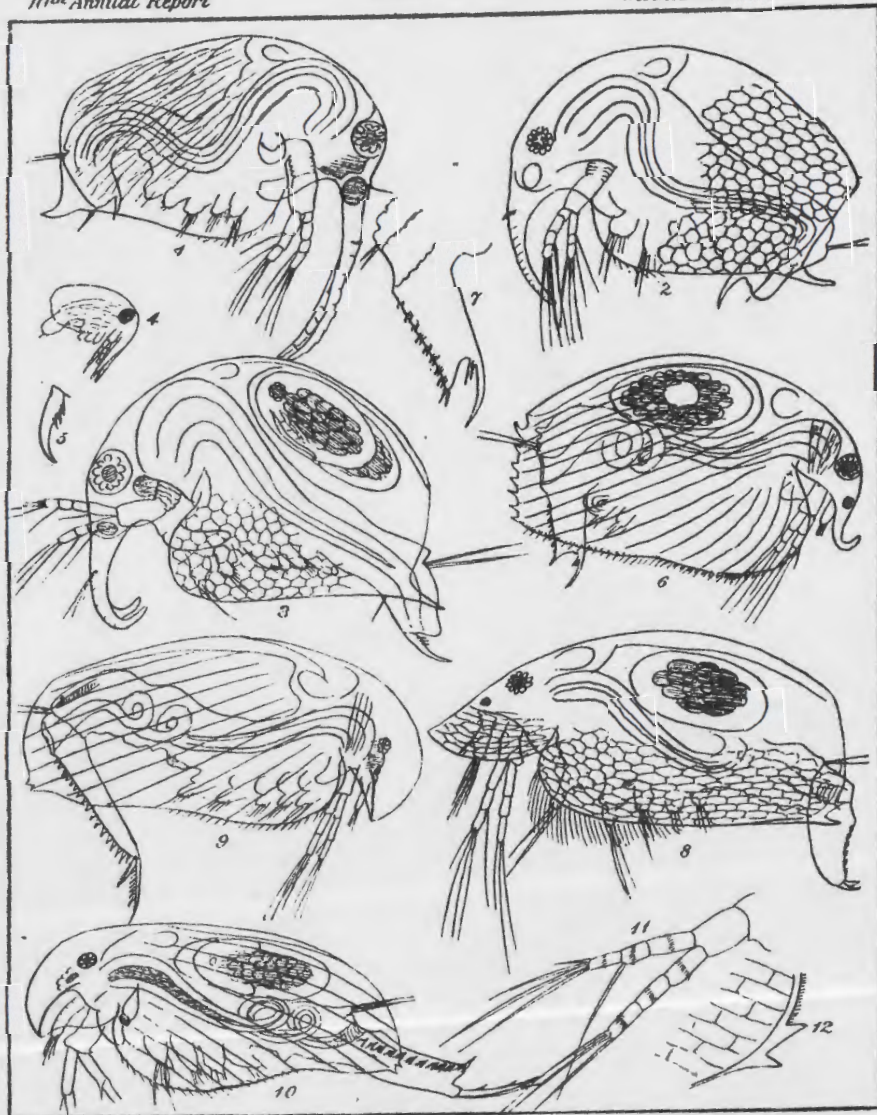
PLATE X.

Geol. & Nat. Hist. Sur. Minn.

PLATE X.

- 1. *Boemina striata.*
- 2. " *longirostris.*
- 3-5. " *cornuta.*
- 6-7. *Pleuroxia procurovatus.*

- 8. *Graptolebris inermis.*
- 10. *Acroperus* sp?
- 11-12. *Graptolebris inermis.*



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PLATE XI.

Geol. & Nat. Hist. Sur. Minn.

PLATE XI.

1. *Limnetes* sp? male.
2. First foot of male.
3. Antenna.
4. Mandible.
5. Maxilla.
6. Mandibler teeth.
7. Caudal appendages of female.
8. Head, labrum etc., of female.

9. Antenna (2d) of female.
10. Foot of female.
11. Exterior of whole animal from in front.
12. Modified (sexually) foot of female.
13. End of process of same.
14. Magnified spines of lateral limbs of same.
15. *Daphni* sp. ?
16. *Daphni* sp. ?

