

XXVI.—SYNOPSIS OF THE NORTH AMERICAN FRESH-WATER LEECHES.

BY A. E. VERRILL.

The leeches are related to the fisheries in three ways. Some of the large blood-sucking species, like *Macrobdella decora* and the species of *Hirudo*, attack many fishes directly, even when of considerable size, and destroy them very quickly by sucking their blood; and the species of *Icthyobdella* and *Cystobranchus* are true parasites of fishes, and often, when numerous, do them much injury. Other kinds, like the various species of *Clepsine*, *Nephelis*, *Aulastomum*, &c., destroy all sorts of small mollusks and worms, which otherwise might become the food of fishes. But, on the other hand, certain kinds of leeches are fed upon, to some extent, by the lake white-fish and probably by other fishes.

In a paper published in February, 1872, I gave a synopsis of all the North American fresh-water leeches then known to me. Since that time, however, I have had opportunities to examine numerous living specimens of most of the described species, and have been able to study the variations more fully, and thus to improve many of the descriptions. A few new species and marked varieties have also been added to the list. I have also had opportunities to examine the various collections of leeches obtained from the great lakes by Mr. J. W. Milner while engaged in the investigation of the fisheries; by Mr. Oscar Harger and Mr. T. M. Prudden while on the Yale scientific expeditions to the Rocky Mountains in 1871 and 1873; by Dr. Josiah Curtis, Dr. H. C. Yarrow, and H. W. Henshaw, while on the surveys west of the one-hundredth meridian, under Lieutenant Wheeler; by Dr. Elliott Coues, on the northwest-boundary commission; and by Dr. Hayden's expeditions. These collections have afforded many facts of great interest in relation to the geographical distribution of the species, although they have added but few new forms to those previously known.

In order to facilitate the identification of the genera, the following artificial key has been prepared. It is intended to apply only to the genera included in the present paper.

Analytical key to the genera of American leeches described in the following article.

- a. Head tapering, continuous with the body, (*b* :)
- a a. Head dilated; neck constricted, (*h* :)
- b. Ocelli marginal in a curved line; no proboscis, (*c* :)

- bb.* Ocelli in one to four pairs along the median line; an exsertile proboscis..... *Clepsine*, (p. 677.)
- bbb.* Ocelli none; no proboscis..... *Liostomum*, (p. 688.)
- c.* Œsophagus with folds, and armed with three convergent jaws, (*d*:)
- cc.* Œsophagus with folds; no jaws, (*f*:)
- d.* Jaws with denticles, (*e*:)
- dd.* Jaws without denticles..... *Democedes*, (p. 671.)
- e.* Œsophagus with 9 folds; jaws prominent.. *Macrobdella*, (p. 667.)
- ee.* Œsophagus with 12 folds; jaws small..... *Aulastomum*, (p. 670.)
- eee.* Œsophagus with 6 folds; jaws broad..... *Hirudo*, (p. 688.)
- f.* Folds, 12; 3 transverse lobes; ocelli, 8 or 10. *Semiscolax*, (p. 671.)
- ff.* Folds, 6; 3 transverse lobes; ocelli, 10.... *Hexabdella*, (p. 672.)
- fff.* Folds, 3; no transverse lobes; ocelli, 6 or 8, (*g*:)
- g.* Body distinctly dilated and flat posteriorly; ocelli, 8..... *Nephelopsis*, (p. 673.)
- gg.* Body not much dilated posteriorly; sub-depressed; ocelli, 6 or 8..... *Nephelis*, (p. 675.)
- h.* Body subterete; no lateral appendages, (*i*:)
- hh.* Body somewhat depressed; a row of pulsating vesicles along each side..... *Cystobranchus*, (p. 685.)
- i.* Head obliquely attached, dilated; margins not fringed..... *Ichthyobdella*, (p. 686.)
- ii.* Head campanulate; margin fringed with minute bristles..... *Astacobdella*, (p. 688.)

MACROBDELLA Verrill.

American Journal of Science, vol. iii, p. 137, 1872.

Body strongly annulated, stout, broad, depressed throughout, tapering but little. Cephalic lobe large, rounded in front, composed of five segments, its lower surface rugose with longitudinal sulcations, and at the base having a transverse fold, which forms sockets for the protection of the maxillæ when retracted. Maxillæ three, stout, and prominent, the outer edge denticulate, with numerous acute teeth. Nine plications within the œsophagus. Stomach voluminous, divided into several compartments, with very large and irregular dilations or pouches on each side. Ocelli 10. Male orifice of the typical species in the twenty-seventh* segment behind the mouth; vulva between the thirty-first and thirty-second. Anal opening dorsal, in advance of the posterior sucker.

This genus has a remarkable combination of the characters of several diverse genera. It has, like *Bdella*, sulcations on the cephalic lobe beneath; maxillæ similar to those of *Hirudo*, but more prominent; a plicated œsophagus, similar to that of *Aulastomum*; a stomach most

* Leidy says that the male orifice perforates the twenty-fifth annulus, but he apparently excludes the buccal segment from his count.

like that of *Hæmopsis*; internal reproductive organs similar to those of *Hirudo*; while the external male organ is more like that of *Hæmopsis*. The genus differs from all the others, however, in the situation of the genital orifices, in the form of the maxillæ, the number of plications in the œsophagus, &c. It includes one of the stoutest, largest, and most powerful of the leeches hitherto described.

MACROBDELLA DECORA Verrill.

American Journal of Science, vol. iii, p. 138, fig. 4, February, 1872.

Hirudo decora Say, Long's Second Expedition, vol. ii, p. 268, 1824; Diesing, Systema Helm., i, p. 474; Leidy, Proc. Phil. Acad. Nat. Sci., 1868, p. 230.

Body large, stout, broad, considerably depressed throughout; in extension much elongated, and gradually tapering anteriorly; strongly annulated. Length of the larger specimens twelve inches or more; greatest breadth upward of an inch. Head rounded in front, the cephalic lobe capable of considerable dilation, consisting, apparently, of five segments. Ocelli, 10: the first pair between the second and third segments; the second on the third; the third on the fourth; the fourth pair on the sixth, or buccal; and the fifth on the ninth segment, or fourth behind the mouth. Cephalic lobe rugose and wrinkled beneath, and with conspicuous longitudinal sulcations, of which three, corresponding with the maxillæ, are deepest; posteriorly with a conspicuous semicircular fold, surrounding and partially concealing the maxillæ when retracted into their fossæ. Maxillæ thick, very prominent, higher than broad; outer edge rounded in front, and finely and closely denticulate. Below each maxilla, in the œsophagus, is a broad plication or fold, which often divides into two a short distance beyond; alternating with these are three simple narrower folds, making six or nine in all. External male organ prominent, stout, conical; the broad wrinkled base rising from the twenty-fourth to the thirtieth segments; the terminal portion smoother, with six sulcations; the orifice small, with six lobes, opening in the twenty-seventh segment. Female orifice also with small lobes, surrounded by a slightly elevated area, formed upon the thirty-first and thirty-second segments; posterior to these, there are four conspicuous rugose elevations in a quadrangle on the thirty-sixth to the thirty-eighth segment, and smaller ones on the thirty-ninth segment, with less marked ones on two or three of the previous and following segments; corresponding to these rugosities, there are well developed internal glands.

The reproductive organs are here described from preserved specimens, of large size, taken in the breeding season, in spring. At other seasons, and in smaller specimens, these characters are not so obvious. Acetabulum large, separated from the body by a well marked constriction.

