# Leeches from Borneo and the Malay Peninsula

*By* J. Percy Moore

(Plates VI, VII)

This paper deals with several small lots of land and freshwater leeches mostly submitted by Mr. F. N. Chasen, Director, and Mr. M. W. F. Tweedie, Curator, of the Raffles Museum, as follows: 12 vials from Mt. Kinabalu, North Borneo, collected by F. N. Chasen and H. M. Pendlebury in 1929; 2 vials from the lowlands near Kuching, 1932; 1 vial from Upper Perak, Federated Malay States, collected by A. G. Billing in 1932; 6 lots from Sarawak, collected by E. Banks in 1933; 1 vial from Trengganu, north Malay Peninsula, collected by Dr. R. Braine; and two lots from the valley of the river Plus in Upper Perak collected by Mr. Tweedie in 1933. In addition are several lots collected by Dr. H. M. Smith and Dr. A. S. Pearse in Siam and one vial collected in Cochin-China by E. Poilane, and sent to me by Dr. W. L. Schmitt of the U. S. National Museum.

These collections are all incomplete and contain representatives of two families only, the jawed blood-sucking Hirudidæ and the predacious burrowing Erpobdellidæ.

Although including only three species the leeches from Perak are of especial interest as being the first that have been reported from that area. As might be expected they show faunal affinities with both China and Malaysia. There is a second species of *Gastrostomobdella*, differing sharply from the Bornean type species, numerous examples of a new subspecies of *Haemadipsa sylvestris*, first discovered in Siam and known from Cochin-China also, and several specimens of *Myxobdella annandalei*, previously known from China and India. Those from Mt. Kinabalu were taken at elevations from 3,300 to 10,000 feet and include three forms of true land leeches: *Haemadipsa picta*, *H. zeylanica*

*sumatrana,* and *H. z. subagilis;* and two species of burrowing predacious Erpobdellidæ: *Gastrostomobdella monticola* and *Mimobdella büttikoferi.* The first four were found by Dr. Mjoberg at similar elevations on Mt. Poi and other peaks but the latter was unrepresented in his collection.

Details concerning the collecting stations on Mt. Kinabalu will be found in Smith and Chasen, Herpetology of Mt. Kinabalu, 1931.

Through the kindness of the Director of the Raffles Museum I am permitted to keep the type of *G. vagabunda* which with that of *M. s. interrupta* will be deposited in the Academy of Natural Sciences of Philadelphia. Sections used in this study were prepared by Miss Margaret Long under a grant from the Special Research Fund of the University of Pennsylvania.

## GLOSSIPHONIDAE

**Paraclepsis vulnifera** Harding 1924.

A single small specimen is the sole representative in these collections not only of the family but of the suborder Rhynchobdellæ. It was collected by Dr. A. S. Pearse from the branchial chamber of a ♀ fresh-water crab (*Paratelphusa sinensis* M.-Edw.) at Bangkok, Siam, on Dec. 27, 1929. It is less than one-half the size of Harding's specimens, measuring 8×2.5 mm. which explains the inconspicuousness of the numerous small papillæ. The arrangement of the eyes, genital orifices and annulation, so far as worked out, agree with Harding's description. In life this leech is probably nearly colorless or pale red as there appears to be no definite pigmentation. In the preserved specimen the skin is translucent and there are faint light and dark longitudinal lines due to the longitudinal muscle bundles and brownish transverse bars due to the ingested blood in the gastric cæca. The only other record of this species is of the types, also from the branchial chamber of a *Paratelphusa* (sp. ?) taken in the Tanjore Dist., Madras Presidency. That this species is really distinct from *P. praedatrix* remains to be established by the study of more abundant material.

## HIRUDIDAE

**Myxobdella annandalei** Oka 1917.

This very interesting species was found by Mr. Tweedie in the hills of Perak associated with *Haemadipsa sylvestris interrupta* and *Gastrostomobdella vagabunda.* Three of the specimens are quite small, varying from 15×5×2 to 18×6.6×3.5 mm., and two are full grown, measuring 68×19×8 and the largest strongly contracted one 55×22.5×8.5 mm. (Pl. VI, fig. 5; Pl. VII, fig. 9.).





Several have the cuneate form which is so characteristic of most preserved examples of the species. In all the caudal sucker is very large and the annulation normal, presenting that noteworthy inequality of depth of the interannular furrows of the several orders which is indicative of their phylogenetic succession and one of the striking characteristics of the genus. Most of the specimens exhibit much less of that tumidity and oedema which were noted in earlier writings but they are present in some degree in all and markedly on some specimens. In all cases the peculiar velar papilla is evident projecting from the posterior buccal wall and perforated by the small, triangular mouth, through which the three small jaws may be seen. This papilla is the homologue of the tip of the proboscis of the Rhynchobdellae. While five pairs of eyes are invariably present only the first two or in some cases three are visible without special preparation, the fourth and fifth pairs being very small and deep-seated. The position of the genital orifices at XI *b5/b6* and XII *b5/b6* is constant. Nephropores are frequently visible on the caudal margin of *b2* of many somites.

The ground color as preserved is pale, gray or yellowish gray, more or less thickly blotched both dorsally and ventrally with black spots which may be rather large and confluent or contracted to give a finely speckled appearance.

