RECORDS

of the

INDIAN MUSEUM

(A JOURNAL OF INDIAN ZOOLOGY)

Vol. XXVI, Part IV

JUNE, 1924

Calcutta:
PUBLISHED BY THE DIRECTOR, ZOOLOGICAL SURVEY OF INDIA

1924

Price Two Rupees.

COLLEMBOLA OF THE SIJU CAVE, GARO HILLS, ASSAM.

By GEORGE H. CARPENTER, *D.Sc., M.R.I.A., Keeper of the Manchester Museum, University of Manchester.*

The Springtails collected during the exploration of the Siju Cave[1] are referable to four species all of which appear to be undescribed. All belong to the family Entomobryidae, two being species of the widespread genus *Lepidocyrtus*, and one belonging to *Paronella* whose members are distributed over the tropics of the Eastern Hemisphere. This latter and one of the Lepidocyrti were found only at the cave entrance and have no claim to be regarded as belonging to the cave fauna. The other *Lepidocyrtus*, though occurring as far as 500 feet into the cave, is in no respect modified, being normally pigmented and possessing well-developed eyes. There remains the fourth species—*Cyphoderopsis gracilis*—which belongs to a tribe all of whose members are eyeless and excessively pale, so that they present the aspect usually distinctive of cave-dwellers. This insect was found very sparingly 500 feet and 800 feet from the entrance, and in some numbers in the farthest recesses of the cave—3,500 feet in. The tribe Cyphoderini includes many cave-haunting Springtails, but the majority of its members live under stones, in ants' nests, and in other comparatively shallow concealed situations, so that there is much doubt if the "cavernicolous" appearance of even this species can be regarded as a result of the environment afforded by its subterranean home.

All the specimens described are preserved in the collection of the Indian Museum.

ENTOMOBRYIDAE.

ENTOMOBRYINI.

Lepidocyrtus magnificus, sp. nov.

(Figs. 1-3.)

Mesonotum very prominent, four times as long as metanotum; fourth abdominal segment seven times as long as third. Feelers twice

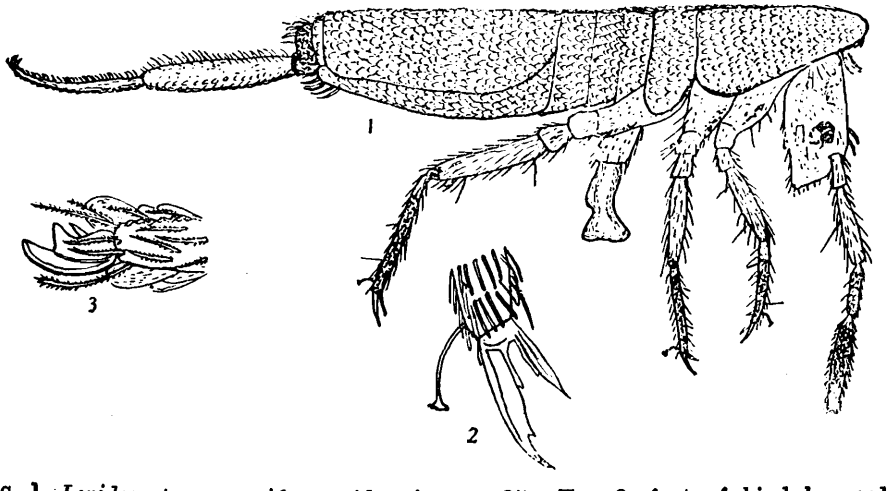


FIG. 1. *Lepidocyrtus magnificus*, side view: ×25. FIG. 2, foot of hind leg: ×160 FIG. 3, tip of dens and mucro of spring: × 320.

[1] For a description of the cave and of the remainder of its fauna see *Rec. Ind. Mus.* XXVI, pp. 1-136.

as long as head, proportional length of their segments as 6 : 14 : 10 : 17. Foot-claw elongate, slightly curved, with narrow internal lamella proximal and distal teeth; empodial appendage narrowly lanceolate with delicate lamella (fig. 2). Spring half as long as body, manubrium somewhat longer than dentes; mucro relatively stout with strong teeth, the dorsal spine short (fig. 3).

Length 2·75 mm. Colour pale yellow, with the third and fourth antennal segments, the edges of the mesonotum and metanotum, some spots on the haunches, the tips of the thighs, the shins, and the last abdominal segment dark violet.

Locality.—Siju Cave, Assam, at entrance; one specimen, February 1922.

This attractive species belongs to the group of large Lepidocyrti which includes *L. maximus* Schött (1893) from the Cameroon, *L. robustus* Imms (1912) from Travancore, and *L. imperialis* Carpenter (1916) from the Seychelles. The relatively short third antennal segment and the strong teeth of the mucro appear to be the most evident structural distinctions. The eyes are normally developed and the species is not at all modified as a cave-dweller.

Lepidocyrtus exploratorius, sp. nov.

(Figs. 4-6.)

Mesonotum two and a quarter times as long as metanotum (fig. 4); fourth abdominal segment four times as long as third. Feelers half as long again as head, proportional length of their segments as 5 : 7 : 7 : 11. Foot-claw elongate and slender with feeble proximal and distal teeth; empodial appendage narrowly lanceolate (fig. 5). Spring nearly half as long as body, manubrium slightly longer than dentes; mucro relatively slender with prominent teeth, the dorsal spine elongate and acute (fig. 6).

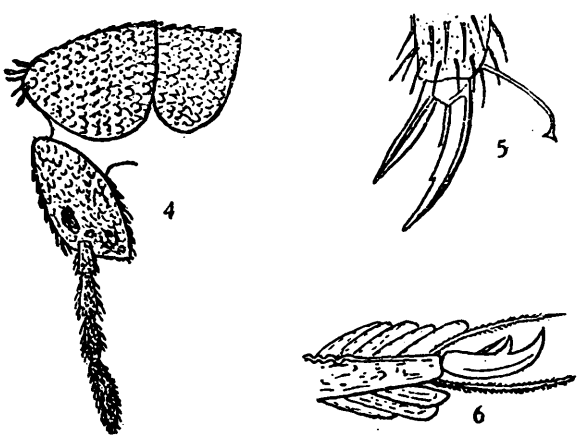


Fig. 4. *Lepidocyrtus exploratorius*, side view of head and thorax: × 50. Fig. 5, foot of hind leg: × 240. Fig. 6, tip of dens and mucro: × 320.

Length 1·7 mm. Colour uniformly pale yellow except the feelers which are deep violet, and some feeble violet streaks on the thighs.

Locality.—Siju Cave, Assam, 100-300 feet from entrance, twelve specimens; 400-500 feet from entrance, three specimens.

The eyes of all these insects appear to be normal and the distribution of the species in the cave suggests that it is a casual immigrant from the outer world. It is closely related to *L. obscuricornis* Carpenter (1916) from the Seychelles, differing in the relatively longer mesonotum and shorter fourth abdominal segment, while the foot-claw and the mucro are closely similar.

PARONELLINI.

Paronella brunnea, sp. nov.

(Figs. 7-9.)

Feelers one and two thirds times as long as body, the first and second segments stouter than the third and fourth, relative lengths as 10 : 8 : 4 : 11. Fourth abdominal segment eight times as long as third. Legs with indication of joint between shin and foot; foot-claw with small paired basal lateral and internal teeth, and an internal distal tooth; empodial

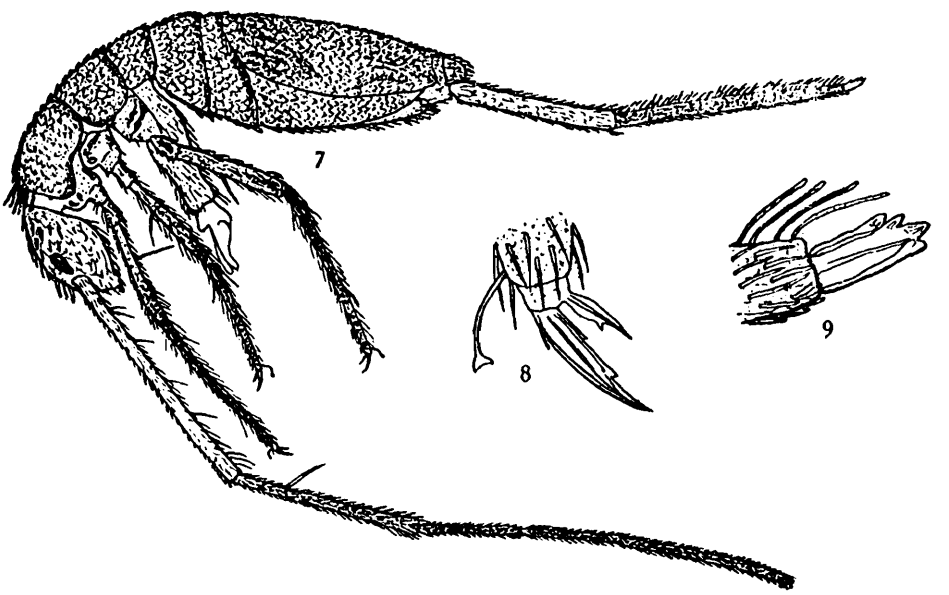


FIG. 7. *Paronella brunnea*, side view: × 25. FIG. 8, foot of hind leg: × 130. FIG. 9, tip of dens and mucro: × 80.

appendage slender, lanceolate, with distinct internal tooth (fig. 8). Spring four-fifths as long as body, dens half as long again as manubrium, without scale-like appendage at base of mucro; mucro (fig. 9) with two terminal and two dorsal teeth, the ventro-terminal tooth having a rounded lateral lobe.

Length 2·5 mm. Colour ochreous brown with dark transverse bands on the hind margins of the terga, and alternating dark and pale longitudinal streaks on the fourth abdominal segment; manubrium pale; dentes, tips of thighs and whole of shins, also second antennal segments, dusky; third and fourth antennal segments almost black.

Locality.—Siju Cave, Assam, at entrance; five specimens, February 1922.

This handsome springtail is readily distinguished from other species of *Paronella* by the elongate feelers in combination with the toothed empodial appendage and the absence of a scale-like appendage at the base of the mucro. Its nearest described ally seems to be *P. insignis* Imms (1912) from Travancore, which agrees with it in the last named character. The specimens from Siju Cave were all found at the entrance and the insect is in no respect modified for life underground.

CYPHODERINI.

Cyphoderopsis gracilis, sp. nov.

(Figs.10-12.)

Feelers twice as long as head, proportionate length of their segments as 3 : 6 : 6 : 10. Feet without clubbed hairs ; foot-claw long, slender and strongly curved, untoothed ; empodial appendage elongate and narrowly lanceolate, untoothed (fig. 11). Fourth abdominal segment six times as

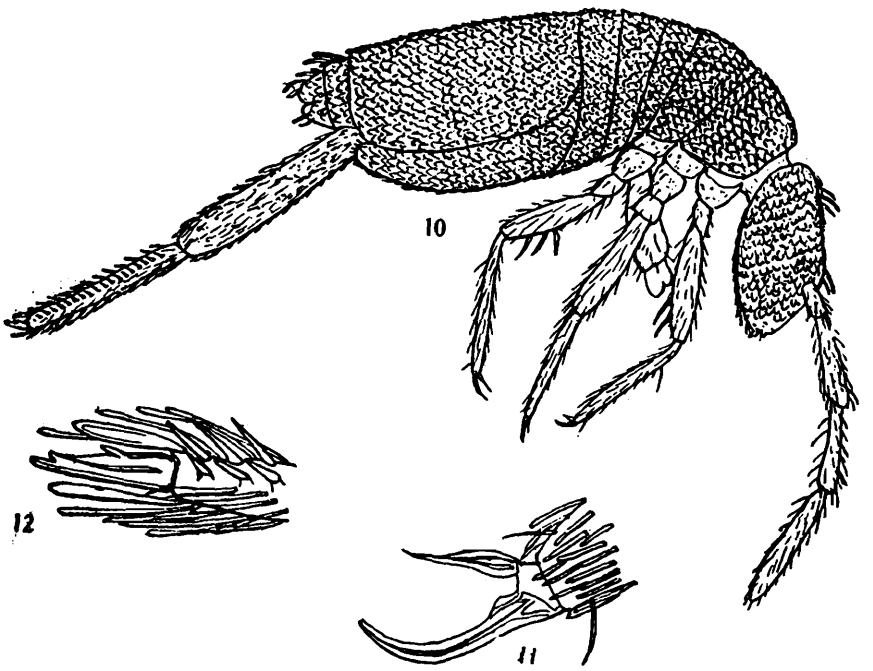


Fig. 10. *Cyphoderopsisgracilis,* side view: × 240. Fig. 11, foot of hind leg: × 240. Fig. 12, tip of dens and mucro: × 240.

long as third. Spring nearly three-quarters as long as body, dens three-quarters as long as manubrium ; mucro relatively short with blunt terminal and two acute dorsal teeth (fig. 12).

Length 1·5 mm. Colour white with feeble yellowish or brownish mottlings.

Locality.—Siju Cave, Assam, 400-500 ft. from entrance, 1 specimen ; 800 feet from entrance, 4 specimens ; 3,500-3,600 ft. from entrance, 10 specimens.

This is the single characteristic cavernicolous insect of the collection. The members of the tribe (Cyphoderini) to which it belongs are all blind and pale in colour : most of them live in ants' nests, under stones, and in similar situations. The observed distribution of the species in Siju Cave suggests strongly that it is an inhabitant of the deeper galleries only. The genus *Cyphoderopsis* (Carpenter, 1917) was founded for a springtail (*C. kempi*) from Rotung, Assam, collected under stones by the Abor Expedition. *C. gracilis* is easily distinguished from *C. kempi* by its long feelers, its very long, curved toothless foot-claw, and its much shorter mucro ; there appears to be no scale-like appendage at the base of the mucro but the dentes are thickly scaled. The simple foot-claw and empodial appendage and the short mucro, no longer

relatively than that of the Paronellini, are annectant characters more strongly marked in *C. gracilis* than in *C. kempi*, and may afford evidence of the primitive standing of this deep-dwelling inmate of the Siju Cave.

REFERENCES.

1916.—G. H. CARPENTER.—The Apterygota of the Seychelles. *Proc. R. Irish Acad.* xxxiii (B), 1916, pp. 1-70, pls. i-xviii.

1917.—G. H. CARPENTER.—Zoological Results of the Abor Expedition, 1911-12. Collembola. *Rec. Ind. Mus.* viii, 1917, pp. 563-8, pls. lv-lvii.

1912.—A. D. IMMS.—On some Collembola from India, Burma and Ceylon with a Catalogue of the Oriental Species of the Order. *Proc. Zool. Soc. Lond.* 1912, pp. 80-125, pls. vi-xii:

1893.—H. SCHÖTT.—Beiträge zur Kenntniss der Insekten-fauna von Kamerun. Collembola. *Bih. t. K. Svensk. Vet. Akad. Handl.* xix, pt. iv, No. 2, 1893.

NOTES ON THE TYPES OF DIPTERA NEMATOCERA (MYCETOPHILIDAE AND TIPULIDAE) DESCRIBED BY MR. E. BRUNETTI.

By F. W. EDWARDS.

(*Published by permission of the Trustees of the British Museum.*)

On his return from India in June 1921 Mr. Brunetti brought with him on loan from the Indian Museum a representative set of all the Nematocerous Diptera (excluding Sciarinae, Cecidomyiidae, Chironomidae and Culicidae) contained in the collections of that institution. Included in the material so borrowed were the types of the great majority of the species described by him since 1908.

The re-examination by Mr. Brunetti and the present writer has brought to light so many points, both in regard to corrections in synonymy and details of structure not noted at the time of description, that we have thought it desirable to bring all these together and publish them in one paper. In the notes which follow, although the present author is of course alone responsible for statements made, it is only right to state that in regard to the Tipulidae the conclusions were arrived at in conjunction with Mr. Brunetti, and that in nearly every case (excepting only some cases of generic location) he is in agreement with the results as here given.

The species are dealt with under the genera and in the chronological order in which they were described by Brunetti. For brevity, "*Rec.*" is used for "*Records of the Indian Museum,*" and "*Fauna*" for "*Fauna of British India, Diptera Nematocera.*" Where the actual type was not re-examined, comment has as a rule been omitted, because in some cases it appeared that a mistake had been made in identification of the examples which were brought to London to represent the species.

A few additional corrections have been made by Dr. C. P. Alexander (*Insecutor Inscitiae*, i, 1913, pp. 118-120) and adopted by Mr. Brunetti in his later work.

MYCETOPHILIDÆ.

Macrocera brunnea (*Fauna*, 53). This differs from all the other species described by Brunetti in having dense macrotrichia on the apical half of the wing. Tip of *R1* much swollen, also the middle part of *Rs*.

M. elegans (*Fauna*, 54). The figure is incorrect in showing a cross-vein in cell *Cu1* and in showing *Sc* darkened. The antennæ are longer than in the other species, nearly four times as long as the body.

M. inconspicua (*Fauna*, 54). Eyes unusually large, the lateral ocelli touching the eye-margins. Claspers peculiar, with a sharp sinuous blackened tooth about the middle, a pale finger-like projection just beyond it, and one black claw at the tip (not two as described).

M. ferruginea (*Fauna*, 55). This is almost certainly the female of *M. inconspicua.*

Platyura suffusinervis (*Fauna*, 60). Differs from all the other species described by Brunetti in the form of the antennae, which are not only conspicuously flattened, but have the points of attachment of the short, deep segments much above the middle, as in *Ceroplatus*; the species is however excluded from *Ceroplatus* by its long slender palpi. It also differs from all Brunetti's species except *P. indistincta* in having the pleurotergites distinctly hairy. The fine setae of the tibiae are not arranged in conspicuous rows.

P. apicipennis (*Fauna*, 61). This belongs to the group of species (*P. fasciata* Mg. and allies) which have the pleurotergites bare; postnotum pointed, with a few short bristles at its tip; fine tibial setae arranged in conspicuous longitudinal rows; *An* not reaching the wing-margin.

P. affinis (*Fauna*, 62). Evidently near *P. apicipennis*, though the type is much damaged and rubbed. Differs in the rather longer antennae (basal flagellar segments quite as long as broad), longer costa (extending nearly half-way from *R4+5* to *M1*), longer *R2+3* and relatively shorter third section of the costa (less than half as long as the fourth).

P. marginata (*Fauna*, 62). Only paratype male examined: agrees, with description except that the whole wing-tip is dark. It is probably the male of *P. affinis*. The female mentioned by Brunetti from Naini Tal belongs to another species altogether.

P. flaviventris (*Fauna*, 62). Nearly allied to the two preceding, but distinct by the abdominal coloration. The mesonotum should have been described as brownish with three darker stripes, less sharply defined than in *P. affinis*.

P. vicina (*Fauna*, 63). Pleurotergites and postnotum bare, but *An* distinctly reaching the wing-margin though faint towards the tip. A slight cloud below the apical half of *Cu2*. Ninth tergite of male trilobed (one of the types is a male).

P. octosegmentata (*Fauna*, 64). Pleurotergites and postnotum bare; *An* reaching the margin. Costa not reaching quite half-way from *R4+5* to *M1*.

P. ruficornis (*Fauna*, 64). Pleurotergites bare, postnotum with a few small bristles at the tip. *An* abbreviated as are also *M2* and *Cu1*. Costa reaching more than half-way from *R4+5* to *M1*; third costal division quite two-thirds as long as the fourth. The type is from Sylhet, 2.ii.05; the male mentioned from Naini Tal is a different, undescribed species.

P. indistincta (*Fauna*, 65). Pleurotergites hairy; postnotum bare and not much produced. *An* faint and not quite reaching the margin. *R2+3* ending quite close to the tip of *R1*. Antennæ somewhat flattened, but the segments articulated in the middle. Male claspers simple, ending in a single black spine.

P. longifurcata (*Fauna*, 65). Structurally rather similar to *P. vicina*, but ninth tergite of male bilobed, not trilobed.

P. funerea (*Fauna*, 65). As pointed out by Brunetti, this is peculiar in having only two ocelli, placed close together as in *Mycomyia*. Pleurotergites and postnotum bare. *An* not quite reaching the margin; *m-cu* nearly vertical.

P. flavomarginata (*Fauna*, 66). Apparently nearly allied to *P. vicina*. Abdomen of type lost.

P. fumipes (*Fauna*, 66). Pleurotergites and postnotum bare. *An* reaching the margin close to tip of *Cu2*, *m-cu* continuing the direction of *Cu1a*. *Sc* reaching well beyond the base of *Rs*.

Isoneuromyia annandalei (*Fauna*, 67). This is a *Platyura* belonging to the same group as *P. grandis* Brun. and *P. fumipes* Brun.

I. rufescens (*Fauna*, 559). Differs especially from *P. annandalei* in having the antennae much less flattened and a trifle longer (not shorter) but evidently belongs to the same group.

Mycomyia flaviventris (*Fauna*, 72). The type is a female, not a male. *Sc* ends in *R1* (not free as stated in the key). Fork of *Cu* beyond base of *r-m*. Evidently belongs to the group of *M. trilineata* Zett. Possibly the female of *M. flavithorax* Brun.

M. bifascipennis (*Fauna*, 72). The type of this species is also a female; subgenus *Neoempheria*.

M. basalis (*Fauna*, 73) and **M. tinctipennis** (*Fauna*, 74) are both typical members of the subgenus *Neoempheria* with a vein-like fold between *R4+5* and *M1*, and the costa extending well beyond *R4+5*.

M. ferruginea (*Fauna*, 74). This is also a *Neoempheria*, although the spurious vein is not well marked, and the costa only extends slightly beyond *R4+5*. The specimen from Kurseong is labelled type, although it agrees better with the description of the second specimen. The figure of the wing is inaccurate in several respects, *e.g.*, in showing *An* complete and in omitting the apical darkening of the wings.

M. trilineata (*Fauna*, 75). Belongs to *Mycomyia* s. str., as do all the remaining species. Mid coxa with long spur. Scutellum with four bristles. First segment of front tarsus slightly longer than the tibia. Fork of *Cu* before base of *r-m*. The name is preoccupied by *M. trilineata* Zett., but a substitute is unnecessary as the species appears to be identical with the European *M. winnertzi* Dz.

M. indefinita (*Fauna*, 76). Mid coxa with short spur, as in *M. incisurata* Zett. First segment of front tarsus longer than the tibia. A slight dark cloud over *r-m* and the small cell. Fork of *Cu* immediately before the base of *r-m*. Fork of *M* twice as long as its stalk.

M. indica (*Fauna*, 76). Mid coxa with long spur. First segment of front tarsus as long as the tibia. Fork of *Cu* well before the base of *r-m*.

M. flavithorax (*Fauna*, 77). Structurally identical with the species Dziedzicki has figured as *M. affinis* Staeg., though this is a case of mistaken identification. The colour differences are unimportant, the species being very variable in this respect. The correct name for the species is *M. fimbriata* (Mg.).

M. curvilinea (*Fauna*, 77). Mid coxa with short spur, and in other respects resembling *M. incisurata* Zett., though with different hypopygium. Apical (not basal) margins of tergites paler. Fork of *M* as long as its

stalk. The specimen from Darjiling (*Brunetti*) and another from Bhowali (*Imms*), also labelled type, belong to two different, undescribed species.

Polylepta dubiosa (*Fauna*, 79). This is nearly allied to the European *P. undulata* Winn., differing in having dense small microtrichia (dot-like under a magnification of 100) as well as macrotrichia on the wings. In *P. undulata* there are no microtrichia. Venation much as in *P. undulata*, but *M1* not interrupted at the base. There are three ocelli, the median one quite distinct.

P. incerta (*Fauna*, 79). The type is a male *Mycomyia*, closely related to *M. cinerascens* Zett., but differing slightly in the hypopygium.

Gnoriste brevirostris (*Fauna*, 83). The type is a female (not male) *Boletina*. Pleurotergites hairy ; postnotum bare. A small brown cloud over the stalk of *M* and base of fork.

Palæoanaclinia flavohirta (*Fauna*, 86). A *Boletina*. Pleurotergites bare. *Sc* ends above base of *Rs* ; *Sc2* absent. Costa reaching barely a third of the way from *R4+5* to *M1*.

Greenomyia nigricoxa (*Fauna*, 87). Brunetti in his recent catalogue has sunk this genus under *Leia*, but though it is evidently related to *Leia* I believe it to be quite distinct, chiefly by having the lateral ocelli far removed from the eye-margins, and *Cu1* not detached at the base.

Odontopoda indica (*Fauna*, 90). This is an *Anaclinia*, quite close to *A. nemoralis* Mg., differing chiefly in having only a few macrotrichia towards the tip of the wing, mainly in cell *R1*.

Anomalomyia indica (*Fauna*, 91). By the position of the ocelli close together on the front, and the absence of a comb on the hind tibia, this is nearer to *Greenomyia* than to *Anomalomyia*, though differing from *Greenomyia* in having the costa produced and *Cu1* detached at the base. From *Acrodicramia*, it differs in the absence of *Sc2* and the comparative shortness of *r-m*, as well as in the position of the ocelli.

Leia insignis (*Fauna*, 101). The type is a male, not female, well distinguished by the extraordinarily long and pointed parameres.

L. nigra (*Fauna*, 101). This is a *Greenomyia*, differing from *G. nigricoxa* in the black femora and front coxae, and distinctly shorter *Sc*.

Rhymosia flavolimbata (*Fauna*, 103). This is not a *Rhymosia*, but belongs to that group of *Leiomyia* (Leia Joh.) in which the lateral ocelli are all but in contact with the eyes, *Sc 2* is faint and placed before the middle of *Sc*, the tip of which is also very faint.

R. genitalis (*Fauna*, 104). This is a *Trichonta*, belonging to the small atypical group of species which have a fairly strong basal bristle on the hind coxa. Upper clasper long and narrow, with three long bristles at the tip.

R. albolateralis (*Fauna*, 104). A true *Rhymosia*. Third segment of front tarsus rather suddenly narrowed towards the tip, with a row of six short blunt spines, fifth very slender, a little longer than fourth, claws barely distinguishable.

R. annulicornis (*Fauna*, 105). A *Leiomyia*, nearly related to *L. flavolimbata*, though with very different hypopygium.

R. humeralis (*Fauna*, 106). Another *Leiomyia*, related to the last, ut again with very different hypopygium.

Macrobrachius longicosta (*Fauna*, 109). Type not examined, but he figure of the genitalia raises the suspicion that it may be an *Exechia.*

Phronia simplex (*Fauna*, 111). This is really an *Exechia*, related o *E. basilinea*, but distinct. *Rs* straight, *r-m* about twice as long as he stalk of *M.*

P. semifumata (*Fauna*, 111). Type not examined, but by figure f genitalia is evidently an *Exechia.*

Mycetophila cinctiventris (*Fauna*, 115). The type is a female not male) *Delopsis.* Ventral bristles of second abdominal segment listinct. Mid-tibial bristles 5 dorsal, 3 external, 4 ventral, 1 internal. A slight but quite distinct dark cloud over *r-m.*

M. quadrifasciata (*Fauna*, 115). The chaetotoxy of the mid-tibiae is somewhat unusual: 6 dorsal, 3 external, 3 ventral, 4 internal, also one out of line, at two-thirds of the length of the tibia, between the dorsal and external rows.

M. suffusa (*Fauna*, 117). Related to the European *M. czizeki* Landr., the wing being the same. Mid-tibial formula 5.3.2.3.

M. himalayensis (*Fauna*, 117). A *Delopsis*, identical with *D. cinctiventris* (Brun.). In some specimens the fifth as well as the fourth abdominal tergite is yellow laterally at the base.

M. binotata (*Fauna*, 118). Appears to be only a variety of the European *M. lineola* Mg.; no new name is therefore required, although *M. binotata* has been used before by Haliday.

Delopsis collaris (*Fauna*, 119). As this name is preoccupied by *D.* (*Mycetophila*) *collaris* Enderlein, I have already renamed it *D. brunettii.* Mid-tibial formula 5.4.3.0, hence quite distinct from *D. cinctiventris.*

Euryschalis spectralis (*Fauna*, 560). This is a typical member of the genus *Coelosia.*

TIPULIDAE.

Dicranomyia marmoripennis (*Fauna*, 369). Identical with *Rhipidia pulchra* de Meij., which apparently belongs to Alexander's subgenus *Arhipidia* of *Rhipidia.*

D. demarcata (*Fauna*, 370). Evidently a *Rhipidia* (s. str.), very close to *javanensis* de Meij. Flagellar segments with short necks (♀) and much enlarged ventrally. *Sc* ending a little before middle of *Rs.*

D. absens (*Fauna*, 372). Type not brought to London.

D. saltans (*Fauna*, 373). These specimens are evidently wrongly determined as Doleschall's species, on account of the venation and the conspicuously darkened tips of the wings. In my opinion they are *D.* (*Thrypticomyia*) *apicalis* (Wied.).

D. fraterna (*Fauna*, 378). Very close to the European *D. didyma* Mg., differing in the absence of any dark cloud at the tip of the wing.

D. fascipennis (*Fauna*, 379). Apparently identical with *D. fullowayi* Alex., probably also, as suggested by Brunetti, with *D. punctulata* de Meij., this last being the oldest name.

D. subfascipennis (*Fauna*, 380). Very near *D. fraterna* and the European *D. didyma* Mg., differing from both chiefly in the absence of the black tips to the femora.