Color above, dark livid brown, or olive-green, with a median dorsal row of about 20 to 22 bright or pale red spots, which are sometimes obsolete, and a row of rounded black spots near each margin, corresponding in number, and nearly in size, with the red ones. Lower sur-

face bright or dark orange-red, or reddish brown, sometimes with black spots near the margins.

This species is very common, and widely diffused in the fresh waters of the Northern United States. Its range northward and southward is unknown. It is the only true blood-sucking leech known to me from the Northern States. It is capable of drawing blood from the human skin, but ordinarily subsists upon fishes, frogs, and tadpoles. It often attaches itself to the throat, and speedily kills them, even when of considerable size. It is frequently used instead of the imported leeches by physicians, and is equally efficacious.

Vermilion River—Say; Norway, Me.; in many lakes and streams in other parts of Maine; and in streams and ponds near New Haven—A. E. Verrill; Minnesota—Dr. Leidy; Madeline Island, Lake Superior—J. W. Milner; Smoky River, Kansas—O. Harger.

Subgenus *PHILOBDELLA* Verrill.

The remarkable characters of the reproductive organs in the following species entitle it to at least subgeneric rank. The jaws also differ considerably from those of the preceding species, and it may be hereafter necessary to make it a distinct genus.

MACROBDELLA FLORIDANA Verrill, *sp. nov.*

Body much depressed, except near the head; in preserved specimens about 1.5 inches long and 0.28 of an inch wide. Ocelli, ten, small; the first two pairs are near together, on the front of head, apparently on the first segment; the third pair is on the second segment; the fourth is on the fourth; and the fifth pair is on the seventh segment, or fourth posterior to the mouth. The anterior lip is, in the preserved specimens, short, broadly rounded, and incurved; the lower surface longitudinally sulcated, with a thin, elevated, transverse fold posteriorly, in advance of the jaws, behind which they can be retracted. Jaws, or maxillæ, small, but prominent, about as thick as broad, scarcely compressed, except close to the blunt edge, which is armed with about twenty acute teeth. Œsophagus with nine distinct folds, some of which are occasionally partially divided posteriorly. Acetabulum rather small. In ordinary specimens, the visible external reproductive organs consist of a small orifice (male?) between the twenty-eighth and twenty-ninth segments; and an elevated conical papilla (female?) arising from the twenty-ninth and thirtieth segments, and followed by about three pit-like depressions. But two specimens, taken and preserved while *in coitu*, have an entirely different appearance. In these, there is a large orifice, probably the true male opening, apparently in the twenty-eighth segment behind the mouth. Just in front of this, on the twenty-sixth and twenty-seventh segments, there are two small lunate, median pits or openings, with raised borders; and just behind it, on the twenty-ninth segment, there is a larger transversely-bilobed orifice, or deep pit. These four openings are surrounded by a raised area, somewhat circular in form, on

which there are several small raised verrucæ, five or six on each side of the median line. The parts described appear to belong to the male system of organs, and have their exact counterparts in the female system of organs farther back. These consist of a large, obtuse, prominent central papilla, at about the thirty-first segment, having what appears to be the true female orifice at its concave summit; just posterior to this, there are two slender, median papillæ, bilobed at the end, corresponding in size and form with the two pits in front of the male orifice; just in advance of the large papilla, on the thirtieth segment, there is a shorter, transversely-bilobed papilla, agreeing in form and size with the pit just behind the large central male orifice. These female organs are also surrounded by a swollen area, on which there are several small rounded depressions, corresponding in size and number to the small verrucæ on the male area. The two specimens are alike in all these arrangements, and were firmly united, head to head, by means of the organs, which were inserted into the corresponding sockets, which act, therefore, somewhat like suckers, and serve to securely hold the two individuals in the proper position.

Color, in alcohol, dark brownish above, with two faint bands of reddish brown along each side toward the margin, separated by a narrow line of blackish; margins and ventral side dull reddish brown.

Lake Okechobee, Florida—Dr. Edward Palmer. One specimen, when preserved, was engaged in swallowing a small lumbricoid worm.

AULASTOMUM LACUSTRE Leidy.

Proceedings Acad. Nat. Sciences of Philadelphia for 1868, p. 229; Vorrill, American Journal of Science, vol. iii, p. 135, 1872.

This species, as described by Dr. Leidy, has 10 ocelli; 8 in the upper lip, the last pair separated by an annulus from the others. Male aperture in the twenty-fourth annulus; female orifice in the twenty-ninth. Oesophagus capacious, with twelve folds. "Jaws thin, small, when at rest included in pouches formed by an eversion of the mucous membrane. Teeth, 12 in number to each jaw, bilobed at base." Color (var. *a*) throughout olive green, closely maculated everywhere with confluent spots of a darker hue of the same color. When full-grown, this species becomes 6 to 8 inches or more long and half an inch broad.

Var. b, tigris.—Large and broad, depressed. Color yellowish green to dark olive-green, with scattered irregular blackish spots and blotches.

Var. c, fuliginosum.—Color uniform dusky or brownish black.

Var. d, virescens.—Color uniform greenish, or yellowish green, varying to dark green; usually paler beneath.

In my specimens, the male organ is long, very slender, thread-like, and is protruded from an opening in the twenty-fifth segment, behind the mouth, (counting the buccal segment.) The female orifice is small, with slightly raised borders, and is situated between the twenty-ninth and thirtieth segments. The fourth pair of ocelli is on the buccal segment; and the fifth pair is on the third segment behind the mouth.

Var. *a*, Twin Lake, Minnesota, and Lake Superior—Leidy; Denver, Col.—Mr. Henshaw, Wheeler expedition, 1872; Yellowstone Lake and Yellowstone River, abundant—Dr. J. Curtis, Wheeler expedition, August, 1872; between Santa Fé and Wingate, New Mexico—Dr. Loew, Wheeler expedition; New Haven—A. E. Verrill.

Var. *b*, Lake Superior—Leidy; Fairfield, Utah—Dr. Yarrow, Wheeler's expedition; Utah, in a tributary of Great Salt Lake—Mr. Gorman; Cool Spring, Fire-Hole Basin—No. 224, Collection Smithsonian Institution.

Var. *c*, New Haven—A. E. Verrill; lake near Long's Peak, elevated 9,000 feet—Hayden's expedition.

Var. *d*, Springs, Saguache, Colorado—Ernest Ingersoll, Hayden's expedition, (also var. *b*.)

DEMOCEDES Kinberg.

Ofversigt af Kongl. Vet. Akad. Förhandlingar, xxiii, p. 356, 1867; Verrill, op. cit., p. 137, 1872.

This genus, according to Kinberg, has "three muscular, compressed, edentate maxillæ," with the habit of *Hirudo*. The two species first named by him are from Port Natal, and have 10 ocelli. The remaining species has but 8 ocelli, and is described as follows:

DEMOCEDES MACULATUS Kinberg.

Op. cit., p. 356; Verrill, loc. cit., p. 137, 1872.

Body tuberculose, with minute tubercles, cinereous, with irregular black and white spots; cephalic lobe 5- or 6-annulate; ocelli 8; fourth pair on the buccal segment; abdominal orifices in the twenty-fifth and thirtieth segments; segments, 94; length, 88^{mm}.

Wisconsin—Kumliu.

SEMISCOLEX Kinberg.