Two localities are recorded: "Near River Yum, Plus Valley, Perak, Mar. 18, 1933;" and "Kuala Legap, Plus Valley, Perak, March, 1933." Previous records are from a mountain near Hong Kong, the Dawna Hills in Lower Burma and hills at Yercaud, Madras, all from streams. I found it under stones in a small spring-fed stream at 2,800 ft. at Mungpoo in the eastern Himalayan foothills of Darjeeling District. More recently Oka (1932) has greatly extended the range of this species by recording a specimen taken at Tiflis, Georgia.

**Hirudinaria manillensis** Lesson 1842.

The synonymy and other aspects of this species are fully discussed in Moore, 1927, p. 218–226. It is an abundant species in the lowlands of the entire oriental region and the Raffles Museum collections include several lots from the vicinity of Kuching, Sarawak and from the Kinabatangan R., North Borneo. Also one from the U.S. National Museum, Bangkok, Siam, Oct. 20, 1932, H. M. SMITH.

**Hæmadipsa zeylanica sumatrana** (Horst) 1883.

Although previous records (Moore '29) indicate that this is the common ground leech throughout Borneo except the western end, the collection includes but four examples, one from Kenokok, Mt. Kinabalu, Apr. 26, 1929 at 3,300 ft. in the

high forest, one (presumably near Tenompok) at 4,500 ft. on May 2, and two from Mt. Dulit, Sarawak, No. 5. There is also a doubtful specimen which approaches the next and which was taken along with a planarian of similar color pattern by H. M. Pendlebury on Mt. Kinabalu between Lumu Lumu and Kamborangah at about 6,000 ft., Mar. 19.

**Hæmadipsa zeylanica subagilis** Moore 1929.

The only undoubted specimen of this subspecies was taken on Mt. Penrissen, Sarawak.

It is typical in every way.

The specimen from Lumu Lumu referred to under subspecies *sumatrana* resembles *subagilis* more closely in color, except that the median dark line is limited to the anterior half. On the other hand the head characters are more like the former. It differs from both in having partially developed dark brown supra-and submarginal stripes.

**Hæmadipsa** sp.[1]

Several egg-cases (Pl. VII fig. 8) produced at Singapore, July 3, 1933, resemble those of other species of the genus seen by me. They are nearly globular, 8–9 mm. in outside diameter, with the inner capsule about half as large and enclosed in a single layer of about 35 irregularly polygonal compartments open externally and usually measuring about 2.5 mm. across at the periphery, with some smaller ones crowded among them. The material is translucent dusky-brown in color and of the consistency of rubber or soft cartilage. Two of them opened proved to be quite empty. Prof. W. A. Young of the Medical College at Singapore furnishes the following note which agrees with my own observations on capsule formation in Indian Hæmadipsæ. "They were laid on moist sand in a jar under leaves previously dried. The first sign of egg-laying is the deposition of what appears to be a froth-like material laid between a leaf and the sand. This appears to harden and form these peculiar egg capsules. The act of copulation has not been observed. Under a dissecting microscope the newly laid eggs were seen to contain a few unpigmented worm-like structures moving freely inside the capsule. None of the eggs came to maturity."

**Hæmadipsa sylvestris interrupta** subsp. nov.

*Diagnosis.*—General aspect of *H. sylvestris* but smaller than the typical lowland form (the largest of over 80 specimens barely exceeding 1 in.) and differing in the following respects: Prehensile sucker papilla prominent and usually pointed and

1. Probably *H. sylvestris interrupta*, M.W.F.T.





hooked; furrow pits best developed on somites IX and X, inconspicuous or absent on XII; median dorsal stripe broken into a series of distinct, quadrate metameric spots on *a2* and *b5* or confined to *a2*. (Pl. VI fig. 1–4).

Description of type from Koh Chang, Siam. Length in mm. 25, to ♂ pore 7.5; widths, buccal 1.6, at ♂ pore 2.2, maximum (XXIII) 3.4, anus 2.; depths at same levels, except anus, 1.5, 2, 2.5; sucker 3.4×4. Form robust and somewhat flattened posteriorly, tapering, slender and terete anteriorly. Lip with a shallow median ventral groove flanked on each side by 10–12 narrow ridges each bearing a series of minute sense papillæ. On the dorsal face of the lip the marginal welt, bearing 3 or 4 rows of labial sense organs, is very distinct from the tessellated head annuli. Eyes very conspicuous, the five pairs as usual on annuli 2, 3, 4, 5 and 8. Median head areas present on somites III, IV and V and two small areas on each side between the 3rd and 4th eyes. Annuli V *a3* and VI *a1* complete, Somite VII 4-annulate and VIII 5-annulate. Furrow pits deep and in white spots on somites IX and X, smaller and less conspicuous on VIII and XI, absent on XII. Gonopores and nephropores as usual, the position of the latter indicated by minute black spots. On complete somites all annuli are divided into about 22–24 dorsal and as many ventral areas, each bearing a papillated rosette of 8 to 20 sense organs. At the caudal end somite XXIII is 4-annulate, XXIV 3-annulate, XXV-XXVII uniannulate. Auricles 3-lobed, the middle one smallest and triangular. Caudal sucker oval, sharply pointed with a prominent ventrally hooked papilla; rays 77. Color faded but generally like *sylvestris;* ground yellowish brown becoming reddish on venter, paler in mid-dorsal field. Dark brown pigment concentrated on margins of median dorsal field to form a pair of somewhat broken outer paramedian brown stripes which at one point in the caudal 1/3 nearly unite across the median field. Median stripe nearly black, broken into a series of metameric, sharply defined, quadrate or truncate spots on annuli *a2* and *b5* or confined to *a2*. Marginal pale and dark stripes practically obsolete. Sensillæ and auricles colorless or nearly so.

