XXV.—THE CRUSTACEA OF THE FRESH WATERS OF THE UNITED STATES.

By Sidney I. Smith.

A—SYNOPSIS OF THE HIGHER FRESH-WATER CRUSTACEA OF THE NORTHERN UNITED STATES.

The following synopsis is intended to include all the species of decapod and tetradecapod *Crustacea* known to inhabit the fresh waters of the Northern United States east of the Mississippi River. It has been limited to this particular region, because there has been at hand no material of any importance from other parts of the country, and because very few species have been described from localities outside of the region included. I should, perhaps, except from this statement the numerous species of *Astacidæ*, but these have been so recently monographed by Professor Hagen that it seems needless to repeat an account of them here. The fresh-water *Crustacea* are of great economic importance as food for very many, if not all, our fresh-water food-fishes; and on this account, as well as for purely scientific reasons, I hope this imperfect synopsis will be of service to all those interested in the subject, and trust it will hasten the preparation of a more complete work, including all the species of the United States.

I am indebted to Mr. Oscar Harger for the descriptions of the species of *Asellus* and *Asellopsis*.

MACRURA.

Family Astacidæ.

The following list of the species of this family I have compiled largely from Dr. Hagen's most valuable work,* to which the reader is referred for the full account of the species. The crawfishes of all the eastern part of the United States belong to the genus *Cambarus*, but the species appear to be quite numerous, and are difficult to distinguish without careful study.

Cambarus acutus Girard.

Proceedings Academy Nat. Sci. Philadelphia, vol. vi, p. 91, 1853; Hagen, op. cit., p. 35, pl. 1, figs. 1–5; pl. 2, figs. 106–127; pl. 3, figs. 143, 144.

This species, one of the largest of our crawfishes, has an extensive

* Illustrated Catalogue Museum Comp. Zool., No. 3; Monograph of the North American Astacidæ, 1870.

First pair of thoracic legs chelate; carpus small, triangular, and closely united with the propodus, which is thickened in the male, with a broad, low tubercle on the inner margin a little above the base; dactylus more than half as long as the propodus, its palmary edge armed with spines, of which the distal ones are the larger, and at the end with a large spine; carpus and propodus in the remaining six pairs of legs of about equal length, movably articulated, and armed with acute spines along their posterior edges; dactylus much less than half as long as the propodus, armed with spines along the posterior margin, and biunguiculate at tip. Three proximal segments similar in all the legs, the first being longest, and the third short and triangular, or quadrant-shaped.

The first abdominal segment is furnished, in the males, with two pairs of appendages, of which the outer is composed of a small oval plate, with a few articulated spines along the inner border, and articulated at its extremity with a larger and longer plate, which is expanded along its outer border, and ciliate along its exterior and distal margin. The inner or upper pair of appendages consists, on each side, of a robust quadrate plate, to the distal margin of which two biarticulate rami are attached. The inner ramus has its proximal segment short, much expanded, but not in the form of a hook, as in *A. aquaticus* as figured by Sars;* its terminal segment is pear-shaped, as in that species. The outer ramus has its proximal segment also expanded and triangular; the distal segment quadrate and ciliate externally and distally. The corresponding abdominal segment, in the females, with a single pair of plates, which are subquadrant-shaped but broader than long, with their inner margins straight and meeting each other on the median line. Outer plates of the next pair of abdominal appendages thickened, and forming an operculum covering the remaining branchial plates. These opercular plates are semi-ovate, truncated at the extremity, straight on the inner side, and meet along the median line. They are each divided into two very unequal portions by a suture, running from near the end of the inner straight margin, diagonally across the plate, to a point on the outer curved margin about one-third of the way from the base to the apex; the distal portion is thus much the smaller.

Posterior pleopoda, or caudal stylets, slender; proximal segment somewhat larger than the fourth segment of the antennæ, cylindrical, as are the two rami, of which the outer is only half as long as the inner.

Length, excluding antennæ and caudal stylets, 8^{mm} to 13^{mm}.

Color above dark-fuscous, spotted, and mottled with yellowish.

Common among *Cladophora*, in 8 to 13 fathoms, on the south side of the island of Saint Ignace, also in 4 to 6 fathoms at the eastern end of that island, and in 6 to 8 fathoms among the Slate Islands in Lake Superior; and since collected by Mr. J. W. Milner on algæ drifted into nets, 30 fathoms, Thunder Bay, Lake Huron.

