CONTRIBUTION TO OUR KNOWLEDGE OF AUSTRALIAN *HIRUDINEA*.

Part iii.

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(Plates xlv.-xlvi.)

The present paper deals with two species of *Glossiphonia* Johnson, 1816, (syn. *Clepsine* Savigny,1820), one of which is new to science, the other a cosmopolitan form now recorded for the first time from the Australian region; and also with a description of our commonest and longest known aquatic Arhynchobdellid, which I find is now to be known as *Limnobdella australis* in place of *Hirudo quinquestriata* after taking into consideration the generic characters, and giving preference to Bosisto's prior specific name rather than to Schmarda's *quinquestriata*.

Since describing two species of *Glossiphonia* in these Proceedings (1908, p.320), and *Dineta*, gen.nov. (*op. cit.* p.854), I have been fortunate enough in collecting to obtain a number of aquatic Hirudinea, the greater number of which belong to the genus *Glossiphonia*.

I can here preliminarily also record the occurrence of *Herpobdella* (syn. *Nephelis*), specimens of which I obtained in the vicinity of Sydney, and in the Maitland District.

I have met with specimens of *Glossiphonia* in a very large number of places in the coastal district, including Fairfield, Narara, Auburn, Oberon, Omega, Gerringong, and Maitland. In some cases, as in creeks, they are found on floating weeds or reeds; in the case of ponds or dams, one finds them frequently, in abundance, adhering to floating or submerged pieces of wood. I have found that species of this genus are always associated with

a freshwater gastropod, *Bythinia australis* Tryon, etc. Indeed, wherever I have noticed specimens of these molluscs, I have never yet failed to obtain specimens of *Glossiphonia*, nor have I ever obtained specimens where these molluscs do not occur. This association between freshwater gastropods and Glossiphonid species is not unusual in many parts of the world, and there can be no doubt that the former form the main host of these leeches. At Wallis's Creek I found specimens in intimate association with the molluscs.

Grube recorded *Clepsine octostriata* from Rockhampton (New Holland); and the same genus is represented in the vicinity of Brisbane, according to the evidence of Mr. Henry Tryon. I have found no record of the occurrence of the genus in Victoria, but I think there can be no doubt that the genus is extremely abundant throughout Eastern Australia. I am indebted to Mr. Geoffrey Smith, of Oxford, for specimens which he obtained at Great Lake, Tasmania, representing a specially interesting new species. These were obtained under stones, along the margin of the lake, and associated with a species of *Ancylus*.

I must also express my thanks to Mr. Tillyard for specimens from Auburn, and to Mr. Thomas Steel for some excellently extended and preserved individuals of *Limnobdella*, which have been of the greatest use to me in working out that form.

Glossiphonia intermedia, sp.nov.

The individuals of this new species were obtained at Orphan School Creek, near Fairfield. Only two specimens were secured, and these were found attached to submerged pieces of timber in a pond in the bed of the creek, the only other form of life noticeable being *Bythinia australis*.

The specimens, on being placed in an aqueous solution of corrosive sublimate, quickly rolled themselves into a ball, after the fashion of Oniscus, as do most species of the genus. This form is a very active species, and, when disturbed, moves fairly rapidly, unlike most species, and after the fashion of Herpobdella and Limnobdella.

External characters.—The anterior half of the body is of a blue-grey colour dorsally, the posterior half being a dirty yellow. When removed from the substratum, the cæca of the crop were plainly visible, and had a greenish colour, the last pair in one individual being reddish-brown. When fully extended, the body was greatly attenuated towards the anterior end, the posterior half being the widest body-portion and this in uniformity. Length in state of extension 33; length in state of contraction 14; greatest breadth 4·6 mm. The ventral surface is deeply concave in killed specimens, the lateral margins of the body projecting downwards for a considerable distance.

No ornamentation, in the way of pigmented areas or prominent sensory papillæ, was noted in the living individuals, but in the killed specimens sensory papillæ are plainly visible. These can be traced from the posterior extremity forwards, as far as the 22nd annulus, in the form of minute white tubercles, by no means prominent, as regards size, but standing out slightly against the surrounding body-surface, under detailed examination, as flattened structures of a purer white colour. The colour mentioned is no doubt due to the bleaching action of the corrosive sublimate, and, in all probability, the colouration of the papillæ themselves differs in no wise from that of the ordinary body-surface. They can be traced forwards as far as the 51st annulus from the posterior extremity, and serve in this way as the only external sign of the somitic constitution. Except at the posterior extremity, where abbreviation has taken place and the triannulate somite lost, they occur on every third annulus, each papilliferous annulus bearing four papillæ, two occurring on each side of the median line as shown in fig. 9. The papilla on either side of the median line is much more prominent than that nearer the margin. The surface in general may be described as smooth. Total number of annuli about 70.

