

A REVISION OF THE BRITISH LEECHES.

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(From the Zoological Laboratory, Cambridge.)

(Plates XIII to XV and 16 Text Figures.)

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Introduction.

SINCE the appearance of Johnston's *Catalogue of the British Non-parasitical Worms in the Collection of the British Museum*—a work which although not published until 1865 had been completed some ten years earlier and consequently embodies observations made more than half a century ago—the Hirudinea of the British Islands have been largely neglected. Apart from this the interest now being taken in leeches by students of their protozoan parasites and the absence of any recent work upon this group of our fauna seems sufficient apology for the revised descriptive catalogue attempted in the following pages.

The material upon which these observations are based has been collected, as far as the fresh-water species are concerned, for the most part in the neighbourhood of Cambridge. Consignments of leeches however have been received from other quarters, and in this connection my thanks are due, amongst others, to Mr Thomas Edwards for specimens of *Piscicola* from the River Test, in Hampshire; to Dr F. W. Gamble for examples of *Trocheta* from the Withington Sewage Works, near Manchester; to Mr Hugh Stowell and Mr C. H. Ball for further material from the same source, and to Mr M. R. Pryor for special information regarding the occurrence of this species in England

most readily placed at my disposal. Finally I desire to express my thanks to Mr Edwin Wilson, of Cambridge, who has spared no pains to make the coloured illustrations accompanying this memoir exact representations of the living examples placed before him.

With regard to the number of the British leeches, it may be stated of the fresh-water forms with some degree of certainty that ten species now occur in these Islands. An eleventh species, *Hirudo medicinalis*, is included in the following list, although there is very little doubt that it no longer occurs in the wild state. We cannot speak so positively regarding the number of marine species. Our knowledge of the marine Ichthyobdellidae leaves much to be desired and few European species are well established. *Pontobdella* alone is frequent upon our shores; *Branchellion* has been noted twice, and there remain a number of forms which have been recorded from time to time, chiefly from the coast of Scotland, the descriptions of which are generally not sufficiently adequate to enable us to do more than guess at the species upon which they have been based. Some of these have been referred provisionally to *Trachelobdella lubrica* (Grube, 1840) and it seems not improbable that at least one other species has been observed in British waters in addition to the three marine leeches already noted.

The descriptions here given apply to features which may be seen either by the naked eye or with the assistance of a good dissecting lens. The form described, unless otherwise stated, is that assumed by the leech when in a moderate or average state of extension. The treatment of the various morphological features indicated in the series of figures supplementing the coloured illustrations is purely schematic.

Whilst every endeavour has been made to make the synonymical tables as complete as possible, the accompanying bibliographical references make no pretence of being exhaustive.

The Classification here adopted is that laid down by Professor Raphael Blanchard in a well-known monograph on the leeches of Italy (1894) and subsequently modified by him in other works. The same authority also has generally been followed with respect to the synonymy of the species referred to.

Diagnostic Characters.

In the leech, as is well known, the number of rings exceeds the number of somites or segments into which the body is divided, and throughout the greater part of its length these rings resolve them-

selves into a series of regularly recurring groups corresponding to the successive somites of the body.

Towards the ends of the body the number of rings in a group becomes smaller, and we frequently find at the extremities one or more somites represented respectively by only one ring.

For the sake of brevity the ring or group of rings corresponding to the metameric divisions of the body are themselves alluded to as somites (segments, zoonites), and for each of the similar groups containing an equal number of rings, which occur throughout the greater part of the body of every leech, the term *complete somite* has been retained.

In the number of rings of which a complete somite is composed, in the number of such complete somites, in short, in an analysis of the external metamerism, we have characters of the greatest importance in the determination of genera and species.

In the following descriptions I have not adopted the neuromeric standard of somite limits advocated by Moore (1900) and Castle (1900 b) and since supported by Livanow but, as far as the delimitation of somites is concerned, have adhered to the original conception of Gratiolet (1862) which has subsequently been elaborated and supported by writers of such divergent opinions as Whitman and Blanchard on the one hand and Apáthy on the other. The first ring of the complete somite, as here understood, is the sensory ring which lodges a ganglion of the ventral chain and bears externally the "metameric sensillae" (Whitman) often rendered conspicuous by association with special colour markings and by elevation upon more or less prominent papillae. It has long been recognised that a somite is determined by the presence of a ganglion and that in the central nervous system we have twenty-one free single ganglia with a mass of fused ganglia at either extremity. Apáthy (1888 b) found six ganglia in the circumpharyngeal ganglionic mass, whilst in the posterior ganglionic mass Whitman (1892) found seven; and these results have been confirmed by subsequent workers.

Thus there are 34 ganglia and somites in the body of the leech. Of these somites, seven are absorbed by the posterior sucker and consequently we have to account for 27 in the rest of the body. The first four somites and sometimes part of the fifth may be involved in the formation of the anterior sucker, and the genital apertures, as Apáthy first pointed out, invariably occur, the male in somite XI and the female in somite XII. This rule holds good even in the case of

Helobdella stagnalis, where the male and female genital apertures still emerge from their respective somites although opening by a common orifice between them.

With regard to the sense organs, we are only concerned with the "metameric sensillae" already referred to, which are confined to the first or sensory ring of each somite and occur in strict series in definite longitudinal lines. In describing these lines the nomenclature adopted is that suggested by Livanow (1904) which again is but a modification of that given by Apáthy. These lines occur dorsally and ventrally in pairs with respect to a median line, and counting from the median line outwards we get (1) an inner and (2) an outer paramedian pair; (3) an intermediate pair; (4) an inner and (5) an outer paramarginal pair. Finally (6) a marginal pair coincide with the edges of the body. Ventrally the outer paramedian lines are slightly nearer together than dorsally. Sensillae are not present on all these lines in every species.

By noting the position of any colour spot, papilla or other external feature with regard to its situation transversely on any particular ring and longitudinally on one of the above lines, we are able to locate precisely as it were its latitude and longitude on the surface of the body.

The remaining diagnostic characters call for no special explanation and we may now proceed to a consideration of the species enumerated on pp. 186—187.

Sub-order I. RHYNCHOBDELLAE.

Marine and fresh-water Hirudinea with colourless blood, with an exsertile proboscis, without jaws.

Family I. ICHTHYOBDELLIDAE.

Body cylindrical or flattened, formed of two distinct regions, (i) a short narrow anterior portion or "neck" which includes the clitellum with the genital orifices and (ii) a long, large posterior region or "abdomen." The anterior as well as the posterior sucker is a permanent cupuliform or discoid organ distinct from the body. Eggs included in chitinous capsules which are attached to foreign bodies.

Genus: Branchellion, Savigny, 1822.

Synonymy:

Branchiobdella, de Blainville, 1827 (not *Branchiobdella*, Odier, 1819). *Branchellia*, Gervais, 1845.

Marine leeches, ectoparasitic on fish. Body flattened, the posterior region with lateral, paired, foliaceous, non-digitate branchiae. Suckers cupuliform, excentrically attached, the posterior very large and studded upon its inner surface with numerous, small subsidiary suckers. Complete somite formed of three rings.

This genus is represented in European waters by a single species (Blanchard, 1894 a, p. 85).

***Branchellion torpedinis*, Savigny, 1822.**

Plate XIII, Figs. 1, 2, 3. Text Fig. 1.

Synonymy and Literature:

Branchellion torpedinis, Savigny, 1822, p. 109; Risso, 1826, p. 432; Savigny, 1826, p. 451; Moquin-Tandon, 1826, p. 141; Milne-Edwards, in Lamarck, 1835, p. 529; Cuvier, 1836, p. 51, pl. xxiii, fig. 3; Moquin-Tandon, 1846, p. 282, pl. i, figs. 1—10 (coloured); Leydig, 1851, p. 315, pl. ix, fig. 1 (anatomy of branchia); Grube, 1851, p. 108; Johnston, 1865, p. 38 (recorded from England); Apáthy, 1888 a, p. 153, etc., pl. viii, fig. 1 (diagram of annulation, etc.), and fig. 11 (details of branchiae); R. Blanchard, 1894 a, p. 85; R. Blanchard, 1894 b, p. 11; Apáthy, 1901 a, p. 211 (neurofibrillae); Apáthy, 1901 b, p. 707 (histology of light sensory cells); Pérez and Gendre, 1904 a, p. 113 (muscle fibres); *ibid.* 1904 b, p. 605 (ovogenesis); Pérez, 1906, p. 447; Holt, 1907, p. 102 (recorded from Ireland).

Hirudo (Branchiobdella) rudolphii, de Blainville, 1827, p. 241.

Branchiobdella rudolphii, Diesing, 1850, p. 443; Polonio, 1863.

Branchiobdella torpedinis, de Blainville, 1828, p. 556, pl. xxxiv, figs. 1, 1 a and 1 b.

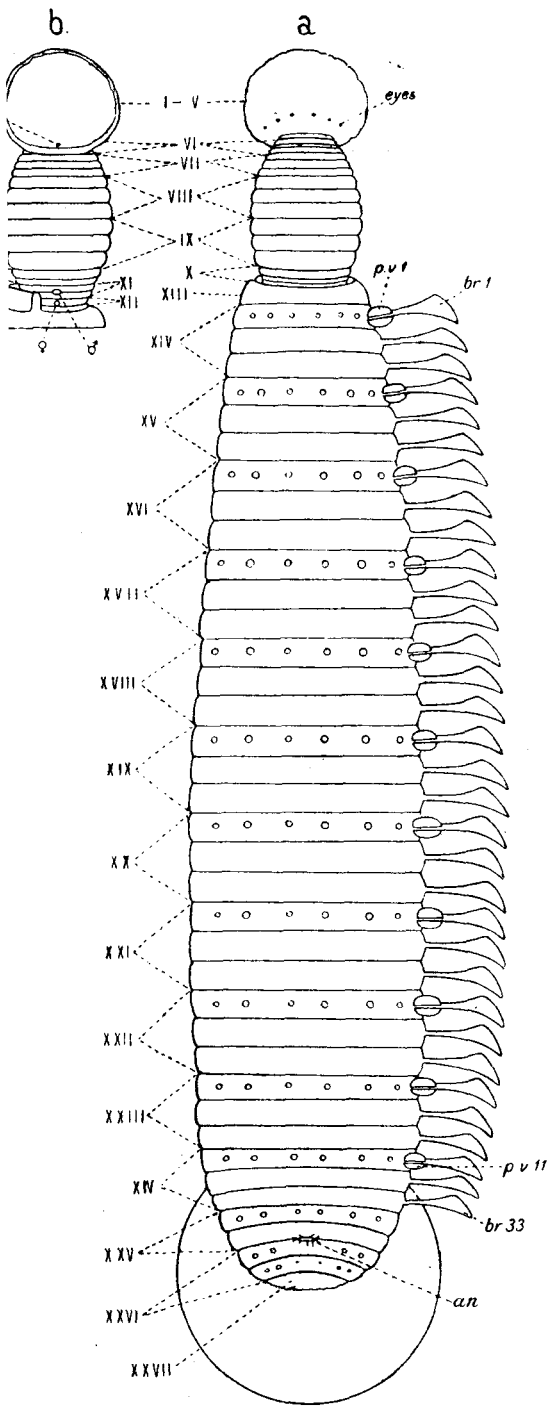
Hirudo (Branchiobdella) torpedinis, Gervais, 1836, p. 627, pl. cxi, fig. 1.

Branchellia torpedinis, Gervais, 1845, p. 573.

Branchellion orbinensis, de Quatrefages, 1852, p. 279, pl. vi, fig. 1 and figs. 2—13 (anatomy).

Branchellion rhombi, van Beneden and Hesse, 1863, p. 33, pl. ii, figs. 17—21 (bad).

Diagnosis. The two regions of the body are sharply defined. The anterior is partly invaginated into the posterior region, the first ring of which forms a fold surrounding and overlapping the posterior half of the clitellum. [Apáthy (1888 a, p. 170) has pointed out that this fold is really composed of two rings, one lying upon its outer and one upon its inner surface. These two rings, which form somite XIII, lie one in front of the other in very young individuals and are gradually gathered up into a "preputial fold" as maturity is approached.] Colour brownish black, with six longitudinal series of yellowish white spots on the dorsal and four on the ventral surface; the spots occur on the first ring of each



A.H. del.

Fig. 1. *Branchellion torpedinis*.

g. 1. *Branchellion torpedinis*. (a) Diagram showing annulation on dorsal surface, position of branchiae and other external features. Branchiae omitted on left side of body for the sake of clearness. br. 1, br. 33, branchiae of the first and thirty-third pairs. Mth. Mouth. an. Anus. pv. 1, pv. 11, pulsating vesicles of the first and eleventh pairs. Somites indicated in Roman numerals. (b) Diagram showing ventral surface of anterior extremity; the "preputial fold" cut away so as to show genital apertures. (Founded on a diagram by Apáthy.)

g. 2. *Piscicola geometra*. Diagram showing disposition of somites (in Roman numerals), pulsating vesicles (pv. 1 to pv. 11), white spots, etc. (See p. 140.)

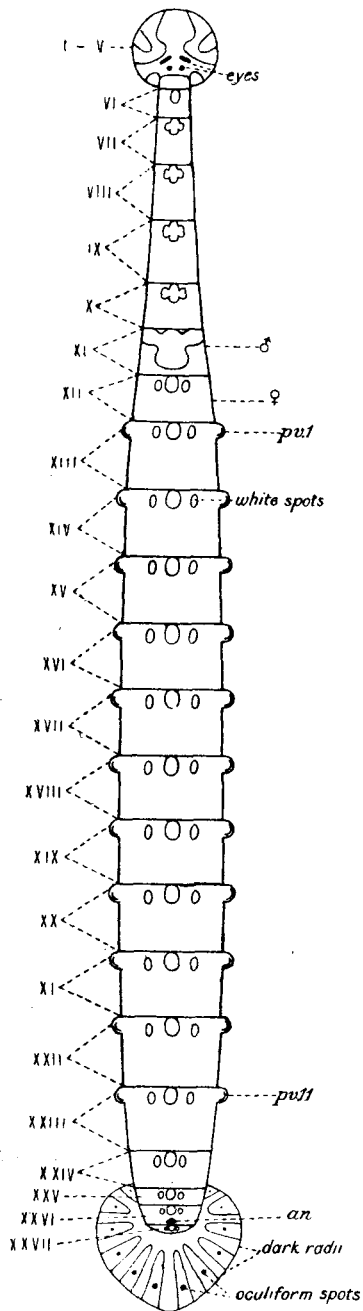


Fig. 2. *Piscicola geometra*.

somite. Or the colour may be of a roseate hue which fades in alcohol. (R. Blanchard.)

Somites XIV—XXIV in the posterior region of the body are complete with three rings. Each of the 33 rings composing these eleven somites carries a pair of lateral, foliaceous, crispate branchiae. A pulsating vesicle is situated at the base of each of the branchiae arising from the first ring of each somite. Six eyes, disposed in a transverse curved line, on the dorsal surface of the anterior sucker, in somite V (Apáthy). The male genital orifice is situated between the two rings of somite XI; the female orifice lies upon the first ring of somite XII; somites X, XI and XII, each composed of two rings, form the clitellum. The anus lies between somites XXV and XXVI.

Length 30—50 mm.; width 8—16 mm. including the branchiae.

[The following measurements are taken from an example in alcohol, from Naples, in the possession of the University Museum of Zoology, Cambridge:—Length 49 mm., width of body 11 mm., total width including branchiae 16 mm.; diameter of anterior sucker 3·5 mm., of posterior sucker 9 mm.]

Distribution, Hosts. *B. torpedinis* is parasitic chiefly upon the electric rays (*Torpedo*). Blanchard records it from a wrasse (*Labrus* sp.) and from *Rhinobatus thouin*; van Beneden and Hesse found it on a turbot (*Psetta* [*Rhombus*] *macima*) and its occurrence on *Raia clavata* is noted below. It is found in the Mediterranean, and in the Atlantic where its range extends along the West coast of Africa as far as Senegal (Blanchard). In British waters it has been recorded twice. (1) Johnston (1865, p. 39) catalogues an English example (precise locality unknown) taken "with soles," and (2) Holt (1899, p. 4) records a single individual taken from the pelvic fin of a thornback (*Raia clavata*) in Blacksod Bay on the west coast of Ireland.

Genus: *Trachelobdella*, Diesing, 1850.

Synonymy:

Calliobdella, van Beneden and Hesse, 1864. *Callobdella*, R. Blanchard, 1894.

Ectoparasitic on marine fish. Without eyes. Anterior sucker reduced. Posterior region of the body cylindrical or flattened in young individuals, ventricose in adults, with paired lateral pulsating vesicles. Complete somite composed of six rings, formed by the more or less distinct subdivision of three primitive rings.

That this genus is represented in British waters is beyond dispute; we are unable however to state positively to which species of *Trachelobdella* the examples recorded from our coasts are to be referred.

Dalyell (1853) describes two marine leeches in addition to *Pontobdella*. Of one of these, which he calls *Hirudo campanulata*, he had but two specimens and his description and drawings are altogether inadequate; of the other, which he obtained in considerable numbers, we have a detailed description and fairly good figures. In this latter species, which he describes as *Hirudo vittata*, a name originally proposed by Chamisso and Eysenhardt (1821), the two regions of the body are well defined, the posterior region bears paired lateral pulsating vesicles, there are no eyes and we have clearly an example of *Trachelobdella*.

Johnston (1845) under the name *Piscicola marina*, which in his *Catalogue* of British species (1865) is changed to *Pontobdella littoralis*, gives an indifferent description of a leech parasitic on *Aspidophorus cataphractus* from the coast of Northumberland, with which he considers Dalyell's *Hirudo vittata* to be synonymous. To Johnston's species Thompson (1856, p. 426) refers three leeches from the Irish coast taken respectively from *Lophius* sp., from a halibut and from a cod, and M'Intosh (1875, p. 114, pl. 5, figs. 3—6) ascribes a form, of which he gives coloured figures, said to be not uncommon on *Cottus bubalis*, at St Andrews.

In 1864, van Beneden and Hesse described three species of *Calliobdella* (= *Trachelobdella*), viz:—*C. lophii*, parasitic on *Lophius piscatorius*, *C. punctata* parasitic on *Cottus bubalis*, and *C. striata*. Insufficient and inaccurate as the descriptions and figures are, it is evident that *Hirudo vittata* and *C. lophii* are synonymous and that *Pontobdella littoralis* has affinities with the other two forms.

Finally Scott (1901, p. 138) records from the coast of Scotland a leech which he describes as *Trachelobdella lophii*, found "In the gill pouches of the angler-fish, *Lophius piscatorius*, captured in the Firth of Forth (1894), and in the Moray Firth (1899)."

From the above evidence it is clear that *Trachelobdella* is represented upon our coasts, and that in more than one instance we have records of a form which appears to be identical with the *Trachelobdella* (*Calliobdella*) *lophii* of van Beneden and Hesse.

Whether or not *T. lophii* is a good species remains to be considered.

Apáthy (1888 c) unhesitatingly refers *C. lophii*, *C. punctata*, *C. striata*, *Pontobdella littoralis* (Johnston) and perhaps *H. campanulata* (Dalyell) to one species, *Calliobdella lubrica* (Grube), of which he

gives a diagnosis based on abundant living material. R. Blanchard (1894 b), who establishes the identity of the genus *Callobdella* with *Trachelobdella* (Diesing, 1850) largely supports this view, amending the specific characters of *T. lubrica* and including among its synonyms *C. punctata*, *C. striata* and *P. littoralis*. Concerning *C. lophii* he writes, "La validité spécifique...nous semble...très douteuse,...il sera probablement nécessaire de la réunir un jour soit à l'espèce précédente (*T. lubrica*) soit à la *P. campanulata* Dalyell, si tant est que celle-ci constitue une espèce solidement établie."

Johansson, on the other hand, in a work on the Swedish Ichthyobdellidae (1898, pp. 672—5) denies even that *Callobdella* and *Trachelobdella* are synonymous. His observations which, as far as *Callobdella* is concerned, are based upon material preserved in alcohol, are far from convincing. Of two facts at least we may be certain. *Trachelobdella* and *Callobdella* are synonymous, and only one European species is at present firmly established, namely *T. lubrica* (Grube, 1840).

In the present state of our knowledge, therefore, and until the examination of living material can be carried out, we are compelled provisionally to refer to this species the examples of *Trachelobdella* recorded from our coasts.

***Trachelobdella lubrica*, Grube, 1840.**

Synonymy and Literature:

Pontobdella lubrica, Grube, 1840, p. 60.

Piscicola marina, Johnston, 1846, p. 441, pl. xv, figs. 4—6; Thompson, 1856, p. 426.

Ichthyobdella marina, Diesing, 1850, p. 442.

Hirudo vittata, Dalyell, 1853, p. 9, pl. i, figs. 16—21.

(?) *Hirudo campanulata*, Dalyell, 1853, p. 12, pl. i, figs. 26—27.

Pontobdella oligothela, Schmarda, 1861, p. 5, pl. xvi, fig. 144.

(?) *Calliobdella lophii*, van Beneden and Hesse, 1863, p. 36, pl. iii, figs. 11—16.

C. punctata, van Beneden and Hesse, 1863, p. 37, pl. iii, figs. 1—14.

C. striata, van Beneden and Hesse, 1863, p. 38, pl. ii, figs. 1—10.

Pontobdella littoralis, Johnston, 1865, pp. 42 and 304, pl. i, figs. 4—6 (repeated from 1846).

Scorpaenobdella elegans, Saint Loup, 1886, p. 1180.

Calliobdella lubrica, Apáthy, 1888 a, p. 134, *et seq.*, pl. ix, figs. 3 a, b and c, 4 and 9.

Apáthy, 1888 c, p. 57.

Calliobdella nigra, Apáthy, 1888 c, p. 58.

Callobdella lubrica, R. Blanchard, 1894 b, p. 14.

Trachelobdella lubrica, R. Blanchard, 1894 b, p. 64.

(?) *Calliobdella lophii*, Johansson, 1898 a, p. 675.

Diagnosis. Body vermiform in young individuals, claviform in adults, blackish yellow or olive, spotted with white. Anterior region with four pairs of lateral non-pulsating tubercles. Clitellum retracted and composed of three large rings followed by six small rings; the male orifice opens between the first and second, and the female orifice between the fourth and fifth, of these small rings.

Each of the first twelve somites of the posterior region of the body bears a pair of lateral pulsating vesicles which, in diastole, arch up the skin of the first two rings. Eight small rings separate the last pair of vesicles from the campanuliform posterior sucker; the anus lies between the antepenultimate ring and the last ring but one. Length 50 mm. in extension; 20—30 mm. in contraction.

[*Note.* The diagnosis of the genus *Trachelobdella* and the description of *T. lubrica* are condensed from those given by R. Blanchard (1894 b). The synonymy of this species is chiefly taken from the same source.]

Hosts. This species is found on the gill-covers, in the pharynx and rarely on the ventral fins of various fish, generally of small size, such as *Scorpaena porcus*, *Sargus annularis*, *Corvina umbrina*, *Caranx trachurus*, *Uranoscopus scaber*, *Lophius piscatorius*, *Blennius pholis*, *Gobius niger*, *Coris giofredi*, *Solea vulgaris* (Apáthy).

Genus: Piscicola, de Blainville, 1818.

Synonymy:

Piscicola, de Blainville, in Lamarck, 1818. *Haemocharis*, Savigny, 1822, p. 106 (not *Haemocharis*, Filippi, 1837). *Ichthyobdella*, de Blainville, 1827.

Fresh-water leeches, ectoparasitic on fish. Body very long, smooth and cylindrical, the posterior region with paired, lateral, pulsating vesicles. Suckers large and eccentrically attached, the posterior and largest with a paramarginal series of oculiform spots. Four eyes upon the anterior sucker, the first pair linear and oblique. Complete somite formed of fourteen rings.

***Piscicola geometra*, Linnaeus, 1761.**

Plate XIII, Figs. 4, 5, 6. Text Fig. 2 (p. 135).

Synonymy and Literature:

- Hirudo alba perexigua piscibus adhaerens*, Aldrovandus, 1602, p. 722.
Hirudo ore caudaque ampla, Frisch, 1729, p. 25, pl. ii; Ledermüller, 1764, pl. lxxxvii, figs. a—i.
Hirudo teres extremitatibus dilatatis, Linnaeus, 1746, p. 365, No. 1275.
Hirudo piscium, Rösel von Rosenhof, 1747, p. 199, pl. xxxii, figs. 1—4; Bergman, 1757, p. 310; O. F. Müller, 1774, p. 43; O. F. Müller, 1776, p. 220; Gmelin, 1788, p. 3097; Bruguière, 1824, p. 133, pl. li, figs. 12—19 (after Rösel); Bosc, 1802, p. 257; Pennant, 1812, p. 70, pl. xxi, fig. 3 (after Rösel); Stewart, 1817, p. 357; Ray Society Reports, 1845, p. 286.
Hirudo dorso elevato, cauda latiore—the great tailed Leech, Hill, 1752, p. 17; Linnaeus, 1758, p. 650.
Hirudo geometra, Linnaeus, 1761, No. 2083; Weser, 1765, p. 44; Linnaeus, 1767, p. 1080, No. 8; Barbut, 1783, p. 20, pl. ii, fig. 7; Pennant, 1778, p. 38, pl. xx, fig. 13; Turton, 1806, p. 70; Turton, 1807, p. 129; Pennant, 1812, p. 70, pl. xxi, fig. 3; Johnson, 1816, p. 35; Brightwell, 1842 a, p. 11, pl. i, figs. 1—8 (coloured); Brightwell, 1842 b, p. 65.
Hirudo galearia, Braun, 1805, p. 35, pl. iii, figs. 1—3 (coloured).
Piscicola piscium, de Blainville, in Lamarck, 1818, p. 294; Milne-Edwards, in Lamarck, 1838, p. 525; Stark, 1828, p. 142; Apáthy, 1888 a, p. 154 *et seq.*, pl. viii, fig. 8 (diagram of somite); Apáthy, 1888 b, p. 774 *et seq.*; Apáthy, 1889, p. 305 (complete somite has 14 rings).
Haemocharis piscium, Savigny, 1822, p. 112.
Piscicola geometra, Moquin-Tandon, 1826, p. 131, pl. vii, fig. 1; Fleming, 1822, p. 604; Leo, 1835, p. 419, pl. xi (anatomy); Henle, 1836, p. 220; Thompson, 1844, p. 437 (occurrence in Ireland); Johnston, 1846, p. 441; Grube, 1851, p. 112; Thompson, 1856, p. 426 (occurrence in Ireland); Johnston, 1865, p. 43; Blanchard, 1894 b, p. 18; Johansson, 1897; Johansson, 1898 a, p. 677; Johansson, 1898 b, p. 581 *et seq.*, fig. 19 (nephridium); Scharff, 1898, p. 190; Plehn, 1898, p. 370; Montgomery, 1899; Brumpton, 1900, p. 47, fig. 1, A—D (cocoon); Castle, 1900, p. 298 (somite growth); Selensky, 1906, p. 33; Johansson, 1909, p. 70, figs. 115—117.
Ichthyobdella geometra, de Blainville, 1827, p. 244; de Blainville, 1828, p. 558, pl. xxxiv, figs. 5, 5 a; Gervais, 1836, p. 628, pl. ccxi, fig. 8; Diesing, 1850, p. 440.
Ichthyobdella percae, Templeton, 1836, p. 236, fig. 28 a, b and c (woodcuts); Diesing, 1850, p. 442.
Ichthyobdella piscium, Egidy, 1844, p. 107, pl. iv, fig. 73.
Piscicola percae, Johnston, 1846, p. 441; Thompson, 1856, p. 426 (occurrence in Ireland); Johnston, 1865, p. 43.

