ON THE CYCLOPIDÆ AND CALANIDÆ OF CENTRAL WISCONSIN.

By C. Dwight Marsh.

The material on which this paper is based has been largely collected from the immediate vicinity of Ripon. The fauna of Green Lake I have been enabled to study with considerable thoroughness; I have not only made a large number of collections, but they have been made at all seasons from early spring to December, and the work has extended over several years. From some ponds in the neighborhood of Ripon, I have made similar repeated collections. From Lake Puckaway, Lake Winnebago, and the smaller lakes in Fond du Lac and Green Lake counties, my collections were for the most part made in the months of July and August.

Through the kindness of Prof. E. A. Birge, I have also had material collected by him from lakes in the northern part of the state, and by Miss H. Merrill from the Great Lakes.

This is not presented as a final report, for I still feel very doubtful in regard to the relationships of some species. But to properly define these relationships seems likely to involve a long period of study, and possibly it cannot be done satisfactorily until more is known of the embryonic and larval stages. Inasmuch as so little has been published in regard to American copepoda, I may be justified in publishing this paper, although I am well aware of its imperfections.

While faunistic studies of fresh-water crustacea have been quite thoroughly prosecuted in Europe, and to some extent in Asia and Africa, only a few localities in the United States have been studied with any degree of thoroughness. The only considerable publications on copepoda have been made by Prof. Forbes, Prof. Cragin and Prof. Herrick. Prof. Forbes, who has made very important additions to our knowledge of

American entomostraca, made his collections in Illinois, southern Wisconsin, the Great Lakes, and Montana and Wyoming. Prof Cragin collected in eastern Massachusetts. Prof. Herrick has collected very widely through the Mississippi valley and the southern states. His reports on the Minnesota crustacea (**22, 25, 26**) covered a region with a fauna nearly identical with that of Wisconsin. His work of exploration must have been done very thoroughly, for my work in Wisconsin gives me little to add in the way of new species. Because of incomplete descriptions or a lack of figures, it is, in some cases, however, difficult to identify his species.

In Wisconsin the cladoceran fauna is better known than in any other part of the United States through the well-known work of Prof. Birge, but the copepoda have been almost entirely neglected.

While the number of copepods in a collection from any locality is frequently very large, the number of species is generally small. In pools which are swarming with individuals, frequently there are not more than two or three species. In pelagic collections there are seldom more than four to six species. Of diaptomus there is ordinarily only one species in a locality, although two or three species are sometimes found together in pelagic collections.

Some species of copepods may be considered strictly pelagic, and some as strictly littoral, while others are found only in stagnant pools. But many species readily adapt themselves to all these conditions, and with little or no change of structure seem to thrive equally well wherever they may be.

The following may be considered a fairly accurate division of the species according to their habitat:

	Pelagic.	Littoral.	Stagnant Pools.
Diaptomus sanguineus	.....	.....	x
" *leptopus*	.....	.....	x
" *pallidus*	.....	x	.....
" *sicilis*	x	.....	.....
" *ashlandi*	x	.....	.....
" *minutus*	x	.....	.....
" *oregonensis*	x	.....	.....
Epischura lacustris	x	.....	.....
Limnocalanus macrurus	x	.....	.....
Cyclops americanus	.....	x	x
" *brevispinosus*	x	x	.....
" *navus*	.....	.....	x
" *pulchellus*	x	.....	.....
" *parcus*	.....	.....	x
" *leuckarti*	x	x	.....
" *signatus*	x	x	x
" *modestus*	.....	x	.....
" *fluviatilis*	x	.....	.....
" *serrulatus*	x	x	x
" *phaleratus*	.....	.....	x
" *bicolor*	.....	.....	x
" *fimbriatus*	.....	.....	x

None of our species is peculiar to this immediate region, and it is probable that they are widely distributed over the northern part of the United States and the southern part of British America. Indeed, the copepod fauna of North America resembles very closely that of Europe and northern Asia. This fact has already been remarked by Prof. Birge in regard to the cladocera, and it seems no less true of the copepoda. Many of our species are identical with those of Europe, even in the minutest details, as in the case of *Cyclops leuckarti* Sars. In other cases the structural differences are slight, and it is very probable that we should consider them of only varietal value, were we acquainted with the limits of species variation. That the species should be identical, or nearly so, over such a wide extent of territory is not at all strange when we remember how easily the living animals and their eggs may be transported by water-fowl. Most of the forms, too, seem to readily

adapt themselves to change of environment with little perceptible change of structure. Thus *Cyclops pulchellus* Koch, is a common pelagic form of the larger lakes, and seems well adapted to its environment, but I have found it in Rush Lake, a reed-covered, shallow body of water, in which we would hardly expect to find any distinctive pelagic fauna.

It is to be noticed that the American species of *Diaptomus* are distinct from those of Europe, and that they are, in some cases, quite limited in their distribution.

The pelagic species are generally colorless, and the body and appendages are more elongated than in the littoral forms. When a species occurs both in shallow and in deep water, the same difference is noted, the pelagic forms in some cases forming well marked varieties.

The species of shallow water and stagnant pools are frequently highly colored, but the color is generally of little value in distinguishing species. Quite generally all the copepoda and cladocera of a pool have the same prevailing color, while the same species under other conditions of environment may be entirely colorless. This was noticed by Herrick in 1883 (25 p. 385.) Certain species, however, seem to have a coloration peculiarly their own,—like the purple tips of the antennæ in *Diaptomus leptopus*. The specimens of *Cyclops modestus* which I have found, have possessed a distinct purple tinge, very different from the colors of the species with which they were associated.

In the synonomy of species I have followed the European authors. It seems to me next to an impossibility to identify the species of Koch and Baird, for their descriptions are of no value whatever. All that is left for one to do is to accept them as defined by later authors.

It has not been my aim to add to the already sufficiently numerous descriptions of "new species," but rather to make more clear the descriptions already given, to indicate the proper synonymy, and to reduce the number of specific names rather than to increase them. In doing this, I know I have laid myself open to criticism, for it is, perhaps, presuming too much to revise another author's descriptions. My only excuse

is my reluctance to add to the cumbersome nomenclature of the genera under discussion. For example, I have no doubt of the identity of a Wisconsin species with *Cyclops brevispinosus* Herrick, but Herrick's description is not sufficient for a satisfactory identification. Therefore, rather than to add a new species name, I have ventured to describe this species more completely.

Inasmuch as printed descriptions, even when accurate, are frequently misleading, and as a list of species is only valuable when one is certain of the accuracy of the identification, I have, in most cases, drawn figures of the essential anatomical characteristics of the species treated of, and trust that I shall have made clear at least what species I have described, and have rendered it possible, if I have made mistakes, for others to detect those mistakes.

	Green Lake.	Little Green Lake.	Lake Winnebago.	Twin Lakes.	Spring Lake.	Rush Lake.	Heart Lake.	Lake Puckaway.	Lake Minocqua.	Great Lakes.	Stagnant Pools.
Diaptomus sanguineus	..	..	..	..	..	..	..	..	..	..	x
" *leptopus*	..	..	..	..	..	..	..	..	..	..	x
" *pallidus*	..	..	..	..	..	..	x	..	..	..	..
" *sicilis*	x	..	..	..	..	..	..	..	..	x	..
" *ashlandi*	..	..	..	..	..	..	..	..	..	x	..
" *minutus*	x	..	..	..	..	..	..	..	..	x	..
" *oregonensis*	..	x	x	x	..	..	..	..	x	x	..
Epischura lacustris	x	..	..	..	..	..	..	x	..	x	..
Limnocalanus macrurus	x	..	..	..	..	..	..	..	..	x	..
Cyclops americanus	x	x	..	..	..	x	..	..	..	..	x
" *brevispinosus*	x	x	x	x	x	x	x	x	x	x	..
" *navus*	..	..	..	..	..	..	..	..	..	..	x
" *pulchellus*	..	..	..	..	..	x	..	..	x	x	..
" *parcus*	..	..	..	..	..	..	..	..	..	..	x
" *leuckarti*	x	x	x	x	x	x	x	x	x	x	..
" *signatus*	x	x	..	..	x	x	x	x	x	..	..
" *modestus*	..	..	..	..	..	x	..	..	..	..	..
" *fluviatilis*	x	x	..	..	..	..	..	..	x	..	..
" *serrulatus*	x	x	x	x	x	x	x	x	x	x	x
" *phaleratus*	x	x	..	..	x	x	..	..	..	..	x
" *bicolor*	..	..	..	..	..	..	..	..	..	..	x
" *fimbriatus*	..	..	..	..	..	..	..	..	..	..	x

The foregoing table will give an idea of the distribution of the species in some of the bodies of water which I have examined. Green Lake is about seven miles long and has a maximum depth of a little less than two hundred feet. The other lakes—the Great Lakes excepted—are shallow. Lake Winnebago, although a large body of water, is said to be nowhere more than twenty-five or thirty feet in depth. Rush Lake is pretty largely covered with a growth of rushes and wild rice, and is being gradually filled up. Lake Puckaway is an expansion of Fox river, is to a considerable extent covered with wild rice and rushes, and is very shallow.