Op. cit., p. 357, 1867; Verrill, Amer. Journ. Science, vol. iii, p. 136, 1872.

According to Kinberg, this genus has the following characters: maxillæ wanting; pharynx with a transverse sulcus below the posterior margin of the buccal segment, and below that provided with longitudinal sulci; habit of *Hirudo*.

SEMISCOLEX JUVENILIS Kinberg.

Op. cit., p. 357; Verrill, loc. cit., p. 136.

This, the typical species, has a smooth body, with a narrow median dorsal fascia, and a series of spots on each side. Cephalic lobe a little elongated, three-annulate; ocelli eight, with the fourth pair on the second segment of the body; abdominal orifice in the twenty-sixth segment; segments, 97; length, 40^{mm}.

Montevideo, in fresh water.

SEMISCOLEX GRANDIS Verrill, *sp. nov.*

Body very large, broad, stout, with about 90 well marked annulations, forming crenulations along the margins; length, in full extension, 10 to 12 inches or more; greatest breadth, 1 to 1.25 inches. Head somewhat prolonged and tapered, composed of several distinct annulations. Ocelli, 10: the first pair near together on the first annulus of the head; the second pair on the second annulus; the third pair on the third annulus; the fourth pair on the fifth annulus; and the fifth pair on the eighth annulus. Upper lip divided beneath into two median and two lateral areas by three deep, triangular fossæ; each of these areas is subdivided by numerous longitudinal and transverse wrinkles, the small interspaces being rather smooth; the lip is separated from the opening of the œsophagus by a deep transverse groove, bordered below by a membrane, which rises into three transverse folds or lobes, but these are often rather indistinct in preserved specimens. Œsophagus relatively small and short, with about twelve unequal plications or folds, some of which are often indistinct, or united anteriorly, and sometimes with additional small ones intercalated between the larger ones posteriorly. No distinct maxillæ could be detected. Male orifice situated between the twenty-fourth and twenty-fifth annuli behind the mouth; female orifice in the thirtieth annulus. The male orifice is in a small, circular pit, from which, in one specimen, a long, filiform, intromittent organ is extended to a distance equal to half the breadth of the body, or about 0.5 of an inch, (11^{mm}.) The female orifice is transversely elliptical, with slightly raised and rugose margins. Acetabulum small and deep, projecting less than half its diameter beyond the end of the body. Anal orifice large, surrounded by numerous convergent plicæ.

Color dusky brown above, somewhat paler beneath, sometimes with a few rather large, roundish, but irregular, distantly scattered dark spots on the back, and often with two or three beneath; sometimes nearly uniform slate-brown, with only a few, small, remote blackish spots.

Var. b, maculatus.—Form and size as in the preceding variety. Color above olive-green or yellowish green, thickly spotted with irregular angular, more or less confluent, blotches of blackish. The folds of the œsophagus, in the single specimen examined, consist of three broad ones, imperfectly and rather indistinctly divided into three subplicæ; alternating with the three broad folds were three narrow and inconspicuous ones.

Var. a, West River, New Haven, Conn.—A. E. Verrill; Lake Huron, at Au Sable, Michigan.—J. W. Milner.

Var. b, Madeline Island, Lake Superior—J. W. Milner.

HEXABDELLA Verrill.

Op. cit., vol. iii, p. 136, 1872.

Body depressed posteriorly. Cephalic lobe prolonged, composed of four segments, with three longitudinal folds beneath, followed by three transverse fleshy lobes, or folds; below these, the œsophagus is fur-

nished with six longitudinal plications. Ocelli, ten: the fourth pair on the buccal segment; the fifth on the second segment behind the buccal. Anus dorsal, at the posterior end of the body. Acetabulum round, separated from the body by a deep constriction.

This genus, although evidently allied to *Semiscollex*, differs in the structure of the cephalic lobe and œsophagus.

HEXABDELLA DEPRESSA Verrill.

Op. cit., vol. iii, p. 136, 1872.

Body strongly annulated, broad and much flattened posterior to the clitellus, tapering and somewhat rounded in front of it. Length, in partial contraction, 1.50 inches; breadth 0.40 inch. Head, or cephalic lobe, somewhat elongated, rounded in front, with four annulations, the first or terminal one oval, separated from the following by a decided depression, or fossa. Ocelli, ten: the first pair near together on the posterior edge of the first cephalic segment; the second pair, on the second, and the third, on the third segment, form a nearly regularly curved line; those of the fourth pair are on the sides of the fifth or buccal segment; and those of the fifth are on the seventh segment, or the third of the body. Cephalic lobe divided beneath into three broad lobes by two deep sulcations, each lobe subdivided into smaller ones by less marked, divergent grooves. Behind each of the three lobes, there is an elevated, transverse, rounded, fleshy lobe, or fold; behind these, and separated by a deep groove, there are six well marked plications in the œsophagus. Anus with elevated, crenulate borders. Male organ between the twenty-fourth and twenty-fifth segments of the body. Acetabulum round, of moderate size. Color of the preserved specimen, dark slate-brown above, with few irregularly scattered, remote black spots, and with still fewer small, white specks; beneath, lighter slate-brown, with very few black spots toward the margins.

Near New Haven, Connecticut—A. E. Verrill.

NEPHELOPSIS Verrill.

American Journal of Science, vol. iii, p. 135, 1872.

Body broad and flattened behind the clitellus, rounded and tapering in front of it. Upper lip large, dilated, wrinkled, and radiately sulcated beneath; œsophagus with three broad folds, as in *Nepheleis*. Intestine simple, resembling that of *Trocheta*. Ocelli eight, in the typical species. External male organ expanded at the end into a disk-like form, with a raised margin and depressed center, in which there is a four-lobed orifice, as in *Trocheta*. The internal male organs resemble those of *Aulastomum* and *Hirudo*; the testicles being rather large, rounded or pyriform vesicles, apparently but eleven on each side.

This genus has a remarkable combination of the characters of *Nepheleis*, *Trocheta*, and *Aulastomum*. In general habit and form of body, it is much like *Trocheta*, but there are no maxillæ.

NEPHELOPSIS OBSCURA Verrill.

American Journal of Science, vol. iii, p. 135, 1872.

Body much elongated in extension, depressed posteriorly, distinctly annulated, a little rugose anteriorly in contraction. Length, in extension, 4 to 5 inches; breadth, 0.25 to 0.35 of an inch. Head obtusely rounded in front. Ocelli eight: two pairs on the first ring near the front, the inner pair larger, well separated; two pairs on the sides of the buccal segment, small, distant, the upper pair a little below the level of the outer pair of anterior ones. Inner surface of the upper lip very rugose, the sulcations and folds diverging outwardly. Mouth large; folds of the œsophagus broad, prominent, the outer end pointed, triangular. Anal orifice large, with raised borders, situated on the dorsal surface a little in advance of the posterior sucker, which is large, rounded, the disk expanded, and considerably larger than the pedicel. Clitellus much thickened; male organ short, protruded as a low truncate cone, with disk-shaped end. When examined by transmitted light, a row of eleven rather large, translucent, pyriform spots may be seen midway between the dark intestine and the flattened margin, which appeared to correspond with the testicles. Color, above and below, dull dark brown, umber-brown, or fuscous, usually with numerous obscure, narrow, longitudinal stripes of lighter and darker brown.