The large number of individuals representing this subspecies are remarkably uniform. Very rarely the median dorsal stripe is continuous but in such examples it is alternately broad at *a2* and much constricted between. On very small specimens it is often faint. The most striking character is the prominence of the prehensile papilla on almost every specimen. The sucker rays vary from 74 to 83. Occasionally there is a complete transverse row of areas between the third and fourth eyes.

This leech is evidently abundant as most of the lots are large. It represents *H. sylvestris*, which is extensively distributed throughout Burma and eastern India, in a broad belt extending through the Malay Peninsula, Siam, and Cochin-China. Whether the *H. sylvestris* reported from Java and Sumatra by Blanchard belongs to this form is at present unknown.

Koh Chang, Siam, June 9, 1930, in forest, Dr. A. S. Pearse, 40, including type; Bienhoa, Cochin-China, Nov. 20, 1932, E. Poilane, U.S.N.M. No. 123/397, 3; Kuala Legap, Plus Valley, Perak, March, 1933, M. W. F. Tweedie, 30+ with *Gastrostomobdella* and *Myxobdella*. Although running smaller than the other lots, the number of sucker rays is very uniformly larger—80–83. Sungai Piah, Perak, Mar. 24, 1932, A. G. Billings, 30+; Trengganu, Raffles Mus. No. 7., 11. In this last lot the median stripe tends to be more continuous and the paramedian stripes send hooked extensions into the dorso-median field.

**Hæmadipsa picta** Moore 1929.

This gayly-colored and distinctive species is widely distributed on the forested mountains of Borneo, being especially characteristic of the zone between 2,000 and 4,000 ft. It is a bush-climbing species, and like the related *H. ornata* of India it is largely solitary and its bite is pungent. With the exception of three specimens from Mt. Matang, the type locality, all in this collection came from Mt. Kinabalu, being represented by single specimens from a number of localities at several stations.

Mt. Matang, Sarawak, No. 2, 3 and 4; Kenokok, Mt. Kinabalu 3,300 ft., Apr. 1929, F.N.C. and H.M.P.; same, Apr. 23, on *Ratufa* sp.; same, Apr. 24; same Apr. 26, 3 specimens; Lumu Lumu, 5,500 ft., Apr.; Marei Parei, 6,000 ft., May 1, H.M.P.

The number of sucker rays on these specimens from the north-east end of the island is somewhat more variable, from 79 to 89, and averages a little larger, about 85, than those from Sarawak previously described. There is also some variation in the color pattern, chiefly in the extent and arrangement of the dark stripes, one of the most unusual being a single specimen from Mt. Matang in which the posterior half of the supramarginal dark stripe forms a broad brown band reaching across the entire intermediate field to the line of the intermediate sensillæ.

ERPOBDELLIDAE

**Gastrostomobdella vagabunda** sp. nov.

*Diagnosis.*—Similar in structure, size and form to *G. monticola* Moore. Complete somites sexannulate, consisting of 3 shorter (*b1, c11* and *c12*) and 3 longer (*b2, a2* and *b5*) annuli.





Genital orifices separated by 9 annuli, the ♂ at XI *b5/c11*, ♀ at XIII *b1/b2*. Gastropore in XIV *a2*, more than 7 annuli behind ♀ pore, undeveloped in young. Color pattern apparently solid without definite spots or stripes. Type locality Plus Valley, Perak, Federated Malay States. (Pl. VII fig. 6, 7).

*Description.*—The material presents a wide range of size and proportions from 24×2.4 to 109×9.8 mm. The type measures—length 83, to ♂ pore 18.6; widths, buccal ring 2.8, ♂ pore 6.6, maximum (XVII) 9, anus 6.2; depths at same points 1.5, 4, 6.6, and 3.2 mm.; sucker 5.4 mm. The largest example from the Larut Hills has the corresponding measurements: 109, 18.6; 3.2, 6.7, 9.8, 5.7; 2, 5.6, 7.4, 4.5; and 5.5, the caudal sucker being more contracted. Immature individuals are more slender, one measuring 52, 12.4; 1.6, 3.2, 4.8, 4; 1.5, 2.2, 3, 2.2, and 3.1 mm. Mature specimens are robust, of rounded, subcylindrical form and nearly uniform diameter throughout the post-clitellar region, with diameter greatest and flattening least near the middle (about somite XVII). Small specimens present more nearly the typical erpobdellid form, being slender and tapering to the head from about somite XIX, most nearly terete except at the ends, but others are depressed throughout.

Head, as in *G. monticola* and other burrowing members of the family, prolonged scoop-shaped and very mobile, the anterior margin or lip spreading and flattened, the sides farther back progressively rolled in ventrad and meeting at the buccal ring. Ventral surface with four broad longitudinal ridges separated by furrows which fork anteriorly to terminate in the notches between the marginal crenulations. The ridges are faintly tessellated and each area bears a sense organ; four rows of labial sense organs are concentrated along the margin of the lip. The sides of the buccal chamber are formed by the faint lobes in which the head annuli terminate laterally and the buccal ring is divided into 6 deep lobes. Dorsally the head and lip is annulated throughout, there being a distinct apical annulus anterior to the first pair of eyes. Eyes 4 pairs, 2 labial situated on annuli 2 and 3 resp., widely separated medially but those of the two pairs close together laterally, both apparently belonging to the outer paramedian or intermediate series of sensillæ; 2 buccal pairs (marginal and supramarginal) close together on the lateral faces of the middle annulus of V; all small, black with the pigment cups deep-set. On the large specimens they are rather obscure, on the small ones conspicuous. Clitellum not evident externally on any of the specimens. Gonopores (Pl. VII, fig. 6, ♂ and ♀) separated by 9 annuli, the ♂ at XI *b5/c11*, the ♀ at XIII *b1/b2* and constant in position on all specimens. On the small leeches the male pore is a small but distinct orifice deep in the furrow, the female a still smaller and less distinct pore, also