* Histoire Naturelle des Crustacés d'Eau Douce de Norvège, 1e livraison, pl. x, fig. 6, 1867.

Mr. Milner has also collected at Ecorse, Mich., on the Detroit River, specimens probably of this species, but differing from the form above described as follows: The flagellum of the antennulæ contains one or two more segments. The lateral portions of the head and segments of the body, especially in fully adult specimens, are expanded so that the outline of the animal is a broader oval. The open sinus in the lateral margin of the head is a narrow incision, rounded at the bottom, but with the sides sometimes meeting. The propodus in the first pair of legs is nearly as much enlarged in the males as in *A. communis*, and is armed on its palmary margin with three acute teeth, of which the middle one is the largest.

I propose the variety-name *dilata* for this form, although inclined to regard it as the more typical form of the species, which was, however, first described from the less perfectly developed specimens found in Lake Superior.

CÆCIDOTEA STYGIA Packard.

American Naturalist, vol. v, p. 751, figs. 132, 133, 1871; Fifth Annual Report Peabody Academy of Science, Salem, p. 95, 1873.

Cæcidotea microcephala Cope, American Naturalist, vol. vi, p. 411, figs. 109, 110, p. 419, 1872, and reprinted in Third and Fourth Annual Reports of the Geological Survey of Indiana, p. 163, 1872, (*teste* Packard;) Smith, American Naturalist, vol. vii, p. 244, 1873.

Found in Mammoth Cave, Kentucky; Wyandotte Cave, Indiana; and from wells at Orleans, Ind.

I have had no specimens of this species for examination, but, as Professor Packard suggests in his last paper, it is evidently very closely allied to *Asellus*, and has no affinity with *Idotea*. Professor Packard was at first misled by having only a single specimen and that one having lost the caudal stylets. Professor Cope figures and describes his specimens as having external "egg-sacs" attached to the tip of the abdomen. These egg-sacs undoubtedly really belonged to some *Entomostracan*, and probably to the parasite of the blind fish from the same cave. Professor Packard says they were the caudal stylets mistaken for egg-sacs by Professor Cope, but this seems impossible, as they are figured and described as short, broad sacs filled with spherical bodies.

B—THE CRUSTACEAN PARASITES OF THE FRESH-WATER FISHES OF THE UNITED STATES.

Scarcely anything has as yet been published upon the crustacean parasites infesting our fresh-water fishes, and the principal object of the following partial synopsis is to call attention to the subject, and furnish a basis for future investigation, which is of special practical importance to all those engaged in raising fishes confined in ponds or other restricted areas.

The few species here enumerated are doubtless only a small fraction

of those which really prey upon our common fishes. The species are usually not conspicuous, and are very likely to be overlooked by ordinary observers. The Lernæans, which include the commonest and by far the most injurious species, may be attached to any part of the fish, and should be specially looked for upon the gills and about the gill-openings and throat. It is important that specimens should be collected in large numbers for study. For this purpose, they should be preserved, while quite fresh, in small bottles of alcohol or other strong spirit.

Family ARGULIDÆ.

ARGULUS CATOSTOMI Dana and Herrick.

American Journal of Science, 1st series, vol. xxx, p. 388, 1836, and vol. xxxi, p. 297, plate, 1837.

Parasitic on the "sucker," a species of *Catostomus*, in Mill River, near New Haven, Conn., in both fresh and brackish water.

Argulus Funduli Kroyer, (Bidrag til Kundskab om Snyltekrebsene, p. 20, pl. 2, fig. 1, 1863,) should, perhaps, be included in this list, as it is described as found upon *Fundulus limbatus* Kroyer, from New Orleans, but it is not stated whether from salt or fresh water.

Family CALIGIDÆ.

LEPEOPHTHEIRUS SALMONIS Kroyer.

Caligus Salmonis Kroyer, Naturhistorisk Tidsskrift, vol. i, p. 622, 1837, vol. ii p. 13, 18, pl. 6, fig. 7, 1838; Edwards, Hist. Nat. des Crustacés, vol. iii, p. 455; Steenstrup and Lütken, Bidrag til Kundskab om det aabne Havs Snyltekrebs og Lernæer, p. 15, 1861.

Caligus vespa Edwards, op. cit., vol. iii, p. 456.

Lepeoptheirus Strömii Baird, British Entomostraca, p. 274, pl. 32, figs. 8, 9, 1850.