Var. b, maculata.—Form and size nearly as described above. Color of preserved specimens greenish yellow or clay-color, with small, irregular spots of black scattered over the back; lower surface nearly plain clay-color. Ocelli, eight, but often not very distinct in preserved specimens. Three small, acute, triangular lobes above and alternating with the upper ends of the œsophagal folds. A specimen from Fire Hole Basin was much darker; the black blotches being larger and more or less confluent.

Var. a.—Madison, Wisconsin, very abundant in the lakes near the city—A. E. Verrill.

Var. b.—San Luis Valley, Colorado, common—Lieutenant Marshall, Wheeler's expedition, 1873; Snake River—Dr. Josiah Curtis; lake near Long's Peak, elevated 9,000 feet—Hayden's expedition; Cool Spring, Fire-Hole Basin—Smithsonian Institution.

This species was first taken in Wisconsin, in May, 1870, when numerous egg-capsules were also found attached to the stones along the shores. These were yellowish in color, broad-oval or elliptical, terminating in a point or mucro at each end, flat below, smooth and slightly convex above, with a thin margin. They were 5^{mm}.5 to 8^{mm} long by 3^{mm}.5 to 4^{mm} broad. Each one contained from five to ten eggs, or young leeches; some of the latter were already leaving the capsules; these were 5^{mm} or more in length, and even at this age, though pale in color, they had the characteristic form of the adult, and the eight ocelli were distinctly visible.

NEPHELIS LATERALIS Verrill.

Hirudo lateralis Say, Long's Second Expedition, vol. ii, p. 267, 1824; Diesing, Syst. Helm., vol. i, p. 474.

Nephelis lateralis Verrill, American Journal of Science, vol. ii, p. 451, 1871; vol. iii, p. 133, 1872.

? *Nephelis vermiformis* Nicholson, Canadian Journal, 1873, (young.)

The original specimens, described by Say from the waters between Rainy Lake and Lake Superior, were dull livid with "a few very remote minute black points, and a rufous line along each side;" the "six ocular points are placed in a regularly curved line."

Specimens from New Haven, apparently belonging to the same species, were 3 or 4 inches long in extension, and 0.15 to 0.25 of an inch wide; rather slender and subterete anteriorly, somewhat depressed posteriorly, with the margins rounded. Head obtusely rounded in front, not very distinctly annulated. Ocelli six, distinct, sometimes with faint colored spots, like indications of another pair on the first segment; the front pair, on the first segment, is very distinct and much larger than any of the others, well separated, round, and blackish; the two pairs on the sides of the buccal segment are very small and well separated. Acetabulum as wide as the body, when extended, with a circular row of blackish submarginal spots. The three folds of the œsophagus are about as in the following species. The color above is sometimes plain dark brown, and often dull dark orange-brown, with numerous fine longitudinal lines, alternately darker and lighter, and with many small irregular black spots scattered unevenly over the surface, except along the middle of the back; an obscure reddish line passes along each side near the margin, apparently due to an internal vessel showing through the integuments; lower surface plain, dull orange-brown, somewhat lighter than the back; head light flesh-color. Several other varieties occur. Some are nearly black, with few scattered lighter specks; others are pale brown, or light slate, specked with small darker brown or blackish spots.

Whitneyville Lake, and Farmington, Conn., and Peak's Island, Casco Bay, Maine—A. E. Verrill; Bad River and Madeline Island, Lake Superior—J. W. Milner; Clear Lake, Colorado, (plain brown variety)—Hayden's expedition; Lake Huron (pale variety)—J. W. Milner.

NEPHELIS QUADRISTRIATA Grube.

Famil. des Annel., pp. 110 and 149; Diesing, Sitzungsberichte der kaiserlichen Akad. der Wissenschaften, math.-naturwiss. Classe, xxxiii, p. 496, 1859; Verrill, op. cit., vol. iii, p. 133, 1872.

Body, in extension, 2 to 4 inches long, by 0.12 to 0.25 inch broad, slender subterete, tapering to the anterior end; in contraction broader and somewhat depressed posteriorly; the sides rounded. Posterior sucker large, nearly as wide as the body, to which it is broadly attached. Mouth rather large, suborbicular, the upper lip a little expanded, rounded in front, wrinkled within, smooth externally, and not distinctly annulated

The cesophagus has the three longitudinal folds slightly prominent, rounded at their exterior ends. Six ocelli were all that could be distinguished; of these, those of one pair, situated on the front of the first segment, are much the largest; two pairs, much smaller and inconspicuous, are placed well apart on the sides of the buccal segment. Anal orifice large, with a raised border, situated a little in advance of the posterior end of the back.

Color above, brownish black, dark brown, fuscous, or dark cinereous, with four longitudinal rows of irregular, nearly confluent, black spots, intermingled with light brown or grayish spots, which often also form the centers of the black spots. Lower surface plain brown or fuscous, usually a little lighter than the back.

Var. b.—Back with a light reddish or brownish median stripe, and a broad band of blackish on each side, often more or less interrupted with lighter mottlings.

Var. a.—New Haven and Farmington, Conn.—A. E. Verrill; Falmouth, Mass.—Dr. Edw. Palmer; Lake Raymond, Nebraska—T. M. Prudden, 1873. This variety is very common in the fresh waters of New England.

Var. b.—Yellowstone Lake—Dr. Josiah Curtis; San Luis Valley, Colorado—Lieutenant Marshall, Wheeler's expedition, (also *var. a.*;) Colorado—Hayden's expedition 1873, (*var. b.* and plain dark brown variety.)

NEPHELIS MARMORATA Verrill.

American Journal of Science, vol. iii, p. 134, 1872.

Hirudo marmorata Say, op. cit., p. 267.

(?) *Nepheleis punctata* Leidy, Proc. Acad. Nat. Sci. of Philad., 1870, p. 89.

This species, found by Say associated with *N. lateralis*, appears to differ in no important particulars, and may be only a differently colored variety of the same species. It is described as blackish or fuscous, with irregular whitish or light colored spots; beneath pale, generally immaculate, but sometimes with confluent black spots. Ocular points six, in a regularly curved line.

When a larger series of living specimens from various localities can be studied, the three preceding forms, admitted here as distinct, may prove to be mere varieties of one species, no less variable than the *Nepheleis vulgaris* of Europe. The agreement in the number and arrangement of the ocelli is very close in the three forms.

The leech described by Dr. Leidy from the vicinity of Philadelphia and from Beverly, N. J., appears to differ in no essential characters. It was blackish olivaceous above; the annuli minutely punctate with yellowish olivaceous or dusky white, and narrowly bordered with the same; beneath grayish.

NEPHELIS FERVIDA Verrill.

American Journal of Science, vol. ii, p. 451, 1871, and vol. iii, p. 134, 1872.

Body 2 or 3 inches long, 0.20 to 0.30 of an inch wide, elongated and slender.

der in full extension, very little depressed, most so posteriorly, often round and tapering anteriorly. Mouth large, nearly circular, subterminal; the upper lip, in contraction, short and rounded; within the œsophagus are three conspicuous folds. Ocelli eight, small, nearly equal, blackish, conspicuous; two pairs, a little apart, on the first ring of the head; two pairs, wider apart and farther back, on the third ring. Color, bright brick-red when living; the preserved specimens show numerous faint longitudinal lines of brown.

In 8 to 13 fathoms, south side of Saint Ignace, Lake Superior—S. I. Smith.