Diagnosis. Body soft and semitransparent, of nearly uniform width posteriorly, attenuated anteriorly, in extension as much as twenty times as long as broad. Anterior sucker circular, about half as wide as the

posterior sucker, the dark pigment upon its upper surface disposed in a more or less distinct cruciform pattern, in the central portion of which are situated the two pairs of eyes. Posterior sucker ovoid, about twice the width of the extended body, with fourteen dark rays and a para-marginal series of fourteen black oculiform spots. Colour greenish, yellowish or brownish, usually finely sprinkled above and below with minute black or brown stellate pigment cells, which are disposed more or less regularly in longitudinal and transverse rows. The body is marked with eight rows of generally elliptical white spots, viz. a pair of marginal rows and, dorsally and ventrally, a single median row situated between a pair of intermediate rows. The spots composing the dorsal median and the two marginal series are the largest and distinguish the first rings (in the middle portion of the body, usually the first four rings) of each somite.

All these spots are subject to considerable variation in form and in the extent to which they are developed. Frequently they tend to fuse into transverse bands in the anterior part of each somite; the three ventral series are the least conspicuous and may be more or less obliterated.

The first eleven somites of the posterior region of the body (XIII—XXIII) are complete with fourteen rings and each of them is provided with a pair of pulsating vesicles which, in diastole, arch up the skin of the first four rings. The male genital orifice lies in somite XI, usually distinguished above by an irregular white blotch, often extending over the whole of its dorsal surface; the female opening lies in somite XII, which under certain conditions may become constricted. Somites I—IV and the anterior portion of V, which is distinguished by a white transverse band, are included in the anterior sucker. Somites VII, VIII and IX are complete. The anus opens in the posterior part of somite XXVI. The seven pairs of rays and oculiform spots seen on the posterior sucker correspond to the seven somites XXVIII—XXXIV of which it is composed. These observations however require revision.

Dimensions. The English living examples which I have examined measured as follows:

Length 20—30 mm.; width 1.5—2 mm.

Larger dimensions appear to be attained. Brightwell's specimens (1842) were "from one to two inches long"; the measurements given by Johansson (1909) are, 20—50 mm. long and 1.2—5 mm. wide.

Distribution, Hosts, etc. *Piscicola geometra* is widely distributed in Europe and not uncommon in the British Islands. It attacks probably most of our species of fresh-water fish and at times is found in considerable numbers by breeders of trout, when these fish are examined during the spawning season. This little leech attaches itself firmly by the posterior sucker to some convenient object, and stretching itself out like a rod and swaying its body to and fro lies in wait for its prey. With the anterior sucker it strikes at and fixes upon any passing fish with remarkable speed and precision and, letting go its hold posteriorly, is carried off attached to its victim. It remains upon its host for some days, drawing blood chiefly from the fins, and drops off when gorged. The process of digestion is comparatively short. The dark brown opaque elliptical cocoons are about 1.5 mm. long and attached to some foreign body.

The rings in this small species cannot be distinguished without the aid of a lens. In preserved specimens they frequently become merged into irregular groups and a correct count is often an impossibility. If not carefully "fixed" the pulsating vesicles usually collapse when the leech dies and in carelessly preserved material they may be inconspicuous or entirely obliterated.

Genus: Pontobdella, Leach, 1815.

Synonym:

Albione, Savigny, 1822.

Marine leeches, ectoparasitic on skates and rays. Body long and cylindrical, without pulsating vesicles or branchiae, covered by papillae which usually project as conspicuous spiny or warty protuberances but may be partly or entirely retracted. Anterior sucker discoid and excentrically attached, posterior sucker centrally attached and campanulate. Without eyes. Complete somite formed of four rings.

Apáthy (1888 c) has shown that the two species described by Leach (1815) viz. *Pontobdella verrucata* and *P. areolata*, together with the *P. laevis* of de Blainville (1827) merely represent different stages in the appearance of *P. muricata* due to the partial or entire retraction of the warty papillae.

***Pontobdella muricata*, Linnaeus, 1758.**

Plate XIII, Figs. 7—12. Text Fig. 3 (p. 147).

Synonymy and Literature:

Hirudo marina, Rondelet, 1554, p. 3; Gesner, 1558, p. 553, fig.; Aldrovandus, 1638, p. 733.

Insectum marinum hirudini affine cornubiense Ray, 1710, p. 4.

Hirudo muricata, Linnaeus, 1754, p. 93, pl. viii, fig. 3; Linnaeus, 1758, p. 650; Linnaeus, 1761, No. 2084; Weser, 1765, p. 44; Linnaeus, 1767, p. 1080; Barbut, 1783, p. 20, pl. ii, fig. 8; Gmelin, 1788, p. 3098; Bosc, 1802, p. 248; Turton, 1806, p. 71; Turton, 1807, p. 130; Pennant, 1812, p. 71, pl. xxi, fig. 4; Pennant, 1766, p. 38, pl. xx, fig. 14; Oken, 1815, p. 371; Johnson, 1816, p. 38; Stewart, 1817, p. 357; Cuvier, 1817, p. 532; Derheims, 1825, pp. 10 and 22; Grant, 1827, No. 14; Dalyell, 1827, p. 391; Dalyell, 1853, p. 3, pl. i, figs. 1—15 (coloured).

Hirudo piscium, Baster, 1760, p. 82, pl. x, fig. 2.

Hirudo blochii, Braun, 1805, p. 43, pl. iv, figs. 1—6.

Hirudo verrucosa, Fleming, 1811, p. 245; Johnson, 1816, p. 39.

Pontobdella spinulosa, Leach, 1815, p. 12, pl. lv, figs. 1, 2; de Blainville, in Lamarck, 1818, p. 294; Risso, 1826, p. 432; de Blainville, 1827, p. 241; de Blainville, 1828, p. 557, pl. xxxiv, figs. 2, 2 a; Stark, 1828, p. 142; Templeton, 1836, p. 236; Grube, 1840, p. 50; Egidy, 1844, p. 106; Johnston, 1846, p. 442; Diesing, 1850, p. 437; Thompson, 1856, p. 427.

Pontobdella verrucata, Leach, 1815, p. 11, pl. lxiv, figs. 1, 2; de Blainville, 1827, p. 242; de Blainville, 1828, p. 557; Milne-Edwards, in Lamarck, 1835, p. 525; Grube, 1840, p. 60; Egidy, 1844, p. 106; Moquin-Tandon, 1846, p. 288, pl. ii, figs. 10, 11 (coloured); Diesing, 1850, p. 438; Grube, 1851, p. 108.

Pontobdella areolata, Leach, 1815, p. 10, pl. lxiii; de Blainville, 1827, p. 242; de Blainville, 1828, p. 557; Moquin-Tandon, 1846, p. 290, pl. ii, fig. 12 (coloured); Diesing, 1850, p. 439; Grube, 1851, p. 108.

Pontobdella muricata, de Blainville, in Lamarck, 1818, p. 293; Risso, 1826, p. 432; de Blainville, 1827, p. 242; de Blainville, 1828, p. 557; Stark, 1828, p. 142; Templeton, 1836, p. 236; Egidy, 1844, p. 106, pl. iv, fig. 71; Grube, 1840, p. 60; Moquin-Tandon, 1846, p. 285, pl. i, figs. 11 (coloured) and 12, and pl. ii, figs. 1—9 (anatomy); Grube, 1851, p. 108; Thompson, 1856, p. 426 (in Ireland); van Beneden and Hesse, 1863, p. 23, pl. i, figs. 1—6; Vaillant, 1870; M'Intosh, 1874, p. 192; M'Intosh, 1875, p. 114, pl. v, fig. 1 (coloured); Bourne, 1884; Dutilleul, 1885, p. 349 and 1886a, p. 127, pl. i (genital organs); Dutilleul, 1886b, p. 559, and 1886c, p. 572, pl. xii (anatomy); Apáthy, 1888a, p. 153, etc., pl. viii, figs. 5, 16 and 17 (head) and fig. 6 (diagram of somite); Apáthy, 1888c, p. 47 *et seq.*; Rhode, 1891 (nervous system); Gibbs, 1898, p. 330 (habits); Johansson, 1898a, p. 668; Johansson, 1898b, pp. 582 *et seq.* (anatomy); Robertson, 1909, p. 119, pl. ix (*Trypanosoma raiæ* in alimentary canal).

Albione muricata, Savigny, 1822, p. 110; Delle Chiaje, 1823, p. 49, pl. i, fig. 14; Moquin-Tandon, 1826, p. 136, pl. vii, fig. 4.

Albione verrucata, Savigny, 1822, p. 111; Moquin-Tandon, 1826, p. 137, pl. vii, fig. 5.

Sipunculus marinus, De Serres, 1822, p. 61.

Sanguisuga muricata, Bruguière, 1824, p. 133, pl. lii, fig. 5.

Albione areolata, Moquin-Tandon, 1826, p. 138.

Pontobdella laevis, de Blainville, 1827, p. 243; de Blainville, 1828, p. 557, pl. xxxiv, fig. 3; Moquin-Tandon, 1846, p. 290; Thompson, 1846, p. 391 (recorded from Ireland); Diesing, 1850, p. 439; Grube, 1851, p. 108; Thompson, 1856, p. 427.

Pontobdella verrucosa, Leydig, 1851, p. 318, pl. ix, fig. 2 (anatomy).

Diagnosis. Body cylindrical, fusiform, much attenuated anteriorly, grayish green or brownish green, somewhat lighter on the ventral surface, with irregular dark brown spots. Anterior sucker with six small marginal papillae.

The anterior sucker includes the first four somites. Somites V, VI, X, XI, XII and XXIV—XXVII biannulate, VII, VIII and IX triannulate; the eleven somites XIII—XXIII following the clitellum, are complete with four rings. The first ring of the complete somite is the largest, the third is the smallest, the second and fourth are of equal length. The papillae in each somite are disposed upon their several rings according to a definite and characteristic pattern which however may become modified to a certain extent when, as not infrequently happens, some papillae are missing or extra ones are intercalated. The typical arrangement on the dorsal surface is indicated in Text Fig. 3 (p. 147). The largest papillae occur on the first ring of the somite and are eight in number, and there are usually ten upon the second and twelve upon the fourth ring.

The papillae may be prominent, conical and terminated by an array of spiny tubercles forming a kind of rosette [the typical form], less acute, mammiform and without the terminal rosettes [*P. verrucata*], so far sunk into the body as to leave an irregular basal marking [*P. areolata*] or entirely retracted, leaving the surface smooth [*P. laevis*].

The clitellum extends from the second and last ring of somite X up to and including the last ring of somite XII.

The male genital orifice lies between the two rings of somite XI, that is, between the 16th and 17th rings following the anterior sucker. The female orifice is situated two rings behind the male, between the first and second rings of somite XII.

The anus lies upon the first ring or between the two rings of somite XXVI. The crop has a single undivided caecum reflected posteriorly.

Length, at rest, 75—100 mm.; fully extended, up to 200 mm. Width 8—15 mm.

Distribution, Hosts, etc. *Pontobdella muricata* is parasitic on *Raja batis* and other species of skate and has been recorded also from *Torpedo marmorata*. It is found in the Mediterranean, and on the western and northern coasts of Europe, and is of fairly frequent occurrence in British waters, where it is known to fishermen as the "skate leech" or "skate sucker." The egg capsules are opaque, tough, leathery, barrel-shaped structures about 5 mm. long and 4 mm. in width, attached by a pedicle to foreign bodies. One leech will produce a considerable number of these capsules, one after another, at short intervals; the interior of some empty bivalve shell appears to be a favourite place for their deposition and they are found in groups containing from three or four to fifty or more; fifty-four is the largest number as yet observed in a group (Dalyell). The process of digestion in this species, as in *Hirudo medicinalis*, is exceptionally slow, and when fully gorged it can live for many months without taking food. It has been stated that *P. muricata* is unable to swim; when not too fully distended with blood it can and does swim, the body being somewhat flattened for the purpose, after the manner of other leeches. It is usually however a very sluggish animal, remaining for long periods attached to some convenient object by its powerful posterior sucker, the body tightly curled upon itself or more or less extended and unrolled.

Several attempts, all of them unsatisfactory, have been made to account for the existence of the warts which form such a characteristic feature of this species. In this connection we may note the striking resemblance both in colour and in form between this leech and the thorny body of its host.

Family II. GLOSSOSIPHONIDAE.

Synonym:

Clepsinidae.

Fresh-water Rhynchobdellae with ovate, flattened, never cylindrical body. Differentiation of the head region into a permanent anterior sucker distinct from the body may occur, but never to the same extent as in the Ichthyobdellidae. Crop and stomach with conspicuous, paired lateral caeca; the stomach always with four pairs. The eggs are usually fixed, and the young attach themselves to the ventral surface of the parent. Certain species deposit their eggs upon foreign bodies and brood over them.

Genus: Protoclepsia, Livanow, 1902.

Synonymy:

Glossiphonia, Johnson, 1816 (partim). *Clepsine*, Savigny, 1822 (partim). *Haemocharis*, de Filippi, 1837 (partim; not *Haemocharis*, Savigny, 1822). *Theromyzon*, Philippi, 1867. *Hemiclepsis*, Vejdovsky, 1883 (partim). (?) *Protoclepsine*, Moore, 1898.

Glossosiphonidae of medium size, with four pairs of eyes. Complete somite formed of three rings. Somites III—XXIII are complete. Crop with more than six pairs of many-lobed lateral caeca, the last and longest pair reflected posteriorly. "The presence of two nuclei in each muscle cell is a special peculiarity." (Livanow.)

This genus has been created by Livanow (1903, p. 339) in order to admit *P. tessellata*, a species formerly included in *Hemiclepsis* (*q.v.*) and several eight-eyed forms occurring for the most part in Lake Baikal. These comprise a well-defined and homogeneous little group, the members of which are somewhat difficult to distinguish one from another. This close similarity, if we are to believe Livanow, has led to the confusion of two species under the name *Hirudo tessellata* (O. F. Müller 1774.) Such a possibility had already been contemplated by Blanchard (1892, p. 62.) The species which Livanow has isolated from the *H. tessellata* of previous authors has been described by him under the name of *Protoclepsis meyeri*. The genus *Protoclepsis* is divided by its author into two groups characterized as follows:

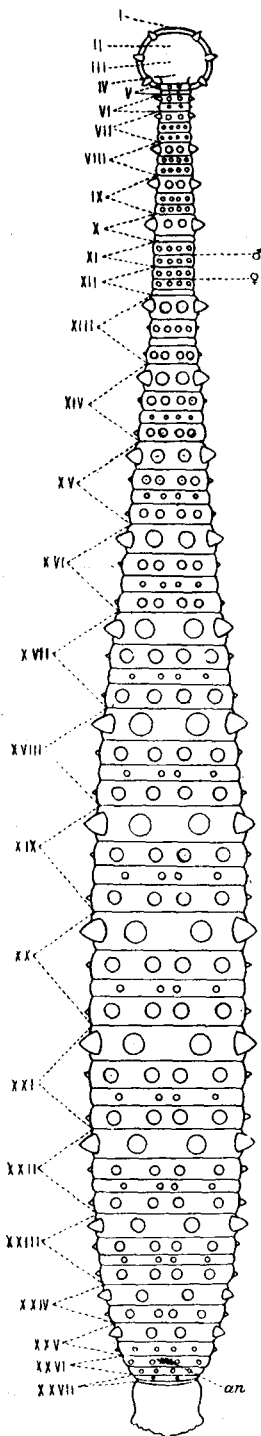
A. Genital apertures separated by two rings. A primitive form of vagina is present in adults. It is undeveloped in young individuals and the oviducts opening directly to the exterior on either side of the ventral median line appear as two separate female genital apertures.

B. Genital apertures separated by more than two rings. The female opening is the single aperture of a well-developed vagina.

P. meyeri falls within the first and *P. tessellata* within the second of these groups.

The synonymy of *P. tessellata* and *P. meyeri* is inextricably confused, since the inadequacy of the descriptions given by most writers renders it impossible to determine which of these two species they had in view.

Only Malm and R. Blanchard have noted the position of the genital orifices; to the latter we owe the first satisfactory diagnosis of *P. tessellata*, whilst in the description of Malm (1860) we have the only positive record of *P. meyeri* in Western Europe.



W.A.H. del.

Fig. 3. *Pontobdella muricata*.

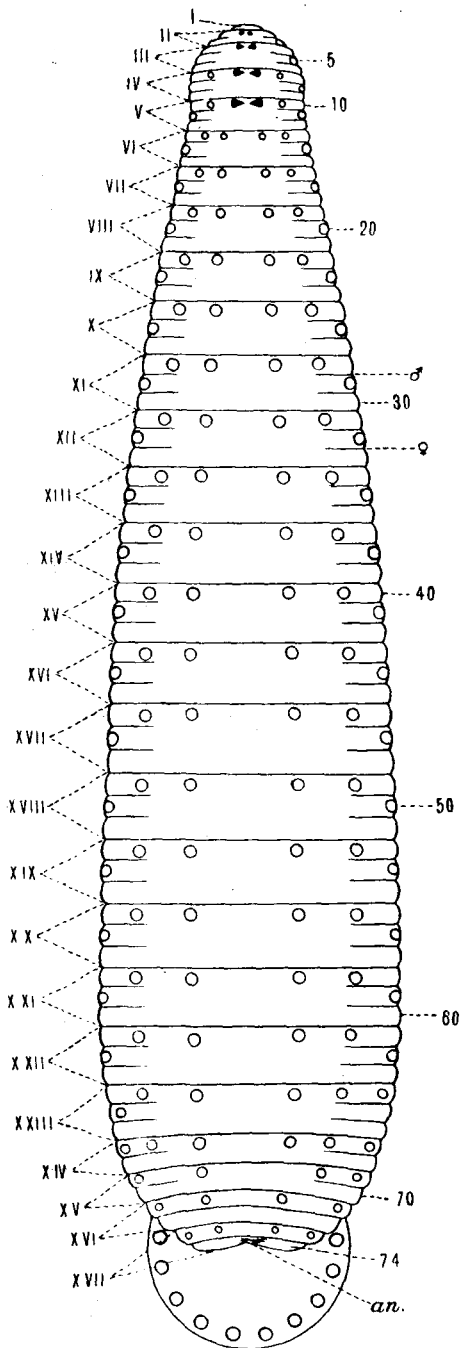


Fig. 4. *Protoclepsis tessellata*.

Fig. 3. *Pontobdella muricata*. Diagram showing annulation and external features on dorsal surface. Somites indicated in Roman numerals.

Fig. 4. *Protoclepsis tessellata*. Diagram showing annulation, position of spots and other external features on dorsal surface. an. Anus. Somites indicated in Roman numerals and rings in figures.

That *P. tessellata* occurs in England is proved by the discovery of the example which forms the subject of the accompanying description and figures, and this fact substantiates the opinion expressed by Livanow and shared by the present writer, that Brightwell (*Nephelis tessellata*, 1842), Thompson (*Glossiphonia eacheana*, 1856) and Houghton (*G. tessellata*, 1865) all had this form, and not *P. meyeri*, before them.

Protoclepsius tessellata, O. F. Müller, 1774.

Plate XV, Figs. 33—35. Text Fig. 4 (p. 147).

Synonymy and Literature:

- Hirudo tessulata*, O. F. Müller, 1774, p. 45; O. F. Müller, 1776, p. 220; Gmelin, 1788, p. 3098; Schrank, 1803, p. 161; Braun, 1805, p. 56, pl. vi, figs. 6—10 (coloured); Turton, 1806, p. 70; Johnson, 1816, p. 33; Fleming, 1824, p. 400.
- Hirudo tessellata*, Bosc, 1802, p. 247; de Blainville, 1827, p. 261; Dalyell, 1853, p. 38, pl. iv, figs. 24—30 (coloured).
- Erpobdella tessulata*, Fleming, 1822, p. 604; Thompson, 1844, p. 437 (in Ireland); Johnston, 1846, p. 440.
- Ichthyobdella tessellata*, de Blainville, 1828, p. 558.
- Erpobdella vulgaris*, var. *tessellata*, de Blainville, 1828, p. 564.
- Nephelis tessellata*, Savigny, 1822; Brightwell, 1842, p. 13, pl. i, figs. 15—17 (coloured).
- Clepsine tessulata*, Fr. Müller, 1844 a, p. 376; Fr. Müller, 1844 b, p. 21; Fr. Müller, 1846, p. 138, pl. viii, figs. 1—4 and 7—13 (anatomy of genital organs); Diesing, 1850, p. 447; Diesing, 1858, p. 495; Grube, 1851, p. 114; Malm, 1860, p. 81; Orley, 1886, p. 100; Apáthy, 1888 a, p. 154 *et seq.*, pl. viii, fig. 14 (head); Apáthy, 1888 b, p. 789 *et seq.*; Spooß, 1889, p. 16; Brandes, 1900, p. 126 (copulation).
- Glossiphonia tessellata*, Moquin-Tandon, 1846, p. 379; Thompson, 1846, p. 390 (in Ireland); Johnston, 1865, p. 50; Houghton, 1865, p. 88 *et seq.*; R. Blanchard, 1892 f, p. 56 (description); R. Blanchard, 1892 g, p. 117 (in Chile); de Guerne, 1892, p. 360 (on waterfowl); R. Blanchard, 1893 b, p. 23 (in Piedmont); R. Blanchard, 1893 h, p. 197; R. Blanchard, 1893 i, p. 2 (in Syria); Méguin, 1905, p. 71 (on waterfowl).
- Hirudo vitrina*—the *Glassy Leech*, Dalyell, 1853, p. 42, pl. v, figs. 20—23 (coloured); Johnston, 1865, p. 53.
- Glossiphonia eacheana*, Thompson, 1846, p. 390; Thompson, 1856, p. 425; Johnston, 1865, p. 54.
- Haemocharis eacheana*, Thompson, 1856 b, p. 425.
- Hemiclepsis tessellata*, Vejdovsky, 1883; R. Blanchard, 1894 b, p. 32; Bayer, 1898, p. 648 *et seq.* (sense organs); Scharff, 1898, p. 192 (in Ireland).
- Clepsine tessellata*, Weltner, 1887, p. 85; Collin, 1892, p. 164 (from *Cygnus atratus*).

Diagnosis. Body flattened and very soft; in extension ovate-oblong, with nearly parallel sides and the head region slightly dilated; in extreme contraction ovoid, the length being equal to about twice the

breadth. Colour grayish olive above, pale gray beneath; the anterior extremity and the posterior sucker are finely sprinkled with black, stellate, superficial pigment cells.

Dorsal surface with six longitudinal series of rounded yellowish spots. The spots composing four of these series occur on the first ring of each somite and correspond to the outer paramedian and intermediate sense organs, the inner paramarginal sense organs on this ring being without spots, whilst the spots composing the two remaining series are situated on the outer paramarginal lines on the second ring of each somite. The paramarginal spots are the largest and sometimes overlap on to the ventral surface. All the spots are subject to individual fluctuations in size; usually some of them are imperfectly developed or absent. Papillae, generally small and scarcely perceptible, occur dorsally on the first rings of each somite and correspond to the outer paramedian, intermediate and inner paramarginal sense organs. Similar papillae are situated on the outer paramedian and inner paramarginal lines and occasionally (Livanow) on the intermediate lines on the first rings of each somite on the ventral surface. These are not associated with yellow spots.

74 rings. Somite I uniannulate, somites II and XXIV—XXVII biannulate; the 21 somites III—XXIII are complete with three rings.

The four pairs of eyes lie respectively on the first rings of somites II, III, IV and V, that is, upon rings 2, 4, 7 and 10.

The male genital orifice lies between rings 28 and 29, that is, between the first and second rings of somite XI; the female orifice is four rings behind the male, between rings 32 and 33.

The anus opens behind ring 73 and is separated by the seventy-fourth and last ring, which is incomplete, from the posterior sucker.

Dimensions. The following measurements are taken from the single living English example which I have had the opportunity of examining.

At rest, but moderately extended, 16 mm. long and 2 mm. wide. At rest, in extreme contraction, about 8 mm. long and 4 mm. wide. In extreme extension, 24 mm. long.