Lepeophtheirus Salmonis Kroyer, Bidrag til Kundskab om Snyltekrebsene, p. 137, pl. 17, fig. 1, in Naturhistorisk Tidsskrift, III, vol. ii, 1863.

Parasitic on the salmon of our eastern coast and of Europe. It is perhaps more properly a marine than a fresh-water species, but is carried by the salmon far up the fresh water rivers.

Ergasilus Funduli Kroyer, (Bidrag til Kundskab om Snyltekrebsene, pp. 228, 238, pl. 11, fig. 1, 1863,) from *Fundulus limbatus* Kroyer, from New Orleans, is perhaps to be added to this list.

Family LERNÆOPODIDÆ.

ACHTHERES PIMELODI Kroyer.

Bidrag til Kundskab om Snyltekrebsene, pp. 272, 275, pl. 17, fig. 5, 1863.

Upon a specimen of *Pimelodus maculatus*, from Cincinnati, according to Kroyer, from whose work I translate the following diagnosis: "Arms, by which the animal is attached, much longer than the head, slender, nearly straight; bulla (the extremity of the united arms) very small, sessile. Body annulated into five segments, and marked with two dorsal, longitudinal sulcations. External ovaries equaling or exceeding the length of the animal, slender, linear, provided with about twenty series of eggs longitudinally, and two, or at the most three, transversely."

ACHTHERES LACÆ Kroyer.

Op. cit., pp. 274, 275, pl. 17, fig. 6, 1863

This species is described by Kroyer from a "North-American species of perch, (*Perca Laca,*)" and should probably be included in this list. The following is a translation of the diagnosis: "Arms, by which the animal is attached, scarcely or a little longer than the head, stout, arcuate; bulla distinctly petiolate. Body neither annulated nor longitudinally sulcated; external ovaries much shorter than the animal, about equaling the body; stout, obclavate, filled with about twelve series of eggs longitudinally, and transversely, with four anteriorly, three in the middle, and two posteriorly."

LERNÆOPODA FONTINALIS, *sp. nov.* (Plate III, fig. 12, lateral and dorsal views; figs. 13 and 14, details.)

Female.—Head nearly as long as the body, and longer than broad. Body, short and thick, not very much longer than broad. Prehensile hooks (fig. 14, *a*) stout, nearly half as long as the head, with a small papilliform process on the inside of the penultimate segment; terminal segment rather slender, tapering, straight to near the tip, which is suddenly curved backward, and terminating in an acute point. Arms by which the animal is attached nearly or quite as long as the body; bulla with an elongated petiole, and broadly expanded at the extremity; ova-sacs as long as or a little longer than the body, with three or four series of eggs transversely, and ten to twenty longitudinally.

Entire length, from mouth to extremities of ova-sacs, 5^{mm}; diameter of body, $1^{mm}.5$; length of ova-sacs, 2^{mm}; diameter of ova-sacs, $0^{mm}.75$.

This species is apparently allied to the *L. carpionis* of Kroyer, (op. cit., p. 277, pl. 14, fig. 4,) and seems to belong to this genus as understood by Kroyer. In our species, the antennulæ (fig. 13, *c*) are very short and small processes, not reaching beyond the mouth. The antennæ (fig. 13, *d*) are large, and extend as far forward as the mouth, and each one is divided at the extremity into three lobes, of which the median lobe is again minutely bilobed, or obscurely forcipulate, while the lateral ones (dorsal and ventral in relation to the animal) are armed with numerous minute hooks, and on the outer side, just below the tip, there is another similar lobe armed with minute hooks. The palpi-like appendages (fig. 13, *b*) on each, just below the mouth, are each tipped with three papilla-like lobes. The mandibles (fig. 14, *b*) are each armed with four stout distal and three much smaller proximal teeth.

Found upon the brook-trout, (*Salmo fontinalis,*) at Norway, Me., in the trout-breeding establishment of Mr. A. B. Crockett. The specimens were all attached to the gills, and were apparently the cause of the

death of the fish on which they were found. It is probably a common and widely-distributed species.

I have considerable hesitation in referring this and the next species to the genus *Lernæopoda*, which is usually restricted to parasites of marine or partially marine fishes. Our species certainly do not agree generically with the typical species of *Achtheres*, described and figured by Nordmann, while they seem to agree very well with species of *Lernæopoda* described by Kroyer. It is possible our species may belong to *Basanistes*, but in all external characters they seem to differ widely. In fact, the species of this group have many of them been so poorly described that it is very difficult to make out what the characters of genera really are. The European species, upon which most of the genera are based, need careful revision.