The disposition of the annuli, with reference to the somites, has been made out chiefly from a study of the sensory papillæ, of the position of the eyes, and the arrangement of the nerve-ganglia.

Somite i.	Annuli 1.	Constitution,	Uniannulate.
„ ii.	„ 2.	„	Uniannulate.
„ iii.	„ 3-8.		
„ iv.			
„ v.			
„ vi.-xxiv.	„ 9-65.	„	Triannulate.
„ xxv.	„ 66, 67.	„	Biannulate.
„ xxvi.	„ 68, 69.	„	Biannulate.
„ xxvii.	„ 70.	„	Uniannulate.

The oral sucker is constituted by eight annuli, the eighth forming its lower lip. The mouth lies slightly anterior to the central point of the oral sucker, in the posterior region of somite iii. The posterior sucker, as in most species, is slightly longer than broad. The anus lies between the second and third last annuli.

In one specimen two pairs of eyes were made out, and in the other an unpaired eye(?) was present in addition to these. The paired eyes lie on the posterior region of annulus 5, and the anterior region of annulus 6; that is, in somites iv., and v., respectively. The unpaired eye(?) was made out to the right side of the median line, and lay partly on annuli 3 and 4. The first paired eyes which the unpaired eye represents(?) are evidently undergoing degeneration as regards pigmentation.

In the case of the specimen in which the eye in an unpaired condition was not seen, examination of sections failed to show any trace of an ocular structure in the position occupied by it in the other specimen. We may then take it as granted that the characteristic number for the species is four. It would seem probable, further, that the apparent ocular organ between annuli 3 and 4 is not in reality an eye, although much resembling the same, on external examination, as regards shape and pigmentation.

Digestive system.—In general this system bears close resemblance to that of *G. heteroclita* and *G. australiensis.* The mouth is situated in annulus 4, anterior to the mid-point of the oral sucker. The proboscis extends from the seventh postoral annulus

to the 20th, that is, it extends through annuli 14-27, in its normal retracted condition, and constitutes fully one-third of the body in thickness. It measures about 2 mm. in length, passing into the œsophagus at about the position of the male genital aperture.

The œsophagus is short, extending through only two annuli, namely 28 and 29. In longitudinal vertical sections it is readily distinguishable from the crop by its much narrower lumen and the irregular folded nature of its epithelium, grading, as it does, from the proboscideal nature to that of the crop, and differing markedly from the proboscis by the absence of the strong circular muscular fibres so abundantly developed in the latter, and, in general, by the more feebly developed musculature. The proboscis and œsophagus lie in somites vii.-xii.

The crop bears six pairs of cæca, a pair arising behind each pair of testes, and thus occurring in somites xiv.-xix. The last pair are long and lobed, as in *G. heteroclita*, thus differing from the simple unlobed cæca of *G. stagnalis*, *G. fusca*, and *G. parasitica*, to which in other respects it is so closely allied.

The stomach is provided with four pairs of auricular sacs which are found to lie in somites xix.-xxii., the first pair really arising in somite xx., but extending forwards into xix., and, as in the case of the crop-cæca, representing an originally metameric arrangement.

Reproductive organs.—There are six pairs of testes in most species of *Glossiphonia*. They lie in annuli 32, 33, 34; 35, 36, 37; 38, 39; 41, 42; 44, 45; 47, 48. Three annuli thus intervene between the anterior limit of any one testis and the anterior limit of the next, and all are found to lie intersegmentally in the following somites $\frac{\text{xiii.}}{\text{xiv.}}, \frac{\text{xiv.}}{\text{xv.}}, \frac{\text{xv.}}{\text{xvi.}}, \frac{\text{xvi.}}{\text{xvii.}}, \frac{\text{xvii.}}{\text{xviii.}}, \frac{\text{xviii.}}{\text{xix.}}$ as in species of *Glossiphonia* in general. The regularity about this intersegmental position of the testes enables one to use it as a ready means of checking the somites in sections of the organism.