FAMILY CALANIDÆ.

Genus DIAPTOMUS Westwood.

KEY TO SPECIES OF DIAPTOMUS FROM CHARACTERISTICS OF MALE.

Antepenultimate joint of antenna without appendage,
- Fifth feet nearly equal in length, *oregonensis.*
- Left fifth foot shorter than right, *pallidus.*

Antepenultimate joint of antenna with hyaline lamella, *leptopus.*

Antepenultimate joint of antenna with appendage,
- Appendage short and blunt, *sanguineus.*
- Appendage as long or longer than penultimate joint,
  - Terminal hook of right fifth foot broad, lateral spine minute, *minutus.*
  - Terminal hook falciform,
    - Lateral spine nearer outer extremity of joint, *sicilis.*
    - Lateral spine stout, near base of joint, *ashlandi.*

Diaptomus sanguineus Forbes.

Plate III. Figs. 1–3.

1876. *D. sanguineus* Forbes (**17**) pp. 15, 16 and 23, figs. 24, and 28–30.
1882. *D. sanguineus* Forbes (**22**) p. 647, pl. VIII, figs. 1–7, and 13.
1884. *D. sanguineus* Herrick (**26**) p. 138, pl. Q, fig. 12.
" " *minnetonka* Herrick (**26**) p. 138, pl. Q, figs. 8–10.
1889. " *sanguineus* DeGuerne and Richard (**32**) p. 20, pl. IV, fig. 24.

This species, which is found in pools in the spring months, is readily recognized by the characters of the male antennæ and fifth feet. My specimens differ in minute particulars from the figures given by Forbes; the lateral spine on the terminal joint of the outer ramus of the right fifth foot in the male is nearer the distal end of the joint, while Forbes's figure makes its position nearly median; the blunt spine on the inner angle of the second joint of this foot is a little longer than the spine at the outer angle, instead of shorter, as in his figure.

D. minnetonka Herrick is probably a variety of *D. sanguineus.*

Diaptomus leptopus Forbes.

Plate III. Figs. 4 and 5.

1882. *D. leptopus* Forbes (**22**) p. 646, pl. VIII, figs. 17–19.
1884. " *longicornis* var. *leptopus* Herrick (**26**) p. 140.
1889. " *leptopus* DeGuerne and Richard (**32**) pl. II, fig. 19, pl. III, fig. 9.

Forbes, in his description, states that the antepenultimate segment of the right male antenna bears a small hook. I have failed to find a hook in my specimens; the segment is armed only with a very inconspicuous hyaline lamella. DeGuerne and Richard have also noted the absence of the hook.

It is quite common in the summer and fall months. As I have found it, it has been of a brownish red color, much like *D. sanguineus*, with purple tipped antennæ and caudal setæ.

D. kentuckyensis Chambers, is probably identical with *leptopus*, although the imperfect figures make it impossible to decide with certainty.

Diaptomus pallidus Herrick.

Plate III. Figs. 6, 7 and 9.

1879. *D. pallidus*, Herrick (**18a**) p. 91, pl. II, a–d.
1884. " " " (**26**) p. 142, pl. Q, fig. 17.
1889. " " DeGuerne and Richard (**32**) p. 62, fig. 17.

A small, slender species. Cephalothorax elongated oval, widest at about the middle; the last segment is armed with two minute lateral spines.

The first abdominal segment of the female is as long as the remaining part of the abdomen, and is dilated laterally. The second abdominal segment is shorter than the third. The furcal joints are about twice as long as broad.

The antennæ reach beyond the furca. The right antenna of the male is swollen anterior to the geniculating joint; it bears no appendage on the antepenultimate joint.

The outer ramus of the fifth foot of the female is two-jointed; the third joint is represented by two blunt spines. The inner ramus is one-jointed, equaling in length the first joint of the outer ramus; it is armed with a short spine at tip, and two larger ones on inner margin of tip; the inner surface of the tip is covered with short hairs.

The fifth feet of the male are slender, with the basal joints nearly equal in length. The first joint of the outer ramus of the right foot is a little shorter than the basal joint. The second joint is nearly twice as long as the first; on its inner margin at about a third of its length is a short spine-like projection; the lateral spine is slender, situated near the outer end of the joint. The terminal hook is falciform, but not with

a regular curvature, and is about once and a half the length of the second joint. The inner ramus is slender, one-jointed, as long as the first joint of the outer ramus.

The left foot extends to nearly one half the length of the second joint of the outer ramus of the right. The first joint of the outer ramus is about as long as the first joint of the outer ramus of the right foot. The second joint terminates in two projections,—a blunt finger-like process on the exterior side, with a pad armed with minute spines on its inner surface, and a slender falciform process from the inner margin, which curves over and nearly meets the process on the outer margin. There is also a small blunt projection on the inner margin of the joint. The inner ramus is slender, one-jointed, and equals in length the first joint of the outer ramus.

Length of the male, .875 mm.; of the female, 1.01 mm.

Locality, Heart Lake, near Marquette.

Herrick's descriptions of *D. pallidus* are not sufficient to identify the species, and his figures in the report of 1878 do not help the matter. In the final report on the Minnesota Crustacea, there is but one figure of *pallidus*—that of the left fifth foot of the male—and it is mainly from this figure that I have considered *D. pallidus* identical with my specimens. I have not found it quite as large as stated by Herrick, but in other respects it corresponds quite well with his descriptions, and it does not seem best to introduce a new name.

I have found *D. pallidus* in only one locality—Heart Lake, a small shallow lake south of Marquette.

Diaptomus sicilis Forbes.

Plate III. Figs. 8 and 10.

1882. *D. sicilis* Forbes (**22**) p. 645, pl. VIII, figs. 9 and 20.
1884. " " Herrick (**26**) p. 142, pl. Q, fig. 18.
1889. " " DeGuerne and Richard (**30**) p. 23, figs. 13 and 14, pl. II, fig 13.
1891. *D. sicilis* Forbes (**35**) p. 702, pl. 1, fig 6.

This species, which is abundant in the Great Lakes, I found as a common pelagic species in Green Lake in the summers of 1890 and 1891. In a large number of collections made in 1892, however, I did not find a single individual. This seems particularly strange, as the collections in 1892 were made at about the same seasons as in the preceding years.

The Green Lake specimens differ slightly from Forbes's type. They are somewhat smaller, the males averaging .9 mm., and the females 1.08 mm. The inner rami of the male fifth feet are not evidently two-jointed.

Diaptomus ashlandi sp. nov.

Plate III. Figs. 11–13.

A small pelagic species closely resembling *D. sicilis* Forbes. In form it is slender, hardly to be distinguished from *D. sicilis* and *D. minutus*.

The first joint of the abdomen in the female is longer than the remaining part of the abdomen, is dilated at the sides, and bears two minute lateral spines. The second and third joints are so closely united that the abdomen appears two-jointed. The furcal joints are about twice as long as broad.

The antennæ reach just beyond the furca. The right antenna of the male is much swollen anterior to the geniculating joint, and bears on the antepenultimate joint an appendage slightly exceeding in length the penultimate joint. This appendage may be blunt pointed or slightly enlarged at the extremity.

The fifth feet of the female are rather slender; the outer ramus is two-jointed. The third joint is represented by two short spines. The inner ramus is one-jointed, a little longer than the first joint of the outer ramus, armed at tip with two rather long spines.

The fifth feet of the male are slender. The basal joint of the right foot is about twice as long as that of the left. The first joint of the outer ramus is a little wider than long. The second joint is wider at the inner than at the outer end; the

lateral spine is stout, curved, situated near the inner end. The terminal hook is slender and falciform. The inner ramus is slender, one-jointed, and about one-third longer than the first joint of the outer ramus.

The left foot extends a little beyond the first joint of the outer ramus of the right. The second joint of the outer ramus has three blunt spines upon its apex and is armed with minute bristles within. The inner ramus is slender, one-jointed, and reaches about half the length of the second joint of the outer ramus.

Length of male, .89 mm.; female, .97 mm.

Localities, Lake Superior and Lake Erie.

D. ashlandi is smaller than *D. sicilis*, from which it is distinguished by the form of the male fifth feet. The appendage of the antepenultimate joint of the right male antenna resembles the form in *sicilis* and *minutus*. The female is not so readily distinguished, although the fifth feet are more slender than in *sicilis*.

I have specimens from only two localities. In pelagic collections made by Prof. Birge at Ashland it occurred with *D. oregonensis* and *D. minutus*. In a collection made by Miss Merrill on Lake Erie nearly all the *Diaptomi* belonged to this species, *D. sicilis* being represented very sparingly.

Diaptomus minutus Lilljeborg.

Plate IV. Figs. 1–3.

1889. *Diaptomus minutus* DeGuerne and Richard (Lilljeborg) (**32**) p. 50, pl. I, figs. 5, 6 and 14, pl. III, fig. 25.

1891. *Diaptomus minutus* Marsh (**38**) p. 212.