LERNÆOPODA SISCOWET, *sp. nov.* (Plate III, fig. 15, fig. 16, details.)

Female.—Head not more than half as long as the body. Body short, but little longer than wide, semi-annulated by three or four obscure constrictions on the ventral side, and the posterior extremity extending only slightly beyond the bases of the ova-sacs. Prehensile maxillipeds fig. 16, *b*) proportionally smaller than in the last species; the penultimate segment with a process upon the inside terminated by two small, papilla-like appendages, (fig. 16, *b'*;) the terminal segment regularly curved from the base to the acute tip, and armed on the under side near the tip with a spinous prominence. Arms about as long or considerably longer than the body, slender, nearly straight; bulla with a distinct petiole and a broadly-expanded margin. Ova-sacs longer than the head and body together, linear, with twenty to thirty longitudinal and about four transverse series of eggs.

The antennulæ are a little longer than in the last species, and the antennæ and palpi are quite similar to the antennæ and palpi of that species. The mandible, (fig. 16, *a*,) on one side, at least, is broad toward the base, and is armed with four stout distal, and one, or possibly two, small proximal teeth.

Entire length of a specimen, from mouth to extremities of ova-sacs, 13^{mm}; length of body, 5^{mm}; diameter of body, 3^{mm}.2; length of ova-sacs, 8^{mm}.3; diameter of ova-sacs, 1^{mm}.2.

This species was found upon the siscowet (*Salmo siscowet*) at Outer Island, Lake Superior, by Mr. J. W. Milner.

LERNÆOPODA (?) COREGONI, *sp. nov.* (Plate III, fig. 17.)

Head more elongated than in the preceding species. Body elongated and with some obscure indications of annulation, due perhaps to contraction in alcoholic specimens. The prehensile maxillipeds (fig. 17, *a*) reaching nearly as far forward as the mouth; the basal portion very stout; the terminal portion slender, cylindrical, flexible, and armed at the extremity with a minute, strongly-curved hook, (fig. 17, *a'*.) Arms slender, but shorter than the body; the bulla with a short but distinct petiole. Ova-sacs nearly as long as or considerably longer than the body, linear, with three or four transverse and eighteen to thirty-five longitudinal series of eggs.

The antennulæ are much longer than in the species just described, extending fully as far forward as the mouth. The antennæ are proportionally rather larger than in either of the species here described, but are similar to them in structure. The palpi are small, and each one is terminated by two minute, papilla-like appendages. The mandibles (fig. 17, *b*, *c*) each have four stout distal teeth, besides a smaller terminal one, which is nearly obsolete on one mandible and conspicuous on the other, and three small proximal teeth on one and two on the other.

Entire length of a specimen, from mouth to extremities of ova-sacs, 13^{mm}; length of body, 5^{mm}.5; diameter of body, 1^{mm}.8; length of ova-sacs, 6^{mm}; diameter of ova-sacs, 1^{mm}.

Found by Mr. J. W. Milner on the white-fish (*Coregonus albus*) at Ecorse, Mich., and at Outer Island, Lake Superior.

This species is probably not a true *Lernæopoda*, and is perhaps the representative of an undescribed genus.

CAULOXENUS STYGIUS Cope.

Proceedings Academy Nat. Sci. Philadelphia, 1871, p. 297; American Naturalist vol. vi, pp. 420, 412, figs. 111–113, 1872, and reprinted in Third and Fourth Annual Reports of the Geological Survey of Indiana, pp. 175, 164, 1872; Packard Fifth Annual Report Peabody Academy of Science, Salem, p. 94, 1873.

This is a peculiar lernæan, described by Professor Cope as parasitic on the blind fish (*Amblyopsis*) of Wyandotte Cave, Indiana; also from a cave in Bradford, Orleans County, Ind., according to Professor Packard. According to Professor Cope, it is allied to *Achtheres* and *Lernæopoda*, although the arms by which the animal is attached are united for their whole length, and it is stated that it "is not a sucker or devourer of its host, but must feed on the substances which are caught by the blind fish and crushed between its teeth"!

Family LERNÆOCERIDÆ.

LERNÆOCERA CRUCIATA Lesueur.