D. ornatipes (*Fauna*, 380). Not a *Dicranomyia* at all, but a *Gonomyia*, identical with *D.* (*Lipophleps*) *pilifera* de Meij.

D. cinerascens (*Fauna*, 381). Flagellar segments shortly oval, short-haired. "Rostrum" of hypopygium long, with two rather long and slender spines. *Sc1* ends above base of *Rs*, *Sc 2* well before its tip. The dark seam extends along the whole of *Cu*.

D. delicata (*Fauna*, 383). Very similar to *D. chorea* Mg., perhaps the same, but female only examined. Flagellar segments shortly oval, short-haired. Stigma grey on the basal part only, otherwise faint. Slight cloud at tip of *Rs*.

D. flavobrunnea (*Fauna*, 384). Flagellar segments oval, hairs half as long again as the segments. A ♂ from Chota Nagpur looks the same, except for position of *Cu-a* far before the discal cell. It has two short, widely separated spines on the "rostrum."

D. fortis (*Fauna*, 385). Brunetti has evidently mistaken a somewhat abnormal ♀ ovipositor for a ♂ hypopygium. A specimen (paratype) brought to London agrees with the description. Flagellar segments elongate, except the first three or four, long-haired. This is very close to *D. nongkodjadjarensis* de Meij., but has no trace of darkening on the cross-veins.

D. nigrithorax (*Fauna*, 385). Close to the European *D. morio*. Type not examined. In a female specimen the apparent 15th antennal segment appears to be only the narrow apical portion of the 14th. *Sc* ending slightly beyond base of *Rs*.

D. subtessellata (*Fauna*, 565). Genus *Rhipidia* (s. str.), very near *R. maculata* Mg. Antennae shrivelled in type; as far as can be seen the basal flagellar segments have each two appendages, last two segments simple, previous three each with one short appendage. *Sc* ending just before middle of *Rs* (the most obvious distinction from *R. maculata*). This species has recently been redescribed by Senior-White as *Rhipidia zeylanica*.

D. bicinctipes (*Fauna*, 566). Very close to *D. kobusi* de Meij., as determined by Brunetti. Flagellar segments oval, with short necks, dorsal hair not distinctly differentiated. Fleshy lobes of hypopygium elongate. Tibiae with the ground-colour white, not brownish-yellow. Pre-arcular portion of the wing not so elongate as in *Thryptocomyia*. *Rs* rather short, *Ax* somewhat sinuous, anal angle faintly indicated.

D. columbina (*Fauna*, 567). Very close to *D. tipulipes* Karsch but *R* with *two* dark areas besides those at the base and tip. The species occurs in Africa as well as India (Brit. Mus. Coll.), and has probably been described under other names.

D. approximata (*Fauna*, 567). Almost identical with *D. fortis* Brun. but the wings are transparent, without the brown tinge of *D. fortis*; they are also somewhat narrower in proportion to their length.

D. innocens (*Fauna*, 568). Flagellar segments shortly oval, short-haired. Two shortish spines on rostrum of hypopygium. *Sc2* close to tip of *Sc1*. Tip of *R1* turned sharply up at *r*. This is probably

identical with *D. sordida* (Fauna, 382); a paratype ♀ of the latter agrees in all important respects.

D. bicolor (*Rec.* xv, 285). A very distinct species probably better referred to *Limnobia*. The hypopygium is rather remarkable, the fleshy lower clasper carrying a long pointed appendage blackened at its tip, similar in form to the upper clasper but with a blunt ended basal arm. *Sc* ending far beyond base of *Rs*, *Sc2* close to its tip.

D. prominens (*Rec.* xv, 285). *Sc* ending much before the base of *Rs*, almost as far as the length of *Rs*.

D. niveiapicalis (*Rec.* xv, 285). This is not a *Dicranomyia*. In many respects it resembles a *Teucholabis*, and may perhaps be referred to that genus for the present, but on account of the peculiar structure of the antennae and palpi a new genus might well be formed for it. The basal six flagellar segments are almost united into a large cone, with short dense pubescence, remainder (6-8 segments, probably 8 but not easy to count) very slender, with long hairs. Palpi very short, second segment swollen, nearly globular, third and fourth small, together much smaller than the second. Pleura with two broad deep chocolate-brown stripes, the lower one extending from the neck to the base of the abdomen. Tibiae pure white towards the tips, tarsi mostly snow-white, claws large and simple, empodia present. *Cu1a* and *r-m* at about the same level, well beyond base of discal cell. *Cu2* curved downwards at tip. Alexander's *Limnobia (?) teucholabina*, recently described from Fiji, is evidently closely related to this species, though not identical with it.

D. pictipes (*Rec.* xv, 286). Very close to *bicinctipes* Brun., and *kobusi* de Meij., differing from the former in having the mid femora longer and more slender, and the brown cloud over the base of *Rs* much more distinct.

Ceratostephanus antennatus (*Rec.* vi, 272). As already known, this is a *Rhipidia*, nearly allied to *R. maculata* Mg. Apparently distinguishable from *R. subtesselata* (Brun.) by the shorter *Sc*, which ends only very slightly beyond the base of *Rs*, and by the presence of a rather large and distinct grey spot over the base of *Rs* and the tip of *Sc*.

Limnobia festiva (*Fauna*, 400). Seems to be rather a *Dicranomyia* than a *Limnobia*, though the male claspers are small and concealed. Claws with one small sub-basal tooth, empodium small. Wing markings not quite so strong as shown in the figure.

L. tinctinervis (*Fauna*, 401). A *Dicranomyia*, identical with *D. puncticosta* Brun.

L. indica (*Fauna*, 401). On venational characters (the long and rather curved cell *R 2+3*, and the condition of the media, cell *M* being distinctly longer than cell 2nd *M2*: or in other words, the *anterior* instead of the posterior branch of the fourth longitudinal vein being forked) this species seems to be nearer to *Libnotes* than to *Limnobia*. The relationship to *Libnotes* is also indicated by the structure of the hypopygium, which is of the *Dicranomyia* type as in all typical *Libnotes*. *L. indica* is very close to, if not identical with the species described by van der Wulp as *Dicranoptycha signaticollis*.

L. trimaculata (*Fauna*, 402). This is nearly allied to *L. indica*, and like that species should probably also be referred to *Libnotes*. Both

are evidently related to *Libnotes picta* Alex. from Guam, and *L. montivagans* Alex. from Java.

L. longinervis (*Fauna*, 403). Certainly a *Libnotes*. In the type the wing-markings are much less conspicuous than is indicated in Brunetti's figure, ground colour pale grey. No markings on pleura. Outer flagellar segments rather elongate, the last twice as long as the penultimate.

L. centralis (*Fauna*, 403). Intermediate between *Limnobia* and *Libnotes*, though perhaps with more affinity with the former, since cells *M1* and *2nd M2* are equal, and the hypopygium is of the *Limnobia* type. Very close indeed to *L. nigra*, hypopygium practically identical, but venation differs somewhat; discal cell shorter and broader, and *Rs* longer, almost equalling *R 2+3*.

L. niveipes (*Fauna*, 404). Perhaps a true *Limnobia*, but differs in some respects from the typical forms of the genus. Flagellar segments rather elongate oval, without necks, and without long dorsal hairs. Tarsi short, basal half of first segment black, apical half white like the remaining segments. Wings rather narrowed at base, no definite anal angle, *Ax* sinuous near base.

L. nigra (*Fauna*, 404). This is identical with the Australian *L. bidentata* Skuse, specimens of which are in the British Museum collection from Queensland (*Bancroft*) and have been compared with Brunetti's type. There is no structural difference. Some of the Australian specimens have a pale area on the sides of the praescutum and on the pleura, but others agree with Brunetti's type in having these parts dark like the rest of the thorax. This is therefore a most interesting case of extremely wide distribution in a small, obscure, and apparently uncommon cranefly. The species is perhaps better referred to *Libnotes* than to *Limnobia*; at any rate the venation is practically the same as in *Libnotes nigricornis* Alex.

L. triangularis (*Fauna*, 406). This is really an *Antocha*, very near *A. unilineata* Brun., but perhaps distinct (legs and stigma darker).

L. flavocincta (*Rec.* xv, 289). The yellow colour of the venter of the second specimen, mentioned by Brunetti, is due to its being covered with mites. Front tarsi all dark, mid tarsi somewhat pale at tips only. *Sc* ends beyond the middle of *Rs*. Tip of *R1* turned sharply upwards and equalling *r* in length, a rather long spur continues the direction of *R1*. *Cu1a* at base of discal cell. Wings brownish, stigma oval, dark brown.

L. marginata (*Rec.* xv, 290). A true *Limnobia*. Outer flagellar segments rather elongate. Cerci extremely short, though the ninth segment is large.

L. confinis (*Rec.* xv, 290). Also a true *Limnobia*. The antennae are remarkable in having one long hair on each oval flagellar segment, as in *Thrypticomyia*. Hypopygium of simple structure. Wings much infuscated, not iridescent.

L. bipunctata (*Rec.* xv, 291). Also probably a true *Limnobia*, but identical with *Dicranomyia bicolor*, described on a previous page in the same paper.

L. tritincta (*Rec.* xv, 291). This is certainly a *Libnotes* and not a *Limnobia;* the cell *M1* is distinctly longer than cell *2nd M2*. The other venational detail mentioned by Brunetti (the straight *Rs*) is characteristic of one group only of *Libnotes*, and not of the whole genus as he supposed. The present species appears to be nearly allied to *L. nervosa* de Meij.

L. longipennis (*Rec.* xv, 292). *L. 5-notata* (Rec. xv, 292) and *L. nigrescens* (Rec. xv, 293) are all correctly placed in *Limnobia*. The last two are nearly allied, resembling *L. umbrata* (de Meij.) but with hypopygium of simpler structure. *L. longipennis* is structurally identical with *L. infixa* Walker of New Guinea, of which it is doubtless merely a darker variety.

L. punctithorax (*Rec.* xv, 293). Genus *Libnotes*. Tip of *R 1* turned sharply up to costa, a little shorter than *r*, with which it makes a very obtuse angle. *Rs* straight and rather short, its branches long and curved. Discal cell about twice as long as broad, square at base. Cells *M1* and *2nd M2* equal. *Cu1a* just before middle of discal cell.

Atypophthalmus holopticus (*Rec.* vi, 273). The genus cannot be maintained, but must fall under either *Dicranomyia* or *Limnobia;* de Meijere and Alexander would favour the former, though I incline to the latter. The species is identical with *Dicranomyia umbrata* de Meij.

Geranomyia genitalis (*Rec.* vi, 275). This appears to be identical with *G. fletcheri* Edw.

G. circipunctata (*Fauna*, 390). This proves to have a very wide distribution, as it has been redescribed from Java by de Meijere as *G. decemguttata* and by Alexander from Queensland as *G.* (*Pseudaparosa*) *venustithorax*.

G. flaviventris (*Rec.* xv, 289). Extremely similar to *G. semistriata*, but fleshy claspers longer.

Aporosa aurantia (*Rec.* xv, 288). An *Elephantomyia*, belonging to the same group as *E. delectata* (Walk.), *E. egregia* de Meij., and *E. fuscomarginata* (End.), being evidently closely allied to the last named. First scapal segment globular, like the second. Flagellum with 12 distinct segments, verticils very long, five times the length of the segments. *Rs* rather short, strongly arched at its base. *R 2+3* strongly arched upwards at its base, then running close to and parallel with *R1*. Cell *Ax* very narrow. All veins very distinct, black.

Rhamphidia abnormalis (*Rec.* xv, 296). This is probably identical with *R.* (*Eurhamphidia*) *niveitarsis* Skuse.

Conithorax (*Rec.* xv, 298), as has already been pointed out by Alexander, is a synonym of *Ceratocheilus*. The presence of a corniculus on the front is not, as I formerly supposed, a constant character of this genus. *C. latifrons* (Rec. xv, 299) has no corniculus, and *C. brevifrons* (Rec. xv, 300) has only a very minute one.

Teucholabis insignis (*Fauna*, 430). I doubt if this is more than a variety of *T. fenestrata* O.S. The peculiar hypopygium is almost identical in structure, as are the fifth sternites.

T. biannulata (*Fauna*, 430). This is not a *Teucholabis* but a *Limnobia*, probably a variety of *L. annulifemur* de Meij., from which it

only differs in having the extreme tips of the femora pale; the hypopygium and wing-markings are identical.

T. angusticapitis (*Rec.* xv, 305) is an earlier name for my *T. nocticolor*, described from Sumatra.

T. ornata (*Rec.* xv, 305). Scutellum and middle of scutum yellowish. A dark suffusion at tip of *Ax*. Stem of halters blackish.

T. ornata var. **assamensis** (*Rec.* xv, 305) is perhaps more probably a distinct species, as apart from the conspicuous difference in the wing-markings there are small distinctions in the hypopygium and abdominal sternites.

Gymnastes bistriatipennis (*Rec.* xv, 307). Cross-vein *r* vertical, twice its length from tip of *R1*. *R2* present, oblique, ending in costa more than its own length beyond tip of *R1*.

G. pennipes (*Rec.* xv, 308). Very close to *G. flavitibia* Alex., the venation being the same, but tip of wing scarcely darkened, and the first tarsal segment of the middle legs not distinctly pale at the base.

Molophilus inconspicuus (*Fauna*, 444). Hypopygium resembling that of the European *M. medius* de Meij., with a single long slender pleural appendage.

M. assamensis (*Fauna*, 445). Side pieces of hypopygium with a very long, slender, sinuous apical process, similar to that seen in the Australasian genus *Amphineurus*. The two pairs of claspers each as long as this process, one hairy.

Erioptera distans (*Fauna*, 451). The type is not a male, but a female, with a short fleshy ovipositor of peculiar construction. By the short, almost straight vein *Ax* it seems to be nearer *Acyphona* than *Erioptera*.

E. brevior (*Fauna*, 452). Brunetti is doubtless correct in identifying this with his *Empeda inconspicua* (Fauna, 475), but both names should fall as synonyms of *E. gracilis* de Meij.

E. parallela (*Fauna*, 453). A very distinct species on account of the great length of the cells.

E. subtincta (*Fauna*, 455). The hypopygium is practically as in *E. notata* de Meij., but the parameres are long, curved and sharply pointed. Probably synonymous with *E. notata*, as a Javan male I have examined agrees in structure and has the palpi brown, not yellow.

E. flava (*Fauna*, 455). The name is preoccupied by *E.* (*Empeda*) *flava* Schum., but as Brunetti states that his *E. halterata* is the same species, this name may perhaps be used. I have not seen the types of either, but a male selected by Brunetti to represent the species proved to be identical with *E. subtincta*.

E. genitalis (*Fauna*, 456). This is a *Molophilus*. The two pairs of claspers are equal in length, with blackened tips, one ending in a sharp hook, the other in an irregular-shaped knob.

Mesocyphona nigripes (*Fauna*, 458). This is not a *Mesocyphona* but a *Gonomyia*, perhaps referable to Alexander's subgenus *Progonomyia*. The figure is correct in showing no marginal cross-vein, but *Sc2* is present, just beyond the base of *Rs*. The type is not a male, but a female, with a fleshy ovipositor resembling that of *Erioptera distans* Brun.

M. gracilis (*Rec.* xv, 310). This is doubtfully distinct from *M. nigripes*, it is smaller and more slender, but the venation and ovipositor are the same.

Gonomyia flavomarginata (*Fauna*, 472). In the paratype males examined the venation is pretty much as in *G. incompleta*, cell *R4+5* being almost as conspicuously narrowed as in that species, but *R1* distinctly reaching the costa. All the veins are brownish, none conspicuously yellow as in some allied species. Brunetti does not make clear the main difference in colour, which is the presence in this species of a conspicuous whitish stripe on the pleura extending from just above the base of the front coxa to the base of the abdomen. The side pieces of the hypopygium are short, without terminal projection like that of *G. incompleta*, the claspers long, curved, black, and somewhat flattened.

G. antica (*Fauna*, 568). This, like *Eriopeta brevior*, is a synonym of *Empeda gracilis* de Meij.

Lechria nepalensis (*Rec.* xv, 317). This is exceptionally interesting, as it appears to belong to the genus *Trichoneura*, hitherto only known from two fossil species described by Meunier from Baltic amber. In Brunetti's type *R1* apparently ends in the costa, and is slightly indented downwards at *r*, as in the fossil species, though to a less extent. Almost certainly, however, this is not the true interpretation; it is more probable that the apparent tip of *R1* is (as Brunetti supposed) really the last section of *R2*, and the apparent *R* the transverse basal part of *R2*. We must then suppose that the tip of *R1* is atrophied, leaving no trace, and *r* is almost horizontal, simulating the tip of *R1*. Some support may be lent to this view by the fact that there are no macrotrichia on the part of the vein which is presumed to represent *r*. A comparison with amber specimens of *Trichoneura* in the British Museum strongly confirms this interpretation. *L. nepalensis* agrees closely with the fossil forms in size and habitus, differing only in minor points such as having *Cu2* curved downwards at the tip. The venation of *Trichoneura* rather closely resembles that of *Dicranoptycha*, and it is possible that a similar interpretation should be applied to the latter genus.

Gnophomyia genitalis (*Fauna*, 490). This is a *Crypteria* (*Neolimnophila*) close to *placida* Mg. The male type has lost its antennae, but the hypopygium is almost as in *placida*, except that the eighth sternite has a dense though short tuft of brownish-yellow hair.

G. furcata (*Fauna*, 491). This is an *Adelphomyia*, resembling the European *A. senilis* (Hal.); the wing-tip is slightly but distinctly hairy. Identical with *A.* ("*Cladura*") *flavescens* (Brun.).

G. strenua (*Fauna*, 492). The type of this species was not brought to London, but is evidently a true *Gnophomyia*, probably identical with *G. orientalis* de Meij.

G. nigra (*Fauna*, 494). This, in my opinion, is nearer to *Gonomyia* than to *Gnophomyia*, though it is certainly not a typical member of the former genus. I have examined the female recorded by Brunetti from the Nilgiri Hills, and find it identical with *Gonomyia* ("*Mesocyphona*") *nigripes* (Brun.). Doubtless the type is also the same. It may be noted that Brunetti has reversed his references to his figures of the wings of this and *G. strenua*.

Cladura flavescens (*Rec.* vi, 284). Alexander was correct in supposing that this is not a true *Cladura*. It is in fact an *Adelphomyia*; the wing-tip has a few very evident macrotrichia, and the tibiae have minute but distinct spurs.

C. interrupta (*Rec.* xv, 319). A distinct *Dicranophragma*, with short tibial spurs, cross vein in cell *R2*, etc. Very close to *D. pulchripennis* Brun., but *Ax* simple at tip and no dark spot on wing-margin behind tip of *Ax*.

Paracladura (*Rec.* vi, 286). Alexander has sunk this under *Trichocera*, but I believe it is a perfectly good genus, both on details of venation and on a very peculiar tarsal character which is not known in any true Tipulid : the first tarsal segment on all the legs is extremely short, much shorter than the second and only about three times as long as broad, recalling the condition in many Cecidomyiidae and in the Culicid genus *Molchlonyx*. The genus *Paracladura* is further distinguished from *Trichocera* (as correctly pointed out by Brunetti) by the entire absence of tibial spurs.

Trichocera flava (*Fauna*, 512) is almost certainly the female of *Paracladura gracilis* Brun., from which it differs only in having the knob of the halters yellowish instead of dark.

Rhaphidolabis indica (*Fauna*, 519). Although I have only examined the female type, I think there can be little doubt that this is identical with *R. sordida* (Brun.).

Limnophila pallidicoxa (*Fauna*, 523). This was apparently described from a mixture of species. Of the pair brought to London (not the types) the male is a *Pilaria*, the female a *Pseudolimnophila*.

L. simplex (*Fauna*, 523). This is a *Crypteria*, identical with *C.* ("*Gnophomyia*") *genitalis* Brun., as already stated by Brunetti.

L. multipunctata (*Fauna*, 569). This seems to be a *Pseudolimnophila*. The venation agrees with Alexander's genus, and the usual small anterior mesonotal pits are present ; the head is crumpled so that the long neck of *Pseudolimnophila* is not obvious ; abdomen broken.

L. honesta (*Rec.* xv, 324). Anterior mesonotal pits present but minute.

L. claripennis (*Rec.* viii, 153). This is a *Crypteria*, very close to if not identical with the genotype, *C. limnophiloides* Bergr. The flagellar cone is normal.

L. quartarius (*Rec.* viii, 154). A *Gnophomyia* (s. str.), very close to *G. strenua* and allies. The male resembles *G. maculipleura* Edw. and *G. fraterna* Edw. in having two large black spots on the pleura; its hypopygium is similar to that of *G. fraterna*, but the parameres are large and rounded, not split. The female mentioned by Brunetti appears to be identical with my *G. nigrescens* ; I do not think it belongs to the same species as the type male.

L. annulipes (*Rec.* xv, 324). Subgenus uncertain. *Sc* ending much beyond apex of *Rs*, *Sc2* near its tip ; *R2* a little longer than *R2+3*, arched at base and curved upwards at tip ; *r-m* below base of *R2*, scarcely half as long as the basal section of *R4+5*.

L. parvicellula (*Rec.* xv, 325). A *Gonomyia*, probably identical with *G. affinis* Brun., at any rate a male identified by Brunetti as *G. affinis* has the same hypopygial structure, although *Cu1a* is rather nearer the base of the discal cell. *G. bryanti* Alex. (Java) is very similar, perhaps distinguishable by the rather longer and more oblique *R2*.

L. glabra (*Rec.* xv, 325). As far as I can see this is identical with *L. palmeri* Alex., described from Java. Perhaps belongs to *Pseudolimnophila*, although the head is rather less narrowed behind than in the genus. Flagellar segments with very long hair, especially on the upper surface, where it is 3-4 times as long as the segments (as in *Pilaria*).

L. fusca (*Rec.* xv, 326). A *Pseudolimnophila*. Thorax dull. Claspers simple, equal in length, the outer with slightly hooked tip. Cells longer than in *L. glabra*.

L. incompleta (*Rec.* xv, 326). A *Gonomyia*, identical with *G.* ("*Mesocyphona*") *nigripes* Brun. The specimens are females.

L. inconsequens (*Rec.* xv, 326). Subgenus uncertain. First four flagellar segments rather larger than the others. Verticils about as long as the segments. Claspers rather short, outer shorter than inner. Tibial spurs minute.

L. flavipennis (*Rec.* xv, 327). I have not seen the type of this species, but from the figure given of the wing it would appear to be a *Tricyphona*.

L. ornatipennis (*Rec.* xv, 328). An obvious *Epiphragma*. The figure is correct in showing the usual cross-vein in the costal cell. Distinguished from allied species by the pale legs, the femora being scarcely darkened.

Dicranophragma pulchripennis (*Fauna*, 542). A rather remarkable character of this species is that the vein *Ax* is forked near its tip, the posterior branch not reaching the margin.

D. gracilis (*Rec.* viii, 156). In this species there is no trace of tibial spurs; this fact, together with the position of *Cu1a* before the discal cell, will exclude it from this genus. Possibly it should be referred to *Cladura*. The antennae are broken, but the first few flagellar segments are preserved. The first is large, conical, perhaps representing a fusion of several as in *Crypteria*.

Eriocera rufithorax (*Fauna*, 534). The identity of this with my *E. ctenophoroides* may be confirmed.

E. aterrima (*Fauna*, 540). Examination of the type shows that this is wrongly placed in my key to the old-world species of this genus, since *R2* is about five times as long as *R2+3*. It will therefore run down to heading 37, and is distinguished from the other species there included by the following characters: Abdomen entirely black, four posterior cells, tip of *R 1* twice as long as *r*, traces of shining bands at the bases of the abdominal segments. By this last character it is evidently close to *E. morosa* O.-S.

E. nigerrima (*Fauna*, 571). The abdomen is not wholly dull black, but has broad somewhat shining basal bands on the tergites. The species would therefore be better included under the first division of heading 71 in my key. Quite possibly my *E. robinsoni* may be simply an immature specimen of *E. nigerrima*. A rather remarkable character is that the sternopleura are densely hairy.

E. nigroapicalis (*Rec.* xv, 335). This is a *Nephrotoma*, identical with *N. hypocrites* (Brun.). The coloration certainly is remarkable for a *Nephrotoma*, and strongly suggestive of a red and black *Eriocera*.

E. decorata (*Rec.* xv, 337). This species is remarkable in having the cross-vein *r* about the middle of *R 2+3* as correctly shown in the figure. In order to allow for this, to the second part of heading 2 in my key should be added the words, "or else *R 2* longer than *R 2+3*". The small spots of the wings are mostly yellow, only the larger ones white.

E. caliginosa (*Rec.* xv, 339). Correctly placed in my key. In the specimen examined there is a small fork to *M 1+2* in one wing only.

Stibadocerella pristina (*Rec.* xv, 283). The vein *Ax* is absent, and the genus therefore antedates de Meijere's *Agastomyia*. The species is close to, but not identical with *A. albitarsis* de M.

Pselliophora flavofasciata (*Rec.* xv, 259). Identical structurally with my *Ps. gracilicornis*, which is evidently only a light variety of Brunetti's species.

Dolichopeza obscura (*Fauna*, 355). Flagellum of male about as long as head and thorax together. *Rs* absent. All the tarsi (in the type) have the last four segments and the apical fourth of the first segment white.

D. postica (*Fauna*, 564). The specimen examined (not the type, but a male from the Garo Hills, Assam) differs from Brunetti's description in having the mesonotum uniformly shining blackish. Antennae about as long as the whole body. *Rs* very short and nearly transverse. *R2* absent.

D. infuscata (*Fauna*, 565). Flagellum about as long as the head and thorax together. *Rs* horizontal, curved at the base, nearly twice as long as *R2+3*. *R2* present but faint.

D. costalis (*Rec.* xv, 277). Belongs to *Nesopeza*; very close to *N. gracilis* de Meij., but fork cell shorter, etc.

Nesopeza albitarsis (*Rec.* xv, 278). Not a *Nesopeza*, perhaps may be referred to *Megistomastix*, since the wing of the type ♀ is precisely as in Alexander's *M. portoricensis*. Brunetti does not mention the antennae of the type male, which I have not seen.

N. longicornis (*Rec.* xv, 278). Seems rather a *Dopichopeza* than a *Nesopeza*, though all the genera of this group are poorly characterised. The structure of the male antennae is very distinctive, and suggests *Megistomastix* again. *Rs* horizontal, a little longer than *R2+3*, *R2* absent, *M-Cu* fusion very slight, discal cell long and narrow. Hind tibiae wholly white. Clasper forked, one part much thicker than the other.

N. picticornis (*Rec.* xv, 279). This is simply a *Tipula* with a somewhat peculiar venation; very near *T. inconspicua* de Meij., but perhaps distinct by the thorax markings. *R2* long and oblique, *r-m* very short, almost obliterated, discal cell very small, practically only four-sided (diamond shaped), *M3* coming off from it almost at the same point as *M1+2*, *Cu-1a* oblique, in slightly more than punctiform contact with the lower corner of the discal cell. Flagellum verticilate. Ninth tergite with blunt median projection.

Tipula fumifasciata (*Rec.* vi, 250). Identical with *T. nova* Walker, by comparison of types.

T. ochripes (*Rec.* vi, 260). This is close to the Malayan *Ctenacroscelis umbrinus* (Wied.), but differs distinctly in the shape of the flagellar segments, especially in the male.

T. princeps (*Fauna*, 306). Belongs to the *fulvipennis* group; resembles *T shirakii* Edw., but is larger and darker, and with quite different hypopygium. The outer clasper is sharply pointed, with a triangular enlargement just before the middle.

T. fuscinervis (*Fauna*, 312). Identical with *T princeps*. The figure is not very accurate.

T. splendens (*Fauna*, 314). In spite of the arched vein *R2*, this is a true *Tipula* and not a *Ctenacroscelis* or *Holorusia*.

T. himalayensis (*Fauna*, 315). Brunetti has evidently confused two or more species in his description; in two paratype males from Darjiling examined by the writer (which in general agree well with the description, and are doubtless conspecific with the type) the hypopygium has a very different structure from that shown in Brunetti's figures, which must represent some quite different species. In the form which seems to be the true *T. himalayensis*, the ninth tergite is small and usually almost completely hidden beneath the eighth, outer claspers black, rounded at tip, bent inwards, pleural suture rather distinct, the pleurite conical with a more or less blackened point, this point being sharper in some specimens than others, and the pleurite sometimes bent inwards. The femora vary somewhat in colour; in pale specimens the yellow ring is indistinct.

T. tessellatipennis (*Fauna*, 317). The two little median projections of the ninth tergite beset with minute black bristles. Outer claspers broadened and bent in the middle.

T. quasimarmoratipennis (*Fauna*, 320). This is apparently identical with the Formosan species subsequently described by me as *T. biserra*.

T. griseipennis (*Fauna*, 321). Judging from the description, this must be very close to or perhaps the same as *T thibetana* de Meij. though there may be differences in the hypopygium.

In Brunetti's species the ninth tergite is of peculiar form: pointed, but for the apical part bent downwards, covered with fine black setae, at the bend a tuft of yellowish hair on each side.

T. striatapennis (*Fauna*, 325). The figure is incorrect in showing *R2* complete. It is really abbreviated as in the closely related *T. mutila* Wahlgren of Europe. Matsumura has apparently redescribed this species from Japan as *T. quadrifasciata*.