I reported *D. minutus* in 1891 from Green Lake. I have since found it in collections from the Great Lakes, the St. Clair river, and one lake in northern Wisconsin. It was described by Lilljeborg from specimens obtained in Greenland and Newfoundland. It was later reported from Iceland (**39**).

It is probable, as stated by DeGuerne and Richard, that it is a common species through the northern part of North America. It is common in the pelagic collections from Green Lake, but I have found it nowhere else in central Wisconsin; it is possible that this is near the southern limit of the species. The stout terminal claw of the outer ramus of the right fifth foot in the male, and the short, leaf-like inner rami of the fifth foot of the female, make this species one easily recognized.

Diaptomus oregonensis Lilljeborg.

Plate IV. Figs. 4 and 5.

1889. *D. oregonensis* DeGuerne and Richard (Lillj.) (**32**) p. 53, pl. II, fig. 5, pl. III, fig. 8.

This is the most common species of *diaptomus*, being found quite generally in the shallower lakes. It is easily distinguished from the other species by the form of the male fifth foot.

The type specimens were obtained from Portland, Oregon, and according to the figures in DeGuerne and Richard's "Revision" are somewhat more slender in all their parts than are my specimens.

Genus EPISCHURA Forbes.

Epischura lacustris Forbes.

Plate IV. Fig. 6.

1882. *E. lacustris* Forbes (**22**) pp. 541 and 648, pl. VIII, figs. 15, 16, 21, 23, pl. IX, fig. 8.

1884. *E. lacustris* Herrick (**26**) p. 131, pl. Q, fig. 13.

1889. " " DeGuerne and Richard (**32**) p. 90, pl. IV, figs. 3, 9 and 10.

1891. *E. lacustris* Forbes (**35**) p. 704, pl. I, figs. 1–5, pl. II, fig. 7.

I have found *E. lacustris* in only two localities beside the Great Lakes—in Green Lake and Lake Puckaway. Probably, however, it is abundant in other localities, as Forbes reports it from many lakes in Illinois, Michigan, and southern Wis sin.

The peculiar form of the male abdomen distinguishes nis in a striking manner from all other copepods.

Genus LIMNOCALANUS Sars.

Limnocalanus macrurus Sars.

Plate IV. Fig. 7.

1863. *L. macrurus* Sars (**11**) pp. 228–229.
1882. " " Forbes (**22**) p. 648.
1886. *Centropages grimaldi* DeGuerne (**29**) pp. 1–10.
1888. *L. macrurus* Nordqvist (**31**) pp. 31–37, pl. I, figs. 9–11; pl. II figs. 1–5; pl. III figs. 1–4.
1889. *L. macrurus* DeGuerne and Richard (**32**) p. 77, pl. IV, figs. 5, 11 and 12.
1891. *L. macrurus* var. *auctus* Forbes (**35**) p. 706.

L. macrurus is abundant in Green Lake. It is a species of especial interest because of its wide distribution. It is found quite generally throughout northern Europe. Forbes has found it in Lake Michigan, Lake Superior and Lake Geneva. I have found it also in collections from Lake Huron, Lake St. Clair, and the St. Clair river.

Family CYCLOPIDÆ.

Genus CYCLOPS Mueller.

KEY TO THE WISCONSIN SPECIES OF CYCLOPS.

Antennæ 17-jointed, fifth foot two-jointed,
- Second joint of fifth foot armed with seta and short spine,
  - Terminal joint of outer branch of swimming feet armed externally with three spines,
    - Furca of moderate length, *americanus.*
    - Furca elongated, *brevispinosus.*
  - Terminal joint of outer branch of swimming feet armed externally with two spines, *parcus.*
- Second joint of fifth foot with two terminal setæ,
  - Furca short, *navus.*
  - Furca elongated, *pulchellus.*
- Second joint of fifth foot, with one terminal and one lateral seta, *leuckarti.*
- Second joint of fifth foot, with three setæ, *signatus.*

Antennæ 16-jointed, fifth foot 3-jointed, *modestus.*

Antennæ 12-jointed, fifth foot 1-jointed,
- Furca variable in length, armed externally with a row of small spines, *serrulatus.*
- Furca short, without armature of spines, *fluviatilis.*

Antennæ 11-jointed, swimming feet three-jointed, *phaleratus.*
swimming feet two-jointed, *bicolor.*

Antennæ 8-jointed, *fimbriatus.*

Cyclops americanus sp. nov.

Plate IV. Figs. 8–10.

1882. *C. ingens* Herrick (**23**) p. 228, pl. V, figs. 1–8.
1883. " *viridis* Cragin (**24**) p. 3, pl. IV, figs. 8–16.
1884. " " Herrick (**26**) p. 145.

Cephalothorax oval, the first segment being about half its total length. Antennæ 17-jointed, about as long as first cephalothoracic segment. Abdomen rather slender, the last segment armed on its posterior border with small spines. All the abdominal segments in immature individuals are strongly pectinated posteriorly. Furca about three times as long as its average breadth, the lateral spine situated well towards the end. The first and fourth terminal setæ are short, slender and plumose, nearly equal in length. Of the internal setæ, the outer is a little more than three-fourths the length of the inner.

The armature of the terminal joints of the swimming feet is as follows:

FIRST FOOT.

Outer br. ex. 3 spines.	Inner br. ex. 1 seta.
ap. 2 setæ.	ap. 1 spine, 1 seta.
in. 2 setæ.	in. 3 setæ.

SECOND AND THIRD FEET.

Outer br. ex. 3 spines.	Inner br. ex. 1 seta.
ap. 1 spine, 1 seta.	ap. 1 spine, 1 seta.
in. 3 setæ.	in. 3 setæ.

FOURTH FOOT.

Outer br. ex. 3 spines.	Inner br. ex. 1 seta.
ap. 1 spine, 1 seta.	ap. 2 spines.
in. 3 setæ.	in. 2 setæ.

Fifth foot two-jointed, basal joint very broad, armed with one seta. Terminal joint armed with a seta and a blunt spine.

Length, 1.2 mm.

This takes the place in our fauna that is occupied by *C. viridis* Fischer, in Europe. In general form and appearance the two forms seem identical, and have been so considered by Herrick and Cragin. I have hesitated to propound a new species name, but it seems necessary. So far as Uljanin and Vosseler have figured *viridis* it corresponds to our species; but

neither gives figures of the swimming feet. From the original description by Fischer our species differs markedly. According to his figure the antennæ reach to the third cephalothoracic segment, while in *americanus* they hardly exceed the first. He makes the furca about equal in length to the last abdominal segment; in *americanus* it equals or exceeds the last two segments. He gives a figure of "a foot," not designating which, but it corresponds to no one of the four in our species.

Sars says the terminal joint of the external ramus of the fourth foot has two external spines; *americanus* has three.

Brady's figure of the terminal joint of the outer branch of the fourth foot (**18**, pl. 20, fig. 7) corresponds to Sars' statement. He also figures the terminal joint of the inner branch (**18**, pl. 20, fig. 8,) which shows a very different armature from that in *americanus*.

Schmeil (**41**, p. 97, pl. VIII, figs. 12–14,) gives a more elab orate description of *viridis*. His formula for the spines of the swimming feet corresponds to the descriptions of the other European authors. Schmeil, however, does not consider the armature of the swimming feet as constant, and according to his view *americanus* should be a variety of *viridis*. In an examination of a large number of specimens from widely separated localities I have found no variation in the number and arrangement of the spines and setæ of *americanus*, and until such variation is shown, there seems to be no alternative but to institute a new species for the American form.

C. americanus is widely distributed. It occurs quite generally in stagnant pools, and is also found to some extent in lakes.

Cyclops brevispinosus Herrick.

Plate IV. Figs. 11 and 12.

1884. *C. brevispinosus* Herrick (**26**) p. 148, pl. S, figs. 7–11.

Cephalothorax oval, the first segment reaching about half its

total length. Antennæ 17-jointed, shorter than first cephalothoracic segment. Abdomen slender, the last segment armed on its posterior border with a row of small spines. Furca slender, longer than the last two abdominal segments, lateral spine at two-thirds the distance from base to extremity. Of the terminal setæ, the outer is a short blunt spine, the inner slender and somewhat longer; the outer median seta rather more than two-thirds the length of the inner.

The armature of the terminal joints of the swimming feet is as follows:

FIRST FOOT.

Outer br.	ex. 3 spines.	Inner br.	ex. 1 seta.
	ap. 2 setæ.		ap. 1 spine, 1 seta.
	in. 2 setæ.		in. 3 setæ.

SECOND FOOT.

Outer br.	ex. 3 spines.	Inner br.	ex. 1 seta.
	ap. 1 spine, 1 seta.		ap. 1 spine, 1 seta.
	in. 3 setæ.		in. 3 setæ.

THIRD FOOT.

Outer br.	ex. 3 spines.	Inner br.	ex. 1 spine.
	ap. 1 spine, 1 seta.		ap. 2 spines.
	in. 3 setæ.		in. 3 setæ.

FOURTH FOOT.

Outer br.	ex. 3 spines.	Inner br.	ex. 1 spine.
	ap. 1 spine, 1 seta.		ap. 2 spines.
	in. 3 setæ.		in. 2 setæ.