The ovaries lie in the usual position, as two unequal sacs, one extending backwards to about annulus 46(somite xviii.), and the other to about annulus 42(somite xvii.).

The genital ducts call for no special remarks. The genital apertures are separated by a single annulus. The male pore lies between annuli 27, 28 (20th and 21st postoral annuli), and the female pore between 28, 29 (21st and 22nd postoral annuli). From an examination of fig.8, showing the metameric constitution of the animal, it will be seen that the male pore lies between the 1st and 2nd, the female pore between the 2nd and 3rd annuli of somite xii. In this connection I would remark that it would be preferable if all workers at the group stated the position of the genital apertures definitely in terms of the postoral annuli, inasmuch as their exact position is an important point; and, it seems to me, many mistakes are liable to creep in, in stating their position in terms of the anterior annuli in an absolute way. The position of the genital pores in somite xii., agrees in detail with that in *G. stagnalis*, *G. fusca*, and *G. elongata*; and that of the male pore alone with the similar aperture in *G. heteroclita*.

In connection with the position of the genital apertures, lies something of phylogenetic interest, particularly so as one can, I think, make out the primitive condition with some accuracy in regard to the genital apertures. Taking, firstly, into consideration the commoner European and North American species, one finds the arrangement of the apertures to be as follows :—

G. complanata...	♂ between annuli o somites xi.,xii.	apertures separated by two annuli.
G. concolor.....		
G. parasitica....	♀ between annuli 2 and 3, somite xii.	
G. elegans.....		
G.. heteroclita....	♂ ♀ united, between annuli 1 and 2, somite xii.	
G. stagnalis	♂ between annuli 1 and 2, somite xii.	apertures separated by one annulus.
G. fusca.....		
G. elongata.....	♀ between annuli 2 and 3, somite xii.	
G. intermedia...		

From the central position occupied by *G. heteroclita*, with regard to the other species, not only in connection with the genital apertures, but also numerous other characters; and taking into consideration the fact that the positions of the apertures in the three groups given above, into which the species fall, one may conclude that the genital apertures are in their

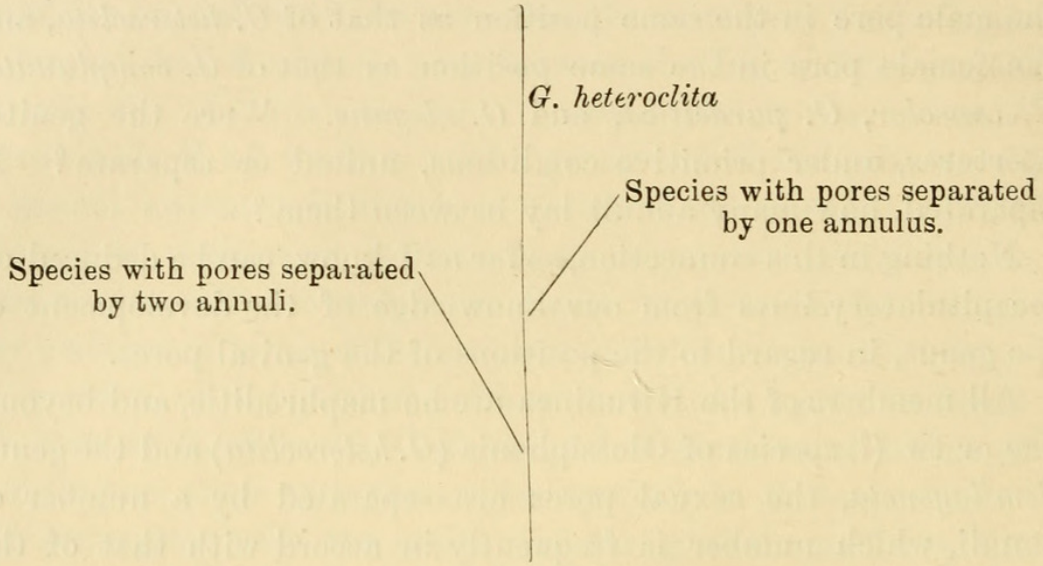
primitive position, in regard to the genus, in somites xi.-xii. Castle has already considered the species from a phylogenetic standpoint, and has placed *G. heteroclita* on the central stem. From the above table it will be seen that *G. stagnalis*, *G. fusca*, and *G. elongata*, in connection with the genital apertures, have the male pore in the same position as that of *G. heteroclita*, and the female pore in the same position as that of *G. complanata*, *G. concolor*, *G. parasitica*, and *G. elegans*. Were the genital apertures, under primitive conditions, united or separate? If separated, how many annuli lay between them?