T. continuata (*Fauna*, 328). This is evidently allied to *T sessilis* Edw. (*Pachyrrhina demarcata* Brun.), differing in the pale central area of the scutellum and in the structure of the hypopygium, which is large, swollen and black, only slightly emarginate apically.

T. quadrinotata (*Fauna*, 330). Extremely close to *T. shirakii* Edw., differing almost solely in the shape of the outer claspers, which are more pointed, not square-tipped. The Himalayan female recorded by me as that of *T. shirakii* is doubtless this species, of which the Formosan *T. shirakii* can hardly be more than a variety.

T. tenuipes (*Fauna*, 333). The type agrees with that of *T. fulvipennis* Walker (*nec* Deg.). Since Brunetti had previously renamed Walker's species, his name *walkeri* must replace *tenuipes*.

T. munda (*Fauna*, 336). By comparison of types, this is the same as *T. vicaria* Walker 1856 (*nec* Walker 1848).

T. cinctoterminalis (*Fauna*, 338). The cell *Ax* is rather narrow, much narrower than in *T munda*, which is otherwise similar.

T. elegantula (*Fauna*, 339). Type not examined. The figure of the wing attributed to this species really represents *T fumifascipennis* Brun. 1918.

T. imperfecta (*Rec.* ix, 260). This is my *Brithura conifrons*, which it antedates by three years.

T. gravelyi (*Rec.* xv, 264). Synonymous with my *Brithura crassa*.

T. contigua (*Rec.* xv, 265). Antennae nearly twice as long as the thorax. Claspers with a short hairy upper lobe and a long curved lower lobe the apical part of which is bare, the tip black. Cell *Ax* extremely narrow.

T. simillima (*Rec.* xv, 265). Clasper trilobed, middle lobe the longest, bare, black-tipped, lower lobe more slender, hairy, also black-tipped. Basal half of second and third segments, and the whole of the last two segments of front and middle tarsi blackish, base of second segment only narrowly black in hind legs. White rings on the fore and mid femora duller and not quite so close to tip as in *gracillima*, *Cu2* dark-bordered, not clear as in *gracillima*. Cell *Ax* much narrower than in *gracillima*, but less so than in *contigua*.

T. fumifascipennis (*Rec.* xv, 266). Belongs to the *fulvipennis* group; differs from *T shirakii* and *T. quadrinotata* in the faintness of the dark lateral stripe from the pronotum to the base of the abdomen, also in small details of the hypopygium, the forked apex of the median projection of the ninth tergite is spinose in *shirakii*, hairy in *fumifascipennis*. Also, the basal two-thirds of cell *M* is quite clear in the present species, infuscated in *shirakii*. From *T jacobsoni* Edw. the most obvious distinction is that the pale area near the tip of cell *M* is only faintly indicated and is immediately instead of some distance before *Cu1a*.

T. fumicosta (*Rec.* xv, 266). Another member of the *fulvipennis* group. Probably identical with *T quadrinotata*, though the male clasper differs slightly in shape from that of the specimens (not the type) of *T. quadrinotata* examined and agrees better with the type of *T. shirakii* Edw.

T. filicornis (*Rec.* xv, 267). The structure of the antennae is remarkable, and quite unlike that of any other Oriental species known to me. These organs are longer than the whole body, the flagellar segments with scattered long bristly hairs along their whole length, these hairs being about 5 times as long as the diameter of the segments, apart from these there is a moderately dense erect pubescence 3-4 times as long as the diameter of the segments. Ninth tergite rather long, rounded at tip, hairy. Costal cell slightly but obviously darkened. Cell *Ax* moderately broad.

T. flavithorax (*Rec.* xv, 268). The outer clasper is of peculiar shape, being bent at right angles before the middle, the outer portion very slender, and bare, the inner portion hairy. Ninth tergite with a pair of triangular projections.

T. fasciculata (*Rec.* xv, 269). The wings of this species are very similar to those of the European *T. vernalis* Mg., but it is quite distinct by the structure of the hypopygium and ovipositor.

T. brevis (*Rec.* xv, 270). Identical with *T. reposita* Walker, by comparison of types. The claspers are of very peculiar shape.

Pachyrrhina demarcata (*Fauna*, 344). This is a *Tipula*, related to *T. contigua* Brun. Since the name has already been used in *Tipula*, I have suggested the new name *Tipula sessilis* (Ann. Mag. Nat. Hist., ser. 9, Vol. viii, p. 96). In proposing this name I had before me specimens from the Nilgiri Hills which I believed to be *P. demarcata* Brun., but a comparison with the type now shows that these represent a distinct though allied species. The name *sessilis* should be applied to Brunetti's type, which is characterised especially by the ringed flagellum (not all black as stated in Brunetti's description), the mainly yellow legs, and the very long, narrow outer claspers.

THE TADPOLE OF *TYLOTOTRITON VERRUCOSUS* ANDERSON.

By MALCOLM A. SMITH, *F.Z.S.*

(Plate XX.)

I am indebted to Dr. Annandale for the privilege of examining a fine series of adult and larval specimens of *Tylototriton verrucosus* obtained in the neighbourhood of Darjiling and Kurseong, in which district they are, he records, very abundant.[1] Last November whilst on Chieng Dao, N. Siam, my native collector also met with this newt at between 5,000 and 6,000 feet and obtained a number of larvae, but unfortunately no adults. Siam is a considerable extension southwards of the range of *T verrucosus* hitherto recorded from the Eastern Himalayas, Yunnan and Upper Burma. For the following information about its breeding habits I am indebted to Dr. Annandale, who has also kindly supplied the drawings which accompany this article :—

" *T verrucosus* is common at certain places in the Darjiling District at altitudes between 4,000 and 6,000 feet, but it is very local and I have been unable to obtain any evidence of its occurrence west of the Tista watershed.

" The life-history is interesting and the metamorphosis apparently prolonged. The adults enter the water as soon as the first spring showers fall in March or April and the females begin to lay their eggs shortly afterwards. The eggs are lightly attached, singly, to weeds, etc., and apparently hatch rapidly. The breeding season probably continues throughout the rainy season but the adults have left the water by the beginning of October. The growth of the larva is very slow in the first year, but the four legs are usually, if not always, developed before winter, in which growth probably ceases. I am not sure whether the young leave the water in the following year or whether there is a further larval period of one or more years, but I think that the metamorphosis is completed by the beginning of the second winter at any rate in most individuals. There may, however, even be a kind of " axolotl " stage in suitable conditions. The larva may, at any rate, attain about half the size of the adult before its gills begin to shrivel up and it leaves the water. This it does in October before the gills have completely disappeared."

The eggs of this newt are large although somewhat variable in size, measuring, when the gelatinous envelope is fully distended by the developing embryo, between 6 and 10 mm. in diameter. The young one on emerging is about 11 mm. long, and is provided with well developed external gills, with a pair of elongated " balancers " originating from a point behind and below the eye and in a line with the continuation of the mouth backwards, with a crested tail and budding fore-limbs.

[1] Annandale, *Rec. Ind. Mus.* vi, p. 215 (1911).

These latter develop rapidly and all four legs, with their digits, are complete at quite an early stage in life. The " balancers " apparently soon disappear, although a trace of them often persists in the form of a small tubercle at their point of origin.

The following description applies to a fully grown tadpole in which absorption of the external gills has not yet commenced :—

Head a little longer than broad, broader than, and about half the length of, the body ; eyes almost entirely lateral, the distance between them greater than the distance between the nostrils which are close to the tip of the snout. Tail as long as, or a little shorter than, the head and body, its tip obtusely pointed ; upper crest full, from one and a half to twice the depth of the lower crest, not reaching as far forwards as the head. The skin may be finely or coarsely granular ; the prominent ridges upon the sides of the head, which are so characteristic of the adult, are just apparent, while the knob-like projections upon the flanks are visible as elongated vertical folds of skin. The opercular folds are well developed and extend backwards on either side of the neck leaving a deep notch in the mid line ; these lateral prolongations are absorbed when the creature leaves the water, and in the adult are represented by a transverse fold of skin. The external gills are usually three in number on either side. Dr. Annandale has figured an example with two only, but this appears to be unusual and may be accidental. The colour of the tadpole is olive brownish, thickly speckled with darker markings. His statement about the size attained by it before leaving the water is borne out by a specimen [1] in his collection (90 mm. in total length), but not by my series (about 40 examples) from Siam. Possibly his individual is an example of partial neoteny and no doubt the actual stage in growth at which the tadpole leaves the water is variable and dependent partly upon the available water supply of the stream or pool it inhabits. My series were all caught in one place, in a shallow marshy spot upon the hill-side, and several of them, in which the gills have almost entirely disappeared, are only 52 mm. in total length. Others with the gills still persisting are larger, the biggest measuring 75 mm. in length.

Some of these larvae were kept in captivity for several weeks, but none evinced any desire to continue their aquatic existence ; one by one they clambered out of the water and hid themselves in some damp weeds provided for them close by.

The absorption of the crests occurs before the absorption of the gills, the latter process apparently not taking place until after the creature has left the water.

---

[1] This specimen was taken at the edge of a small lake on the Sitong Ridge, Darjiling district.

EXPLANATION OF PLATE XX.

FIG. 1.—Eggs of *Tylototriton verrucosus*, nat. size. From small pool at Kurseong.

FIG. 2.—Young tadpole soon after emerging from the egg, × 2. From same locality.

FIG. 3.—Head of the same, × 8.

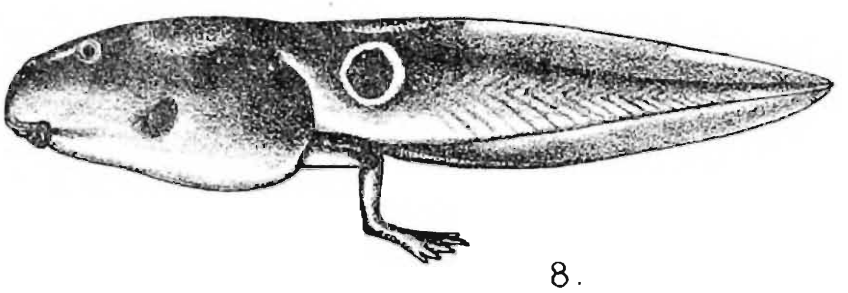
FIG. 4.—Young tadpole, showing unusual gill formation, × 2. From same locality.

FIG. 5.—Head of the same, × 8.

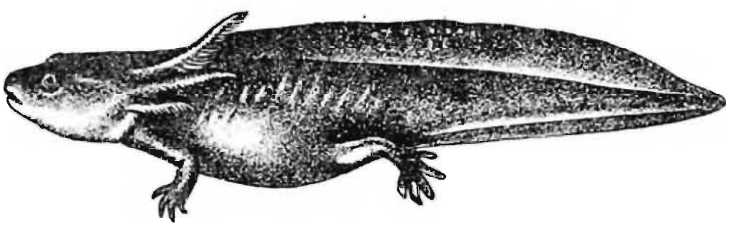
FIG. 6.—"Axolotl" stage, nat. size. From lake on Sitong Ridge, Darjiling district.

FIG. 7.—Condition on leaving the water, nat. size. From edge of same lake.

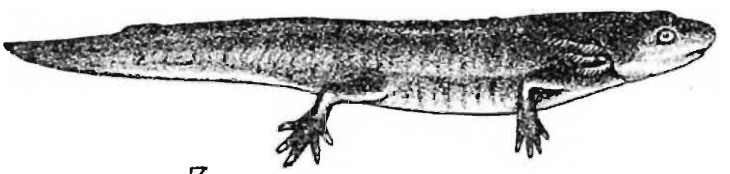
FIG. 8.—Larva of *Rana alticola* Blgr. from Shillong, Khasi Hills. (I publish this figure for comparison with that of the much darker specimen from Siam figured by Dr. Malcolm Smith on pl. vii of this volume of the "Records." *N. Annandale*).



8.

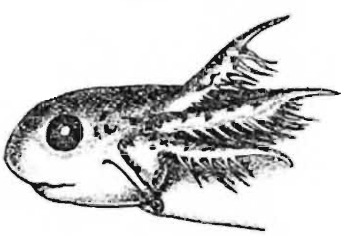


6.



7.

1.

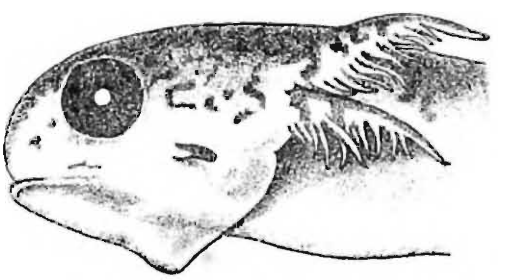


3.

2.

4.

5.



A.Chowdhary del &lith.

INDIAN BATRACHIA.

A NEW MYRMECOPHILOUS GENUS OF COCCIDAE (HEMIPTERA) FROM INDIA.

By F. Silvestri.

I describe here an interesting new genus of Coccidae kindly sent me for study by Dr. N. Annandale, who collected it and made important observations on its relation with the ants.

Gen. **Xenococcus,** nov.

(Fig. I—V).

♀ Corpus (fig. I) ovale parte magis attenuata postica, a segmento penultimo sursum vergente.

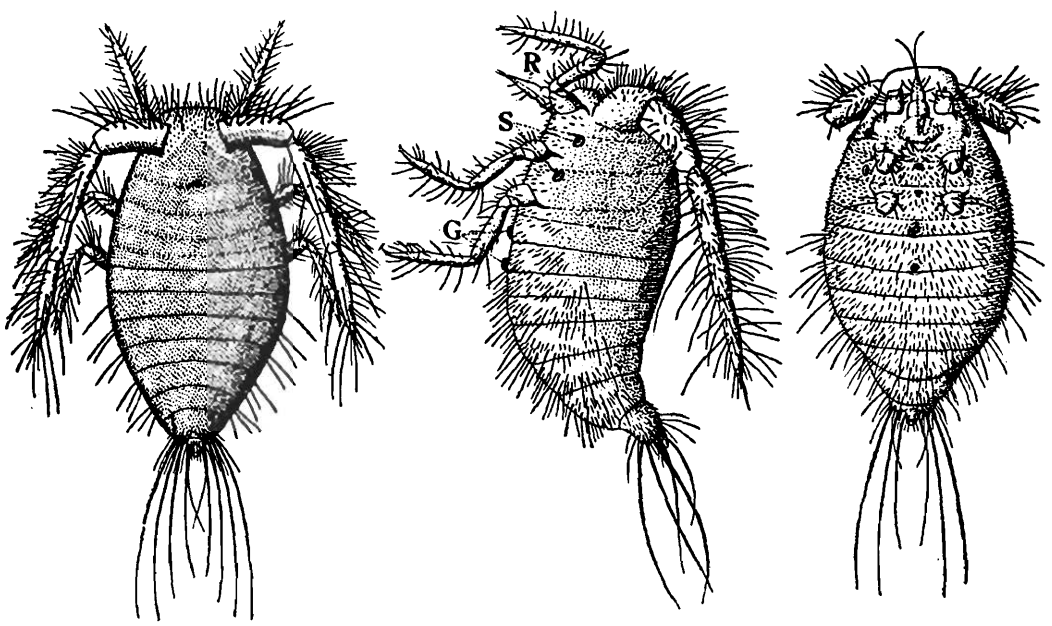


Fig. I.

1—3. *Xenococcus annandalei*; femina supra, lateraliter et subtus inspecta: A=antenna, G=glandulae ventrales, R=rostrum, S=stigmata.

Caput breve, latum, antice late convexum occulis nullis, antennis longiusculis 4-articulatis, supero-lateralibus retrorsum directis, rostro sat longo, biarticulato, articulo secundo quam primus longiore.

Thorax quam abdomen c. $\frac{3}{4}$ brevior cum capite et cum abdomine dorsualiter haud multo manifeste distinctus, pedibus sat longis, articulis consuetis, articulatione tibio-tarsali obsoleta, lineari, praetarso unguiformi setis duabus brevibus aucto.

Abdomen segmentis decim quorum primo et secundo dorsualiter sat confusis, ceteris bene distinctis compositum, parte postica angustata, segmento penultimo angustiore utrimque setis 3, longioribus instructo ultimo angustissimo brevissimum, aperturam analem superam terminalem gerente et utrimque seta sat longa et seta longiore aucto.

Thoracis et abdominis dorsum usque ad segmenti penultimi partem proximalem pilis minimis obsessum, ventre setis plus minusve numerosis plus minusve longis instructo.

Stigmata utrimque duo, magna, parum longe a coxa secundi et tertii paris in parte antica mesonoti et metanoti sese aperientia. Sternum secundum et tertium glandula pluricellulari mediana sat magna instructa.

Vivipara.

Mycetoma magnum ventrale, super urosterna 2^{um} ad 4^{um} situm.

Mas : ignotus.

Typus : *X. annandalei*, sp. n.

Observatio. Genus hoc inter Coccidarum genera valde diversum est, ad genus *Orthezinella* Silv. (quod perproximum ad *Ortheziola* Sulc. est) pedum tibiotarsi fabrica simile, sed characteribus ceteris perdiversum est. Quum mas notus sit, positio huius generis inter Coccidarum subfamilias melius consideranda est.

Xenococcus annandalei, sp. n.

♀ Corpus melleum.

Caput supra area postica mediana triangulari, ut thoracis dorsi superficies, pilis minimis obsessa, fronte setis brevissimis, setis brevibus

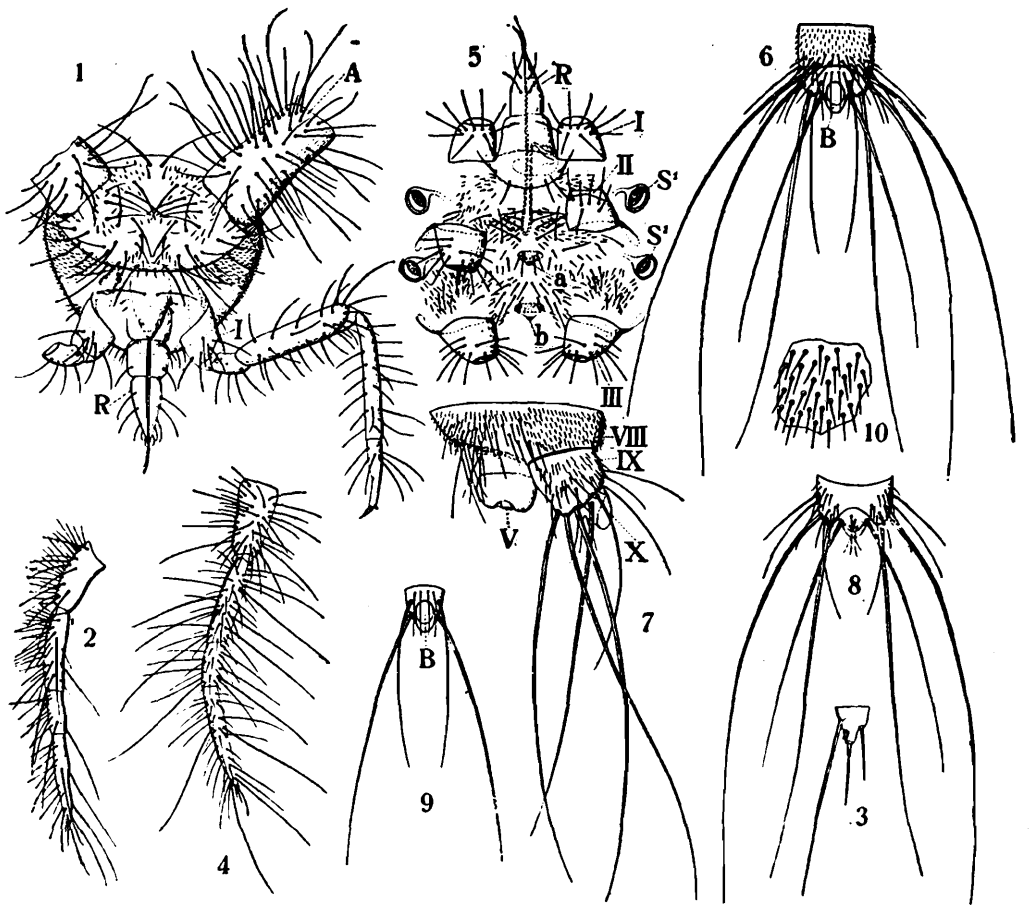


FIG. II.

Xenococcus annandalei : 1. caput et prosternum antice inspecta ; 2. antenna laeva integra supra inspecta ; 3. ejusdem apex ; 4. antenna laeva exempli alii a superficie externa inspecta ; 5. thoracis sterna ; 6. abdominis segmenta penultimum et ultimum prona ; 7. abdominis pars postica a segmento antepenultimo lateraliter inspecta ; 8. abdominis segmenta penultimum et ultimum supina ; 9. abdominis segmentum ultimum pronum.

A=antennae pars proximalis ; B=apertura analis ; R=rostrum ; S^1 et S^2=stigmata ; V=vulva cum vagina aliquantum extroflexa ; *a* et *b* foveae furcosternales ; I-III pedum par primum, secundum et tertium ; VIII-X segmenta abdominalia octavum, nonum et decimum.

et setis sat longis (usque ad mm. 0·130) instructa, clypeo setis duabus medianis brevibus instructo.

Antennae quam corpus parum breviores articulo quarto quam ceteri singuli longiore vel in exemplo nonnullo articulo secundo subaequali et quam tertius, magis quam duplo longiore, articulo secundo quam tertius duplo longiore et quam primus parum minus quam duplo longiore, aticulis omnibus setis brevibus, setis longis et setis robustis longioribus (usque ad mm. 0·50) per faciem superam et inferam externam (internam antennis retrorsum directis inspectis) instructis.

Rostrum articuli primi parte basali infera seta brevi et setis duabus brevissimis instructa et parte distali setis duabus brevibus, articulo secundo utrimque setis duabus sat longis proximalibus et setis tribus distalibus brevibus instructo nec non subtus setis 3 + 3 aucto. Setae mandibulares et maxillares longae, extensae usque ad mm. 0·70.

Thorax dorso et lateribus usque ad stigmata pilis minimis obsessus, sternitis (Fig. II, 5) setis brevioribus et brevibus sat numerosis.

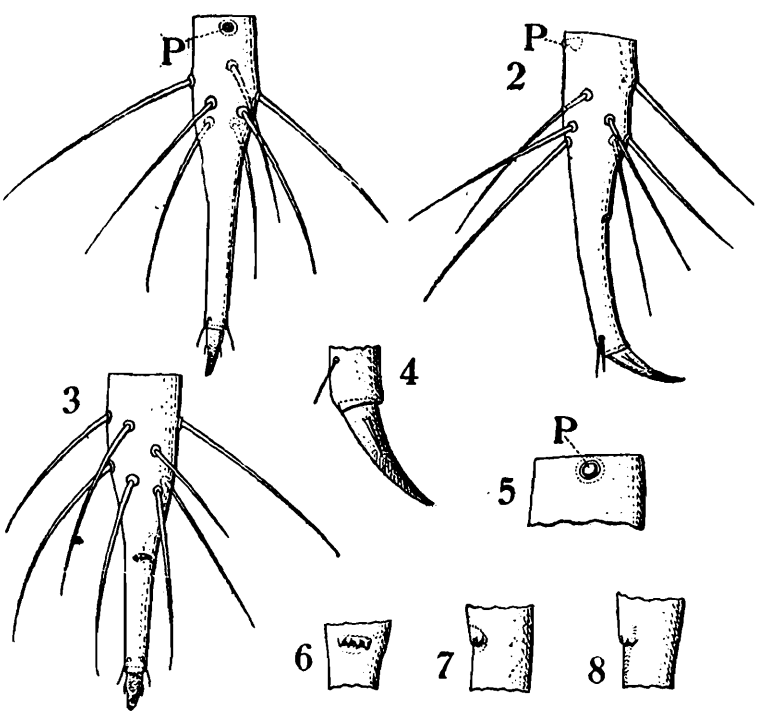


FIG. III.

Xenococcus annandalei : 1—3. pedis tertii tarsus et praetarsus supra, lateraliter et subtus inspecta ; 4. ejusdem tarsi apex et praetarsus ; 5. tarsi pars proximalis supra inspecta ; 6—8. tarsi pars submediana subtus et lateraliter inspecta ; P = tarsi sensillum placoideum.

Pedes hirtelli, setis sat numerosis sat longis instructi, coxa parum ad basim latiore quam longiore, trochantere brevi, femore tibiam longitudine subaequante tibia quam tarsus fere duplo longiore, tarso (Fig. III, 1—5) basi dorsuali sensilli placoideo circulari parvo instructo, dimidia parte distali cylindracea, subtus ad basim partis cylindraceae transverse sinu parvo affecta margine postico vix 4-lobulato ; praetarso (Fig. III, 4) ungue sat longo, utrimque seta brevi proximali aucto, constituto.

Abdomen dorso, ut dixi, usque ad segmenti noni parte proximali pilis minimis obsesso, segmentis 3—8 lateribus et segmentis 1—8 ventre setis numerosis brevibus et magis numerosis longis (usque ad mm. 0·200) vestitis. Segmentum nonum parte distali dorsuali setis brevibus c. 10 et setis sat longis (usque ad mm. 0·150) instructa, lateraliter utrimque

setis duabus posticis longioribus (usque ad mm. 0·90) subtus utrimque seta apicali longiore, seta praeapicali longa et setis aliis sat brevibus aucta; segmentum decimum multo angustatum, aperturam analem superam posticam nudam gerens et supra setis brevioribus quatuor praeanalibus, lateraliter seta supera longa (ad mm. 0·65) et seta infera longiore (ad mm. 0·90) instructum, subtum setis brevioribus 3—4.

Segmenti secundi et tertii glandulae ventralis rima rotunda (diam. 30—40μ).

Long. corp. mm. 1·70, lat. abdominis 0·90 ; long. antennarum 1·42 ; pedum paris tertii 1·10.

Patria. Barkuda I., Chilka Lake, Madras distr. (Dr. N. Annandale legit.)

Habitat. Sub radicibus plantae "*Ficus obtusa*" cum formica "*Acropyga acutiventris* Rog."

Notes. The specimens of *Xenococcus* received by me were preserved only in alcohol as museum specimens and not for histological research, but in view of the interest of this curious myrmecophilous insect, I have cut sections of some specimens and can make the following statements about the internal structure.

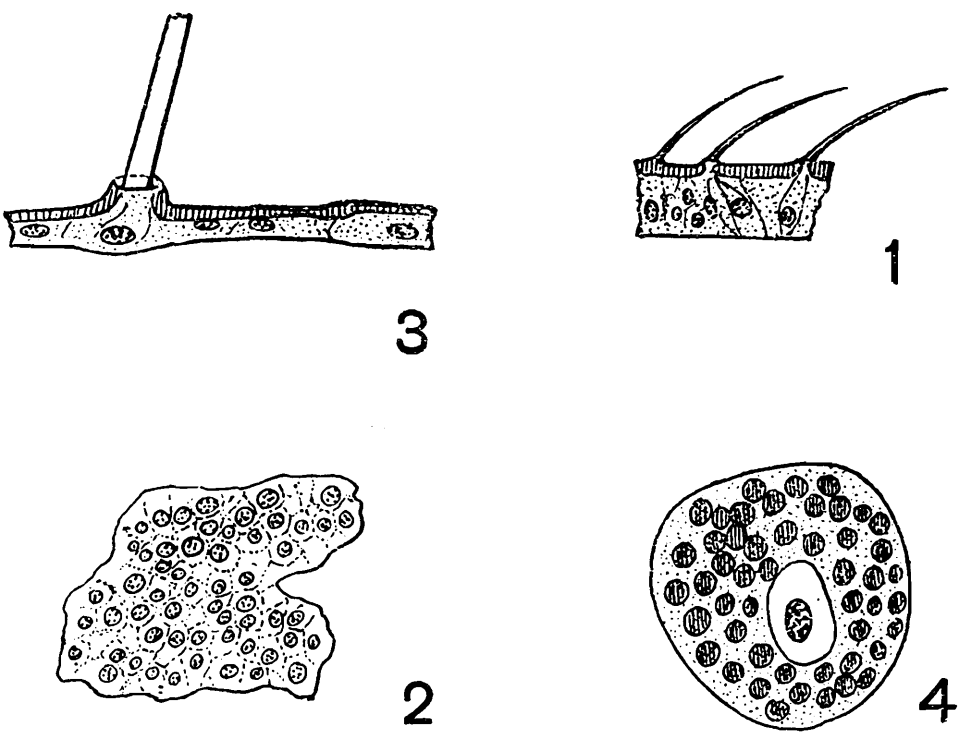


FIG. IV.

Xenococcus annandalei : 1. Section of dorsal thoracic hypoderm and cuticule ; 2. part of the same hypoderm seen flat ; 3. section of ventral abdominal hypoderm and cuticule ; 4. a cell of the mycetoma (all the figures have been delineated with 8 comp. ocular and 3 mm. apohrom. object).

The hypoderm under the cuticule of the dorsum (Fig. iv, 1), covered with short setae, is formed of cells 11μ high and 2-3μ wide, furnished with very small nuclei and with the protoplasma having the appearance of being glandular ; but it is necessary to study well preserved material to confirm this statement.

The hypoderm of the uresterna (Fig. iv, 3) is about half as high as the described hypoderm.