The fifth foot is two-jointed. The basal joint is very broad and is armed with one seta. The terminal joint is armed with one seta and a short spine.

Length about 1 mm.

Herrick's description of *C. brevispinosus* is so imperfect that it is difficult to identify the species with certainty. The armature of the swimming feet is different from that in *C. parcus*, although one might infer from his statement that it is the same. The form and armature of the furca, however, is char-

acteristic, and his figure of the furca makes me so certain of the identity of the form, that I have ventured to redescribe the species rather than to propose a new name. It is easily recognized by its short, 17-jointed antennæ, and the elongated furca, with the outer terminal seta reduced to a short blunt spine.

It is widely distributed in lakes and ponds, and is a pelagic species, though sometimes occurring in littoral collections.

I have had some doubt as to whether this should be considered a distinct species. In most of its structural features it closely resembles *americanus*, and I have suspected it to be a pelagic variety of that species. I have specimens of *americanus* with elongated furca like *brevispinosus*, and I have specimens of *brevispinosus* in which the outer terminal seta of the furca is slender and plumose as in *americanus*. For the differences in the armature of the swimming feet, however, I have as yet found no intermediate forms, and so must, for the present at least, consider the two distinct.

Cyclops navus Herrick.

Plate IV. Figs. 13–15.

1882. *C. navus* Herrick (**23**) p. 229, pl. V, figs. 6–13, 15–17.
1884. " " " (**26**) p. 152.

Larger than *C. pulchellus*, the antennæ being about as long as first two segments of cephalothorax, as in that species. Armature of swimming feet as in *pulchellus*. Fifth foot armed as in *pulchellus*, but terminal joint more elongated, and its setæ more nearly equal in length, the inner being fully two-thirds the length of the outer. The furca is short, with the lateral seta on the posterior third; of the terminal setæ the first and fourth are short, the outer median about three-fifths as long as the inner.

It is generally reddish in color and occurs in pools. Herrick considers *navus* as probably a variety of *pulchellus*, and I am inclined to agree with him. The principal difference between the two species is in the form of the furca, and the difference is just that which we would expect from the difference of environment. It is just the difference which exists between the

extreme forms of *serrulatus*. So far as I know, however, no one has reported forms intermediate between *C. pulchellus* and *C. navus*. In my collections, while I have seen many instances of considerable variation in *C. pulchellus*, particularly in the form and armature of the furca, I have found no forms which at all approach *C. navus*. Until such intermediate forms are discovered, *C. navus* must be considered distinct.

Cyclops pulchellus Koch.

Plate IV. Figs. 18 and 19.

1838. *C. pulchellus* Koch (**3**) H. 21, pl. 2.
1857. " *bicuspidatus* Claus (**8**), p. 209, pl. XI, figs. 6 and 7.
1863, " " " (**9**), p. 101.
1863. " *pulchellus* Sars (**11**), p. 246.
1870. " *bicuspidatus* Heller (**12**), p. 71.
1872. " *bicuspidatus* Fric (**13**), p. 221, fig. 6.
1876. " *bicuspidatus* Hoek (**16**), p. 17, pl. I, figs. 7–11.
1880. " *pulchellus* Rehberg (**19**), p. 543.
1880. " *helgolandicus* Rehberg (**20**), p. 64, pl. IV, fig. 5.
1882. " *thomasi* Forbes (**22**), p. 649, pl. IX, figs. 10, 11 and 16.
1883. ,, *pectinatus* Herrick (**25**), p. 499, pl. VII, figs. 25–28.
1883. " *thomasi* Cragin (**24**), p. 3, pl. III, figs. 1–13.
1884. " *thomasi* Herrick (**26**), p. 151, pl. U, figs. 4, 5, 7 and 8.
1885. " *pulchellus* Daday (**27**), p. 220.
1886. " *pulchellus* Vosseler (**28**), p. 194, pl. V, figs. 19–28.
1891. " *thomasi* Forbes (**35**), p. 707, pl. II, fig. 8.
1891. " *bicuspidatus* Brady (**36**), p. 13, pl. 5, figs. 1–5.
1891. " *thomasi* Brady (**36**), p. 14, pl. VI, figs. 1–4.
1891. " *bicuspidatus* Schmeil (**37**), p. 27.
1891. " *bicuspidatus* Richard (**39**), p. 229, pl. VI, fig. 6.
1892. " *bicuspidatus* Schmeil (**41**), p. 75, pl. II, figs. 1–3.
1893. " *thomasi* Forbes (**42**), p. 249, pl. XXXIX, figs. 9–12; pl. XL, fig. 13.

[1] Herrick considered *C. thomasi* a variety of *C. pulchellus* Koch. Brady also raises the question as to the specific distinction of the American form. I have gone over the literature of the subject with considerable care, and I can see no good reason for

separating our American form from *C. pulchellus* Koch, or *bicuspidatus* Claus. All the European descriptions agree very closely with our form. We find in *C. thomasi* the same variations which Vosseler records in the European form,—for example, the variable position of the lateral spine of the furca. In general form, length of antennæ, form of furca and armature of swimming feet and fifth feet, it is difficult to find any clear distinction between the forms of the two continents. I cannot agree with Herrick and Brady in considering *C. bisetosus* Rehberg a synonym of *pulchellus*, for *pulchellus* has the swimming feet armed with two spines externally, while *bisetosus* has three, and my observations lead me to think that the armature of the swimming feet is quite constant.

The armature of the terminal joints of the swimming feet is as follows:

FIRST FOOT.

Outer br. ex. 2 spines.	Inner br. ex. 1 seta.
ap. 2 setæ.	ap. 1 spine, 1 seta.
in. 2 setæ.	in. 3 setæ.

SECOND AND THIRD FEET.

Outer br. ex. 2 spines.	Inner br. ex. 1 seta.
ap. 1 spine, 1 seta.	ap. 1 spine, 1 seta.
in. 3 setæ.	in. 3 setæ.

FOURTH FEET.

Outer br. ex. 2 spines.	Inner br. ex. 1 seta.
ap. 1 spine, 1 seta.	ap. 2 spines.
in. 3 setæ.	in. 2 setæ.

C. pulchellus occurs everywhere in the great lakes in pelagic collections, and in some of the smaller lakes of Wisconsin.

Cyclops parcus Herrick.

Plate IV, fig. 16; plate V, fig. 1.

1882. *C. parcus* Herrick (**23**), p. 229, pl. VI, figs. 12–15.
1884. " " " (**26**), p. 148, pl. R, fig. 22.

C. parcus, in the armature of the swimming feet is like *C. pulchellus* and *C. navus*, while its fifth feet are like those of *C. americanus* and *C. brevispinosus*, although the basal joint is

somewhat narrower. My specimens agree with Herrick's description, except in the armature of the inner terminal segment of first feet, and his statement is evidently inaccurate, for no normal armature would be as he describes it.

C. parcus occurs in stagnant pools, and I have not found it common.

Cyclops leuckarti Sars.

Plate IV, fig. 17; plate V, figs. 2–6.

1863. *C. leuckarti* Sars (**11**), p. 239.
1874. " *simplex* Poggenpol (**14**), p. 70, pl. XV, fig. 1–3.
1875. " *tenuicornis* Uljanin (**15**), p. 30, pl. IX, figs. 12 and 13.
1876. " *leeuwenhoekii* Hoek (**16**), p. 19, pl. III, figs. 1–12.
1880. " *simplex* Rehberg (**19**), p. 542.
1886. " " Vosseler (**28**), p. 193, pl. IV, figs. 15–17.
1887. " " Herrick (**30**), p. 17, pl. VII, fig. 1, a–j.
1891. " *leuckarti* Schmeil (**37**), p. 25.
1891. " *edax* Forbes (**35**), p. 709, pl. III, fig. 15; pl. IV, figs. 16–19.
1881. (*C. scourfeldi* Brady)? (**36**), p. 10, pl. IV, figs. 1–8.
1891. " *leuckarti* Richard (**39**), p. 230, pl. VI, fig. 20.
1892. " *leuckarti* Schmeil (**41**), p. 57, pl. III, figs. 1–8.

This species was particularly abundant in the collections from Lake Puckaway.

I have compared my specimens very carefully with the descriptions of the European form as given by Sars, Hoek and Schmeil, and the correspondence is almost perfect. The only difference seems to be that the lower side of the second joint of the outer maxilliped is ordinarily crenulated rather than "*geperlte.*" Specimens from Heart Lake, however, have more minute crenulations to which the term "*geperlte*" would be more properly applied. But in other points there is perfect agreement, noticeably so in the toothed appendage of the last antennal joint.

Schmeil states that the membrane of the last antennal segment of the female has a single deep indentation. My speci-

mens have several, agreeing in this respect with the figure of Hoek.

It occurs in both day and evening collections, and is generally reddish in color.

This is one of the most widely distributed of all the species of *Cyclops*, being found in various parts of Europe, in Asia, Africa, Madagascar, Ceylon, and the East Indies (**34**). Herrick mentions it as occurring in Alabama (**30**), and it is probable that it is widely distributed in America. It seems to me probable that the species identified by Herrick as *oithonoides* (**26**, p. 150, pl. S, figs. 2–6), is really *leuckarti*.