A small specimen, probably the young of this species, taken in 13 to 15 fathoms, in Simmons' Harbor, was translucent, tinged with flesh-color, with a dark brown intestinal line posteriorly.

Egg-capsules, apparently of this species, were found in August by Mr. Smith, attached to the leaves of *Nupha*, in a small lake near Simmons Harbor. These are broad-oval or elliptical, above smooth and convex, translucent yellowish brown, with a thin, flat, lighter border, each end prolonged slightly into a short tubular neck, with a terminal orifice. Lower surface flat. Each contained two, three, or more young leeches, mostly upward of half an inch long, plain whitish, with eight distinct black ocelli. The largest capsule was 11^{mm}.5 long by 9^{mm} wide, including the margin; the smallest was 9^{mm}.5 long by 7^{mm}.5 wide. These capsules closely resemble those of *Nephelopsis obscura*, but are larger than those that were found to belong to that species.

This species approaches *Nephelopsis* in several characters, and especially in having eight distinct ocelli. When more specimens, and of larger size, can be examined, it may prove to be a true *Nephelopsis*.

CLEPSINE Savigny.

This genus is very abundantly represented in our waters, both in individuals and species. All of these species are apt to be quite variable in character in different localities, as well as at different periods of growth. Most of the species are elegantly, and some are quite brilliantly colored, but the colors are often quite variable in the species, and cannot be relied upon for distinguishing them without other characters of more importance. The form varies extremely, according to the state of contraction or extension. They are most frequently found adhering to the under surfaces of floating logs and old pieces of boards, or beneath the loosened bark of submerged branches and trunks of decaying trees. Occasionally, they adhere to the lower surface of larger leeches, turtles, or other animals, but they probably never suck blood. They feed upon insect larvæ, small worms, mollusks, &c. When disturbed, these species curl themselves up after the manner of "pill-bugs" and certain insect larvæ. The eggs, when laid, are retained in a cluster beneath the expanded and concave posterior portion of the body, which is arched over them and kept in continuous undulatory motion during

the period of incubation. The young, when hatched, adhere in a group to the posterior part of the lower surface of the body of the parent by means of their posterior suckers, and before quitting the parent usually present the essential characters, and often nearly the pattern of color of the adult, though paler.

Section A.—Ocelli 2, separate or confluent.

Subsection a.—Back smooth.

CLEPSINE PARASITICA Diesing.

Hirudo parasitica Say, Major Long's Second Expedition to the Source of Saint Peter's River, Lake Winnepeek, &c., vol. ii, p. 266, 1824.

Clepsine parasitica Diesing, Systema Helminthum, vol. i, p. 450, 1850; Verrill, op. cit., vol. iii, p. 128, 1872.

This species is one of the largest and most conspicuously colored of the genus.

Body smooth, but distinctly annulated, much depressed, broad, tapering anteriorly to the obtusely rounded head, broad and emarginate posteriorly, with a broad, round, posterior sucker or acetabulum, about half of which is exposed behind the end of the body. Length, in extension, 3 inches; greatest breadth 0.3 to 0.5 of an inch, according to the degree of extension. Ocelli usually united into one inconspicuous spot, placed near the anterior margin of the head; two or three other minute black spots, somewhat resembling ocelli, sometimes occur along the margins of the head anteriorly.

Upper surface variegated with green, yellow, and brown; the ground-color is usually dark greenish brown, with a broad median vitta of pale greenish yellow, which at intervals expands into several large irregular spots; unequal, oval, and rounded spots are also irregularly scattered over the back. The entire margin is surrounded by a series of alternating square spots of dark green and yellow. Lower surface longitudinally striped with numerous purplish brown and black lines; the margin spotted like that of the upper side.

West River, near New Haven, Connecticut, on the lower side of floating wood, and at Norway, Maine—A. E. Verrill; frequent in the lakes of the Northwestern States, adhering to the sternum of tortoises—Say

CLEPSINE PICTA Verrill.

Op. cit., vol. iii, p. 128, 1872.

Body smooth, much depressed, broad posteriorly, somewhat tapering anteriorly, about 2.50 inches long in extension, varying in greatest breadth from 0.25 to 0.30 of an inch. Acetabulum large, rounded. Ocelli two, close together, and sometimes confluent, surrounded by a triangular white area, which extends backward. Color of upper surface, dark brownish green, finely variegated with orange; toward the margins the green becomes brighter; a row of semicircular orange spots, centered with flesh-color or white, extends along each margin. Small, distant,

flake-white spots are scattered over the upper surface, and arranged in about five irregular longitudinal rows. Acetabulum varied with green and orange, the green forming rays toward the margin, alternating with salmon-colored spots. Lower surface darker than the upper; deep greenish on the central part.

Another variety agrees in most respects with the preceding, but has a median, brown line along the back, interrupted by six irregular light green blotches, the last one largest and elongated, the rest of the back purplish brown varied with greenish, the colors appearing as if in fine checks, owing to lighter and darker lines running in both directions; a row of rounded light green spots on each side midway between the dorsal line and margins, and a row of flesh-colored semicircular spots, alternately large and small, along the margin. Acetabulum varied with light purple and flesh-color. Lower surface pale bluish, with lighter lines.

A young specimen, about 0.75 of an inch long, had the same pattern of color, but the upper surface was lighter, reddish brown, and the dark brown lobes of the intestine were visible through the integuments.

Other variations of color were observed. In some, the blotches interrupting the median brown line were dull orange, and the marginal spots were orange-yellow. The sides of the back were orange-brown, thickly specked with dark brown and with a row of small pale green spots on each side; lower surface plain purplish brown, and there was a whitish spot in front of the ocelli.

Whitneyville Lake and West River, near New Haven; common on submerged or floating wood, and beneath dead bark, in stagnant pools near New Haven, April 20, 1873, without eggs or young—A. E. Verrill.

CLEPSINE MODESTA Verrill.

Op. cit., p. 129, fig. 2, 1872; vol. v, p. 388, 1873

Clepsine submodesta Nicholson, Canadian Journal, 1873.

Body in extension elongated, tapering and very slender anteriorly, broader and obtusely rounded posteriorly.

Length, 0.5 of an inch in extension. Back smooth, faintly annulated, translucent. Head small, obtuse, whitish. Ocelli two, black, near

Fig. 1



together. The general color above is usually pale purplish brown or purplish flesh-color, with minute specks of brown and very small round spots of dull yellow, and often of light green; margins and a median dorsal line, pale. Acetabulum moderately large; whitish. Auditory vesicle or "cervical gland," placed near the head, small, rounded, slightly prominent, conspicuous, deep brown, surrounded by a whitish circle. Lower surface pale purplish. The attached young, about 0.3 of an inch long in extension, were slender, whitish, and subdiaphanous, with the brown intestine showing through posteriorly.

West River and Whitneyville Lake, with the preceding, and carrying

young, common; very abundant in stagnant pools near New Haven, April 20, 1873, without eggs or young. White Mountains, Arizona—Lieut. Henshaw, Wheeler's expedition; Beaver Creek—Dr. H. C. Yarrow; Lake Raymond, Nebraska—T. M. Prudden, Yale scientific expedition, 1873; Lake Okechobee, Florida—E. Palmer; Springs, Saguache, Colorado—Ernest Ingersoll, Hayden's expedition.

Subsection *b*.—Back papillose.

CLEPSINE ORNATA Verrill.

American Journal of Science, vol. iii, p. 130, 1872.