The two glandulae of the 2nd and 3rd urosternum have a circular platform of about 20μ in diameter bordered by a ring (Fig. v, 1-2). Under the platform there are the apex of numerous pyriform cells, which are distributed all around for an area of about 84μ (Fig. v, 1). Each cell (Fig. V, 3) is elongated pyriform, has a distal nucleus near the basis and the protoplasma proximally much vacuolated. These glandulae ventrales certainly secrete some kind of liquid, which may be attractive to the ants, and I note that in no other Coccid hitherto known are there similar glandulae.

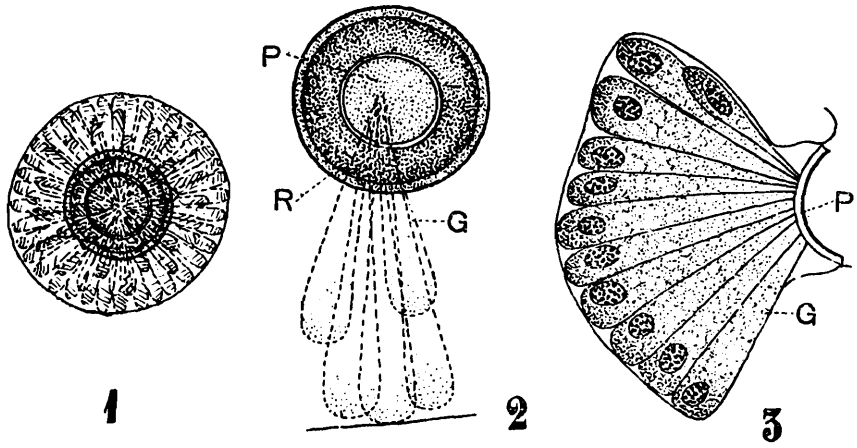


FIG. V.

Xenococcus annandalei: 1. A glandula ventralis seen from external surface; 2. platform and ring seen from external face and outline of some glandular cell; 3. sagittal section through the glandula.

The nervous, alimentary, respiratory and reproductive systems are as in Lecaniinae and Pseudococcinae, but the mycetoma is similar to the "yellow body" of *Pseudococcus*. The mycetoma of *Xenococcus* is ovoid in shape and depressed; it is about 400μ large and 20 wide. It is composed of subspherical cells (Fig. v, 4) with a central nucleus and protoplasm replete with small spherical bodies, which are also mycetocytes with symbiotic fungi in varying number and size.

Biology. We are indebted to Dr. Annandale for the following interesting observations:

"*Xenococcus* is invariably found in the nests of the little yellow ant *Acropyga acutiventris* on the rootlets of various trees of the genus *Ficus*. In cold and dry weather both ants and coccids retire deep into the ground, but so long as the soil is damp [1] and warm they remain under stones just below the surface. The workers of the ants are entirely sunterranean in habit and the males and females apparently stay for some time in the nest after hatching from their coccoons before leaving it to form new colonies. If the nest is disturbed the females as well as the workers carry off the coccids. When they leave the nest each female carries in her jaws a female of the coccid as a kind of dowery. This accounts for the universal distribution of the coccid in the nests of the ant, in which a very peculiar, blind, small, colourless Isopod is also usually to be found.[2]

[1] I have recently discovered that the ants, and a few of the Coccids, can be attracted to the surface even in hot dry weather by keeping the earth moist under a stone among the roots of a fig-tree. *N.A.*

[2] This Isopod is now being described by Dr. B. Chopra of the Zoological Survey of India. *N. A.*

ON SOME INDIAN OLIGOCHAETA, WITH A DESCRIPTION OF TWO NEW GENERA OF OCNERODRILINAE.

By J. STEPHENSON, *M.B., D.Sc., Lecturer in Zoology, Edinburgh University.*

(Plates XXI—XXIII.)

CONTENTS.

INTRODUCTION.

The worms described below have been received from several sources; but the great majority have been sent from the Indian Museum, and I must thank Dr. Annandale for giving me the opportunity of examining some very interesting material. Of the specimens received from other correspondents, much the most noteworthy were contained in a few tubes sent by the Government Entomologist, Agricultural College, Coimbatore, S. India. These contained two new genera of Ocnerodrilinae. The last of the worms described in the present paper is not an Indian species; it was found in Palestine by Major Sewell. I may here draw attention to some of the more general results of the present investigations.

The Ocnerodrilinae have till recently been represented in India by only a single endemic species, *Gordiodrilus travancorensis* (*Nematogenia panamaensis* and *Ocnerodrilus occidentalis* are peregrine). Michaelsen in 1921 added a second, *Curgia narayani* (7). *Curgia* has affinities with *Maheina*, one of the more primitive members of the sub-family, which is found in the Seychelles. The new genera described below, *Malabaria* and *Aphanascus*, are to some extent intermediate between *Maheina* and *Curgia*, and therefore help us in filling in the outlines of the phylogenetic tree of the sub-family. *Malabaria* is in all probability the immediate ancestor of *Aphanascus*, and *Aphanascus* very possibly leads on to *Curgia*; *Maheina* however cannot be the ancestor of *Malabaria*; the latter genus, though on the whole the more advanced of the two, must have branched off from the phylogenetic tree above the origin of *Maheina*.

Zoogeographically, the discovery of these worms strengthens the evidence of a faunistic relationship between India and E. Africa. While these genera, along with *Curgia*, point to the Seychelles, the genus *Gordiodrilus*, to which the other endemic Indian Ocnerodriline belongs, is found outside India in Zanzibar and Madagascar. Several species of *Howascolex*, a genus of Octochaetinae known before 1921 only from Madagascar, were described from Southern India by Michaelsen in the same paper (7) which contained the account of *Curgia*; while *Erythraeodrilus*, a near relative and perhaps an immediate descendant of *Howascolex*, is one of the characteristic worms of Western India.

It is interesting to find the two new genera occurring in the same place, and collected at the same time. It has already been said that *Aphanascus* is a direct descendant of *Malabaria;* apart from the fact of their occurring together the evidence from anatomy would, I think, be sufficient to show this. It may reasonably be surmised that the birth of the younger genus has taken place here, and at no remote period.

But though the significance of the facts of structure seems to me to be unmistakable, still the morphological differences between the two worms are not inconsiderable. In the younger genus, *Aphanascus*, the posterior pair of prostates have disappeared, and also the anterior pairs of testes and male funnels; *i.e.*, instead of being acanthodriline and holandric, it is microscolecine and metandric. These are characteristic stages in the evolutionary history of the line, and the result

must be marked by a distinction of genera. The structure of the prostate (on which Michaelsen has laid some stress) is also different in the two, the wall being one cell thick in *Malabaria*, more than one in *Aphanascus*.

If the above considerations are well founded, it would seem to follow that large morphological changes,—sufficiently large to give rise not merely to new species but to new genera,—may come about in no great length of time; and that evolution may proceed, at times, with large strides and at a rapid pace.

The two new Ocnerodrilines, along with the related genus *Curgia*, illustrate one of the difficulties of systematic investigations in the group of the Megascolecidae, namely the partial, or sometimes the complete, disappearance of the leading character of a group. The Ocnerodrilinae originated from the common ancestor of the Megascolecidae by the development of paired vascular sacs on the ventral side of the oesophagus; in these three genera the structures have no longer the form of sacs, and are merely small tubular diverticula embedded in the oesophageal wall; so that if the investigation is confined to dissection, the true condition will be overlooked. So in the Octochaetinae, the original differentiating feature is the development of the micronephridial condition, which persists throughout all the ramifications of the subfamily; yet in the genus *Ramiella* the micronephridia are few in number and large in size,—it may be only one on each side of each segment; and the organs can only be recognized as micronephridia by the fact that they have no ciliated nephrostome and no connection with the septa. In the Diplocardiinae the characteristic feature, the appearance of which differentiated the ancestor of the subfamily from the original stock, is the double gizzard; yet in *Monogaster* the two gizzards have coalesced again, and it is only the geographical relations that permit us confidently to assign to the worm its true position.

Passing to another of the worms described below, it is surprising to find, for the first time, and in the very middle of India, a species of *Diplocardia*. I have looked carefully for any indication (*e. g.*, in the nephridia, or in the presence of calciferous glands) that the worm might belong to another genus, but without result; and we must, I think, take the facts as we find them.

The subfamily Diplocardiinae was already represented in India by a number of species of *Dichogaster*, of which however the majority are peregrine, and have certainly been introduced; these small worms are among the common wanderers of the warmer regions of the globe, and at most only two Indian species are possibly endemic. With *Diplocardia*, the parent genus of the subfamily, it is different. This genus has hitherto been found only in North America (United States and Mexico), where, therefore, it is probable that the subfamily branched off from the "original Acanthodriline." We must suppose that *Diplocardia* reached India in the natural way, by slow progression during countless generations, and this assumes a continuous land bridge between America and Asia. Such a bridge existed formerly in the North, between Siberia and Alaska; and it is this bridge which apparently also explains the occurrence of the Megascolecine genera *Megascolides*

and *Plutellus* in North America. The Megascolecinae originated, apparently, somewhere in the S. E. of the Eastern Hemisphere; and *Megascolides* and *Plutellus* therefore passed across the bridge in the opposite direction to *Diplocardia*.

The discovery of *Notoscolex palniensis* prompts a final remark. It must now be recognized (Michaelsen, 5, 6; Stephenson, 10) that species of the large genus *Megascolex* have originated at different times and in different places from different ancestors, these ancestors being in several cases different species of *Notoscolex*. I would myself go further than this, and say that more than one genus (*Notoscolex*, *Perionyx*, and perhaps *Spenceriella*) has given origin to species of our present genus *Megascolex* (9). But however this may be, it is interesting to meet with another case where a close relationship, perhaps actual filiation, between certain species of *Megascolex* and a *Notoscolex* can be traced (*cf.* the remarks on *Megascolex sylvicola* var. *marianae* also).

Fam. NAIDIDAE.

Genus **Nais** Müll. em. Vejd.

Nais communis Piguet var. **caeca** Steph.

Small muddy channel, north of Loktak Lake, Manipur, Assam. 18. xi. 1920. Numerous specimens.

Nais paraguayensis Mich. var. **aequalis** Steph.

Bombay, in a tank. August 1923. J. P. Mullan. Numerous specimens.

Genus **Haemonais** Bretscher.

Haemonais laurentii Steph.

Within the mantle-cavity of *Vivipara bengalensis*, in shallow water tanks near railway station, Nagpur, Central Provinces. H. S. Rao. 13. xi. 1922. A single specimen.

Length 7 mm.; diameter 0·28 mm.; segments 50. No budding zone. Dorsal setae begin in segm. xvii.

The curious habitat of the worm naturally led to its being labelled as ? *Chaetogaster*.

Genus **Branchiodrilus** Mich.

Branchiodrilus menoni Steph.

Madras, in a tank in the Horticultural Gardens in which *Victoria regia* was growing. From K. S. Padmanabha Aiyer. 1909. A number of specimens.

Trivandrum, Travancore, from an unused tank in which *Nymphaea lotus* flourished. From K. S. Padmanabha Aiyer. 1922. A number of specimens.

Fam. TUBIFICIDAE.

Genus **Branchiura** Bedd.

Branchiura sowerbyi Bedd.

Northern portion of Loktak Lake, Manipur, Assam; Manipur Survey; 2,600 ft. 16-17. xi. 1920. Several fragments.

Inlé Lake, Southern Shan States; N. Annandale. A single small and incomplete specimen, in two fragments.

Genus **Bothrioneurum** Stolč.

Bothrioneurum iris Bedd.

Waterworks, Kodaikanal, Palni Hills, S. India ; 7,500 ft.; in wet mud under stone. S. Kemp. August 1922. A number of specimens.

Fam. MONILIGASTRIDAE.

Genus **Moniligaster** E. Perr.

Moniligaster perrieri Mich.

(Pl. XXI, figs. 1, 2.)

Vanderavu, Palni Hills, S. India ; ca. 7,400 ft.; under stones in stream in jungle S. Kemp. 26. viii. 1922. Five specimens, of varying sizes, some immature

Near neutral saddle, Palni Hills, S. India ; 4,200 ft. under stones in donse jungle. S. Kemp. 14. ix. 1922. A single specimen, in very bad condition.

Ex. W. $\frac{707}{1}$. Kodaikanal, Palni Hills, S. India. S. Kemp. August 1922. Three specimens, two with hinder ends regenerating.

From among the snakes, in the Balfour Room, Cambridge University Museum; original locality unknown. Sent by Dr. H. R. Mehra. A single specimen.

I give first some details of the atrial gland, the distinguishing character of the genus, and then discuss the great variability of the species.

The atrial gland is large, much larger than the spermathecal ampulla ; it consists of two halves, one in segment vii and one in viii ; each of these forms a large ovoid mass, and takes up the whole length of the segment in which it lies. The two portions are joined together by a narrower region, and this communicates with the exterior by a short common stalk, the whole forming a **V** or **Y**-shaped organ (fig. 1). Each half is composed of a large number of minute lobules, but the basal part of each, as well as the common stalk, is shining, *i.e.*, muscular ; the spermathecal duct, coming from above, joins between the two halves. In the specimen from the Balfour Room, only the common stalk is muscular, and the mode of junction of the spermathecal duct differs slightly (fig. 2).

The great variability of the species may be illustrated by the fact that I at first separated as distinct species two of the four batches enumerated above ; and it was only when I came to collate my descriptions for the purpose of the present paper that I saw that all the Moniligasters must be united. The chief distinctions I had thought to be the size, the setal intervals and the prostates ; but in all these characters intermediate terms are found which link together the extremes.

The largest worm was that from Cambridge ; this was 290 mm. long, and 15-18 mm. in diameter ; it had 256 segments ; this large size of course was answerable for its confusion with the snakes. The uninjured specimen of the third batch measured 220 mm., with a diameter of 10 mm., and 230 segments ; those of the first batch were of varying sizes ; while that of the second was only 55 mm. long, and 3 mm. in diameter, with 80 segments.

The setae were noted to be absent or indistinguishable in the first few segments in the specimens of two of the batches. As to the setal intervals ;—in the first, $aa=bc$, dd=half or perhaps five-ninths of the

circumference; in the second, *aa*=*bc*, or anteriorly may be rather greater than *bc*, while *dd* is rather more than half the circumference; in the third, *aa* is throughout less than *bc*,—about three-fourths of *bc* in the hinder part of the body, but the difference between the two is rather less in front while in some segments behind the genital apertures they may be almost equal; in this batch *dd*=four-sevenths of the circumference. In the specimen from Cambridge *aa*=four-fifths of *bc*, and *dd* =four-sevenths of the circumference.

The male pores may or may not be situated in depressions, as in the original description of the species; they may even be on small papillae.

The spermathecal apertures, which in the original specimens were in line with *cd*, were in three of the four batches situated immediately below the line of setae *c*.

The gizzards vary considerably, both in number and position. There may be four, in segms. xvi-xix; or four, in the same segments, with rudimentary gizzards in addition in xv and xx; or four, in xv-xviii, with a rudimentary gizzard in xlv; or lastly there may be six, in segms. xv-xx. The original description gave five, in xvii-xxi, the last almost rudimentary.

The ovisacs may be confined to segm. xii, or may extend through xiii also, or through xiv too.

The prostate varies very much in length, and also in the form of its duct. It is longest in the specimen from Cambridge, where it is sausage-shaped, and bent sharply on itself; but *per contra* the duct seems to be shortest here, since the glandular investment ceases only just before the organ joins the body-wall; the ectal end is crossed by two stout muscular bands. In the specimen of the second batch the glandular portion is ovoid with its long axis anteroposterior, the vas deferens joining it at its anterior pole; the duct comes off from the middle of the gland, is equal in size to the glandular part, is swollen in its middle, constricted above and below, at its junction with the gland and with the body-wall; muscular bundles radiate from the outer border of the duct to the body-wall. In the third batch the gland is somewhat mushroom-like,—a rounded mass with a stout duct, distinctly marked off, underneath it; into the duct are inserted a number of muscular bands, mostly transverse in direction, and the duct perhaps widens a little as it enters the body-wall beneath these bands; the vas deferens seems to enter the anterior and internal surface of the gland. Finally in the first batch the gland is subspherical, constricted at its base, where it is attached by a short stout stalk which swells out as it enters the body-wall; the vas deferens joins the anterior and internal surface of the gland.

Genus **Drawida** Mich.

Drawida barwelli Bedd. var. **impertusa** Steph.

Bombay. Coll. J. P. Mullan. Thirteen specimens.

This variety has previously been described from Bombay. The male pores were here on small papillae, the ridges previously described as the prominent anterior and posterior lips of the pores being in front of and

behind the papillae. The gizzards were three in number in the dissected specimen, in segments xiv-xvi; there was some strengthening of the alimentary wall in xiii also. The spermathecal atrium was represented only by a slight widening of the termination of the spermathecal duct as it entered the body-wall.

var. **hehoensis** var. nov.

He-ho, Yawnghwe State, S. Shan States, Burma; 3,800 ft. iii. 1922. N. Annandale. A single specimen, hard and brittle.
He-ho plain. 8. iii. 1922. Four specimens, in bad condition.

External Characters.—Length 45-95 mm. (the latter in softened specimens); diameter 3·5 mm. Segments 150; no secondary annulation. Colour light olive, mottled.

Prostomium absent or indistinguishable in the first specimen; perhaps epilobous $\frac{3}{4}$, the tongue cut off behind in the others.

Dorsal pores absent; some vestiges seen as small depressions on the surface in the second batch, but there were no perforations.

The setae begin on segment ii, and are relatively very large at the hinder end; they are closely paired; *aa*=*bc*; *dd* comprises five-eighths of the circumference.

The clitellum extends over segms. x-xiii (=4).

The male pores are in groove 10/11, midway between the lines of setae *b* and *c*.

The female pores are in 11/12, immediately outside, or possibly in, the line of setae *b*.

The spermathecal pores are in 7/8, in line with *cd*.

Internal Anatomy.—Septa 5/6—7/8 are stout, 8/9 is thinner but still moderately stout, 9/10 is thin.

The gizzards in the first specimen are three in number, in segms. xiii-xv; they are firm, spherical, and very large; those in xiv and xv were found lying side by side, the septum between them being oblique. In the second batch four gizzards were found, in xv-xviii; and there was some thickening, due to distinct longitudinal strands of muscle fibres in the wall of the gut, in xiv also.

The last heart is in segment ix.

The testis sacs vary somewhat; in the first specimen they were confined to segment x, and had a characteristic shape, being roughly ovoid with the long axis transverse and the inner pole prolonged to or across the middle line as a long tapering tail-like appendage. In the dissected specimen of the second batch the sacs were large, the main portion being in segm. x and taking up the whole length of this segment, while each had an elongated narrower and shorter portion in ix; a tail-like appendage was continued downwards and backwards from the hinder end of each sac.

The vas deferens consists of a not very large number of coils, situated altogether in segm. x.

The prostates are shortly cylindrical, the height of each being about twice its thickness; the surface is soft and "glandular", and not shining; each narrows below to be attached to the body-wall by a short stalk, and receives the vas deferens at about two-thirds of its height (measured upwards from its attachment).

Ovaries and funnels are contained in segm. xi; there is no ovarian chamber. The ovisacs are confined to segm. xii.

The spermathecal ampullae are ovoid sacs of moderate size; the duct is contained in segm. viii, and winds somewhat in its course; the atrium is represented only by a slight widening of the duct as it enters the body-wall.

Remarks.—The characters which distinguish these worms from both the type form of the species and from the var. *impertusa* are the enlarged setae at the hinder end, the shape of the prostates, and perhaps the "tails" of the testis sacs; in addition, the present specimens differ from the type form in having no dorsal pores, and from the var. *impertusa* in having the setal interval *aa* equal to *bc* throughout, and in wanting the papillae on segm. x.

Drawida fluvaitilis sp. nov.

(Pl. XXI. fig. 3).

Along the White-crow stream, near Yawnghwe, Southern Shan States, Burma, S. L. Hora. 29. iii. 1922. Parts of apparently six worms, but most of them in two fragments; five pieces were sexual.

External characters.—Length 74 mm.; diameter in general about 2 mm. at clitellum 2·5 mm. Segments 145; segments in general more or less distinctly triannular. Colour light brown, equable throughout, except that the clitellum is rather lighter; no difference between dorsal and ventral surfaces.

Prostomium small, round, prolobous.

Dorsal pores absent, but small dark spots are seen in places, probably where the longitudinal muscular coat is wanting.

The setae begin on segm. ii; they are small, but larger in the anterior part of the body, especially on the clitellum; they are closely paired; *aa* is slightly less than *bc*; *dd* is four-sevenths of the circumference.

The nephridiopores are in line with *cd*; but in many places, especially towards the hinder end, there appears to be a second, also continuous, series of pores in *ab*; this however is an appearance only, and on dissection only one pair of nephridia are found in each segment, the ducts discharging in the line of the lateral setae.

The clitellum includes half or rather more of segm. ix and half or more, or even all segm. xiv (=5–ca. 5½); it is ring-shaped, lighter in colour, and the segments smoother, but is nevertheless not very marked.

The male pores are in groove 10/11; they are small slits, with their centres midway between *b* and *c*, or perhaps slightly nearer to *b*.

The female pores are indistinct, but seem to be in groove 11/12 just within the line of setae *a*.

The spermathecal pores are inconspicuous, in groove 7/8, in line with *c*.

There are no other genital markings.

Internal Anatomy.—The body-wall is thinner and more translucent than usual, and this is not due to bad preservation.

Septa 5/6–8/9 are moderately thickened.

There are three gizzards, in segms. xiv-xvi; these are firm and round, and each has behind it, in the hinder part of its segment, a ring of thin-walled gut where the muscular development is absent. The oesophagus is somewhat strengthened by longitudinal muscular bands in xiii also.

The last heart is in segment ix.

The testis sacs are large, reddish, antero-posteriorly elongated, and either cylindrical throughout or narrower in front; the greater part of each is in segment x, and about a third or a fourth of their length in ix; x is a long segment, and the sacs extend quite to its hinder limit, and press septum 11/12 backwards.

The vas deferens is a very fine coiled tube, which lies altogether on the posterior side of the septum (9/10).

The prostate (fig. 3) is relatively very small, cylindrical, curved so as somewhat to resemble a sausage; it has a soft, almost papillose surface, and there is no separate duct. The vas deferens enters it about one-third of its length from its anterior end. The gland lies on the ventral body-wall, and is not curved round the alimentary canal.

There is an incomplete ovarian chamber, septa 10/11 and 11/12 being close together but separable; the chamber has however a complete floor above and at the sides of the alimentary canal.

The ovisacs are large and stoutly cylindrical; they extend back to the level of the hinder end of segment xiv (by bulging back septum 13/14) or halfway through xv (by bulging back septum 14/15).

The spermathecal ampullae are ovoid sacs; the duct is thin and slightly coiled, and lies on the hinder face of the septum (7/8); there is no trace of an atrium.

Remarks.—The present species comes nearest to *Drawida barwelli* var. *impertusa*, or to *D. pellucida* f. *typica* or var. *pallida*; but the form of the prostate is characteristic.

Drawida nandiensis sp. nov.

(Pl. XXI, fig. 4).

Nandi Hills, Bangalore; 4,800 ft.; under damp earth. Coll. J. P. Mullan. Very numerous specimens.

External characters.—The length of the worms varies, a large one being about 90 mm., and one of average size about 70 mm. or less; diameter 4-5 mm. Segments of a worm of 70 mm. 205, so that each segment is very short; the segments are biannular in the anterior part of the body. Colour a light and slightly pinkish grey.

The prostomium is not distinguishable.

Dorsal pores are absent.

The nephridiopores are in line with *cd*.

The setae begin in segm. ii, and are closely paired; *aa* is slightly less than *bc*, and *dd* is slightly greater than half the circumference.

The clitellum was not distinguishable.

The male pores are between the lines of *b* and *c*, but nearer *b*; they are situated on small papillae, which are sometimes so prominent as to resemble small penes.

The female pores are small, and are situated in line with setae *b*.

The spermathecal pores are immediately ventral to the line of setae *c*.

All the genital apertures are in the usual grooves.

Internal Anatomy.—Septa 5/6-8/9 are much thickened.

There are three gizzards, which may be in segms. xv-xvii, with in addition some thickening of the alimentary wall in xiii and xiv ; or the gizzards may be in segments. xiv-xvi, and the thickening in xiii may be absent.

The last heart is in segm. ix. A large vessel leaves the dorsal trunk at the anterior limit of segm. x on each side ; it passes downwards, outwards and backwards, and branches on reaching the body-wall at the hinder limit of the segment.

The testis sacs are of moderate size, and project slightly into segm. ix, though their main mass is in x ; they are somewhat irregular in shape.

The vas deferens is very fine, and forms a large tightly convoluted coil in segms. ix and x ; the portion in x is rather thicker than that in ix.

The prostates are of moderate size ; each is roughly spherical, and is attached to the parietes by a broad, scarcely constricted base ; the vas deferens enters the gland at the middle of its anterior face ; the surface of the prostate is smooth but not shining,—and can scarcely be called either " muscular " or " glandular."

There is a complete ovarian chamber.

The ovisacs are short, cylindrical, and end behind in segment xiii.

The spermathecal ampulla is oval in shape ; the duct is thin and coiled, and lies in segm. viii ; it pierces the septum (7/8) low down, and unites with the atrium, which forms an irregularly lobed mass in segm. vii, low down near its base (fig. 4).

Fam. MEGASCOLECIDAE.

Subfam. *MEGASCOLECINAE.*

Genus **Plutellus** E. Perr.

Plutellus kempi sp. nov.

(Pl. XXI, figs. 5, 6).

Kodaikanal, Palni Hills, S. India ; 6,850-7,000 ft. August 1922. S. Kemp Under logs of wood. A single specimen, in very bad condition, the hinder end wanting.

External characters.—The length of the specimen, which lacked the hinder end, was 75 mm., and its diameter 2·5 mm. The segments were uncountable, owing to the condition of the worm ; a number of preclitellar segments showed secondary annulation,—from two to five rings.

The prostomium is small and epilobous $\frac{1}{2}$; the sides of the tongue converge but do not meet.

Dorsal pores begin in groove 9/10.

The setae are very small and difficult to see ; they are paired, and in front of the clitellum the relations are $ab = \frac{1}{3}aa = \frac{1}{2}bc = \frac{2}{3}cd$; immediately

behind the clitellum the pairs seem to be considerably closer, —*ab*= $\frac{1}{5}aa=\frac{1}{3}bc=\frac{3}{4}cd$; towards the hinder end *ab* is slightly less than $\frac{1}{3}aa$, and is equal to $\frac{1}{2}bc$ and nearly equal to *cd*; in the rest of the body the setae are invisible in the present specimen; *dd* is equal to half the circumference.

The clitellum extends over $\frac{1}{3}$xiii-xvii (=$4\frac{1}{3}$).

The male area (fig. 5) is situated on segm. xviii; it takes up the whole ventral surface of the segment, and bulges the limits of the segment forwards and backwards; it is bounded in front and behind by a lip, but not at the sides. Within this area are two large rounded papillae, approximated in the middle line, where they are separated only by a longitudinal groove. The male pores are indicated on the summit of the papillae, about in line with the setae *ab*.

The female apertures were not seen.

The spermathecal apertures are two pairs, situated on the anterior parts of segms. viii and ix, and in line with setae *a*; but this statement is derived from the results of dissection rather than from external inspection, the pores being very inconspicuous,—the anterior pair invisible.

Internal Anatomy.—Septa 4/5 and 5/6 are thin, 6/7 is slightly thickened, 7/8 and 8/9 somewhat strengthened, 9/10—11/12 moderately stout, and 12/13 slightly thickened.

The gizzard is of moderate size, firm and barrel-shaped, in segm. v. There are no calciferous glands.

The last heart is in segm. xiii.

The excretory system is meganephridial.

Testes and funnels are free, in segms. x and xi.

The seminal vesicles are one pair, in segment xii, of moderate size, racemose.

The prostates are tubular; the glandular part forms a closely convoluted coil occupying segms. xvii, xviii and xix; the duct is very thin, transverse in direction, slightly shining, only slightly bent, and rather wider in its ectal portion.

Ovaries and funnels are situated in xiii.

The spermathecae (fig. 6) are two pairs, in segms. viii and ix; the ampulla is ovoid; the duct is not sharply marked off, and is as long or nearly as long as and half as thick as the ampulla; there is a single diverticulum, small, ovoid and shining, somewhat longer than the duct is wide, without stalk, which enters the ectal end of the duct.

There are no penial setae.

Plutellus campsiaulus[1] sp. nov.

(Pl. XXI, fig. 7).

Vandaravu, Palni Hills, S. India; ca. 7,400 ft.; under stones in stream in jungle. S. Kemp. 26. viii. 1922. Two specimens, one mature.

External characters.—Length 65-75 mm.; diameter 2·75 mm. Colour pale, with no difference between dorsal and ventral surfaces. Segments of the longer worm 155; no secondary annulation.

[1] Κάμψις, "curvature" and αὐλός, "a tube, pipe"; in reference to the bent spermathecal duct.

Prostomium epilobous $\frac{1}{2}$, the tongue not closed behind.

The dorsal pores begin in groove 5/6 in one, and apparently in 4/5 in the other but this is perhaps rudimentary, not perforating the body-wall.