in the furrow. The latter undergoes very little change even in the largest and most mature individuals. The male pore increases in size and prominence, becoming, on half-grown specimens, a somewhat elevated, large, transverse slit with margins lobulated by radiating furrows. On the largest individual it is raised on the summit of a prominent, broad-based, conical papilla occupying the full length of annuli XI *b5* and *c11*. On one example 51 mm. long the two sperm ducts open separately, each slightly off of the middle line, the right one in the normal position, the left two annuli caudad at XI/XII; this being the position of the ♂ in *G. monticola*. The gastropore (Pl. VII, Fig. 6, *g*.) varies slightly in position but always within the limits of XIV *a2* and usually 1/3 from the cephalic margin, that is, separated from the ♀ pore by seven and a fraction annuli. On the smallest specimens it is totally absent; on those 36 to 51 mm. long it is a slight, transverse, slit-like depression, deeper and wider with increase in size of the leech. On the single mature specimen it is a large and conspicuous, transversely elongated opening with lobed and somewhat protuberant lips on the venter of XIV *a2*. Within the body wall it bifurcates and opens into the digestive tract by a pair of pores as in *G. monticola*. Nephropores are also easily detected on most specimens and on some are elevated on small but distinct papillæ in the ventral intermediate line at the caudal border of *b2* of somites VIII to XXIII inclusive. Anus a rather large opening with radial lobes, at XXVI/XXVII. Caudal sucker of medium size with broad peduncle, discoid and directed ventrad, dorsally rough with numerous small sensory papillæ, ventrally smooth, showing circular and radial muscles and on some specimens a few small sense organs.

*Annulation* well-defined by clear regular furrows especially on the well preserved specimens of medium size in which the difference in length of annuli is constant, although the furrows are nearly uniform in depth. On the mature specimens unequal contraction and distortion obscures the plan. Sense buds are numerous and generally discernible on all annuli, becoming increasingly conspicuous caudad by being elevated on prominent conical papillæ, due to which the caudal end is quite rough. Except that they tend to form two transverse rows on each annulus, those of the posterior row being larger, and are somewhat larger on annuli *b2* and *a2*, there is no definite arrangement. Besides the definite papillæ of various sizes many of the sense organs are not elevated at all. Some of the latter are included in the rows of 18 to 25 and others are scattered irregularly. On the venter the sense organs are similarly arranged but are smaller and rarely elevated on papillæ.





I uniannulate, a distinct preocular ring. II uniannulate, bearing first pair of intermediate or outer paramedian eyes. III biannulate, $(a1\ a2)>a3$. 2nd pair of eyes close to II/III and laterad of 1st pair and probably also of intermediate series. IV like III, no eyes but a transverse series of minute sense organs on each annulus. V 3-annulate, $a1=a3<a2$ with marginal and supramarginal eyes on *a2* and a row of sense organs on each annulus. IV*a3* and V*a1*, *a2* form lateral buccal lobes and V*a3* the buccal ring. VI 3-annulate dorsally, ventrally *a1* and *a2* unite to form the post-buccal ring and *a3* remains distinct. On the type there is a variation on the right dorsal field of this somite by which the furrow *a1/a2* disappears. VII 4-annulate $(a1=a2=b5<b6)$, ventrally *b5* slightly$<a2$. VIII 5-annulate, $a1\ (b1b2)>a2=b2>c11=c12$; a faint *b1/b2* furrow is much nearer to the anterior margin of *a1*; 1st nephropore. IX 6-annulate, $b1=b5=c11=c12<a2<b2$. X to XXIV 6-annulate and complete $b1<\text{or}=c11=c12<b2=a2=b2$, that is the first and last two annuli normally are shorter, the middle three longer, but the first may be shorter than the last two or equal to them, the former condition being most evident at the cephalic, the latter at the caudal end of the series. These differences in length of annuli are most obvious on well-preserved half-grown individuals but appear on the adults also, but on the adults in this collection are often obscured by unequal contraction and distortion. Last nephropore on XXIV *b2*. XXV 4-annulate, $a1=a2=b5=b6$; *b5* and *b6* are less separated dorsally but shorter ventrally. XXVI 2-annulate, $(a1a2)$ nearly twice *a3* with a short *a1/a2* furrow at margins. XXVII 1-annulate. Metamerism and constitution of the complete somites verified by dissection of the nerve cord, the ganglia of which lie mainly in *a2* but extend into *b2*, that of XIV being crowded forward principally into *b2* by the gastrostome canal. There is some variation in annulation at the caudal end. XXIV may be 5-annulate by the failure of differentiation of *c11* and *c12* and XXV may be 3-annulate, $(a1a2)>b5=b6$. In general the somites at both ends of this species are more elaborately annulated than on *G. monticola*. This is especially the case on the head and on somites XXIV and XXV.

Living color unknown. Preserved specimens gray or light slate color above, light drab or more or less yellowish (cream color) below with indications of more vivid yellow marginal stripes. Except that on some specimens the larger sensory papillæ are yellowish there appear to be no markings.