Brady's *scourfeldi* corresponds to this species in all details except the armature of the terminal joint of the outer branch of the fourth foot. The special character by which he distinguishes the species,—the marginal setæ of the second maxillipedes,—I find in my specimens. In his figure of the fourth foot, the terminal joint of the outer branch has one spine and *two setæ* on the apex, instead of the normal armature of one spine and one seta. Schmeil's figure of the fourth foot (**41**, pl. III, fig. 6) shows an armature like that of the American specimens, and one cannot help thinking that Brady's figure must have been drawn from an abnormal specimen.

C. edax Forbes appears to differ from *leuckarti* only in that it lacks the ridge on the terminal joint of the antennæ, and is probably simply a less highly developed variety of the same species.

There is considerable variation in the form of the spines of the swimming feet; in some specimens they are very slender and the joints are at the same time somewhat elongated, while in other cases they are robust. The robust form appears to be characteristic of the littoral specimens, and the slender form of the pelagic.

The armature of the terminal joints of the swimming feet is as follows:

FIRST FOOT.

Outer br. ex. 2 spines.	Inner br. ex. 1 seta.
ap. 2 setæ.	ap. 1 spine, 1 seta.
in. 2 setæ.	in. 3 setæ.

SECOND AND THIRD FEET.

Outer br.	ex. 2 spines.	Inner br.	ex. 1 seta.
	ap. 1 spine, 1 seta.		ap. 1 spine, 1 seta.
	in. 3 setæ.		in. 3 setæ.

FOURTH FOOT.

Outer br.	ex. 2 spines.	Inner br.	ex. 1 seta.
	ap. 1 spine, 1 seta.		ap. 2 spines.
	in. 3 setæ.		in. 2 setæ.

Cyclops signatus Koch.

Plate V, figs. 7–9.

1820. *Monoculus quadricornis albidus* Jurine (**2**), pp. 44 and 47, pl. II, figs. 10–11; pl. III, fig. 24.
1820. *Monoculus quadricornis fuscus* Jurine (**2**), p. 47, pl. II, fig. 2.
1841. *C. signatus* Koch (**3**), H 21, pl. VIII.
1841. " *annulicornis* Koch (**3**). H 21, pl. VI.
1850. " *quadricornis* var. *b* Baird (**4**), p. 202, pl. XXIV, fig. 4.
1850. " " var. *c* Baird (**4**), p. 203, pl. XXIV, fig. 5.
1857. " *coronatus* Claus (**7**), p. 29, pl. II, figs. 1–11.
1857. " *tenuicornis* Claus (**7**), p. 31, pl. III, figs. 1–11.
1863. " *coronatus* Claus (**9**), p. 97, pl. II, fig. 16; pl. X, fig. 1.
1863. " *tenuicornis* Claus (**9**), p. 99, pl. I, fig. 3; pl. II, fig. 17; pl. IV, fig. 5.
1863. " *signatus* Sars (**11**), p. 242.
1863. " *annulicornis* Sars (**11**), p. 243.
1863. " *tenuicornis* Sars (**11**), p. 242.
1863. " *coronatus* Lubbock (**10**), p. 199.
1863. " *tenuicornis* Lubbock (**10**), p. 202.
1872. " *coronatus* Fric (**13**), p. 218, fig. 11.
1872. " *tenuicornis* Fric (**13**), p. 219, fig. 12.
1874. " *clausii* Poggenpol (**14**), p. 70, pl. XV, figs. 4–14.
1875. " *signatus* Uljanin (**15**), p. 29, pl. IX, figs. 6–11; pl. XI, fig. 8.
1876. " " Hoek (**16**), p. 12, pl. I. figs. 1–4.
1876. " *coronatus* Hoek (**16**), p. 12.

1878. *C signatus* Brady (**18**), p. 100, pl. XVII, figs. 4–12.
1876. " *tenuicornis* Brady (**18**), p. 102, pl. XVIII, figs. 1–10.
1883. " " Cragin (**24**), p. 3, pl. II, figs. 1–14.
1883. " *signatus* var. *fasciacornis* Cragin (**24**), p. 2, pl. II, fig. 15.
1884. " *tenuicornis* Herrick (**26**), p. 153, pl. R, fig. 16.
1885. " " Daday (**27**), p. 211.
1885. " *signatus* Daday (**27**), p. 208.
1886. " " Vosseler (**28**), p. 189, pl. IV, figs. 1–5.
1886. " *tenuicornis* Vosseler (**28**), p. 189, pl. IV, figs. 6–10.
1891. " *gyrinus* Forbes (**35**), p. 707, pl. II, fig. 9; pl. III, fig. 14.
1891. " *albidus* Schmeil (**37**), p. 23.
1891. " *signatus* Brady (**36**), p. 6, pl. 2, fig. 5.
1891. " *fuscus* Richard (**39**), p. 223, pl. II, fig. 6.
1891. " *annulicornis* and *tenuicornis* Richard (**39**), pp. 224–226.
1892. " *fuscus* Schmeil (**41**), p. 123, pl. I, figs. 1–7*b*; pl. IV, fig. 2.
1892. " *albidus* Schmeil (**41**), p. 128, pl. I, figs. 8–14*b*; pl. IV, fig. 14.

Brady considers *signatus* as the ultimate form of which *tenuicornis* is the penultimate. The serrated ridge on the last antennal joint must be considered, then, as not distinctive of the species, but of the ultimate stage of the species. With this opinion I am inclined to agree, although I have not material to demonstrate their identity. Schmeil (**41**) discusses the relations of the two forms in detail, and gives his reasons for believing them specifically distinct. In this same paper, however, he describes certain "bastard" forms which combine the characters of *signatus* and *tenuicornis*, and it would seem that the existence of such "bastards" would be a strong argument in favor of the identity of the forms.

C. signatus is a widely distributed species, being found in northern and western Europe, and in Great Britain, as well as in North America. It occurs in standing pools, but is more common in the lakes, being found in both pelagic and littoral collections.

CYCLOPS MODESTUS Herrick.

Plate V, figs. 10–13.

1883. *C. modestus* Herrick (**25**), p. 500.
1884. " " " (**26**), p. 154, pl. R, figs. 1–5.
1887. " " " (**30**), p. 14.

I have found *C. modestus* in only one locality,—Rush Lake. Herrick found it in Alabama and Minnesota. It appears to be a clearly marked species. The color in all my specimens was distinctly purplish, a color entirely different from that of the other entomostraca in the same collections. In all my specimens the antennæ were 16-jointed, and about as long as the first segment of the cephalothorax. The cephalothorax is oval and very broad as compared with the abdomen. The abdomen is slender. The furca is about as long as the last two abdominal segments, with the lateral spine situated about midway of its length. The external margin of the furca is hollowed out below the lateral spine. Of the terminal setæ, the first is small and spine like, the second about four-fifths the length of the third, and the fourth slightly shorter than the second.

The armature of the terminal joints of the swimming feet is as follows:

FIRST FOOT.

Outer br.	ex. 3 spines.	Inner br.	ex. 1 seta.
	ap. 1 spine, 1 seta.		ap. 2 spines, 1 minute seta.
	in. 3 setæ.		in. 2 setæ.

SECOND FOOT.

Outer br.	ex. 3 spines.	Inner br.	ex. 1 seta.
	ap. 1 spine, 1 seta.		ap. 2 spines.
	in. 4 setæ.		in. 1 spine, 2 setæ.

THIRD FOOT.

Outer br.	ex. 2 spines.	Inner br.	ex. 1 seta.
	ap. I spine, 1 seta.		ap. 2 spines.
	in. 4 setæ.		in. 1 spine-like seta, 2 setæ.

FOURTH FOOT.

Outer br.	ex. 2 spines.	Inner br.	ex. 1 seta.
	ap. 1 spine, 1 seta.		ap. 2 spines.
	in. 4 setæ.		in. 2 setæ.

The fifth foot is three-jointed, the second joint armed with a seta, and the third joint with two terminal setæ.

CYCLOPS FLUVIATILIS Herrick.

Plate V, figs. 14 and 15; plate VI, fig. 1.

1882. *C. fluviatilis* Herrick (**23**), p. 231, pl. VII, figs. 1–9.
1883. " *magnoctavus* Cragin (**24**), p. 5, pl. III, figs. 14–23.
1884. " *fluviatilis* Herrick (**26**), p. 159, pl. Q^3, figs. 1–9.
1887. " " " (**30**), p. 15.
1891. " *magnoctavus* Brady (**36**), p. 19, fig. 1-4.

I see no valid reason for separating *fluviatilis* and *magnoctavus*, although they are considered by Brady distinct species. *C. pentagonus* Vosseler is like *fluviatilis* in the form of the antennæ and abdomen, and in the armature of the feet. In the form of the cephalothorax it differs widely from *fluviatilis*, the first segment being short, broad and angular, while in *fluviatilis* the first segment is long and rounded, the whole cephalothorax being oval in outline. *C. fluviatilis* is not likely to be confounded with any other *Cyclops*, as we have only one other species with twelve-jointed antennæ,—*C. serrulatus*,—from which it is readily distinguished by its smaller size, and the different form of the abdomen and furca.