The setae are paired, the ventral widely, the lateral very widely. In the middle of the body $ab=\frac{2}{3}aa=\frac{1}{2}bc=\frac{3}{4}cd$; dd is about equal to aa, and is $\frac{4}{3}cd$. Behind the clitellum $ab=\frac{4}{7}aa=\frac{2}{5}bc=\frac{2}{3}cd$, while dd is equal to $2cd$. In front of the clitellum dd is much increased; $ab=\frac{4}{7}aa=\frac{2}{5}bc=\frac{4}{7}cd$, while $dd=\frac{5}{2}cd$. Thus bc is on the whole the greatest interval, being exceeded by dd only in the anterior part of the body.

The clitellum extends over $\frac{2}{3}$xiii-xvii ($=4\frac{2}{3}$) ; it is smooth, and setae are present.

The male pores are situated on segm. xviii, in line with setae *b*, on small papillae. The papillae are seated on a slightly dumbbell-shaped transverse thickening of the ventral surface, and are delimited in front and behind by slight grooves.

The female pores are minute, on segm. xiv, immediately in front of the setae *a*.

The spermathecal pores are two pairs, in grooves 7/8 and 8/9, immediately outside the line of setae *b*.

Internal Anatomy.—Septa 5/6 and 6/7 are slightly strengthened, 7/8 and 8/9 are somewhat thickened, 9/10–11/12 moderately strengthened, and 12/13 and 13/14 somewhat less so.

The gizzard, in segm. v, is small, round, and soft, and in consider able degree rudimentary. There are no calciferous glands ; the oesophagus is somewhat dilated and vascular in segms. vii and viii. The intestine begins in xvii.

The last heart is in xii.

The excretory system is meganephridial ; the nephridia are small in the anterior segments, and increase in size from the prostatic region.

Testes and funnels are free in segms. x and xi.

The vesiculae seminales are two pairs, in segms. ix and xii ; they are racemose, and of moderate size, each meeting its fellow dorsally.

The prostates are tubular, and are thrown into several loops, which occupy segms. xviii and xix ; the duct is thin, short, and curved, the ectal portion being rather stouter and shiny.

There are no penial setae.

The ovaries and ovarian funnels are contained in segm. xiii. There are relatively large racemose ovisacs in xiv.

The two pairs of spermathecae (fig. 7) are situated in segms. viii and ix ; the ampulla is an irregular sac, very definitely marked off from the duct, which is bent at a knee-like angle ; the length of the duct, if straightened out, is somewhat greater than that of the ampulla, and its width in general is a quarter that of the ampulla, but it is a little wider at the bend. There is a single diverticulum, almost globular, with a short stalk which attaches it to the bend of the duct ; the diameter of the diverticulum is about the same as that of the duct.

Genus **Spenceriella** Mich.

Spenceriella duodecimalis Mich.

(Pl. XXI, figs. 8-13.)

Kodaikanal, Palni Hills, S. India ; 6,850-7,000 ft.; under logs of wood. S. Kemp. August 1922.
Kodaikanal ; 6,900 ft.; under rotten wood. S. Kemp. August 1922.

In 1909 Michaelsen (3) described *Spenceriella duodecimalis* from two specimens taken at Kodaikanal in the Palni Hills. In the present collection there are numerous specimens of the same species, which however fall into at least four groups, with well marked and distinctive characters.

f. **typica.**

The original specimens investigated by Michaelsen had twelve setae per segment in the anterior half of the body, arranged in distinct pairs (three pairs on each side) in front of the clitellum ; behind the clitellum the paired arrangement ceased, and the distribution became irregular behind segment xlv or l, while the number per segment increased to 16 or 17.

Several somewhat similar specimens were found in the present collection in the first batch of material mentioned above. For example, in one specimen, at the hinder end there was some irregularity of arrangement, and the number of setae per segment increased to 14, 16 or 17. In another, the number 12 was maintained till near the hinder end, which had apparently been regenerated; in this portion the setae were irregularly arranged and more numerous, about 16 per segment. In a third, the hinder end had obviously been regenerated, and a similar irregularity and increase of numbers were found.

In the first of the above specimens, which was examined internally also, the spermathecal diverticulum was three-quarters or five-sixths as long as the ampulla (fig. 8). The prostates extended back to segment xlii. Externally, there was a pair of small white papillae on the hinder part of segment xvii, in the line of setae *b* on one side, a little external to it on the other ; there was nothing internally corresponding to these papillae.

f. **regularis.**

From both localities mentioned above, five specimens from the first, six from the second.

In these specimens the setae were 12 per segment throughout the body, in three pairs on each side. In general $aa = 1\frac{2}{3}$ or nearly $2ab = bc = cd = de$ (or may be rather less than de) $= ff$; $ab = ef$; thus setae *cd* can scarcely be said to be paired. Or again $ab = \frac{3}{4}\, aa = ef = ff$; *ab* is here slightly less than *bc*, which in turn $= cd$ and is two-thirds of *de*. The setae are of considerable size relatively to the size of the worm.

In a dissected specimen of the first batch the spermathecal ampulla was a club-shaped sac with no definitely distinguishable duct; the diverticulum was also clubshaped, slightly shorter than the main pouch, and half as broad as the latter, which it joined at the body-wall (fig. 9),

The proportions of ampulla and diverticulum however appear to vary very much; the relations in two dissected specimens of the second batch are illustrated in figs. 10 and 11.

Regarding other characters the following brief notes may be added. The length of the longest specimen was 84 mm., the average diameter 1·25 mm., and the maximum 1·75 mm. The segments of the longest specimen numbered 125. The dorsal pores began in furrow 4/5. The clitellum was constricted, and embraced segms. xiv-xvi (=3). The male pores were on small round papillae in the setal zone of xviii, the papillae being in, and equal in extent to, the intersetal intervals *ab*; each has a small secondary papule on its surface, the papule being surrounded by a groove. The female pore was single and midventral, immediately in front of the setal zone of segm. xiv. The spermathecal pores were in furrow 7/8, in line with *b*. The gizzard was in segm. vi. The calciferous glands were sessile on the oesophagus and not stalked, but they formed considerable ovoid swellings of the gut in segm. xiii, and there was some swelling in xiv also, but less than in xiii. There were small ovisacs in xiv. The prostates reached segm. xxxvi.

f. quadripapillata.

A single specimen, from the first batch, was noted. In this form, as in the last, the setae are twelve per segment thoughout the body; $ab = \frac{1}{2}aa = \frac{2}{3}bc = \frac{2}{3}cd = \frac{1}{2}de = \frac{2}{3}ef$; *ff* is little more than *ef* (*ca.* $1\frac{1}{4}$ *ef*); at the hinder end *de* is reduced, so that *bc*, *cd*, *de* and *ef* are about equal.

The male field is characteristic of this form. On each side of segm. xviii, on the ventral surface, are two small round papillae side by side, taking up the equivalents of the setal interspaces *ab* and *bc* respectively. The male pores are on what might be called a "col" between the two papillae of a side, *i.e.*, the narrow interval between the two papillae of a side is raised somewhat, but not to the level of the top of the papillae themselves; the pores are thus in line with *b*.

On dissection, the spermathecal ampulla was found to be regularly ovoid in shape; the duct was distinct, rather more than half as long and a quarter as wide as the ampulla; the diverticulum was cylindrical and long,—somewhat longer than the ampulla and duct together, and was bent round the end of the ampulla; it was nearly as thick as the duct, but slightly thinner towards its ectal end, which was attached to the ectal end of the duct (fig. 12).

Additional characters were as follows:—Length 38 mm.; diameter 1·75 mm.; segments 81; colour pale. Prostomium epilobous $\frac{3}{4}$, tongue open behind. Dorsal pores beginning in furrow 3/4. Clitellum $\frac{1}{2}$xiii-$\frac{1}{2}$xvii (=4), not constricted. The female pores appeared here to be double, situated just in front of and internal to *a* on segm. xiv. The gizzard was in segm. vi. The calciferous glands formed a single relatively large spherical swelling on each side, occupying segments xiii and xiv; the portion in xiii was opaque white in colour, that in xiv showed longitudinal vascular striations. The prostates were shorter than in the other "forms" and extended back to segm. xxix only.

f. **ditheca.**

A single specimen from the first batch of material showed two pairs of spermathecal apertures. These were situated in grooves 7/8 and 8/9, between the lines of *b* and *c*, but nearer *b*. The ampullae were ovoid sacs, the duct equal in length to the ampulla and half as thick as the latter; the diverticulum was cylindrical and very long,—twice or nearly twice as long as ampulla and duct together (fig. 13).

The setae were twelve per segment; but in the last few segments there was some irregularity, both in arrangement and in numbers; *e.g.*, there might be five setae on one side of the body and eight on the other. Not all the segments at the hinder end show irregularity, and when there is irregularity it more often affects the arrangement than the numbers. In the middle of the body $ab=\frac{1}{2}aa=\frac{3}{4}bc=\frac{3}{4}cd=\frac{1}{2}de=\frac{1}{2}ef$ (or perhaps $\frac{4}{9}ef$); $ff=1\frac{1}{2}ef$.

Among other points the following may be noted:—Length 70 mm.; diameter 3 mm.; segments 135; colour pale, no difference between dorsal and ventral surfaces. The worm was flattened dorsoventrally. Dorsal pores began in furrow 4/5. The clitellum was possibly four segments in extent, xiv-xvii, but was scarcely marked. The male pores were on a pair of papillae which were turned so as to look directly inwards; the midventral part of segm. xviii was rather depressed, the lateral boundaries of the depression being formed by the papillae. The female pore or pores were not seen. Calciferous glands were much as in f. *regularis*. The prostates extend back to segm. xxxiii or xxxiv.

Spenceriella kempi sp. nov.

Marian Shola, Palni Hills, S. India; ca. 7,000 ft.; under wood in jungle. S. Kemp. 24. viii. 1922. A single specimen.

External characters.—Length 58 mm.; average diameter 2·5 mm. Segments 112. Colour an equable grey, with narrow middorsal stripe.

Prostomium epilobous $\frac{1}{2}$, the tongue broad, not cut off behind.

Dorsal pores begin in furrow 5/6.

The setae are in rings; the dorsal break is small, about equal to $2yz$; the ventral break is equal to $2\frac{1}{2}ab$ in the anterior and to about $3ab$ in the hinder part of the body; the setae are set closer ventrally. The following numbers were counted:—48/v, 50/ix, 51/xii, 49/xix, and 49 in the middle of the body.

The clitellum was not distinguishable.

The male field showed a pair of papillae on the posterior third of segm. xviii contiguous in the middle line, and abutting on and partly obliterating furrow 18/19. A narrow groove crosses the midventral region between the anterior and middle thirds of segm. xviii; and the male pores are perhaps visible as small whitish points in the course of this groove, about in line with *cd* or *d*.

The female and spermathecal apertures were not visible.

Internal Anatomy.—Septa 4/5 and 5/6 are very thin, 6/7 is thin, 7/8 and 8/9 are slightly thickened; 9/10–12/13 are moderately thickened,—the thickest of the series; 13/14 is slightly and 14/15–16/17 are very slightly thickened.

The gizzard is cylindrical, and long anteroposteriorly; it is in segm. vi, since septum 6/7 can be peeled backwards from its surface or a needle inserted without injury between the septum and the surface of the gizzard. Calciferous glands are situated in segm. xiv, where they constitute large lateral bulgings of the oesophagus, smooth, with an ovoid contour, and with longitudinal vascular striations; they are not set off from the gut. In segm. xiii there is a small gland on the right side, separate from the one behind it; but on the left side there is only a slight extension of the gland in xiv forwards through the septum. The intestine begins suddenly in xvii.

The last heart is in xii.

The micronephridia are small, and fairly numerous in segms. xiii-xviii (which probably represent the clitellar region) and in some of the anterior segments; they are relatively few, and scattered, behind the clitellar region; towards the hinder end one or two of the innermost micronephridia of a row seem to be rather larger than the rest, but the difference is not by any means constant nor is it at all striking.

Testes and funnels are free in segms. x and xi. Seminal vesicles are present in xi and xii, those in xii rather larger, and both pairs much cut up into small rounded lobules.

The prostates are tubular, long and narrow, extending back to segm. xxix or xxx; they are thrown into a number of small loops. The terminal portion is shiny, and considerably stouter, and bends inwards to terminate in segment xviii; perhaps the part from xxi forwards may be called the duct.

There are no penial setae.

The female organs were not identified.

What appeared to be the spermathecae in an undeveloped condition were seen in segm. ix; but whether the structures, which look like flat empty sacs, were really such is doubtful, since they occupied the hinder part of the segment over the situation of furrow 9/10, and one of them appeared to be further out from the middle line than the other.

Remarks.—Leaving aside the doubtful spermathecae, the difference of this form from *S. duodecimalis* consists in the very much greater number of setae, and, of course, the loss of the paired arrangement. Small differences are seen in the prostomium and the calciferous glands; the gizzard is probably in the same segment in the two worms.

Genus **Notoscolex** Fletcher.

Notoscolex palniensis sp. nov.

(Pl. XXI, figs. 14-16).

Marian Shola, Palni Hills, S. India; ca. 7,000 ft.; under wood in jungle. S. Kemp. 24. viii. 1922. A single specimen.

External characters.—Length 120 mm.; diameter in general about 3 mm., at the bulbous anterior end 4 mm. Colour an equable brownish grey. Segms. 155; segment vi biannular, vii-x triannular, or with one or two further subdivisions; xi-xiii with four or five annuli.

Prostomium apparently absent.

Dorsal pores begin in furrow 10/11.

The ventral setae are paired, but the lateral scarcely so. In the middle of the body $ab=\frac{2}{5}aa=\frac{3}{5}bc=\frac{3}{5}cd$; dd =half the circumference; behind the genital region $ab=\frac{1}{2}aa=\frac{1}{2}bc=\frac{1}{2}cd$, and dd is rather greater than half the circumference; in front of the genital region $ab=\frac{2}{3}aa=\frac{1}{2}$ or $\frac{4}{7}bc=\frac{1}{2}$ or $\frac{4}{7}cd$. The setae in front of the male region are enlarged.

The clitellum embraces $\frac{3}{4}$xiv–$\frac{3}{4}$xviii ($=4\frac{1}{2}$); setae, dorsal pores and intersegmental grooves are present.

The male area (fig. 14) covers the whole of the ventral surface of segm. xviii, and presses its boundaries forwards and backwards. It is bounded by a distinct lip; from within the area rises a beau-shaped papilla, transversely placed, with the hilus anterior; the area in front of the hilus is depressed. The male pores are possibly represented by a pair of small triangular depressions on the surface of the papilla, in line with setae *b*, which are connected across the middle line along the ridge of the papilla by a narrow groove; the groove also extends outwards beyond the triangles.

The female apertures were not seen.

The spermathecal pores are two pairs, in grooves 7/8 and 8/9; they are slit-like, with their centres in line with *a*.

There are no other genital markings.

Internal Anatomy.—Septum 4/5 is thin, 5/6 is moderately strengthened, 6/7–11/12 are all much strengthened, the last two or three (9/10–11/12) perhaps rather less than the others; thence the thickening decreases to 16/17, which is thin.

There is a large firm gizzard in segm. v, rather triangular in shape, broad in front and narrow behind. There are no calciferous glands. The intestine begins in segm. xvi, but the widening is gradual. There are lymph glands over the dorsal vessel and intestine, like those in *Pheretima*, except that here they are single and median, not paired.

The last heart is in segm. xii.

The excretory system is micronephridial, the nephridia in the anterior segments being in the form of considerable tufts or rosettes; to these are added, beginning in segm. xxi, a pair of meganephridia as transversely placed loops in each segment. After segment xxvi the whole nephridial system becomes very much less conspicuous, but this is probably due only to some accidental cause. In the hinder part of the body there are, in addition to micronephridia, well marked meganephridia as long loops on each side, though these do not gain any connection to the septa, and no nephrostomes were found on microscopical examination.

Testes and funnels are free in segms. x and xi; the funnels are conspicuous, but what were taken for testes may possibly have been nephridia. Seminal vesicles are found in xi and xii; both pairs are small; those in xi are situated laterally in the segment; those in xii have their main mass dorsal, but they extend round the sides as a thin band.

The prostates occupy segms. xviii-xix or xviii-xx. That on the right side is shown in fig. 15; I thought at first that it was tubular, and the worm accordingly a *Megascolides*, but on sectioning it there was found to be no central lumen; indeed there were no ducts at all in the mass

of the gland, only an irregular aggregate of prostatic cells like those of *Pheretima*. The prostate of the other side was much more pressed together. The appearances are reminiscent of Michaelsen's description of *Megascolides cochinensis* (4), where however the organ was not sectioned. The prostatic duct is narrow, bent, with on the whole a transversely inward course, slightly wider at its ectal end, where it is also very slightly shiny.

There are no penial setae.

The spermathecae (fig. 16) are two pairs; the ampulla is ovoid; the duct is as long as or slightly longer than the ampulla and half as wide as the latter, and it may be straight or bent on itself; there are two diverticula, finger-like and cylindrical, opposite each other and attached to the ectal end of the duct, in length equal to two-thirds or three-quarters of the length of the duct.

Remarks.—The remarkable similarity of this worm to *Megascolex vilpattiensis* is apparent on comparing the two descriptions; the resemblances extend to the colour, extent of dorsal pores, enlargement of anterior setae, position of spermathecal pores, the gizzard in segment v, the nephridia ("Lampito" arrangement), the prostates ("almost bandlike" in *M. vilpattiensis*) and the rather characteristic shape of the spermathecae. The differences (besides the generic difference of the number of setae per segment) are in the shape of the prostomium, and in the facts that the last heart is in the present species in segm. xii, and the testes and funnels are two pairs instead of one (the holandric as against the metandric arrangement). There is a difference also in the male genital field.

It is not impossible that the present species is the direct ancestor of *M. vilpattiensis;* both are inhabitants of the Palni Hills. That they are closely related seems indisputable; and *M. vilpattiensis* is to be looked on, therefore, as a member of the genus *Megascolex* which has originated separately from the bulk of the remaining species.

Genus **Megascolex** Templeton.

Megascolex konkanensis Fedarb.

Nandi Hills, Bangalore; 4,800 ft.; under damp earth. Coll. J. P. Mullan. One mature and a number of smaller immature specimens.

Bombay. Coll. J. P. Mullan. Nine specimens.

Megascolex mauritii (Kinb.).

Bombay. August 1923. J. P. Mullan. A single specimen.

Bangalore. December 1922. J. P. Mullan. Several specimens.

Megascolex trilobatus (Steph.)

(Pl. XXI, figs. 17, 18).

Bombay. Coll. J. P. Mullan. A single specimen.

Bombay. From S. Setna. Four specimens.

The discs on segment xviii, on which the male pores are situated, are not here distinctly trilobed on their outer edge (a character from

which the species was named). They may be somewhat depressed in their centres, and so rather suckerlike.

I give drawings of the spermatheca and penial setae of the present specimens. The penial setae may have the end of the thin lamella which spans the interval between the terminal prongs scooped out (fig. 17); but I am not sure that this is always the case; these setae are difficult to observe, since owing to their curvature they settle down on the slide in such a position that the distal end is seen edgewise, with the prongs one above the other.

The spermatheca was originally stated to have no separate duct; but from the present examples it would seem that the ectal portion of the irregularly lobed sac shown in fig. 4 of my previous paper (8) is really the much swollen duct; compare the figure here given (fig. 18).

Megascolex sylvicola (Mich.) var. **marianae** var. nov.

(Pl. XXI, figs. 19, 20).

Marian Shola, Palni Hills, S. India; ca. 7,000 ft.; under wood in jungle. S. Kemp. 24. viii. 1922. Four specimens.

External characters.—Length 110 mm.; diameter 2·5 mm. Colour an equable light grey, the anterior end a little darker. Segments 188; slight indications of secondary annulation in some preclitellar segments.

Prostomium absent.

Dorsal pores exist from groove 9/10 backwards.

The setae are in rings; the dorsal break is in general large, in the most anterior segments one-third of the circumference, behind the clitellum one-fourth of the circumference, in the middle of the body one-tenth of the circumference, or 3-4*yz*, while at the hinder end it is small, equal to 2*yz*. The ventral break is in the first few segments equal to 2*ab*, then for the rest of the anterior half of the body it is equal to 3*ab*, and again decreases somewhat towards the hinder end, where it becomes equal to 2*ab*. Setae *ab* are paired, the interval *bc* being greater than *ab*, equal to $1\frac{1}{2}$ or sometimes nearly 2*ab*; in the anterior part of the body there is some indication of the pairing of *cd* also (*de* slightly greater than *cd*). The following numbers were counted;—16/v, 18/ix, 19/xii, 24/xix, 24/27 in the middle of the body, and 29 at the hinder end.

The clitellum extends over perhaps xiv-$\frac{2}{3}$xviii, but it is indistinct.

The male area (fig. 19) is marked by a transverse ridge (*r*), slightly bowed backwards, stretching across the ventral surface of the anterior part of segm. xviii; the anterior margin of the ridge coincides with the anterior margin of the segment, and the ridge runs up to a fairly distinct crest. Behind the ridge is a correspondingly curved shallow trench (*g*), which takes up the posterior part of the segment. The male pores (♂) appear as small papillae in this trench, in line with the setae *ab*.

The female apertures were not visible, nor the spermathecal apertures; but from internal dissection the latter open in grooves 7/8 and 8/9 in line with setae *a*.

Internal Anatomy.—Septum 4/5 is very thin, 5/6 thin, 6/7 and 7/8 slightly, 8/9, 9/10, and 10/11 increasingly thickened; 10/11 and 11/12 are

perhaps the thickest of the series, and may be called moderately strong; the rest as far as 15/16 are slightly thickened.

The gizzard is in segm. v; septum 5/6 can be peeled back from its surface, though it seems at first to be in vi. There are no calciferous glands. The intestine begins in xvi.

The last heart is in xiii.

Micronephridial tufts are present by the side of the alimentary canal in the anterior segments, but no nephridia are visible on the general body-wall anterior to the clitellum. A number of fairly large tufts are visible on the body-wall in the clitellar region; while behind this there exists a row of small tufts on the hinder side of each septum (though they are perhaps not attached to the septum), and from xxi onwards there is also a considerable meganephridial loop placed transversely on the body-wall.

Testes and funnels are free in segm. xi; there are none in x. The seminal vesicles, of moderate size and much cut up into lobes, are one pair only, in segment xii; a mass of coagulum in xi simulates a pair of vesicles however.

The prostates, of the Pheretima-type, and cut up into lobes, take up segments xviii and xix; the duct, transverse in its general direction, is bent into an **S**, slightly shiny, and narrow, though slightly wider in its sectal portion.

There are no penial setae.

Ovaries and funnels are present in segm. xiii; there are small ovisacs in xiv.

The spermathecae (fig. 20) are two pairs, in segms. viii and ix; the ampulla is ovoid or fusiform, narrowing to the duct, which is not sharply marked off; taking the place of origin of the diverticula as the beginning of the duct, this latter is half to two-thirds as long and about a quarter as thick as the ampulla. The diverticula are two, opposite, slightly clubshaped, and one-third to two-fifths as long as the ampulla (that part of the main pouch above their origin).

Remarks.—The present form resembles both *M. vilpattiensis* and *M. sylvicola*, but is perhaps closest to the latter. The differences are the absence of the prostomium in the present form, the absence of the cushion on segm. xix, the configuration of the male area, and perhaps a difference of one segment in the position of the gizzard; probably however the position of the gizzard is the same in both.

Striking resemblances between all three forms are found in the nephridial arrangement, in the metandric condition of the male organs, and in the shape of the spermathecae. All are found on the Palni Hills, and together with *Notoscolex palniensis* (from the same place and in the same tube as the present form) constitute a well marked natural group.

Megascolex porphyrozonus sp. nov.

(Pl. XXII, figs. 21, 22).

Nandi Hills, Bangalore; 4,800 ft.; under damp earth. Coll. J. P. Mullan. Numerous specimens.

External characters.—Length 52-68 mm.; diameter 2·5—3·5 mm. Segms. 101 in each of two specimens, 103 in a third. Colour a pinkish

brown, somewhat darker on the dorsal than on the ventral surface; the clitellum a deep purple, standing out against the rest of the animal.

Prostomium epilobous or combined pro-and epilobous $\frac{2}{5}$; a median longitudinal furrow extends over the prostomium and first segment.

Dorsal pores begin in furrow 6/7; or there may be a rudimentary pore in 5/6.

The setae are in rings; the ventral break is fairly regular, equal to $2ab$; the dorsal break varies from one specimen to another, and from one part of the same specimen to another, and is from 2-4yz, averaging about 3yz. The setae are rather closer set ventrally. The following numbers were counted:—28/v, 32/ix, 29/xii, 26/xix, 25 in the middle of the body.

The clitellum extends over xiv-xvii (=4).

The male pores are on segment xviii, in line with b or ab, on small papillae which are approximated in the middle line and separated only by a longitudinal groove. The thickening of the male field may extend on to the anterior part of xix.

The female pores, on segment xiv, are apparently paired, in a whitish area, in front of the setal zone, and about in line with setae a.

The spermathecal apertures are on minute papillae in grooves 7/8 and 8/9, in line with a.

Internal Anatomy.—Septa 4/5, 5/6 and 6/7 are all thin; 7/8 is moderately, 8/9–11/12 much thickened; 12/13 is moderately and 13/14 slightly thickened.

The gizzard, in segm. vi in one, in segm. vii in another, is rounded, rather short antero-posteriorly, firm, and of moderate size. There are no calciferous glands. The intestine begins in segm. xv.

The last heart is in segm. xiii.

The excretory system is micronephridial; there are a few large tufts on the body-wall in the clitellar region; behind this the tufts are of moderate size, and are still relatively few.

The testes and funnels are free in segms. x and xi, along with masses of firm coagulum. Seminal vesicles are present in ix and xii, of moderate size, deeply lobulated along the dorsal border.

The prostates occupy segms. xviii and xix, and are much cut up into small lobes; the duct is very short, straight, lying transversely, not shining; a large and long penial setal sac is seen on the inner side of the gland.

Ovaries and funnels are present in segment xiii.

The spermathecal ampulla is ovoid, and is continued into the duct without sharp demarcation; the duct is as long and half as thick as the ampulla; the single diverticulum is as large as the ampulla, and as long as the duct, from which it arises at the ectal end of the latter; the margin of the diverticulum is lobulated by a number of small more or less spherical seminal chambers (fig. 21). In a second specimen the ampulla was more elongated, and irregularly bent and doubled up.

The penial setae are much curved, into a semicircle or into the shape of an **S**, and the curves lie in more than one plane; they have a purplish tinge. The full length may be 2·5 to 3 mm., and the shaft is 16μ thick in its middle. The tip is flattened, and about half as broad again as the

shaft, and the extremity of a number of setae appears to be softened and deformed, twisted and bent; normally it appears to be cut off somewhat squarely, and jagged, toothed or indented (fig. 22). There is no other ornamentation.

Genus **Pheretima** Kinb.

Pheretima elongata (E. Perr.)

Betel Vine Gardens, Singanallur, Coimbatore District, S. India. 2. x. 1922. Two specimens.

Same place. 27. i. 1922. A number of specimens.

Poona. March 1923. J. P. Mullan. Ten specimens.

Bombay. August 1923. J. P. Mullan. A single specimen.

In the latter part of last year (1922) the Government Entomologist at the Agricultural College, Coimbatore, S. India, wrote to me as follows: —"The Betel-Vine (Piper betel) Gardens in the neighbourhood of Coimbatore have for some years past been reported to be damaged by earthworms burrowing into the soil around the roots till it becomes honeycombed with the tunnels. They are also reported to feed on the cattle manure supplied, and to rob the plants of their nutriment. The Rootknot Eelworm has been found in many of the roots of the plant, but it is not yet proved how far (or whether at all) the earthworm itself is responsible for the reduced yield." The worms that were sent for identification were however in such extremely bad condition that I decided not to describe them, and sent a request for more worms. These arrived in the early part of this year, and proved to be *Pheretima elongata* (E. Perr.).

I now recognize that the first consignment also consisted of worms of the same species; but the copulatory papillae were invisible on account of their bad condition. As is well known, spermathecae may be altogether absent in worms of this species, and this was the case in one of the first batch; in the other of this batch there were three spermathecae side by side on the right side of one of the anterior segments (opening apparently in furrow 5/6, but it was impossible to be certain), and none elsewhere.

Pheretima hawayana (Rosa).

Bombay. Coll. J. P. Mullan. Eight specimens.

Pheretima heterochaeta (Mich.)

Kodaikanal, Palni Hills, S. India; 7,000 ft. Fletcher coll. September 1921. A single specimen.

Kodaikanal; 6,850 ft.; under stones at edge of lake. S. Kemp. August 1922. Ten specimens.

Kodaikanal, 6,900 ft.; under rotten wood. Same collector and date. Several specimens.

Kodaikanal, 6,850-7,000 ft.; under logs of wood. Same collector and date. Three specimens.

Cantonment Hill, Cherrapunji, Assam; 4,300 ft.; under stones in damp places. S. L. Hora. 20. xi. 1923. Numerous specimens.

Pheretima houlleti (E. Perr.)

Matheran, near Bombay, Coll. J. P. Mullan. October 1921. A single specimen.
Bansda, Surat; in muddy pools. Coll. J. P. Mullan. October 1922. Four specimens.
Gorge below Chota Tank, Buldana, Berar; 2,190 ft. H. S. Rao. 17. xi. 1923. Two specimens.
Bombay. Coll. J. P. Mullan, Two specimens.