Larger dimensions are probably attained; the results of the following observers are however somewhat conflicting:—O. F. Müller, 1774, 18 lines long and 5 lines wide; Brightwell, 1842 (English example), "about an inch long"; Moquin-Tandon, 1846, 18—25 mm. long and 4—5 mm. wide; Thompson, 1846 (Irish examples) "size commonly...nine lines";

Houghton, 1865 (English examples) "nearly an inch in length"; Johnston, 1865 (English examples), 18 lines long and 5 lines wide; Dalyell, 1853 (Scotch examples), at rest, 5—6 lines long and about $2\frac{1}{2}$ inches long when extended; Blanchard, 1893 h, 24 mm. long and 10 mm. wide (in alcohol); Livanow, 1902, 15 mm. long and 3 mm. wide; Johansson, 1909, 10—30 mm. long and 2—6 mm. wide.

Distribution, Habits. *P. tessellata* is an extraordinarily active and restless animal, starting into movement upon the slightest disturbance. It is very prolific, carrying, according to Houghton, as many as 200 young, and more than 300, if we are to believe O. F. Müller.

Its range appears to be confined to Europe and, perhaps, adjacent parts of Asia; the single example recorded by Blanchard (1892 g) from Chile (on the body of a rat, *Myopotamus coypu*) may probably have been introduced, as that writer believes, by artificial means. It is nowhere abundant and is of rare occurrence in the British Islands. Fleming (1822) first included it among the British species. Brightwell (1842) described a single example from the River Wensum, at Costessy, near Norwich, and Houghton (1865, p. 88), who considered it to be less rare than generally supposed, obtained it in weedy pools and found it "not uncommon in the Shropshire Union Canal." Johnston (1865) catalogues a specimen from Holy Island Lough, and recently, I have taken from a stagnant, weedy pond at Histon, near Cambridge, a single individual of which coloured figures accompany this description.

In Scotland it is "rarely disseminated" according to Dalyell (1853), who records it from Coldingham Loch, Berwickshire, the counties of Edinburgh and Linlithgow and the Island of Bute.

Scharff (1898) states that it is rare in Ireland and in addition to Tuam and Lough Neagh, where it was found by Thompson (1844), records it from Clonbrock, from Santry, Co. Dublin, and from Glenomeragh, Co. Clare.

Hosts. There appears to be no doubt that *P. tessellata* is parasitic upon various species of waterfowl and particularly upon the fresh-water ducks (*Anatinae*) although, in the instances of parasitism cited below, we cannot state with certainty in every case whether the descriptions apply to this leech or to some closely allied species such as *P. meyeri*. Weltner (1887, p. 85) states that at a farm at Wanzenau, near Strasbourg, the ducks and geese were nearly all destroyed by a leech, described as *Glossiphonia (Protolepsis) tessellata*, which attached itself to the walls of the oesophagus.

De Guerne (1892) has collected interesting evidence showing that migrating ducks can become active agents in the distribution of living leeches attached to their bodies. Leeches obtained by him from the breast plumage of a wigeon (*Mareca penelope* L.) and a teal (*Querquedula crecca* L.) were described by Blanchard (1893, p. 62) as *P. tessellata*, though Livanow would have us believe that they were specimens of *P. meyeri*.

Blanchard (1893 h, p. 197) describes two undoubted examples of *P. tessellata*, taken from the nasal cavities of *Anas glacialis*.

Finally Mégnin (1905, p. 71) instances the case of a domestic duck choked by an accumulation of leeches, also referred by Blanchard to *P. tessellata*, which had penetrated into the air passages and completely blocked the trachea.

Genus: Hemiclepsis, Vejdovsky, 1883.

Synonymy:

Haemocharis, de Filippi, 1837 (partim; not *Haemocharis*, Savigny, 1822). *Glossiphonia*, Johnson, 1816 (partim). *Clepsine*, Savigny, 1822 (partim). *Hemiclepsis*, Vejdovsky, 1883 (partim).

Glossosiphonidae of medium size, with two pairs of eyes. Complete somite formed of three rings. The 21 somites III—XXIII are complete. Head region dilated into a permanent anterior sucker distinct from the body. Crop with more than six pairs of many-lobed lateral caeca, the last and longest pair reflected posteriorly.

This genus has recently been revised by Livanow (1902) who has separated from it the genus *Protoclepsis* (q.v.).

***Hemiclepsis marginata*, O. F. Müller, 1774.**

Plate XIV, Figs. 28—32. Text Figs. 5 and 6 (p. 153).

Synonymy and Literature:

Hirudo marginata, O. F. Müller, 1774, p. 46; O. F. Müller, 1776, p. 200; Gmelin, 1788, p. 3098; Bosc, 1802, p. 257; Schrank, 1803, p. 162; Turton, 1806, p. 70; Johnson, 1816, p. 36; Baer, 1827, p. 728, pl. xxxii, fig. 10.

Hirudo variegata, Braun, 1805, p. 61, pl. vii, figs. 1—6 (coloured).

Hirudo cephalota, Carena, 1820, p. 298, pl. xii, figs. 19, 20; Carena, 1823, p. 336; de Blainville, 1827, p. 266, pl. xxvii, figs. 5, 5 a (named in plate *Ichthyobdella cephalota*).

Hirudo oscillatoria, Saint Amans, 1825, p. 193, pl. viii.

- Piscicola marginata*, Moquin-Tandon, 1826, p. 133, pl. vii, fig. 2.
Piscicola tessellata, Moquin-Tandon, 1826, p. 133.
Glossobdella cephalota, de Blainville, 1827, p. 266.
Ichthyobdella marginata, de Blainville, 1828, p. 558.
Haemocharis marginata, de Filippi, 1837, p. 26.
Clepsine marginata, Fr. Müller, 1844, p. 377, pl. x, fig. 4; Diesing, 1850, p. 447; Apáthy, 1888 a, p. 154, etc., pl. ix, fig. 1 (head); Apáthy, 1888 b, p. 789, etc.; Whitman, 1878, p. 2 *et seq.* (development); Leuckart, 1894, fig. 280 (digestive tract); Oka, 1894, p. 81 *et seq.*, pl. v, fig. 24, etc. (sinus system, nephridia).
Glossiphonia marginata, Moquin-Tandon, 1846, p. 375, pl. xiv, figs. 10—20; Houghton, 1860, p. 248, pl. xvi, C, figs. 1, 2 (first record in England); Houghton, 1861, p. 34, pl. iii, fig. 15 (coloured); Houghton, 1865, p. 83, pl. i, fig. 10 (coloured); R. Blanchard, 1892 b, p. 173 (description).
Hirudo flava—the *Yellow Leech*, Dalyell, 1853, p. 45, pl. v, figs. 1—19 (coloured).
Glossiphonia flava, Johnston, 1865, p. 53.

Diagnosis. Body claviform, flattened and more or less transparent. With the exception of the margins and anterior extremity, which are colourless or hyaline, the ground colour is pale yellow, variegated above with orange, reddish brown, lemon yellow and an intense green. Usually the green pigment predominates; there is however a form in which it is entirely absent, leaving the body yellow. The general colouration is considerably modified when the crop is distended with blood. Green or reddish brown transverse stripes traverse the clear margins of the first rings of each somite.

Dorsal surface with seven longitudinal series of lemon yellow spots. The spots composing four of these rows occur on the first rings of each somite and correspond to the outer paramedian and intermediate sense organs.

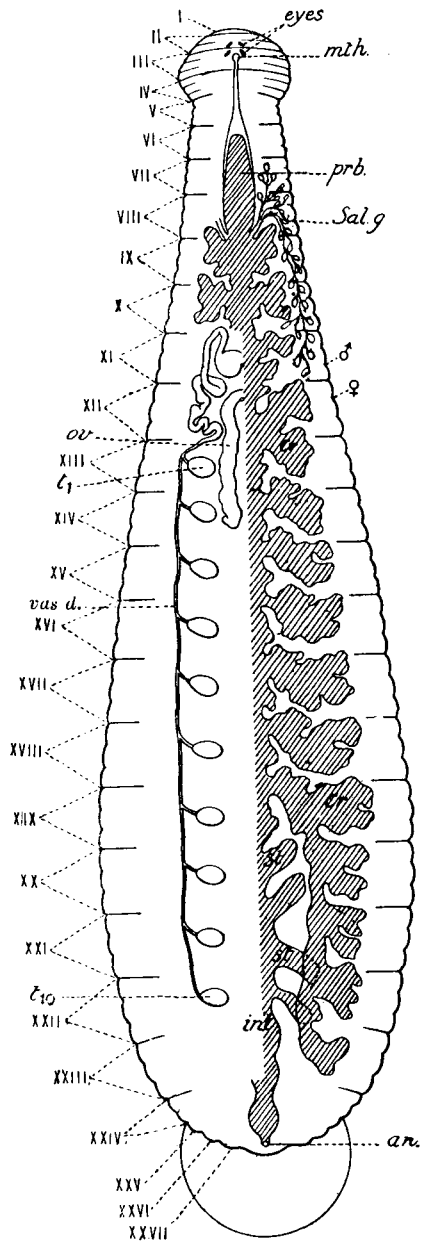
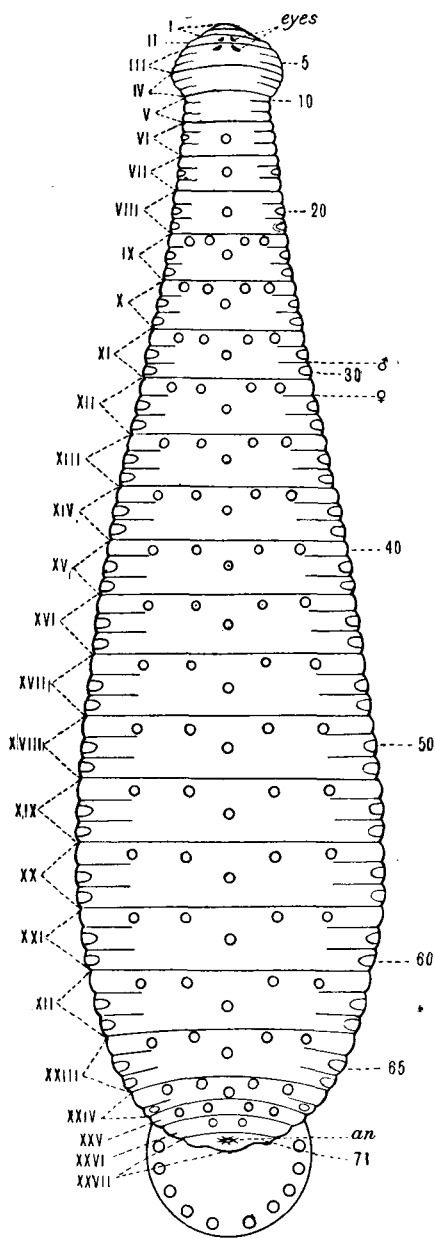
The spots composing a median row fall upon the second rings of each somite, whilst those forming the two remaining series occupy a paramarginal position and occur on both the second and third rings of each somite.

These spots are subject to individual fluctuations in size and may not all be present. The right and left paramarginal spots in each somite not infrequently are fused together, forming irregular C-shaped markings.

Low papillae correspond to the outer paramedian and intermediate sense organs and spots on the first ring of each somite.

Ventral surface without spots or papillae.

Posterior sucker with a paramarginal row of lemon yellow spots, between which reddish brown rays frequently appear.



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Fig. 5. *Hemiclepsis marginata*.

Fig. 6. *Hemiclepsis marginata*.

Fig. 5. *Hemiclepsis marginata*. Diagram showing annulation, position of spots, etc., on dorsal surface. Somites in Roman numerals, rings in figures.

Fig. 6. The same. Alimentary tract shown on the right side; reproductive system on the left. mth. Mouth. prb. Proboscis. Sal. g. Salivary glands. Cr. Crop. st. Stomach. int. Intestine. ov. Ovary. vas d. Vas deferens. t 1, t 10, Testes of the first and tenth pairs. an. Anus. (Schematic.)

72 rings, of which the last is inconspicuous and incomplete. Somites I, XXIV and XXVII biannulate; II, XXV and XXVI uniannulate, the 21 somites III—XXIII complete with three rings.

The first pair of eyes lies on ring 3; the second and largest pair is situated on ring 4, that is, upon the first ring of somite IV.

The proboscis is short, extending posteriorly to the last ring of somite VIII. The mouth opens in the posterior part of somite III.

The male genital orifice lies between rings 29 and 30, that is, between the second and third rings of somite XI; the female opening is two rings behind the male, between rings 31 and 32. Testes 10 pairs.

The anus lies behind the first ring of somite XXVII.

Eggs attached to the ventral surface of the parent.

Length, at rest, 16—18 mm., width, at rest, 2·5—8 mm. Length, in extreme extension, 27—30 mm.

Distribution, Food, etc. This beautiful species occurs throughout the greater part of Europe. It has not been recorded from Ireland. It is rare in Scotland, according to Dalyell (1853, pp. 45—49, pl. v, figs. 1—19), who describes the yellow form already referred to, under the name *Hirudo flava*. It is equally rare in England, where it was first recorded in 1859 by Houghton (1860, p. 248, pl. xvi, C, figs. 1—2, who took one example in Bala Lake and several others in a small stream near Solihull in Warwickshire, and again later (1865, p. 89) "on one or two occasions...found it in the Shropshire Union Canal."

Since 1865 it does not appear to have been noticed in Great Britain, probably because it has not been sought for. Recently (1898—9) I have taken a number of examples from a stagnant weedy pond, stocked with fish, at Histon, near Cambridge. These were found among aquatic plants together with other *Glossosiphonidae*.

This species is a fish parasite (Houghton, 1865, p. 89; Whitman, 1878, p. 10; Blanchard, 1884, p. 33). Apáthy (1888 b) states that it attacks the smaller species of carp.

Genus: *Glossosiphonia*, Johnson, 1816.

Synonymy:

Glossiphonia, Johnson, 1816. *Glossopora*, Johnson, 1817. *Clepsine*, Savigny, 1822. *Erpobdella*, de Blainville, in Lamarck, 1818. *Glossobdella*, de Blainville, 1827. *Clepsina*, de Filippi, 1837. *Glossosiphonia*, R. Blanchard, 1894.

Glossosiphonidae of small or medium size, with three pairs of eyes. Complete somite formed of three rings. Crop with six pairs of sub-lobate lateral caeca, the last and longest pair reflected posteriorly.

Glossosiphonia heteroclita, Linnaeus, 1761.

Plate XIV, Figs. 18—21. Text Fig. 7 (p. 157).

Synonymy and Literature :

- Un Ver plat et blanc*, Trembley, 1744, p. 147, pl. vii, fig. 7 ; Ledermüller, 1764, p. 165, pl. lxxxiv, figs. k—q.
- Hirudo heteroclita*, Linnaeus, 1761, No. 2085 ; Weser, 1765, p. 44 ; Linnaeus, 1767, p. 1080 ; Turton, 1806, p. 70 ; Johnson, 1816, p. 34.
- Hirudo hyalina*, O. F. Müller, 1774, p. 49 ; O. F. Müller, 1776, p. 220 ; Gmelin, 1788, p. 3097 ; Bosc, 1802, p. 256 ; Schrank, 1803, p. 163 ; Stewart, 1817, p. 357 ; Baer, 1827, p. 728 ; pl. xxxii, fig. 11.
- Hirudo papillosa*, Braun, 1805, p. 64, pl. vii, figs. 7—10 (coloured).
- Hirudo trioculata*, Carena, 1820, p. 303, pl. xii, fig. 22 ; Carena, 1823, p. 334.
- Clepsine hyalina*, Moquin-Tandon, 1826, p. 106 ; Müller, F., 1844 b, p. 27 ; Diesing, 1850, p. 453.
- Clepsine carenae*, Moquin-Tandon, 1826, p. 105, pl. iv, fig. 4 ; Diesing, 1850, p. 454.
- Glossobdella hyalina*, de Blainville, 1827, p. 263 ; de Blainville, 1828, p. 565.
- Glossobdella trioculata*, de Blainville, 1827, p. 267, pl. xxxvii, fig. 4.
- Glossobdella carenae*, de Blainville, 1828, p. 565.
- Clepsina carenae*, de Filippi, 1839, p. 6.
- Clepsina hyalina*, Brightwell, 1842, p. 15, pl. i, figs. 18 and 19 (erroneously named *C. complanata* ; fig. 20 represents, not *C. hyalina*, but *C. complanata*) ; Thompson, 1844, p. 437 (recorded from Ireland).
- Glossopora* (?) *hyalina*, Johnston, 1846, p. 440.
- Glossosiphonia heteroclita*, Moquin-Tandon, 1846, p. 358, pl. xiii, figs. 1—6 (coloured) ; Johnston, 1865, p. 52 ; Castle, 1900 a, p. 42, pl. v and pl. viii, figs. 35—38 (complete description).
- Glossosiphonia carenae*, Moquin-Tandon, 1846, p. 362, pl. xiii, figs. 7—9 (coloured).
- Clepsine papillosa*, Grube, 1851, p. 113.
- Glossosiphonia hyalina*, Thompson, 1856, p. 425 (occurrence in Ireland).
- Glossosiphonia hyalina*, Houghton, 1861, p. 33 *et seq.* ; Houghton, 1865, p. 82, pl. i, figs. 5 and 6 (coloured).
- Clepsine heteroclita*, Whitman, 1878, p. 2 *et seq.* (development) ; Orley, 1886 ; Apáthy, 1888 a, p. 154, pl. vi, fig. 3 (head region) ; Oka, 1894, p. 81 *et seq.* (sinus system, nephridia) ; Leuckart, 1894, p. 552, fig. 237 (head) and fig. 239 (sense organ) ; Scharff, 1898, p. 191 (occurrence in Ireland).
- Glossosiphonia trioculata*, R. Blanchard, 1893 b, p. 4.
- Glossosiphonia heteroclita*, R. Blanchard, 1894 b, p. 26 (diagnosis) ; Johansson, 1909, p. 75, figs. 127, 128.

Diagnosis. Body ovate-acuminate, much flattened, without papillae, of a clear and pellucid amber yellow colour. Minute brownish or blackish spots, which tend to group themselves into transverse striae upon the third ring of each somite, may be present on the dorsal surface.

The three pairs of eyes are somewhat variable in position. The eyes forming the anterior and smallest pair are closely approximated (in an inner paramedian position) and lie, generally in ring 5, occasionally in ring 4 or in ring 6; one or both of them may be devoid of pigment. The eyes composing the second and third pairs are wider apart (in an outer paramedian position) and situated respectively in rings 7 and 8.

71 rings. The male and female genital ducts have a common orifice between rings 28 and 29. Testes, 6 pairs. The anus lies between rings 70 and 71.

Eggs attached to the ventral surface of the parent.

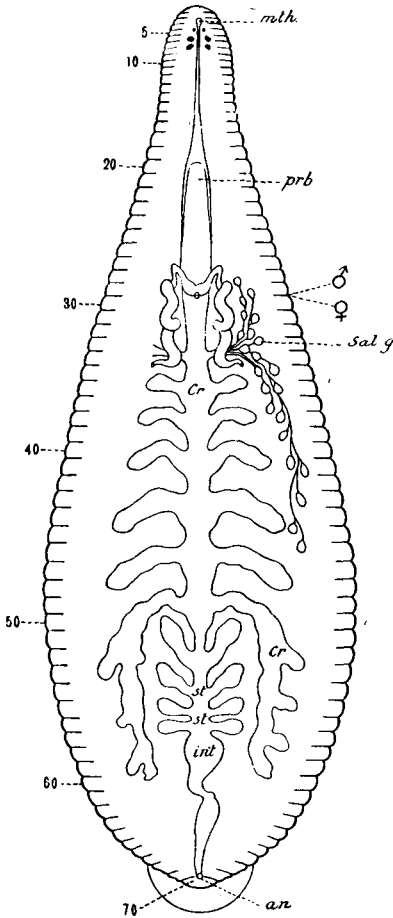
Length, at rest, 10—13 mm.; width, at rest, 3—4.5 mm.

Distribution, Food, etc. A sluggish species, common in England, in stagnant and slowly running waters, chiefly among aquatic plants. Its range probably extends into Scotland but its occurrence there does not seem to have been recorded. In Ireland it is found in a few localities but is not common (Scharff, 1898). It is widely distributed in central Europe and occurs in Sweden, in Sardinia (Blanchard, 1894) and in North America (Castle, 1900).

It breeds in England in June and July: large individuals may carry more than 60 eggs. It is parasitic chiefly upon gasteropods.

Varieties. Apáthy (1888 b, p. 790) states that the colouration of this leech shows "numerous transitions to a variety (*striata*) which is distinguished by intensely black transverse stripes, more or less interrupted, on every third ring." Castle (1900, p. 42, pl. viii, fig. 38) finds in the United States all gradations between the clear yellow form and a form with transverse striae and an irregular longitudinal band on the dorsal surface, due to the presence of orange, dark brown or black superficial pigment cells. Dark brown or blackish pigment is rarely present in British examples of *G. heteroclita*. Houghton (1865) does not refer to it and among a very large number of individuals examined, I have not found one in which it occurred. Johnston however states in his *Catalogue* of British species (1865) that "the back is sometimes speckled with blackish dots."

In rare cases not only the eyes composing the first pair but also the right and left components of the second and third pairs are so closely approximated as to give the appearance of three single eyes. On this trioculate and triangular disposition Carena (1820) founded his supposed species *Hirudo trioculata*.



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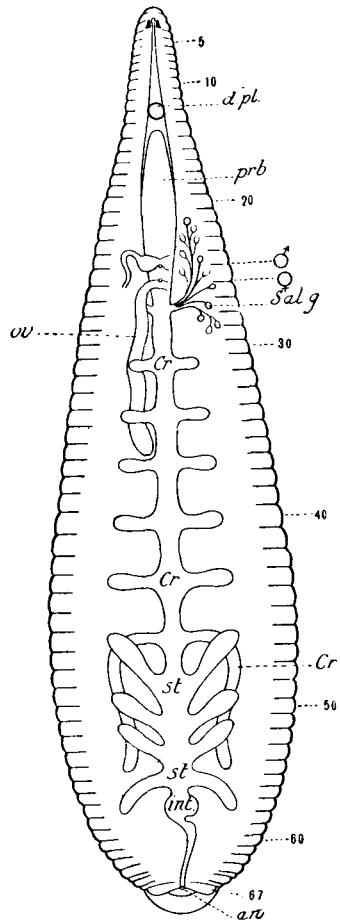
Fig. 7. *Glossosiphonia heteroclita*.Fig. 8. *Helobdella stagnalis*.

Fig. 7. *Glossosiphonia heteroclita*. Annulation and digestive tract. *mt.h.* Mouth. *prb.* Proboscis. *sal. g.* Salivary glands. *Cr.* Crop. *st.* Stomach. *int.* Intestine. *an.* Anus. Ovary omitted. (Schematic.)

Fig. 8. *Helobdella stagnalis*. Annulation, digestive tract, etc. *d. pl.* Dorsal plate. Other lettering as before. (Schematic.)

Among a number of individuals taken from the same locality one often may find forms exhibiting stages intermediate between the normal and the trioculate type and not infrequently examples in which the eyes are more or less asymmetrically disposed.

***Glossosiphonia complanata*, Linnaeus, 1758.**

Plate XIV, Figs. 22—27. Text Figs. 9 and 10 (p. 161).

Synonymy and Literature:

A very small sort of Leech, (!) Baker, 1753, p. 415.

Hirudo lateribus attenuatis—the *Snail-leech*, Hill, 1752, p. 16.

Hirudo sexoculata, Bergman, 1757, p. 313, pl. vi, figs. 12, 13; Schrank, 1803, p. 162.

Hirudo complanata, Linnaeus, 1758, p. 650; Linnaeus, 1761, No. 2082; Weser, 1765, p. 44; Linnaeus, 1767, p. 1079; O. F. Müller, 1774, p. 47; O. F. Müller, 1776, p. 220; Gmelin, 1788, p. 3097; Ure, 1793, p. 233; Bosc, 1802, p. 256; Braun, 1805, p. 58, pl. vi, figs. 11—16 (coloured); Turton, 1806, p. 69; Turton, 1807, p. 129; Pennant, 1812, p. 72; Stewart, 1817, p. 357; Carena, 1820, p. 97, pl. xii, figs. 17, 18; Derheims, 1825, p. 10; Dalyell, 1853, p. 30, pl. iv, figs. 1—16 (coloured).

Hirudo crenata, Kirby, 1795, p. 320, pl. xxix; Turton, 1806, p. 71; Turton, 1807, p. 129.

Hirudo crinata, Pennant, 1812, p. 72.

Glossosiphonia tuberculata, Johnson, 1816, p. 25.

Glossopora tuberculata, Johnson, 1817, p. 346, pl. xvii, figs. 1—10; Johnson, 1825, p. 49, pl. xvii, figs. 1—10; Stark, 1828, p. 142; Thompson, p. 482.

Erypobdella complanata, de Blainville (in Lamarck), 1818, p. 296; de Blainville, 1827, p. 263; Templeton, 1836, p. 235.

Clepsine complanata, Savigny, 1822, p. 120; Savigny, 1826, p. 463; Moquin-Tandon, 1826, p. 101, pl. iv, fig. 1; Risso, 1826, p. 431; Fr. Müller, 1844 b, p. 25; E. Blanchard, 1845, p. 377, pl. xviii, fig. 9 (nervous system); Leydig, 1849, p. 2; pl. iii, figs. 1—11 (anatomy); Diesing, 1850, p. 452; Grube, 1851, p. 113; Picaglia, 1877, p. 153; Whitman, 1878, p. 2 *et seq.* (development); Schultze, 1883, p. 80, figs. 1—4 (nephridia); Nussbaum, 1885, p. 181 (development of reproductive organs); Oka, 1894, p. 81 *et seq.*, pl. iv, figs. 4—15, pl. v, fig. 16, etc., pl. vi, fig. 39, etc. (sinus system, nephridia); Leuckart, p. 584, fig. 297; R. Blanchard, 1896 c, p. 140 (in North America).