I have found *C. fluviatilis* only in pelagic collections. Cragin and Brady have found it in ditches. But Brady remarks: "It is curious that in both cases the animal was found in ditches immediately connected with large sheets of water."

Herrick says, "it is one of the most abundant forms in the larger lakes, and especially in streams."

CYCLOPS SERRULATUS Fischer.

Plate VI, figs. 2–5.

1838. *C. agilis* Koch (**3**), H 21, pl. III.
1851. " *serrulatus* Fischer (**5**), p. 423, pl. X, figs. 22, 26–31.
1853. " " Lilljeborg (**6**), p. 158, pl. XV, fig. 12.
1857. " " Claus (**7**), p. 36, figs. 1–3.
1863. " " Sars (**11**), p. 45.
1863. " " Claus (**9**), p. 101, pl. I, figs. 1 and 2; pl. IV, fig. 12; pl. XI, fig. 3.
1863. " " Lubbock (**10**), p. 197.
1870. " " Heller (**12**), p. 6.
1872. " " Fric (**13**), p. 222, fig. 18.
1875. " " Uljanin (**15**), p. 34, pl. VIII, figs. 1–8.
1878. " " Brady (**18**), p. 109, pl. XXII, figs. 1–14.
1880. " *agilis* Rehberg (**19**), p. 545.
1882. " *serrulatus* Herrick (**23**), p. 230.
1883. " *pectinifer* Cragin (**24**), p. 6, pl. IV, figs. 1–7.
1884. " *serrulatus* Herrick (**26**), p. 157, pl. O, figs. 17–19.
1885. " *agilis* Daday (**27**), p. 240.
1886. " *agilis* Vosseler (**28**), p. 190, pl. V, figs. 29–31.
1891. " *serrulatus* Schmeil (**37**), p. 29.
1891. " " Brady (**36**), p. 18, pl. VII, fig. 1.
1891. " " Richard (**39**), p. 234, pl. VI, fig. 19.
1892. " " Schmeil (**41**), p. 141, pl. V, figs. 6–12.

C. serrulatus is found everywhere. It is the most common of all the species of *Cyclops*. In the larger bodies of water it is more common in littoral collections, but it occurs not infrequently in pelagic collections.

This species has a wide limit of variation, the extreme forms differing so much that one is at first inclined to rank them as separate species. At one extreme is the form common in ditches, pools, and littoral collections, which seems to correspond nearly to *montanus* Brady. It averages .85 mm in length; the furca is not quite as long as the last two abdominal segments, and the external terminal seta is transformed into a stout spine

three-fourths as long as the furca, projecting laterally from the body. At the other extreme is the pelagic form, *C. elegans* Herrick. It averages 1.25 mm in length. The furca is once and a third as long as the last two abdominal segments, and the external terminal seta is short and weak.

Sometimes the two forms occur together in pelagic collections, but only once have I found the *elegans* form as a littoral species. The European form is, in its characteristics, intermediate between these extreme forms.

Although the extreme varieties sometimes occur together, they are almost always entirely distinct. In only two localities have I found connecting forms. In Heart Lake I found an intermediate form associated with the smaller variety, and in Lake Puckaway I found the typical form in connection with both extremes.

Cyclops phaleratus Koch.

Plate VI, figs. 6 and 7.

1841. *C. phaleratus* Koch (**3**), H 21, pl. IX.
1851. " *canthocarpoides* Fischer (**5**), p. 246, pl. X, figs. 24, 32–38.
1853. " " Lilljeborg (**6**), p. 208.
1857. " " Claus (**7**), p. 37, pl, I, figs. 6–10.
1863. " " " (**9**), p. 102, pl. IV, figs. 1–4.
1863. " " Lubbock (**10**), p. 202.
1863. " *phaleratus* Sars (**11**), p. 46.
1872. " *canthocarpoides* Fric (**13**), p. 223, fig. 19.
1874. " *lascivus* Poggenpol (**14**), p. 72, pl. XV, figs. 22–24; pl. XVI, figs. 7 and 8.
1875. " *phaleratus* Uljanin (**15**), p. 38, pl. IX, figs. 1–5.
1878. " " Brady (**18**), p. 116, pl. XXIII, figs. 7–13.
1882. " *adolescens* Herrick (**23**), p. 231, pl. VI, figs. 16–20.
1883. " *perarmatus* Cragin (**24**), p. 7; pl. I, figs. 9–18.
1884. " *phaleratus* Herrick (**26**), p. 161, pl. R, figs. 6–10.
1885. " " Daday (**27**), p. 252.
1887. " " Herrick (**30**), p. 14, pl. VII, fig. 2, a–d.
1891. " " Schmeil (**37**), p. 36.

1891. *C. phaleratus*, Brady (**36**), p. 25, pl. IX, fig. 2.
1891. " " Richard (**39**), p. 238, pl. VI, fig. 12.
1892. " " Schmeil (**41**), p. 170, pl. VIII, figs. 1–2.

The European *C. phaleratus* has ten-jointed antennæ. Our specimens ordinarily have eleven joints, although sometimes, according to Herrick, occurring with ten. In other respects, my specimens agree with those figured by European authors even in minute details, and there seems no good reason for making a new species of our form.

It occurs quite widely distributed in the smaller lakes, and in stagnant pools.

Cyclops bicolor Sars.

1863. *C. bicolor* Sars (**11**), p. 253.
1880. " *diaphanus* Rehberg (**19**), p. 547.
1884. " " Herrick (**26**), p. 160, pl. R, fig. 12.
1885. " " Daday (**27**), p. 246.
1887. " " Herrick (**30**), p. 16, pl. VII, figs. 3a–e.
1891. " *bicolor* Schmeil (**37**), p. 34.
1891. " *diaphanus* Richard (**39**), p. 236, pl. VI, fig. 26.
1892. " *bicolor* Schmeil (**41**), p. 118, pl. VI, figs. 6–13.

The antennæ are 11-jointed, hardly as long as the first cephalothoracic segment. The abdomen is somewhat elongated, the last segment armed with spines posteriorly. The furca is nearly as long as the last two abdominal segments. The lateral spine is situated at about the posterior third. The first and fourth terminal setæ are short, the inner considerably longer than the outer. The median setæ are strongly plumose, and the longer is about as long as the abdomen.

The rami of the swimming feet are two-jointed. The armature of the terminal joints is as follows:

FIRST FOOT.

Outer br.	ex. 3 spines.	Inner br.	ex. 1 seta.
	ap. 2 setæ.		ap. 1 seta, 1 large spine.
	in. 3 setæ.		in. 3 setæ.

SECOND AND THIRD FEET.

Outer br. ex. 3 spines.	Inner br. ex. 1 seta.
ap. 1 spine, 1 seta.	ap. 1 spine, 1 seta.
in. 4 setæ.	in. 4 setæ.

FOURTH FEET.

Outer br. ex. 2 spines.	Inner br. ex. 1 seta.
ap. 1 spine, 1 seta.	ap. 2 spines.
in. 4 setæ.	in. 3 setæ.

The last cephalothoracic segment is expanded laterally, and bears upon each side a long seta. The fifth feet are attached to these expansions, are one-jointed, linear, and each bears at the tip a single seta.

Females average a little more than $\frac{1}{2}$ mm. in length. The color in all the specimens I have seen has been purplish. My specimens agree very well with the descriptions of Sars and Schmeil, the only marked difference being in the length of the caudal setæ. More complete descriptions of the European form may show other differences, but so far as the descriptions go, they apply very well to our form.

C. bicolor occurs in stagnant pools, and is somewhat rare.

Cyclops fimbriatus Fischer.

Plate VI, figs. 8 and 9.

1785. *C. crassicornis* Mueller (**1**), p. 113, pl. XVIII, figs. 15–17.
1853. " *fimbriatus* Fischer (**5**), p. 94, pl. III, figs. 19–28 and 30.
1863. " *crassicornis* Sars (**11**), p. 47.
1870. " *gredleri* Heller (**12**), p. 8, pl. 1, figs. 3 and 4.
1872. " *pauper* Fric (**13**), p. 223, fig. 20.
1875. " *crassicornis* Uljanin (**15**), p. 39, pl. VIII, figs. 9–16; pl. XII, fig. 1.
1878. " " Brady (**18**), p. 118, pl. XXIII, figs. 1–6.
1880. ' *poppei* Rehberg (**19**), p. 550, pl. VI, figs. 9–11.
1880. " *fimbriatus* Rehberg (**19**), p. 548, pl. VI, figs. 7 and 8.
1882. " *crassicornis* Herrick (**23**), p. 232, pl. IV, figs. 9–14.