Pheretima lignicola Steph.

Bombay. Coll. J. P. Mullan. A single specimen, not quite mature.

Pheretima posthuma (L. Vaill.)

Bombay. Coll. J. P. Mullan. A number of specimens.

Pheretima suctoria Mich. var. **mullani** var. nov.

Bombay. Coll. J. P. Mullan. Eleven specimens.
Bombay. From S. Setna. A single specimen.

In a previous paper (10) I described some specimens of *Pheretima suctoria* which differed from Michaelsen's original examples in a number of points; these were from Bombay, while Michaelsen's specimens came from the Andaman Islands. I have recently had two fresh batches of the same worm, again from Bombay, and I find that these agree with my former specimens from Bombay in all particulars. The only notes I would add are that the length of these worms was 120-170 mm., and that the enlargement of the setae of the anterior segments extended a little further back than in my previous examples, to segment viii.

Since the peculiarities of the Bombay specimens are thus constant, it seems proper to separate them as a definite variety. The points of difference from the type of the species are the following.

The prostomium is epilobous $\frac{4}{5}$, the tongue not cut off behind, and the grooves which bound it at the sides hardly differ from the numerous other longitudinal grooves round the mouth. The setae of segments ii to vi or viii are enlarged. The male pores are at the centre of the characteristic discs on segment xviii (not on their outer border), and scarcely a quarter of the circumference apart; a faint ridge runs transversely across each disc; twelve to fourteen setae intervene between the male pores, the setal ring being continued a little way on to the disc on each side. The female pore is single. Septa 5/6–7/8 are extremely stout. The testis sacs enclose the hearts, and in segm. xi the seminal vesicles also. The prostatic ducts become stouter towards the ectal end. There are no ovisacs. The spermathecal ampulla is ovoid, and the duct narrowed at its upper end.

Genus **Perionyx** E. Perr.

Perionyx excavatus E. Perr.

Calcutta, from a filtered water tap; 14. vi. 1922. Sent by the Corporation of Calcutta Analyst to the Indian Museum. A single specimen, in two pieces, in very bad preservation.
Tai-o, near the iron bridge, Yawnghwe, S. Shan States, Burma, 28. iii. 1922. Numerous specimens.
Rangoon, under bricks at edge of a pond; 5. iii. 1922. N. Annandale and H. H. Marshall. Two specimens.
Ballygunge, Calcutta. March 1923. E. C. Dormieux. A single specimen.

Though this species is one of the commonest Indian worms, and notwithstanding the fact that I had just previously had the specimens

from Tai-o through my hands, I did not suspect the identity of the worms from Rangoon till, at the very close of the examination, I investigated the penial setae under the microscope. Instead of being, as usual, of approximately equal diameter throughout the greater part of the body, the present specimens were much constricted at the clitellum, and swollen in front of this; in particular, the male area was much more distinctly characterized than usual:—a moderately deep depression, with clean-cut margins and steep or even overhanging sides, rather irregular and somewhat trapezoid in shape, the anterior border rather longer than the posterior, was situated midventrally on segment xviii, taking up, with the lip which bordered it, the whole length of the segment; taking up the greater part of the bottom of the depression were two papillae, oval in shape, with their long axes longitudinal, touching each other in the middle line; the male pores were seen as black dots on the centres of the papillae. In addition, the gizzard was fairly well marked,—small, but moderately firm.

Perionyx m'intoshi Bedd.

Cantonment Hill, Cherrapunji, Assam; 4,300 ft.; under stones in damp places. S. L. Hora. 20. ii. 1923. A single specimen.

The specimen differed in one or two points from previous examples of the species. The prostomium was epilobous $\frac{2}{3}$, the tongue cut off behind. There were small dorsal and ventral breaks in the setal rings; the ventral break was only $1\frac{1}{4}$ or $1\frac{1}{2}$ *ab*, or even imperceptible; the dorsal was variable and irregular, up to 2 *yz*. The setal numbers were smaller than in previous specimens:—57/v, 69/ix, 71/xii, 64/xix, 63 in the middle of the body. The male area was much less marked, and there was no clitellum; possibly the present specimen was not fully mature, though there was no evidence of this internally. Interesting similarities to former examples were the rudimentary seminal vesicles in segm. xiii, and rudimentary ovisacs in xiv.

On the other hand there were a number of resemblances between the present specimen and *P. modestus*, which I have recently described from the same locality (10). But the differences are also fairly considerable;—the prostomium, the larger number of setae, the greater approximation of the male and spermathecal pores, the much better developed gizzard, which is here in segm. vi. In some ways,—*e.g.*, size, and numbers of setae, the present specimen is intermediate between *P. m'intoshi* and *P. modestus*.

Perionyx sansibaricus Mich.

Kodaikanal, Palni Hills, S. India; 6,900 ft.; under rotten wood. S. Kemp. August 1922. A single specimen, incomplete posteriorly.

Kodaikanal; 6,850–7,000 ft.; under logs of wood. S. Kemp. August 1922. Three specimens.

Goreghar, between Panchgani and Mahableshwar, Western Ghats; in damp earth. Prof. J. P. Mullan. November 1922. Numerous specimens, the majority immature.

Gorge below Chota Tank, Buldana, Berar; 2,190 ft. H. S. Rao. 17. ii. 1923. Several specimens.

Poona. March 1923. J. P. Mullan. Numerous specimens, mostly immature

Perionyx horai sp. nov.

(Pl. XXII, fig. 23.)

Cantonment Hill, Cherrapunji, Assam; 4,300 ft.; under stones in damp places. S. L. Hora. 20. ii. 1923. A number of specimens.

External Characters.—Length 86 mm.; diameter 3 mm. Body somewhat flattened dorsoventrally. Segments 144; no secondary annulation. Colour deep purple dorsally, pale ventrally.

Prostomium variable; epilobous $\frac{1}{2}$, the sides converging but not meeting, and the tongue not cut off behind; epilobous $\frac{1}{2}$, the sides parallel, open behind; or epilobous $\frac{4}{5}$, the sides parallel, open behind.

Dorsal pores begin in furrow 4/5.

The setae are in rings; the dorsal and ventral breaks are small ($1\frac{1}{4}ab$ or $1\frac{1}{4}yz$) or absent; they are closer set ventrally, and none are specially enlarged. The following numbers were counted:—54/v, 55/ix, 50/xii, 48/xix, and 49 in the middle of the body.

The clitellum was indistinct or absent.

The male area showed a relatively large and deep excavation on the ventral surface of segm. xviii, with sharp edges; with its lip, this excavation takes up the whole of the length of the segment, pressing the bounding grooves respectively forwards and backwards; in shape the excavation is roughly circular, or slightly oval in a transverse direction, and in transverse extent it takes up the middle third or rather more of the ventral surface.

From the bottom of this pit protrude, directed rather inwards, a pair of penis-like projections, each grooved on its outer and anterior side. The tips of these processes may or may not attain or project beyond the level of the ventral surface of the animal; as a consequence of the position of the penes, their tips are near together and not far from the middle line.

The female pore was not recognized.

The spermathecal pores are two pairs, with slight whitish lips, in line with setae *c*. Their situation varies; out of six specimens, they were once in furrows 6/7 and 7/8, once in 8/9 and 9/10, and four times in 7/8 and 8/9; the latter thus appears to be the normal condition.

Internal Anatomy.—Septum 5/6 is extremely thin, 6/7 is thin, 7/8 and 8/9 are slightly and 9/10 and 10/11 somewhat thickened.

There is a vestigial gizzard in segm. vi. There are no calciferous glands, but the oesophagus shows yellowish brown ovoid lateral bulgings in segms. xiii and xiv. The beginning of the intestine is indefinite.

The last heart is in segm. xiii.

The nephridia end in the same line.

Testes and funnels are free in segms. x and xi; these segments contain large masses of flocculent coagulum much resembling seminal vesicles. The seminal vesicles are in segm. xii; they are large and flocculent, fused in the middle line above the intestine in segm. xii, and extending back to the level of the hinder end of xiv (by bulging back septum 13/14).

The prostates are small, in segm. xviii, with a smooth surface. The duct is moderately stout, curved or looped, shining, of equal diameter throughout.

The ovaries and funnels are situated in segm. xiii.

The spermathecal ampulla is small, pyramidal, and nodulated ; the duct is long, nearly twice as long as the ampulla, and stout, its first part, below the ampulla and above the diverticula, being the narrowest, and the part below the diverticula swelling out somewhat ; this swollen part is fully equal to the ampulla in width. The diverticula are two in number, each flat, composed of a large number of excessively minute seminal chambers ; the diverticula almost meet on the inner side of the duct, but are separated by an interval on the outer ; between them they embrace the greater part of the circumference of the duct ; the diverticula are situated at two-thirds the height of the duct (fig. 23).

Remarks.—A second specimen, with the spermathecal pores in 8/9 and 9/10, was dissected. Besides the difference in the position of the spermathecae, the last heart was found to be in segm. xiv, and the testes and funnels in xi only.

Perionyx sp.

Bombay. Coll. J. P. Mullan. A few specimens, immature.

The above record is made only because Bombay does not happen to have been hitherto noted as a locality for the genus. Possibly the species was one of the peregrine worms, *P. excavatus* or *P. sansibaricus*.

Subfam. *OCTOCHAETINAE.*

Genus **Octochaetus** Bedd.

Subgenus **Octochaetoides** Mich.

Octochaetus (Octochaetoides) fermori Mich. f. **typica.**

Bombay. From S. Setna. A single specimen, considerably softened.
Bombay. J. P. Mullan. Four specimens.

f. **tetracystis.**

Bombay. Coll. J. P. Mullan. Three specimens.

It is perhaps worth while distinguishing these specimens as a separate form on account of the possession of two pairs of seminal vesicles instead of one pair. These occur in segms. xi and xii, and are small and scarcely lobed.

The penial setae end in a gentle simple curve, without any S-shaped twist ; but I have seen this in specimens of the f. *typica*, with only one pair of seminal vesicles. The attachment of the spermathecal diverticulum was here higher up on the duct than in the original examples of the species ; and the tongue of the prostomium was very narrow, in one merely a groove, so that the prostomium here appeared prolobous. But it is quite possible that these features also may be present sometimes in specimens of the typical form.

Genus **Ramiella** Steph.

Ramiella parva sp. nov.

(Pl. XXII, figs. 25-28.)

Along the White Crow Stream, near Yawnghwe, S. Shan States, Burma. 29. iii. 1922. S. L. Hora. Two specimens.

External Characters.—Length 30-35 mm.; diameter 1 mm. Unpigmented, pale on both dorsal and ventral surfaces.

Prostomium procpilobous.

Dorsal pores not seen.

The body-walls are very thin, the nephridia appearing through as a pair of opaque masses in each segment of the middle region of the body.

In the pregenital region setae *a* and *b* are enlarged; *ab* is slightly greater than $\frac{1}{3}aa$, and $= \frac{2}{7}bc$ and $= cd$; behind the genital region *ab* is nearly equal to $\frac{1}{3}aa$, while the other ratios appear to be the same as further forward.

The clitellum (seen in sections only) extends over segments xv-xix (=5).

The prostatic pores are on segments xvii and xix, on transverse elevations with pointed lateral extremities; these elevations may be divided by a slight depression in the middle line so as to produce two small triangular papillae in each segment (fig. 25); or on the other hand they may be joined by a longitudinal ridge in the midventral line, with the result that a figure is produced which somewhat resembles the letter H lying on its side (fig. 26). The prostatic pores are close to setae *a* of their respective segments, and those of the same side are connected by a straight groove bordered by faint white walls.

The male pores, seen only in sections, are on segment xviii close to setae *a*.

Setae *a* and *b* are present on all three segments, and are not modified in shape; but on xvii and xix they are closer together than in other segments.

The female and spermathecal pores were not distinguished externally. In sections the two pairs of spermathecal pores are found to open respectively on the anterior part of segment viii and in groove 8/9.

Internal Anatomy.—Septa 5/6–8/9 somewhat thickened, 9/10 slightly so, succeeding ones thin.

There are no calciferous glands.

The last heart is in segment xii.

The nephridia are one pair per segment; behind the genital region they are relatively very large flocculent looking lobed masses, while in front they are smaller, more transparent and consequently less conspicuous. They have no connection with the septa. In sections they are seen to begin as, apparently, a blind tubule; no sign of a nephrostome was seen in the organs of a number of successive segments, but the possibility of the existence of a nephrostome can perhaps not be definitely excluded. For a short distance the beginning of the tubule is free from any special investment, and floats freely in the body-cavity; but further down a large number of very granular cells—the granules

large, but not staining deeply—form a covering for the tubule; and there are in addition a number of large clear cells.

Testes and funnels are relatively large, and are free in segments x and xi. Segment x is rather short, and contains a mass of coelomic corpuscles (in the specimens sectioned).

Seminal vesicles are invisible in the dissected specimen; in sections a pair are seen in segment xii, but these contain no morulae or spermatozoa, but only coelomic corpuscles.. The vas deferens can be traced back on the ventral body-wall to end in segment xviii in line with the prostatic pores.

The prostates are narrow tubes, of relatively very great length, twisting and winding about in several segments in a complicated manner. Microscopically the tube consists of a single layer of granular very faintly staining cells (fig. 27). The duct is the short thinner terminal portion of the tube.

The ovaries are large; they and the funnels occupy the usual position.

The spermathecae are two pairs, in segments viii and ix; each ampulla is an elongated ovoid sac of relatively moderate size, with a long thin tubular and somewhat winding duct which is as long as or longer than the ampulla (fig. 28); there is no diverticulum.

There are no penial setae.

Remarks.—The presence of only a single nephridium (which however is to be considered as a micronephridium) on each side in each segment is a characteristic shared by the present species with *R. bishambari* and *R. heterochaeta*; from these it is distinguished by the absence of penial setae and spermathecal diverticula.

Genus **Eudichogaster** Mich.

Eudichogaster trichochaetus Steph.

(Pl. XXII, fig. 29.)

Bombay. Coll. J. P. Mullan. Two specimens.
Andheri, a few miles from Bombay. From S. Setna. Nine specimens, much softened.

The present specimens are more fully mature than the original examples, and some features are worth recording. Those of the second batch were larger than the original specimens, being 80–100 mm. in length, and 3 mm. in diameter. The prostomium was in these pro-epilobous.

Fully mature specimens show the following features :—The clitellum extends over segms. xiii-xvii (=5). The male field is depressed, with a prominent lip; it includes segms. xvii-xix, and perhaps a little of xvi and xx; it is square or rectangular in shape, and extends over almost the whole breadth of the ventral surface. Two rather deep and narrow trenches cross the area, one on xvii and one on xix. The prostatic pores are situated near the ends of these trenches, in line with *a* or *ab*. The seminal grooves are shaped like brackets ([ ]), and run in or a little outside the line *b*, just within or even on the lateral lip of the area. In one specimen there is a distinct kink outwards at the middle of their extent, presumably to connect with the male pores, which would thus

be on the summit of the lip; the brackets here have somewhat the form of { }.

The spermathecal pores are visible externally, in or very slightly behind the setal zones of segms. viii and ix, between setae *a* and *b*, on large flat oval papillae which take up nearly the whole of the segment; these papillae are confluent in the middle line, and extend outwards to *c*.

The seminal vesicles are two pairs, in ix and xii, of fair size, those in ix rather the larger; both pairs are cut up into small lobules, being almost racemose. The spermathecae (fig. 29) are also rather different from those of the previous examples; the ampulla is pear-shaped, with the smaller end either above or below (ental or ectal); the duct is fully as long as the ampulla, stout, rather constricted off from the ampulla, and dilated in its upper part where it is about as wide as the ampulla; the diverticulum is single, cylindrical, sausage-like, and at its fullest development as long as the duct and half as wide as the ampulla (it is thus, at its largest, relatively larger than shown in the figure); the diverticulum joins the upper part of the duct.

The last heart is definitely in segm. xii (" apparently in xii " in the original specimens).

The original descriptions should therefore be amended in respect of the sexual characters. I may say that the examination of the penial and copulatory setae of the present specimens dispels any doubt as to the specific identification.

Eudichogaster matheranensis sp. nov.

(Pl. XXII, fig. 24.)

Matheran, near Bombay. October 1921. Coll. J. P. Mullan. Ten specimens, some immature.

External Characters.—Length estimated at 90-100 mm. (the specimens are strongly curled). Maximum diameter (in the anterior segments) 5 mm. Colour light greyish brown; no difference between dorsal and ventral surfaces. Segments 225; vii triannular, viii quadriannular, thence to the clitellum the segments may be 5-annular, or the secondary annulation may not be marked.

The majority of the specimens had a peculiar conformation of the anterior end; segments i and ii were in these very small and narrow, and looked like an appendage stuck on in front of the succeeding bulbous portion.

Prostomium variable; it may be nearly tanylobous, with a very narrow tongue which is not closed behind; or combined pro- and epilobous $\frac{1}{2}$, the tongue narrow and closed behind; or epilobous $\frac{1}{2}$ and not closed behind.

Dorsal pores begin in 11/12, or perhaps in 12/13.

The setae are paired; in the middle of the body $ab = \frac{2}{5}aa = \frac{2}{3}bc = cd$, or $= \frac{1}{3}aa = bc$ = slightly less than cd; just behind the genital region $ab = \frac{1}{3}$ to $\frac{2}{7}aa = {}_2bc = \frac{1}{2}cd$; in front of the clitellum $ab = \frac{1}{2}aa = \frac{2}{3}bc = \frac{4}{5}cd$, though these ratios are variable; dd = half the circumference in the hinder part of the body, and rather more than half at the middle of the body.

The clitellum is constricted, but there is not much other change, except that its surface is rather rough ; it seems to extend over ½xii—½xviii (=6).

The male pores are on segm. xix, on large papillae, in line with *b* ; mature specimens show large penial setae projecting from the apertures. The papillae press the boundaries of the segment forwards and backwards ; they extend inwards to within the line of *a*, and outwards nearly as far as the line of *c*.

The female pore is single and median, just in front of the setal zone of segm. xiv. The spermathecal pores are one pair, in furrow 7/8, and appear as transverse slits in line with *b*.

In a number of specimens are, more or less distinct, a series of genital markings in the midventral line, in segms. x, xi and xii (once in ix, x and xi) ; when well marked these have the form of low transversely oval papillae, slightly depressed in the centre and of eyelike appearance, contained well within the limits of the lines of setae *a*.

Internal Anatomy.—Septum 5/6 is stout, 6/7 extremely thin, 7/8 thin ; 8/9 is somewhat and 9/10 moderately thickened, as are also 10/11 and 11/12 ; 12/13 is thin.

There are two stout gizzards, in segms. vi and vii. Calciferous glands are present in segms. x, xi, xii and xiii ; they are flattened anteroposteriorly, oval in outline, not lobed, and stalked. The intestine begins in xvii.

The last heart is in segm. xii.

The excretory system is micronephridial ; the organs are numerous in the clitellar segments, and sparser elsewhere ; throughout the hinder two-fifths of the body there is a transverse row of about six on each side in each segment, the innermost on each side being considerably larger and more conspicuous than the others ; this difference in size is not to be observed in the anterior part of the body.

Testes and funnels are free in segms. x and xi. Seminal vesicles are present in ix and xii, of moderate size ; those in ix form a row of small lobulated masses stretching across the segment on the anterior face of septum 9/10 ; those in xii are also lobulated, but more compactly.

The prostates are one pair ; each consists of a number of closely addressed loops, which take up two or three segments (xix-xxi) ; the duct is of some length, is much thinner than the glandular portion, with a generally transverse direction but with considerable windings, of the same diameter throughout, and shiny in its ectal part.

The spermathecae (fig. 24*a*) are one pair, of moderate size, the ampulla ovoid and slightly nodular, the duct conical, broad where it joins the ampulla and narrowing to its ectal end ; there is no diverticulum.

The penial setae (fig. 24*b*) are thick, strong, and brown ; the shaft is gently curved, 2·2 mm. in length and 35μ thick at the middle ; the distal portion tapers gently, is somewhat sinuous, and bluntly pointed ; a part of the shaft near the distal end, but not the tip, is ornamented with numerous stout flat triangular spines of an average length of 15μ.

Remarks.—The penial setae are characteristic ; and so also is the balantine reduction (one pair of prostates opening on segm. xix). While most species of the genus have the acanthodriline condition of the pos-

terior male organs, several show the microscolecine reduction, while in one (*E. barodensis*) the single pair of prostates opens on xviii ; but in no other does the single pair of prostates open on xix.

Genus **Eutyphoeus** Mich.

Eutyphoeus incommodus Bedd.

Kasauli, W. Himalayas ; under grass roots. 3. viii. 1922. Sent by Prof. Matthai, Lahore. Four specimens.

Genus **Erythraeodrilus** Steph.

Erythraeodrilus mullani sp. nov.

(Pl. XXII, figs. 30, 31.)

Matheran, near Bombay. Coll. J. P. Mullan. October 1921. A number of specimens.

External Characters.—Length 110-120 mm. ; maximum diameter 6 mm. Segments 122 ; no secondary annulation. Colour light brown, rather darker dorsally, especially in the anterior part of the body.

Prostomium epilobous $\frac{4}{5}$, with a transverse groove across the tongue at the middle of the length of segm. i.

Dorsal pores begin in furrow 4/5.

The setae are in rings, rather closer set ventrally ; the ventral break is small, up to 2*ab* in the anterior part of the body, smaller or absent behind ; the dorsal break is similar, up to 2*yz* in front, diminishing to *ca.* $1\frac{1}{4}yz$ behind. The following numbers were counted :—70/v, 77/x, 76/xii, 61/xix, and 58 in the middle of the body.

The clitellum embraces segms. xiii-xvi (=4) ; it is purple in colour, rather swollen, and setae are present.

The male field (fig. 30) presents two small but deep depressions, on xvii and xix respectively, which, with their lip, take up the length of each of these segments and slightly encroach on and narrow segm. xviii. The transverse extent of the depressions is somewhat greater than their length, and varies, reaching the line of the fifth to the eighth seta on each side. The prostatic pores are indicated by small circular depressions within these larger ones, in the setal zones of segms. xvii and xix, and near the middle line. In the lateral parts of the larger depressions there may be small papillae, *e.g.*, on the left side in xvii, or on the left side in xix ; the depression may then be extended further out so as to embrace the papilla, and is then asymmetrical (*vide* fig.). No male pores were visible, nor any seminal grooves.

The female pore is single, in front of the setal zone of segm. xiv, in a small white area.

The spermathecal pores are two pairs in the setal zones of segms. viii and ix, small and very near together ; there may or may not be a few black points in their neighbourhood,—setae displaced from their normal line.

Internal Anatomy.—Some of the anterior septa are displaced ; the first, septum 4/5, is normally placed ; 5/6 is at the level of the setal zone of segm. vi ; 6/7 is at the level of furrow 7/8, 7/8 is behind the furrow 8/9, in part about the level of the setal zone of ix ; 8/9 is inserted a little

behind furrow 9/10; 9/10, 10/11 and 11/12 are united together at the periphery, and inserted at the level of furrow 11/12; these three septa thus enclose two narrow chambers, representing segms. x and xi. Septa 11/12 and 12/13 are slightly thickened, 9/10, 10/11, 13/14 and 14/15 very slightly so.

The gizzard is large, firm and barrel shaped, and occupies segm. vi.

Calciferous glands are present in segms. x, xi, xii and xiii; they are rather bean shaped, and well set off from the oesophagus; those in x and xi are smaller than those of the two hinder segments, the glands of x being smallest of all. The intestine begins in xvi; there are no lymph glands like those of *Pheretima*.

The last heart is in segm. xiv; this is a little, but not much, smaller than that in xiii; I described a corresponding vessel not as a heart but as a "commissure" in previous accounts of species of this genus. The first heart is in segm. vii.

The micronephridia are numerous and small. The first meganephridia are visible in segm. xiv, but they only attain their full size in xx (they were not distinguishable in segms. xvii, xviii and xix in the specimen dissected).

Testes and funnels are free in segms. x and xi (testis doubtfully identified in x). The seminal vesicles, in segms. ix and xii, are of moderate size and slightly lobed.

The prostates are two pairs. The anterior pair begin behind in segm. xxvi, and form a succession of loops, closely pressed together in a series, about eight in number in each gland; this glandular portion occupies xxii-xxvi, and the tube then suddenly becomes much thinner, and passes forward, dilating towards its end into a stout shining fusiform chamber lying transversely or obliquely and ending in xvii. Lying against the inner side of this terminal portion is a soft and yellowish accessory gland, without duct, sessile on the body-wall. The posterior glands are similar to the anterior, and begin behind in segm. xxx; the glandular portion extends forwards to segm. xxv; accessory glands are present, as just described.

In addition, in the specimen first dissected, there was, on the *outer* side of the left posterior prostate, a second and much larger accessory gland,—a very conspicuous stoutly sausage-shaped mass, extending back to segm. xxiii, the inner end then curling forwards. This gland was several times the diameter of the terminal portion of the prostate, had no separate duct, and joined the body-wall in a position corresponding to the papilla within the posterior depression (*cf.* fig. 30). In a second specimen, where there was a papilla within the left border of the anterior depression, one of these large sausage-like accessory glands had a corresponding situation internally.

The vas deferens was not seen. In the region of the thin portion of the prostatic ducts three tubes are seen, lying side by side; one of these is the duct, and the other two are probably blood vessels.

Ovaries and funnels are present in segm. xiii; there appear to be small ovisacs in xiv.

The spermathecae (fig. 31) are of considerable size. The ampulla is of an inverted pearshape, or sometimes rounded; the duct is short,

about one-third the length of the ampulla, narrow where it joins the body-wall, swollen in its upper part ; the diverticula are 7-10 in number, small, sessile and wart like, on the upper part of the duct ; they may be at unequal distances, so that gaps appear in the ring.

A number of spermathecal accessory glands are present, soft, white, cylindrical and fingerlike, without set-off ducts, in length about one-third of the spermathecal ampulla and duct together ; a cluster of three or four such glands occurs quite close to the middle line, rather behind or behind and internal to the ending of each spermathecal duct (fig. 31). Each such cluster may be enclosed in a thin-walled sac ; sometimes however they are not so enclosed, and the sac then lies by the side of the glands. These sacs seem to correspond to those which may be seen in Lumbricids enveloping the ventral setae of certain anterior segments. One or two similar glands may be present, in addition, on the outer side of the ducts of the posterior pair of spermathecae ; these are not contained in a sac.

Remarks.—The present species comes near *E. suctorius*, from which it is distinguished by the configuration of the male genital field, the position of the posterior spermathecal apertures, and the two kinds of accessory prostates.

Erythraeodrilus khandalaensis sp. nov.

(Pl. XXII, figs. 32-34.)

Khandala (20 miles from Matheran) ; under stones. J. P. Mullan. Twenty-six specimens.
Bombay. Coll. J. P. Mullan. Numerous specimens.
Andheri, near Bombay. July 1923. J. P. Mullan. A single specimen.

External Characters.—Length of an average specimen 130 mm. ; diameter 4·5 mm. Colour brown, with sometimes a pinkish tinge ; slightly darker dorsally. Segments 98 ; no secondary annulation.

Prostomium epilobous $\frac{4}{5}$, the sides parallel, the tongue not cut off behind ; no transverse groove across the tongue.

Dorsal pores begin in furrow 4/5. The setae are in rings, and are set closer ventrally. The dorsal break is usually about 3*yz*, but may be as much as 4*yz* ; the setae on the dorsal side are as a rule arranged pretty regularly in pairs throughout the body. The ventral break is about 2 *ab* ; there is no regular pairing of the ventral or lateral setae, though indications of pairing are visible in the region between the genital apertures and the middle of the body. The following numbers were counted :—46/vi, 49/ix, 48/xii, ca. 44/xix, and 44 in the middle of the body.

The clitellum was hardly distinguishable ; it appears to extend from xiv (or $\frac{1}{2}$ xiii) to xvi.

The prostatic pores are small, and in line with setae *b* (the setae *ab* of segms. xvii, xviii and xix are absent) ; they are seated on minute papillae which are themselves in minute depressions in the course of furrows 17/18 and 18/19 ; finally the papillae and depressions are all within but near the margin of a shallow saucer-like depression which takes up the interval between the setal zone of xvii and that of xix (fig. 32).

Over furrow 19/20, midventrally situated, is a considerable well defined circular or transversely oval depression with a flat bottom ; in its centre is a minute papilla bearing a definite pore. The centre of the depression may be accurately over the situation of the furrow, or it may be rather in front or behind, the depression then being mainly on segm. xix or xx respectively.

On segms. xx to xxiv or xxv there were seen a number of indefinite slight elevations, reddish brown in colour, and approximately circular in shape, one per segment, midventral, each about equal to the length of its segment. The condition of the specimens was not very good and what these structures might be like in the fresh condition I cannot say.

The female pore is minute, in the middle line, and just in front of the setal zone of segm. xiv.

The spermathecal pores are two pairs, small, on small flattish papillae pretty near the middle line (about in line with setae *b*), one pair in front of and the other pair behind the setal zone of segm. viii,—rather nearer the setal zone than the anterior and posterior intersegmental furrows. There was no disarrangement of the setae in the neighbourhood.