*Anatomy*.—Pharnynx very muscular, reaching to XIV/XV, euthylæmatous with no trace of anterior denticles or stylets. The difference in the musculature of the pharynx between this species and *G. monticola*, in which the muscles are weak, is very

striking and requires further study. The appearance is due in part at least to the poor condition of preservation of the material of the latter which are soft, relaxed and somewhat macerated. At its caudal end the three muscular ridges become subdivided before reaching the pharyngo-gastric annular valve. Except for the slight difference in position the gastropore and canal are exactly as in *G. monticola*.

*Reproductive organs* are similar to those of *G. monticola*. Testes much subdivided into numerous very small (about .75–1 mm.×.5 mm.), pyriform or tear-shaped sacs filling the greater part of the parenchymatous space between the gut and the longitudinal muscles and lateral vessels from somite XV to XXV. They are so small and so closely packed that the number could not be determined definitely but was estimated at about 60 on each side of most segments but fewer at both ends of the series. Thirty-eight were counted on both sides of a single section. They taper into short efferent ducts which open into the vas deferens lying close to the ventral longitudinal muscles nearer to the nerve cord than the margins of the body. The vasa deferentia are extremely slender and very slightly sinuous in the testicular somites but anterior to the testes gradually increase to 2 or 3 times the diameter and form rather close spiroid coils but neither of the two not fully matured individuals studied in this respect has the enlarged sperm vesicles usual in the family. They enter the tips of the atrial cornua anterior to which they do not extend. Atrium a short subcylindrical chamber embedded in the ventral muscles beneath the nerve cord and opening below into the male bursa. From its summit arise the pair of relatively large, curved, bluntly conical cornua which diverge caudo-laterally and nearly horizontally, scarcely rising above the level of the nerve cord. The cornua are strongly muscular and have a satiny luster. None of the specimens is fully mature which accounts in part for the smallness of the atrium. The testis sacs contain spermatogonia but no fully mature spermatozoa were seen in any part of the system.

Female organs also very simple, consisting of a short, slender, vertical, common oviduct reaching from the ♀ pore to a point immediately ventral to the nerve cord where it ends in a small globular expansion. From this the paired oviducts pass into the slender, tubular, considerably folded and twisted ovisacs, which extend through the neural sinus to XV/XVI. In the more mature specimen the ovisac and duct of only one side is developed.

The collection includes 13 specimens of this species all from Perak, received through Mr. M. W. F. Tweedie of the Raffles Museum. "Larut Hills, 3,700 ft. Feb. 6–17, 1932, H. M. Pendlebury, Federated Malay States Museum," 1 (the largest)





specimen; "Kuala Legap, Plus Valley, Perak, March, 1933", 1, with *H. S. interrupta* and *M. annandalei;* "Plus Valley, near River Yum, Mar. 18, 1933, 11 specimens including type, with *M. annandalei*.

The association of this species with *Haemadipsa* and *Myxobdella* indicates that it is of amphibious habit[1], living along streams under stones, etc. and wandering at night to burrow in the soil in search of earthworms and insect larvæ for food. Like many other burrowing leeches, mature individuals are shaped much like earthworms. The development of the gastropore with advance toward maturity indicates a possible function in relation to reproduction.

**Gastrostomobdella monticola** Moore 1929.

This species, originally described from Mt. Murud, Borneo is represented in the Mt. Kinabalu collection by three specimens taken singly at Lumu Lumu, 5,500 ft. Apr. 1929, F.N.C. and H.M.P.; Lumu Lumu, 5,500 ft. Apr. 7, 1929, H.M.P.; and Pakka, 10,000 ft. Mar. 19, 1929, F.N.C. and H.M.P.

None of these is mature and the gastropore is entirely absent or represented only by a slight slit including a transverse row of minute slits. On all three the male pore is in the typical position at XI/XII but in two the female pore has been shifted slightly caudad into XIII *b1*. On the smallest (30 mm. long) specimen, anterior to XVI the furrows *b1/b2* and *c11/c12* are scarcely developed so that the somites appear to be 4-annulate.

**Mimobdella büttikoferi** Blanchard.

There is a single specimen of this fine burrowing species taken on Mt. Kinabalu at 8,000 ft., March 20, 1929, F.N.C.

It is well-preserved, extended and very hard. The measurements in mm. are length 146, to ♂ pore 24; widths, buccal 3.6, ♂ pore 5.6, maximum near middle of body 6.8, anus 6.4; depths at same points 3.8, 6, 6.5, 4; sucker 5.5, showing that the body is cylindroid with nearly uniform diameter for most of the length but somewhat flattened caudally, the general shape strikingly like an earthworm. No eyes are visible. The gonopores are separated by 6½ annuli, the ♂ being at XII *b2* (*c3/c4*), the ♀ at XIII *b1/b2*. There is no trace of a gastropore, complete somites are 10-annulate, the formula as indicated by the position of the nephropores being $b1<b2$ $(c3, c4)<a2$ $(b3, b4)>2$ $d17<d18>c10<c11=c12$. The label states the living color as coral red and a water color sketch agrees with scarlet vermilion of Ridgway's color charts, which is close to his coral

1. In the Plus Valley this species, together with *Myxobdella*, was collected in small streams. *Haemadipsa* was abundant in damp jungle, but was never found in water. M.W.F.T.

red. It may be pointed out that the position of the gonopores agrees with Blanchard's description of *Scaptobdella horsti* from Borneo not with those from Sumatra.