The specimens of this species originally described, although found carrying young, were probably immature. Specimens of much larger size, and having more numerous papillæ, have since been obtained. They are so different as to be easily mistaken for another species, but their young have been found to agree with the original description. It is probable that this, and other species of *Clepsine*, begin to breed long before they become full grown, and that they live several years. The following is the original description:

"Body somewhat depressed, rather broad and obtusely rounded posteriorly, in extension tapering, but not slender anteriorly, about 1.25 inches long. In contraction elliptical, and about 0.20 broad in the middle. Back with a median papillose dorsal carina, and two similar ones midway between it and the margins. Head broad, acuminate, whitish in front and at the margins. Ocelli united into a single, small, transverse spot, situated at the edge of the white area. Acetabulum moderately large, round, about half of its breadth exposed behind the end of the body.

"A dark green line passes along the median carina, interrupted anteriorly by several transverse orange vittæ, and farther back by some pale orange spots; the first of the transverse spots or vittæ is pale orange, and is just behind the white area of the head; this is followed by a transverse greenish brown one, which is succeeded by a longer transverse orange one; farther back is another transverse vitta, or band, of the same color. The posterior part of the back and upper side of acetabulum are flesh-color, specked with pale orange and purplish. The papillæ of the lateral carinæ are partly orange and partly brown. The margin is pale purplish, with conspicuous squarish spots, alternately bright green and orange. The rest of the upper surface is variegated with bright green and pale brown, and specked with darker brown. Lower surface pale green, with a median light line; the margins colored as on the upper side.

"The attached young, June 6, were about 0.12 of an inch long, and very slender in extension. Anteriorly, they were purplish red, with bright red specks, and with a median row of red points, while several median white spots occupied the positions of the large transverse orange spots of the adults. Posteriorly the branched lobes of the intestine gave a

greenish color to the body. Ocelli closely united into a transversely triangular or bilobed spot of bright red.

"West River, on the lower sides of submerged wood and pieces of boards."

Var. b, stellata.—Body broad-oval in contraction; moderately elongated in extension; strongly annulated; in extension, about 1.25 to 1.50 inches long, and 0.20 to 0.30 broad; in contraction, about 0.40 long, but sometimes larger than this; head obtuse in front; ocelli more or less confluent into a conspicuous transversely triangular or bilobed eye, usually surrounded by a white area; back moderately convex, with numerous quite small papillæ, forming a transverse row on each annulus. Along the middle of the back, there is a longitudinal row of somewhat larger and more prominent, yet small, conical papillæ, and two similar rows exist on each side, between the median row and the margins. The larger papillæ are usually tipped with white; color above variegated dark greenish brown, with a median line and marginal spots. The surface is covered with brown and green stellate specks, and sometimes with some orange-colored ones, the green ones generally prevailing toward the margins. Along each edge and around the acetabulum, there is a series of flesh-colored, pale yellowish, or light orange semicircular spots; head with a transverse median spot of white. A pale yellow or white transverse line crosses the neck. The dark green, brown, or blackish median dorsal line is scarcely interrupted. One or two longitudinal rows of flake-white often extend along each side of the median line on the papillæ, and similar white specks are often scattered over the back; lower surface brownish, with stellate specks of green; near the margin, like the upper surface. Some of the specimens, which were quite dark colored when caught, in April and early in May, carried large clusters of bright, deep yellow eggs, and others were just laying. The specimens, though quite dark colored when taken, were kept until July 17. By that time they had become much lighter, the yellow, pale orange, and greenish hues prevailing, though stellate specks of dark green and brown were still present.

Var. c, rugosa.—Larger than the preceding; strongly annulated, each annulation with a row of 20 to 30, or more, larger, conspicuous, rough, conical papillæ, with many unequal smaller ones between them, in several irregular rows, or scattered. Ocelli very close together, but separated by a narrow light line, in adult preserved specimens; united in the attached young. The color, in alcoholic specimens, is yellowish green, variegated with blotches of dark brown; margin of body and acetabulum with semicircular, pale, orange spots, covering the width of about two annulations, and separated by narrower, greenish brown spots, about half as wide; head with a light, longitudinal vitta. The attached young have three dorsal, longitudinal rows of small papillæ, the median one double

posteriorly, and a few others scattered over the surface between. The most papillose specimens were collected by Dr. Elliott Coues, on the northwest-boundary commission. This may prove to be a distinct species, but this is rendered improbable on account of the close agreement of the attached young with the ordinary varieties.

Var. d.—The largest specimen that I have seen belonging apparently to this species was over 3 inches long in extension, and upward of half an inch wide. The body was strongly annulated, with crenulated margins; on each annulation there was a transverse row of numerous small but conspicuous papillæ. Ocelli united. The color was dark olive and fuscous brown on the back, with a row of small, semicircular, light yellowish spots along each margin at every third annulation; head with an interrupted pale yellow vitta; ventral surface striped with olive-green and dull grayish. This specimen was taken, without eggs or young, near New Haven, about the 1st of May.

Another somewhat similar specimen, from the same locality, was 3 inches long in extension, and 0.5 to 0.75 broad; in contraction, 1.5 long and 1 inch broad. Body much depressed, with thin margins, obtuse anteriorly. Back covered with numerous small, unequal, conical or rounded verrucæ, arranged in transverse rows of twenty or more on each annulation. Ocelli black, confluent, or very closely approximate. Head, in front of ocelli, brownish white, with lateral brown spots; behind the ocelli, with a short median orange-brown stripe. General color of body dark greenish brown. The ground-color is brown, varied with very numerous minute stellate specks of dark green; toward the lateral margins of the body and edges of the acetabulum, the color is lighter orange-brown, with fewer green specks; and a marginal series of roundish pale brown spots extends along each side and around the acetabulum; beneath, pale bluish, with sixteen to twenty stripes of green.

On the lower side, the dark brown viscera show very distinctly, through the integuments, eleven branches or lobes on each side; these are elongated, well separated, with few short open branches; the anterior ones are but little shorter and are not crowded. In this respect, this species is very distinct from *C. pieta*, in which the branches are twenty or more on each side, short, much branched, crowded, the anterior ones becoming much smaller and more crowded.

Var. a.—West River and Whitneyville Lake, New Haven—A. E. Verrill.

Var. b.—Pools near Goffe street, New Haven, on submerged wood, and adhering to the ventral surface of *Macrobdella decora*—A. E. Verrill; Clear Lake, Colorado, Hayden's expedition; Snake River—Dr. J. Curtis, Wheeler's expedition; Birchwood Creek, Nebraska—O. Hargreaves, Yale scientific expedition, 1873; No. 183—Dr. Yarrow, Wheeler's expedition.

Var. c.—Northwest-boundary survey—Dr. Elliott Coues.

Var. d.—Pools near Goffe street, New Haven—A. E. Verrill.

CLEPSINE PAPILLIFERA Verrill.

Op. cit., vol. iii, p. 130, 1872.

Body decidedly convex above, broad and obtusely rounded behind; in extension long, slender, and tapering anteriorly. Length, when extended, about 1 inch; greatest breadth, in contraction, about 0.20 of an inch. Back covered with small, distant, subconical papillæ, arranged in transverse rows, of which the anterior contain about three papillæ, and the posterior ones eight or nine. Head small, narrow, subacute, white in front. Ocelli two, distinct, but close together, black, placed at the posterior edge of the white area. Color above, obscure yellowish brown, produced by alternating narrow lines of flesh-color and olive-brown, which are crossed by fine longitudinal lines of dull olive-green, giving a checkered appearance under the microscope. The dorsal papillæ are specked with opaque white at the tips, and usually surrounded by a darker spot of olive-green at the base.