Internal Anatomy.—Septum 4/5 is slightly thickened, thicker than 5/6 which is very thin ; 6/7 and 7/8 are also thin, 8/9–13/14 are slightly thickened, 10/11 and 11/12 rather more than the rest ; 9/10, 10/11 and 11/12 are, as in the last species, united at their periphery, the whole appearing like one greatly thickened septum.

The gizzard, in segm. vi, is large, firm and barrel-shaped.

The calciferous glands are four pairs, in segms. x, xi, xii and xiii ; they are somewhat kidney-shaped, and are attached at the hilus ; they are all about equal in size, and rather small.

The last heart is in segm. xiii ; but a fair-sized vessel, which however has not the appearance of a heart, is present in xiv ; this vessel arises nearer the anterior than the posterior limit of the segment (*cf.* the last species).

The micronephridia are numerous throughout the body ; meganephridia begin in xiv, and are small at first, attaining their full size in segm. xx.

Testes and funnels are free in segms. x and xi. Seminal vesicles are found in ix, x and xii ; those in ix and xii are large, and deeply cut up into a transverse series of large lobes ; those in x are quite small, are found towards the bottom of the segment, and are not cut up.

The glandular portions of the anterior prostates extend from segm. xxvi or xxv to xxii or xxi ; as in the last species, each consists of a number of closely apposed loops ; the duct, thin at first, ends in a wider shiny portion (fig. 33, *a.p.d.*). The glandular parts of the posterior prostates extend from xxxi or xxx to xxv, and are similar to those of the anterior pair. Close to the termination of each duct is a spherical bulb, placed posterior to the end of the duct in the case of the anterior prostate (*a.b.*), anterior in the case of the posterior prostate (*p.b.*). The vasa deferentia (*v. def.*) are separate throughout the whole of their course, and run side by side ; one enters the bulb which is situated near the termination of the anterior, the other that near the termination of the posterior prostatic duct.

A relatively very large, thickly cylindrical gland lies on the ventral body-wall, occupying segms. xx-xxiii, and attached to the parietes in the middle line between segms. xix and xx ; it thus corresponds to the circular depression on the external surface (*v.* fig. 32), and is to be compared with the glands of similar appearance but of different position in the last species. Smaller accessory glands are situated around and between the ends of the prostatic ducts, in segms. xvii, xviii and xix ; these are sessile and have no separate ducts.

Ovaries and funnels are found in segm. xiii ; there are well marked racemose ovisacs in xiv.

The spermathecae together with their ducts form pear-shaped organs, a slight constriction marks off the duct, while the broader upper part forms the ampulla. The duct is about equal in length to the ampulla, and narrows towards its termination. The diverticula are like those of the last species, and about twelve in number ; the circle being double, however, for a part of its extent (fig. 34).

Accessory glands are present here also, two on each side ; each is of large size, like a tubular prostate in appearance, undulating in form ; when straightened out each would be longer than the ampulla and duct of the spermatheca, and each has its own short, narrow and shining duct. The two accessory glands of each side are encased in a sac, which has to be ripped open before the glands can be displayed ; the sac and glands together are inserted between the ectal ends of the two spermathecae of a side (fig. 34).

Remarks.—There is a general resemblance to the last species ; but there are also very definite differences. The number of setae is smaller ; the form of the male field, and the position of the pores differ ; the positions of the spermathecal apertures is distinctive ; there are here seminal vesicles in segm. x also ; the position of the accessory prostate, and the fewer and larger accessory spermathecal glands, also distinguish the two species.

f. **dichordarius.**[1]

Bombay. July 1923. Coll. J. P. Mullan. Several specimens.
Andheri, near Bombay. July 1923. J. P. Mullan. A single specimen.

The character from which I have named this form is the presence of two median large accessory prostates, instead of one only. One or two other characters also differ in the two forms.

The prostomium is epilobous $\frac{5}{6}$ or more,—almost tanylobous ; a transverse groove crosses the tongue near its anterior end.

The setal numbers are rather greater than those previously given :— 57/v, 62/ix, 62/xii, 62/xix, and 54 in the middle of the body. The dorsal break is irregular, about 2-3*yz*. I have no note of any pairing of the setae.

The male area is as for the last form, with the addition of a similar median depression, with central papilla and pore, in front of the prostatic region as well as behind it ; this anterior depression has its centre over furrow 16/17 or on the posterior part of xvi. In one case there was

[1] χορδάριον, diminutive of χορδή, a sausage ; referring to the accessory glands in the prostatic region.

a third such depression, in front of the setal zone of xvi, the lip of the depression lying over furrow 15/16.

Internally, as was to be expected, a second accessory gland, large and cylindrical, corresponds to the anterior of the two depressions on the surface. The posterior of the two glands passed from its attachment at the body-wall obliquely backwards and to the right on the body-wall; the anterior was curved upwards round the alimentary canal.

The spermathecal diverticula here form a double, or incompletely double ring round the duct.

Subfam. *DIPLOCARDIINAE.*

Genus **Diplocardia** H. Garman.

Diplocardia indica sp. nov.

(Pl. XXII, fig. 35.)

Gorge below Chota Tank, Buldana, Berar; 2,190 ft. H. S. Rao. 17.ii. 1923. Three specimens.

External Characters.—Length of the longest specimen 50 mm.; diameter 2·5 mm. Colour pale, slightly olive green, the same on both dorsal and ventral surfaces. Segments 117; no secondary annulation.

The prostomium is tanylobous; the tongue is fairly broad; a transverse groove passes across the tongue at about the middle of the length of segment i.

Dorsal pores begin in furrow 10/11.

The setae are paired. In the middle of the body $ab = {}^2aa = \frac{4}{7}bc = cd$; $dd = \frac{4}{5}$ ca. of the circumference. Behind the male pores $ab = \frac{2}{5}aa = \frac{1}{2}bc = cd$; and the ratios are much the same in front of the clitellar region.

The clitellum is not very distinct; it covers xiv-xvii (=4).

The seminal grooves are seen, slightly bowed inwards, between the lines of *a* and *b* on segm. xviii and the neighbouring portions of xvii and xix. The prostatic pores are presumably at the ends of the grooves, and therefore behind and in front of the setal zones of xvii and xix respectively. Segm. xviii is short, as seen from the ventral surface, and the grooves are short also. The male pores were possibly seen on segm. xviii rather internal to the bottom of the groove.

The female pores were not distinguished.

The spermathecal pores are two pairs, respectively in front of and behind furrow 8/9, and not far from the middle line. The distance between the line *a* and the pore of that side is equal to the distance between the two pores.

A pair of small transversely oval papillae are present on the anterior part of segm. xvii, a little outside the line of *b*; a similar single median papilla is seen in the setal zone of xviii.

Internal Anatomy.—Septum 4/5 is thin, 5/6 somewhat thickened, 6/7 moderately and 7/8–9/10 considerably strengthened; 10/11 is somewhat thickened and 11/12 slightly so.

There are two fairly well developed and shortly barrel-shaped gizzards in segms. v and vi. There are no calciferous glands; the oesophagus is somewhat bulged in segms. x–xiii, but this would ordinarily have passed without comment; there are no signs of special vascularity. The intestine begins gradually, about xvi or xvii.

The last heart is in segm. xii.

The excretory system is meganephridial throughout the body; the funnel has the normal relation to the septum, and is of the usual type, with central and peripheral cells in the upper lip. I thought that certain small masses by the side of the nerve cord in the hinder part of the animal might be micronephridia; but on microscopical examination they proved to be only small coagula.

Testes and funnels were free in segms. x and xi. The seminal vesicles are two pairs, in xi and xii, of moderate size, racemose, meeting dorsally above the alimentary canal.

There are two pairs of prostates, one extending from segm. xxii or xxi to xvii, the other from xxiii or xxii to xix. They are tubular, and each consists of a series of apposed loops. The duct is thin,—thinner at its ental end, and cylindrical in the rest of its extent; shining, and passing transversely inwards from the anterior end of the glandular portion.

There are no penial setae.

Ovaries and funnels are present in segm. xiii.

The spermathecae (fig. 35) are two pairs, in segms. viii and ix. The ampulla is somewhat pyramidal, or pear shaped, the inner end being the smaller. The duct is relatively thin, cylindrical, and half the length of the ampulla. There is a single diverticulum, cylindrical or finger-like in shape, which is given off from the junction of ampulla and duct, and is as long as the duct; it lies on the posterior side of the septum, and a fine strand passes from its free end to be attached to the septum in its dorsal part and not far from the middle line.

Remarks.—The interest of the occurrence of a worm of this genus India has been referred to in the Introduction.

Subfam. *OCNERODRILINAE.*

The two new Ocnerodriline worms described below, for which I have erected the genera *Malabaria* and *Aphanascus*, are interesting as showing relations on the one hand to the recently discovered *Curgia* (Michaelsen, 7), and on the other to *Maheina*, and as illustrating a relationship between the Oligochaete faunas of India and East Africa.

In 1897 Michaelsen described *Acanthodrilus braueri* from the Island of Mahé in the Seychelles (1), and in 1899 he instituted for it a separate genus *Maheina* (2). In 1921 (7) he transferred the genus from the Acanthodrilinae to the Ocnerodrilinae, on account of its paired oesophageal appendages in segments ix and x; in this same paper he also described a new genus *Curgia*, with unpaired oesophageal diverticula in segments ix and x, which showed some degree of affinity to *Maheina*.

The new genera *Malabaria* and *Aphanascus* are to some extent intermediate between *Maheina* and *Curgia*,—not strictly so, as will be

seen immediately,—but still forming something of a series :—*Maheina, Malabaria, Aphanascus, Curgia.*

Maheina has a purely acanthodriline posterior male apparatus (two pairs of prostates opening respectively on xvii and xix ; vas deferens opening on xviii) ; it is however metandric (testes and funnels in xi only), though it retains the original two pairs of spermathecae opening in 7/8 and 8/9. There are two pairs of large stalked oesophageal appendages in ix and x, without proper central lumen. There is a strong gizzard in vi. The setae are very widely paired in the anterior and middle regions of the body.

Malabaria has a much modified acanthodriline arrangement of the posterior male apparatus (two pairs of excessively long prostates discharging respectively on xvii and xx ; vas deferens opening in conjunction with anterior prostates on xvii). It is holandric (two pairs of testes and funnels in x and xi respectively) ; but it has only one pair of spermathecae, which open in 8/9. There are no projecting oesophageal appendages, but in the substance of the thickened ventral wall of the oesophagus there are two pairs of small tubular diverticula. There is a rudimentary gizzard in vii. The setae are closely paired throughout.

Aphanascus has a purely microscolecine posterior male apparatus (one pair of prostates—here excessively long—opening on xvii in conjunction with the vas deferens) ; it is metandric, and has only one pair of spermathecae, which open in 8/9. The oesophageal diverticula, gizzard, and setae are as in *Malabaria.* The wall of the prostatic glands appears to be (for the most part) more than one cell in thickness (in *Maheina, Malabaria* and *Curgia* the wall is only one cell thick).

Curgia resembles the last genus in the microscolecine arrangement of the posterior male organs, in being metandric, and having only one pair of spermathecae. The oesophageal sacs, in ix and x, are sessile on the ventral wall of the oesophagus and unpaired,—single and median,—in each segment. The gizzard is fairly large, in vii. The setae are closely paired.

It is evident, from a comparison of *Malabaria* and *Aphanascus*, that the latter can easily be derived from the former. The anterior pairs of testes and funnels, and the posterior pair of prostates, have disappeared ; *i.e.*, the holandric and acanthodriline conditions have given place to the metandric and microscolecine. An additional layer of cells seems also to have been added in the prostate glands. The two worms are found in the same place, and there seems no reason to doubt that *Malabaria* is the immediate ancestor of *Aphanascus.*

Though *Maheina* shows in several ways more primitive characters than *Malabaria* (purely acanthodriline posterior male organs, two pairs of spermathecae, well developed gizzard), it is not the ancestor of the latter. In the matter of the anterior male organs *Malabaria*, being holandric, is more primitive than *Maheina*, and must therefore have branched off from the phylogenetic tree above the origin of *Maheina.* The setal disposition of *Malabaria* also is probably more primitive than that of *Maheina* ; and the gizzard is in a different segment. The evolution of the oesophageal pouches has proceeded along different lines in the two genera ; in *Maheina* the appendages remain as considerable

stalked masses, but the central lumen has disappeared; in *Malabaria* the appendages are no longer recognizable as such, but the central lumen is distinct, though embedded in the oesophageal wall.

Curgia may, I think, be considered as a direct descendant of *Aphanascus*. The disposition of the sexual organs corresponds in the two throughout. The oesophageal appendages are sessile by the whole of their bases in *Curgia*,—a condition which is perhaps not very different from that which I figure for *Aphanascus* (fig. 40); the diverticula are unpaired in *Curgia*, paired in *Aphanascus*, and I illustrate below (fig. 39) from an actual specimen of *Malabaria* the way in which the unpaired has probably arisen from the paired condition. The double layer of cells in the prostate gland of *Aphanascus* has again given place to the single layer; and the atrophied gizzard has begun to strengthen again. This last is what causes me some hesitation; as is well known, Dollo has shown good reason for believing that an organ which has once undergone degeneration never redevelops in its previous form, though its function may on occasion be taken over by some other structure which becomes modified in accordance with requirements. Perhaps we may say that, though *Curgia* may not be descended from *Aphanascus* as we have it at the present day, still its ancestor would probably, if we knew it, be sufficiently close to the present-day *Aphanascus* to be classed together with it in the same genus.

Both these worms were sent to me by the Government Entomologist at the Agricultural College, Coimbatore, along with the second batch of *Pheretima elongata* (v. ant., p. 339); they were reported to be damaging paddy roots at Kollengode, South Malabar District.

Genus **Malabaria** gen. nov.

Diagnosis.—Setae closely paired. Two pairs of prostatic pores, on xvii and xx; vasa deferentia discharging in conjunction with the anterior prostates. One pair of spermathecal pores in 8/9. Gizzard vestigial, in vii. No projecting oesophageal appendages, but in the substance of the thickened ventral wall of the oesophagus there are, in segments ix and x, two pairs of small tubular diverticula. Two pairs of testes and funnels, in x and xi. Spermathecae without diverticula.

Distribution.—S. Malabar (a district on the western coast of India, near the southern end of the peninsula).

Malabaria paludicola sp. nov.

(Pl. XXIII, figs. 36-39.)

Among the roots of Anaikomban paddy in the wet lands, Kollengode, S. Malabar. January 1923. Sent by the Government Entomologist, Coimbatore. A number of specimens.

External Characters.—Length 70 mm.; diameter 2–2·5 mm. Colour variable,—pale to light brown; darker, sometimes with a reddish tinge at the anterior end. Segments 173.

Prostomium epilobous $\frac{1}{2}$, tongue cut off behind.

Dorsal pores absent.

Setae closely paired; $aa = 5ab = \frac{5}{6}bc = 5cd$; dd = half the circumference.

I estimated the clitellum variously in different specimens,—xi-xx, xii-½xxi, xiii-½xxi (=8½—10) ; it is rather smoother than the rest of the surface.

The male pores are conjoined with the anterior prostatic pores on segment xvii, on small but rather prominent papillae in line with the setae *b*, and in the setal zone ; setae *a* and *b* are absent. The posterior prostatic pores are on segment xx, in the setal zone, on small papillae which are contiguous in the middle line ; the posterior pores and papillae are rather closer together than the anterior, the centres of the papillae being in line with the setae *a* ; setae *a* and *b* are absent.

The female pores were not distinguished.

The spermathecal pores are one pair, in groove 8/9, on small papillae in line with setae *b*.

Internal Anatomy.—Septum 5/6 is considerably strengthened, 6/7, 7/8, and 8/9 are much thickened, 9/10 is fairly strong, 10/11 somewhat thickened, and 11/12 slightly so.

There is a vestigial gizzard in segment vii.

There are no distinct oesophageal sacs to be seen in the dissection ; but in each of the two segments ix and x there is on the ventral side of the oesophagus an opaque yellowish ovoid bulging, not set off from the gut ; or, it may be, merely a general swelling, perhaps rather more marked below ; a pair of blood-vessels may be seen coursing over the ventral projection, one on each side of the middle line (figs. 37, 38, 39, *v.*).

The structure of this part of the alimentary tract will perhaps be best elucidated by following a series of transverse sections backwards through segments ix and x.

The first departure from the normal condition of the gut wall is the appearance, in segment ix, of an increased thickness of the gut epithelium on the ventral side ; a number of cells (cell outlines are however not visible in the actual preparations) are seen below the columnar epithelial lining of the lumen of the canal (*ep. col.*), and the lower ends of the columnar layer are continued down without interruption into this deeper layer (*ep. deep.*) (as shown in fig. 36, which however is taken from further back).

Next, the blood space which normally exists outside the gut epithelium begins to penetrate into this deeper cell mass. There is a certain regularity in the way in which this penetration occurs ; in transverse sections the appearance is that of inward projections of the blood sinus into the cell mass. Actually, these projections must represent antero-posteriorly extended layers of blood (*l. bl.*), separated by intervening layers of cells (*l. c.*) (fig. 37). Each cell layer is only one cell in thickness ; there are several alternating couples of blood-layers and cell layers on each side of the midventral line.

The mass of cells into which the blood-layers penetrate has a faintly pink-staining cytoplasm. The blood stains brightly with the eosin, and the pink of the cytoplasm grades so gently, in some places (where the regular layering of blood and cells is not so marked), into the deeper tint of the blood that the impression is given of a gradual disintegration of the cells to form the blood. There is never any kind of separating membrane between the cells and the blood.

Passing onwards, the whole gut wall becomes thinner again between segments ix and x, the deeper mass of cells, below the columnar layer, having diminished in bulk (fig. 36). Outside the whole cell-layer is the blood sinus (*s*), which here sends inwards only short projections into the cell mass. This condition, a halfway house between the usual structure of the gut wall and that above described, illustrates the interpretation of the more complicated state of affairs;—these projections lengthen inwards so as to produce the layers of blood intervening between the layers of cells.

In segment x the thickening of the gut wall due to the mass of cells below the columnar layer extends further upwards into the dorsal half of the alimentary tube. As before, the deeper cells are in direct continuity with those of the columnar layer (*ep. col.*). The blood spaces are in communication with the dorsal vessel above, and with the two vessels on the ventral aspect of the gut below (these two vessels, *v.* in figs. 37, 38, 39, are those seen on the ventral side of the oesophagus in the dissection). The combined vascular and cellular layer extends all round the oesophagus, but is thickest below (*cf.* fig. 40, taken from *Aphanascus*), and the arrangement of alternating plates of cells and blood (*l. c.*, *l. bl.*) also only exists below.

In another series, the plates of cells which intervene between the plates of blood seem to split (fig. 38), so as to give two thin layers separated by a narrow space; the individual cells are much flattened, and the appearance in a transverse section is that of blood spaces with definite walls of flattened cells. Indications of such a cleavage of the cell plates are seen in other series also (fig. 37, and slightly in fig. 39). The difference in the appearances may perhaps be due to a difference in the stage of functional activity.

The diverticula are small, and extend downwards side by side in the substance of the oesophageal wall in both the segments. They are lined by ordinary columnar epithelium (as in fig. 40, taken from *Aphanascus*, and fig. 39). In segment ix the pits are vertical; in x they bend forwards, so that in following a series of transverse sections backwards they are first seen at their blind anterior ends, which are deep in the cell mass, and near the position of the two ventral blood-vessels on the under-surface of the oesophagus. In one series of sections, the two diverticula in segment x unite to open into the lumen of the gut in common (fig. 39); this was not seen elsewhere in either segment (the circular cavities (*x*) in the gut wall near the middle line in this figure represent small *backward* projections from the pits, which originate just in front of the plane of the section).

I do not think that the narrow spaces produced by the splitting of the cell layers communicate with the lumen of the oesophagus; appearances which here and there suggest such a communication are perhaps due to faulty preservation or to tearing in the cutting of the sections.

To resume the systematic account of the anatomy:—The last hearts are in segment xi.

The excretory system consists of meganephridia; these are opaque and yellowish, and are only distinguishable in the dissection behind

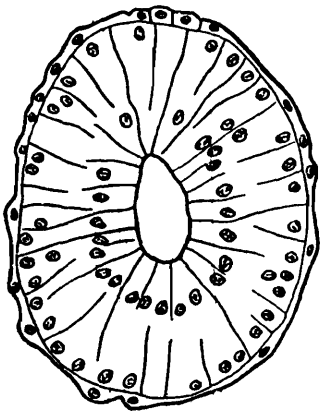
segment xx ; they exist, however, in front of this, and are seen in sections ; but they are not rendered conspicuous in the dissection by the opaque peritoneal investment. This investment, in the middle of the body, forms the main mass of the nephridium ; the peritoneal cells are full of large granules, and recall the similar cells in the nephridia of the Diplocardiinae (*Dichogaster*, etc.).

Testes and funnels are free in segments x and xi ; they are of moderate size, and equal in the two segments.

The seminal vesicles are large and racemose ; there are two pairs, in segments xi and xii, or one pair only, occupying segments xii and xiii.

The prostates are two pairs of tubes, ending in segments xvii and xx ; they are excessively long, extending more than half way towards the hinder end of the body ; but this by no means represents their full length, since they are much looped and convoluted in the hinder part of their extent. Their terminal portion is slightly shiny, and is to be considered as the duct.

The prostatic gland cells are one layer only in thickness, the elongated cells extending through the whole substance of the wall (text-fig. 1) ; the nuclei however are in two layers,—one nearly halfway up the height of the cells, nearer to the lumen than to the base of the cells, and the other peripheral, close to the peritoneal layer. The cytoplasm stains lightly, and contains numerous granules.



Text-fig. 1. *Malabaria paludicola* ; transverse section of prostate ; × 330.

The posterior prostatic pores are without the bulbs which are so conspicuous in *Aphanascus* (*v. post.*). The epithelium of the whole of the ventral surface around and between the pores is very high, and the ventral body-wall is very thick. This thickness is due partly to the thickness of the epithelium, and also and more especially to the thickness of the longitudinal muscular layer, here divided up into bundles by very numerous strands of connective tissue which run transversely amongst the muscle fibres. A number of gland cells in the body-wall near the pores take up the haematoxylin so strongly as to appear black.

The anterior prostatic pores are also without bulbs. The papillae on which they are situated are obvious in sections ; the epithelium surrounding the pores is high, especially to the inner and outer sides of the centres of the papillae ; the ventral body-wall however is not thickened between the papillae. Gland cells are present in the immediate neighbourhood of the pores, as in the posterior pair.

There are two vasa deferentia on each side, which run close together; they enter the substance of the anterior prostatic papillae, and join the anterior prostatic duct just before it discharges on the surface ; the two vasa are separate to the end.

There is one pair of spermathecae, in segment ix ; these are irregular sacs, each with a long bent cylindrical duct which comes off from one side of the sac ; the duct is slightly thicker in its ectal half. There is no diverticulum ; a fine tube may perhaps be seen in association with the organ, but it will be found on microscopic examination to be nephridial.

There are no penial setae.

Remarks.—In spite of the fairly large number of specimens at my disposal (and the same applies to *Aphanascus*), the investigation by means of sections was by no means easy; the histological condition was in some very unsatisfactory, and as there had been no attempt to clean the alimentary canal there was a large amount of tearing due to earth in the gut. For the prostatic region I opened the specimens and dissected out the alimentary canal before sectioning.

Genus **Aphanascus**[1] gen. nov.

Diagnosis.—Setae closely paired. One pair of prostatic pores on xvii; vasa deferentia discharging in common with the prostates. One pair of spermathecal pores, opening in 8/9. Gizzard vestigial, in vii. No projecting oesophageal appendages, but in the substance of the thickened ventral wall of the oesophagus there are, in segments ix and x, two pairs of small tubular diverticula. One pair of testes and funnels, in xi. Spermathecae without diverticula.

Distribution.—S. Malabar (a district on the western coast of India, near the southern end of the peninsula).

Aphanascus oryzivorus sp. nov.

(Pl. XXIII, figs. 40-42.)

Among the roots of Anaikomban paddy in the wet lands. Kollengode, S. Malabar; January 1923. Sent by the Government Entomologist, Coimbatore. A number of specimens.

External Characters.—Length 75 mm.; diameter 1–1·25 mm. Segments 205. Unpigmented, grey in colour owing to the intestine and its contents showing through the body-wall; the prostates also seen through the thin parietes, going back to xxxiv, and forming a much coiled mass in xvii and xvi.

Prostomium zygolobous.

Dorsal pores absent.

Setae closely paired; *ab*=*cd*, *aa*=*bc*, *dd*=half the circumference.

Clitellum not distinguishable in most specimens; seen in a series of longitudinal sections extending over xiv-xxii (=9).

On segment xvii are a pair of small round prominent papillae, teat-like, bearing the prostatic pores, which are just external to the line of setae *b*.

The female pores were not distinguished.

The spermathecal pores are in groove 8/9, on small papillae, in line with setae *b*.

Internal Anatomy.—Septa 5/6, 6/7 and 7/8 are considerably thickened; 8/9 and 9/10 are somewhat strengthened, 10/11 and 11/12 very little. Segment x is very short, since ix is bulged out by the spermathecae, and xi by free spermatozoa.

Pharyngeal gland cells extend back as far as segment vii.

---

[1] From ἀφανής, "hidden, concealed," and ἀσκός, "a sac"; since the oesophageal diverticula are hidden in the wall of the gut.

There is a vestigial gizzard in segment vii.

The oesophageal diverticula and the structure of the oesophageal wall are much as has been described for *Malabaria*. No ventral sac or sacs can be seen distinct from the oesophagus externally. In sections, there is seen in segment ix a pair of pits (fig. 40, *div.*), ventrally situated in the thickened wall of the oesophagus, side by side, and separated in the middle line only by a blood space; the pits are surrounded by a cellular mass (*ep. deep*), to which the thickening of the oesophageal wall is due, and in which are occasional blood spaces (*l. bl.*).

In segment x is a second pair of diverticula; these open at their hinder ends into the lumen of the oesophagus and, extending forwards, end blindly in front about the level of septum 9/10, in the midst of a cell mass composed of layers of cells; the cell-layers are one cell thick, and blood spaces intervene between the layers. The two vessels seen in the dissection on the ventral wall of the oesophagus are visible also in sections (*v.* fig. 40).

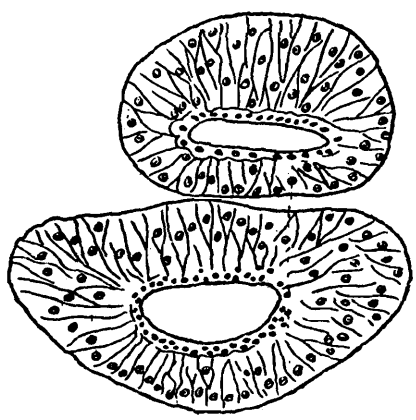
The last hearts are in segment xi.

The excretory system is meganephridial. The nephridia begin to have an opaque peritoneal investment in segment xxii; this investment increases gradually in thickness and opacity through a few succeeding segments before attaining its full development.

The worms are metandric; testes and funnels are free in segment xi. Free spermatozoa are present in segment xi. Seminal vesicles are present in segment xii, or xii-xiii, racemose in form.

The prostates are one pair, tubular, and very long; they form a large closely coiled mass in segments xvi and xvii, and to a less degree in xviii; thence they extend backwards through many segments, with only slight undulations; in one specimen they extended back to segment liii. In xvi and xvii the two glands are twisted together. The duct is the excessively fine and short terminal portion; it is very much finer than the glandular portion, and is transparent in its ental, slightly thicker and opaque in its ectal half.

Microscopically, the cellular wall of the glandular part of the prostate is more than one cell thick (text-fig. 2). The bulk of the tube consists of a layer of elongated cells, which extend through nearly the whole of the thickness of the wall; but there is also another layer, of small low cells, which lines the lumen. These smaller cells are continued into the epithelial layer of the prostatic duct, the larger, glandular, cells having disappeared; they are less numerous towards the hinder end of the gland, where, therefore, the structure approximates to that which is supposed by Michaelsen to be characteristic of the Ocnerodrilinae,—a single-layered epithelium (7, p. 57).



Text-fig. 2.—*Aphanascus oryzivorus*; transverse section of prostate; × 160.

Surrounding the termination of the prostatic duct on the inside of the body-wall, and corresponding therefore to the papilla seen externally,

is a spheroidal mass (fig. 41). The duct as it enters the mass (*p. d.*) has a lumen about 12μ or less in diameter; within the mass it becomes suddenly dilated into an irregular chamber (*term. dil.*) with a lumen of about 33μ in diameter before it opens on the surface. Also comprised within the spheroidal mass is a gland (*gl.*), composed of a layer of large clear cells surrounding a pearshaped lumen, which opens into the prostatic duct just before it ends. The remainder of the mass consists of a thick layer of muscular fibres (*m.*), in which the clear gland and the terminal part of the prostatic duct are embedded.

In only one specimen was the vas deferens distinguished. It joins the termination of the prostatic duct within the mass. In this specimen, apparently the only quite fully developed one that was sectioned, there was no distinct clear gland in connection with the termination of the prostatic duct; it is possible therefore that this gland disappears at full maturity.