Glossopora complanata, Fleming, 1822, p. 604; Johnston, 1846, p. 440.

Sanguisuga complanata, Bruguière, 1824, p. 132, pl. li, figs. 20, 21 and A.

Glossobdella complanata, de Blainville, 1827, p. 263, pl. xxxvii, figs. 1, 2; de Blainville, 1828, p. 565; Gervais, 1836, p. 629.

Clepsina complanata, de Filippi, 1837, p. 27; Brightwell, 1842, p. 14, pl. i, fig. 20 (coloured, and named in error *C. hyalina*; figs. 18 and 19 represent *C. heteroclita* and not *C. complanata* as named).

Glossipora tuberculata, Thompson, 1841, p. 482, and 1856, p. 245 (occurrence in Ireland).

- Glossiphonia sexoculata*, Moquin-Tandon, 1846, p. 353, pl. xii, figs. 1—6 (coloured), 7—21 (anatomy); Thompson, 1846, p. 390 (recorded from Lough Neagh, Ireland); Johnston, 1865, p. 51; Dutilleul, 1887 a, p. 128 (dorsal organ, etc.); R. Blanchard, 1892 c, p. 178, figs. 1, 2; R. Blanchard, 1893 b, p. 3; R. Blanchard, 1893 d, p. 92 (in Norway); Bolsius, 1894 b, p. 292 *et seq.*; Bolsius, 1895, p. 159, pl. ix (Gregarines in intestine); Bayer, 1898, p. 648 *et seq.* (sense organs).
- Glossiphonia ciminiiformis*, Baird, 1869, p. 317.
- Clepsine elegans*, Verrill, 1872, p. 684.
- Clepsine pallida*, Verrill, 1872, p. 684.
- Clepsine patelliformis*, Nicholson, 1873, p. 494.
- Clepsine sexoculata*, Apáthy, 1888 a, p. 154, etc., pl. viii, fig. 2 (head); Apáthy, 1888 b, p. 791, etc.; Bürger, 1902, p. 525 *et seq.*, pls. xxx—xxxii (development).
- Glossosiphonia complanata*, Blanchard, 1894 b, p. 27, figs. 2, 3; Johansson, 1909, p. 74, figs. 125, 126.
- Glossiphonia complanata*, Scharff, 1898, p. 192.
- Glossiphonia elegans*, Castle, 1900 a, p. 46, pl. vii, pl. ii, fig. 5, pl. iii, fig. 11.

Diagnosis. Body ovate-elliptical, of a firm and cartilaginous consistency, with a somewhat rough surface, more or less transparent, greenish or brownish, very variable in colour and markings.

Dorsal surface with two longitudinal, dark brown, interrupted lines, arising in somite V, in an outer paramedian position and, typically, with six longitudinal rows of yellowish spots, which occur on the first ring of each somite and correspond to the inner paramedian, intermediate and outer paramarginal sense organs and papillae. These spots may be rounded and compact aggregations of pigment cells or more or less spread out into irregular confluent blotches; the intermediate and, less frequently, the paramarginal series may be absent. The series of spots corresponding to the inner paramedian (and largest) papillae are the most constant and occasion the interruptions in the dark brown lines.

Two interrupted brown lines occur on the ventral surface. These are wider apart and less conspicuous than the dorsal pair and rarely traverse the entire length of the body.

68 rings. Somites I—III and XXVI—XXVII uniannulate, IV, XXIV and XXV biannulate, the nineteen somites V—XXIII complete with three rings.

The six eyes are disposed in two close parallel rows (on the inner paramedian lines). The first and smallest pair, which occasionally is absent, occurs in somite II but may be shifted somewhat further back and appear between somites II and III or in the anterior part of somite III. The second and larger pair lies in the posterior part

of somite III and the third pair is situated in the first ring of somite IV.

The second ring of somite IV, often imperfectly divided from the first ring of somite V, forms the posterior boundary of the anterior sucker. The mouth opens in somite II.

Male genital orifice between rings 25 and 26, that is, between the second and third rings of somite XI; female orifice two rings behind the male, between the first and second rings of somite XII. Testes 10 pairs.

Eggs attached to some foreign body and brooded over by the parent.

Anus behind ring 67, separated from the posterior sucker by the sixty-eighth and last ring, which is incomplete.

Length, at rest, 15—20 mm.; width, at rest, 5—9 mm. Length, fully extended, up to 35 mm.

Distribution, Food, Varieties. A sluggish species very readily rolling itself up into a ball (like *Oniscus*) when disturbed; producing eggs during April and May, for a period of not much more than four weeks and rearing only one brood (Whitman, 1878, p. 10).

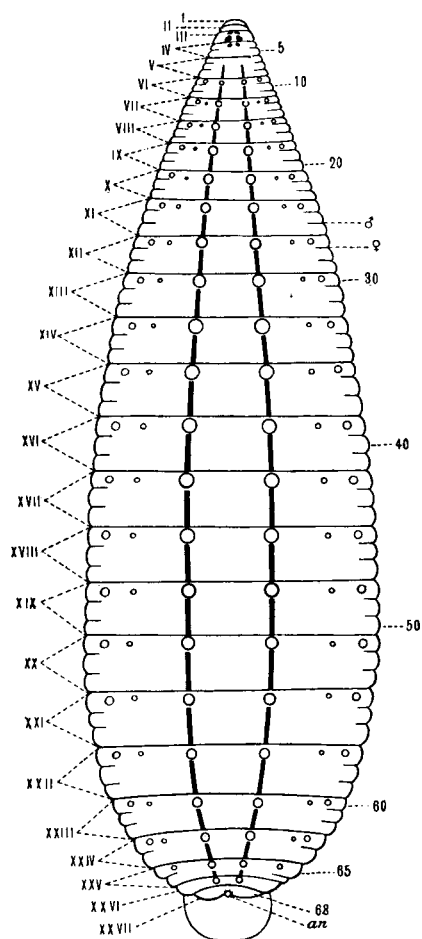
Very common in the British Islands, in running and stagnant water, among aquatic plants and upon or beneath stones. It is parasitic chiefly upon *Limnea* and *Planorbis* but also attacks other fresh-water molluscs, the larvae of *Chironomus* ("bloodworms") and probably aquatic annelids. Houghton (1865, p. 87) described three varieties of this leech and my own observations largely confirm his results. English examples resolve themselves more or less into the three following forms:

A. Body greenish, the six dorsal rows of yellow spots well marked (the typical form).

B. Body brown, the brown pigment being disposed in the form of minute longitudinal and transverse striae; the six dorsal rows of spots more or less dispersed into irregular blotches.

C. Body olive brown or brown, the pigment not striated, the longitudinal dark brown lines less distinct; without spots in regular rows; the anterior pair of eyes sometimes absent.

I have found A and B about equal in frequency; C is of rarer occurrence and approaches the variety *concolor* described by Apáthy from the Danube, and considered by him as a separate species. The matter requires further investigation.



W.A.H. del.

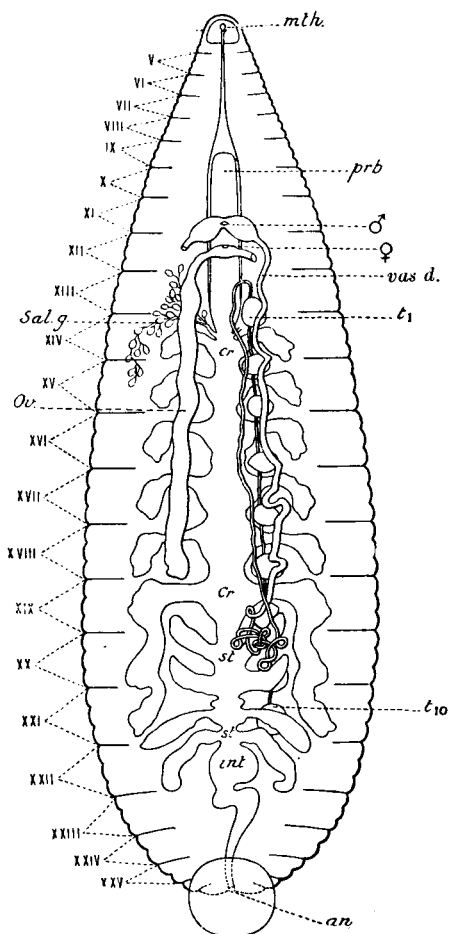
Fig. 9. *Glossosiphonia complanata*.Fig. 10. *Glossosiphonia complanata*.

Fig. 9. *Glossosiphonia complanata*. Diagram showing dorsal pattern and annulation. Somites numbered in Roman numerals and rings in figures.

Fig. 10. The same. Ventral view of alimentary and reproductive systems. *mth.* Mouth. *prb.* Proboscis. *sal. g.* Salivary glands. *cr.* Crop. *st.* Stomach. *int.* Intestine. *an.* Anus. *vas d.* Vas deferens. *t 1, t 10,* testes of the first and tenth pairs. *Ov.* Ovary. (Schematic.)

Genus: *Helobdella*, R. Blanchard, 1896.

Synonymy:

Glossiphonia, Johnson, 1816 (partim). *Clepsine*, Savigny, 1817 (partim).

Small Glossosiphonidae with one pair of eyes. Body generally without papillae. Complete somite composed of three rings. Crop with six pairs of simple lateral caeca, the last and longest pair reflected posteriorly.

This genus has been established by Professor R. Blanchard (1896 a, p. 4) in order to admit *Glossosiphonia stagnalis* (Linnaeus, 1758) and a number of closely allied species which are found for the most part in South America. Johnson's genus *Glossosiphonia* is thus reduced to a more homogenous group containing only six-eyed forms.

***Helobdella stagnalis*, Linnaeus, 1758.**

Plate XIV, Figs. 13—17. Text Fig. 8 (p. 157).

Synonymy and Literature:

Hirudo bioculata, Bergman, 1757, pl. vi, figs. 9—11; O. F. Müller, 1774, p. 41; O. F. Müller, 1776, p. 220; Gmelin, 1788, p. 3096; Ure, 1793, p. 234; Schrank, 1804, p. 161; Braun, 1805, pp. 53—55, pl. vi, figs. 1—5 (coloured); Bosc, 1802, p. 256; Stewart, 1817, p. 357; Carena, 1820, p. 302, pl. xii, fig. 21 (coloured); Bruguière, 1824, p. 132, pl. li, figs. 9—11.

Hirudo stagnalis, Linnaeus, 1758, p. 649; Linnaeus, 1761, No. 2081; Weser, 1765, p. 44; Turton, 1806, p. 69; Turton, 1807, p. 129; Pennant, 1812, p. 71; Dalyell, 1853, p. 36, pl. iv, figs. 1—16 (coloured).

Hirudo pulligera, Daudin, 1800, p. 19, pl. i, figs. 1—3; de Blainville, 1827, p. 266.

Hirudo circulans, Sowerby, 1806, p. 31, pl. lxxvi; Turton, 1807, p. 129; Pennant, 1812, p. 72; Johnson, 1816, p. 27.

Helluo (*Hirudo*) *bioculata*, Oken, 1815, p. 368.

Glossiphonia perata, Johnson, 1816, p. 26.

Glossopora punctata, Johnson, 1825, p. 50, pl. xvii, figs. 11—13.

Erpobdella bioculata, de Blainville (in Lamarck), 1818, v, p. 296; de Blainville, 1827, p. 265.

Clepsine bioculata, Savigny, 1822, p. 119; Carena, 1820; Moquin-Tandon, 1826, p. 102, pl. iv, fig. 2; Leydig, 1849, pl. iii, figs. 9—11; Diesing, 1850, p. 448; Metschnikoff, 1871, p. 505 (development); Whitman, 1878, p. 2 *et seq.* (development); Apáthy, 1888a, p. 154 *et seq.*, pl. viii, figs. 4 and 10 (head region); Apáthy, 1888 b, p. 790 *et seq.* (diagnosis); Leuckart, p. 610, fig. 260 B (proboscis); Oka, 1894, p. 81 *et seq.* (sinus system, nephridia).

Glossopora bioculata, Fleming, 1822, p. 604.

Hirudo stagnorum, Derheims, 1825, pp. 10 and 20.

Clepsine sowerbyi, Moquin-Tandon, 1826, p. 107; Diesing, 1850, p. 451.

Hirudo (*Glossobdella*) *pulligera*, de Blainville, 1827, p. 266, pl. xxxvii, fig. 6.

- Glossobdella bioculata*, de Blainville, 1828, p. 565, pl. xxxvii, figs. 3, 3 a and 3 b ; Gervais, 1836, p. 629, pl. ccxi, fig. 9.
- Erpobdella stagnalis*, Templeton, 1836, p. 235.
- Clepsina stagnalis*, de Filippi, 1837, p. 27 ; de Filippi, 1839, p. 6 ; Brightwell, 1842, p. 14.
- Glossiphonia bioculata*, Moquin-Tandon, 1846, p. 366, pl. xiii, figs. 16—26 ; Thompson, 1846, p. 390, footnote (recorded from Lough Neagh, Ireland) ; Houghton, 1861, p. 33 *et seq.*, pl. iii, figs. 5 and 8 (cervical plate with parasitic *Epistylis*) ; Houghton, 1865, p. 82 *et seq.*, pl. i, figs. 7—9 (coloured) ; Ninni, 1889 ; R. Blanchard, 1893 d (in Norway) ; R. Blanchard, 1893 k, p. 43 (occurrence in Azores).
- Glossiphonia circulans*, Moquin-Tandon, 1846, p. 384.
- Glossipora bioculata*, Thompson, 1856, p. 425 (occurrence in N. Ireland).
- Clepsine filippi*, Polonio, 1863.
- Clepsine modesta*, Verrill, 1872, p. 679.
- Clepsine submodesta*, Nicholson, 1873.
- Clepsine viridissima*, Picaglia, 1877.
- Glossosiphonia stagnalis*, R. Blanchard, 1894 b, p. 25 (diagnosis).
- Helobdella stagnalis*, R. Blanchard, 1896 a, p. 4 (occurrence in S. America) ; Johansson, 1909, p. 76, figs. 131, 132.
- Glossiphonia stagnalis*, Scharff, 1898, p. 191 ; Castle, 1900 a, p. 21, pl. i, figs. 1—3 and pl. ii, fig. 4 ; Evans, 1905, p. 215 (occurrence in Scotland).
- Helobdella bioculata*, Beyer, 1898, p. 648 *et seq.* (sense organs).

Diagnosis. Body elliptic-lanceolate, much flattened, without papillae, more or less transparent, pale gray, often with a greenish, yellowish or brownish tinge, finely speckled with black. 68 rings.

The two eyes are closely approximated (in an inner paramedian position) and lie upon the third ring or between rings 2 and 3.

A rounded, brownish chitinous plate is situated in the dorsal median line, between rings 12 and 13.

The male genital orifice lies between rings 24 and 25 ; the female orifice is situated one ring behind the male, between rings 25 and 26.

Testes, 6 pairs.

Eggs attached to the ventral surface of the parent.

The anus lies behind ring 67 and is separated from the posterior sucker by the sixty-eighth and last ring, which is incomplete.

Length, at rest, 8—12 mm. ; width, at rest, about 4 mm. Length, fully extended, 23—26 mm.

The length of the body in extreme extension may be as much as twelve times the width.

Distribution, Food, etc. A small and active species common, and in some places abundant, in the British Islands, in lakes, ponds, ditches and sluggish streams, chiefly among aquatic plants.

Parasitic largely upon gasteropods, but preys upon a variety of other hosts. The larvae ("bloodworms") of several species of *Chironomus*, which contain haemoglobin, are a favourite source of food and impart a scarlet colour to its crop. The whole contents of the body of the larva are extracted, leaving the transparent integument entire.

Moore (1901) states that it attacks small annelids, injured fish and frogs, and Blanchard (1894 b) records it from the bodies of newts.

Its range extends throughout the greater part of Europe into western Asia. It is found in Canada (Nicholson, 1873, = *Clepsine submodesta*) and in the United States from the Atlantic to the Pacific coast (Verrill, 1872; Blanchard, 1900; Moore, 1901). In South America it has been recorded by Blanchard (1896) from Paraguay and from the western slopes of the Andes.

Dorsal plate. The dorsal chitinous plate which forms a characteristic feature of this species, has been shown by Apáthy (1888 d, p. 202) to be the survival of an embryonic attachment gland, giving off a tuft of tenacious chitinous threads, like a byssus, which hardens in the water and serves, before its suckers are developed, to fix the embryo to the venter of the parent. The somewhat rough and hollow surface of this structure is a favourite place of attachment for colonies of *Epistylis*.

A second example of a dorsal plate has been described by Blanchard (1900, p. 9) in the South American species, *Helobdella scutifera*.

A provisional attachment gland, which leaves scarcely perceptible traces in the adult, occurs, according to Apáthy (*loc. cit.*) in the embryo of *Glossosiphonia heteroclita* and inconspicuous rudiments of similar organs have been described in several other species (Apáthy, *loc. cit.*; Nusbaum, 1885, p. 181; Dutilleul, 1887 a, p. 128).

For the general anatomy of *H. stagnalis* see Castle (1900), p. 21 *et seq.*

Sub-order II. ARHYNCHOBDELLAE.

Fresh-water and terrestrial Hirudinea with red blood, without an exsertile proboscis, generally with jaws. Anterior sucker with a ventral aspect, not distinct from the body. Seventeen pairs of nephridia.

Family I. GNATHOBDELLIDAE.

With five, or rarely with four, pairs of eyes and, except in the Semiscolecinae, with three denticulate jaws. Eggs enclosed in a free spongy cocoon which is deposited above the water line.

This family, which includes the typical ten-eyed blood-sucking leeches, has been divided by Blanchard (1896 a, p. 9) into the following sub-families:—(1) The *Haemadipsinae*, comprising the blood-sucking land-leeches; (2) the *Hirudininae*, discussed below and (3) the *Semiscolecinae*, a small group of amphibious forms without jaws, possessing distinct affinities with the *Herpobdellidae*. With the exception of one species of *Haemadipsinae*, the curious *Xerobdella lecomtei* (von Frauenfeld, 1868), found in the Austrian Alps, the first and third of these sub-families are not represented in Europe.

Sub-family. HIRUDININAE.

With five pairs of eyes and with denticulate jaws. Complete somite formed of five rings. The nephridial pores open near the margins of the body upon the ventral surface.

Blanchard (1896 b) divides this group into two series based upon characters exhibited by the teeth and jaws.

Series 1. Distichodonta.

Jaws without papillae and armed with two rows of infrequent, blunt, irregular teeth.

Genus: Haemopsis, Savigny, 1822.

Synonymy:

Aulastoma, Moquin-Tandon, 1826. *Hirudo* (*Pseudobdella*), de Blainville, 1827. *Hirudo* (*Hippobdella*), de Blainville, 1827. *Pseudobdella*, de Blainville, 1828. *Aulacostomum*, Grube, 1850. *Aulostomum*, Polonio, 1860.

Crop with one pair of elongate, lateral caeca reflected posteriorly. Genital openings usually separated by five rings. Upper lip of anterior sucker not divided inferiorly by a longitudinal groove.

Haemopsis sanguisuga, Linnaeus, 1758.

Plate XV, Figs. 39—41. Text Figs. 11 and 12 (pp. 167 and 170).

Synonymy and Literature:

Rossaglen, Aldrovandus, 1602, p. 722.
Horseleech, Mouffet, 1634, p. 323, woodcut.
Hirudines venenatae, Horse-Leeches, Sibbald, 1683, p. 34.
Hirudo maxime apud nos vulgaris—the Horse-Leech or Bloodsucker, Ray, 1710, p. 3.

Hirudo nigra, *abdomine plumbeo*—the *Horse-Leech*, Hill, 1752, p. 16.

Hirudo sanguisuga, Merret, 1667, p. 207; Bergman, 1757, pl. vi, figs. 3, 4; Linnaeus, 1758, p. 649; Gislér, 1758, p. 95; Linnaeus, 1761, No. 2078; Müller, 1774, p. 38; Müller, 1776, p. 220; Barbut, 1783, p. 20, pl. ii, fig. 6; Gmelin, 1788, p. 3095; Bosc, 1802, p. 246; Turton, 1806, p. 68; Turton, 1807, p. 129; Watson, 1812, p. 13; Pennant, 1812, p. 70; Johnson, 1816, p. 30; Stewart, 1817, p. 356; Cuvier, 1817, p. 532; Carena, 1820, p. 286, pl. xi, figs. 7, 8, 12, 23, 25 and 26; Bruguière, 1824, p. 132, pl. li, figs. 3, 4; Audouin, 1825, p. 8; Derheims, 1825, pp. 9 and 19; Stark, 1828, p. 356; Templeton, 1836, p. 235; Bowerbank, 1845, p. 301, pl. 18 (cocoon); Dalyell, 1853, p. 2, pl. iii, figs. 1—10 (coloured).

Hirudo gulo, Braun, 1805, p. 12, pl. i, figs. 1—7 (coloured).

Hirudo vorax, Johnson, 1816, p. 62; Pelletier et Huzard, 1825, p. 121.

Hirudo sanguisorba, de Blainville (in Lamarck), 1818, p. 291; Fleming, 1822, p. 604; Milne-Edwards (in Lamarck), 1835, p. 521.

Haemopsis nigra, Savigny, 1820, p. 116; Brandt et Ratzeburg, 1829, pl. xxix, B. figs. 12—17 (anatomy).

Haemopsis sanguisorba, Savigny, 1820, p. 115; Brightwell, 1842, p. 12; Quekett, 1843 (not Diesing, 1850).

Haemopsis luctuosa, Savigny, 1822, p. 116.

Haemopsis lacertina, Savigny, 1822, p. 117.

Hirudo carnivora, Brossat, 1822, p. 34 (?).

Aulostoma nigrescens, Moquin-Tandon, 1826, p. 124, pl. vi, fig. 3 (bad); Cuvier, 1836, p. 215; Williams, 1851, p. 238.

Hirudo (*Pseudobdella*) *nigra*, de Blainville, 1827, p. 249.

Hirudo (*Hippobdella*) *sanguisuga*, de Blainville, 1827, p. 254; Gervais, 1836, p. 638, pl. cexi, fig. 4, a and d.

Pseudobdella nigra, de Blainville, 1828, p. 560, pl. xxxv, fig. 1.

Hippobdella sanguisorba, de Blainville, 1828, p. 561, pl. xxxv, fig. 2.

Hirudo (*Pseudobdella*) *vorax*, Gervais, 1836, p. 628, pl. cexi, figs. 6 and 6 a and b.

Haemopsis ornata, de Filippi, 1837, p. 25, fig. 14.

Aulostoma gulo, Moquin-Tandon, 1846, p. 313, pl. v, figs. 1—6 (coloured); Chworostansky, 1886, p. 446 (genital organs); Apáthy, 1888 a; Apáthy, 1888 b; Apáthy, 1889 a, p. 267; Graf, 1894 b.

Haemopsis vorax, de Filippi, 1837, p. 25; Leydig, 1849 b, p. 16, pl. iii, fig. 4 (anatomy); (not Moquin-Tandon, 1826 b, p. 108).

Haemopsis vorax, Johnston, 1846, p. 442; Thompson, 1856, p. 427 (in Ireland).

Haemopsis nigra, Johnston, 1846, p. 442.

Haemopsis sanguisuga, Hardy, 1850, p. 96; Hertwig, 1877, p. 2 *et seq.* (development); R. Blanchard, 1892 c, p. 3, figs. 1, 2; *ibid.*, 1893 a, p. 25; *ibid.*, 1893 b, p. 4; *ibid.*, 1893 d, p. 92 (in Sweden); *ibid.*, 1893 i, p. 3 (in Palestine); *ibid.*, 1894 b, p. 48; Scharff, 1898, p. 193 (in Ireland) (not Moquin-Tandon, 1846, p. 318).

Aulostomum gulo, Diesing, 1850, p. 461; Polonio, 1860; Schneider, 1880, pp. 19 and 256.

Aulacostomum gulo, Grube, 1851, p. 110; Grube, 1871, p. 97, pl. iii, fig. 7 (variety).

Aulostomum italicum, Polonio, 1860.

Aulostoma gulo, Johnston, 1865, p. 46.

Aulostoma nigra, Johnston, 1865, p. 46.

Aulastomum gulo, Rhode, 1891, p. 1 *et seq.* (nervous system); Retzius, 1891, p. 1 *et seq.* (nervous system); Leuckart, 1894, p. 617, fig. 264 (pharynx).

Diagnosis. Body soft and flaccid, flattened, attenuated anteriorly, bluntly rounded posteriorly, the sides more or less parallel from the clitellum to somite XXIII. It is less contractile than *Hirudo medicinalis* and incapable of assuming the form of an olive. *Very young individuals* are grayish, finely speckled above and below with black and bear upon the dorsal surface a geometrical pattern of which the most

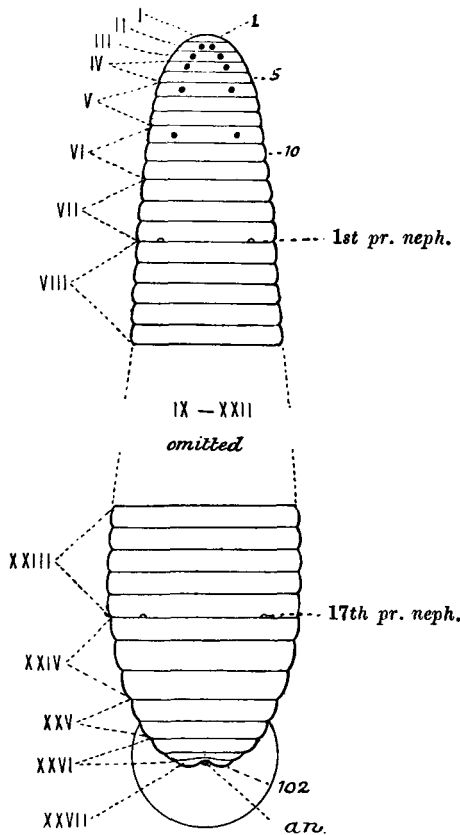


Fig. 11. *Haemopsis sanguisuga*. Diagram of anterior and posterior extremities. Somites numbered in Roman numerals, rings in figures. The 5 pairs of eyes are indicated by black dots. 1st pr. neph., 17th pr. neph., position (on ventral surface) of first and seventeenth pairs of nephridiopores. an. Anus. (Adapted from Whitman.)

conspicuous feature consists of a pale median, longitudinal band, margined with black, alternately wide for the length of three rings and narrow for the length of two rings. The constricted portions of this band correspond to rings 3 and 4 of each somite and the dilated portions traverse rings 5, 1 and 2 of contiguous somites. *Adults* are blackish green, olive green, yellowish green or brownish, paler and often bright green ventrally, and more or less densely flecked with black above and below. The geometrical pattern seen in young individuals is almost or entirely obliterated. The pale, median dorsal band sometimes may be traced in favourable examples of light colouration; its black margins frequently persist in the form of two somewhat broken and irregular black stripes.