Var. b.—Specimens taken in Whitneyville Lake, October 4, carrying young, differ considerably from the preceding, and may prove distinct. These have the form of body, head, and ocelli as described, but the tubercles of the back are less numerous, forming a single median row anteriorly, which becomes double posteriorly, where there is also a row on each side, midway between it and the margin. The general color above is dull greenish yellow, transversely and longitudinally lined with lighter; the tubercles are dark brown, and small flesh-colored spots are scattered over the back, but form rows posteriorly. Lower surface lighter.

Var. c.—The specimens thus designated in my former paper appear to belong rather to *C. ornata*.

Var. d, lineata, nov.—Body in contraction broad-oval, much depressed. Ocelli two, distinctly separated by a space equal to about twice their diameter. The alcoholic specimen has about twelve longitudinal stripes of deep brown, alternating with as many of yellowish white; both crossed by fine transverse lines of whitish. Back nearly smooth, with only a few minute and but slightly raised papillæ. This may prove to be a distinct species.

Var. e, carinata, nov.—Body in contraction rather short and thick, tapering rapidly to the head. Ocelli two, conspicuous, well separated, with a space between equal to their diameter, or greater. Back with three conspicuous carinæ, each surmounted by a close row of prominent papillæ; toward the posterior end, the middle carina ceases, and a short one, with few papillæ, is introduced on each side of the median line close to the posterior end of the body; other much smaller papillæ are usually scattered over the surface between the principal rows, especially near the margin, where they often form a submarginal row. Color, of alcoholic specimens, dull brown; the back covered with many narrow longitudinal stripes of dark brown, alternating with lighter lines.

West River, Conn., and in small tributary streams, among the stems of

water-plants and on floating wood, common—A. E. Verrill; Bad River, Lake Superior—J. W. Milner, (var. with few large papillæ, mostly in three rows.)

Var. *d.*—Lake Raymond, Nebraska—T. M. Prudden; Lake Okechobee, Florida—Dr. E. Palmer.

Var. *e.*—Ecorse, Michigan—J. W. Milner.

Section B.—Four ocelli.

No American species belonging to this section are known to me.

Section C.—Six ocelli.

Subsection *a.*—Back smooth.

CLEPSINE PALLIDA Verrill. (Fig. 2, *a*; head enlarged.)

Op. cit. vol. iii, p. 131, fig. 3, *a*, 1872.

Var. *a.*—Body depressed, broad and obtusely rounded posteriorly,

b Fig. 2. *a* tapering, but not very slender, anteriorly; about 1 inch long in extension, and 0.15 of an inch broad in contraction. Back smooth, somewhat convex. Head obtuse, with six ocelli, those of the anterior pair nearer together. Acetabulum rather small. Intestine whitish, showing

through the integuments, with two large anterior lobes and about six smaller lateral ones. Auditory vesicle very distinct. Color above pale yellowish, with scattered blackish specks, and with a median light line, interrupted by a row of distant, small, black spots. Beneath pale flesh-color.

Var. *b.*—Back smooth, grayish green, with two dorsal dark lines, and specked over the whole surface with small blackish dots, which are arranged somewhat in longitudinal lines. Ocelli as in var. *a*. Length about 0.75 of an inch, (18^{mm} to 20^{mm}.) Taken September 17.

West River, New Haven, Conn., both varieties, on submerged wood—A. E. Verrill; Colorado—Hayden's expedition; lake near Long's Peak, elevated 9,000 feet—Hayden's expedition, 1873; (var. *b*, with narrow, dark stripes.)

Subsection *b.*—Back papillose.

CLEPSINE ELEGANS Verrill. (Fig. 2, *b*; head. See above.)

American Journal of Science, vol. iii, p. 132, fig. 3 *b*, Feb., 1872; vol. v, p. 387, 1873.

Clepsine patelliformis Nicholson, Canadian Journal, 1873.

Body depressed, strongly annulated, broadly rounded posteriorly, tapering, but not slender, anteriorly. Length, in extension, about 1.25 inches; breadth, in contraction, 0.20 of an inch. Acetabulum moderately large, projecting considerably beyond the posterior end of the body. Head small, obtusely pointed, white in front and along the edges. Ocelli six, the three pairs close together on the white area of the head, those of the middle pair largest, black. Back covered with distant, slightly elevated, yellow papillæ. Color olive-green, thickly specked, especially toward the margins, with purplish brown, and with dark brown transverse lines, corresponding with the intervals between the annulations;

anteriorly there is a pale yellowish green median line; a slight distance from the middle there is, on each side, a narrow black line extending the whole length, and between these and the margins there are other faint longitudinal lines. Along each margin, there is a row of about six sulphur yellow spots, and a few smaller raised yellow spots are scattered over the back, the anterior ones often becoming greenish. Lower surface pale green, specked with brown, and with a light median and two black longitudinal lines, corresponding to those above.

Var. b.—Two anterior ocelli nearer together than the others. Body deep brown, in preserved specimens, with six or more irregular rows of yellow spots on slightly raised papillæ.

West River, with the two preceding—A. E. Verrill; Lake Ontario—Nicholson; northwest-boundary survey—Dr. E. Coues, (*var. a* and *b.*)

This is a very active species. It adheres firmly by means of its posterior sucker, but when much disturbed quickly rolls itself into a ball. One of the specimens, taken June 6, carried about a dozen slender young ones, of a pale pink-color.

In addition to the preceding species, *Clepsine oniscus* Diesing, (Blainville, sp.,) and *Clepsine swampina* Dies. (Bosc, sp.,) have been indicated from North America. The first has not been described sufficiently to be recognized, all the characters mentioned applying equally to nearly every species of the genus.

Clepsine swampina Diesing is thus described: "Body subelliptical, depressed, anteriorly narrowed, above transversely sulcated, below plumbeous. Ocelli six, two closely approximate. Acetabulum orbicular. Length, 6-7 lines; width, 3 lines."

Carolina, upon the surface of tortoises and frogs—Bosc.

Section D.—Ocelli 8.

Subsection *a.*—Back smooth.

CLEPSINE OCCIDENTALIS Verrill, *sp. nov.*

Body rather stout; in contraction thick and convex; about 0.75 of an inch long, and 0.30 broad; tapering to both ends. Ocelli eight: those of the second and third pairs largest; those of the third farthest apart; those of the fourth small and near together. Dorsal surface smooth, with faint indications of small, low papillæ anteriorly. Acetabulum small. Color, in alcohol, yellowish brown, with fine transverse lines of darker.

San Luis Valley, Colorado—H. W. Henshaw, Wheeler's expedition, 1873.

CYSTOBRANCHUS VIVIDUS Verrill.

Op. cit., vol. iii, p. 126, fig. 1, 1872.

Body elongated, somewhat depressed, tapering both ways, but most so anteriorly. Surface smoothish, but with minute, hemispherical hya-

line vesicles. Length, in extension, about one inch; breadth, in middle, 0.10 to 0.12 of an inch. Head excentrically pedicellate upon a slender neck, small, disk-like, rounded in front, or somewhat heart-shaped, with the rounded point forward. Ocelli four, small, brownish, placed near the attachment of the neck on each side; those in the anterior pair farther apart. Acetabulum large, well-rounded, as wide as the body, disk-shaped, and attached nearly centrally. Male organ, when protruded, elongated, conical, acute, placed just behind the fourth pair of large lateral white spots.