Lerneocera cruciata Lesueur, Journal Academy Nat. Sci. Philadelphia, vol. iii, 286, pl. 11, fig. 4, 1824; Edwards, Hist. Nat. des Crustacés, vol. iii, p 527.
Lernea cruciata DeKay, Nat. Hist. of New York, Crustacea, p. 59, 1844.

On *Centrarchus æneus* in Lake Erie, according to Lesueur.

LERNÆOCERA CATOSTOMI Kroyer.

Bidrag til Kundskab om Snyltekrebsene, p. 321, pl. 18, fig. 4, 1863.

Described by Kroyer as found in the Mississippi River, at Saint Louis, on *Catostomus macrolepidotus*, and so is very likely to be found much farther north and east.

Another species is described by Kroyer, (*L. Pomotidis*, op. cit., p. 323, pl. 15, fig. 5,) from a species of *Pomotis* taken at New Orleans.

Plate III.

Fig. 12

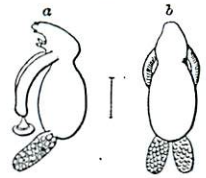


Fig. 13

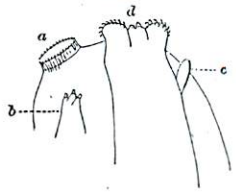


Fig. 14

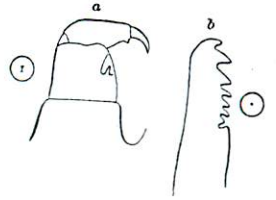


Fig. 16

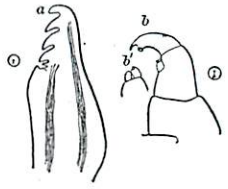


Fig. 15

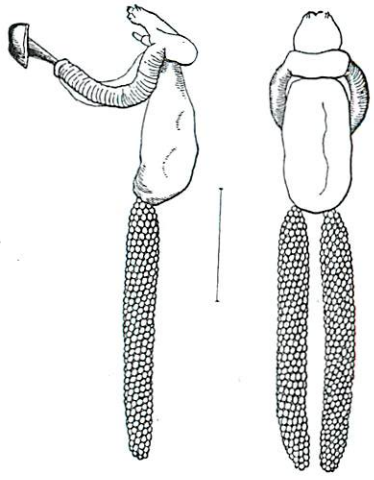


Fig. 17

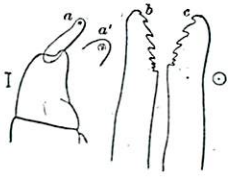


Fig. 18

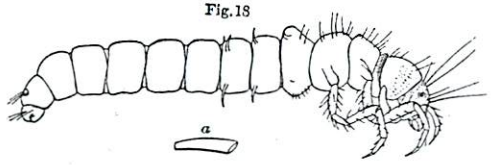


Fig. 19

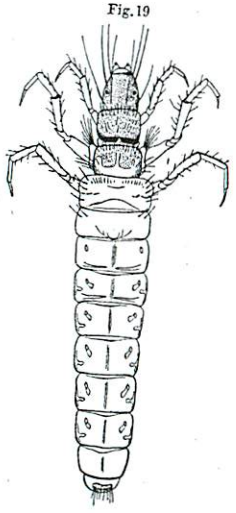


Fig. 20

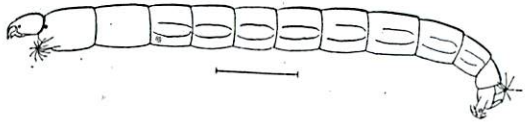


Fig. 21

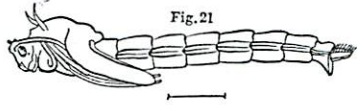
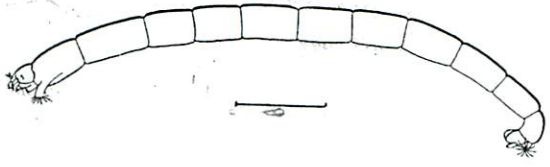


Fig. 22



42D CONGRESS, 3d Session. } SENATE. { MIS. DOC. No. 74.

UNITED STATES COMMISSION OF FISH AND FISHERIES.

PART II.

REPORT

OF

THE COMMISSIONER

FOR

1872 AND 1873.

A—INQUIRY INTO THE DECREASE OF THE FOOD-FISHES.
B—THE PROPAGATION OF FOOD-FISHES IN THE WATERS OF THE UNITED STATES.

WITH SUPPLEMENTARY PAPERS.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1874.