102 rings. Rings 6 and 7 are united ventrally to form the posterior margin of the anterior sucker. Rings 8 and 9 are also fused on the ventral side. The last ring (102), which is pierced by the large anus, may show signs of sub-division: Whitman (1886, pp. 371—372) assigns to it the value of two rings.

Somites I, II, III and XXVII, uniannulate; IV, XXV and XXVI biannulate; V, VI, VII and XXIV triannulate; the sixteen somites VIII—XXIII are complete with five rings.

The five pairs of eyes lie respectively in rings 2, 3, 4, 6 and 9. [*Note.* The disposition of the eyes and the external metamerism, except in the case of somite XXVII, are the same as in *Hirudo medicinalis*. In the latter leech somite XXVII is biannulate and consequently its body possesses one ring more than *Haemopsis sanguisuga*.]

Oesophagus with twelve longitudinal plications, the three largest ending anteriorly in jaws.

Each jaw is armed with 11—18 pairs of irregular, blunt teeth (R. Blanchard).

The male genital orifice is situated between rings 31 and 32, that is between the second and third ring of somite XI, or upon ring 32; the female orifice lies between rings 36 and 37, that is between the second and third rings of somite XII, or upon ring 37. One or both of these orifices may thus be shifted forwards by the space of half a ring; normally they are separated by the space of five rings.

Size. The following dimensions apply to average, medium-sized individuals:

In contraction, 25—35 mm. long and 10—12 mm. wide. Fully extended 90—100 mm. long and 5—6 mm. wide. Individuals occur,

however, which can extend to a length of nearly six inches. The largest example I have met with measured :—contracted, at rest, 40 mm. long and 15 mm. wide. Fully extended, 147 mm. long and 7 mm. wide.

Distribution, Food, etc. This well-known leech occurs throughout the greater part of Europe and its range extends, according to Blanchard (1893 a, p. 25; 1893 i, p. 3) into Transcaucasia and Syria.

In England, Scotland and Ireland it is common, chiefly in the mud at the bottom of sluggish streams and ponds. It leaves the water voluntarily in order to deposit its cocoons and probably also in pursuit of its prey.

Haemopsis sanguisuga is carnivorous, devouring piecemeal earth-worms and, according to several authorities, molluscs, aquatic larvae, tadpoles, and small or wounded fish and frogs. It attacks *Herpobdella*, *Trocheta* and, under the influence of hunger, even members of its own species; Ébrard counted it among the enemies of *Hirudo medicinalis*. Probably as Dalyell states, "few animal substances are rejected" by this voracious species.

The blunt teeth of this leech cannot pierce the human skin. Its character as a blood-sucker appears to be due to confusion with *Hirudo medicinalis* and *Limnatis nilotica*, and to the same cause must be attributed its alleged habit of lurking in drinking places and crawling into the mouths and nasal apertures of horses and cattle. Early writers frequently refer to the "horse-leech or bloodsucker" when the medicinal leech is intended (e.g. Burton: *Anatomy of Melancholy*, Pt. 2, S. 5, Mem. 3, s. 1).

The term "horse-leech" or "cattle-leech" has been applied to more than one species of *Limnatis*, in which the above habit is strongly developed. *Limnatis nilotica*, the only other "horse-leech" found in Europe, occurs in Italy and Spain and is frequent in North Africa and parts of Western Asia. This dangerous parasite is sometimes inadvertently swallowed by human beings and by cattle¹.

Varieties. A number of colour-varieties of this species have been described, the most important of which, such as *H. ornata*, de Filippi (1837), are dependent on the amount of persistence shown by the primitive dorsal geometrical pattern seen in young individuals.

¹ A description of accidents of this nature, together with a note on this leech, have already appeared in the pages of this Journal. [Masterman, *Parasitology*, I. p. 186; Harding, *ibid.* p. 282.]

The blackish green pigment generally prevalent on the dorsal surface of adults is more soluble in alcohol than the black markings which it frequently obscures. In specimens which have been submitted to prolonged immersion in alcohol it becomes entirely dissolved and the primitive pattern again is rendered more or less evident. Blanchard (1892 e, p. 3, fig. 1) gives a figure of an adult specimen of this kind in the Dresden Museum, in which the pattern is almost perfectly preserved.

Confusion of species. Moquin-Tandon confused the species now under consideration with *Limnatis nilotica*, Savigny, 1822. In the two editions (1826 and 1846) of his classical monograph we have a far from adequate description of *Limnatis nilotica* and also what is, in its essential characters, nothing more than a second description of the same species,

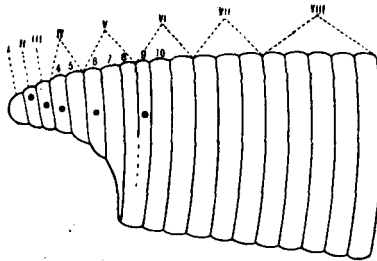


Fig. 12. Side view of head region in *Hirudo medicinalis* and *Haemopsis sanguisuga*. Somites numbered in Roman figures, Rings in *italics*. The eyes are indicated by black dots.

under the names *Haemopsis vorax*, 1826, and *Haemopsis sanguisuga*, 1846. When therefore this writer turns to the true *Haemopsis sanguisuga* it becomes necessary to provide for it a new name, and accordingly he establishes for its reception a new genus *Aulastoma* (1826) and, in the second and best known edition of his work (1846), we find it described as *Aulastoma gulo*.

Thus arose the erroneous idea that *Aulastoma gulo* and *Haemopsis sanguisuga* were two distinct species.

Whitman (1886) and Apáthy (1888 a) rejected *Haemopsis sanguisuga* as described by Moquin-Tandon, but it remained for Blanchard (1894 b, p. 43) to give a complete solution of the difficulty.

Series 2. **Monostichodonta.**

Jaws with or without papillae and armed with a single row of numerous sharp teeth.

Genus: **Hirudo**, *Linnaeus*, 1758.

Synonymy :

Sanguisuga, Savigny, 1822. *Iatrobdeella*, de Blainville, 1827.

Jaws devoid of papillae and armed with less than 100 sharp teeth. Crop with ten pairs of lateral caeca of which the last and longest pair is reflected posteriorly. Genital openings separated by five rings. Upper lip of anterior sucker not divided inferiorly by a longitudinal groove.

Hirudo medicinalis, *Linnaeus*, 1758.

Plate XV, Figs. 36—38. Text Figs. 12 and 13 (pp. 170 and 174).

Synonymy and Literature :

Hirudo major et varia, Gesner, 1558, p. 503.

La Sangsue, Rondelet, 1558, p. 169.

Hirudo varia, Aldrovandus, 1602, p. 763.

Hirudo minor variegata, Muralto, 1685, p. 579.

Bloetsuyger, Swammerdam, 1737, p. 62.

Hirudo depressa, nigra ; *abdomine subcinereo*, *Linnaeus*, 1746, p. 365.

Hirudo nigrescens, flavo-variegata—*the Common Leech*, Hill, 1752, p. 16, pl. ii.

Hirudo medicinalis, Ray, 1710, p. 3 ; Dillenius, 1719, Cent. 7, pl. v, figs. 1—4 ; Bergman, 1757, p. 308, pl. vi, figs. 1, 2 ; *Linnaeus*, 1758, p. 649 ; Gisler, 1758, p. 95 ; Salomon, 1760, p. 35 ; *Linnaeus*, 1761, No. 2079 ; Weser, 1765, p. 41 ; Pennant, 1766, p. 36 ; *Linnaeus*, 1767, p. 1079 ; Shaw, 1769 ; O. F. Müller, 1774, p. 37, No. 167 ; O. F. Müller, 1776, p. 219, No. 2658 ; Barbut, 1783, p. 19, pl. ii, fig. 5 ; Gmelin, 1788, p. 3095 ; Cuvier, 1798, p. 632 ; Bosc, 1802, p. 245, pl. viii, fig. 6 ; Draparnaud, 1803, p. 31 ; Turton, 1806, p. 68 ; Turton, 1807, p. 129 ; Pennant, 1812, p. 69 ; Oken, 1815, p. 368 ; Cuvier, 1817, p. 532 ; Stewart, 1817, p. 356 ; de Blainville, in Lamarck, 1818, p. 291 ; Bojanus, 1819, p. 468, pl. f, figs. 1—5 ; Carena, 1820, p. 279, pl. xi, figs. 1, 2 ; Delle Chiaje, 1823, p. 47 ; Bruguière, 1824, p. 131, pl. li, figs. 1, 2 ; Fleming, 1822, p. 604 ; Leach, 1824, p. 451, pl. xxvi ; Payraudeau, 1826, p. 17 ; Fischer, 1827 ; L. G. Müller, 1830 ; Milne-Edwards, in Lamarck, 1835, p. 520 ; Moquin-Tandon, 1846, p. 327, pls. vii—xi ; Johnston, 1846, p. 442 ; Diesing, 1850, p. 465 ; Grube, 1851, p. 109 ; Dalyell, 1853, p. 26, pl. iii, fig. 11 (coloured) ; Ranke, 1875, p. 152, figs. 1—12 (eyes) ; Hermann, 1875 (nervous system) ; Ollson, 1875, p. 3 ; Bourne, 1880, p. 283, pls. xxiv and xxv (nephridia) ; Lankester, 1880 a, p. 85 ; Lankester, 1880 b, p. 305 (intra-epithelial capillaries) ; Lankester, 1880 c, p. 307 (connective tissue) ; Schneider, 1880, pp. 19

- and 256 (embryology); Carlet, 1883 a, p. 448 and 1883 b (fixation of suckers); Schultze, 1883, p. 87, figs. 15, 16 (nephridia); Bourne, 1884 (nephridia, etc.); Whitman, 1884, p. 76 (external morphology); Haycraft, 1884, p. 478 (secretion of an anticoagulin); Bertelli, 1887, p. 284 (salivary glands); Apáthy, 1888 a; Apáthy, 1888 b; Apáthy, 1889 a, p. 267; Griffiths, 1889, p. 346 (nephridia); Biedermann, 1891, p. 434 (nerve fibres); Retzius, 1891 (nervous system); Henking, 1892, p. 319, pl. xxxiii (digestive tract); R. Blanchard, 1893 k, p. 44 (in Syria); R. Blanchard, 1894 b (in Italy, descr.); Croockewit, 1894, p. 427 (jaws); Bürger, 1894, p. 440 (embryology); Graf, 1894 a, p. 485 (nephridia); Bertelli, 1896, p. 147, pl. ii (pharyngeal glands); Apáthy, 1897, p. 37, pls. iv—vi (glands); Scharff, 1898, p. 193 (in Ireland); Goodrich, 1899, p. 477, pls. xlii—xliv (communication between vascular system and coelom); Schuberg, 1899 (reproductive organs); Havet, 1899, p. 73 *et seq.* (nervous system); Allen, 1902, p. 161 (topography of internal organs); Spiess, 1902, p. 548 (digestive tract); Livanow, 1903 (neuro- and myosomite); Spiess, 1903, p. 151 (digestive tract); Fage, 1904, p. 1450 (nephridia); Spiess, 1905 a, pp. 415 and 577, and 1905 b, pp. 333 and 506 (biliary pigments).
- Hirudo venesector*, Braun, 1805, p. 24, pl. xi, figs. 1—9 (coloured).
- Medicinal Leech*, Kurzmann, 1819, p. 312.
- Sanguisuga medicinalis*, Savigny, 1822, p. 114; Savigny, 1826, p. 456; Risso, 1826, p. 428; Moquin-Tandon, 1826, p. 114, pl. v, fig. 2; Fischer, 1827, p. 440, figs. 1—4; Brandt et Ratzeburg, 1829, p. 238, pl. xxviii, figs. 3—17 and A—M (coloured, except figs. 10—17), pl. xxix A, figs. 1—58 (anatomy), pl. xxix B, figs. 1—11 (anatomy), and pl. xxx, figs. 5—25 (embryology, etc.); de Filippi, 1837, p. 26; Wedeke, 1842, p. 183; Wedeke, 1843, p. 296; Brightwell, 1842, p. 13.
- Sanguisuga officinalis*, Savigny, 1822, p. 330; Savigny, 1826, p. 457; Moquin-Tandon, 1826, p. 112, pl. v, fig. 1; Fischer, 1827, p. 441, figs. 5—10; Audouin, 1829, p. 109; Brandt et Ratzeburg, 1829, p. 237, pl. xxx, figs. 1 and A, B, C (coloured).
- Hirudo provincialis*, Carena, 1820, p. 282, pl. xi, figs. 4, 5; Brandt et Ratzeburg, 1829, p. 237 (syn. *S. officinalis*), pl. xxx, fig. 1* and M (coloured).
- Hirudo verbana*, Carena, 1820, p. 285, pl. ix, fig. 6.
- Hirudo officinalis*, Derheims, 1825, pp. 9 and 11.
- Sanguisuga verbana*, Moquin-Tandon, 1826, p. 117, pl. vi, fig. 1; Audouin, 1829, p. 109; Brandt et Ratzeburg, 1829, p. 235, pl. xxx, fig. 2 (coloured); de Filippi, 1837.
- Sanguisuga carena*, Risso, 1826, p. 429.
- Sanguisuga obscura*, Moquin-Tandon, 1826.
- Iatrobella (Hirudo) medicinalis*, de Blainville, 1827, p. 254.
- Iatrobella medicinalis*, de Blainville, 1828, p. 561, pl. xxxv, figs. 4 and 4 a—4 d, also pl. xxxvi, figs. 1—3 (varieties); Egidy, 1844, p. 113, figs. 62, 63.
- Sanguisuga chlorogaster*, Brandt et Ratzeburg, 1829, p. 238, pl. xxviii, figs. 1, 2.

Diagnosis. Body elongate, flattened, widest at about the sixteenth somite, tapering anteriorly and posteriorly, capable of contracting into the form of an olive (Moquin-Tandon).

Dorsal surface usually olive green, richly variegated with reddish brown, yellowish green, orange and black, and exhibiting an extremely

variable pattern based generally upon three pairs of reddish brown or yellowish, more or less distinct, longitudinal stripes often interrupted by black ocelli or spots occurring on the last ring of each somite.

Ventral surface usually yellowish green, more or less spotted with black, with a pair of black marginal stripes.

103 rings. Rings 6 and 7 are fused ventrally to form the posterior margin of the anterior sucker. Rings 8 and 9 are also united on the ventral side. Somites I, II, III and XXVII uniannulate; IV, XXV and XXVI biannulate, V, VI, VII and XXIV triannulate; the 16 somites VIII—XXIII are complete with five rings.

The male genital orifice lies between rings 31 and 32, that is, between the second and third rings of somite XI; the female orifice is five rings behind the male, between the second and third rings of somite XII.

The anus opens in ring 102 or between this and the preceding ring.

Length, in extreme extension, 100—125 mm.; in extreme contraction, 30—35 mm. Width, in extreme extension, 8—10 mm.; in extreme contraction, 15—18 mm.

Distribution. *Hirudo medicinalis* occurs in sluggish and stagnant waters in Europe and the adjacent parts of Asia. In Europe, where it was formerly abundant, it is now chiefly confined to the South and East. In Germany it is still found in the Island of Borkum, near Marksuhl, in Thuringia and perhaps also near Mieselstein, in Allgau (Johansson, 1909, p. 78).

It was at one time a common British species but was becoming less frequent as early as 1816. "Formerly," says Johnson (1816, p. 41), "this species was very abundant in our island; but from their present scarcity, owing to their being more in request among medical men, and to the rapid improvements which have of late years taken place in agriculture, particularly in the draining and cultivation of waste-lands, we are obliged to receive a supply from the Continent." In 1842, according to Brightwell (p. 13), it was found occasionally in the neighbourhood of Norwich, but was by no means common, and Johnston (1865, p. 49) states that the only British examples he had seen were the two in the British Museum Collection which he refers in his *Catalogue* to the variety *chlorogastra*.

In Scotland Dalyell (1853, p. 29) notes that medicinal leeches "of late years...had become scarce at the places previously affording them," and Thompson (1856, p. 427) states that, although becoming scarce, they

were still found in Ireland in 1849. There seems to be no doubt that this species is now extinct in the British Islands.

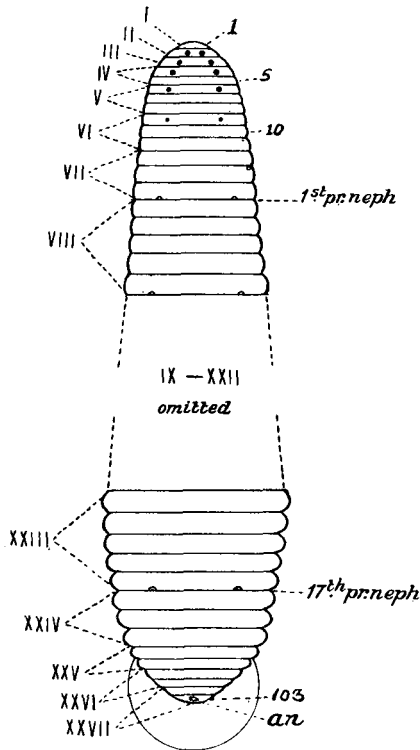


Fig. 13. *Hirudo medicinalis*. Diagram of anterior and posterior extremities. Somites are numbered in Roman numerals and rings in figures. The 5 pairs of eyes are indicated by black dots. 1st pr. neph., 17th pr. neph., position (on ventral surface) of first and seventeenth pairs of nephridiopores. an. Anus. (Adapted from Whitman.)

Leeches in Commerce. Although *Hirudo medicinalis* was known to the ancients it was not in great demand for use in phlebotomy until the beginning of the nineteenth century. The traffic in medicinal leeches soon assumed enormous proportions and reached its zenith in France in 1832, in which year, Ébrard tells us, nearly $57\frac{1}{2}$ millions of these annelids were imported into that country. As the natural sources of supply failed, the artificial cultivation of leeches in special ponds became a profitable industry. For further information on the subject

of Hirudiniculture the curious reader is referred to the comprehensive monograph of Ébrard (1857).

Leech farming was never practised in this country, although according to Johnson (1816) and Dalyell (1853) "leech-gathering" appears to have been a not uncommon and somewhat remunerative calling in the earlier part of the last century. In Ireland Thompson (1856, p. 427) states that, in 1849, the medicinal leech (for which the Irish name was *dallo*) was still found in pools in the neighbourhood of Lough Mask and that "in summer the leech-gatherers sat with their legs in the water on which the creatures fasten and are thus obtained."

The indigenous supply was supplemented by large importations of leeches from abroad. In 1816 we employed "at least one hundred foreign leeches for every British leech" (Johnson). Brightwell, in 1842, refers to a dealer in Norwich who kept a stock of about 50,000 leeches in two large tanks. At this time leeches were imported in large sacks, sometimes but not always packed in damp grass, and the resulting mortality among them was very great.

Not infrequently consignments of the medicinal leech were adulterated with quantities of the innocuous horse-leech.

Hirudo medicinalis is not the only leech which has been used in phlebotomy. *Hirudo troctina* (Johnson, 1816), occurring in North Africa and in Southern Europe, where it is perhaps an introduced species, was largely imported at one time for medical uses.

The characteristic ocelli on the dorsal surface of the latter species earned for it in England the name of "trout leech" whilst the fact that large numbers were imported from Algiers, together with the supposed resemblance of its dorsal pattern to the uniform of a French dragoon, led to the name of "*le dragon d'Alger*" by which it was known to the foreign trade.

Several other species have been used for blood-letting in different countries. *Limnatis* (*Poecilobdella*) *granulosa* in India, *Haementaria officinalis* in Mexico, *Hirudo nipponia* in Japan (Whitman) and *Macrobodella decora* in the United States (Verrill) are or have been used in phlebotomy.

Varieties. A large number of colour-varieties of *Hirudo medicinalis* have been described. For descriptions and coloured illustrations of these the reader is referred to the works of Brandt and Ratzeburg (1829), Moquin-Tandon (1846) and particularly to the monograph of Ébrard (1857).

Family II. **HERPOBDELLIDAE.****Synonym :***Nephelidae.*

Non-parasitic, carnivorous Arhynchobdellae without denticulate jaws. Eyes, when present, generally eight in number, disposed transversely in two groups which are separated by one or more rings. Complete somite composed of 5—11 often unequal rings. The nephridial pores open near the margins of the body on the ventral surface. Eggs deposited in flattened elliptical capsules which are attached to some foreign body.

This family is represented in the British Islands by two genera, *Herpobdella* and *Trocheta*.

In the first genus the rings composing a complete somite are all of equal size. This is not the case however in the second of these genera where, as we shall see, the complete somite, in its primitive form, consists of a number of equal rings together with one ring, the fourth, which is only half the size of the others. This odd ring or *intercalated ring* is found in the complete somite of several genera of *Herpobdellidae* and according to its absence or presence Blanchard (1897, pp. 101—103) has divided this family into two series:—(1) The *Haplodesminae*, in which the complete somite is composed of a simple (ἀπλοῦς) chain (δεσμός) of equal rings, and (2) the *Epactodesminae*, in which the somite is complicated by the presence of an intercalated (ἐπακτος) ring. The intercalated ring is not always the smallest in the series; in *Dina* (R. Blanchard, 1892), a genus closely allied to *Herpobdella*, and represented in Europe, it is the largest ring in the somite and divided transversely.

Series 1. **Haplodesminae.**

Complete somite without an intercalated ring.

Genus : Herpobdella, de Blainville, 1818.

Synonymy :

Helluo, Oken, 1815 (not *Helluo*, Bonelli, 1813). *Erpobdella*, de Blainville, 1818. *Nephelis*, Savigny, 1822. *Hirudo* (*Erpobdella*), de Blainville, 1827. *Herpobdella*, R. Blanchard, 1894.

With four or three pairs of eyes, the first pair of which always occurs in somite II. Complete somite formed of five equal, undivided rings. The

clitellum, well marked during the breeding season, extends from the second ring of somite X to the second ring of somite XIII, inclusive.

The two species, *H. octoculata* and *H. atomaria*, which represent this genus in the British Islands have constantly been confused. The latter species generally has been considered to be merely a variety of *H. octoculata* and has shared in its synonymy. The synonymy of *H. atomaria* has been here given as far as it could be ascertained, but a number of references which may apply indiscriminately to either species will be found under *H. octoculata*.

***Herpobdella octoculata*, Linnaeus, 1758.**

Plate XV, Figs. 42—44. Text Fig. 14 (p. 179).