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## EXPLANATION OF PLATES

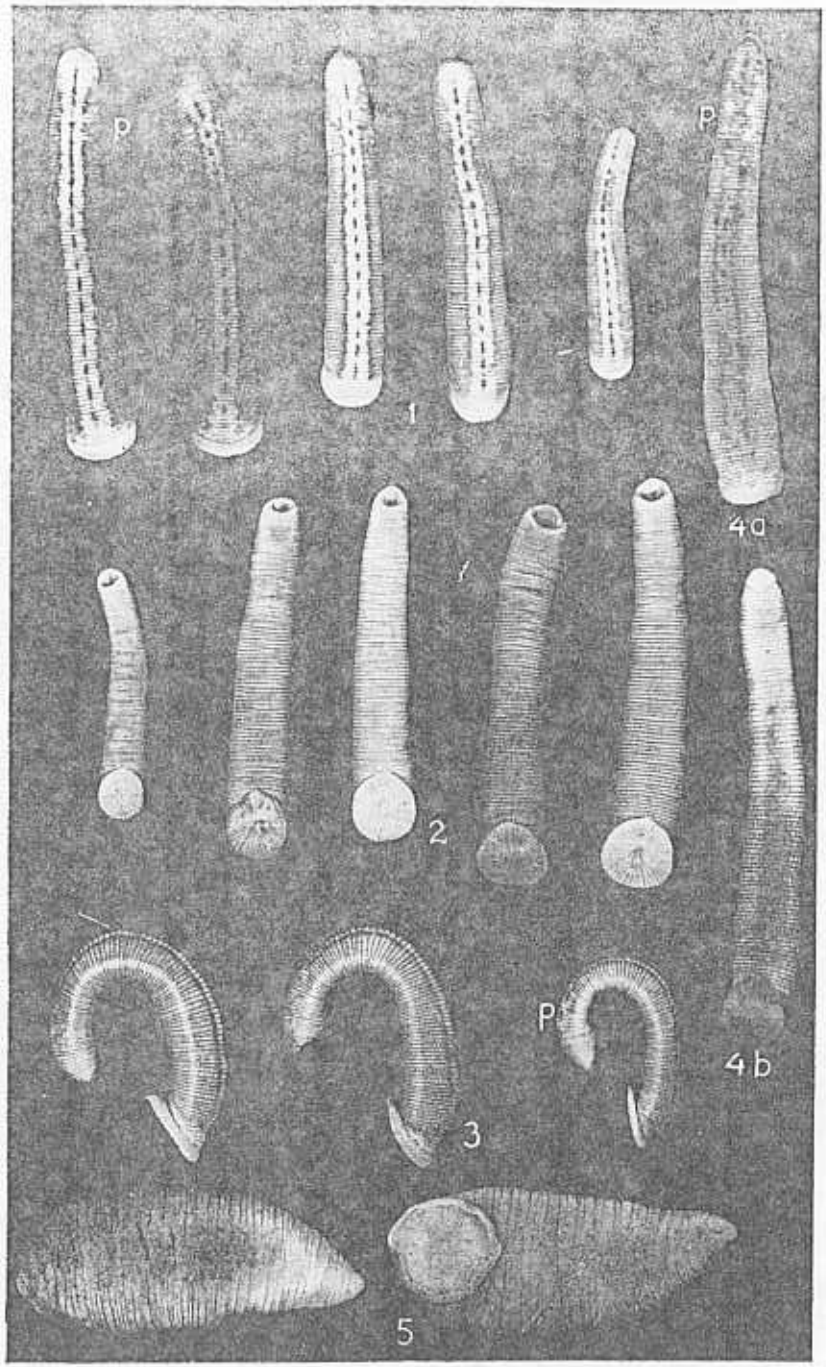
All photographs made under water.

PLATE VI.