1884. *C fimbriatus* Herrick (**26**), p. 162, pl. R, fig. 11.
1885. " " Daday (**27**), p. 262.
1885. " *margoi* Daday (**27**), p. 264, pl. III, figs. 20–25.
1886. " *fimbriatus* Vosseler (**28**), p. 192, pl. VI, figs. 4–8.
1891. " " Schmeil (**37**), p. 35.
1891. " " Brady (**36**), p. 25, pl. IX, fig. 1.
1891. " " Richard (**39**), p. 238, pl. VII, figs. 13 and 14.
1892. " " Schmeil (**41**), p. 161, pl. VII, figs. 8–13.

This, our only eight-jointed species, I have found in only two localities. It corresponds quite exactly with the descriptions of the European authors. Brady, however, in fig. 4, pl. XXIII of his monograph, represents the terminal joint of the inner ramus of the second foot as armed with a *spine* on the inner margin. In my specimens this joint has a *seta* on the inner margin. But making allowance for possible inaccuracies in the figure, I see no reason for doubting the identity of the forms.

Herrick states that the color is always reddish. I have found nearly colorless individuals, and I think that the color of this, as of other species, varies according to the environment.

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EXPLANATION OF PLATES.

PLATE III.

Fig. 1. *Diaptomus sanguineus*—terminal joints of male antenna x 163.
2. " " fifth feet of male x 163.
3. " " fifth foot of female x 163.
4. " *leptopus*—fifth foot of female x 163.
5. " " fifth feet of male x 163.
6. " *pallidus*—fifth feet of male x 300.
7. " " fifth foot of female x 300.
8. " *sicilis*—fifth feet of male x 163.
9. " *pallidus*—abdomen of female x 300.
10. " *sicilis*—fifth foot of female x 300.
11. " *ashlandi*—fifth feet of male x 163.
12. " " fifth foot of female x 163.
13. " " terminal joints of male antenna x 300.

PLATE IV.

Fig. 1. *Diaptomus minutus*—fifth feet of male x 163.
2. " " fifth foot of female x 300.
3. " " terminal joints of male antenna x 300.
4. " *oregonensis*—fifth feet of male x 163.
5. " " fifth foot of female x 300.
6. *Epischura lacustris*—abdomen of male x 92.
7. *Limnocalanus macrurus*—abdomen of male x 40.
8. *Cyclops americanus*—abdomen of female x 58.
9. " " fourth feet x 163.
10. " " fifth foot x 300.
11. " *brevispinosus*—furca x 163.
12. " " fourth foot x 163.
13. " *navus*—abdomen of female x 68.
14. " " fourth foot x 163.
15. " " fifth foot x 300.

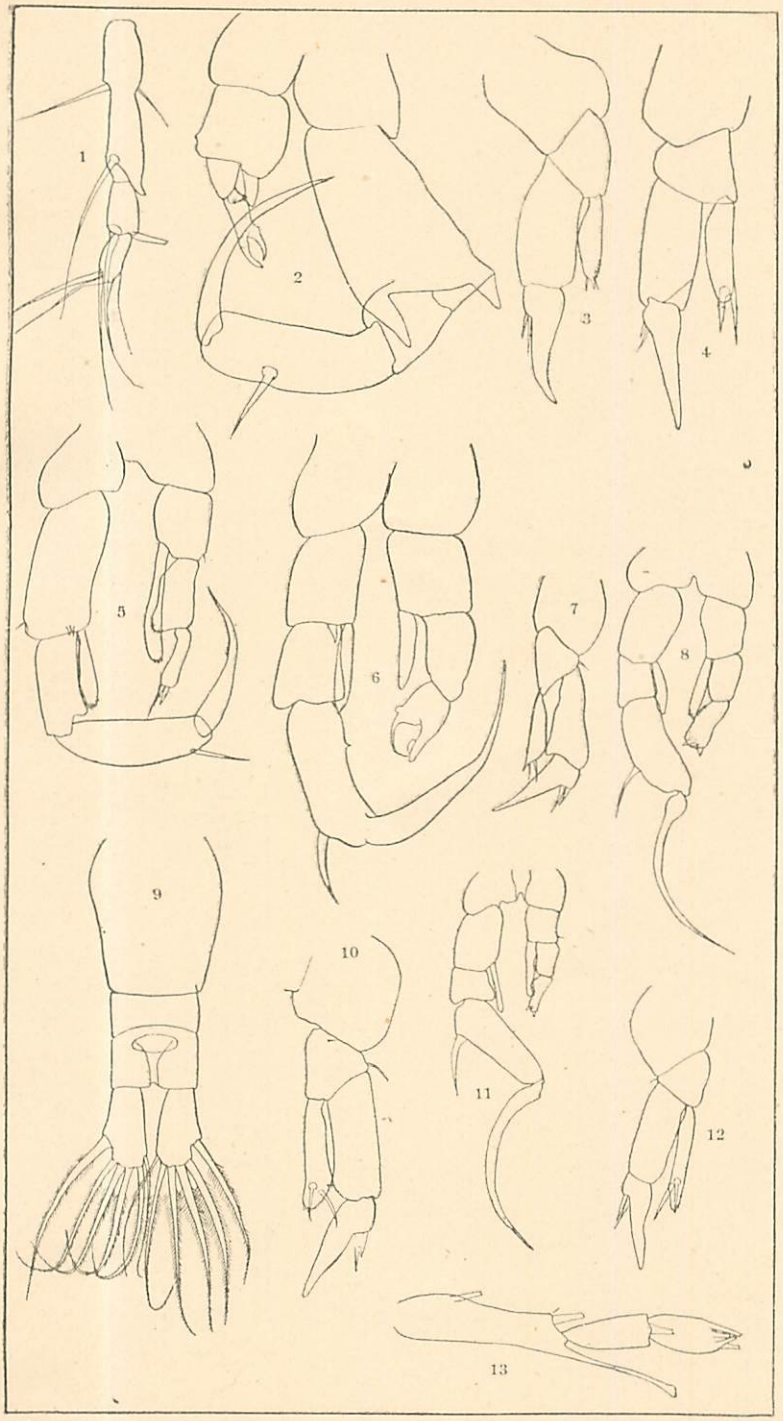
16. *Cyclops parcus*—fifth foot x 300.
17. " *leuckarti* from Heart Lake — second joint of outer maxilliped x 163.
18. " *pulchellus*—fifth foot x 300.
19. " " abdomen of female x 163.

PLATE V.

Fig. 1. *Cyclops parcus*—fourth foot x 163.
2. " *leuckarti*—fifth foot x 300.
3. " " last antennal joint of female x 300.
4. " " from Lake Gussie — outer maxilliped x 300.
5. " " abdomen of female x 58.
6. " " littoral variety—fourth foot x 163.
7. " *signatus*—fourth foot x 163.
8. " " fifth foot x 300.
9. " " last antennal joint of female x 300.
10. " *modestus*—fourth foot x 195.
11. " " furca x 163.
12. " " fifth foot x 360.
13. " " outer terminal joint of third foot x 300.
14. " *fluviatilis*—fifth foot x 360.
15. " " fourth foot x 300.

PLATE VI.

Fig. 1. *Cyclops fluviatilis*—abdomen of female x 300.
2. " *serrulatus*—abdomen of female, extreme pelagic form, x 75.
3. " " abdomen of female, intermediate form, x 100.
4. " " abdomen of female, littoral form, x 178.
5. " " fourth foot x 178.
6. " *phaleratus*—abdomen of female x 92.
7. " " second antenna x 300.
8. " *fimbriatus*—fourth foot x 300.
9. " furca x 300.



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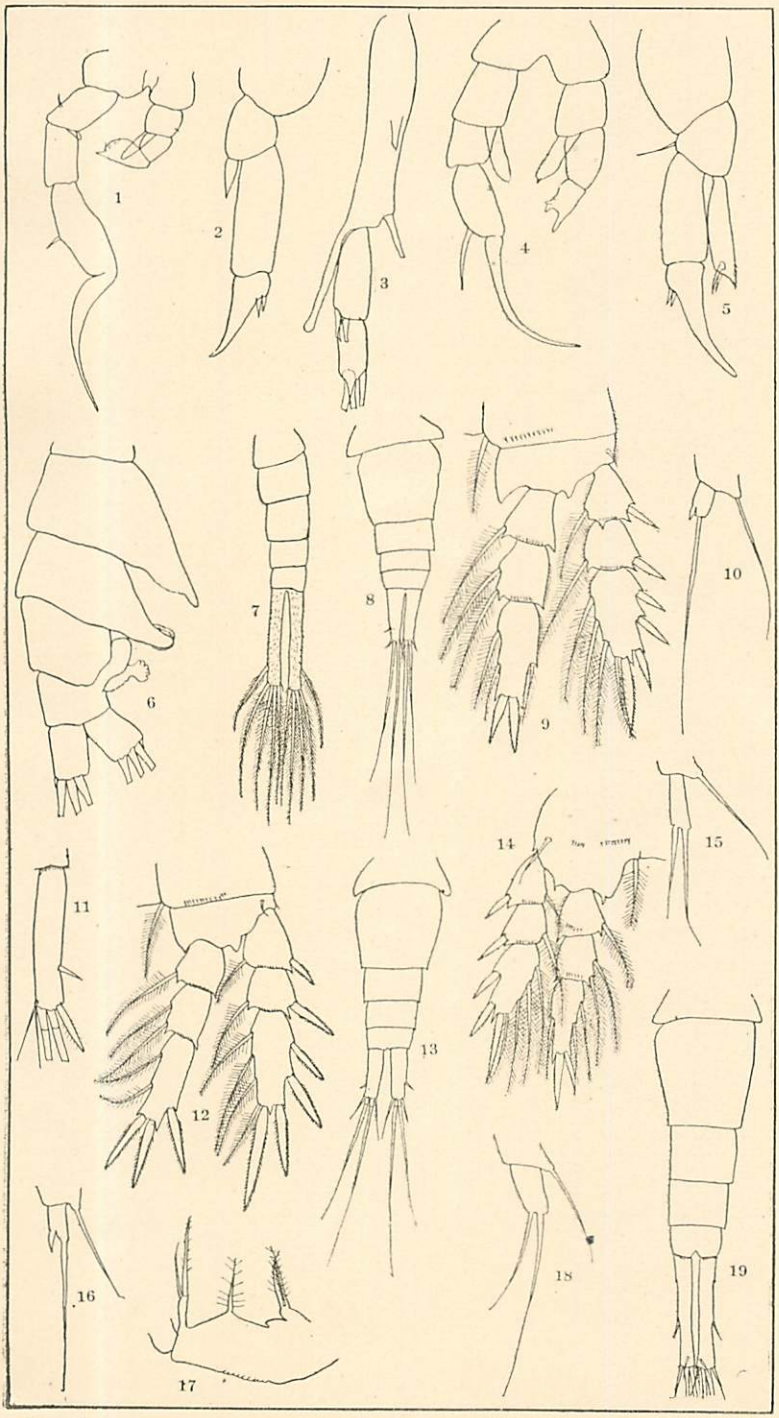