Nothing in this connection, so far as I know, can be deduced on recapitulatory lines from our knowledge of the development of the genus, in regard to the positions of the genital pores.

All members of the Hirudinea are hermaphroditic, and beyond one or two(?) species of Glossiphonia (*G. heteroclita*) and the genus *Semilageneta*, the sexual pores are separated by a number of annuli, which number is frequently in accord with that of the annuli composing a somite. In the *Glossiphoniidæ* there is no trace of a penis, as is found in many other leeches, and mutual impregnation, as seen in other leeches, is very likely not possible among the members of this group. This idea I draw from the interesting fact noted by Whitman, that hypodermic impregnation obtains in *G. parasitica*, and most likely in all species of the genus; and, further, that no species (and many have been studied attentively in freshwater aquaria, in various parts of the world) has ever been seen to copulate, as do many other leeches. In addition, the structure of the genital apparatus would seem to strengthen this idea.

From a study of the Hirudinea in general, it would seem logical to conclude that the separation of the genital apertures is really correlated with the possibility of mutual impregnation. An interesting fact can be noted, in that all members of the genus from any part of the world—and most large regions have some endemic species—fall into two groups, one of which has the apertures separated by one annulus, the other being characterised by the presence of two annuli between the pores.

From the above data I conclude that the primitive stock from which the Glossiphonid forms were derived, was originally provided with a penial structure, and that the genital apertures were separated by a number of annuli, the pores being situated probably in successive somites.



Castle's elaborate and complete studies on the anatomy of the North American *Rhynchobdellidæ*, render it possible to construct a phylogenetic tree, showing the position of the species in regard to one another; and the above is, in the main, in agreement with his conclusions on fundamental grounds. The study of the position of the genital pores enables one to decide the points at which the two side-groups left the central stem. There has been a stimulus urging the approach of the genital apertures. In the *concolor*-group we see a much nearer approach to other leeches in general in regard to the position of the pores, this group leaving the main stem, and being characterised by (1) three pairs of eyes, (2) seven pairs of lobed crop-diverticula, (3) a rough papilliferous integument, (4) asymmetrically arranged egg-clusters, and (5) genital apertures separated by two annuli. Before this group had left the main stem, sufficient time had probably elapsed to permit of the shifting back of the male pore so that it now lay between somites xi. and xii., instead of being situated further forward in somite xi.(very probably between annuli 2 and 3 of somite xi.). Along the main stem there had been a further

shifting backwards of the male pore, until it came to lie between annuli 1 and 2 of somite xii. At this stage the *stagnalis*-group would seem to have left the main stem. No further moving backwards of the male pore seems to have then resulted in a moving forwards of the female pore in forms situated on the main stem, the examples of these conditions being represented in *G. heteroclita*. The *stagnalis*-group, after leaving the main stem, developed the following characters—(1) a single pair of eyes, (2) crop-diverticula simple, never exceeding six pairs, (3) a smooth integument, (4) egg-clusters arranged in two longitudinal rows, and (5) genital apertures separated by one annulus (this character probably having developed much earlier).

Glossiphonia heteroclita(?).

The occurrence of this now universally distributed species in Australia, is not unexpected. In the first examination of *G. australiensis* mihi, I was strongly inclined to regard that form as a variety of *G. heteroclita*, but ultimately came to the conclusion that I was dealing with quite a different species. That form is very large, when compared with *G. heteroclita*, and, having now had the opportunity of examining the latter form, I am convinced that *G. australiensis* is entitled to new specific rank. *G. heteroclita* is abundant in Europe and North America.

The single individual representative of this species was obtained at Narara Creek, in the Gosford district. It was found adhering to a piece of floating timber, and evidently was not abundant in that particular spot, as I failed to obtain other specimens after several hours' search. The creek had been in flood a few weeks before, and the leech may, as a result of this, have been transported on the timber from the upper reaches of the stream. No freshwater mollusca were found, but small native perch were abundant, and very possibly the latter may serve as a host for the species.