Synonymy and Literature:

- Hirudo tenuior et a cauda muris non multum diversa*, Aldrovandus, 1602, p. 722.
- Hirudo octoculata*, Bergman (partim), 1756, p. 199; Bergman (partim), 1757, pl. vi, figs. 5—8; Linnaeus (partim), 1758, p. 649; Linnaeus (partim), 1761, No. 2080; Weser, 1765, p. 44; Linnaeus (partim), 1767, p. 1079; Turton, 1806, p. 69; Turton, 1807, p. 129; Blumenbach, 1807, p. 432; Pennant, 1812, p. 71; Blumenbach, 1825, p. 244; Derheims, 1825, p. 10.
- Hirudo vulgaris*, O. F. Müller (partim), 1774, p. 40; O. F. Müller (partim), 1776, p. 220; Gmelin, 1788, p. 3096; Bruguière, 1791, pl. li, figs. 5—8; Bosc, 1802, p. 256; Schrank, 1803, p. 161; Braun, 1805, p. 39, pl. iii, figs. 4—11 (coloured); Johnson, 1816, p. 33; Johnson, 1817, p. 21, pl. ix; Stewart, 1817, p. 356; Carena, 1820, p. 290; Johnson, 1825, p. 29, pl. ix.
- Nondescript* Leech, Ure, 1793, p. 236.
- Helluo (Hirudo) octoculata*, Oken, 1815, p. 367.
- Erpobdella vulgaris*, de Blainville (partim, in Lamarck), 1818, p. 296; Fleming, 1822, p. 604; (not Delle Chiaje, 1823, p. 49); de Blainville (partim), 1828, p. 564, pl. xxxvi, figs. 4 and 4 a—4 i; Milne-Edwards (in Lamarck), 1835, p. 528; Egidy, 1844, p. 134, fig. 64; Johnston, 1846, p. 439; Thompson, 1856, p. 425 (in Ireland); (not Verany, 1846).
- Nephelis tessellata*, Savigny (partim), 1822, p. 117.
- Nephelis testacea*, Savigny, 1822, p. 117; de Filippi, 1837.
- Nephelis tessulata*, Risso (partim), 1826, p. 431.
- Nephelis vulgaris*, Moquin-Tandon (partim), 1826, p. 125, pl. vi, figs. 4, 5; de Filippi, (partim), 1837, p. 28; Brightwell, 1842, p. 13, pl. i, figs. 9—14 (egg-capsules); Leydig, 1849 b; Diesing (partim), 1850, p. 456; Grube, 1851, p. 110; Robin, 1865, p. 5 *et seq.* (embryology); Hertwig, 1877, p. 2 *et seq.* (embryology); Hoffmann, 1880 (embryology); Schneider, 1880, pp. 19 and 256 (embryology); Jijima, 1882, p. 12 (ovary and egg-strings); Bergh, 1884, p. 284, pls. xviii and xix (development); Filatow, 1898, p. 645 (embryology); Graf, 1899, p. 224

- et seq.* (cytoanatomy, etc.); Brandes, 1899, p. 122 (copulation); Havet, 1899, p. 69 *et seq.* (nervous system); Brumpt, 1900 (cocoon); Sukatschoff, 1900, p. 618; Schuberg, 1904, p. 629 (with parasitic Nematodes).
- Hirudo (Erpobdella) vulgaris*, de Blainville (partim), 1827, p. 259; Gervais, 1836, p. 629, pl. cxi, fig. 7.
- La Nephelis vulgaire*, Dugès, 1828, pp. 312 and 335, pl. ix, fig. 8 (egg-capsule).
- Nephelis octoculata*, Moquin-Tandon (partim), 1846, p. 302, pl. iii, figs. 1—11 (coloured), 12—33 (anatomy); Thompson, 1846, p. 389 (in Ireland); Apáthy, 1888 a, p. 154, etc., pl. viii, fig. 12 (head region); Apáthy, 1888 b; R. Blanchard, 1892 a, p. 171, fig. 5, A and B (diagram of somite); R. Blanchard, 1893 a, p. 31 fig. 13, A and B (diagram of somite incorrectly copied from Blanchard, 1892, fig. 5); R. Blanchard, 1893 b, p. 8, figs. 3—5 (diagrams of annulation, etc.); R. Blanchard, 1893 c, p. 194 (identity with *N. sexoculata*, Schneider, established).
- (Not *Nephelis tessellata* (?), Brightwell, 1842, p. 13, pl. i, figs. 15—17 = *Protoclepsis tessellata*.)
- Hirudo octo-oculata, seu vulgaris*, Dalyell, 1853, p. 14, pl. ii (coloured).
- Nephelis sexoculata*, Schneider, 1883, pl. iv, fig. 4.
- Erpobdella octoculata*, R. Blanchard, 1894 b, p. 52, figs. 15—17 (same as figs. 15—17 in Blanchard, 1893 b); Scharff, 1898, p. 194 (in Ireland); Evans, 1905, p. 215 (in Scotland).

Diagnosis. Body elongate, flattened, attenuated anteriorly, bluntly rounded posteriorly, of a uniform width posterior to the clitellum.

Colour deep brown, yellowish or reddish brown, paler ventrally, sometimes with blackish markings and a median dark stripe on the dorsal surface.

Somites I—IV uniannulate, V triannulate; the 18 somites VI—XXIII complete with five rings. Somites XXV—XXVII biannulate.

[Somite XXIV usually with four rings, occasionally with five owing to the subdivision of the last ring, similarly somite XXV is sometimes triannulate owing to the transverse subdivision of the second ring.] Eight eyes. The first and second pairs lie in a transverse curved line on somite II; not infrequently the second (and outer pair) lie between somites II and III or entirely in somite III. The third and fourth pairs are situated on the first ring of somite V, but may encroach to some extent upon the succeeding ring.

The male genital orifice lies between rings 36 and 37, that is, between the fourth and fifth rings of somite XI; the female orifice is four rings behind the male, between the third and fourth rings of somite XII.

The anus lies between the two rings of somite XXVI.

Length 30—50 mm.; width 2—5 mm.

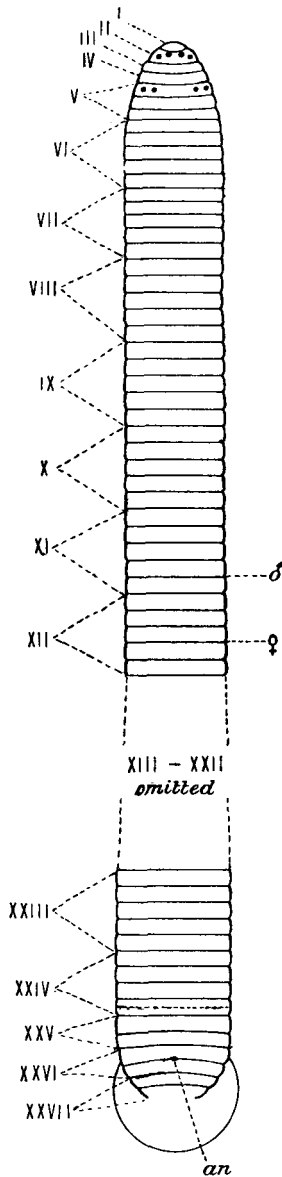


Fig. 14. *Herpobdella octoculata*. Diagram of dorsal surface. Somites numbered in Roman numerals. The eyes are indicated by black dots. *an.* Anus. (Adapted from R. Blanchard.)

Distribution, Food, etc. This species is widely distributed in Europe and very common in the British Islands, in running and stagnant water, upon the muddy bottom, beneath stones and among aquatic plants. It breeds from May to October and its dark brown, transparent egg-capsules are 4—6 mm. long and 2—4 mm. wide and attached at each extremity to the stalks of aquatic plants and other submerged foreign bodies.

This and the succeeding species devour small Oligochaetes such as *Tubifex*, Planarians (Moquin-Tandon) and probably a variety of other soft-bodied aquatic animals. Bristol (1898) fed the *N. American* *H. lateralis*, in confinement, upon "chopped fresh-water clams."

***Herpobdella atomaria*, Carena, 1820.**

Plate XV, Fig. 45. Text Fig. 15.

Synonymy and Literature :

Hirudo atomaria, Carena, 1820, p. 295, pl. xii, fig. 16.

Nephele atomaria, Moquin-Tandon, 1826, p. 128, pl. vi, fig. 6; R. Blanchard, 1892 a, p. 165, figs. 1—4; R. Blanchard, 1893 b, p. 4, figs. 1, 2.

Hirudo (*Erpobdella*) *atomaria*, de Blainville, 1827, p. 261, pl. xxxvi, fig. 5.

N. octoculata, var. *atomaria*, Moquin-Tandon, 1846, p. 304, pl. iii, fig. 7.

N. reticulata, Malm, 1860, pl. iii, fig. 7.

N. scripturata, Schneider, 1885, p. 129 (see R. Blanchard, 1893 d, p. 195).

N. crassipunctata, Schneider (see R. Blanchard, 1893 e, p. 197).

Herpobdella atomaria, R. Blanchard, 1894 b, p. 56, figs. 18—22.

Diagnosis. Body closely resembling *H. octoculata* in form, usually fulvous or greenish brown, paler and unicolorous ventrally.

Dorsal surface, except at the anterior extremity, with a series of reddish or yellowish white spots on every ring and generally with a black reticulated pattern. The first ring of each somite is rendered conspicuous by the accentuation of the yellowish white spots, which are often fused into a transverse band, and by the absence of black pigment.

Somites I—IV uniannulate, V and XXV usually biannulate but sometimes triannulate owing to the subdivision of the second ring, XXVI and XXVII biannulate; the 18 somites VI—XXIII complete with five rings. Somite XXIV usually quadri-, sometimes quinque-annulate owing to subdivision of the last ring.

The male genital orifice is situated between the fourth and fifth ring or upon the fifth ring of somite XI; the female orifice lies between the second and third ring or upon the third ring of somite XII. These

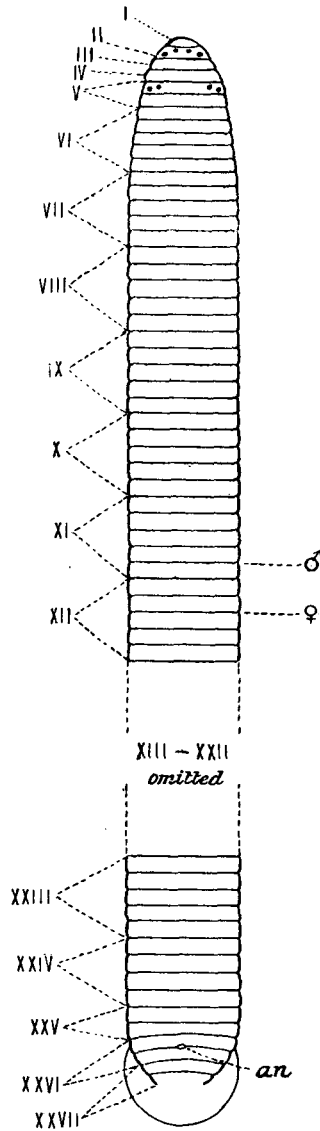


Fig. 15. *Herpobdella atomaria*. Diagram of dorsal surface. Somites numbered in Roman numerals. The eyes are indicated by black dots. *an*. Anus. (Adapted from R. Blanchard.)

orifices are usually separated by three rings; they are never separated by more than three and a half rings or by less than two and a half rings.

Length 50—70 mm.; width 4—6 mm.

Distribution, etc. This species, widely distributed in Europe, is found in the same situations as *H. octoculata* and subsists on the same food. It is probably of frequent occurrence in the British Islands. In the neighbourhood of Cambridge it is nearly as common as *H. octoculata*. The egg-capsules closely resemble those of the latter leech but according to L. Johansson (1909, p. 81, fig. 144) the openings at the ends of the capsule are closed by spherical plugs which project into the interior.

H. atomaria, it will be seen, differs from *H. octoculata* in the position of the genital openings, in its somewhat larger size, and generally in colouration and in small modifications in the external metamerism. Somite V, which is triannulate in the latter species, is usually biannulate in *H. atomaria*; colouration, which is variable in both species, is not always an infallible distinction between them and in doubtful cases we have to rely in the last resort upon the number of rings separating the genital apertures.

Series 2. **Epactodesminae.**

Complete somite with an intercalated ring.

Genus: Trocheta, Dutrochet, 1817.

Synonymy:

Trochetia, de Blainville (in Lamarck), 1818. *Hirudo* (*Trochetia*), de Blainville, 1827.
Geobdella, de Blainville, 1828.

Amphibious Herpobdellidae with four pairs of eyes. Complete somite formed rarely of six rings all equal in size except the fourth (intercalated) ring, which is half the width of the others; and generally of a varying number of rings not exceeding eleven, due to the subdivision frequently of rings 5 and 6 and occasionally also of rings 1, 2 and 3; the normal form consists of three equal large rings followed by five equal half rings.

***Trocheta subviridis*, Dutrochet, 1817.**

Plate XV, Figs. 46 and 47. Text Fig. 16 (p. 185).

Synonymy and Literature:

- Trocheta subviridis*, Dutrochet, 1817, p. 130; Moquin-Tandon, 1846, p. 309, pl. iv, figs. 1—5 (coloured), 6—21 (anatomy); Blanchard, 1892 d (occurrence in Liguria and descr.); Blanchard, 1893 b, No. 4, figs. 1—8 (fig. 6 is defective); Blanchard, 1893 c, p. 31, figs. 1—4 (annulation, etc.); Blanchard, 1894 b, p. 64, figs. 25—30 (diagrams of annulation, etc.), also p. 52, fig. 14 C, D, E (diagram of somite compared with *Herpobdella* and *Dina*); Diesing, 1850, p. 459; Johnston, 1865, p. 45; Gedge, 1869, p. 396.
- Trochetia subviridis*, de Blainville (in Lamarck), 1818, p. 292; Milne-Edwards (in Lamarck), 1838, p. 523; Bosc, 1819, p. 500; Schintz, 1822, p. 826; Cuvier, 1829, p. 215; Gray, 1850, p. 52; Gray, 1851, p. 429; Murie, 1865, p. 659; Lee, 1871, p. 21; Harting, 1877, p. 515 (occurrences in England, with references).
- Nephelis gigas*, Moquin-Tandon, 1826, p. 127, pl. vi, figs. 5 A—D.
- Nephelis trochetia*, Moquin-Tandon, 1826, p. 129.
- Hirudo* (*Geobdella*) *trochetii*, de Blainville, 1827, p. 246; Gervais, 1836, p. 628.
- Erpobdella vulgaris*, var. *gigas*, de Blainville, 1827, p. 564.
- Hirudo* (*Geobdella*) *viridis*, de Blainville, 1827, pp. 244 and 246; de Blainville, 1828, p. 559, pl. xxxiv, figs. 6, 6 a, 6 b.
- Geobdella trochetii*, de Blainville, 1828, p. 559, pl. xxxiv, fig. 3.
- Trocheta cylindrica*, Orley, 1886.
- Nephelis trocheta*, Apáthy, 1888 a, p. 154 *et seq.*, 1888 b.

Diagnosis. Body elongate, vermiform, more or less cylindrical anteriorly, posteriorly flattened, with keeled margins. Colour grayish green or reddish, paler ventrally; generally with two longitudinal, paramedian brown lines upon the dorsal surface.

Somites I—IV and XXVI—XXVII uniannulate, V and XXV biannulate; the 19 somites VI—XXIV complete and composed generally of three large rings followed by five small rings.

Clitellum more or less swollen and conspicuous, beginning with the third large ring of somite X and extending to and including the second large ring of somite XIII.

The male genital orifice is situated between somites XI and XII or upon, or immediately anterior to, the last short ring of somite XI. The female orifice lies immediately behind, immediately before, or upon, the short ring which lies posterior to the intercalated ring of somite XII. The eight eyes are disposed in two groups of four each, as in *Herpobdella*; the anterior group lie in ring 2 and the posterior group in ring 5. Anus large and prominent, between the two rings of somite XXV.

Length, at rest, 80—100 mm.; fully extended, 200—215 mm. Width, 7—15 mm.

Distribution, Food, etc. This species occurs in France, where it was first noticed by Dutrochet (1817, p. 130) near Chateau-Renaud (Indre et Loire); in Italy where Blanchard (1892 b) found it in great abundance in the Ligurian Apennines, and in Algeria (Moquin-Tandon, 1846, p. 310). It has not been recorded from Scotland or Ireland, and in England it has appeared at rare intervals, but on more than one occasion in considerable numbers. Harting (1877, pp. 515—523) has collected all available information relating to its occurrences, real or alleged, in this country up to the year in which he wrote.

The first reliable record of the appearance of Dutrochet's leech in England is given by Gray (1850, p. 52) who refers to a single example taken in Regent's Park, which was sent alive to the London Zoological Society's Gardens and subsequently added to the British Museum Collection and catalogued by Johnston (1865, p. 45).

Lee (1871, p. 21; cited by Harting, *loc. cit.*) found it on the Croydon Sewage-irrigation Farm at Beddington and noted its occurrence, upon hearsay evidence only, (1) on the Sewage Farm belonging to the same town, at Norwood, (2) in Hampshire, and again (3) in abundance, at Lindfield in Sussex.

Harting (*loc. cit.* p. 521) refers to a considerable correspondence relating to this species which appeared in the Natural History columns of *Land and Water*, in 1869, and elicited the fact that Mr Broadwood had noticed for many years previously examples of *T. subviridis* on the lawns and paths of his garden at Lyne, between Dorking and Horsham, in Surrey. I have had the opportunity of examining three specimens from this source, presented to the University Museum of Zoology at Cambridge by Mr M. R. Pryor, from whom I learn that this leech has been recorded again recently from the same locality. Mr Pryor informs me further that he has taken *T. subviridis* in the catch pits of drains in garden paths. He reports it from Elstree in Hertfordshire and the Cambridge Museum possesses an example taken by him at Capel, in Surrey, in 1891. In May, 1909, Dr F. W. Gamble was good enough to send me some examples of *T. subviridis* which had been found at the Withington Sewage Works, near Manchester, where these leeches frequent the sewage effluent channels and devour the earthworms which are washed out of the contact filtration beds. To the courtesy of Mr Hugh Stowell, Chief Inspector of the Mersey and Irwell Rivers Board and Mr C. H. Ball, Manager of the Withington Works, I am indebted for additional material and information. Its occurrence, except in the last instance, at no place very remote from London, its first discovery in Regent's Park and the fact that several leeches described

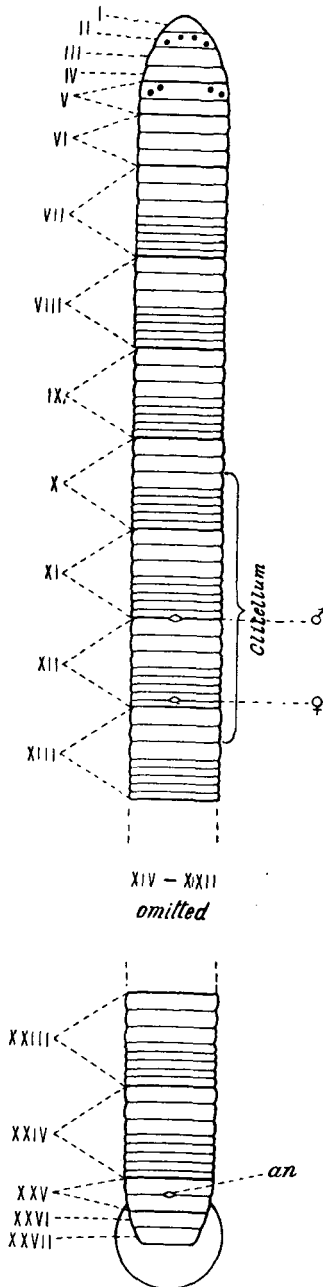


Fig. 16. *Trocheta subviridis*. Diagram of dorsal surface. Somites numbered in Roman numerals. The eyes are indicated by black dots. *an*. Anus. (Adapted from R. Blanchard.)

as *T. subviridis* have been reported from the Zoological Society's Gardens have led to the supposition that this species has been introduced together with some foreign animal, and that the latter locality has been its centre of distribution.

There is little, however, to substantiate this view. The geographical range of *T. subviridis* is, as we have seen, somewhat limited, on the other hand a number of closely allied forms occur in the Oriental Region for which it might be mistaken. To an Oriental species indeed (*Whitmania ferox*) Blanchard (1896, p. 322) has referred the leech described as *T. subviridis* by Murie (1865, p. 659), taken *post mortem* from the viscera of a Moluccan deer in the Zoological Society's possession. The identity again of the land leeches found in 1877 by Professor Garrod in the above Society's Gardens and referred to by Harting (*loc. cit.*) as probable examples of Dutrochet's leech is by no means beyond dispute.

The species in question is in fact rare but indigenous in this country, although the factors which determine its somewhat sporadic occurrences are obscure. It is probably not so uncommon as is generally supposed. Its superficial resemblance to an earthworm may not infrequently have caused it to be overlooked and our ignorance of this species, as in the case of several other English leeches, is undoubtedly largely due to the small amount of attention which British Hirudinea have hitherto received.

Trocheta subviridis is carnivorous, devouring piecemeal various species of earthworms and also (Blanchard, 1894 b, p. 64) the larvae of insects. It is amphibious, frequently leaving the water in order to pursue its prey in moist situations upon land. According to Moquin-Tandon (1845, p. 312) the egg-capsules, which are elliptical, flattened, dark brown and nearly opaque, are attached by their extremities, as in the case of *Herpobdella*, to some foreign body and attain a length of 9—14 mm. and a width of 6—8 mm.

LIST OF BRITISH HIRUDINEA.

Sub-order I. RYNCHOBDELLAE.

Family I. **ICHTHYOBDELLIDAE.**

Genus. Branchellion.

Species. **B. torpedinis.**

Genus. Trachelobdella.

Species. **T. lubrica.**

Genus. Piscicola.

Species. **P. geometra.**

Genus. Pontobdella.

Species. **P. muricata.**

Family II. **GLOSSOSIPHONIDAE.**

Genus. Protolepsis.

Species. **P. tessellata.**

Genus. Hemiclepsis.

Species. **H. marginata.**

Genus. Glossosiphonia.

Species. **G. heteroclita.**

Species. **G. complanata.**

Genus. Helobdella.

Species. **H. stagnalis.**

Sub-order II. **ARHYNCHOBDELLAE.**

Family I. **GNATHOBDELLIDAE.**

Sub-family. **HIRUDININAE.**

Series 1. **Distichodonta.**

Genus. Haemopsis.

Species. **H. sanguisuga.**

Series 2. **Monostichodonta.**

Genus. Hirudo.

Species. **H. medicinalis** (*extinct*).

Family II. **HERPOBDELLIDAE.**

Series 1. **Haplodesminae.**

Genus. Herpobdella.

Species. **H. octoculata.**

Species. **H. atomaria.**

Series 2. **Epactodesminae.**

Genus. Trocheta.

Species. **T. subviridis.**

BIBLIOGRAPHY.

- ALDROVANDUS, U. (1638). De Animalibus Insectis. Fol. Bononiae, 1638.
- ALLEN, B. M. (1902). The topography of organs in typical segments of *Hirudo*. *Biol. Bull. Wood's Holl.* iii. pp. 161—164, 1 fig.
- APÁTHY, S. (1888 a). Analyse der äusseren Körperform der Hirudineen. *Mitth. Zool. Sta. Neapel*, viii. pp. 153—232, pls. viii and ix.
- (1888 b). Süßwasser-Hirudineen. *Zool. Jahrb.* iii. p. 725.
- (1888 c). Systematische Streiflichter. 1. Marine Hirudineen. *Arch. f. Nat.* 1888, liv. 1, p. 43.
- (1889 a). Ueber das Kriechen von *Hirudo* und *Aulastoma*. *Zool. Jahrb.* iv pp. 267, 268.
- (1889 b). Notiz über die Ringelung von *Piscicola*. *Zool. Anz.* No. 323 (1889), p. 649.
- (1897). Die Beschaffenheit und Funktion der Haldrusen von *H. medicinalis*, mit Rücksicht auf die klinische Verwendung ihres Sekretes. *Sitzungsber. Siebenburg. Ver., Medicin. Abth.* xix. pp. 37—77, pls. iv—vi.
- AUDOUIN, V. (1827). Article "Œufs des Annelides" in *Dictionnaire Classique d'Histoire Naturelle, par Messieurs Audouin,...Bourbon,...Brongniart*, etc. xii. p. 127. 16 vols. 8vo. Paris, 1822—30.
- (1829). Article "Sangsue," *loc. cit.* xv. p. 106.
- BAER, K. E. VON (1827). Beiträge zur Kenntniss der niedern Thiere. *Nov. Act. Phys. Med. Acad. C.L.C. Naturae curiosorum*, xiii. pars 2.
- BAIRD, W. (1869). Descriptions of some new Suctorial Annelides in...the British Museum. *Proc. Zool. Soc. London*, 1869, pp. 310—318.
- BAKER, H. (1753). Employment for the Microscope. 8vo. London, 1753.
- BARBUT, J. (1783). The Genera Vermium...Linnaei. 4to. London, 1783.
- BASTER, J. (1760). Opuscula subseciva, I, lib. 2. 4to. Haarlem, 1760.
- BAYER, E. (1898). Hypodermis und neue Hautsinnesorgane der Rhynchobdelliden. *Zeitschr. wiss. Zool.* LXIV. pp. 648—727, pls. xxiii—xxv, 10 text figs.
- VAN BENEDEN, P. J., et HESSE, C. E. (1863). Recherches sur les Bdellodes ou Hirudinées et les Trématodes marins. *Mém. de l'Acad. des Sci. de Belgique*, xxxiv. (1863).
- BERGH, R. S. (1884). Ueber die Metamorphose von *Nephelis*. *Zeitschr. wiss. Zool.* xli. pp. 284—301, pls. xviii and xix.
- BERGMAN, TORBERNO (1757). Afhandling om Iglar. *Kongl. Vetenskaps Acad. Handlingar*, xviii. (1757), pp. 304—314.
- BERTELLI, D. (1887). Glandule salivari nella *Hirudo medicinalis*. *Atti Soc. Toscana... in Pisa (Proc. Verb.)*, v. pp. 284—285.
- (1896). Ricerche [anatomiche sulle glandule perifarinee e sulle glandule labiali della *H. medicinalis*. *Monitore Zool. ital. (Firenze)*, vii. pp. 147—164, pl. ii.
- BIBIENA, F. (1791). De hirudine sermones quinque. *De Bononiensi scientiarum et artium Instituto atque Academia Commentarii*, vii. pp. 55—105. 4to. Bologna.