Accessory structures may be present in neighbouring segments. In one specimen there was, in segment xviii, in line with the male pore in xvii, and just behind septum 17/18 (in front, therefore, of the setal zone of xviii), a well defined ellipsoidal mass equal in length to the anterior half of the segment (fig. 42). The mass rests broadly on the body-wall, and consists of muscle fibres (*m.*) with cells lying in the interstices; in its centre is an irregular cavity (*gl.*) lined by clear cells of the same type as those described in the "clear gland" of segment xvii; outside these cells with their contained cavity muscular fibres are arranged in a layer (*m.*), and there is another layer of tall rather clear cells (*c. c.*) outside this muscular layer. On the surface there is a low elevation, with a minute depression apparently representing a pore, which however does not penetrate far inwards. No duct of any kind opens on the surface (fig. 42; the section is the one that shows the fullest extent of the cavity within the clear cells, not that which shows the small elevation with its minute pore-like depression on the surface).

In another specimen there was, in the anterior half of segment xvi, a pair of white opaque bodies lying on the body-wall, unconnected with the prostates. In these masses there was a considerable cavity, which however here opened to the exterior. Each mass was composed of rather large clear cells resembling those of the "clear gland" in segment xvii, and the cavity was bounded by a regular layer of these cells arranged as a columnar epithelium.

There are thus in all four conditions, found in as many specimens:— (1) A rounded mass in xvii, in which the prostatic duct and vas deferens end; within this mass a distinct "clear gland" joining the termination of the prostatic duct; (2) the same, but no distinct clear gland; (3) a mass in xvii, and also in the anterior part of xvi; (4) a mass in xvii, and also in the anterior part of xviii.

The spermathecae are large irregular thin-walled sacs, adherent to surrounding parts, and filling up the greater part of segment ix. The duct is thin, of some length,—approximately equal in length to the diameter of the sac,—cylindrical, tubular, and somewhat bent. There is no diverticulum.

There are no penial setae.

Remarks.—The same difficulties were encountered in the investigation as in the case of the preceding species.

Fam. LUMBRICIDAE.

Subfam. *GLOSSOSCOLECINAE.*

Genus **Pontoscolex** Schmarda.

Pontoscolex corethrurus (Fr. Müll.)

Bombay. Coll. J. P. Mullan. Eleven specimens.
Bangalore. December 1922. J. P. Mullan. Numerous specimens.

Subfam. *LUMBRICINAE.*

Genus **Allolobophora** Eisen.

Subgenus **Eisenia** Malm.

Allolobophora (Eisenia) foetida (Sav.).

Kasauli, W. Himalayas, from cowdung; 5. viii. 1922. Sent by Prof. Matthai, Lahore. Four specimens, mature.
Calcutta, between cabbage leaves; 10. viii. 1921. E. C. Dormieux. A single specimen.

Subgenus **Allolobophora** Eisen em. Rosa.

Allolobophora (Allolobophora) caliginosa (Sav.).

Kasauli, W. Himalayas, under stones; 16. vii. 1922. Sent by Prof. Matthai. Three specimens, mature.

Of the three specimens two had two pairs of papillae, on segments xxxi and xxxiii respectively, which however extended backwards and forwards so as to meet at the middle of segment xxxii. In the third, the papillae were fused to form a continuous wall on each side. The first two specimens may be referred to the f. *typica*, the third to the subsp. *trapezoides* (Ant. Dug.).

Subgenus **Eiseniella** Mich.

Allolobophora (Eiseniella) tetraedra var. **sewelli** var. nov.

Wadi Ain Zirka, Palestine. R. B. S. Sewell. 20. iv. 1917. A single specimen.

External Characters.—Length 58 mm.; diameter 2·75 mm. Segments 79. Colour pale, yellowish, the same on dorsal and ventral surfaces. The body is four-sided throughout; all surfaces are hollowed behind the clitellum. The anus appears on the end of the square last segment (? hinder end had been broken off).

Prostomium proepilobous.

Dorsal pores begin from furrow 4/5.

The setae are fairly closely paired, and are situated at the angles of the four-sided body. The relations are as follows :—$ab = \frac{1}{4}aa = \frac{1}{4}bb =$

cd; *dd* is rather greater than *ab*,—considerably greater in front of the clitellum, where the dorsal surface is broad and flat.

The clitellum, saddleshaped or at least less marked ventrally, extends over segms. xxi–⅔xxvi; there is possibly some change in xix and xx also. Setae are present, and the intersegmental furrows are not altogether obliterated on the clitellum. The "walls" are very narrow ridges, almost short "wings," extending over ½ xxi to nearly all xxv; there is a sharply defined groove below the ridge. Segments xi, xii, and xiii are also somewhat swollen, and the intersegmental furrows here are fainter.

No sexual apertures were visible, except that the spermathecal pores were possibly indicated, in furrows 9/10 and 10/11, about in line with *d*. Internal examination in fact showed that the spermathecae do discharge in these grooves, apparently a little above the line of *d*.

Internal Anatomy.—Septum 5/6 is thin, 6/7 very slightly and 7/8-11/12 slightly thickened.

The gizzard occupies one segment only,—xvii; the intestine begins in xv, so that the gizzard is in the anterior intestinal region; it is a little soft, but well developed as regards size. There are slight thin-walled bulgings of the oesophagus in segm. x, but none were visible in xi or xii.

The last heart is in xi.

Testes and funnels are free in segms. x and xi. The seminal vesicles are in ix to xii; those in xii are the largest, and these bulge septum 12/13 backwards; those in xi and xii meet dorsally over the alimentary canal; those in ix and x are about equal in size, smaller than the others, but still considerable; all are divided up into a few large lobes.

The spermathecae are two pairs of ovoid sacs, situated in the anterior parts of segms. x and xi, sessile, without ducts, opening into furrows 9/10 and 10/11 a little above the line *d*. Copulation had taken place, the spermathecae being full of glistening spermatozoa.

REFERENCES TO LITERATURE.

(1) MICHAELSEN, W.—Die Terricolen des Madagassischen Inselgebiets. Abh. Senckbg. Ges., xxi, 1897.

(2) ,, —Beiträge zur Kenntnis der Oligochäten. Zool. Jahrb. Syst., xii, 1899.

(3) ,, —The Oligochaeta of India, Nepal, Ceylon, Burma, and the Andaman Islands. Mem. Ind. Mus., i, 1909.

(4) ,, —Die Oligochätenfauna der vorderindisch-ceylonischen Region. Abh. Ver. Hamburg, xix, 1910.

(5) ,, —Oligochäten von Travancore und Borneo. Mit. Mus. Hamburg, xxx, 1913.

(6) ,, —Oligochäten, in: Results of Dr. E. Mjöberg's Swedish Scientific Expeditions to Australia, 1910-1913. Kungl. Svenska Vetenskapsakad. Handlingar, lii, no. 13, 1916.

(7) MICHAELSEN, W.—Oligochäten von westlichen Vorderindien und ihre Beziehungen zur Oligochäten-fauna von Madagascar und den Seychellen. Mit. Mus. Hamburg, xxxviii, 1921.

(8) STEPHENSON, J.—On a Collection of Oligochaeta, mainly from Northern India. Rec. Ind. Mus., x, 1914.

(9) ,, —Contributions to the Morphology, Classification, and Zoogeography of Indian Oligochaeta. II. On Polyphyly in the Oligochaeta. Proc. Zool. Soc., 1921.

(10) ,, —Some Earthworms from Kashmir, Bombay, and other parts of India. Rec. Ind. Mus., xxiv, 1922.

EXPLANATION OF PLATE XXI.

FIG. 1.—*Moniligaster perrieri*; spermathecal apparatus as seen from above. *Amp.*, spermathecal ampulla; *atr.*, atrial gland; *d.*, spermathecal duct.

FIG. 2.—The same, another example; atrial gland.

FIG. 3.—*Drawida fluviatilis*; prostate.

FIG. 4.—*Drawida nandiensis*; spermathecal atrium.

FIF. 5.—*Plutellus kempi*; male field.

FIG. 6.—The same; spermatheca.

FIG. 7.—*Plutellus campsiaulus*; spermatheca.

FIG. 8.—*Spenceriella duodecimalis* f. *typica*; spermatheca.

FIG. 9.—*Spenceriella duodecimalis* f. *regularis*; spermatheca.

FIG. 10.—The same, another specimen; spermatheca.

FIG. 11.—The same, another specimen; spermatheca.

FIG. 12.—*Spenceriella duodecimalis* f. *quadripapillata*; spermatheca.

FIG. 13.—*Spenceriella duodecimalis* f. *ditheca*; spermatheca.

FIG. 14.—*Notoscolex palniensis*; male field.

FIG. 15.—The same; prostate.

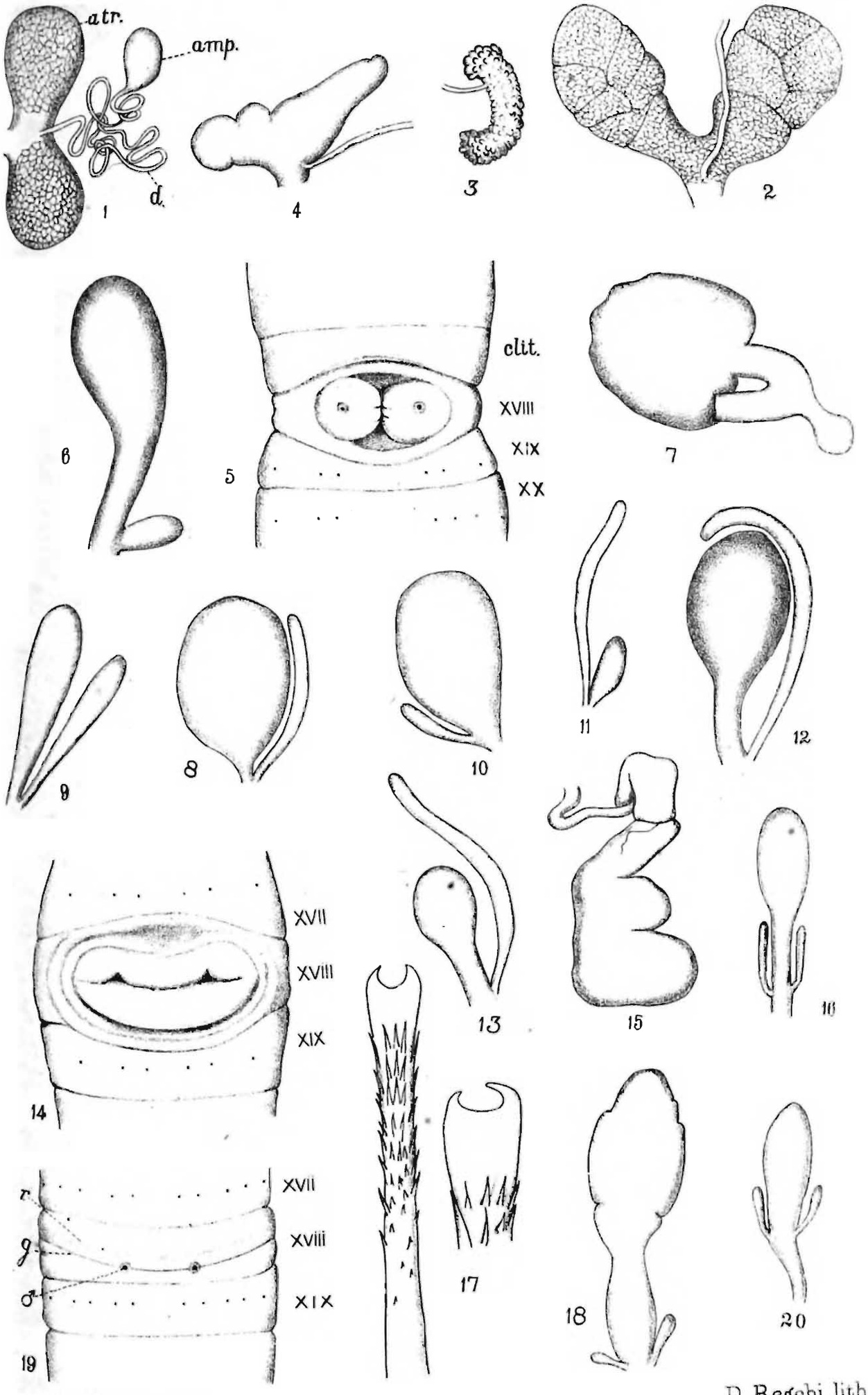
FIG. 16.—The same; spermatheca.

FIG. 17.—*Megascolex trilobatus*; distal end of penial seta, × 175; with tip of another specimen further enlarged, × 350.

FIG. 18.—The same; spermatheca.

FIG. 19.—*Megascolex sylvicola* var. *marianae*; male field. *R.*, ridge; *g.*, groove; ♂, male aperture.

FIG. 20.—The same; spermatheca.



J. Stephenson del.

D. Bøgchi lith.

EXPLANATION OF PLATE XXII

FIG. 21.—*Megascolex porphyrozonus*; spermatheca.

FIG. 22.—The same; distal end of penial seta, × 400.

FIG. 23.—*Perionyx horai*; spermatheca.

FIG. 24.—*Eudichogaster matheranensis*; *a*, spermatheca; *b*, penial seta, distal end; × 130.

FIG. 25.—*Ramiella parva*; the male field, diagrammatic.

FIG. 26.—The same; another specimen.

FIG. 27.—The same; transverse section of prostate, × 245.

FIG. 28.—The same; spermatheca.

FIG. 29.—*Eudichogaster trichochaetus*; spermatheca.

FIG. 30.—*Erythraeodrilus mullani*; male field.

FIG. 31.—The same; spermatheca, with accessory glands.

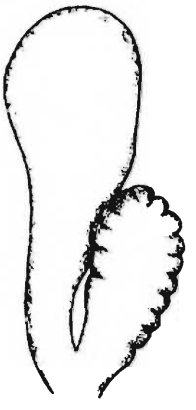
FIG. 32.—*Erythraeodrilus khandalaensis*; male field.

FIG. 33.—The same; ending of prostates and vasa deferentia of left side; the prostatic ducts turned over towards the middle line, to show the bulbs in which the vasa deferentia end. *A. b.*, bulb of anterior vas deferens; *a. p. d.*, anterior prostatic duct; *p. b.*, bulb of posterior vas deferens; *p. p. d.*, posterior prostatic duct; *v. def.*, the vasa deferentia.

FIG. 34.—The same; spermathecae and accessory glands, with their sac torn open; in outline only.

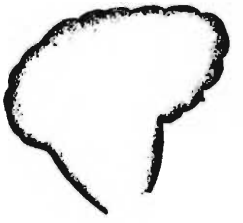
FIG. 35.—*Diplocardia indica*; spermatheca.

22

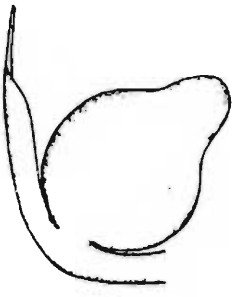


21

23

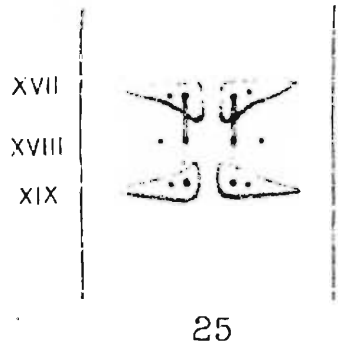


24a

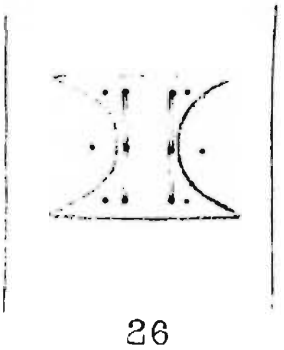


35

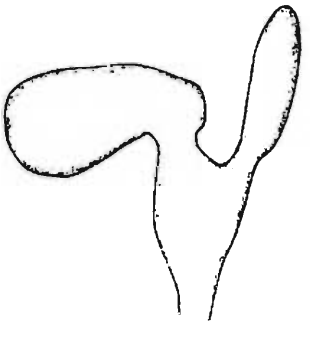
24b



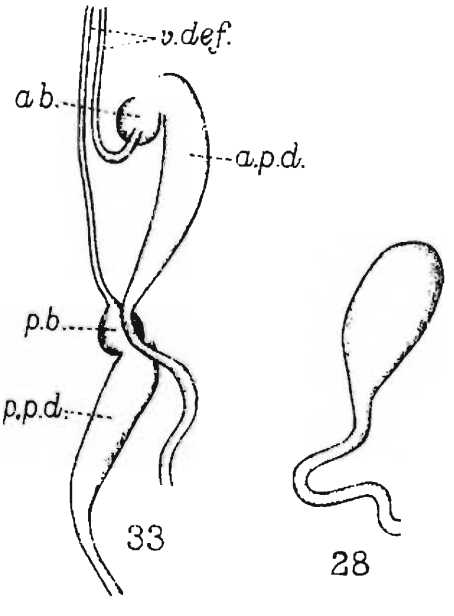
25



26

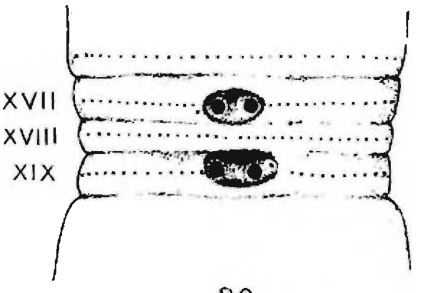


29

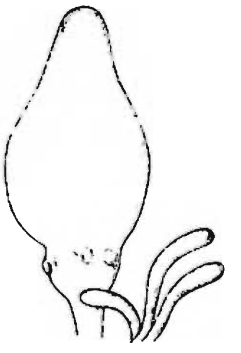


33

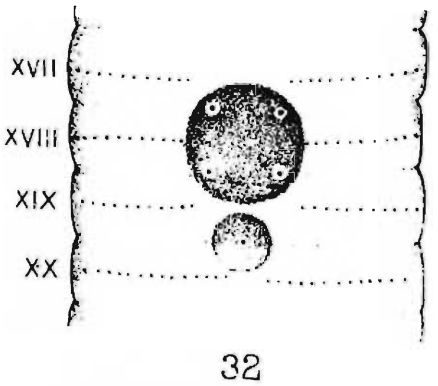
28



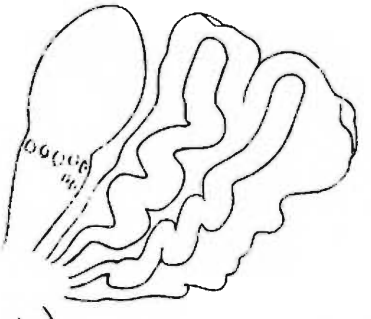
30



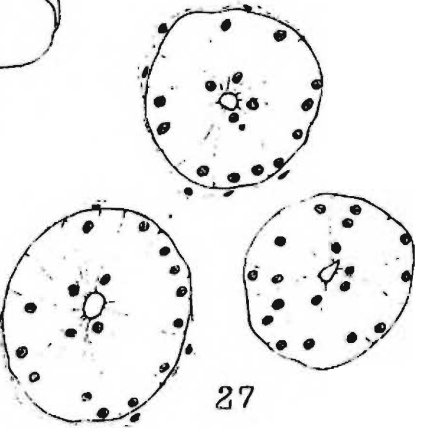
31



32



34



27

EXPLANATION OF PLATE XXIII.

FIG. 36.—*Malabaria paludicola*; transverse section of a portion of the ventro-lateral wall of the oesophagus, between segms. ix and x; to show a simpler condition than that of the fully developed " layers " of blood and cells. *Ep. col.*, columnar epithelium lining lumen of oesophagus; *ep. deep*, deeper epithelial cells; *s.*, blood sinus; *p.*, peritoneal cells; × 245.

FIG. 37.—The same; transverse section of ventral half of oesophageal wall of segm. x, showing layers of blood and cells, some of the latter showing signs of splitting. *Ep. col.*, columnar epithelium; *l. bl.*, layers of blood; *l. c.*, layers of cells, intervening between the layers of blood; *v.*, vessels, visible externally; × 175.

FIG. 38.—The same; another specimen. The cells are here less bulky, the cell layers have split, so as to give the appearance of vessel-walls. Lettering as in the last figure. × 175.

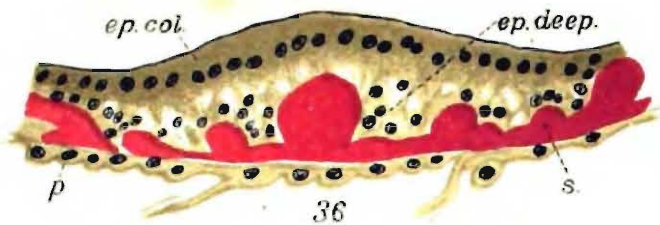
FIG. 39.—The same; the two diverticula in the oesophageal wall in segm. x here unite to enter the lumen of the oesophagus. The diverticula have a slight bifurcation in the depth of the wall; the main tube is continued forwards to its blind termination; but there is a small backward projection, which is cut here in the deeper part of the oesophageal wall. Lettering as before; in addition, *x*, this backward projection. × 225.

FIG. 40.—*Aphanascus oryzivorus*; transverse section of oesophagus in segm. ix, through the diverticula. *D. v.*, dorsal vessel; *div.*, the diverticula; *ep. col.*, columnar epithelium lining lumen of oesophagus; *ep. deep*, deeper epithelial cells; *l. bl.*, layers of blood in the deeper epithelial cell mass; *per.*, peritoneal cells; *v.*, vessels seen on ventral side of oesophagus. × 160.

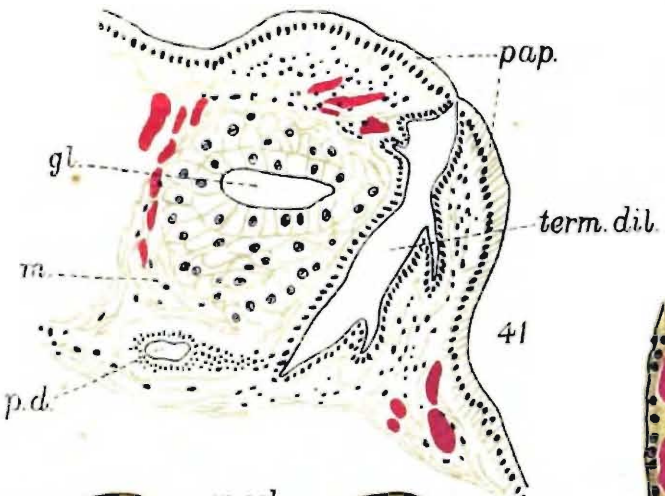
FIG. 41.—The same; longitudinal section of bulb at the termination of prostatic duct in segm. xvii. *Gl.*, clear gland; *m.*, muscular fibres; *pap.*, papilla on surface; *p. d.*, prostatic duct in section, before it dilates; *term. dil.*, terminal dilatation of prostatic duct. × 190.

FIG. 42.—The same; longitudinal section through a bulb similar to that of the ending of the prostatic duct, but containing only a clear gland and muscular fibres. *C. c.*, outer layer of clear cells; *ep.*, surface epithelium; *gl.*, clear gland, which however has no duct; *m.*, layer of muscle fibres. × 175.

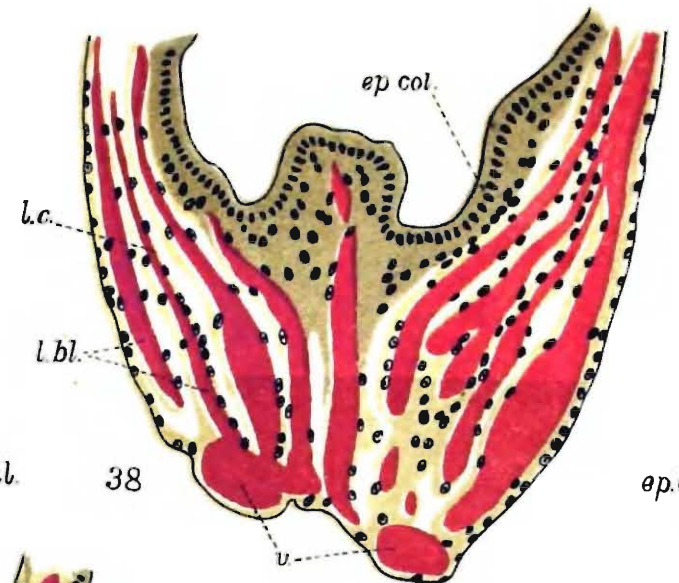
CALCUTTA: PRINTED BY SUPDT. GOVT. PRINTING, INDIA, 8, HASTINGS STREET.



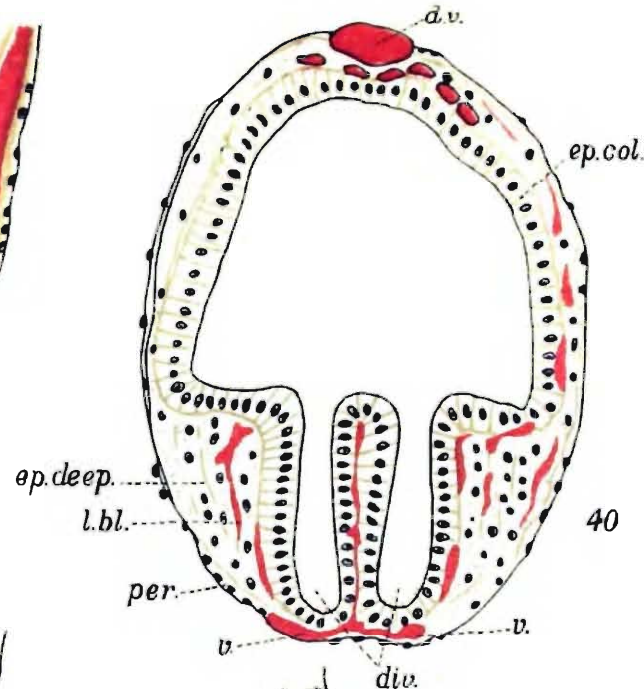
36



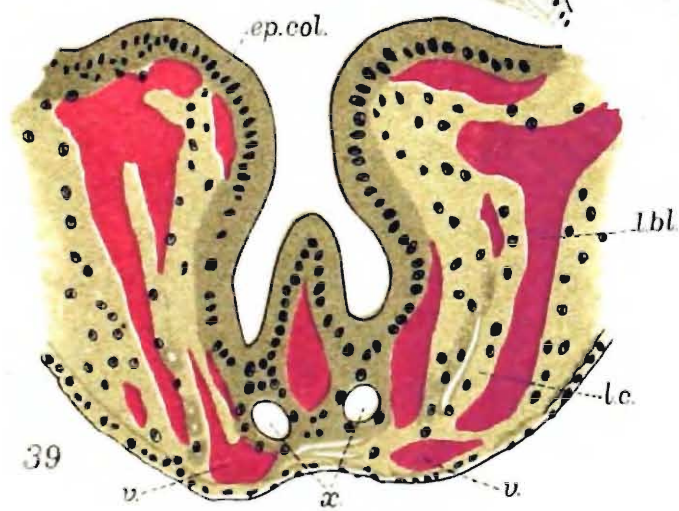
41



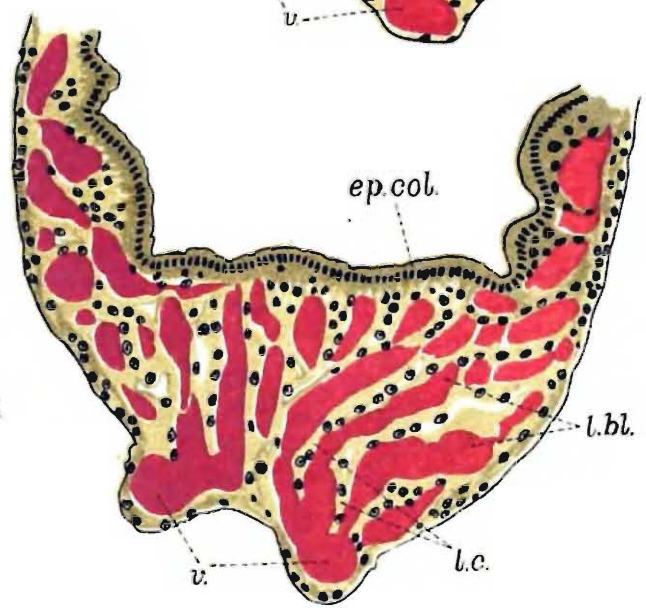
38



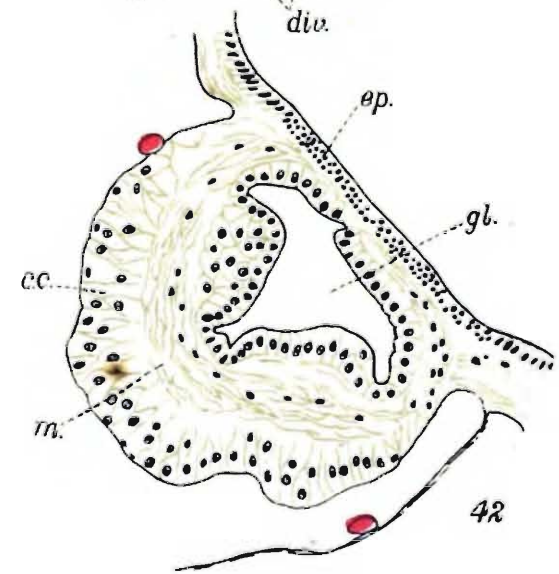
40



39



37



42

J. Stephenson del.