External characters—The body is clear and gelatinous like the substance of a Medusa or jelly-fish, the crop, with its cæca, showing

through the clear body-substance as yellowish-brown structures; it is the presence of these coloured structures that draws the attention of a collector who, otherwise, would recognise nothing in the clear body-mass to consider the presence of a leech. On being placed in a solution of corrosive sublimate, the body became white and opaque, the characteristic features of a leech becoming more evident. No pigment-areas or any traces of structures of metameric significance, such as sometimes occur in *G. heteroclita*, were visible. Length 8·8(contracted specimen); breadth 2·6 mm. (contracted specimen). Annuli 68-72; very inconspicuous in the preserved specimen (much more so in the living condition) except towards the lateral regions of the body. The skin is quite smooth and devoid of any sense-papillæ.

Eyes.—Three pairs of eyes are present, arranged in the form of an arc. The anterior pair are small, and lie close together on the posterior border of annulus 4. The second pair are widely separated, very large, and lie on the posterior portion of annulus 5 and the anterior portion of annulus 6. The third pair are equal in size to the second pair, and lie in close apposition to them, in the posterior region of annulus 6.

Limnobdella australis.

Hirudo australis Bosisto, 1857; *Hirudo quinquestriata* Schmarda, 1861; *Limnobdella quinquestriata* Kershaw, 1904; *Hirudo novemstriata* Grube, 1866.

This species is the commonest of our New South Wales leeches, occurring abundantly in freshwater creeks and moist places throughout the State, and extending its region of occurrence into Victoria and Queensland. It has a keen biting habit, and, in this connection, it is a source of much annoyance in bush travelling. This is due to the large strong teeth borne in the three jaws. This leech is stocked by chemists, and replaces here admirably the Medicinal Leech, *H. medicinalis*, of Europe.

Beyond the meagre descriptions of Bosisto, Becker, and Schmarda, in addition to a few diagrams in Parker and Haswell's "Text-Book," but little is known of this species.

Bosisto described the form under the name *Hirudo australis*, in 1857; Schmarda described a form under the name *H. quinquestriata*, and this name has been upheld to the present time.

Grube has recognised these as synonyms, and his conclusions I can verify by the examinations I have made of a large number of individuals. Bosisto's name consequently has priority.

I must here express my indebtedness to Mr. Thomas Steel, for having placed at my disposal a number of specially interesting individuals, the privileged examination of which has assisted me much in the study of this form, and the determination of synonyms.

In 1904, Kershaw mentions the occurrence of a freshwater leech, *Limnobdella quinquestriata*, at Launching Place, Yarra, Victoria. This is none other than our common freshwater form.

Blanchard, in 1893, proposed the generic name, *Limnobdella*, to include certain species known until then as species of *Hirudo* (and amongst these he mentions *H. quinquestriata*), and the characters of the genus he lays down in the following diagnosis: "Corpus, oculi, porique genitales dispositi ut in Hirudine. Somitus xxiii.^{tius} e 5 annulis completis constat, ut in Macrobdella et in Whitmania; a prima vero hoc differt quod glandulæ copulationis deficiunt, ab altera quod somitus vi.^{tus} solummodo e 3 annulis constat. Maxillæ paucis, longis vero fortibusque dentibus armatæ."

Undoubtedly the species under consideration finds its place in the genus *Limnobdella*, and is then to be known as *L. australis*.

Recently Professor Benham described under a new specific title a New Zealand species of *Hirudo*. This form approaches so closely to *Limnobdella australis*, from the standpoints of internal and external anatomy, that I am strongly inclined to regard them as one and the same species, the New Zealand form, *H. mauiana*, representing a well marked variety (as Professor Benham thought might be the case) of *Limnobdella australis*.

Becker's diagrams give a much better idea of the general appearance of our species than does that of Schmarda.

With a view to settling this point (Professor Benham not having specimens of our form), and also fixing the anatomy of *Limnobdella australis*, I have attempted some work in that connection.

I might also mention that Grube has described a form under the name *Hirudo novemstriata*, from Rockhampton(New Holland), and this no doubt is identical with *Limnobdella australis*. Leaving out of consideration the extreme lateral marginal regions, we get really nine different coloured regions, and, no doubt, this was the colouration-character that Grube described as "novem-striata."