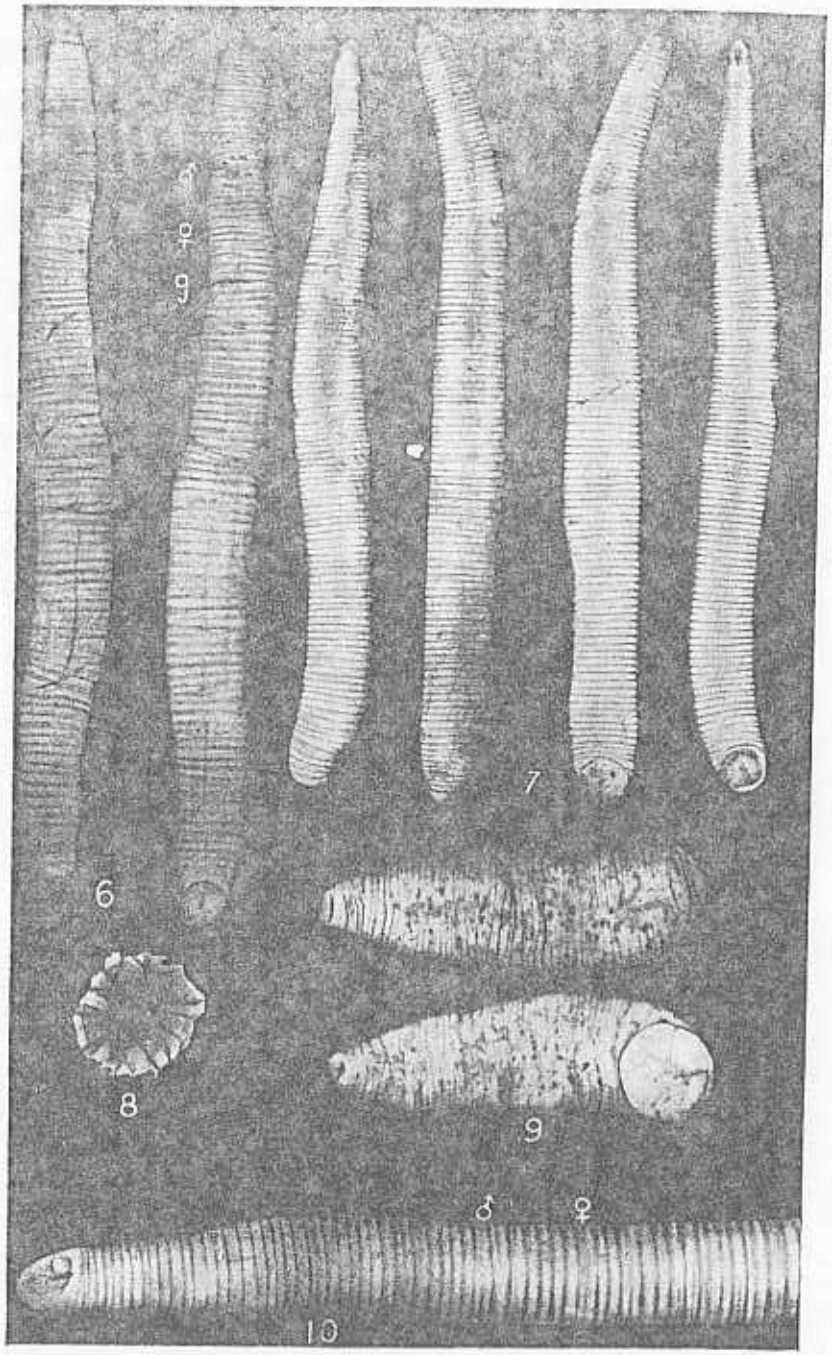
Fig. 1. *Haemadipsa sylvestris interrupta.*—Dorsum of 5 examples from Kuala Legap, Plus Valley, Perak, showing typical color pattern. p—white spots at furrow pits. × 2½.








Malaysian leeches.




Malaysian leeches.



Fig. 2. Ventral aspect of same specimens. Note especially the prominence at the anterior margin of the caudal sucker. × 2½.

Fig. 3. Three examples from the same lot seen from the left side showing the prehensile sucker papilla in different states of flexion and extension. × 2½.

Fig. 4*a* and *b*. *H. s. interrupta*.—Type specimen from dorsum and venter. × 2½.

Fig. 5. *Myxobdella annandalei*.—Dorsal and ventral views of a specimen from River Yum, Plus Valley, Perak, showing the metamerism and annulation. × 2⅔

PLATE VII.

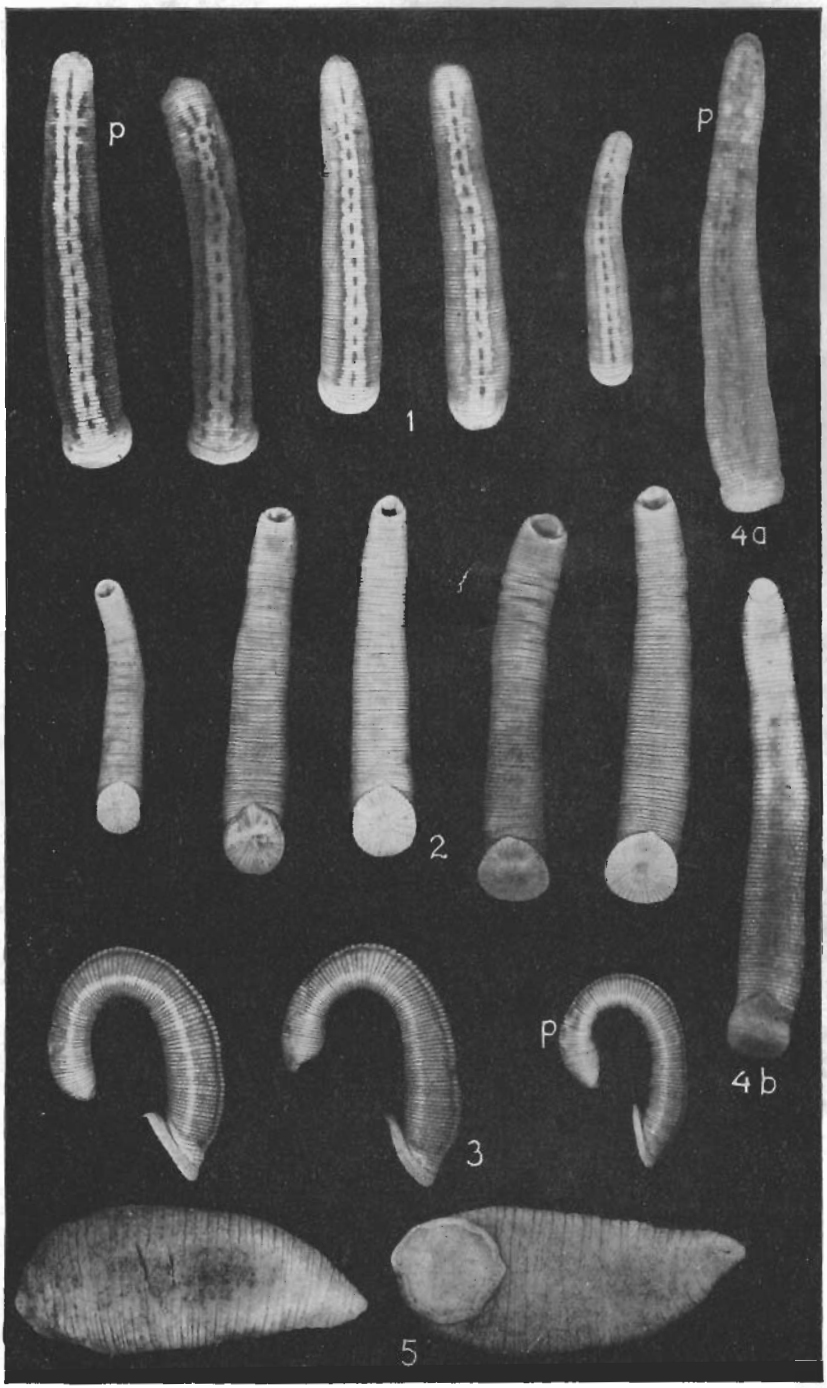
Fig. 6. *Gastrostomobdella vagabunda*.—Large example from Larut Hills, Perak, dorsum and venter, natural size. The gastropore (*g*) is at the posterior margin of the cut made to expose the canal leading to the gut.