- BIEDERMANN, W. (1891). Ueber den Ursprung und die Endigungsweise der Nerven in den Ganglien wirbelloser Tiere. *Zeitschr. f. Naturw.* xxv. pp. 429—449 (*Hirudo*).
- BLAINVILLE, H. M. D. DE (1827). Article "Sangsue" in *Dictionnaire des Sciences Naturelles*, XLVII. Text 60 vols. Atlas 12 vols. 8vo. Strasbourg and Paris, 1816—1830.
- (1828). *Ibid.* Article "Vers," LVII.
- BLANCHARD, EMILE (1845). Mémoire sur l'organisation d'un animal appartenant au sous-embranchement des Annelés. *Ann. des Sci. Nat.* (3), iv. pp. 364—379, pl. xviii.
- BLANCHARD, R. (1892 a). Courtes Notices sur les Hirudinées, III. Description de la *Nephelis atomaria*. *Bull. Soc. Zool. de France*, xvii. p. 165, 1892.
- (1892 b). Courtes Notices sur les Hirudinées, iv. Description de la *Glossiphonia marginata*. *Bull. Soc. Zool. de France*, xvii. pp. 173—178, figs. 1, 2.
- (1892 c). Courtes Notices sur les Hirudinées, v. Description de la *Glossiphonia sexoculata*. *Bull. Soc. Zool. de France*, xvii. pp. 178—182, figs. 1, 2.
- (1892 d). Sur la présence de la *Trocheta subviridis* en Ligurie, et description de cette Hirudinée. *Atti della Soc. ligustica di scienze naturali e geografiche*, III. No. 4 (31 pp., 8 figs.). 8vo. 1892.
- (1892 e). Revision des Hirudinées du Musée de Dresde. *Abh. u. Ber. d. K. Zool. u. Anthr.-Ethn. Mus. Dresden*, 1892—93. No. 4.
- (1892 f). Description de la *Glossiphonia tessellata*. *Mém. Soc. Zool. de France*, v. pp. 56—68, 1 fig.
- (1892 g). Présence de la *Glossiphonia tessellata* au Chili. *Actes de la Soc. Scientifique du Chili*, II. pp. 177—187, figs. 1 and 2. 4to. Santiago, 1892.
- (1893 a). Revision des Hirudinées du Musée de Turin. *Boll. Mus. Zool. Univ. di Torino*, VIII. No. 145, 1893.
- (1893 b). Sur quelques Hirudinées du Piémont. *Boll. Mus. Zool. Univ. di Torino*, VIII. No. 146, 1893.
- (1893 c). Courtes notices sur les Hirudinées, ix. Variations de la constitution du somite. *Bull. Soc. Zool. de France*, XVIII. p. 30.
- (1893 d). Courtes notices sur les Hirudinées, x. Hirudinées de l'Europe boréale. *Bull. Soc. Zool. de France*, XVIII. p. 92.
- (1893 e). Courtes notices sur les Hirudinées, xv. Sur la *Nephelis sexoculata*, Schneider. *Bull. Soc. Zool. de France*, XVIII. p. 194.
- (1893 f). Sur la *Nephelis scripturata*, Schneider. *Bull. Soc. Zool. de France*, XVIII. p. 195.
- (1893 g). Sur la *Nephelis crassipunctata*, Schneider. *Bull. Soc. Zool. de France*, XVIII. p. 197.
- (1893 h). Courtes notices sur les Hirudinées, xviii. Encore la *Glossiphonia tessellata*. *Bull. Soc. Zool. de France*, XVIII. p. 197.
- (1893 i). Hirudinées—Viaggio del Dr E. Festa in Palestina. *Boll. Mus. Zool. Univ. di Torino*, VIII. No. 161, p. 3.
- (1893 k). Hirudinées—Voyage du Dr Th. Barrois en Syrie. *Rév. biol. Nord France*, VI. pp. 41—46.
- (1894 a). Courtes notices sur les Hirudinées, xix. Sur les *Branchellion* des mers d'Europe. *Bull. Soc. Zool. de France*, XIX. 1894.

- BLANCHARD, R. (1894 b). Hirudinées de l'Italie continentale et insulaire. *Boll. Mus. Zool. Univ. di Torino*, ix. No. 192, 1894.
- (1896 a). Hirudinées. Viaggio del dott. A. Borelli nella Argentina e nel Paraguay. *Boll. Mus. Zool. Univ. di Torino*, xi. No. 263.
- (1896 b). Hirudineen aus dem Togoland. *Arch. Naturg.* LXXII. pp. 49—53, pl. iii.
- (1896 c). Courtes notices sur les Hirudinées, xxiv. Présence de la *Glossiphonia complanata* en Amérique. *Bull. Soc. Zool. de France*, xxi. p. 140.
- (1897). Hirudinées du Musée de Leyde, in *Notes from the Leyden Museum*, xix. pp. 73—133, pls. iv—vi, text figs. 7—20.
- (1900). *Hirudinea. Hamburger Magalhaensische Sammelreise*, v. pt. 4 (1900).
- BLUMENBACH, J. F. (1779). *Handbuch der Naturgeschichte*. 8vo. Göttingen, 1779—80.
- (1807). *Ibid.* ed. 8.
- (1825). *A Manual of the Elements of Natural History*. Translated from the tenth German edition. 8vo. London, 1825.
- BOJANUS, L. H. (1819). In *Journ. Physique* (Martini) LXXXVIII. p. 468, pl., figs. 1—5.
- BOLSUS, H. (1894 a). Sur les organes ciliés des *Glossiphonides*. *Ann. Soc. Bruxelles*, xviii. pp. 27—32.
- (1894 b). Contributions à l'anatomie des *Glossiphonides*. *Zool. Anz.* xvii. pp. 292—295, fig. 1.
- (1895). Un parasite de la *Glossiphonia sexoculata*. *Mem. Pontif. Accad. Nuovi Lincei*, xi. 1895, pp. 159—164 (Gregarine).
- BOSC, L. A. G. (1802). *Histoire Naturelle des Vers*. i. Paris.
- (1819). Article "Sangue" in *Nouveau Dictionnaire d'Histoire Naturelle, appliquée aux arts*, xxxiv. New ed. 36 vols. 8vo. Paris, 1816—19.
- BOURNE, A. G. (1880). On the structure of the Nephridia of the Medicinal Leech. *Quart. Journ. Micr. Sci.* xx. pp. 283—302, pls. xxiv and xxv.
- (1884). Contributions to the anatomy of the Hirudinea. *Quart. Journ. Micr. Sci.* xxiv. (1884), pp. 419—506, pls. xxiv—xxxiv.
- BOWERBANK, J. S. (1845). On the Structure of the Cocoon of a Leech. *Ann. and Mag. of Nat. Hist.* xv. (1845), pp. 301—305, pl. xviii, figs. 1—10.
- BRANDES, G. (1899). Die Begattung von *Nephelis*. *Zeitschr. f. Naturw.* LXXII. pp. 122—124.
- (1900). Die Begattung von *Clepsine tessulata*. *Zeitschr. f. Naturw.* LXXII. pp. 126—128.
- BRANDT, J. F., et RATZBURG, J. T. C. (1829). *Medizinische Zoologie...*, II. 2 vols. 4to. Berlin, 1829—33.
- BRAUN, J. F. P. (1805). *Systematische Beschreibung einiger Egelarten*. 4to. Berlin, 1805.
- BRIGHTWELL, T. (1842 a). On *Hirudo geometra*, Linn., and some other species of British Freshwater Leeches. *Ann. and Mag. of Nat. Hist.* ix. (1842), pp. 11—15, pl. i.
- (1842 b). The same, trans. into German. *Froriep's Neue Notizen*, No. 464, Bd. xxii. p. 65.

- BRISTOL, C. L. (1899). The metamerism of *Nepheleis*. *Journ. Morphol.* xv. pp. 17—72, pls. iv—viii.
- BROSSAT, A. (1822). Extrait d'une Mémoire sur diverses Sangsues.... *Journ. de Pharmacie*, viii. p. 34.
- BRUGUIÈRE, J. G. (1824). Tableau encyclopédique et méthodique des Trois Règnes de la Nature. Vers...et Polypiers, I. 4to. Paris, 1824.
- BRUMPT, E. (1900). Reproduction des Hirudinées. Formation du cocon chez *Piscicola* et *Herpobdella*. *Bull. Soc. Zool de France*, xxv. pp. 47—51, fig. 1.
- BÜRGER, O. (1894). Neue Beiträge zur Entwicklungsgeschichte der Hirudineen. *Zeitschr. wiss. Zool.* LVIII. p. 440, pls. xxvi—xxviii.
- (1902). Weitere Beiträge zur Entwicklungsgeschichte der Hirudineen. Zur Embryologie von *Clepsine*. *Zeitschr. wiss. Zool.* LXXII. pp. 525—544, pls. xxx—xxxii.
- CARENA, H. (1820). Monographie du genre *Hirudo*, ou description des espèces de Sangsues qui se trouvent ou qui sont en usage en Piémont. *Mem. Real. Accad. Scienz. Torino*, xxv. p. 273, 2 pls. (coloured).
- (1823). *Ibid.* Supplément, xxviii. p. 331.
- CARLET, G. (1888 a). La mode de fixation des ventouses de la sangsue, étudié par la méthode graphique. *C. R. de l'Acad. des Sciences*, xcvi. pp. 448, 449.
- (1888 b). Le procédé opératoire de la sangsue. *Ann. Sci. Nat.* (6), xv. No. 5, 5 pp.
- CASTLE, W. E. (1900 a). Some North American Fresh-water Rhynchobdellidae, and their parasites. *Bull. Mus. Zool. Harvard*, xxxvi. No. 2, pp. 17—61, pls. i—viii and 4 figs.
- (1900 b). The Metamerism of the Hirudinea. *Proc. Amer. Acad. Arts and Sci.* xxxv. No. 15, p. 285.
- CHWOROSTANSKY, C. (1888). Organes génitaux de l'*Hirudo* et de l'*Aulastoma*. *Zool. Anz.* ix. pp. 446—448.
- COLLIN, A. (1892). Kleine Mittheilungen über Würmer. *Sitzungs. Berlinische nat. Freunde*, 1892, p. 164.
- CROCKEWIT, J. M. (1894). Über die Kiefer der Hirudineen. *Zool. Anz.* xvi. pp. 427—429.
- CUVIER, Baron G. L. (1798). Tableau élémentaire de l'Histoire Naturelle des Animaux. 8vo. Paris.
- (1817). Le Règne Animal. II. 4 vols. 8vo. Paris.
- (1836). *Ibid.* ed. 3, II. 3 vols. 8vo. Bruxelles.
- DALYELL, Sir J. G. (1827). Note on breeding of *Hirudo muricata*, in *Edin. New Phil. Journ.* 1827, p. 391.
- (1853). The Powers of the Creator displayed in the Creation. II. 2 vols. 4to. London, 1851—1853.
- DAUDIN, F. M. (1800). Recueil de mémoires sur des espèces...de Mollusques, de Vers et de Zoophytes. 12mo. Paris.
- DELLE CHIAJE, E. (1823). Sulla Sanguisuga medicinale...in Memoria sulla storia e notomia degli animali senza vertebre del Regno di Napoli. I. 4 vols. 4to. Napoli, 1823—1829.
- (1834). Ueber *Albione muricata*...in *Isis, Encycl. Zeitung v. Oken*. 4to. Jena.

- DERHEIMS, J. L. (1825). *Histoire naturelle et médicale des Sangsues*. 8vo. Paris, 1825.
- DIESING, C. M. (1850). *Systema Helminthum*, I. 2 vols. Vindobonae, 1850.
- (1858). Revision der Myzhelminthen. Abtheilung: Bdellideen. *Sitzungsber. Akad. Wien*, XXXIII.
- DILLENUS, J. J. (1719). De Hirudine, in *Ephem. Acad. Nat. Cur.* (Norimburg) cent. VII. pl. v, figs. 1—4 (cited by Moquin-Tandon, 1846).
- DRAPARNAUD, J. P. R. (1803). *Dissertation sur l'utilité de l'histoire naturelle en médecine*. 8vo. Montpellier, 1803.
- DUTILLEUL, G. (1886 a). Recherches anatomiques et histologiques sur la *Pontobdella muricata*. *Compt. rend. Association Française*, 1886, pt. 2, pp. 572—587, pl. xii.
- (1886 b). Sur l'appareil génital de la *Pontobdella muricata*. *Bull. Sci. Nord*, IX. pp. 125—130, 1 pl.
- (1887). Sur quelques points de l'anatomie des Hirudinées rhynchobdelles. *Compt. rend. Acad. Sci. (Paris)*, CV. pp. 128—130. Transl. in *Ann. and Mag. of Nat. Hist.* (5), XX. pp. 150—152.
- DUTROCHET, H. (1817). Note sur une Annélide d'un genre nouveau. *Bull. des Sciences, par la Société Philomatique de Paris*, 1817, p. 130.
- ÉBRARD, E. (1857). *Nouvelle Monographie des Sangsues Médicinales*. 8vo. Paris.
- EGIDY, —. (1844). Die Blutegelzucht nächst ausf. Beschr. d. Blutegel, seiner Arten und Varietäten (cited by Johnston, 1865).
- EVANS, W. (1905). Additions to Scott and Lindsay's list of Animals...in the Upper Elf Loch. *Ann. Scott. Nat. Hist.* LVI. p. 215.
- FAGE, L. (1904). Sur les fonctions sergastoplasmiques des cellules néphridiales de la Sangsue. *C. R. de l'Acad. des Sci.* CXXXVIII. pp. 1450—1452.
- FILATOW, D. (1898). Einige Beobachtungen über die Entwicklungsvorgänge bei *Nephele vulgaris*. *Zool. Anz.* XXI. pp. 645—647, 2 figs.
- FILIPPI, F. DE (1837). *Memoria sugli Anellidi della famiglia delle Sanguisughe*. 4to. Milano, 1837.
- (1839). Lettera al signor Dott. M. Rusconi su l'anatomia e lo sviluppo delle *Clepsine*. *Giornale delle scienze medico-chirurgiche di Pavia*, XI. fasc. 61. 8vo. Pavia, 1839.
- FLEMING, J. (1822). *The Philosophy of Zoology*, II. 2 vols. 8vo. Edinburgh. 1822.
- (1818). In *Memoirs of the Wernerian Nat. Hist. Society*, II. 8vo. Edinburgh.
- FRISCH, J. L. (1729). Beschreibung von allerley Insecten in Teutschland..., VI. 4to. Nicolai, 1721—1738.
- GEDGE, J. (1869). Rediscovery of *Trocheta subviridis* (in England). *Ann. and Mag. of Nat. Hist.* (4), III. p. 396.
- GERVAIS, P. (1836). Article "Hirudinée" in Guérin's *Dictionnaire pittoresque d'Histoire Naturelle*, III. 8vo. Paris, 1833—34.
- (1845). In *Bull. Soc. d'hist. nat. de France*, 1845, p. 572 (cited by Diesing, 1850).
- GESNER, C. (1558). *Medici Tigurini, historiae Animalium*. Lib. IV. (de Piscium... natura). Tiguri, 1551—1558.
- GIBBS, H. (1898). Notes on *Pontobdella muricata*. *Journ. Marine Biol. Assoc.* V. pp. 330—332.

- GISLER, N. (1758). Om Blod-iglars nytta uti medecin. (On the use of leeches in medicine.) *Svenska vetensk. acad. Handlingar*, 1758, p. 96.
- GMELIN, J. F. (1788). *Systema Naturae Linnaei*, ed. 13, cura J. F. Gmelin, i. pt. 6. 3 vols. 8vo. Lipsiae, 1788—1793.
- GRAF, A. (1894 a). The sphincter of the terminal vesicle of *H. medicinalis*. *Journ. Morphol.* ix. pp. 485—487, 10 figs.
- (1894 b). The funnels and vesiculae terminales of *Nephelis*, *Aulastoma* and *Clepsine*. *Trans. New York Ac.* XIII. pp. 239—241 (Preliminary Note).
- (1899). Hirudineenstudien. *N. Acta. Ac. German* (4to. Halle), pp. 215—404, 15 pls. and 26 text figs.
- GRANT, R. E. (1827). On the eggs of *Pontobdella muricata*. *Edinburgh Journ. of Nat. Science* (1827), No. 14, p. 160.
- GRATIOLET, P. (1862). Recherches sur l'organisation du système vasculaire dans la sangsue médicinale et l'aulastome vorace. *Ann. Sci. Nat.* (4), xvii. (Zool.), p. 174.
- GRAY, J. E. (1850). On a Leech new to the British Fauna. *Proc. Zool. Soc. London*, 1850, p. 52.
- (1851). On a Leech new to the British Fauna (*Trocheta*). Reprinted verbatim in *Ann. and Mag. of Nat. Hist.* vii. ser. 2, p. 429.
- GRIFFITHS, A. B. (1889). On the Nephridia of *H. medicinalis*. *Proc. Roy. Soc. Edinburgh*, xiv. pp. 346—348.
- GRUBE, A. E. (1840). Actinien, Echinodermen und Würmer des Adriatischen- und Mittelmeers.... 4to. Königsberg, 1840.
- (1844). Untersuchungen über die Entwicklung der Anneliden, i. 1, p. 45, pls. i—iii (cited by Diesing, 1850).
- (1851). Die Familien der Anneliden. 8vo. Berlin, 1851.
- GRUBE, E. (1871). Beschreibung einiger Egel-Arten. *Archiv f. Naturg.* xxxvii. pp. 87—121, pls. iii and iv.
- GUERNE, J. DE (1892). Sur la dissémination des Hirudinées par les Palmipèdes. *C. R. Soc. biol.* iv. pp. 360—634. Trans. in *Ann. and Mag. of Nat. Hist.* (6), x. pp. 117—120.
- HARDY, J. (1846). In *Trans. Tyneside Naturalists' Field Club*, i. p. 96. Newcastle-on-Tyne.
- HARTING, J. E. (1877). On the occurrence in England of Dutrochet's Land Leech. *Zoologist*, 3rd ser. i. (1877), pp. 515—523.
- HAVET, J. (1899). Structure du système nerveux des Annélides (*Nephelis*, *Clepsine*, *Hirudo*, etc.). *Cellule*, xvii. pp. 65—136, 7 pls.
- HAYCRAFT, J. B. (1884). On the action of a Secretion obtained from the Medicinal Leech on the Coagulation of the Blood. *Proc. Roy. Soc. London*, xxxvi, p. 478—487.
- HENKING, H. (1892). Darstellung des Darmcanals von *Hirudo*. *Festschr. zum 70ten Geburtstage R. Leuckarts*, pp. 319—327, pl. xxxiii.
- HERMANN, E. (1875). Das Centralnervensystem von *H. medicinalis*. 119 pp. 18 pls. Munchen, 1875.
- HERTWIG, O. (1887). Beiträge zur Kenntniss der Bildung, Befruchtung, und Theilung des thierischen Eies. 2er Theil. 1. Die ersten Entwicklungsvorgänge im Ei der Hirudineen. *Morphol. Jahrb.* iii. pp. 2—32 and 53—83, pls. i—iii.
- HILL, J. (1752). General Natural History, iii. (History of Animals). 3 vols. Folio. London, 1748—52.

- HOFFMANN, C. K. (1880). Untersuchungen über den Bau und die Entwicklungsgeschichte der Hirudineen. 4to. Haarlem.
- HOLT, E. L. W. (1907). Rept. Fisheries Ireland (1905). Dublin, 1907, pp. 102, 103.
- HOME, Sir E., Bart. (1814). Lectures on Comparative Anatomy. London, 1814—1828, 6 vols. 4to. (*H. medicinalis*, i. p. 364; ii. pl. lxx; iv. pl. xxxix, fig. 3.)
- HOUGHTON, The Rev. W. (1860). On the Discovery of the Snail-Leech, *Glossiphonia marginata*, in England. *Ann. and Mag. of Nat. Hist.* v. 3 ser. p. 248, No. 27, pl. xvi, C.
- (1861). Remarks on the *Glossiphoniidae*. *Quart. Journ. Micr. Sci.* 1. new ser. (1861), p. 33.
- (1865). "Snail-Leeches," with a Monograph of the British species. *Intellectual Observer*, Sept. 1865, pp. 81—91, 2 pls. (coloured).
- IJIMA, J. (1882). The structure of the ovary and the origin of the eggs and the egg-strings in *Nepheleis*. *Zool. Anz.* v. pp. 12—14.
- JOHANSSON, L. (1896 a). Über den Blutumlauf bei *Piscicola* und *Calliobdella*. *Lilljeborg's Festschr. Upsala*, 1896, pp. 317—330, pl. xvii.
- (1896 b). Bidrag till Kännedomen om Sveriges Ichthyobdelliden. *Akadensk. afh. Upsala*, 1896, 8vo. 122 pp. 10 pls. (Abstract in *Zool. Centrbl.* iv. pp. 619—623, 2 figs.)
- (1898 a). Die Ichthyobdelliden im Zool. Reichsmuseum in Stockholm. *Öfvers. af K. Vet.-Akad. Förh.* LV. pp. 665—687.
- (1898 b). Einige systematisch wichtige Theile der inneren Organisation der Ichthyobdelliden. *Zool. Anz.* XXI. No. 573, p. 581.
- (1909). *Hirudinea*. Die Süßwasserfauna Deutschlands von Prof. Dr Brauer, 13, pp. 67—84, Jena, 1909.
- JOHNSON, J. R. (1816). A Treatise on the Medicinal Leech. 8vo. London, 1816.
- (1817). Observations on *Glossopora*. *Phil. Trans. Roy. Soc.* London. 4to. p. 21, pl. iv.
- (1825). Further observations on the Medicinal Leech. 8vo. London, 1825.
- JOHNSTON, G. (1846). An Index to the British Annelides. *Ann. and Mag. of Nat. Hist.* XVI. 1845, Supplement. (Leeches, pp. 439—442.)
- (1865). A Catalogue of the British Non-parasitical Worms in...the British Museum.
- KIRBY, W. (1794). Description of three new species of *Hirudo*. *Trans. Linn. Soc.* London. 4to. II. p. 320, pl. xxix. (Only one species is a leech, viz. *Hirudo crenata*=*Glossosiphonia complanata*.)
- KURZMANN, —. (1819). In *London Med. and Physic. Journ.* XLI. p. 312 (cited by Johnston, 1865).
- LAMARCK¹, J. B. P. de (1818). Histoire Naturelle des Animaux sans Vertèbres, v. 7 vols. 8vo. Paris, 1815—1822.
- (1838). *Ibid.* 2 éd. Par G. P. Deshayes et H. Milne-Edwards. 11 vols. 8vo. Paris, 1835—1845.

¹ N.B. I have followed Diesing (1850) in attributing the nomenclature in Lamarck's work (1818) to de Blainville. The latter writer (1827, p. 206) states that "M. de Blainville...a proposé les mêmes subdivisions que M. de Lamarck a adoptées de ses manuscrits," but there is no internal evidence of any further contribution.

We are expressly told by de Blainville that he suggested to Lamarck the names *Piscicola* and *Erpobdella* (1828, pp. 558 and 564).

- LANKESTER, Sir E. RAY (1880 a). Observations on the Microscopical Anatomy of the Medicinal Leech. *Zool. Anz.* III. pp. 85—90.
- (1880 b). On Intra-epithelial capillaries in the Integument of the Medicinal Leech. *Quart. Journ. Micr. Sci.* xx. pp. 303—306.
- (1880 c). On the connective and vasifactive tissues of the Medicinal Leech. *Quart. Journ. Micr. Soc.* xx. pp. 307—317, pls. xxvii and xxviii.
- LEACH, W. E. (1815). Zoological Miscellany, II. 8vo. London.
- (1824). Article *Annulosa* in *Encyclopaedia Britannica*. (See Supplement.)
- LEDERMÜLLER, M. F. (1764). Amusements microscopiques, I. 4to. Nuremberg, 1764—1768.
- LÆE, H. (1871). First Report...of the Croydon Microscopical Club, 1871, pp. 22, 23 (cited by Harting, 1877).
- LEO, J. (1835). Ueber einige ausgezeichnete anatomische und physiologische Verhältnisse der *Piscicola geometra*. *Müller's Archiv für Anatomie*, 1835, pp. 419—427, pl. xi.
- LEUCKART, R. (1894). Die Parasiten des Menschen. New and revised ed. Leipzig, 1894.
- LEYDIG, F. (1849 a). Zur Anatomie von *Piscicola geometrica* mit theilweiser Vergleichung anderer einheimischer Hirudineen, in *Zeitschr. wiss. Zool.* 1 Bd. 1849.
- (1849 b). Zum Circulations- und Respirationssystem von *Nephelis* und *Clepsine*, in *Bericht. Zool. Anst. Würzburg*. Leipzig, 1849.
- (1851). Anatomisches über *Branchellion* und *Pontobdella*. *Zeitschr. wiss. Zool.* 3 Bd. 1851, pp. 315—324, pl. ix.
- LINNAEUS, C. (1746). Fauna Suecica, ed. 1.
- (1754). Museum Adolphi Friderici Regis...in quo...animalia...describuntur.
- (1758). Systema Naturae, ed. 10.
- (1761). Fauna Suecica, ed. 2.
- (1767). Systema Naturae, ed. 12.
- LIVANOW, N. (1902). Die Hirudineen-Gattung *Hemiclepsis* Vejd. *Zool. Jahrb.* (Systematik), xvii. (1902), p. 339.
- (1903). Untersuchungen zur Morphologie der Hirudineen. I. Das Neuro- und Myosomit der Hirudineen. *Zool. Jahrb.* (anat.), xix. I. pp. 29—90, pls. ii—vi.
- (1904). Untersuchungen zur Morphologie der Hirudineen. II. Das Nervensystem des vordern Körperendes und seine Metamerie. *Zool. Jahrb.* (anat.), xx. pp. 153—226, pls. ix—xi.
- (1907). Untersuchungen zur Morphologie der Hirudineen. III. Das Nervensystem und die Metamerie des vordern Körperendes von *Herpobdella atomaria*, *Zool. Jahrb.* (anat.), xxiii. pp. 683—699, pl. xxxvii.
- MALM, A. W. (1860). Svenska Iglar. *Kongl. Vetenskaps och Vitterhets Samhälles Handlingar*, viii. 1860.
- M'INTOSH, W. C. (1874). On the Invertebrate Fauna...of St Andrews. *Ann. and Mag. of Nat. Hist.* xiv. (4), p. 192.
- (1875). The Marine Invertebrates and Fishes of St Andrews. 4to. Edinburgh.
- MÉGNIN, P. (1905). Sangsues parasites des Palmipèdes. *Arch. de Parasitologie* (Paris), x. pp. 71—76, ill.
- MERRET, C. (1667). Pinax rerum naturalium Britannicarum,... 12mo. Londini, 1667.