Colouration.—Mr. Steel's specimens resemble in dimensions those of *Hirudo mauiana*, but approach almost exactly Schmarda's diagram as regards pattern. These specimens had been killed in an excellently extended condition, and preserved in a very suitable manner for external examination in the same manner as that recommended for land-planarians. The specimens obtainable from chemists in Sydney approach much more closely to Benham's *H. mauiana*, in regard to the greater importance of the median pigment-band, and also the relatively greater importance of the dark pigment-bands. At the same time, these specimens show a much greater development as regards thickness and breadth. This difference, however, is very readily explained as being due to distension by blood and also to contraction.

Becker's diagrams give a much better representation of the leech than does that of Schmarda, the latter showing the individual in a thoroughly extended condition.

The measurement given by Grube for the posterior sucker far exceeds the normal size, the measurement in the large number of specimens I have examined being very seldom more than 6 mm. and frequently less. Schmarda's diagram, from a general standpoint, is misleading. One finds some (but very few) specimens which are ornamented, in regard to the dorsal linear pigment areas, in the proportion denoted in Schmarda's figure. On the other hand, the great majority of individuals which I have examined, show a dorsal median pigment-line of much greater

importance. In a very large number this approaches very close in importance to the pigment lines on either side, and in some cases actually outstrips these lines.

This variation is to be noted in individuals collected in different regions, and is to be regarded as a "local variation." In none, however, do these lines approach the great importance of development as seen in Benham's *H. mauiana*. However, I cannot think that these practically small differences in connection with colour-pattern are to be taken so seriously as to be considered a character warranting the institution of a new specific name; rather is it to be more readily understood as a "local variation."

The close agreement in anatomy seems to place it beyond doubt that we have, in New South Wales and New Zealand, one and the same species. We find, in the case of *Hirudo medicinalis*, enormous variations as regards details in connection with colouration, but yet all these conform to a general pattern as do *Limnobdella australis* and *Hirudo mauiana*, and consequently, for the latter, I would propose the name *Limnobdella australis* var. *mauiensis*.

Below are shown the measurements of a number of specimens selected as giving the average in regard to the means and extremes.

Length 64·5 mm.	Breadth 9·5 mm.	Posterior sucker 5 mm.
,, 64·5	,, 9	,, 5
,, 76	,, 11	,, 8
,, 68	,, 8·5	,, 5
,, 76	,, 8·5	,, 6·5
,, 66	,, 10	,, 7
,, 71	,, 11	,, 9
,, 76	,, 3·6	,, 4

The measurements given above were made on preserved specimens, and represent just a few among a great number of measurements. Comparing them with Grube's measurements, it will be seen that they differ for any given length in respect to the breadth and the diameter of the posterior sucker; and it will also be seen

that they approach much more closely to Benham's species than to *Hirudo australis* of Schmarda.

	Length.	Breadth.	Posterior sucker
Hirudo australis Schmarda	72 mm.	16 mm.	10 mm.
Hirudo mauiana Benham	70	5	4·5
Limnobdella australis mihi	68	8·5	5

The total number of annuli is 102, as in species of *Hirudo* and *Limnobdella* in general.

As there are no traces of sensory papillæ on the surface, I have attempted, by means of the positions occupied by the nerve-ganglia, to map out the somitic constitution of the animal, taking also into account the assistance given by the position of the eyes, taking for granted that, especially in the middle region of the body, the nerve-ganglion lies in the middle annulus of a somite, and that abbreviation has taken place at either extremity according to the set plan laid down by Castle's observations.

Somite	i.	Annuli	1.	Nature,	Uniannulate.
,,	ii.	,,	2.	,,	Uniannulate.
,,	iii.	,,	3, 4.	,,	Biannulate.
,,	iv.	,,	5, 6.	,,	Biannulate.
,,	v.	,,	7, 8, 9.	,,	Triannulate.
,,	vi.	,,	10, 11, 12.	,,	Triannulate.
,,	vii.	,,	13, 14, 15, 16.	,,	Tetrannulate.
,,	viii.-xxiii.	,,	17.....96.	,,	Pentannulate.
,,	xxiv.	,,	97, 98.	,,	Biannulate.
,,	xxv.	,,	99, 100.	,,	Biannulate.
,,	xxvi.	,,	101, 102.	,,	Biannulate.

Note that, in the newly arranged diagram showing somite-constitution, annuli 5,6 and 7,8 show fusion on the ventral aspect. This is of interest, inasmuch as it may very reasonably be construed as signifying that the fused annuli belong to one and the same somite. As we find that the number of somites (33) is constant among the Hirudinea in general, it is much more reasonable to conclude that, when abbreviation or extension of the annuli takes place, this is a matter affecting the somite concerned alone.