Color of back dusky brown or purplish brown, finely specked with stellate points of darker brown, and with three irregular rows of conspicuous, small, round, opaque white spots along the upper surface of the back. Sides with a row of about 16, larger and more conspicuous, semicircular, white spots along the margin, each consisting of a cluster of 3 to 9 small round spots, inclosing a more transparent area, in which a diaphanous pulsating vesicle or enlarged vessel may be seen to protrude at each pulsation. Lower surface of body light grayish, specked with darker, and often with obscure transverse bands of whitish; acetabulum similar in color to the body, with small, round, white spots, the margin more or less radiated with lighter and darker. Upper surface of head similar to the back; the sides and front lighter.

West River, near New Haven, on *Fundulus pisculentus*, November and December, 1871—F. S. Smith; Savin Rock, in salt-water, among eel-grass—Prof. J. E. Todd; Casco Bay, among eel-grass, 1873—A. E. Verrill.

This very active species lives in both fresh and salt water.

The transparent lateral vesicles referred to are probably organs of respiration, analogous to the much more highly developed branchial appendages of *Branchiobdella*.

ICHTHYOBDELLA FUNDULI Verrill.

Op. cit., vol. iii, p. 126, 1872.

Body smooth, distinctly annulated, subterete, thickest at about the posterior third, tapering considerably toward the head, and slightly posteriorly. Length about 0.75 of an inch; greatest diameter about 0.08. Head small, rounded in front, scarcely explanate, and separated only by a slight constriction from the body. Ocelli four: two larger well separated, placed near the posterior part of the head; two others, very small and scarcely distinguishable in some specimens, are placed in front of these. Acetabulum scarcely wider than the body, obliquely attached, sessile, and scarcely separated by a constriction from the body. Color light green, finely specked with dark green and brown points; sometimes with distinct bands of whitish alternating with the green on the anterior part of the body, and with a pale dorsal line; neck with a pale band at the constriction.

West River, Conn., on *Fundulus pisculentus*, November and December,

1871, and December 18, 1872—F. S. Smith; near New Haven, on the same fish—Prof. J. E. Todd.

This species differs greatly, in the form and arrangement of the acetabulum and head, from the typical species of the genus, and, when living specimens can be carefully studied, may require separation.

ICHTHYOBDELLA PUNCTATA Verrill.

American Journal of Science, vol. ii, p. 451, 1871; vol. iii, p. 127, 1872.

Body, in extension, slender, in the preserved specimen, about 0.5 of an inch long, 0.06 in greatest diameter, rounded, thickest posteriorly, tapering anteriorly to the anterior sucker, which is broad and thin, subcircular, about three times as wide as the neck where it is attached. Ocelli four, on the upper side of the anterior sucker: two larger, black ones, in front; and two minute ones wider apart and farther back. Posterior sucker large, rounded or oval. Color translucent greenish, with a pale median dorsal line, and with minute black specks arranged in transverse bands; along each side are eight light spots, alternating with the dark punctate bands.

Among the Slate Islands, Lake Superior, in 6 to 8 fathoms—S. I. Smith.

ICHTHYOBDELLA MILNERI Verrill, *sp. nov.*

Body slender, elongated, a little depressed, in alcoholic specimens about 0.75 of an inch long, and 0.06 to 0.08 broad. Ocelli four, conspicuous, the anterior pair larger and wider apart; the head is quite oblique, broadly expanded, and extends out in front far beyond the ocelli. Acetabulum large, about twice the diameter of the body, with a circle of about twelve black, ocelli-like spots, around the middle. Color of body, in preserved specimens, yellowish, with four longitudinal rows of connected large angular spots of greenish, of which one extends along the upper, and one along the lower side, near the margins, leaving a pale band along the middle of the back and of the ventral surface; that of the back is often interrupted by the encroachment of the lateral green spots, the points of which frequently meet across the back, dividing the median pale band into a series of large rounded or transversely elliptical spots. The lateral green spots are variable in form, but often rhomboidal, with the most acute angle toward the median line of the back; they are connected along the margins by a nearly continuous band of green, or else by two narrow lines of green, separated by a pale line. The green spots are made up of small stellate specks of deep green, intermingled with others of orange. Head and acetabulum pale, but usually more or less specked with green and orange; the acetabulum often has a marginal circle of pale spots, alternating with greenish.

Thunder Bay, Michigan, in 25 fathoms, abundant, and also in floating weeds—J. W. Milner, 1873.

ASTACOBDELLA PHILADELPHICA Leidy.

Proceedings of the Academy of Natural Sciences of Philadelphia, vol. v, p. 209, 1851.

Dr. Leidy's description is as follows: "Body whitish, translucent; sides nearly parallel, a little broader posteriorly, 16 alternately broad and narrow segments, exclusive of head and posterior end. Head campanulate, terminated by a circular or elliptical crenated lip, fringed with very minute stiff hairs, one two-thousandth of an inch long."

"Acetabulum circular, one-sixth to one-fourth of a line in diameter; mouth elliptical. Dental plates brown, nearly equal, forming an isosceles triangle, with the base longest and attached. Apex of superior plate ending in a sharp conical point; with several very minute denticulations on each side. Apex of inferior plate bifurcated into two points, with two minute denticulations on each side. Stomach capacious, nearly filling the anterior eight alternately broad and narrow segments posterior to the head. Anus dorsal, one-fifth of a line from the acetabulum. Generative aperture ventral, anterior to the anal aperture.

"Length, one to four lines; breadth, one-sixth to one-half of a line. Head, one-sixth to one-half of a line long. Ovum attached by a pedicle, with an operculum pointed at summit. From base of attachment to point of opercle, one-fifth of a line. Length of body of ovum, one-sixth of a line; breadth, one-eighth of a line.

"*Habitat*.—Found frequently in numbers from one to several dozen upon any-part of the exterior of the body of *Astacus Bartonii* Fab., but more especially upon the inferior surface and the branchiæ."

The following species, which I have not seen, have been described from North America:

LIOSTOMUM COCCINEUM Wagler.

Isis, 1831, p. 533; *ibid.*, 1832, p. 53; Diesing, Sitzungsab. der kais. Akad. der Wissenschaften, xxxiii, p. 495, 1859.

This genus is remarkable in having no ocelli, and no folds, lobes, nor plications within the mouth and œsophagus.

Mexico—Karwinsky.

HIRUDO ORNATA Ebrard.

Nouv. Monog. Sangs., p. 55.

Northwestern America.

HIRUDO(?) COSTARICENSIS Grube and CErsted.

Diesing, *op. cit.*, p. 509.

Costarica—CErsted.

HIRUDO BILLBERGHI Kinberg.

Op. cit., p. 356, 1867.

This species is described as having eight ocelli, with the genital orifice in the twenty-eighth segment. It probably belongs to some other genus.

OXYPTYCHUS STRIATUS Grube.

Fam. d'Annel., pp. 110, 148; Diesing, op. cit., p. 510.]

Montevideo—Burmeister.

CENTROPYGUS JOCENSIS Grube and Ørsted, 1857.

Dies., op. cit., p. 511.

San José, Central America—Ørsted.

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