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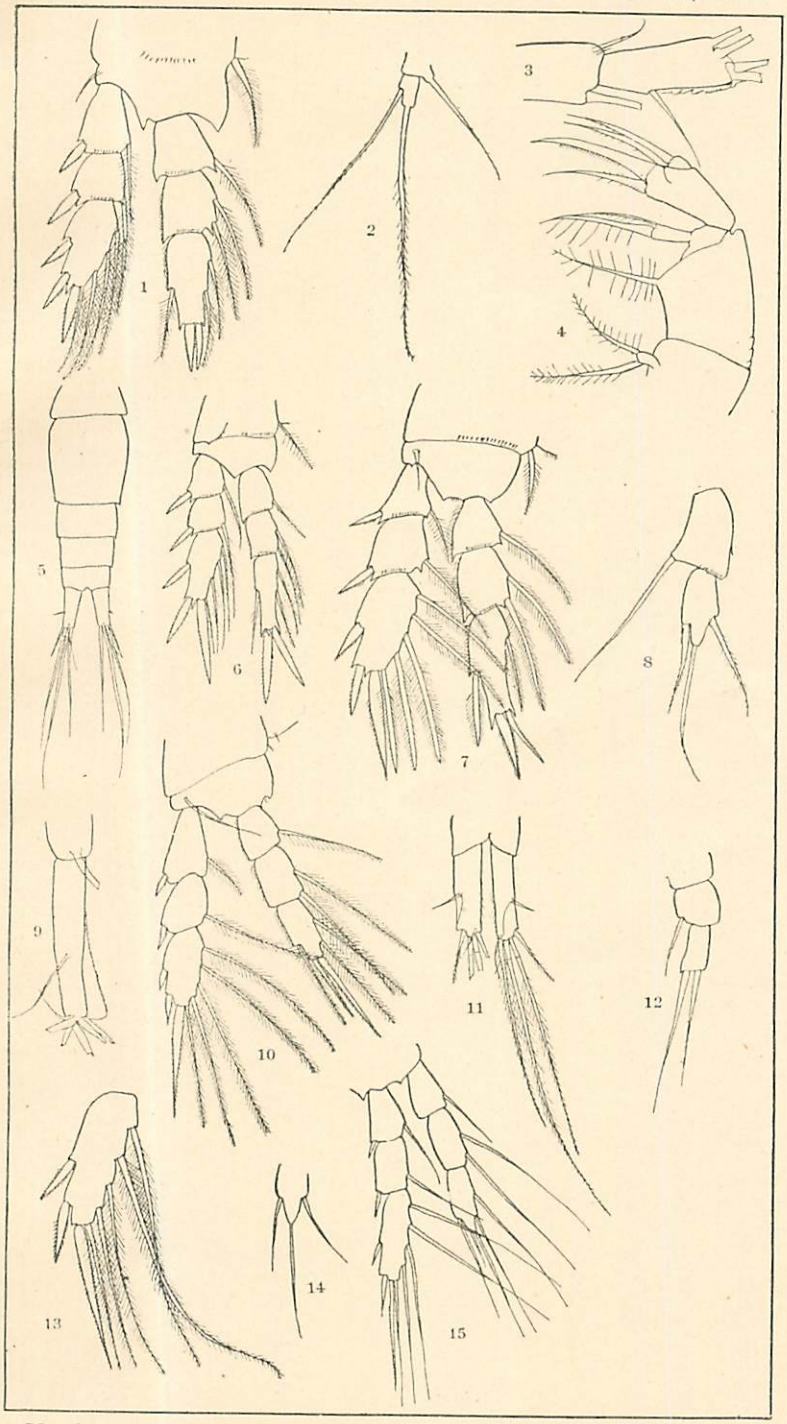

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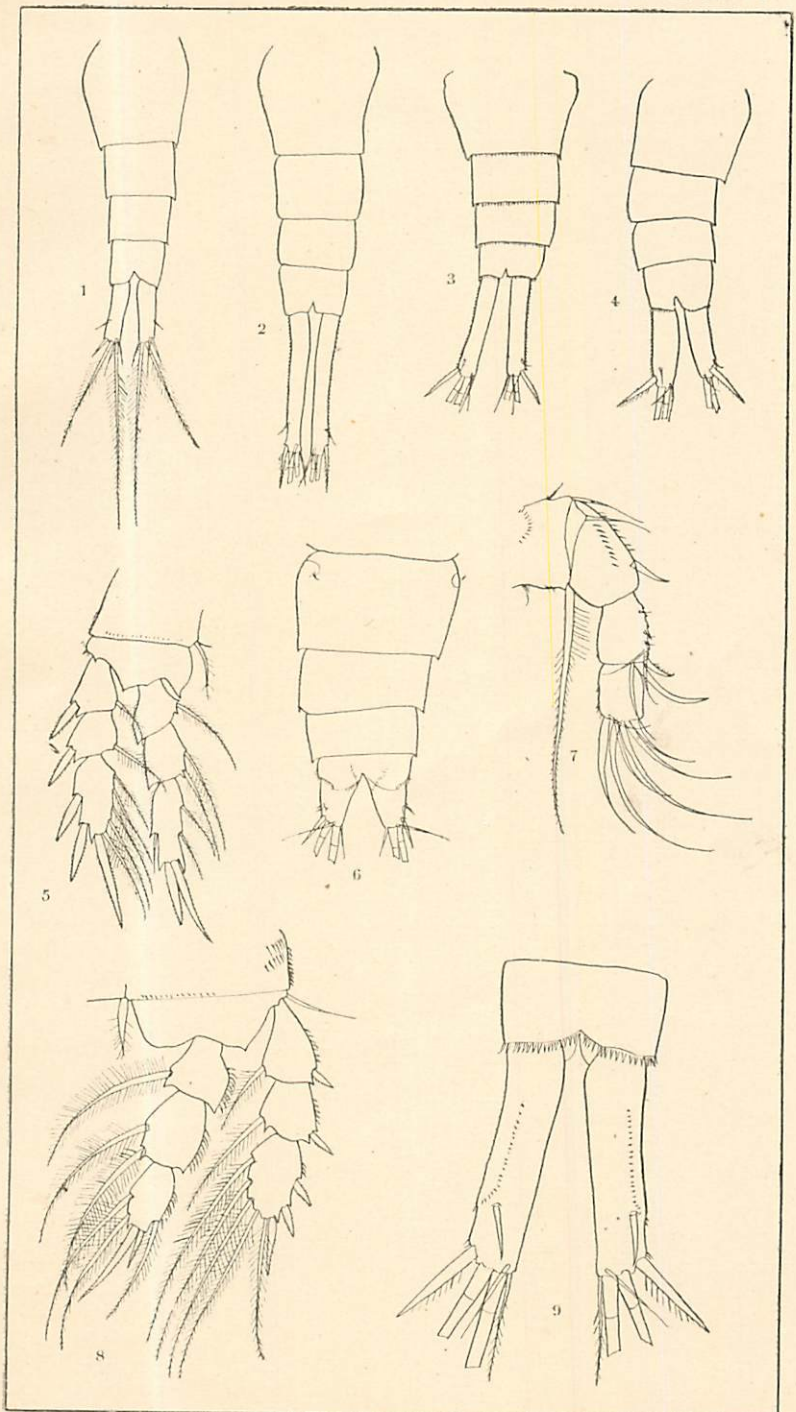

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