In this connection it is noticeable that annuli 5 and 6 show signs of fusion (complete on the ventral aspect), and that these are determined as belonging to and really constituting somite iv. Again, we find annuli 7 and 8, which represent the first two annuli of somite v.(triannulate), are fused on the ventral aspect. In the case of somite iv., the first annulus has evidently disappeared by fusion with annulus 5, which represents the middle annulus of the originally pentannulate, and later triannulate somite; and is oculiferous. In the case of somite v., we find that abbreviation has not taken place to such an extent as in iv., but still it is the first annulus, namely 7, which is showing signs of fusion with the middle constituent of this somewhat abbreviated (triannulate) somite.

This is admirably in keeping with the generalisations made by Castle for the Hirudinea in the matter of somite-extension or abbreviation.

Benham mentions, in his account of *Hirudo mauiana*, that annuli 5 and 6 are fused.

Somite vii. is tetrannulate, the first annulus of the originally pentannulate somite having disappeared, and the somite approaching the condition of somites v. and vi., or that the perhaps more primitive triannulate somite has added an annulus in its posterior region and not in its anterior region.

The order of abbreviation would then appear to be as follows :

Annulus.	Ann.	Ann.	Ann.	Ann.
1	2	3	4	5
(*a*)	(*c*)		(*d*)	(*b*)

Nephridiopores.—Nephridia do not occur in other than tetrannulate or pentannulate somites. The first pair of nephridiopores lie on the first annulus (near its posterior margin) of somite vii., that is, annulus 13. In contracted specimens the nephridiopores would appear to open between two annuli—the annulus bearing it and the succeeding one. The remaining sixteen pairs of nephridiopores lie on the posterior margins of the second annuli of the pentannulate somites viii.-xxiii: that is, they lie on annuli 18,23,28,33,38,43,48,53,58,63,68,73,78,83,88,93.

The eyes occupy the positions characteristic of the genera *Hirudo* and *Limnobdella*, namely, on annuli 1, 2, 3, 5, and 8.

There are present no sensory papillæ on the surface, as in *H. medicinalis*, so that, beyond the assistance given by the five pairs of eyes at the anterior extremity, one has to rely on the nephridiopores and nerve-ganglia. By passing fine needles through these ganglia and the ventral body-wall, I was enabled to make out definitely the relationship of the nerve-ganglia to somite-extent and constitution.

The lower lip is formed by annuli 5 and 6, which, as mentioned above, are fused on the ventral aspect. A similar state of affairs obtains in the case of *Hirudo mauiana*.

The genital apertures occur in the usual position for members of the genera *Hirudo* and *Limnobdella*. The male aperture is to be seen, as a prominent slit, on the 30th annulus, at about the anterior limit of its posterior third. Counting the postoral annuli, it is observed to lie on the apparent 24th annulus seen on the ventral side, but this is, in reality, the 26th postoral annulus, owing to the fusion ventrally of annuli 5,6, and 7,8 respectively. Evidently the annuli are similarly fused in the case of *H. mauiana*, as Benham states that the male aperture lies on annulus 30, or on the posterior limits of the 24th postoral annulus, annuli 5 and 6 being fused to form the lower lip. Such could not be the case were two other annuli not also fused ventrally, and these, in all probability, are annuli 7 and 8, what he calls the 24th postoral annuli being, in reality, the 26th postoral annulus. This is another point of agreement externally between *H. mauiana* and *L. australis*.

The female genital pore lies between annuli 35 and 36, that is postoral annuli 31 and 32, or, counting only the annuli which can be made out on the ventral surface, the 29th and 30th apparent postoral annuli.

The jaws are crescentic in outline in their teeth-bearing portion. The teeth are 48-50 in number, and are very long and strong. Their number and nature are excellently described in the portion of Blanchard's diagnosis bearing on that subject as "Maxillæ

paucis, longis vero fortibusque dentibus armatæ." The arrangement and nature of the teeth may be seen in fig. 10.

The only internal structures which call for any special remark, are the reproductive organs.