Fig. 7. Same, dorsal and ventral views of two from River Yum, Plus Valley. × 2.

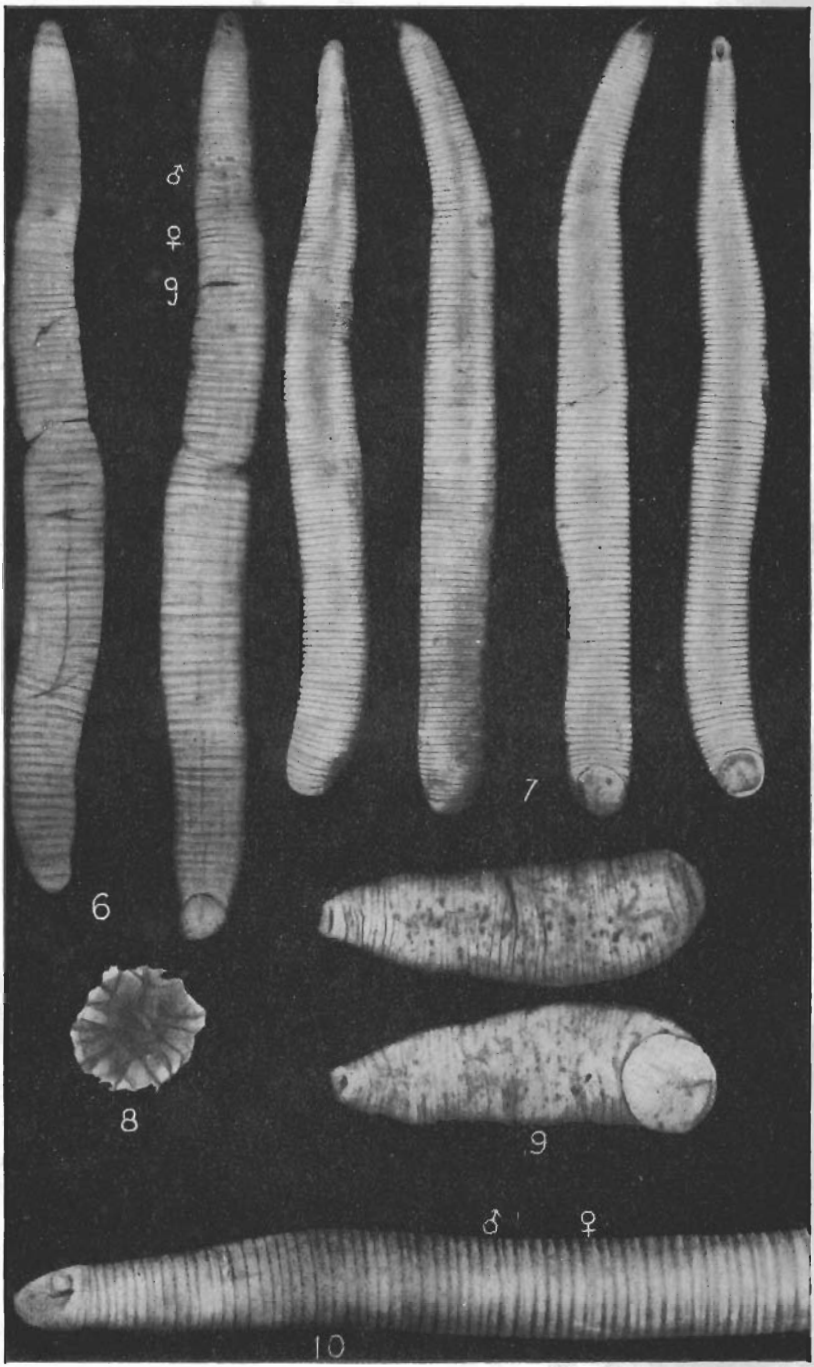
Fig. 8. *Haemadipsa* sp. Egg capsule. × 2.

Fig. 9. *Myxobdella annandalei*.—Dorsal and ventral views of a specimen from River Yum, Plus Valley, especially to show color pattern.

Fig. 10. *Mimobdella büttikoferi*.—Venter of anterior end. × 2½. ♂, male, and ♀ female pores.




Malaysian leeches.




Malaysian leeches.