- METSCHNIKOFF, E. (1871). Beiträge zur Entwicklungsgeschichte einiger niederen Thiere. *Bull. Petersb.* xv. pp. 505, 506 (*Clepsine bioculata*).
- MOQUIN-TANDON, A. (1826). Monographie de la famille des Hirudinées. Ed. 1. 4to. Montpellier, 1826.
- (1846). *Ibid.* Nouvelle édition. 1 vol. 8vo. and Atlas. Paris.
- MÜLLER, F. (1844 a). Ueber *Hirudo tessulata* und *marginata*. *Archiv für Naturg.* 8vo. Berlin, 1844.
- (1844 b). De Hirudinibus circa Berolinum hucusque observatis. Inaug. Diss. Berlin, 1844.
- (1846). Ueber Geschlechtstheile von *Clepsine* und *Nephelis*. *Archiv für Anat.* (Müller). 8vo. Berlin, 1846.
- MÜLLER, J. (1828). Ueber den Kreislauf des Blutes bey *Hirudo vulgaris*, in *Meckel's Arch. f. Anat. und Physiol.* 1828, p. 22.
- MÜLLER, L. G. (1830). Der medicinische Blutegel oder naturhistorische Beschreibung des Blutegels (cited by Moquin-Tandon, 1846).
- MÜLLER, O. F. (1774). Vermium Terrestrium et Fluviatilium. I. Pars 2. 4to. Havniae et Lipsiae, 1773—74.
- (1776). Zoologiae Danicae Prodomus. 8vo. Havniae, 1776.
- MURALTO, J. DE (1673). Vademecum anatomicum seu clavis medica. Tiguri, 1673.
- MURIE, J. (1865). On a leech...found in the Viscera of a Moluccan Deer. *Proc. Zool. Soc. London*, 1865, pp. 659—662.
- NICHOLSON, H. A. (1873). Contributions to a Fauna Canadensis; being an Account of Animals dredged in Lake Ontario in 1872. *Canadian Journal*, xiii. p. 490 (Toronto).
- NINNI, A. P. (1889). Notizie di caccia e note zoologiche...Hirudinea raccolte nelle acque dolci del Veneto. *Rivista ital. di scienze nat. e Bollettino natural.* ix, No. 20, p. 251, 1889.
- NUSSBAUM, J. (1885). Zur Entwicklungsgeschichte der Geschlechtsorgane der Hirudineen. *Zool. Anz.* viii, pp. 181—184.
- OKA, A. (1894). Beiträge zur Anatomie der *Clepsine*. *Zeitschr. f. wiss. Zool.* Bd. 58, p. 79.
- OKEN, L. (1815). Lehrbuch der Naturgeschichte. III (Zool.). 2 vols. and Atlas. Jena, 1815—16.
- OLLSON, P. (1875). Bidrag till Skandinavien's Helminthfauna. *Svenska Ak. Handl.* xiv. pp. 1—6.
- ÖRLEY, L. (1886). A magyarországi pióczák faunája (Fauna Hirudinearum Hungariae). *Math. és természett. Közlemények*, xxii. p. 63, 1886.
- PAYRAUDEAU, B. C. (1826). Catalogue descriptif...des Annélides...de l'île de Corse. 8vo. Paris, 1826.
- PELLETIER et HUZARD fils (1825). Recherches sur le genre *Hirudo*. *Journ. de Pharmacie*, xi. p. 105.
- PENNANT, T. (1766). The British Zoology. iv. Folio. London, 1766.
- (1812). *Ibid.* New ed. iv. 4 vols. 8vo. London, 1812.
- PÉREZ, C., et GENDRE, E. (1904 a). Sur les fibres musculaires du *Branchellion*. *C. R. Soc. Biol.* lvii. pp. 113—115.
- (1904 b). Sur l'ovogenèse du *Branchellion*. *C. R. Soc. Biol.* lvii, pp. 605, 606.
- PÉREZ, C. (1906). Différenciations tendineuses épithéliales chez le *Branchellion*.

- C. R. Soc. Biol.* LVI. pp. 447—448; et *Réunion Biologique de Bordeaux*, 1906, pp. 61, 62.
- PICAGLIA, L. (1877). I Discofori raccolti e classificati dal Dott. Luigi Picaglia. *Annuario della Società dei Naturalisti in Modena*, XI, p. 140. 8vo. Modena.
- PLEHN, M. (1898). Über die Vertilgung von Fischegehn (*Piscicola*). *Allgem. Fisch. Zeitg.* XXIII. (1898), pp. 370—372.
- POLONIO, A. F. (1860). Catalogo delle Bdellidee italiane. Pavia, 1860.
- (1861). Monografia del genere *Aulostomum*. *Atti della Società Italiana di Scienze Naturali*, III. p. 39. Milano, 1861.
- (1863). *Bdellideorum italicorum prodromus*. 8vo. Bononiae, 1863.
- QUATREFAGES, A. DE (1852). Études sur les types inférieurs de l'embranchement des Annelés. Mémoire sur le *Branchellion* d'Orbigny. *Ann. des Sci. Nat.* XVII. sér. 3, 1852.
- QUEKETT, J. (1843). On the Minute Anatomy of the Horse-Leech, *Haemopsis sanguis-orba* (Sav.), *Hirudo vorax* (Johnston). *Zoologist*, I. pp. 17—21, 88—94, 324—330.
- RANKE, J. (1875). Beiträge zu der Lehre von den Uebergangs-Sinnesorganen...das Sehorgan der Hirudineen. *Zeitschr. wiss. Zool.* XXV. pp. 152—164, pl. x (abstract in *Nature*, XIII. p. 75).
- RATHKE, H. (1862). Beiträge zur Entwicklungsgeschichte der Hirudineen. Leipzig, 1862.
- RAY, J. (1710). *Historia Insectorum*;... Sm. 4to. Londini, 1710.
- RAY SOCIETY REPORTS (1845). Reports on the progress of Zoology and Botany of 1841—42. Ray Society, 8vo. London, 1845.
- RETZIUS, G. (1891). Zur Kenntniss des centralen Nervensystems der Würmer. Biologische Untersuchungen, Neue Folge, II. Stockholm, 1891, pp. 1—28, pls. i—ix.
- RHODE, É. (1891). Histologische Untersuchungen über das Nervensystem der Hirudineen. *Zool. Beitr.* III. pp. 1—68, Taf. 1—7; also in *S. B. Ak. Berlin*, 1891, pp. 21—32.
- RISSO, A. (1826). *Histoire Naturelle...de l'Europe Méridionale...* IV. 5 vols. 8vo. Paris, 1826.
- ROBERTSON, M. (1909). Further Notes on a Trypanosome found in the Alimentary Tract of *Pontobdella muricata*. *Quart. Journ. Micr. Sci.* LIV. N.S. pt. 1, pp. 119—139, pl. ix (*T. raiaae*).
- ROBIN, C. (1875). Mémoire sur le développement embryogénique des Hirudinées. 4to. Paris.
- RONDELET, G. (1554). *Libri de Piscibus marinis*, etc. lib. de Insect. et Zoophyt. VII. Folio. Lugduni, 1554.
- (1558). La première (et seconde) partie de l'Histoire entière des Poissons, traduite en François. II. 4to. Lion, 1558.
- RÖSEL VON ROSENHOF, A. J. (1747). Der monatlich herausgegebenen Insecten-Belustigung. III. Nürnberg, 1746—1761.
- SAINT AMANS, B. DE (1825). Description d'une espèce nouvelle de Sangsue. *Mém. Soc. Linn. de Paris*. 8vo. III. p. 193, 1 pl.
- SAINT-LOUP, R. (1885 a). Recherches sur l'organisation des Hirudinées. *Ann. Sci. Nat.* (6), XVIII. No. 2, 127 pp. pls. vi—xiii.

- SAINT-LOUP, R. (1885 b). Remarques sur la morphologie des Hirudinées d'eau douce. *Bull. Soc. Philom.* (1), ix. pp. 23—26.
- (1886). Sur une nouvelle Ichthyobdelle. *C. R. Ac. Sci.* cii. pp. 1180—1183.
- SALOMON, E. D. (1760). An maerkningar om iglars bruke (Observations on the use of leeches), in *Svenska Vetenskaps-Acad. Handlingar*, 1760, p. 132, and *ibid.* 1764, p. 57.
- SAVIGNY, J. C. (1822). Système des Annélides,...in Description de l'Égypte...publié par les ordres...de Napoléon le Grand. Folio. Paris. [N.B. The date (1822) assigned to this work is that given in C. D. Sherborn's bibliography in *Proc. Zool. Soc. London*, 1897, p. 285.]
- (1826). *Ibid.* 2 éd. 8vo. Paris.
- SCHARFF, R. F. (1898). The Irish Fresh-water Leeches. *Irish Naturalist*, vii. pp. 188—194.
- SCHINZ, H. R. (1822). Das Thierreich von Cuvier. Aus dem Französischen...von H. R. Schinz. II. 4 vols. 8vo. Stuttgart, Tübingen, 1821—25.
- SCHMARDT, L. K. (1861). Neue wirbellose Thiere beobachtet und gesammelt auf einer Reise um die Erde in den Jahren 1853—57. I. Folio. Leipzig, 1861.
- SCHNEIDER, A. (1880). Über die Auflösung der Eier und Spermatozoen in den Geschlechtsorganen. *Zool. Anz.* iii. pp. 19—21, 256 and 257.
- (1883). Das Ei und seine Befruchtung. 4to. Breslau, 1883.
- SCHRANK, F. VON P. VON (1803). Fauna Boica, III. 2. Ingolstadt, 1803.
- SCHUBERG, A. (1899). Beiträge zur Histologie des männlichen Geschlechtsorgan von *Hirudo* und *Aulastomum*. *Zeitschr. wiss. Zool.* lxxvi. pp. 1—15, pl. i.
- (1904). Über einen in den Muskelzellen von *Nephelis* schmarotzenden Nematoden. *Verhandl. Vereins zu Heidelberg*, vii. pp. 629—632.
- SCHULTZE, O. (1883). Beiträge zur Anatomie des Excretionsapparates der Hirudineen. *Arch. f. mikr. Anat.* xxii. pp. 78—92, pl. i.
- SCOTT, T. (1901). Notes on some parasites of fishes. 19th Annual Rept. Fish Board, Scotland, Part III. pp. 120 (*Hirudinea*, pp. 137—141).
- SELENSKY, W. (1906). Zur Kenntniss des Gefässsystems der *Piscicola*. *Zool. Anz.* xxxi. 1906, pp. 33, 34.
- SERRES, M. DE (1822). Essai sur les animaux du midi de la France, p. 80 (cited by Moquin-Tandon, 1846).
- SIBBALD, R. (1683). Scotia illustrata, sive Prodromus Historiae Naturalis, etc. 3 parts in 1 vol. Folio. Edinburgi, 1683—84.
- SOWERBY, J. (1806). The British Miscellany. II. 8vo. London, 1804—6.
- SPIESS, C. (1902). La structure intime de l'appareil digestif de la Sangsue (*H. medicinalis*). *Arch. Sci. Nat. (Geneva)*, xiv. pp. 548—552.
- (1903). Recherches...sur l'appareil digestif de la Sangsue. *Rev. Suisse Zool. (Geneva)*, xi. pp. 151—239 and 5 figs.
- (1905 a). La question du foie dans la Sangsue médicinale. *Compt. Rend. Soc. Biol.* 1905, pp. 415—417 and p. 577.
- (1905 b). Sur la présence des pigments biliaires dans la Sangsue Médicinale. *Compt. Rend. de l'Acad. des Sci.* cxli. pp. 333 and 506.
- SPOOF, A. R. (1889). Notes about some species of non-parasitical Worms found in Finland. 8vo. Åbo, 1889.

- STARK, J. (1828). Elements of Natural History. II. 2 vols. 8vo. Edinburgh and London, 1828.
- STEWART, C. (1817). Elements of the Natural History of the Animal Kingdom. II. 2 vols. 8vo. Edinburgh, 1817.
- SUKATSCHOFF, B. (1900). Beiträge zur Entwicklungsgeschichte der Hirudineen. 1. Zur Kenntnis der Urnieren von *Nephelis vulgaris* und *Aulastomum gulo*. *Zeitschr. wiss. Zool.* LXVII. pp. 618—639, pls. xxxiv and xxxv.
- SWAMMERDAM, J. (1737). Bybel der Natuure. Ed. H. Boerhaave with Latin trans. by H. D. Gaubius. 2 vols. 4to. Leyden, 1737, 1738 (*Hirudo*, I. pl. lxii).
- TEMPLETON, R. (1836). A Catalogue of the Species of Annulose Animals,...found in Ireland. *Ann. and Mag. of Nat. Hist.* IX.
- THOMPSON, W. (1841). Additions to the Fauna of Ireland. *Ann. and Mag. of Nat. Hist.* VII. (1841). *Annelida*, p. 482.
- (1844). Additions to the Fauna of Ireland. *Annelida*. *Ann. and Mag. of Nat. Hist.* XIII. (Leeches, p. 437).
- (1846). Additions to the Fauna of Ireland. *Annelida*. *Ann. and Mag. of Nat. Hist.* XVIII. (Leeches, pp. 389—391).
- (1856). The Natural History of Ireland, IV. 4 vols. 8vo. London, 1849—56.
- TREMBLEY, A. (1744). Mémoires, pour servir à l'Histoire d'un genre de Polypes d'eau douce, etc. 4to. Leidaë, 1744.
- TURTON, W. (1806). A General System of Nature, translated from Gmelin, etc. IV. 7 vols. 8vo. London, 1806.
- (1807). British Fauna. 12mo. Swansea, 1807.
- URE, The Rev. D. (1793). The History of Rutherglen and East Kilbride. 8vo. Glasgow, 1793.
- VAILLANT, L. (1870). Contributions à l'étude anatomique du Genre *Pontobdella*. *Ann. Sci. Nat.* XIII. (1870).
- VEJDOVSKY, F. (1883). Excreci Soustawa Hirudinei. *Sitzb. des Königl. Böhm. Gesel. des Wissensch. Prag*, pp. 35—51, 1 pl.
- VERRILL, A. E. (1874). Synopsis of the North American Freshwater Leeches. *Rept. U. S. Fish Commissioner for 1872—3*. Part II. p. 666.
- WATSON, G. (1813). Dissertatio Inaug. de Hirudinibus. 8vo. Edinburgh, 1813.
- WELTNER, W. (1887). In *Sitzungsber. Ges. naturf. Berlin*, p. 85, 1887.
- WESER, D. (1765). On *Hirudo medicinalis* in *Linnaei Amoenitates Academicæ*, ed. 2. VII.
- WHITMAN, C. O. (1878). The Embryology of *Clepsine*. *Quart. Journ. Micr. Sci.* XVIII. new ser. 1878.
- (1884). The External Morphology of the Leech. *Proc. Amer. Acad. Arts and Sci.* XX. p. 76.
- (1886). The Leeches of Japan. *Quart. Journ. Micr. Sci.* XXVI. pp. 317—416, pls. xvii—xxi.
- (1892). The Metamerism of *Clepsine*. *Festschrift zum siebenzigsten Geburtstage R. Leuckarts*, pp. 385—395, pls. xxxiv and lx. 4to. Leipzig, 1892.

DESCRIPTION OF PLATES XIII—XV.

PLATE XIII.

- Fig. 1. *Branchellion torpedinis*, from an example in the Cambridge University Museum of Zoology. Dorsal aspect. $\times 1\frac{1}{2}$.
 Fig. 2. The same. Anterior extremity. Ventral aspect. $\times 3$.
 Fig. 3. The same. Interior of part of posterior sucker, much magnified.
 Fig. 4. *Pisicola geometra*. Dorsal aspect. $\times 3$.
 Fig. 5. The same. Ventral aspect. Yellow example. $\times 3$.
 Fig. 6. The same. Egg capsule, *a*, natural size, *b*, magnified.
 Fig. 7. *Pontobdella muricata*, nat. size.
 Fig. 8. The same, at rest—a characteristic position, nat. size.
 Fig. 9. The same. Yellow variety.
 Fig. 10. The same. Egg capsules attached to a fragment of shell, nat. size.
 Fig. 11. The same. Egg capsule, side view, much magnified.
 Fig. 12. The same. Egg capsule, end view, much magnified.

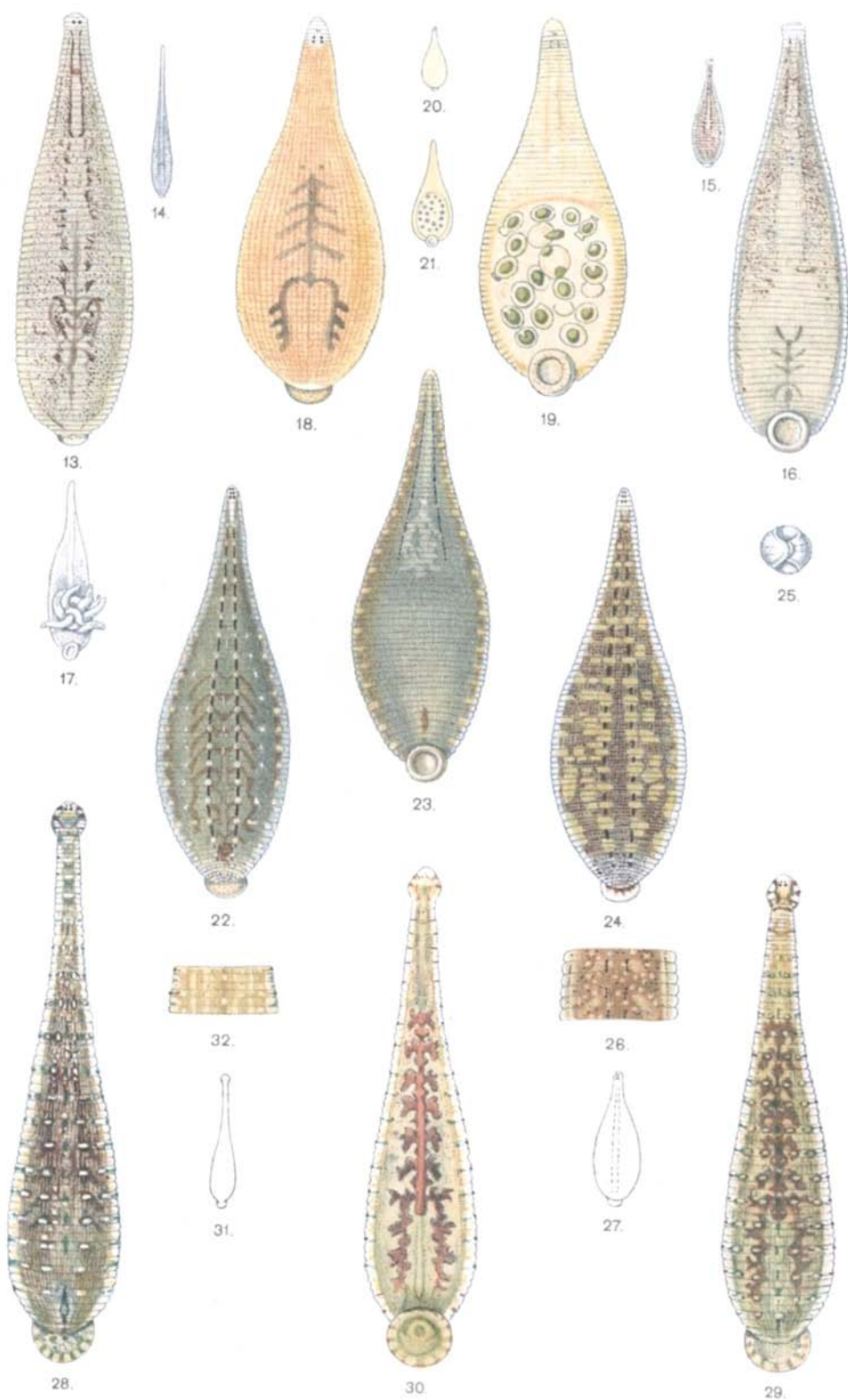
PLATE XIV.

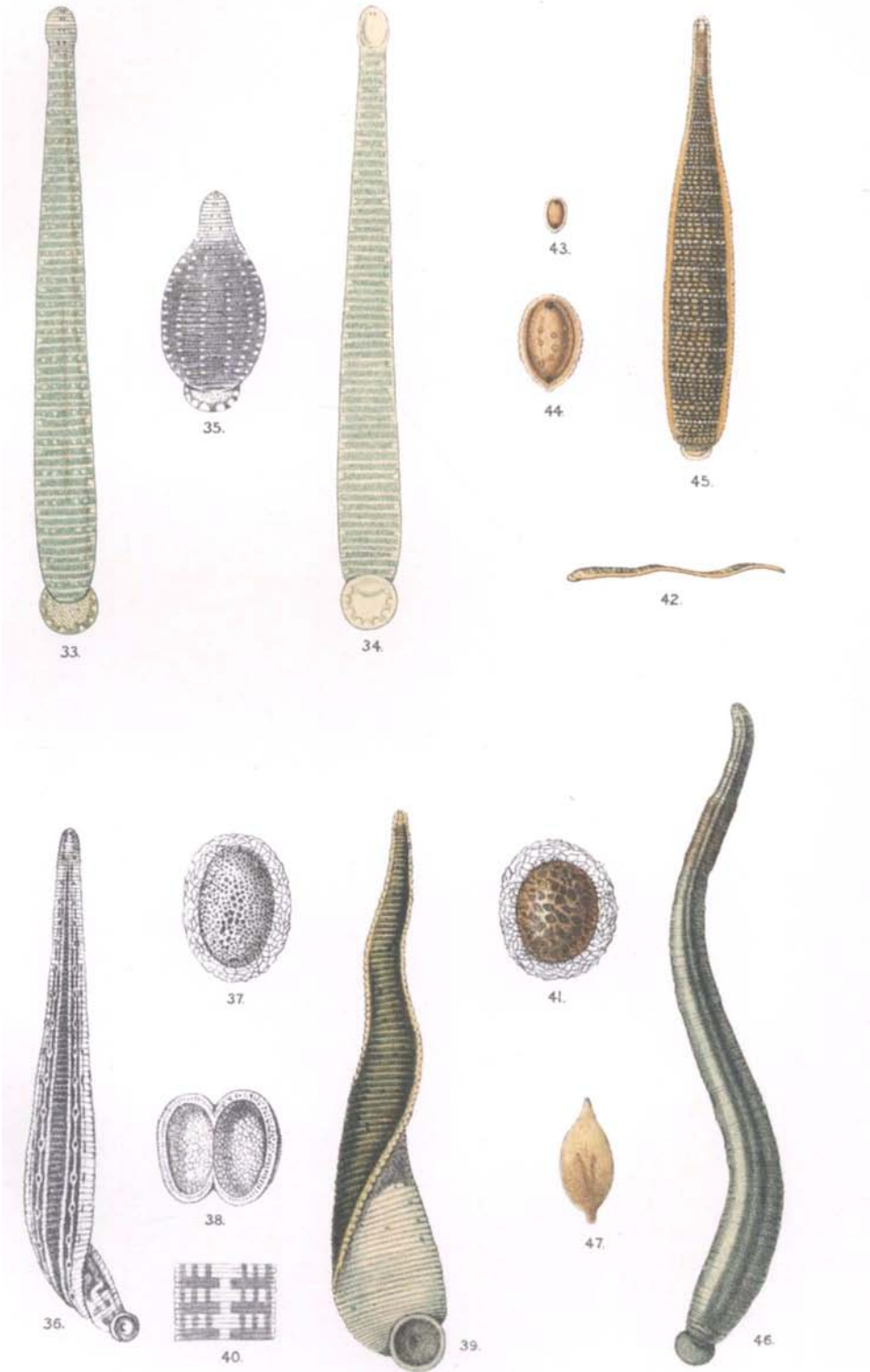
- Fig. 13. *Helobdella stagnalis*. Dorsal aspect. $\times 4$.
 Fig. 14. The same. Fully extended, nat. size.
 Fig. 15. The same. At rest, nat. size.
 Fig. 16. The same. Ventral aspect. $\times 4$.
 Fig. 17. The same. Ventral aspect with adhering young, magnified.
 Fig. 18. *Glossosiphonia heteroclita*. Dorsal aspect. $\times 4$.
 Fig. 19. The same. Ventral aspect with eggs and emerging embryos. $\times 4$.
 Fig. 20. The same. Small example, dorsal aspect, nat. size.
 Fig. 21. The same. Ventral aspect with eggs, slightly magnified.
 Fig. 22. *Glossosiphonia complanata*, var. A. Dorsal aspect. $\times 3$.
 Fig. 23. The same. Ventral aspect. $\times 3$.
 Fig. 24. The same, var. B. Dorsal aspect. $\times 3$.
 Fig. 25. The same. Position assumed when disturbed, nat. size.
 Fig. 26. The same, var. C. Part of dorsal surface. $\times 3$.
 Fig. 27. The same. In outline, nat. size.
 Fig. 28. *Hemiclepsis marginata*. Seen against an opaque background. Dorsal aspect. $\times 4$.
 Fig. 29. The same individual rather more contracted, seen as a transparency. Dorsal aspect. $\times 4$.
 Fig. 30. The same individual. Ventral aspect, seen as a transparency. $\times 4$.
 Fig. 31. The same. In outline, nat. size.
 Fig. 32. The same, var. *flava*. Part of dorsal surface. $\times 4$.

PLATE XV.

- Fig. 33. *Protolepsis tessellata*. Dorsal aspect, extended. $\times 4$.
 Fig. 34. The same. Ventral aspect, extended. $\times 4$.
 Fig. 35. The same. Contracted. $\times 4$.
 Fig. 36. *Hirudo medicinalis*, from an imported example, nat. size.







- Fig. 37. The same. Cocoon, nat. size. (Adapted from J. R. Johnson.)
Fig. 38. The same cocoon, cut open, nat. size. (After J. R. Johnson.)
Fig. 39. *Haemopsis sanguisuga*, nat. size.
Fig. 40. The same. Portion of primitive dorsal pattern seen in a young individual.
Magnified.
Fig. 41. The same. Cocoon, nat. size.
Fig. 42. *Herpobdella octoculata*. Small example, swimming, nat. size.
Fig. 43. The same. Egg capsule, nat. size.
Fig. 44. The same egg capsule, magnified.
Fig. 45. *Herpobdella atomaria*. Dorsal aspect. $\times 2$.
Fig. 46. *Trocheta subviridis*. Dorsal aspect, nat. size.
Fig. 47. The same. Egg capsule. (After Moquin-Tandon.)