The testes lie in the last annular region of somites xii.-xxi., that is, in the second annulus behind the nerve-ganglia of these pentannulate somites. There are present ten pairs, as in most species of *Hirudo*. In *H. medicinalis* there are nine pairs normally present, but occasionally one finds ten pairs. In Parker and Haswell's diagrams there are only nine pairs represented in connection with *H. quinquestriata*. It is quite possible that nine pairs may sometimes be present in our form, although I have dissected a large number of specimens, and have never reckoned less than ten pairs. At first I imagined that, very possibly, if *H. australis* and *H. quinquestriata* were not synonymous, that the former might possess nine pairs and the latter ten pairs. However, such I am sure is not the case, and, as it is well nigh impossible that one would miss one pair when making a count of such conspicuous organs in a dissection, it seems very possible that nine pairs only are present as an occasional variation in *Limnobdella australis*.

Benham notes the presence of ten pairs in *H. mauiana*, and only seven pairs in *H. antipodum*.

In consideration of these facts, it would seem that we must regard the genus *Hirudo* as being originally provided with ten pairs of testes, and that this number has later shown a tendency towards reduction. It is apparently the last pair of testes, as represented in *Limnobdella australis*, which is generally absent in *Hirudo medicinalis*.

The ovaries agree in nature with those of other species, and call for no special remark.

The male apparatus agrees with that of *H. mauiana*, in having a strong muscular sac between the anterior extremity of the seminal vesicle and the "prostate." The vasa deferentia pass along the outer side of the testes, with which they are connected by a delicate vas efferens in the last annulus of each testigerous

somite. Anteriorly each vas deferens passes into a densely convoluted whitish mass, epididymis, which is connected with a large highly muscular sac, ovoid in shape, directed inwards and forwards. As in *H. mauiana*, this corresponds to the "ductus ejaculatorius" of *H. medicinalis*. From each of these muscular sacs a duct passes inwards at right angles to the long axis of the body, and these ducts open as usually into the median globular prostate, from which a long curved penis-sac passes backwards and afterwards forwards, to open at the male pore, behind the sixth ganglion. This agrees in detail with that described by Benham for *H. mauiana*. The female apparatus also agrees in detail with that of *H. mauiana*, the two small ovarian sacs leading by narrow oviducts into an albumen-gland connected with a uterus, which passes forwards and ventrally into a vagina, surrounded by distinct circular muscles, as described by Benham for *H. mauiana*.

Remarks.—If *H. mauiana* and *L. australis* are not to be regarded as one and the same species, it cannot be denied that they are very closely allied species; and the same interest in their distribution obtains, whether one be regarded as a variety of the other, or as a distinct species. Each form is a true endemic representative in either country, in every possibility. The most interesting point is bound up in the characteristic structure of the genital organs, and this character may be possibly an anatomical feature to be found among those forms which Blanchard would place in his genus *Limnobdella*, in contradistinction to that to be found in *Hirudo* (in its narrow sense).

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EXPLANATION OF PLATES XLV.-XLVI.

alb., albumen-gland—*cr.s.*, crop cæcum—*ep.*, epididymis—*ms.s.*, muscular sac (ductus ejaculatorius)—*int.*, intestine—*ne.*, nephridiopore—*ovd.*, oviduct—*œ.*, œsophagus—*pa.*, sensory papilla—*prs.*, prostate glands—*pr.*, proboscis—*pr.sc.*, proboscis-sac—*pn.sc.*, penis-sac—*st.sc.*, stomach-sac—*te.*, testis—*ut.*, uterus—*v.d.*, vas deferens—*vg.*, vagina—*ov.*, ovary.

Plate xlv.

Fig.1.—*Glossiphonia intermedia*, sp.n.; ventral view showing arrangement of the eggs.

Fig.2.—Diagrams showing relative positions of the sexual pores in species of *Glossiphonia*.

Fig.3.—*Limnobdella australis*: male organs.

Fig.4.—*L. australis*: female organs.

Fig.5.—*L. australis*: diagram showing fusion of annuli 5 and 6, 7 and 8.

Fig.6.—*G. intermedia*, sp.n.: diagram showing position of the eyes.

Plate xlvi.

Fig.7.—*L. australis*: anterior region showing somitic constitution.

Fig.8.—*G. intermedia*: diagram showing positions of organs (left half ventral, right half dorsal), and somitic constitution.

Fig.9.—*G. intermedia*: diagram showing arrangement of papillæ.

Fig.10.—*L. australis*: jaw.

Fig.11.—*G. intermedia*: posterior extremity, showing abbreviation of the somites.

Fig.12.—*L. australis*: diagram showing position of testes.

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